Classifying the Contextual Dependency of Critical Quality Factors

A study towards the identification of critical quality factors in the field of project management

DP VAN ROODE
1-7-2016

TU Delft

Witteveen + Bos

Classifying the Contextual Dependency of Critical Quality Factors

A study towards the identification of critical quality factors in the field of project management

By

D.P. van Roode

in partial fulfilment of the requirements for the degree of
Master of Science
in Construction Management & Engineering
at the Delft University of Technology,
to be defended publicly on Friday July 8th of 2016 at 10:30.

Supervisor:	Prof. dr. H.L.M. Bakker	TU Delft - CiTG
Thesis committee:	ir. L.S.W. Koops,	TU Delft - CiTG
	drs. M. Leijten	TU Delft - TBM
	ir. I. Bolier	Witteveen + Bos

This thesis is confidential and cannot be made public.

An electronic version of this thesis is available at http://repository.tudelft.nl/.

PREFACE

This thesis is my final work as a student of the master program of Construction Management & Engineering. Eleven months ago I started this project at Witteveen + Bos after a meeting with Michel, who later took place in my commission. Initially my assignment was described as 'something with quality and client satisfaction', which was so vague that it sounded like a challenge! And a challenge it was.

First I would like to thank my entire graduate committee. First I would like to say thanks to Hans Bakker, you were the first who warned me for the vagueness of my research, but nonetheless gave useful insights that structured this vagueness. Leonie Koops, thank you for always speaking your mind and introducing me to the project managers of Witteveen + Bos. I really enjoyed our discussions and I wish you all the luck finishing your own research, and of course with the implementation of my findings within Witteveen + Bos. Martijn Leijten, thank you for filling in the unexpected open space in my committee, you were a great addition to my committee! Ingrid Bolier, thank you for taking on Michel's space in the committee. Although it was last minute, your comments and original discussions are greatly appreciated. Last but not least I would like to thank Michel Rauwers for all the candy and lekkerbekjes, and of course for your insights in the more practical side of my research, which gave me a clear view of my goal.

Secondly I would like to express my gratitude to all the project managers of Witteveen + Bos that part in the survey. The discussions after the survey gave me some insights that became an essential part of this research. Finally I would like to say thanks to my roommates that helped me test the survey, have long discussions, and who reviewed my concept work.

Quality is remembered long after price is forgotten – Gucci

D.P. van Roode

Delft, May 2016

EXECUTIVE SUMMARY

Increasing projects success is a never changing goal of project management. When the criterion of *quality* is singled out from the classical *success criteria* of the iron triangle, it becomes challenging due to the fact that every individual perceives quality differently. The challenge is to satisfy both the *internal perspective* of *product quality* as the *external perspective*. This alignment of perspectives, in an early phase of a project, is therefore the higher goal. This research objectified the search for a measure to achieve this. This is done through identifying *critical quality factors (CQF's),* which are factors that affect the product quality and thereby contribute to the project management process. The effect that these factors have on the success of a project is hereby dependent of the context. This context can be characterized by different *context dependent elements*, although this research specifically aims to find those factors that are dependent on the type of client, called *client dependent CQF's*. By combining the initial identification of CQF's, and the subsequent study of their dependency on the type of client, the objective of this research is achieved. It is hypothesised that by achieving this objective the current knowledge gap is closed, which states that the ineffective alignment of perspectives between the client and a contractor is challenging the achievement of project quality. This exploratory research is taken from the perspective of a contractor, who has an agreement with a client to achieve both its explicit- as implicit requirements.

By performing a *literature study* combined with a *multiple-case study* among 43 projects, the first identification of critical quality factors is given shape. Both sources are found to be complementary, forming a single baseline from which the research is build up. The list of 16 CQF's that follows is subsequently tested through a *survey* among 30 experiences project managers according to the Best-Worst Method (BWM). This survey differentiates between the types of clients to specifically search for their differences, of which a differentiation is made between (1) a *private organization*, (2) a *small-public organization*, and (3) a *large-public organization*. This causes client dependent CQF's to arise, but until this point only assumptions can be made. The weights that are given to the individual CQF's are therefore validated through different statistical analysis. An analysis of variance between weights of all CQF's validated the early assumptions, which gave light to the identification of other context dependent elements besides the client.

The initial baseline delivered a list of CQF's that, after completion of the survey, seemed not explicit enough. Some formulated CQF's were differently interpreted by the project managers, although the same definitions were found after discussion. After completion of the survey the original list was therefore adapted to better represent the definitions they stand for. This final list of CQF's is presented combined with the results of the BWM survey in figure 1.

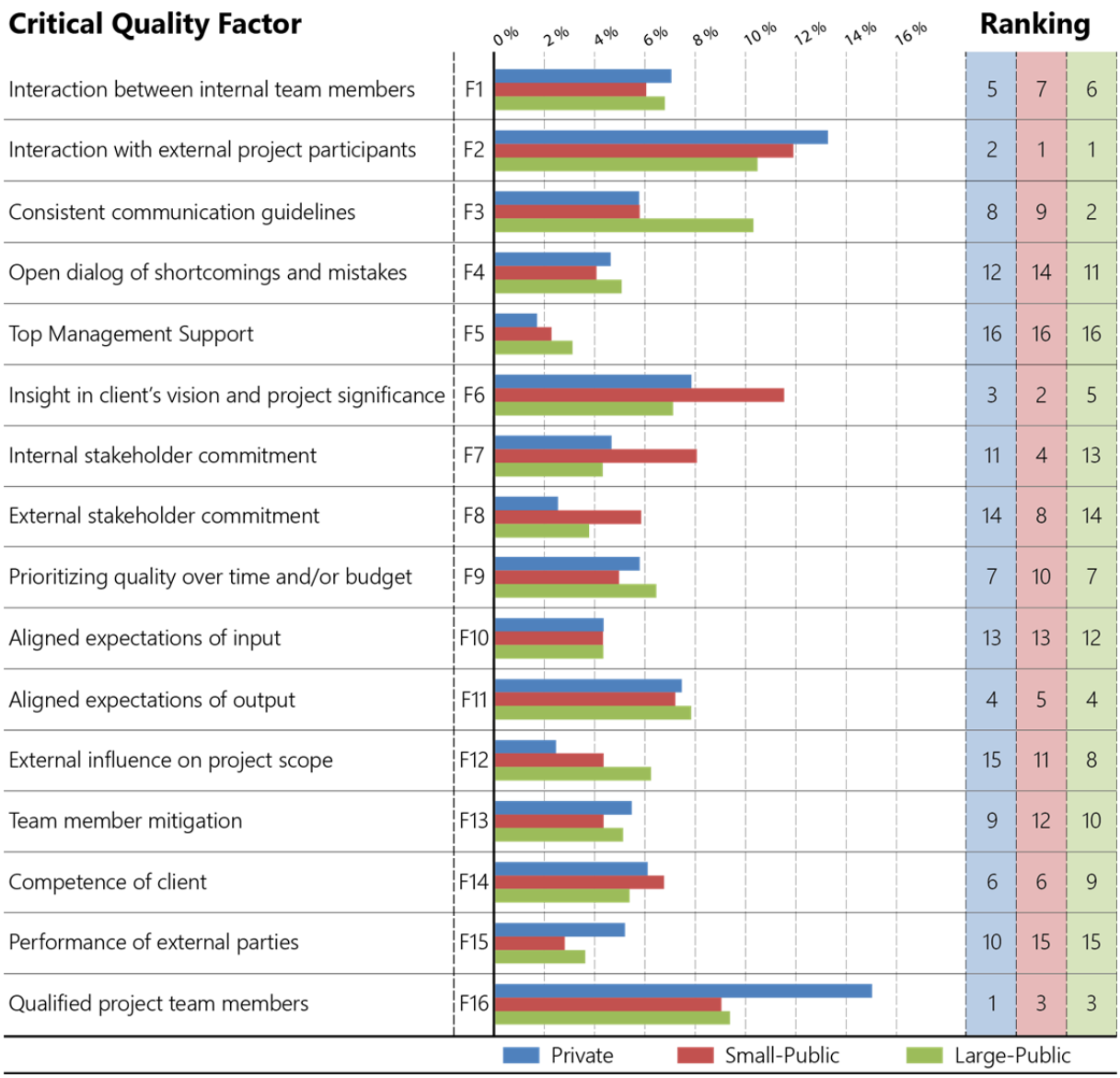


Figure 1 - Final list of CQF's with the BWM Survey results

Calculations were done with the help of the Best-Worst Method, which not only searches for the ordinal preference between factors, but also the strength of their relations. The results are given in the middle column of figure 1. The right column represents the ordinal preference in the form of a ranking per type of client. From these results and through validation of the assumption six client dependent CQF's were found. These are:

- ✓ **F3**: Consistent communication guidelines;
- ✓ **F6**: Insight in stakeholder vision and project significance;
- ✓ **F7**: Internal stakeholder commitment;
- ✓ **F8**: External stakeholder commitment;

- ✓ **F15**: Performance of external parties;
- ✓ **F16**: Qualified project team members.

The contribution to the project management process of these CQF's differ per type of client, making them part of the *client dependent element*. Other elements have also been encountered, but are not statistically validated. These are elements that came forth during the different stages of the study, but showed too little evidence. It is also found that this study is actually a large case study of the company of Witteveen + Bos (W+B), since their data is used.

Other elements that have been found are the *organizational dependent element,* and the *culture dependent element*. The first represent two CQF's (F2 and F11) that are an observable part of the current project management organization. The second represents three CQF's (F1, F5, and F10) that is more a subliminal part of the project management culture of W+B. So the difference between these elements are the acknowledgement of their presence, being divided between the CQF's that are required to be part of project management, making them stand out, and the CQF's that are not actively spoken of, making them more obscure.

The addition of this research to literature is in the form of a more substantial list of CQF's of which some have not been named in earlier publications. Also the identification of context dependent elements gives light to a new subject in literature that can be further explored.

In this research it has been proven that client dependent CQF's exists, making the type of client an important part of the context. Further practical application of this knowledge should therefore initially be used to make these identified CQF's part of all future projects of W+B. This could be achieved by stating the found CQF's as projects 'spearpoints', creating specific points of attention for all project participants. Further it can be recommended to use the list of CQF's for any further project evaluation. This gives a strong standard of which the input demands less effort and the output creates a more statistically sound advice for following projects. This can directly be translated to a form of training, in which the failing CQF's become part of the pursued learning curve. Finally it is recommended that a better awareness of the culture of W+B is created, and the culture dependent CQF's that have been identified in this research. Being aware of the culture gives extra tools for the pursuance of the point of inflection.

TABLE OF CONTENT

1.1. LIST OF FIGURES

1.2. LIST OF TABLES

1 Introduction to the Subject

The project management organization of any company should ideally be able to successfully complete projects of any level of complexity. But every project is unique and therefore every approach is unique. A project management approach that is adaptable to any level of project complexity is therefore sought by many. Finding the most effective and efficient level of adaptability can be achieved by standardizing certain processes while maintaining a high enough level of flexibility. This optimal point is called *the point of inflection* (Milosevic & Patanakul, 2005), which is generally seen as an effective measure to increase project success (Anttila, 1992; Martinsuo & Lehtonen, 2007; NEN, 2015; Payne & Turner, 1999).

The underlying objective of finding the point of inflection is to increase the overall project success rate. The established theory on *project success* is widely represented in current project management literature (De Wit, 1988; Jugdev & Müller, 2005; Koops, Coman, Bosch-Rekveldt, Hertogh, & Bakker, 2015; Mir & Pinnington, 2014; Müller & Turner, 2007; Munns & Bjeirmi, 1996; Shenhar, Levy, & Dvir, 1997; Van Aken, 2009). Looking at the amount of publications trying to grasp the definition of project success, the most common set of *success criteria* are described as the 'iron triangle' (Atkinson, 1999; Cooke-Davies, 2002; Jugdev & Müller, 2005; Söderland, Geraldi, Müller, & Jugdev, 2012), being *time*, *cost* and *quality*. It is described as a triangle since no criterion can be singled out due to their interdependencies. Also, the emphasis on each criterion differs per project-phase due to trade-offs, which is being described by Avots (1984, pp. 535 - 537) as follows: "During the early phase of the project, schedule is of primary importance, while cost takes second place and quality third. Later in the project, cost becomes the controlling interest, with schedule taking a secondary role. After the project has been completed, schedule and cost problems are easily forgotten and quality becomes the key". From these criteria, *quality* is mostly defined as the *technical specifications* of a project (Baccarini, 1999; Bannerman, 2008; Wateridge, 1998). This definition of quality is criticized since the concept of quality is surrounded by ambiguity and vagueness since every individual perceives quality in their own unique way. (Atkinson, 1999; Ika, 2009).

The criterion of *quality* is therefore a challenge to steer upon. This is for instance expressed by a large amount of stakeholders that is characteristic for the construction industry; they all try to influence a project in such a way that their perception of quality is realised. These stakeholders can be individuals, small interest groups or large powerful organizations, each with their own judgement of project success, derived from their (strategic) opinion of the quality of a product or a process (Davis, 2014; McLeod, Doolin, & MacDonell, 2012; Müller & Turner, 2007). Since this attitude is expected of all stakeholders, a weighted optimum is the pursued project outcome of the initiator, disregarding the pursuit of fully satisfied stakeholders. But finding this optimum is not only a challenge due to the amount of stakeholders, there are many more aspects that increase the complexity of projects in the construction industry, creating a unique context in which these projects are executed (Bosch-Rekveldt, Jongkind, Mooi, Bakker, & Verbraeck, 2011; Turner, 2014; Westerveld, 2003).

The challenge of continuously optimizing quality is found in the design of the *project management process* towards project completion. This is a dynamic process, starting from the point in which the initiator presents a substantive design of a certain product, defined by an explicit set of requirements. During the subsequent process the initial requirements are continuously subject to change until the end of this process, effecting the outcome significantly (De Bruijn & Ten Heuvelhof, 2010). This does not necessarily have to be a negative consequence, but it does show the dynamics that play part during the process of striving for quality optimization; the initial pursued quality of the product will almost never be fully reflected by the end-product. In this sense the final product-quality is only defined at the point of delivery, and even then the perceived quality continues to change over time. At this point a major difference in perspective is found between the client and contractor when judging the approach of a specific project. The client (and its stakeholders) see the final product merely as a measure to achieve their overarching goals and in general find less satisfaction in the quality of the process, while the contractor sees the delivered product as their project-goal and see a well-designed process as a measure to achieve this. With this difference between the *project management process* and the *quality of a product,* an important distinction is made.

In practice the process of project management heavily depends on the context of a project. It is noticed that the more complex a project gets, the more attention is put into project management since there is more at stake. In classical literature the ‘one size fits all’ or ‘canned’ process was once seen as an effective way to create a single road to success, independent of project characteristics (Kjærgaard, Kautz, & Nielsen, 2008). Some projects might even still benefit from such an approach if the complexity of these projects is comparable (Nicholas & Steyn, 2012). However, most projects are unique within their context, which caused a rejection of this classic approach in modern project

management; when project conditions are diverse, different processes are needed (Deck, 2001). Shenhar and Dvir (2007b) adapted to this view by introducing the 'adaptive project management approach', which incorporates the idea of fitting the management approach to the *purpose of the project*. Fitting the approach to the purpose of a project has been long conceptualized in legal publications where it is stated that every commodity should have a function (where the 'commodity' is equivalent to an 'approach') and while prescribing that function, the commodity is 'fit-for-purpose' when that function is fulfilled (Martin & Law, 1983). So an approach can be described as 'fit-for-purpose' when the desired intention is achieved (Cox & Thompson, 1997). This early conceptualization of the term 'fit-for-purpose' can be further developed by the modern project management movement of adapting or scaling the process management practice to a purpose that is distinctive for a specific project.

One of the identified *contextual elements* that determine the purpose of a project has to do with the *type of client* involved, who should be seen as an individual with a unique perspective on the quality of a process and/or product. This perspective once formed the explicit- and implicit demands of a project and identifying this perspective should therefore simplify the complexity of a project (Bosch-Rekveldt et al., 2011). Unfortunately identifying and analysing every individual stakeholder is not achievable from a more realistic point of view, although an approximation should be made. When a higher level of abstraction is taken it is possible to characterize larger groups of project initiators that are responsible for most projects. For example, the approach of *private organizations* is assumed to be different than that of a *public organization*, since there are different interests at stake, dependent on their perception of quality. Identifying these differences could help the contracted project manager to design a process that better fits the purpose of a specific client and its project. Designing a tailor-made process is possible by stating certain *critical success factors* that best fit the specific needs indicated to fit the identified *type of client*. These factors are levers that a project manager can pull in order to increase the likelihood of achieving success (Pinto & Slevin, 1988; Söderland et al., 2012; Wateridge, 1998; Westerveld, 2003). Since this research demarcates the factors that stand out for their influence on the criterion of *quality*, here *critical quality factors* are meant. The identification of client dependent critical quality factors and the analysis of these factors for their fit with the purpose of a project, should deliver insights on how an effective project management process is designed.

This research is first aimed at identifying *critical quality factors* for their contribution to the project management process. Secondly, it is aimed at finding those factors that can be classified as *client dependent,* which are the factors that can be proven to have a significantly different contribution to the project management process per *type of client*.

1.1. PROBLEM DEFINITION

An effective project management approach that is derived from the purpose of a project is a challenge in current practice. Designing an effective and efficient project management process in order to increase the chance of project success is therefore desired by many. In this playfield there are several parties involved, of which the *main client* and *contractor* have the most direct influence on the process. In most cases the client is benefitted by a well-designed project management approach, since it increases the chance that the desired level of quality is achieved. Therefore, in current practice, the client has to agree on the design of the *project management process* as proposed by the contractor, indicated in their *project management plan*. The contractor on the other hand has to be able to satisfy the client in fulfilling both explicit- and implicit requirements during the same project management process. The problem with the latter is that the perceived quality of the desired product changes over time and does not let itself be determined on forehand. Continuous alignment of expectations could therefore be a measure to keep track of the perceived quality, which takes place during the project management process. The focus is therefore put on this process instead of the product quality.

The problem that currently exists is that the alignment of the different perspectives is not working effectively. More specifically, the process that takes place between the agreement on a *project management plan* and the delivery of *a high quality product* is not satisfactory enough. The main problem is therefore nested in the ineffectiveness of this phase. The complete process is visualised in a simplified way in figure 2.

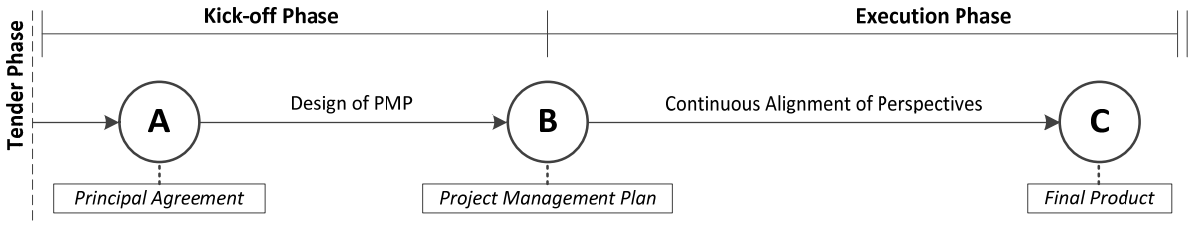


Figure 2 - Visualization of the demarcated process (by author)

The client and contractor initially come to a *principal agreement* (A), meaning that there is only an agreement about the fact that they will collaborate. The contractor is hereby given the permission to *design* their *project management plan (PMP)* (B), which is mostly done in consultation with the client. The project management plan (B) is hereafter to be executed in order to achieve the desired quality of the final product (C). During this process a *continuous alignment of perspectives* about the quality of the product should increase the potential for a product to match the explicit- and implicit demands of the client. The final product (C) is the subsequent outcome of a well guided project management process. Following this line of reasoning it is assumed that putting extra focus on the kick-off phase

during the design of the PMP, favourable circumstances are created for the subsequent alignment of perspectives.

Issues that surface during the execution phase affect the quality of the process. These issues are divided into two groups: the ones that are a by-product of creative freedom, defined as *incidental issues*, and those that are recurrent in all types of projects, defined as *structural issues*. While maintaining the creative freedom of project managers, only the occurrence of *structural issues* could be decreased in an efficient way. Part of the cause of structural issues are found in the study of *critical quality factors* (CQF's), since the effect of CQF's on the project management process can be negative as much as they can be positive. Through the identification of CQF's and the study of their dependency on the different types of clients, could results in the design of a more effective project management plan during the kick-off phase.

Summarizing the problem definition it can be said that the current effectiveness of the project management process is not satisfactory enough. Although the quality of the final product is generally found to be satisfactory, the process towards this product is too often judged as unsatisfactory. The underlying problem is found in the alignment of perspectives during the execution phase, and can be countered during the kick-off phase, in which the design of a more effective project management plan is not reaching its potential. The identification of client dependent CQF's could fulfil this potential. This could clarify one element of the context and thereby deliver a measure to better fit the project management approach to the goal of a project.

1.2. RESEARCH OBJECTIVE

The objective of this research is to identify *critical quality factors* and the magnitude of their influence related to the effectiveness of the *project management process*. This knowledge is subsequently used to identify different *types of clients* differentiated by their *client dependent critical quality factors* from the perspective of a contractor. The underlying idea is that when both the similarities and differences between the types of clients are identified, the *alignment of perspectives* is focused more specifically on the *purpose of a project* instead of the delivery of a product. Reaching this objective narrows the solution space of the defined problem and eventually should lead to a more satisfactory outcome for all parties involved.

This research focusses on the *perspective of the contractor*, since they fulfil the most significant role during project management. Besides this practical side, this research pursues a theoretical contribution to the current knowledge of *project management* related to *CQF's* and their dependency on contextual elements.

To achieve this objective an *exploratory research* will be executed. The specific effect of CQF's on the project management process, related to their dependency of the type of client, is a relatively untouched field in theory. Closing this knowledge gap will eventually pave the road for structural improvement in project management through a more effective client specific project management approach.

1.3. SCOPE DEFINITION

The scope definition will be twofold. First the company Witteveen + Bos (W+B) will be elaborated on, who are meant by 'the contractor' throughout this research. The goal is to give an idea about the 'state of the art' of their project management organization and how this is characterized by their company culture. The second part will be about defining the research scope.

1.3.1. The Company: Witteveen + Bos

Witteveen + Bos is one of the larger engineering companies of The Netherlands and deliver consulting- and engineering services for the design of water-, infrastructure-, environment-, and construction projects (W+B, 2016a). Over time they developed their own specific culture that defines their project management approach, which is seen as a significant added value by their project managers, making them stand out from other engineering firms. A couple of notable cultural aspects that are relevant to this research are (1) their aversion towards the imposition of regulating guidelines within the organization, creating an autonomous atmosphere, (2) their focus on the 'natural growth' of their employees and project managers, meaning that there is no strict grid to comply with, and (3) their passion for the engineering- and tactical aspects of projects. All characteristics have their pros and cons and are essential for further applicability of this research within their company. The consequence is that this research is mainly focussed at the specific project management organization of W+B, but aims to preserve a high enough level of abstraction in order to be an addition to the established theories on project management.

The characteristics that are mentioned mainly determine their project management process, which can be compared to a 'fit-for-purpose approach'; it is set-up to fit a purpose that is distinctive for a specific project. Not by regulations, but by creating an autonomous environment in which project managers design their own project management organization to fit the needs of a project. The downside of this style is the increasing room for structural issues. These issues have a big chance of endurance due to the fact that people mainly learn from each other, without strict guidelines for new employees stating the 'norms and values' of project management.

1.3.2. Research Scope

Place in time: This research focusses on the point in time from where a *principal agreement* is formed between the client and the contractor, until the delivery of the *final product*. Before this timeline a contractor is bound by the rules of tendering in which no open dialogue can be held with the client without endangering the chance of winning the tender (in the case of a public client). So for this research the certainty of project execution lies with the contractor, based on their submitted *project proposal*. This proposal becomes the initial version of the *project management plan*, which is then further developed through client consultation during the kick-off phase. This consultation, or alignment of perspectives, is the main focus of this research. So the problem is identified by the execution of the project management plan, but the solution lies within the kick-off phase.

The 'project': When zooming out from a typical project, a more comprehensive project emerges of which the client is owner. As part of this larger project a contractor fulfils a demarcated assignment that, in the eyes of the client, should align with the rest of the assignments within this overlapping project. So the environment has to be taken into account, in which other assignments could be executed by other parties. The fact that other parties and stakeholders exist is assumed to always be the case within this research. However the main relation is that between the main client and the contractor, and other stakeholders taking second place.

The type of projects: For this research only projects in the construction industry are being handled. The company of W+B distinguishes four sectors that divide this industry, of which the following are included in this research: Infrastructure and Mobility (IM), Built Environment (GOM), Energy Water and Environment (EWM), and Deltas Coasts and Rivers (DKR) (W+B, 2016b). Within these sectors it is only useful to look at recently completed projects (2014/'15/'16) due to the continuous effort of W+B to improve the project management approach through their own company quality improvement plan.

1.4. RESEARCH QUESTIONS

Following up on the problem definition and subsequently the research objective, a main research question can be formed. By answering this question the objective of this research is achieved. The answer gives no conclusive solution for the presented problem, but aims to deliver enough insight to further define the solution space and thereby contributing to both the theoretical- as well as the practical knowledge gap. The main research question goes as follows:

What client dependent critical quality factors can be identified for their contribution to the project management process, and how does this manifest into a classification of other context dependent elements?

The main research question can be divided in sub-questions. These sub-questions create a logical structure that matches the different parts of this research. The following questions are presented:

1. *What **Critical Quality Factors** can been found in **literature** for their contribution to project management?*

    - ✓ *Literature Study*

2. *What **Critical Quality Factors** have indicated to contribute to the project management process of **recent completed projects**?*

    - ✓ *Multiple-Case Study*

2. *What **Client Dependent Critical Quality Factors** are found to contribute to an effective project management approach according to **panel of experts**?*

    - ✓ *Best Worst Method – Survey – Results*

3. *What **insights** can be extracted from a **Context Dependent Classification** of **Critical Quality Factors**?*

    - ✓ *Discussion*

1.5. RESEARCH APPROACH

The presented sub-questions are part of a structured approach, each belonging to a specific part. This research approach describes the structure by discussing the added value of each part. The approach will be consistent with the *reading guide* of the following paragraph of which figure 3 represents the overview.

Part I will present a literature study by describing the most relevant studies that fit the context of this research. This part is called the *Theoretical Baseline*, since the concluding remarks of this literature study will form the *baseline* from which the subsequent research is build up. **Part II** will form the *Practical Baseline* and is the counterpart of the theoretical baseline of Part I, since it gets its input not from theory but from practice. This *baseline* consists of another set of CQF's and is formed by

executing a multiple-case study. By analysing the project evaluations of recent completed projects of W+B, a fitting set of CQF's should be found that best match the perspective of their project managers. A convergence of both baselines will be presented in the concluding remarks of part I and II, which defines the input for the subsequent parts in the form of a single set of CQF's.

Part III will start with a presentation about the used methodology. This method is used to retrieve the required data from the respondents through a survey and subsequently thereby define an initial set of weighted CQF's per types of clients. The execution of the survey is also discussed. A preliminary conclusion will be drawn to end part III. The following **Part IV** will start by presenting the research results, which is then validated to strengthen the findings. The latter is done through different statistical tests to diminish the chance that the finding are based on coincidence. The last chapter of part IV will present a discussion about the secondary findings that are not statistically proven, but show promising context dependent assumptions. This research is build up to the point of presenting the final conclusions, which aim to present the essence of this research, which is then reflected by the recommendations for further practical implementation and research.

1.6. READING GUIDE

<table>
<tr><td colspan="3">Chapter 1 / INTRODUCTION TO THE SUBJECT</td></tr>
<tr><td>Part I</td><td>THEORETICAL BASELINE
Chapter 2 / Literature Study</td><td>Q 1
What Critical Quality Factors can been found in literature for their contribution to project management?</td></tr>
<tr><td>Part II</td><td>PRACTICAL BASELINE
Chapter 3 / Multiple-Case Study Set-up
Chapter 4 / Multiple-Case Study Execution</td><td>Q 2
What Critical Quality Factors have indicated to contribute to the project management process of recent completed projects?</td></tr>
<tr><td>Part III</td><td>BEST-WORST METHOD
Chapter 5 / Survey Set-Up
Chapter 6 / Survey Execution</td><td>Q 3
What Client Dependent Critical Quality Factors are found to contribute to an effective project management approach according to panel of experts?</td></tr>
<tr><td>Part IV</td><td>RESULTS
Chapter 7 / Results
Chapter 8 / Discussing Context Dependency</td><td>Q 4
What insights can be extracted from a Context Dependent Classification of Critical Quality Factors?</td></tr>
<tr><td colspan="3">Chapter 9 / CONCLUSIONS</td></tr>
<tr><td colspan="3">Chapter 10 / RECOMMENDATIONS - PRACTICAL IMPLEMTATION – FUTURE RESEARCH</td></tr>
</table>

Figure 3 - Reading Guide (by author)

Part I

THEORETICAL BASELINE

2 Literature Study

This part focusses on defining the *theoretical baseline* from which the research is built up. This researching strategy is characterized by finding existing material, an absence of direct contact with the research object, and material that is used from different perspectives than the time of production (Verschuren, Doorewaard, & Mellion, 2010). The theoretical baseline is defined by the 'state of the art' of current research.

2.1. THEORETICAL FRAMEWORK

The *theoretical framework* (figure 4) has been designed to structure the literature study and subsequently function as a line of reasoning throughout this research. It represents all subjects that are studied during the literature study and will be discussed accordingly. Most subjects are heavily represented in current theoretical studies, which is why their terminology is used in most cases. The following introduction is meant to give a first impression of what the literature study will include (figure 4).

> Achieving ***project success*** is a challenge due to the unique challenge of each project. The extend of project success can be judged from the perspective of the project team (***internal success***), and their stakeholders (***external success***). Both wield their own set of ***success criteria***, of which the ***iron triangle*** is the most frequently cited set, consisting of ***time***, ***budget***, and ***quality***. Time and budget can be objectively measured and are therefore relatively manageable, but ***quality*** is perceived differently by each individual which changes over time. In order to achieve the most optimal balance of quality improving measures during the execution phase, an effective **project management process** is to be designed. Factors that affect the quality of the result during this process, named ***critical quality factors***, should therefore be identified and subsequently be evaluated for the magnitude of their contribution to the process. By applying the gained knowledge in an early project phase, the challenge towards achieving project success can be overcome.

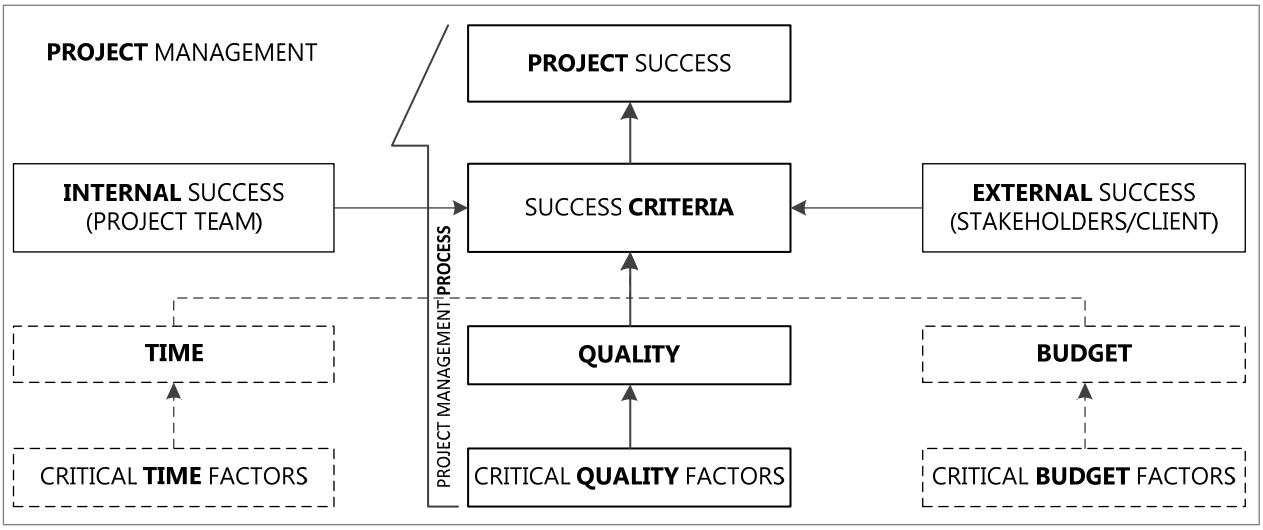


Figure 4 - Theoretical Framework representing the Line of Reasoning (by author)

2.2. PROJECT MANAGEMENT

Projects are seen all around us. A *project* is being defined as a temporary set of activities which is undertaken to complete a unique product, service or result (PMI, 2013). Due to its uniqueness every project requires a different approach, dependent on the context. But the fact that each approach is context dependent, defines this given as the standard situation for all projects.

The distinction between types of projects comes down to their complexity, uncertainty and the form of organization and management that is applied (Nicholas & Steyn, 2012). At the start of a project there is a certain vision, an idea that is just in the mind of an initiator, and the way toward a satisfactory result should be managed accordingly. This is what *project management* does, it is about converting vision into reality (Turner, 2014). Atkinson (1999) suggested that due to the paradox of defining uniqueness, project management cannot easily be defined by definition. But in general, project management is being defined as a process of controlling and organizing the achievement of the stated project objectives (Kerzner, 2013; Meredith & Mantel Jr, 2011; Munns & Bjeirmi, 1996; Shenhar & Dvir, 2007b; Söderlund, 2004). Within the construction industry project management takes on a significant role, since the entire built environment exists of completed projects that at some point needed appropriate management techniques to be completed.

The development of the theory on project management has a long history, both as a profession and as an area of research, being applied in different industries (Crawford, Pollack, & England, 2006). A start was given by a publication of Gaddis (1959), who was one of the first to specifically define the art of managing projects (Söderlund, 2004). Gaddis stood at the start of different themes through history (Kwak, 2005), in which several trends passed of which an oversight is presented in table 4

(Kloppenborg & Opfer, 2002). The last row of table 4 states the current area of research, as identified by Shenhar and Dvir (2007a). According to Shenhar, one of the challenges within project management is researching an 'adaptive project management approach'.

Period	**Theme (Kwak, 2005)**	**PM Research (**Kloppenborg & Opfer**, 2002)**
Prior to 1958	Craft system to Human Relation Administration	
1958 – 1969	Application of Management Science	Planning and Scheduling
1970 – 1979		Automated software for cost and scheduling
1980 – 1994	Production Center: Human Resources	Life-cycle costing, risk management, leadership, and teambuilding
1995 – 2003	Creating a new Environment	Human resource, teams, and leadership
2000 to present	Project typologies, contingency, and strategic project management and globalization of projects	

Table 1 - Periods of project management (Kwak, 2005; Kloppenborg, 2002; Shenhar, 2007a)

The *adaptive project management approach* would be better suited to the demands of a modern competitive environment than a *traditional project management approach*. It focusses more on serving the needs of the customer than just on the traditional success criteria: delivery on time, within budget and according to requirements (Shenhar & Dvir, 2007b). Traditional project management (TPM) was applied in the early years and is built around rigid control and certainty of estimates, which could lock the process into high-cost solution at an early stage (Turner, 2014). This approach adopted the idea that 'one size fits all', which is no longer applicable for the increasing level of complexity of current projects (Shenhar, 2001). This does not mean that TPM is written off, it is still useful for standard projects, but it shows that an effective project management system requires a new approach (Wysocki, 2011).

As a reaction to the mismatch of TPM, the opposite side of the spectrum was explored, being *extreme project management*, which is characterized by projects that are highly uncertain and complex, and therefore cannot be guided by a rigid traditional approach (DeCarlo, 2010). This 'extreme' approach is applicable in all types of sectors, but was mainly shaped by a focus on software development projects. This brought forth e.g. *agile project management,* which has been one of the most popular approaches. Agile project management stands for the ability to create and respond to change in order to profit in a turbulent environment, balancing between flexibility and stability (Highsmith, 2002). It is specifically aimed at projects that qualify as part of the extreme project management environment.

Then not all projects belong to the extreme project management environment, and not all projects let themselves be managed by a rigid standardized structure, which emphasizes that every project has a different purpose dependent on the context. But no matter what purpose is pursued, creating a successful achievement out of this purpose stands above all.

2.3. PROJECT SUCCESS & SUCCESS CRITERIA TRADE-OFFS

The achievement of *project success,* as defined by the one pursuing it, is the reason why projects are being managed. Despite of the subjective nature of 'success', many have tried to objectively measure success, however no significant improvement has been achieved yet (Mir & Pinnington, 2014). The early publications on project success where mainly formed around an understanding that a project should be managed on *time*, within *budget*, and in conformance with predetermined *performance specifications* (Gaddis, 1959; Söderland et al., 2012; Söderlund, 2004) of which the latter is gradually replaced by the term *quality* (De Wit, 1988). This set of success criteria gives us the *Iron triangle* (Atkinson, 1999; Cooke-Davies, 2002; Jugdev & Müller, 2005; Söderland, Geraldi, Müller, & Jugdev, 2012), the *Golden triangle* (Gardiner & Stewart, 2000; Westerveld, 2003), the *Triangle of Virtue* (Ika, 2009) or the *Triple constraint* (Bannerman, 2008; Meredith & Mantel Jr, 2011; PMI, 2013). All meaning the same, roughly speaking, though small differences in definition can be found. These theoretical constructs have been, and still are a popular summation of the most applied criteria of project success.

These criteria are subject to trade-offs and have a shifting significance during the execution of the project (Avots, 1984). Even after a project is completed its success is judged differently in time. Take the Sydney opera House as an example. This project has been a struggle for all parties involved: over budget by ~1450 %, with a delay of ten years, and the architect (Jørn Utzon) resigned, but today it is seen as the icon of Australia and even made it to the UNESCO World Heritage List in 2007 (UNESCO, 2016). But this is today, and not when the project was finished, and certainly not during construction. Abraham and Chinowsky (2003) stated that due to the original criteria of budget, time and quality (here performance specifications are meant); long-term objectives and issues are given less attention, resulting in short sighted solutions. This time dependent aspect of project success increases the uncertainty and complexity that large engineering projects, and the judgements of their success, are subdue to (Baccarini, 1999; Baker, Murphy, & Fisher, 2008). When talking about trade-offs between the triple constraint during the lifetime of a project, the following figure 5 is presented as visualisation, based on the statements of Avots (1984). Also added is the statement of Mikkelsen (1990, p. 143), who claims that "interest in quality is greatest when writing the basic specifications and when the product is a reality".

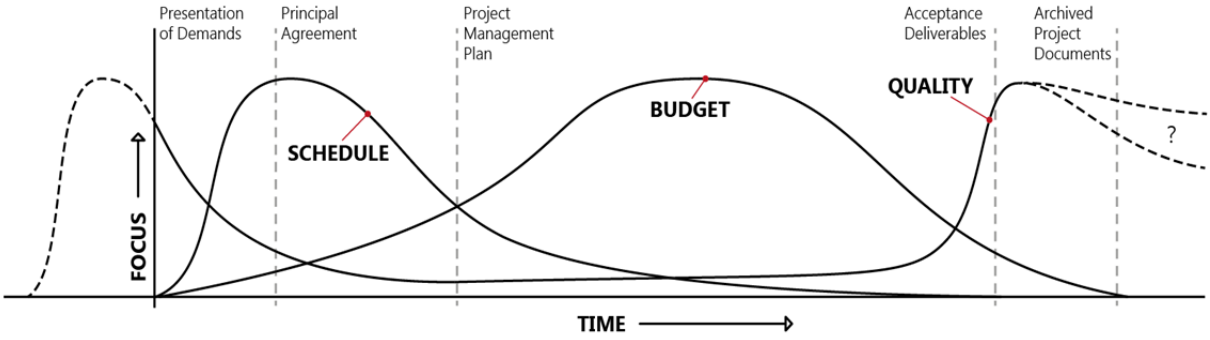


Figure 5 - Visualization of Trade-offs (Avots, 1984; Illustration by author)

This illustrated the fact that project success is a multi-dimensional challenge, widening the original scope of what is meant by project success (McLeod et al., 2012). Therefore it is proposed that a distinction should be made between the success of *project management* and the success of the *achievement of objectives*, in other words a distinction between the success of the *process* and the *product* (Baccarini, 1999; Cooke-Davies, 2002; Jugdev & Müller, 2005; McLeod et al., 2012; Wateridge, 1998). These two dimensions are inextricably linked, and by subsequently looking at the *product* in its future environment other dimensions are found. Namely *business* success and *strategic* success which Bannerman (2008) included in his framework as the higher levels of success criteria. These dimensions are comparable with the earlier published dimensions of project success by Shenhar, Dvir, Levy, and Maltz (2001) labelling this higher dimension as *preparing for the future*. This is part of *why* a client would initiate the project or *why* a group of stakeholders would defend their interests.

This multi-dimensional concept of project success indicates that there are two main perspectives that judge a project by its success, being the *internal perspective on success* and the *external perspective on success*. These two groups represent all project participants that have some sort of influence during the lifetime of a project, aiming to balance the interests (Mikkelsen, 1990). The *internal perspective* is perceived by the contractor who is driven to deliver a qualitatively high standing *process* prior to the delivery of the *product*. On the other side stands the *external perspective on success* that is perceived by the main client (including stakeholders) for its ability to comply with its long-term objectives, and for whom the *process* is less significant compared to the *product*.

The external perspective on success contradicts the trade-offs between success criteria, since is seems logical that a focus on *quality* should be included early on to ensure all *explicit- and implicit requirements* of the product are executed accordingly. Thereby it is said that "quality is remembered long after price is forgotten" (Aldo Gucci), which should be a motive to implement measures for the optimization of quality throughout the whole *process*.

2.4. QUALITY IN THE DOMAIN OF PROJECT MANAGEMENT

As stated before 'quality' within the domain of project management is perceived, and subsequently implemented, differently per individual, organization, and sector and is therefore a subjective concept without strict boundaries in its definition. This vague statement is supported by the early explorations of 'quality', which were collected by Reeves and Bednar (1994, p. 441), who concluded their search by stating that a "basis for choosing pertinent definitions that can guide the development of conceptual frameworks and measurement methods is provided through exploring the roots of various definitions of quality, identifying their strengths and weaknesses, and examining the trade-offs inherent in accepting one definition of quality over another". As part of their research they presented four major trends in literature that highlight different perceptions of quality.

- ✓ **Quality is Excellence**: "Quality is achieving or reaching for the highest standard as against being satisfied with the sloppy or fraudulent" (Tuchman, 1980, p. 38).

- ✓ **Quality is Value**: "Quality does not have the popular meaning of 'best' in any absolute sense. It means 'best for certain customer conditions'" (Feigenbaum, 1951, p. 1). & "Only when differences in quality have been eliminated by standardization does 'cheapest' necessarily coincides with 'best'" (Abbott, 1956, p. 108).

- ✓ **Quality is Customer Satisfaction**: Juran and Godfrey (1999) separated the definition in two parts: 'features of the product', which meets the customer needs and thereby customer satisfaction, and 'freedom of deficiencies' which is the freedom from errors that require reword and creating customer dissatisfaction.

- ✓ **Quality is Meeting and/or Exceeding Customer Expectations**: "Quality is whatever the customer says it is, and the quality of a particular product or service is whatever the customer perceives it to be" (Buzzell & Gale, 1987, p. 111).

The development of quality as a concept within project management started to take shape by the hands of Walter Shewhart, who developed the 'plan-do-check-act' cycle (Shewhart & Deming, 1939). W. Edwards Deming introduced this cycle in his lectures in Japan after the second world war, and due to its popularity it later became known as the 'Deming-cycle', the 'Deming wheel' or PDCA-cycle (Rose, 2005). This cycle describes four iterative activities that focus on the control and continuous improvement of products and processes. A fellow researcher, Joseph M. Juran, introduced a three-step approach on quality: (1) quality planning, (2) quality control, and (3) quality improvement (Juran & Godfrey, 1999). The approach of Juran had an increasing focus on the measurement and quantification

of quality within project management. Another influential person in the world of quality was Kaoru Ishikawa, who emphasized employee participation as a holistic approach towards the implementation to quality management techniques. He codified seven tools especially for this cause, which could be integrated with the ideas of Deming and Juran (Ishikawa, 1982).

The above indicates that quality, as a concept within the domain of project management, is a long studied subject. The implementation of an effective quality management system that acknowledges the existence of different interpretations of 'quality', is therefore a challenge during all projects. The subjective nature of quality does not asks for a rigid and standardized management system, but should offer guidance to enable the strengths of all interpretations of quality converge to a point in which it fulfils the purpose it is intended for (Bannerman, 2008).

2.5. THE DESIGN OF PROJECT MANAGEMENT

The success of a process responds to the need to consider different processes associated with project management at different times throughout the project life cycle, consistent with the aim for quality (Bannerman, 2008). As one of the layers of management within a project, quality management aims to determine a certain quality management system consisting of three main processes: quality planning, quality assurance, and quality control (Nicholas & Steyn, 2012). *Quality planning* defines the future quality improving activities, *quality assurance* performs the *planned quality activities* and utilizes processes necessary to meet standards and requirements, and *quality control* ensures that the activities of *quality assurance* are performed according to the *quality plan*.

So the first step is to define a *quality plan* that has the potential of satisfying all project participants in achieving a successful quality management process. This early phase activity is ideally done in collaboration with all project participants, directly after the *principal agreement* and before signing off the *project management plan* (timeline according to figure 5). By concentrating on the definition of a good quality plan, that suits both the internal- as the external project participants, it is assumed that more value is generated than poor project execution could subtract (Bosch-Rekveldt, 2011). This statement is substantiated by the following figure 6, which is mainly focussed on scope definition by the use of Front-End Development (FED), but with which a parallel can be drawn with the development of a quality plan.

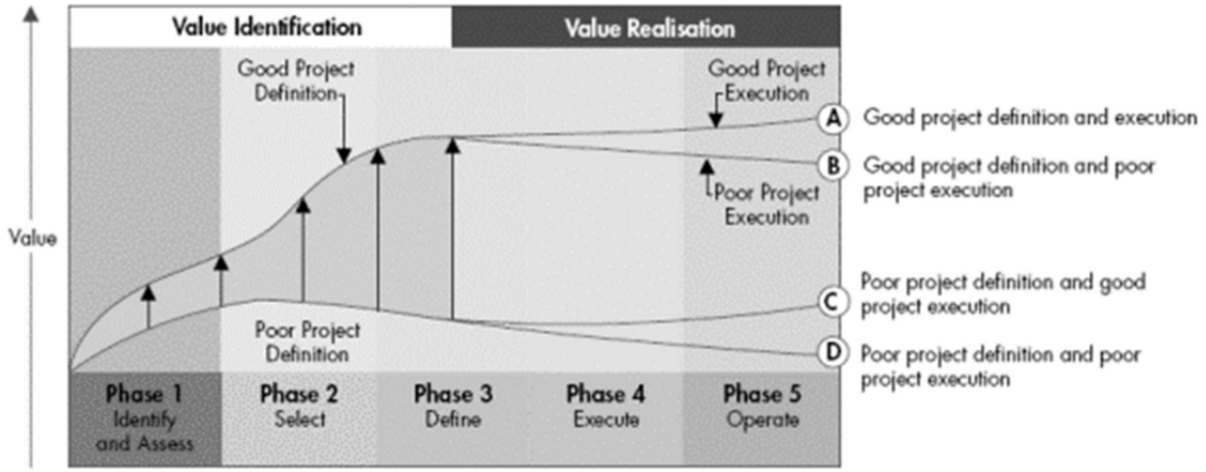


Figure 6 - The influence of FED on the value of a project (Hutchinson & Wabeke, 2006)

The second step is to define a plan for *quality assurance*, which mainly consist of two subjects. The first is to define the activities that are performed during the process of a specific project to ensure the requirements are met. The second one is to define activities that contribute to the continuous improvement of the overall quality management process of future projects of any organization (Nicholas & Steyn, 2012). This last part stands at the base of an effective and efficient project management organization, since no efficiency focussed project manager wishes to start from scratch every time a new project is initiated. In other words, any organization must strive to create a learning environment where 'reinventing the wheel' must be minimized (Von Hippel, Thomke, & Sonnack, 1999). These two steps, *quality planning* and *quality assurance*, have the potential to define a continuously more effective quality management process for future projects. It is suggested by Love, Huang, Edwards, and Irani (2004) that the key success factors for any organization is no longer a matter of size or number of assets, but the quality of experience it can apply and manage.

This research searches for this potential by the identification of relevant *Critical Success Factors* (CSF's). After concluding the principal agreement between the client and contractor, a project manager has ways to 'steer' the process using these *Critical Success Factors*. CSF's are levers that a project manager can pull in order to increase the likelihood of achieving success (Pinto & Slevin, 1988; Söderland et al., 2012; Wateridge, 1998; Westerveld, 2003). Cooke-Davies (2002) researched the 'real' critical success factors and defined them as "inputs to the management system that lead directly or indirectly to the success of the project or business".

These CSF's are meant in the broadest sense of project management and little research has been done on their specific effect on success criteria. By identifying those CSF's that have a distinctive effect on the *quality* of projects, and subsequently integrating them with the development of a *quality plan*, a

more effective process could be designed. When the knowledge is systematically collected through project specific *quality assurance*, and subsequently generalized to fit a broader spectrum of projects, a more effective project management organization can be developed. The latter intensifies the learning curve of the project management organization which is a vital part of any organization

2.6. DEFINING A SET OF CRITICAL QUALITY FACTORS

Starting point of defining a relevant set of CQF's is the more general listing of CSF's in current project management literature. Concerning project management, the search for these success factors was startled by Daniel (1961), and subsequently adapted by Rockart (1978), who defined them as CSF's. From this point many authors have published lists of CSF's with different levels of abstraction, and related to their specific problem domain and type of activities across different industries (Fortune & White, 2006). Both empirical studies as conceptual research approaches have been published (Alias, Zawawi, Yusof, & Aris, 2014; Baker et al., 2008; Fortune & White, 2006; Lim & Mohamed, 1999; Munns & Bjeirmi, 1996; Pinto & Slevin, 1988; Westerveld, 2003) of which the most relevant and complete studies have been used to get an overview of the spectrum of CSF's. Some of them would suggest a universal approach of CSF's that would be applicable on projects of any background. This study specifically aims at the design phase of the construction industry, with an aim on quality. Therefore it is chosen to alter the widely used classification of factors as CSF's, and define those that have an effect on the quality of the result and thereby contribute to the project management process, as Critical Quality Factors, or CQF's.

Defining them as CQF's offers a more unsubstantiated term that does not reject the generalization of CSF's, but classifies a specific selection of CSF's. This research is not the first one to research a demarcated selection of CSF's. It has been subject of research for some time by differentiation between the success criteria of time, budget and quality. For instance, Chan and Kumaraswamy (2000) aim to identify CSF's that show a strong correlation with good quality performance in the construction industry, however only the term CSF was used. This was found to be too indefinite and unclear for this research, leading to the classification of CQF's. Earlier studies that have sought for those factors that affect the quality of a product and/or process are given in the oversight of table 5. For reasons of uniformity the factors found in literature are classified as CQF's.

	Critical Quality Factor	Literature occurrence*				
		1	***2***	***3***	***4***	***5***
1	Project Complexity and constructability	x	x	x	x	x
2	Project Managers Competency/Leadership	x	x	x	x	x
3	Top Management Support	x		x	x	x
4	Interaction between project participants - External	x	x		x	x
5	Interaction between project participants - Internal	x			x	x
6	Qualified project team members	x		x		x
7	Competence of Client		x	x	x	
8	Conflicts and disputes among project participants	x			x	x
9	Consistent communication/meetings		x		x	
10	Project significance, scope and objectives		x	x		
11	Stakeholder commitment of project participants	x			x	
12	Project conceptualization			x	x	
13	Political-/Socio economic stability			x	x	
14	Monitoring performance of external parties	x				

**Note: 1 = Arditi and Gunaydin (1998); 2 = Chua, Kog, and Loh (1999); 3 = Chan and Kumaraswamy (2000); 4 = Jha and Iyer (2006); 5 = Enshassi, Mohamed, and Abushaban (2009).*

Table 2 - CQF's extracted from literature, structured by occurrence of CQF's

The first source of factors comes from Arditi and Gunaydin (1998), who searched for factor that affect process quality during the design-, construction, and operation phase of the life-cycle of a building project. He subsequently ranked them by importance through a questionnaire survey amongst practitioners. Those factors that affected the design phase are used for this research, since the actual construction is not art of this research scope. The second source is the study of Chua et al. (1999) who also identified 'key factors' for the construction project success and differentiated them for their effect on the three success criteria time, budget, and quality. By the use of a questionnaire among project managers with an average experience of 20 years and the subsequently empirical analysis, he found a ranking of CSF's, of which only those are adopted for this research that concern the success criterion of 'quality'. The third publication, by Chan and Kumaraswamy (2000), reports the findings of a study to examine the underlying factors affecting the quality of a building project. They sought the factors that had a strong correlation to 'good' quality performance by doing a multiple-case study on more than 100 building projects in Hong Kong. The fourth study, of Jha and Iyer (2006), researched 55 attributes responsible to impact the quality performance of Indian construction projects. Their study resulted in two distinct sets of success- and failure attributes by executing a questionnaire and subsequently a statistical analysis. The final source of factors comes from (Enshassi et al., 2009), who identifies factors that affect the performance of local construction projects by a questionnaire among 120 respondents

who were divided in three groups, namely owners, consultants, and contractors. They classified the factors in the following groups: time, costs, quality, productivity, client satisfaction, regular and community satisfaction, people, health and safety, innovation, and environmental factors. Only those are used that contributed to the process of project management in the design phase of a project, since their study was mainly aimed at the execution on the construction site.

It became clear that many factors were focussed on the execution phase of building projects. This made some factors not applicable for this study, for example the (*weather)condition on a construction site* does not affect the scope of this research. Several other factors were found not applicable, which were omitted from the study. The total set of factors per publication is given in Appendix A.

2.7. CONCLUDING THE THEORETICAL BASELINE

Besides presenting a study of the research context, this part aims to answer the first sub-question:

> *What Critical Quality Factors can been found in literature for their contribution to project management?*

The completion of projects that both satisfy the internal- as external perception of success is subject to many studies ever since the theory of project management got up to speed. Through literature it stands out that the achievement of 'quality', as one of the classical success criteria of the 'iron triangle', is differently interpreted by all stakeholders involved. Besides this, it is stated that 'quality' is emphasised during project phases in which any form of influence is ineffective in the long run. It is found that by putting effort in designing an effective quality management process during an early project phase the position of quality is strengthened throughout the project execution phase, increasing the chance of project success.

Through the design of a quality plan that fits the purpose of the project a more effective process can be reached, according to the spirit of adaptive project management. It can furthermore be concluded that by the identification of critical success factors during the design of a quality plan a better alignment of expectations can be initiated. While studying these CSF's many empirical studies were founds that presented different conclusive list of CSF's for general effective project management. By specifically searching for articles that focus on CSF's for having a distinctive effect on the product quality that is pursued by the project management process, which are defined as critical quality factors (CQF's), a smaller set of publication were found. These lists were however mainly focussed on the construction phase, which initiated a selection procedure of those CQF's that are applicable during the kick-off phase and which can be influenced by the project manager of the contractor. The assessment

of these CQF's presented considerable a knowledge gap for their effect on quality management that did not directly had a connection with the construction phase of projects.

The conclusion of this literature study consist of mainly the identified CQF's, as presented in table 5. This table shows all articles that delivered different lists of CQF's, of which a more detailed selection procedure is given in Appendix A.

Part II

PRACTICAL BASELINE

3 Multiple-Case Study Set-Up

This chapter discusses the set-up of a multiple case-study, which is aimed at the *identification* and *prioritization* of CQF's by analysing recently completed projects that fit the context of this research. This chapter will build up to a point in which the execution can optimally contribute to the *practical baseline*. The tests for validity and reliability of the multiple-case study are presented in Appendix B.

3.1. CASE STUDY BACKGROUND

The case study is a *holistic multiple-case study* (Yin, 2013), and is executed in order to analyse the project management processes of recently completed projects. This case study is seen as *holistic* since there is one *unit of analysis* for each case that is studied, which will be discussed later. The case study is done for *multiple* cases to create a more reliable outcome and strengthen the external validity (Yin, 2013). In contrast to a *single*-case study, a *multiple* case study is capable of identifying a more diverse set of CQF's. Although a single-case study would offer a more detailed view of a small selection of CQF's, the aim is to identify a reliable set of CQF's that represent a relatively large part of the spectrum.

3.1.1. Unit of analysis- and observation

The project management process is controlled by the project managers that are appointed to a certain project. The goal of the project manager is to steer the process in such a way that the required level of quality is achieved. The execution of this process stands at the core of this research. Therefore the *unit of analysis* of this holistic multiple-case study is the 'project management process'. Within this scope the aim is to identify CQF's for their contribution to the process. The data that is gathered concerning this contribution of the CQF's is therefore the *unit of observation*.

3.1.2. Identification of Cases

The selection of cases will be done according to *replication logic* (Yin, 2013). This method is the opposite of *sampling logic*, and focusses on the selection of cases to replicate the outcome of each individual case study. The outcome of one case study becomes the proposed theory of the next, and

therefore strengthens the initial theory by focussing on the recurrent aspects within each case. Hereby it is assumed that enough projects are available for analysis. The application of this method is demarcated by the following criteria:

- ✓ **The Research Scope**: Projects that are completed and/or evaluated outside this scope are not representative for the current state of the project management organization. Chances are that the identified CQF's of outdated documents are already dealt with through former improvements of their project management organization (of W+B).

- ✓ **Accessible Project Information**: Besides the usefulness of their content, the requested documents should contain information that are not bound to any restrictions. Initially all data should be accessible without, for instance, black-markings that could deny important details. The pursued dataset should contain the general project characteristics, but does not request the publication of specific (political sensitive) details.

- ✓ **Affecting the Project Result**: The studied cases should represent a well enough description of the project management process to identify specific events that influences the process. The extent to which the contribution of CQF's is described can only be judged after disclosure of that information. Therefore the assumption is made that this information is included in the project documentation.

- ✓ **Symmetric Representation of Project Types**: The type of projects that are studied should represent a symmetric representation of projects as completed by W+B. For this criterion it is assumed that full cooperation is offered from all sectors of W+B.

3.2. PROTOCOL OF DATA COLLECTION

The protocol of data collection describes the case study execution in theory. Starting point is the actual search for CQF's. Within the contours of the stated criteria for project selection, first the required project documentation is described. Secondly, the way how this documentation is analysed will be presented, consisting of several steps that aim to optimize the identification, clustering, and finally prioritizing of CQF's.

3.2.1. Project Documentation

It is practically impossible to have an oversight of the available documentation prior to the case study besides the type of documentation that should be available according to the normal course of events. Finding the right information is therefore seen as an experiment; the value of content only reveals

itself at the point of interpretation. The types of documents that initially will be analysed are the following:

- ✓ **Internal Evaluation Reports**: These reports are written by the main project manager of W+B and are the result of an internal analysis on the process as perceived by all team members. The client is not part of this evaluation process. The subject of evaluation is the full project management process, so all elements are represented like budgeting, organizational issues, timeliness, communication, etc.; all can be linked to events that affected the result.. The set-up of the evaluation reports differ per project managers, since internal evaluations are done according to the preferred style of the project manager.

- ✓ **External Evaluation Reports**: These reports are written by the main internal project manager and are the result of an external discussion on the process as perceived by both the project team as the (project team of the) client. Receiving the perception of the client is the main objective during these evaluations. The set-up of this document is mostly standardized and addresses the same subjects as the internal evaluation reports.

- ✓ **Mid-term project evaluations**: The mid-term reports are written by the main internal project manager, and are the result from both an internal- as external discussion on the process (depending on the reasons for evaluation). This document is therefore not a standardized for all projects, but it is more a tool that can be used if needed. These reports are mostly written for the more complex projects and/or projects that endure some sort of setback.

Extending the research by consulting a large variety of project documentation, like for instance the Project Management Plan or the initial agreement with the client, might increase the reliability of the case study. However a choice had to be made while 'efficiency' was the most prominent criterion. This choice was eased by the fact that accessing and analysing the aforementioned documents would take significantly more time compared to the three types of project evaluations.

3.2.2. Three Steps of Data Collection

The three steps that have been designed to filter the right data from the selected documents are described in this paragraph. The objective is to end up with a definite list of prioritized CQF's. The steps that are followed are (1) *filtering* exceptional events that were countered during the project management process, (2) *identifying CQF's,* based on the filtered events, by iterating between different compositions of CQF's until a satisfying level of abstraction is reached, and (3) *prioritization* of the CQF's by the amount of occurrence.

1. FILTERING EVENTS

The filtering of relevant events is initiated by sorting the analysed information in a concise way, with respect to the terminology and structure as used by the original author. It is assumed that all project managers have a different ways of evaluating a project, but with a similar use of terminology as they all work for W+B. This will be essential for the subsequent interpretation of the events as overarching CQF's in the second step. In order to constructively guide this first step, a predetermined layout of the database is given in table 6.

Project	Lessons Learned	What went right?	What went wrong?
#			

Table 3 - Structure for the analysis of Case Study Documents

- ✓ **Lessons Learned**: This is a collection of general statements about aspects of the process that have been noted as suboptimal. These statements are meant for the relevant Sectorial Quality Team (SKT), who evaluates the performance of the Sector to which that project belongs. Therefore these lessons are of great value for this research.

- ✓ **What went right**: This is a common section of the evaluation that specifically aims for aspects that had a positive contribution to the project management process. These statements collected and summarised to find what aspects stand out.

- ✓ **What went wrong**: This is a section of the evaluation, aiming for aspects that had a negative contribution to the process. The challenge is to find the right statements and terminology that might be recurrent in the project evaluations. This should help structuring the next step of identification.

2. IDENTIFYING CQF'S

The specific events filtered by the previous step are clustered into CQF's during this second step. This helps to find an effective level of abstraction through identification of their common denominator. At this point the choice is made to manually cluster the events. A different option would be the application of an 'explorative factor analysis' in order to statistically prove the existence of any underlying explanatory factors. But since this would not serve the objective of this research in an efficient matter, a different method is chosen. This method comprises of selecting the most frequent terminology by hand and subsequently match the corresponding events of step one. For example, if the term 'communication' would turn up in different situations, they are collected as part of the cluster

'communication'. Within this cluster, different terms could be found that give knowledge about the 'flexibility' of communication lines, or the 'directness' of the way of communication. These steps are undertaken until a satisfying representation of all events is found and can subsequently be identified as a set of CQF's. Wrongly interpreting the analysed information is possible, but since there is no useful standardized method at hand, this is found to be the most effective.

3. PRIORITIZING CQF'S

The final step of this case study consists of prioritizing the identified CSF's based on their percentage of occurrence in all studied evaluations. The method is simple: more occurrences results in a higher ranking. This simple way of ranking is chosen due to the lack of substantial evidence that one CQF would rank higher or lower than other CQF's. So for this part of the case study it does not matter if a certain CQF had a positive and/or negative effect on the process. These characteristics of the CQF's will be presented during the execution of the case study, in which all characteristics together will be handled.

4 Multiple-Case Study Execution

This chapter will present the results of the multiple-case study and subsequently discuss the findings. This chapter will start by giving a short introduction of the projects that were selected for the case study.

4.1. CASE SELECTION

The selection of projects gradually shaped the case study due to the fact that the availability of documents was initially unclear, so the search was specifically aimed at finding the most extensive internal-, external, and mid-term evaluations. The cases for which these documents were available were selected according to the criteria as presented in chapter 3.1.2., stating that: *the information should be freely accessible*, *the research scope has to be respected*, *they should evaluate events concerning the project management process*, and the sample of cases should *represent a symmetric selection of W+B*. Selecting projects for the case study is done using the replication logic, as indicated in chapter 3.2.1. A complete oversight of all projects is presented in Appendix C.

4.1.1. Project Characteristic: Sector within W+B

Initially a symmetric representation of projects among the four sectors is pursued. This was unfortunately not feasible. Only the evaluation of the sector Built Environment (GOM), and Infrastructure and Mobility (IM) offered enough insight into their project evaluations. The evaluations of the remaining sectors were not freely accessible. The amount of project evaluations that were received are the following:

- ✓ **The Build Environment - GOM**: 16 projects evaluations;
- ✓ **Infrastructure and Mobility - IM**: 27 project evaluations.

Sector GOM is characterised by a focus on the development of urban areas. Their activities vary from drafting Environmental Impact Reports to the design of Resilient cities. They are mainly employed

during the design phase, but also have expertise in project management during construction. Their main clients used to be private real estate developers, but since the financial crisis their main clients come from public parties. Sector IM is characterized by the design of large infrastructure projects. Since practically all main infrastructures of The Netherlands is owned by the government their main clients are the large public parties like Rijkswaterstaat (RWS) and ProRail (semi-public). By solely looking at the type of clients that are served, it can be seen that differences between the sectors exist, which might manifest in a different emphasis on CQF's throughout the evaluations.

4.1.2. Project Characteristic: Type of Clients

Different evaluations showed events in which the client played a significant role. This resulted in several client related CQF's, in a way that these CQF's are dependent on the type of client that is dealt with. Collecting these events made it interesting to see what differences would appear among the types of clients. The main differences were noticed between clients that represented a private party versus clients from public parties. Even within these types differences would occur, especially between the smaller public parties, like e.g. municipalities, and a larger public parties, like e.g. Rijkswaterstaat (RWS). This finding led to a differentiation between these three types of clients, of which their occurrence is given in table 7.

Type of Client	Studied Cases - GOM	Studied Cases - IM
Small-Public	5	7
Large-Public	4	10
Private	7	10

Table 4 – Multiple-case Study: Types of Clients

Other divisions between the types of clients were considered, like for instance only a division between two categories: public and private, or four categories: small-private, large-private, small-public, and large-public. However, the current split between the three categories gave the most reliable division. Besides this, experienced project managers from the two sectors (GOM and IM) confirmed this finding and stated that this division evenly covers the diversity of clients they deal with on a daily basis.

4.1.3. Project Characteristic: Static properties

The static properties of the cases are coupled to the project size, which are for example the height of the initial budget, the actual reported costs, the timespan in which the project was planned, -and executed, etc. These were mostly available through a study of the archival records, but their added value was not relevant enough for further analysis.

4.2. DISCUSSING THE RESULTS OF THE MULTIPLE-CASE STUDY

The main objective of this case study is to define a comprehensive list of CQF's, ranked by the amount of their occurrence during recently completed projects. This list should represent a cross section of the 'daily project management practice' of W+B. A different company would possibly end up with a somewhat different set and/or ranking of CQF's, personalized for their project management organization. This makes this particular study a case study demarcated by the project management organization of W+B.

4.2.1. Case study Results

Executing the multiple-case study among the 43 projects, according to the four steps presented in the case study set-up of the previous chapter, led to the *identification* of the list of CQF's as given in table 8. Besides their identification, table 8 also shows the amount of positive/negative notions, and the percentage of their occurrence. The *prioritization* of CQF's was done by considering their *percentage of occurrence*. This percentage represents their occurrence in the 43 projects, since more than one CQF could be encountered in a single project evaluation.

	Critical Quality Factor from Practice	Positive Notions	Negative Notions	Percentage of occurrence
1	Output expectation management	3	18	49%
2	Direct Interaction between project participants	10	7	40%
3	Qualified project team members	10	7	40%
4	Consistent communication guidelines	9	6	35%
5	Input expectation management	6	9	35%
6	Stakeholder commitment in kick-off phase	6	4	23%
7	Team mitigation policy	1	8	21%
8	Review of stakeholder commitment	2	7	21%
9	Insight in stakeholder vision and project significance	3	5	19%
10	Involvement of client with mandate	0	7	16%
11	Review consequences of change	5	2	16%
12	Display of misunderstandings and mistakes	0	7	16%
13	Display of shortcomings of info and knowledge	0	5	12%
14	Consistent pattern of evaluations	0	5	12%
	Sum of Total	*55*	*97*	-

Table 5 - Result Case Study: Listing of CQF's with percentage of occurrence

It can be seen that there are almost twice as much *negative notions* that *positive notions*. The distribution of *positive- and the negative notions* do sketch a false image of the average projects of W+B, since writing a project evaluation is not standard practice for all projects. Therefore their

occurrence cannot be extrapolated for all projects of W+B. Some of the main reasons for these kinds of 'false-counts' are given below.

- ✓ **'Business as usual':** Most project activities are completed within acceptable boundaries of normality and therefore do not stand out as positive or negative. So only the more 'extreme' events are encountered. For example, *#7 – team mitigation policy* would stand out during an evaluation if the project manager would suddenly leave the project during execution. This would have a significant effect on both the internal project knowledge as on the relationship with the client. But if that project manager would not be replaced and thereby 'does the job as required', it would not stands out as an event worth evaluating.

- ✓ **Negative bias**: It is more easy to tell what went wrong than what went right. In psychology this is called the negative bias, meaning that negative information tends to influence evaluations more strongly than comparable extreme positive information (Ito, Larsen, Smith, & Cacioppo, 1998). Therefore the evaluations were expected to predominantly describe events that had a negative effect on the process. This is one of the reasons for the skewed balance between the total of positive- and negative notions of table 8.

- ✓ **Routine projects/Low budget**: For many projects it would not be inefficient to conduct an evaluation. Project that are 'done a thousand times' and do not ask a lot of effort only deliver a useful evaluation if there are specific lessons to be learned, which is then initiated by a project manager if that would be the case. Inefficiency is also triggered by low budget projects for which an evaluation would be a big part of the expenditure.

- ✓ **Special lessons learned**: When specific failures occur or an outstanding performance was delivered, it is useful for any project manager to learn from those lessons. Therefore when certain events stand out, an evaluation can be internally requested or initiated by the project manager self.

- ✓ **Time-pressure**: Most project managers are heavily occupied, and some periods more than others. During these busy periods the choice is quickly made to skip an evaluation and put extra effort in activities that are directly profitable. Making project evaluations a secondary activity.

Summarising the above it seems logical that the negative notions are higher than the positive instances. Also, for example the 49% of occurrences of *#1 – output expectation management*, cannot be extrapolated for all projects within W+B, since not all projects are evaluated. All this together makes

it even more challenging to approach the last criterion, requesting a symmetric sample of projects. The project managers mainly 'picks' their own projects to evaluate.

Due to these findings it can be stated that the approach used in the multiple-case study is not satisfying the objective of *prioritization*. It does satisfy the need for *identification*, although a more structured form of evaluating would make the interpretation of events more clear.

4.2.2. Effect of the Type of Client

Expectations of individuals differ per perspective taken and are based someone's personal experiences. Therefore, when the experiences of different clients are analysed it can be noted that for example a small municipality, who acts on a local level, has different experiences than Rijkswaterstaat, who acts on a nationwide level. Extrapolating this line of reasoning, it can be assumed that when the exact same project would be executed, but for different types of organizations, different expectations are to be found. This could manifest in a different approach of the project manager of the contractor when projects are executed for different organizations.

These statements are based on what is found during this case study, but also by talking to experts about their experiences with different types of clients. This was already pointed out in paragraph 4.1.2., of which the division of types of clients (private/small-public/large-public) opt for further analysis of their influence on the approach of a projects manager during the project management process. A further study of the identified types of clients is presented hereunder:

- ✓ **Private Organization**: Organizations that are associated with this category range from small project developers to the bigger industrial oil companies. Turner (2014) characterised the difference between private and public as follows: the public sector will usually give more weight to social and environmental factors than the private sector. From the multiple-case study it stood out that e.g. a private contractor (builder) demands a special approach by repeatedly expressing the need for direct communication to minimize the risk of wrong interpretation.

- ✓ **Small-public organization:** Organizations that belongs to this group are mainly the (smaller) municipalities. Other organizations that were identified were Province's and Waterboards. The latter two are dependent on the geographical location in differentiation between small- and large public organizations. This group is characterized for being the first layer of governance that stands closest to its citizens, and are therefore aimed at projects on a local level (BZK, 2010). This illustrates the arm of power that a small-public organization has. The size of their

projects (budget/geographical/etc.) is their main cause for differentiation from the large-public organization. A municipality usually does not have the knowledge or the organizational capabilities the larger (public) organizations have.

- ✓ **Large-Public Organization**: Organizations that are labelled as large-public are Rijkswaterstaat (RWS) and ProRail (semi-public), who are a big part of the large infrastructure project in The Netherlands. Province's and Waterboards are also associated with this type, but were mostly seen as small-public organizations due to their less professional project management organization. From the multiple-case study it stood out that e.g. RWS controls the process in detail, creating a sluggish situation which slows down their decision making process. Their focus on controlling the process originates from an underestimation of the knowledge of W+B and therefor a lack of trust.

4.3. CONCLUDING PART II

Different findings are hereby presented which conclude Part II: the set-up and execution of the multiple-case study. In order indicate the contribution of this part to the objective of this research, the sub-question is consulted, stating:

> *What Critical Quality Factors have indicated to contribute to the project management process of recent completed projects?*

Before the CQF's could be identified, this case study pointed out that the documents (project evaluations) that were used are not consistent enough for a constructive analysis. Both the *form* in which they were produces as the *mind-set* that stands behind it, lack a standardized approach. Without standards there can be no improvements, so the project management organization of W+B is dependent on the most outstanding flaws. In the long-run this can lead to an organization that only follows the fact instead of being ahead of structural errors.

The second step of the multiple-case study, the identification of CQF's, led to the formation of a list of 14 CQF's. This is an early concept that gives a good view of what CQF's have some contribution to the project management organization of W+B, supported by the project evaluations that were made available. So in a sense, this multiple-case study is also a larger case study of the project management organization of W+B. The final list of CQF's that conclude the findings of the practical baseline are given in table 9.

	Critical Quality Factor from Practice
1	Output expectation management
2	Direct Interaction between project participants
3	Qualified project team members
4	Consistent communication guidelines
5	Input expectation management
6	Stakeholder commitment in kick-off phase
7	Team mitigation policy
8	Review of stakeholder commitment
9	Insight in stakeholder vision and project significance
10	Involvement of client with mandate
11	Review consequences of change
12	Display of misunderstandings and mistakes
13	Display of shortcomings of info and knowledge
14	Consistent pattern of evaluations

Table 6 - Practical Baseline: Identification of the CQF's through Multiple-Case Study

The final step of the multiple-case study, the prioritization of CQF's, did not satisfy the objective of prioritization. This objective is based on a more reliable output, but since most project evaluations are done in a selective matter a true cross section of the company is not achieved. But also due to this selective characteristic, this study did however deliver the more outstanding CQF's that contribute to the project management process of W+B.

Besides the identification of CQF's an extra notion was made about the role of a client during project management. It is found to be an important element of the context, based on both the finding of the multiple-case study as further discussions with experiences project managers. It is therefore assumed that the contribution of most CQF's is dependent on the client. The typology that has been made is the following: (1) Private organizations, (2) Small-Public Organizations, and (3) Large-Public Organizations. This finding is further analysed throughout this research.

Part III

BWM SURVEY

5 Survey Set-up

This chapter presents the set-up of the Survey. First the two lists of CQF's that resulted from the literature study (theoretical baseline) and the multiple-case study (practical baseline) are combined into one list. This forms the final baseline on which the Survey is based. Secondly, the group of respondents and their characteristics are introduced accompanied by an analysis of the sample adequacy.

5.1. CONVERGING THEORY AND PRACTICE INTO A GENERAL BASELINE

Both the practical- and theoretical baseline converge in this paragraph, forming one single set of representative CQF's. This set will define the final list of CQF's for which the survey will be executed, aiming to uncover the assumed differences between the types of clients as judged by a group of project managers of W+B. In order to maximize the outcome of the initial convergence, the following criteria are designed to test the applicability of the CQF's for the intended survey:

C1. *The amount of overlap in terminology must be minimalized;*

C2. *The levels of abstraction in terminology must be comparable with other factors;*

C3. *The factor must be able to be influenced by a project manager or its team members.*

These criteria are applied on both the list of CQF's that resulted from the literature study as the one from the multiple-case study. A full description of this step is described further in Appendix C. The following paragraph will present the final list that resulted from this.

5.1.1. The Final List of CQF's

Defining a final list of CQF's should further minimize vagueness and ambiguity that surrounds any subjectivity of the CQF's. The list of criteria on which both baselines are tested have proven to be useful in demarcating the individual CQF's, but not conclusive. To further minimize the room for

misinterpretation during the survey this paragraph presents definitions of all CQF's, which will also be discussed during the actual survey. Table 10 gives the definition of the final CQF's.

Definitions of CQF's		
	Critical Quality Factor	**Definition**
F1	Interaction between project participants - Internal	Directness of all forms of interaction between team members of W+B
F1	Interaction between project participants - External	Directness of all forms of interaction between team members of W+B and the client
F3	Consistent communication guidelines	Structuring and controlling of guidelines on all forms of communication and evaluation
F4	Review and acceptance of shortcomings and mistakes	Presenting and reviewing shortcomings and mistakes with involved parties
F5	Top Management Support	Involving the higher escalation levels or in this research 'top management'
F6	Insight in stakeholder vision and project significance	Pursuing clarification of the clients vision, also called 'the question behind the question'
F7	Involvement of client with mandate	Involving stakeholders with mandate from within the organization of the client
F8	Stakeholder commitment (during kick-off phase)	Involving external stakeholders and creating commitment in the kick-off phase of the project
F9	Project conceptualization	Prioritizing the quality of the product above activities that influence time and/or budget
F10	Input expectation management	Aligning expectations of incoming information and documentation delivered by the client
F11	Output expectation management	Aligning expectations of outgoing information and documentation delivered by the project team
F12	Political-/Socio economic stability	Pursuing a balanced project environment and thereby securing the boundaries of the scope
F13	Team mitigation policy	Developing a policy for the unexpected mitigation of team members
F14	Competence of Client	Developing an environment in which the competence of the client is optimally used
F15	Monitoring performance of external parties	Controlling the performance and deliverables of external parties and subcontractors
F16	Qualified project team members	Selecting qualified team members; coupling the right person to the right job

Table 7 - Definitions of CQF's

5.1.2. Applying the Best-Worst Method

The judgement of how project managers experience the contribution of the presented CQF's during the project management process, is assumed to differentiate per type of client, as discussed in the conclusion of part II (chapter 4.2.). All project managers have their own opinion on what process design would fit the goal of a specific project best and what CQF would best help to achieve this, depending on the context. Therefore this research differentiates between *types of clients* in order to find those CQF's that can be labelled as *client dependent*. So in a sense a 'decision' has to be made on which CQF's contribute the most to the project management process, compared to other the other CQF's, in a client dependent context.

The method that is used to study this decision is called the Best-Worst Method (BWM). Since there is not such a thing as a perfect solution within this subjective context, an optimum should be found that is able to support a project manager in their unique process, which is more than a simple weighted sum of opinions (Ishizaka & Nemery, 2013). This goal can be achieved by performing BWM, which is a form of Multiple Criteria Decision Analysis (MCDA), and can be aimed at 'making' a decisions, but also at 'analysing' the background of a decision, in order to find an optimal solution. The added value of BWM compared to other MCDA techniques is its unique approach towards pair-wise comparison. Within this approach there are two variables that are sought, being the *direction* and the *strength* of the preferences between criteria. There should be no problem in stating the *direction* of the ordinal preference, but judging the *strength* of one criterion over the next makes it more difficult. A more specific description of BWM and its method of calculating the output are presented in Appendix D.

An adaptation to the list of CQF was therefore needed, which is led by the ambition to create an optimal environment for applying BWM. This ambition dictates that a list of 16 CQF's is too large, since not only an ordinal preference was sought, but also the strength of their interrelationship. This would lead to a Llikert scale of at least 1 to 16 of higher, which was found to be unreliable and practically difficult to understand for the respondents. Therefore it is decided to form *clusters* of CQF's based on their presumed interdependencies.

5.1.3. Structuring the List into Clusters

By clustering the factors, based on their presumed interdependencies, it is possible to apply BWM in a more reliable manner (Rezaei, 2015a). Hereby it is stated that a Likert scale of 9 is preferred for an increase of the reliability. With this in mind, combining 16 CQF's with a Likert scale of 9 is not possible if the strength of their differences is pursued instead of their ordinal preference. So the reason for clustering is that the applied method of BWM is applicable.

The actual clustering of CQF's is done by finding their most fitting higher level of abstraction. By selecting the higher levels of abstraction that correspond to those of other CQF's this process is completed. The final clusters are tested by identifying the causal relationship between the cluster and the underlying CQF. The four categories are (1) *Openness and Communication*, (2) *Commitment*, (3) P*redictability*, and (4) C*apability*, and are presented in table 11. The fact that each cluster is defined by four underlying CQF's is just a coincidence.

Clustering the List of CQF's		
Cluster		**Critical Quality Factor**
C1 *Openness and Communication*	**F1**	Interaction between project participants - Internal
	F1	Interaction between project participants - External
	F3	Consistent communication guidelines
	F4	Review and acceptance of shortcomings and mistakes
C2 *Commitment*	**F5**	Top Management Support
	F6	Insight in stakeholder vision and project significance
	F7	Involvement of client with mandate
	F8	Stakeholder commitment (during kick-off phase)
C3 *Predictability*	**F9**	Project conceptualization
	F10	Input expectation management
	F11	Output expectation management
	F12	Political-/Socio economic stability
C4 *Capability*	**F13**	Team mitigation policy
	F14	Competence of Client
	F15	Monitoring performance of external parties
	F16	Qualified project team members

Table 8 - Clustering the List of CQF's

5.2. THE RESPONDENTS

The group of respondents is selected by demarcating the characteristics of the sample size and stating the preconditions of the selection procedure, since the respondents have to be representative for the company of W+B. Marshall (1996) stated that generalizability of the outcome is not pursued in qualitative research, but rather an adequate sample size that sufficiently answers the research question. The adequacy of the sample size is therefore described in this paragraph. The full list of respondents that are subsequently selected is given in Appendix F.

5.2.1. Preconditions for selection

Four initial preconditions are designed for the respondents to be selected. The respondents that took part in the survey have been selected according to these preconditions to maximize the usability of their response. The following preconditions demarcate the selection of respondents:

- ✓ **Currently employed by W+B**: This research focusses only on the perspective of the project manager as employed by a contractor, which in this research is W+B. It is assumed that project managers of a different company could have a different view on the effect of CQF's, since their internal project management organisation probably differs than that from W+B.

- ✓ **Experience with all types of clients as PM**: Their experience with all type of clients was not accessible without getting in touch with the respondents. Therefore it was decided to conduct the survey with the initial selection, accepting that there is a chance that they do not meet this precondition. In the case they state to be inexperienced with a certain type of client, their response will be marked as 'potentially disruptive' for the final dataset.

- ✓ **Minimum experience as PM of two years**: Two years of project manager experience was found to be enough to be applicable for the survey.

- ✓ **Accessible within an acceptable timeframe**: Due to the amount of surveys and the time consuming method used to execute them, a limited timeframe was available to find the right balance between sample size and effectiveness of the survey.

5.2.2. Sample Adequacy

Achieving sample adequacy, as addition to the stated preconditions, relates to the demonstration that a satisfaction of information has been reached, meaning that there should be enough *depth* as well as *breadth* of information (Bowen, 2008). This is pursued by defining a symmetric sample size that functions as a limited cross section of W+B. The dimensions of this sample size are threefold, which are (1) their *sector within W+B*, (2) their *project management experience*, and (3) their *professional background*. By researching this spread it is assumed that different perspectives can be identified of the perceived contribution of CQF's to the project management process according to the respondents. The three dimensions of the sample size are discussed in this paragraph.

- ✓ **Sectors**: The Company of W+ B consists of four sectors, being (1) Built Environment - GOM, (2) Infrastructure and Mobility - IM, (3) Energy, Water and Environment - EWM, and (4) Deltas, Coasts and Rivers - DKR. All sectors function mostly as independent entities within the

company and thereby have developed their own characteristic project management organisation. Besides this *internal* difference, the *external* influences are also divers. When looking at e.g. the type of client that is predominant within their project portfolio, EWM mostly deals with clients from the Private domain compared to IM in which the Public domain is responsible for most of their projects. This might influence their view of what an effective process of project management should look like. Their corresponding sectors are given in figure 7.

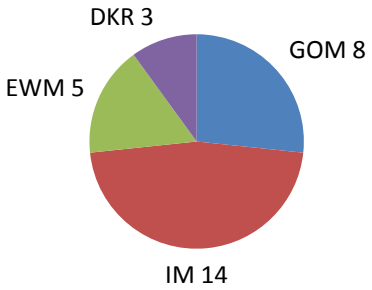


Figure 7 - Respondents: The sector within W+B

As can be seen from figure 7, finding an equal distribution of sectors was not possible. All sectors are represented between respondents, but due to practical limitations not all sectors are equally represented.

- ✓ **PM-experience**: The second dimension is their experience as functioning project manager in years. It is assumed that a respondent with more years of experienced has a more established way of taking on project management, which might affecting their judgement of the presented CQF's per type of client. The outcome of this research should also be applicable for project managers of all levels, which led the search for an equal distribution. Figure 8 shows the distribution of the years of experience (y-axis) for each respondent number (x-axis).

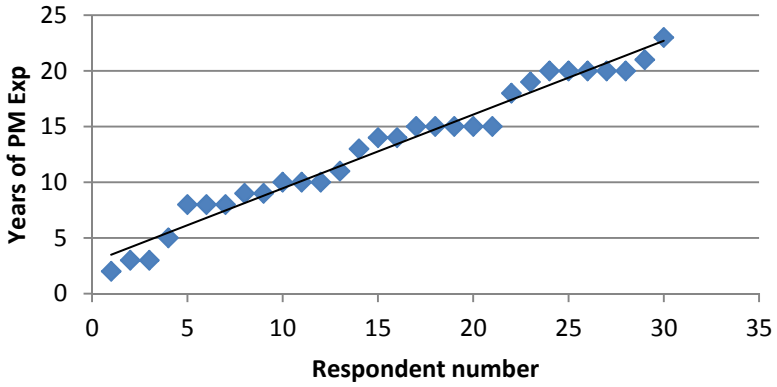


Figure 8 - Respondents: years of experience, given for each individual respondent

Fortunately it was possible to find an equal distribution of years of experience in the field of project management.

- ✓ **Professional background**: The final dimension is the professional background of the respondents. Ideally their previous employer would correspond with the three identified types of clients, being (1) Private, (2) Small-Public, and (3) Large-Public, with addition of a fourth group, being those project managers that never had another employer than W+B. But due to significant amount of employees that never had a different employer than W+B, a different subdivision was pursued. Two groups are defined, the ones that never had a different employer than W+B (WB), and the group that was employed by a different company than W+B (Other). This division is visualised in figure 9.

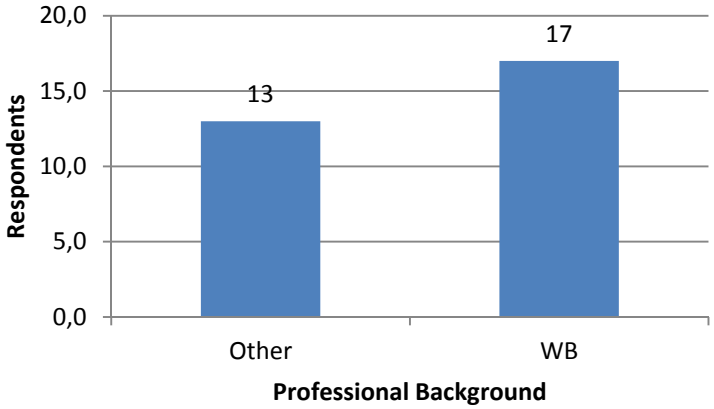


Figure 9 - Respondents: Professional Background

Fortunately these two groups were being formed with enough equality to form a representative perspective of their group.

6 Survey Execution

6.1. THE SURVEY

This paragraph goes into the actual execution, describing the practical set-up, the insights that came to light and what limitations were discovered by the research as well as the respondents. The survey as executed (in Dutch) can be found in Appendix M.

6.1.1. The Survey itself

The survey was executed with a set of 30 respondents within the timespan of four weeks. The list of respondents is added to Appendix F. In order to counter any limitations caused by misinterpretation of the content, it is decided to execute all surveys in person. This made it possible to:

- ✓ Discuss the applied BWM method for it can be a complex methodology at first sight;
- ✓ Explain the definitions of the presented CQF's to minimize misinterpretation;
- ✓ Elaborate on the perspective taken;
- ✓ Create room for extra discussion on the context.

The latter gave essential insights on the role of the project manager and became an important source of information. The survey was set for one hour of which the first 20 minutes were spending discussing the context of the research and explaining BWM (for general understanding). Hereafter 30 minutes were spend filling in the survey according to BWM, keeping track of the right interpretation of the CQF's. Subsequently the control questions were filled in, followed by a discussion on the limitations, the research scope, further application of the outcome, and possibilities for continuous development of further research.

6.1.2. Insights for specification of CQF's

During the surveys and subsequent discussions, different aspects about the list of CQF's were criticised by the respondents. Their comments gave important insights about their initial definitions. Since all CQF's were defined as interpreted by the researcher based on the multiple-case study and literature study, misinterpretations are possible. This led to the idea that the list of CQF's should be adapted. Although most CQF's were generally well interpreted, some did initially lead to a misinterpretation. The most helpful comments are given here:

- ✓ **F7: Involved client with mandate**: The client with mandate is never one person, but a whole internal structure of different stakeholders dependent on size of the organization. A more fitting name would be 'internal stakeholder commitment'.

- ✓ **F9: Project conceptualization**: Most respondents had a challenge grasping the given definition of this factor. The emphasis in the given definition should be more on the 'quality of the product' more than just 'quality'. The initial definition gave the idea that it was about the 'quality of the process', which would be impossible, since all factors are said to influence the quality of the process.

- ✓ **F12: Political-/Socio economic stability:** The name of this factor suggest that it is only an external factor, and therefore impossible to influence. This is true, as it is extracted from literature, but during the interviews is was interpreted and defined as 'proactive controlling the defined project scope for external influences'.

6.1.3. Discussing the Types of Clients

After discussing the CQF's three questions were asked related to the differentiation between types of clients. These were about their experience with all types of clients, their recognition of the differences between them, and if they could propose a different division in typology. The most interesting topics related to client typology are presented here:

- ✓ **Project Management Approach**: At the start most respondents recognized the difference between the presented types of clients and hereby also state that their project management approach differs per type of client. This would mostly go in hand with the remark that the context dictates their approach more than only the type of client. So in this line of reasoning the type of client is only one element that defines the total project context.

- ✓ **Different typology**: Part of respondents suggested to differentiate within the given typology of clients. Although most would confirm the proposed typology, some other useful insights were given as presented hereunder:
    - o 1. Small-Private; 2. Large-Private; 3. Public;
    - o 1. Large-private/public; 2. Small-public; 3. Small-private;
    - o 1. Small-organization; 2. Medium-organization; 3. Large-organization.
- ✓ **Dependent on the person**: One of the more outstanding comments which was repeatedly made was about the dependency of their project management approach. This was also about the types of clients, but more specified on the type of person that is dealt with. So not the type of organization matters, but the specific person that represents that organization. They did recognize that defining different types of clients initiates the approximation towards further identifying the person across the table.

6.2. THE RESULTING LIST OF CQF'S

The execution of the survey raised questions about the list of CQF's as presented as discussed in the previous paragraph. Some CQF's were not specific enough and had room for misinterpretation. Besides this it stood out that the clusters did not always deliver the expected added value. Therefore two adaptations are pursued in this paragraph, the first being a validation of the clusters for their ability to represent a higher level of abstraction of the CQF's they contain, and the second being an adaptation of the initial list of CQF's.

6.2.1. Validating the Clusters

Validating the clusters is meant to find out the value of their addition to the list of CQF's. If this is the case then it would mean that the higher level of abstraction is correct and can further be used for practical implementation or further research. If not the case, they should be ruled out.

After calculating the results by means of BWM all CQF's received a weight between 0 and 1, based on how the respondents judged their contribution to the project management process. As assumed prior to the survey, the presented list is complete and therefore represents the full spectrum of CQF's that can contribute to the project management process. Without this assumption the survey would not reach its full potential. So every CQF claims a percentage of the total, which makes the weights replaceable with percentages, creating a better representation of their meaning. At this point there is

no differentiation between the types of clients, since this part is meant to validate the addition of the clusters.

The CQF's were clustered in groups of four, representing an initially expected underlying factor. Referring back to chapter 5.1.3., this was initially done in order to apply BWM on the survey results. The clusters are the following:

- ✓ ***C1*** – *Openness and Communication*;
- ✓ ***C2*** – *Commitment*;
- ✓ ***C3*** – *Predictability*;
- ✓ ***C4*** – *Capability*.

Any correlation between the CQF's is expected to occur only within these clusters. To test the significance of this correlation an *exploratory factor analysis* is executed. The goal of this analysis is to study the multicollinearity (Williams, Brown, & Onsman, 2012) between the CQF's. Per CQF there are two classifications possible, which are 'unique' and 'common'. The difference between the *common CQF's*, which are the CQF's that are unobservable latent factors that influence more factors than only itself, and *unique CQF's*, which are latent CQF's that influence only itself (Fabrigar, Wegener, MacCallum, & Strahan, 1999).

To execute the exploratory factor analysis SPSS is used. This is a tool that helps to analyse the correlation between factors, which is subsequently used to analyse their relationship with the clusters. The correlation coefficient (c.c.), which is measured between two CQF's, is the result of this analysis can be classified by the following standard:

- ✓ c.c. < 0.3 Low Correlation;
- ✓ 0.3 < c.c. < 0.5 Some Correlation;
- ✓ 0.5 < c.c. < 0.8 Strong Correlation;
- ✓ 0.8 < c.c. Statistically Significant Correlation.

Only the last classification, the statistically significant correlation, would indicate that there is a strong relationship between the measured CQF's. The results of this analysis is presented in table 12, which gives the correlation coefficient per CQF that has some- or a high correlation with a different CQF, e.g. F2 has a shared correlation coefficient of 0,406 with F4. The full SPSS output is given in Appendix G.

Exploratory Factor Analysis Output					
		Critical Quality Factor	**Unique**	**Common**	
				Some c.c. >0,3	**Strong c.c. >0,5**
C1	F1	Interaction between project participants - Internal	x		
	F2	Interaction between project participants - External		F4: 0,406	
	F3	Consistent communication guidelines	x		
	F4	Review and acceptance of shortcomings and mistakes		F2: 0,406	
C2	F5	Top Management Support	x		
	F6	Insight in stakeholder vision and project significance			F7: 0,522; F8: 0,512
	F7	Involvement of client with mandate		F8: 0,427	F6: 0,522
	F8	Stakeholder commitment (during kick-off phase)		F7: 0,427	F6: 0,512
C3	F9	Project conceptualization	x		
	F10	Input expectation management			F11: 0,575
	F11	Output expectation management			F10: 0,575
	F12	Political-/Socio economic stability	x		
C4	F13	Team mitigation policy		F16: 0,430	
	F14	Competence of Client	x		
	F15	Monitoring performance of external parties			F16: 0,672
	F16	Qualified project team members		F13: 0,430	F15: 0,672

Table 9 - Output Exploratory Factor Analysis (SPSS)

From this table it can be seen that *no significant correlations* have been found according to SPSS (c.c. > 0.8). This means that no *underlying explanatory factor* is found between most CQF's that would prove multicollinearity. The results can be summarized by the following statements:

- ✓ **Only correlations are found within the clusters to which those CQF's belong to**: A certain correlation within the clusters was expected beforehand. The extent of their correlation was on the other hand not known, since there was no survey-data at the time of clustering.

- ✓ **Six unique CQF's show low correlations**: All clusters contain one or two unique factors that did not show any indicative correlation with other CQF's.

- ✓ **Ten common CQF's show some or high correlations**: There are ten CQF's found that had a certain correlation with other CQF's. These correlations are measured in groups of three and two CQF's.

- ✓ **No validation of Clusters**: There were no correlations found that included a full set of four clustered CQF's, which means that it can be concluded that the clusters are not validated and are therefore discarded.

6.2.2. Adapting the list of CQF's

As discussed in chapter 6.2.1. different adaptations of the CQF's were proposed by the respondents as a result of their interpretations of certain CQF's. Besides the stated CQF's in that chapter, other adaptions to the list were made to better define their place in project management. The adapted list is given in table 13.

Improved list of CQF's			
	Original Critical Quality Factor		**Improved Critical Quality Factor**
F1	Interaction between project participants – Internal	→	Interaction between internal team members
F2	Interaction between project participants – External	→	Interaction with external project participants
F3	Consistent communication guidelines	→	Consistent communication guidelines
F4	Review and acceptance of shortcomings and mistakes	→	Open dialog of shortcomings and mistakes
F5	Top Management Support	→	Top Management Support
F6	Insight in stakeholder vision and project significance	→	Insight in client's vision and project significance
F7	Involvement of client with mandate	→	Internal stakeholder commitment
F8	Stakeholder commitment (during kick-off phase)	→	External stakeholder commitment
F9	Project conceptualization	→	Prioritizing quality over time and/or budget
F10	Input expectation management	→	Aligned expectations of input
F11	Output expectation management	→	Aligned expectations of output
F12	Political-/Socio economic stability	→	External influence on project scope
F13	Team mitigation policy	→	Team member mitigation
F14	Competence of Client	→	Competence of client
F15	Monitoring performance of external parties	→	Performance of external parties
F16	Qualified project team members	→	Qualified project team members

Table 10 - Improved list of CQF's

6.3. CONCLUDING PART III

A preliminary conclusion hereby presented of Part III: the set-up and execution of the BWM Survey. It is preliminary since the actual answer of the sub-question is given in the results (chapter 7) of this research. The sub-question states the following:

> *What Client Dependent Critical Quality Factors are found to contribute to an effective project management approach according to panel of experts?*

The use of the Best-Worst Method to receive the weights per CQF's in the context of three different types of clients, serves the goal of this research. The data that is produced is directly applicable for further analysis. Besides BWM, the choice to personally conduct the survey seemed useful for both the response that was given as for the discussion that followed the survey. The first measure assured the reliability of all responses and the latter gave extra insight that is further included in the discussion of chapter 8.

The four initial clusters, being (1) *openness and communication*, (2) *commitment*, (3) *predictability*, and (4) *capability*, were initially formed by means of the applicability of BWM. It was assumed that the clusters represented a higher level of abstraction of their underlying CQF's. By means of an *exploratory factor analysis* this was invalidated, which led to the definite omission of the clusters. Thereby it was also found that the internal cohesion of the CQF's did not give rise to any alternative clustering.

During the survey it became clear that certain CQF's did not trigger the right interpretation by the respondents. Therefore a discussion on the right formulation of these CQF's was a useful addition to the current status. This initially ensured an alignment of interpretation during the survey, and subsequently gave way to an optimization of the presented list of CQF's. Hereby the definitions do not change, but the formulation does. The final list of CQF's is given in table 14.

	Final list of Critical Quality Factor
1	Interaction between internal team members
2	Interaction with external project participants
3	Consistent communication guidelines
4	Open dialog of shortcomings and mistakes
5	Top Management Support
6	Insight in client's vision and project significance
7	Internal stakeholder commitment
8	External stakeholder commitment
9	Prioritizing quality over time and/or budget
10	Aligned expectations of input
11	Aligned expectations of output
12	External influence on project scope
13	Team member mitigation
14	Competence of client
15	Performance of external parties
16	Qualified project team members

Table 11 - Final list of CQF's

Since this is a preliminary conclusion, the actual answer of the sub-question if given in the following chapter.

Part IV

DISCUSSING THE RESULTS

7 Results

This chapter aims to validate the assumption that client dependent CQF's have a significant contribution to the project management process. This is done by analysing the BWM output with the help of different SPSS tools. First the data is presented, on which the first assumption is tested. This assumption states that project managers take on a significant different approach dependent on the type of client. Secondly, a test will be done to identify the exact CQF's that have a significant different contribution to the project management process, dependent of the client. So first it is tested if there are differences, followed by the identification of these differences.

7.1. CLIENT TYPOLOGY: ARE THERE ANY DIFFERENCES?

The multiple-case study pointed out that the type of client could have a significant effect on the project management approach of a project manager. Through these results and additional discussions with experienced project manager, this assumption was strengthened. Therefore this paragraph is dedicated to the validation of this hypothesis. This is done by performing a Pearson's Correlation Test (Appendix D), of which the results are presented after the general results.

7.1.1. General BWM results

The output of BWM delivers a list of weighted CQF's, which is a maximized ratio variable divided between 0 and 1 for each type of client. Therefore the results are directly convertible into percentages of the total contribution to the project management process. This makes the output comparable to identify any differences between the types of clients. Given the results as presented in figure 10, two aspects are particularly interesting, being:

- ✓ **Client specific ranking per CQF**: The ranking of CQF's per type of client are given in an ordinal preference. This actually reverses the added value of BWM, which is aimed at indicating the strength of the differences. But it does give a good indication of the preferred CQF's per type of client.

- ✓ **Individual weight per CQF**: The individual weights per CQF, differentiated per type of client, are the direct result of BWM and represent a detailed view of their contribution to the project management process. The percentages of their contribution are added to the graph of figure 10. This data is used as input for the Pearson's Correlation Test.

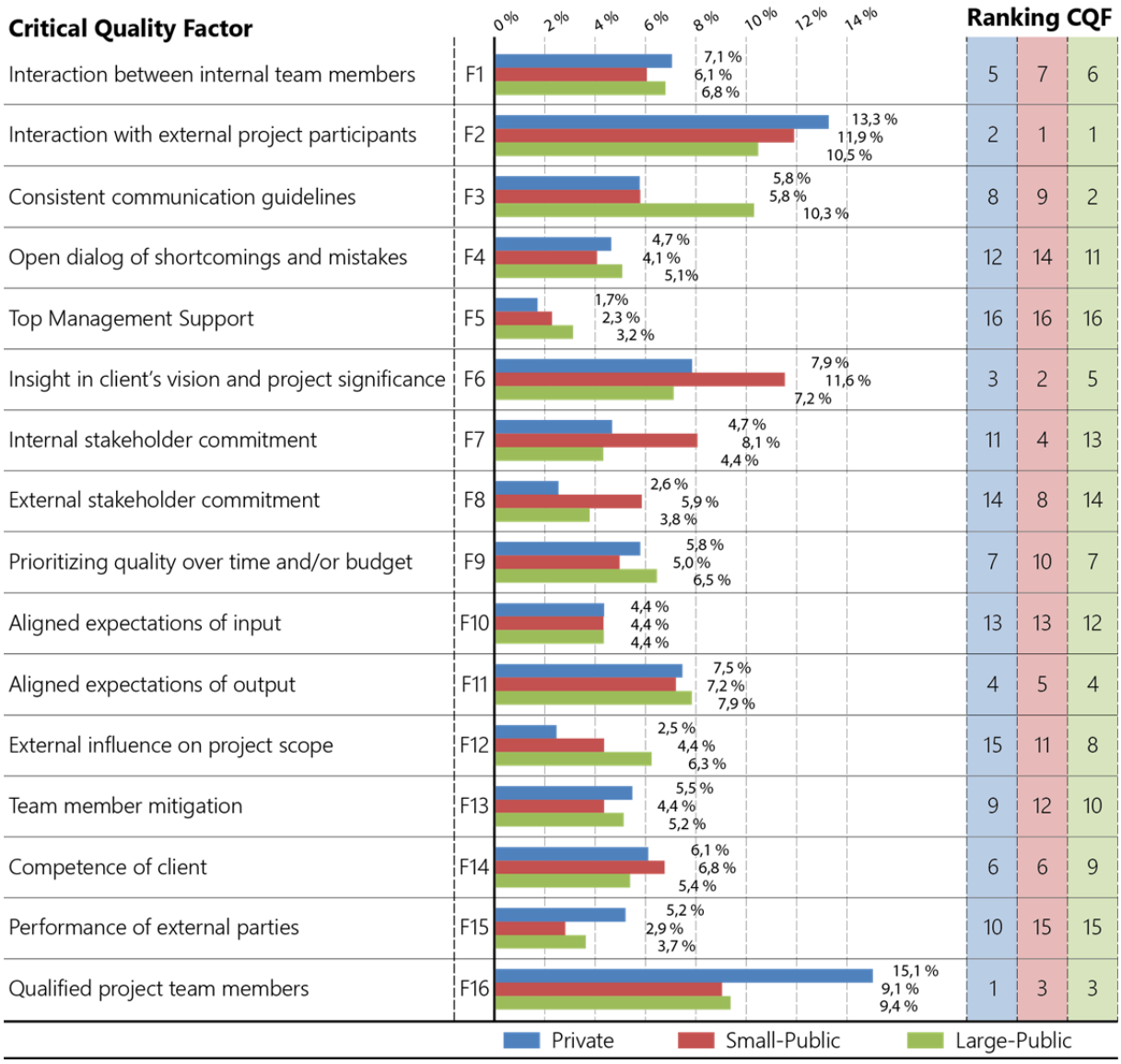


Figure 10 - BWM Combined Results

From the results of figure 10 it can be seen that both differences and similarities exists between the *ranking of CQF's* and the *weighted client specific CQF's*. Therefore just this figure is already an addition to the project management organization of W+B, since it represents the perspective of their project managers. It states which CQF's are valued for their contribution and what CQF's are not.

7.1.2. Correlation of Categories: Pearson's Correlation Coefficient r

As stated in the previous paragraph, a Pearson's Correlation Test has the ability of validating the assumption that differences exists between the identified types of clients. More specifically, this test validates the correlation between variables, which in this case reveals a comparison of the three ranked lists of client specific CQF's. If this test results in a significant correlation ($p<0,05$), it can be concluded that that the differences between the ranks are not diverse enough, which leads to a rejection of the hypotheses. On the other hand, if a significant correlation cannot be found ($p>0,05$) it is statistically proven that the approach of a project manager significantly differs per type of client.

Theoretically all CQF's play a certain role during project management, in which a balance is dictated by the context of that project. Part of this context is hereby exposed and shows the significance of the role of a client. The test is performed using SPSS of which the output is given in table 15.

Pearson's Correlation Test		
Client Combination	**Correlation Coefficient**	**Significance (p)**
Private & Small-Public	0.738	0.001
Small-Public & Large-Public	0.648	0.007
Large-Public & Private	0.760	0.001

Table 12 – Pearson's Correlation Coefficient (SPSS)

The output shows that all combinations are significantly correlated ($p<0.05$), which means that no significant differences are found between the types of clients. This outcome contradicts the statements found during the *multiple-case study* and by *talking to experts*, who emphasised that there are 'big differences' between the types of clients. It is likely that these initial statements are based on actual differences between the clients, which could mean that the 'big differences' have to be found on a much smaller scale than the general approach of project managers. A subsequent analysis should therefore be aimed at the identification of these smaller differences, if there are any.

7.2. CLIENT DEPENDENCY: WHAT ARE THE DIFFERENCES?

It is made apparent by the previous paragraph that not all CQF's need to be tailored to the specific need of a client. This would indicate that the variance of *most* individual weights would not significantly differ between the types of client. Therefore it is hypothesised that *some* significant differences can be identified by comparing the individual variances of the client specific CQF's. An ANOVA Test (Appendix C) is designed to analyse the variance between two variables.

7.2.1. Identifying the Client Dependent CQF's

The One-Way ANOVA Test is a statistical analysis of the variance between the means of all CQF's, which for this research differentiates between the types of clients. The latter is the *independent variable* and the weight of the individual CQF's the *dependent variables,* which are the input variables. The test is executed by adding a *Bonferroni Multiple-Comparison Test*, which made it possible to receive all bivariate comparisons. So for each set of two clients specific CQF's this test is done, which means that 48 bivariate combinations are tested. The *significance* of these relations are presented in table 16, the *direction* of the relation (in favour of *what* client) is discussed per client dependent CQF in the subsequent paragraphs. Only the significant ($p<0.05$) outputs are given. The full SPSS output is given in Appendix H.

One-Way ANOVA Output				
	Critical Quality Factor	**Significance (p)**		
		Private vs. Small-Public	**Small-Public vs. Large-Public**	**Large-Public vs. Private**
F1	Interaction between internal team members	-	-	-
F2	Interaction with external project participants	-	-	-
F3	Consistent communication guidelines	-	0.010	0.010
F4	Open dialog of shortcomings and mistakes	-	-	-
F5	Top Management Support	-	-	-
F6	Insight in client's vision and project significance	-	0.041	-
F7	Internal stakeholder commitment	0.043	0.018	-
F8	External stakeholder commitment	0.000	0.020	-
F9	Prioritizing quality over time and/or budget	-	-	-
F10	Aligned expectations of input	-	-	-
F11	Aligned expectations of output	-	-	-
F12	External influence on project scope	-	-	-
F13	Team member mitigation	-	-	-
F14	Competence of client	-	-	-
F15	Performance of external parties	0.039	-	-
F16	Qualified project team members	0.014	-	0.021

Table 13 - One-Way ANOVA Test (SPSS)

It can be seen that most CQF's did not show any significant different variance (this data is omitted of table 16). This was expected since paragraph 7.1.2. showed that there is no significant correlation between the types of clients. The hypothesis that initiated this test can be confirmed; significant differences have been found between *some* client specific CQF's. Hereby the client dependent CQF's have been identified. They can be defined as CQF's of which the contribution to the project

management process is dependent on the type of client, according to project managers of W+B. To fit this definition it is not necessary for the CQF's to 'belong' to a certain type of client. So generalizing from this point, it can be stated that the following CQF's are identified as client dependent:

- ✓ **F3**: Consistent communication guidelines;
- ✓ **F6**: Insight in client's vision and project significance;
- ✓ **F7**: Internal stakeholder commitment;
- ✓ **F8:** External stakeholder commitment;
- ✓ **F15:** Performance of external parties;
- ✓ **F16:** Qualified project team members.

The following paragraphs discuss the client dependent CQF's in a more detailed manner.

7.2.2. F3: Consistent communication guidelines

Direction of the Relation: The CQF *Consistent communication guidelines* is found to be significantly more effective when a project is executed in the context of a *large-public organization* than with both a *small-public* or *a private organization*. This indicates that putting extra effort in designing consistent communication guidelines accounts for 10,3% of the total effect when dealing with a large-public organization as client, of which the weight is 4,5% more effective than for both a private as a small-public client (figure 10).

Discussing the Outcome: These type of clients upheld a rigid structure of regulations and safety measures, causing a somewhat inefficient process, but all actions are justifiable. The latter is highly valuated, because they own the largest projects nationwide, and are therefore under constant pressure to perform accordingly. Acting the way they do makes them less vulnerable for public comments, since their projects are financed from public money, meaning that that every euro should be accounted for. This is assumed to be the leading cause of this particular judgement of project managers. During surveys they would state that clients, like ProRail and RWS, are receptive for communication guidelines for as far as they have not already imposed a strict structure of communication guidelines.

> ***From the Multiple-case study:*** *One of the projects showed distrust from the side of the large-public client, caused by an inconsistent control of communication (which was not clear during execution). Due to this the client would question every detail, disrupting the process significantly.*

> ***From the Survey**: The large-public clients are focussed on regulations and are afraid to deviate from them. This makes them very receptive for consistent communication guidelines, so they have something to hold on to and we know they will respect the guidelines.*

7.2.3. F6: Insight in client's vision and project significance

Direction of the Relation: *Insight in client's vision and project significance* is found to be more of a contribution with a *small-public organization* than a *large-public organization*. This results states that the comparison of variance is not based on coincidence and that F6 is represents 11,6% of the total contribution of CQF's for a small-public client, which is 4,4% more than for a large-public client (figure 10).

Discussing the Outcome: It is striking to see that keeping the vision of the client in sight is more important for the small-public client than for the other types. It seems likely that the more professionalized parties (large-public/private) 'know what they are doing' and therefore already have a strong focus on the bigger picture. For these parties this results in a less dependent situation of a contractor, like e.g. W+B, to identify with their vision. Literature mainly acknowledges this CQF as 'clear definition of goals' and 'stating realistic project objectives', which says more about the explicit demands. But envisioning is about imagining the bigger picture in pursuance of the both explicit as implicit demands.

> ***From the Survey**: Small-public organizations usually have an idea what they want, but have trouble translating this into viable requirements due to inexperience. Getting to know the 'question behind the question' (vision) helps to imagine the role of the small-public client in order to deliver a process that is implicitly requested.*

From discussions it stood out that this CQF was necessary for an effective process, no matter type of client. Many respondents were convinced of its importance. On the other hand from both the literature study as the multiple-case study there was little evidence of its effect. This CQF is clearly something that everyone appreciates when asked on forehand, but it does not stand out during (or after evaluating) the project management process.

7.2.4. F7: Internal stakeholder commitment

Direction of the Relation: The CQF *internal stakeholder commitment* is found to be significantly more of a contribution when a project is executed with a *small-public organization* than with both a *large-public- as a private organization*. This result indicates that putting extra effort in receiving commitment of all stakeholders of the internal organization of the client accounts for 8,1% of the total effect when

dealing with a small-public organization, which is weighted 3,4% more effective than for a private client and 3,7% more than for a large-public client (figure 10).

Discussing the Outcome: In this context 'internal' means the stakeholders within the organization of the client who represent the different parties over which mandate is divided. Four thing became clear from both the multiple-case study as the discussions during the survey, which were (1) ignoring someone with mandate always disturbs the process, (2) the large-public clients (RWS) have a relative clear line of internal stakeholders (many, but clearly organized), (3) small- and private organizations almost never send someone without mandate to handle a project (mostly it's the owner self), and (4) private parties have a similar structured organization as W+B, which makes it clear where mandate lies. Compared to these statements, it seems that the internal organization of small-public organizational are quite divers. This makes the initial oversight of their organizational structure hard to comprehend at first, affecting the process in the meantime. It is assumed that this cluttered view of a small-public organization led to a higher weighing of this CQF compared to the other types of clients.

> ***From the Multiple-case study**: In practice there are many disturbances of the process caused by intermediate parties without the right mandate. They have a personal interest in keeping the project running and only introduce an extra 'boundary to the right interpretation', meaning that all communication go from (1) the client with mandate, to (2) the mediator/project manager under contract, to end up with (3) the project manager of W+B that subsequently has to (4) deliver the requirements to the project team.*
>
> ***From the Survey**: This factor might even be more important than external stakeholder management for some parties!; The bigger parties have a clear line of internal mandate, therefore it is relative easy to get to someone with the right to make decisions; smaller public organization differ per location, in which you have to deal with different 'desks' each time to get to where you want to be.*

7.2.5. F8: External stakeholder commitment

Direction of the Relation: *External stakeholder commitment* is found to be significantly higher appreciated if a project is executed for a *small-public organization* than for both a l*arge-public- as a private organization*. Putting extra effort in committing the external stakeholders accounts for 5,9% of the total CQF contribution when dealing with a small-public organization as client, which is weighted 3,3% more than for a private client and 2,1% more than for a large-public client (figure 10).

Discussing the Outcome: Commitment of external stakeholder is a typical activity that fits the public clients more than a private client, which is statistically upheld. The difference between the public organization is that the large-public client has a clear oversight of what stakeholders should be involved for a swift process, and small-public organizations leaves it up to W+B to involve them when they find its necessary. Besides this, the private organizations are less dependent on external stakeholders, according to several respondents. The main job of the public parties is to ensure the wellbeing of its inhabitants, which does not go for private parties, who are concerned about their own continuity.

> ***From the Survey**: Private organizations have no real interest in involving external stakeholders when there is no direct need for it, they are less dependent on their commitment than public parties. Large-Public parties do their homework, usually they have a complete list of all possible external stakeholders that should be involved, from whom they already gotten a certain commitment prior to the start of the project.*

7.2.6. F15: Performance of external parties

Direction of the Results: *The performance of external parties* (sub-contractors) is found to be significantly more valued when a project is executed for a *private organization* than for a *small-public organization*. This indicates that it is statistically found likely that the performance of external parties contribute to the project management process for 5,2% of the total effect of studied CQF's for a private client, which is 2,3% more than for a small-public client (figure 10).

Discussing the Result: The performance of external parties has a direct effect on the quality of the work that project manager delivers. This means that a weak performance of a sub-contractor could have a direct effect on the process, which thereafter is perceived by a client as a weak performance of the project manager (or W+B). The statistically significant difference of F15 between a *private organization* and *small-public organization* is coherent with F16 (figure 10), showing a more or less the same variance. Therefore is can be concluded that due to the presence of highly skilled experts at a private organization (relative to those at a small-public organization) the performance of the project team of W+B should better match this level of expertise.

> ***From the Literature Study**: "If each part of the activity of a project is monitored effectively and instances of poor workmanship […] are reported promptly, it aids in achieving the desired quality level." (Jha & Iyer, 2006, p. 1162)*

***From the Survey**: Most private parties have highly trained experts that have a nose for good performance. So if we don't control our own sub-contractors for their performance it is evident that this bad input will reflect on the quality of both the process and our image, 'rubbish in-rubbish out'.*

7.2.7. F16: Qualified project team members

Direction of the Relation: The effort that is put into selecting *qualified project team members* has been proven to contribute significantly more to the project management process for *a private organization* than for both a *small-public- and a large-public organization*. Putting extra effort in selecting qualified team members accounts for 15,1% of the total of CQF's when dealing with a private organization, which is weighted ±6% more effective than both other organizations (figure 10).

Discussing the Result: It makes sense that this factor would come out on top, since a project without qualified team members is doomed to fail. When selecting a team of experts with different specialities, the right fit and the extra effort that is put into finding this fit is judged to be significant contribution to the process. The fact that this effort is significantly more effective for a *private organization* than for *small- or large-public organizations* is evident. Just like the previous CQF (F15), this result indicates that the expertise of a private organization is of a higher level compared to that of the public organizations. Therefore the project manager seeks to match this and judges the extra effort in finding the right fit between project team and their responsibility as a vital contribution. Justification of this output is sought in both the literature study as the multiple-case study. Different causes can be considered, which are: (1) It is more easy to fit an expert to the requirements of a small-public organization (lower standards), (2) for large-public organizations it is not notable since selecting qualified team members is seen as common practice, and (3) their image (of W+B) is more receivable for damage in collaboration with private organizations, causing it to be noted during the survey, but judged as common sense when project evaluations are made.

***Literature Study**: "With respect to the participants' attributes, the capability of the key personnel assigned to the project has been identified as the most important factor". (Chua et al., 1999, p. 148)*

***Survey**: It all starts with qualified team members, especially when we have to meet those of the (bigger) private organizations in comparison with public organizations. Private parties know the added value of selecting their own qualified team members, and expect us to do the same.*

7.3. CONCLUDING PART IV

One of the main objectives of this research was to find what CQF's are dependent on the client typology as judged by experienced project managers. Hereby it was initially assumed that the three types request a significantly different project management approach. However this chapter showed that no significant differences are found between the types of clients, which contradict the statements found during the *multiple-case study* and by *talking to experts*, who emphasised that there are 'big differences' between the types of clients. Therefore it is hypothesised that *some* client dependent CQF's exists, independent of their exact typology. The concluding paragraph of chapter 6 (part III) already introduced the sub-question that is answered by the results as presented in this chapter. The question stated the following:

> *What Client Dependent Critical Quality Factors are found to contribute to an effective project management approach according to panel of experts?*

This question is answered throughout this chapter by first identifying the client dependent factors that resulted from the survey, and subsequently by validating their contribution to project management through statistical analysis of their variance. The client dependent CQF's that have been identified are given hereunder. The type of client for who these CQF's contribute the most are also given.

- ✓ **F3**: Consistent communication guidelines — *Large-Public*
- ✓ **F6**: Insight in client's vision and project significance — *Small-Public*
- ✓ **F7**: Internal stakeholder commitment — *Small-Public*
- ✓ **F8:** External stakeholder commitment — *Small-Public*
- ✓ **F15:** Performance of external parties — *Private*
- ✓ **F16:** Qualified project team members — *Private*

The fact that client dependent CQF's have been identified, questions the existence of other context dependent elements. Some indications of their existence have been found but are not validated through statistical analysis. So these assumption are no 'hard evidence', in contrast to the client dependent CQF's.

8 Discussing Context Dependency

The results as presented in the previous chapter represents the *hard evidence* that client dependent CQF's exist. This has been validated by a statistical analysis and was one of the main objectives of this research. So 6 of the initial 16 CQF's have been labelled as *client dependent*. But what about the others? As the effect of all CQF's are initially dependent on some element of the context, more classifications are assumed to be found. This chapter discusses the existence of these other classifications, based on '*soft evidence*' that came forth during the previous chapters. Besides this, knowing what CQF's contribute to project management and which elements they are dependent on could be a great contribution to any project management organization. This knowledge can be practically applied, which initiates a search for the *point of inflection*, or the most effective point of standardization. This subject is also brought forth during this chapter. This chapter is further guided by finding an answer to the following sub-question: *What insights can be extracted from a Context Dependent Classification of Critical Quality Factors?*

8.1. IDENTIFICATION OF CONTEXT DEPENDENT ELEMENTS

As stated before, the context dictates the approach of a project manager since all project elements are initially part of the context. This also includes the project manager itself. Context dependent elements can be defined as 'elements that derive their influence from the strength of their relation with a certain characteristic of the context'. For this research the initial context has been demarcated by the project management process.

One of the elements, which is defined as a cluster of CQF's, has been identified and statistically valid for its dependency of the *type of client*. Other elements have also been assumed to exists, but have not statistically been proven. Two elements that are assumed to play part in project management are the following:

- ✓ **Organizational Dependent;**
- ✓ **Culture Dependent.**

There are probably more elements than just these two, but an indication of the existence these elements have been countered during the execution of this research. Therefore the following paragraphs will go deeper into these assumptions by discussing their source, and subsequently challenge their existence.

8.1.1. Organizational Dependent CQF's

Organizational Dependent CQF's can be defined as factors that are ingrained in the project management organization as core aspects, and therefore contribute to a project management process independent of the context. Since this element defines part of the project management organization of W+B it is expected that the identified CQF's of this classification are found during the multiple-case study. These CQF's play a more prominent role for the project managers, causing their inclusion in most project evaluations.

Within the given definition there are two important criteria that classify CQF's as Organizational Dependent. These are (1) the fact that it is a core aspect with a relatively high BWM weight, and therefore is essential for an effective and efficient process, and (2) the unchangeable character of the CQF, meaning that within a dynamic environment the contribution of this CQF remains unchanged. Following these two criteria, two CQF's opt for this classification:

F2: *Interaction with external project participants*

> **Multiple-Case Study:** This CQF has been encountered in 40% of the project evaluations, which makes it the second most encountered CQF during the multiple-case study. This validates the assumption that organizational dependent CQF's have relatively high occurrence in project evaluations.
>
> **BWM Survey**: Besides this, the BWM results show that this CQF had the highest average score (independent of the type of client). So project managers find the interaction with external project participants the most contributing CQF to their project management approach. It can be concluded that it seems likely that (1) organizational dependent CQF's exists, and (2) that this CQF belongs to that classification. This assumption should be further researched to be validated.

F11: *Aligned expectations of Output*

Multiple-Case Study: This CQF has been encountered in 49% of the project evaluations, making this the most encountered CQF during the multiple-case study. This validates the assumption, as stated in the introduction of this paragraph, that organizational dependent CQF's have relatively high occurrence in project evaluations.

BWM survey: The discussions during the survey gave light to an important and recurring statement of project managers, which was that 'what is seen by the client' is significantly more important than any internal process. This statement is substantiated if this CQF is compared to its counterpart F10 (aligned expectations of input), which has a significant lower weight (figure 10). This instigates a new discussion about the balance of *internal project management success* and *external project management success*, of which it is said to be of equal importance (chapter 2.2).

8.1.2. Culture Dependent CQF's

Culture Dependent CQF's can be defined as factors that are a subliminal part of the project management organization through organizational and/or company values, and are therefore always part of the project management process. These factors are always part of the project management organization of W+B, but since its presence is mostly assumed to be subliminal it does not stand out from the multiple-case study. Therefore the discussion during the survey are of great value, since this is when the project managers can give their own view on things. In addition the literature study consulted.

Within the given definition there are two important criteria that classify CQF's as Culture Dependent. These are (1) that these CQF probably don't stand out from both the multiple-case study and the BWM results, and (2) the unchangeable character of the CQF, meaning that within a dynamic environment the contribution of this CQF remains unchanged. Following these two criteria, three CQF's opt for this classification:

F5: *Top Management Support*

Literature Study: Most publications, which identified comparable factors in the context of project management, showed that this factor is heavily represented in project management literature (Fortune & White, 2006). This contradicts the results of this study, giving is the lowers

weight of all CQF's. This gives the idea that the culture of W+B had an effect on this outcome, since that is one of the few shared characteristics of the project managers.

BWM Survey: The respondents judged this CQF as an insignificant contribution to the project management process. This was upheld when discussed after completion of the survey, in which their self-reliant way of project management came to light. Besides their aversion to rules and regulation, it stood out that most do not appreciate the contribution that top management support could have. This attitude confirmed the assumption that the culture of W+B had a great influence on this outcome.

F1: *Interaction between internal team members* & **F10**: *Aligned expectations of input*

BWM Survey: The classification of these CQF's are mainly based on the discussions during the survey. Both CQF's are internally aimed, which gives means that any external parties are directly affected by their contribution to the project management process. This makes it, in the eyes of most project managers, a less significant CQF. While a weak effort can slow down the internal process, it is not observable by external parties. This can be illustrated by a remark of one of the respondent, being that 'what is seen by the client' is significantly more important than any internal process. This is related to their self-reliant attitude again. When their internal process is affected it can always be fixed, but if the external process is affected it leaves a permanent mark. This stance is linked to their company culture, which is why both CQF's are classified as culture dependent.

8.1.3. Internal versus External Perspective: Connecting the Elements

When the classified context dependent elements are revisited, it stands out that a division of perspective can be seen. The difference is found between the *internal perspective* and the *external perspective*. Their definitions are given:

Internal perspective: This is defined as all elements that are related to the organization of which the project management organization is studied (in this case W+B). They are elements that would differ if another company would be studied.

External perspective: This is defined as all elements that would stay in place if the project management organization of another company would be studied.

These definition can be applied to the context dependent elements that have already been identified. It stands out that the *organizational dependent CQF* are externally aimed, but from the perspective of a

project manager of W+B, and is therefore classified as *internal*. This layer of organizational dependent CQF's is observable from the perspective of the client, and therefore lies close to the client dependent CQF's. All *culture dependent CQF's* are mainly internally aimed which makes them closely related to their company culture, more than the organizational dependent CQF's. This can be seen as a connected layer, but with more emphasis on the *internal* perspective. The client dependent CQF's are however perceived from an external perspective. If the studied company (internal) would be replaced by a different company, the client dependent CQF's can remain, since the external perspective stays unchanged. To visualize this clash between the *internal and external perspective*, figure 11 is presented.

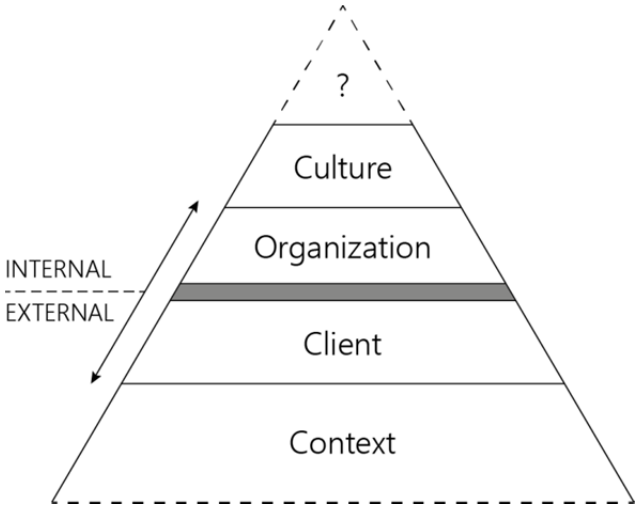


Figure 11 - Classification of Context Dependent Elements (by author)

This figure gives all *context dependent elements* a place relative to each other. The base is formed by the *context dependent CQF's*, which are the CQF's that have not been classified and therefore are still dependent on some elements of the context. These remaining elements have not been identified, which leaves this for further research. On top of this foundation the *client dependent CQF's* are placed. Hereafter the split between the *internal- and external perspective* is drawn, which means that the top layers could be replaced by any other company, with their own specific company related CQF's (and classified by the given elements).

The bottom layer of the internal perspective represents the *organizational dependent CQF's,* which ,as stated before, represents the CQF's that are more on the foreground and therefore better observable than the higher layers. On top of this stands the culture dependent CQF's. As they are more subliminal, they tend to be less observable for both the own organization, and even more for the client. The missing top-part represent a higher level of internal perspective, which for instance could be filled in by more personal dependent elements. By, for instance, identifying specific types of project managers their preferred CQF's can be found, which would subsequently be placed in this layer as *project*

manager dependent CQF's. The latter has no specific cause, but is a rough extrapolation of what was found.

8.2. FINDING THE INFLECTION POINT OF STANDARDIZATION

When the applicability of this research is studied it stands out that different aspects are aimed at some form of standardization. Even though most project managers of W+B see standardization as a bad thing, it can definitely deliver a more effective and efficient project management organization if done correctly. The trick is found in 'if done correctly', since too much standardization could lead to sluggish guidelines, and no standardization could lead to an inefficient organization that keeps reinventing the wheel.

To make the idea of standardization acceptable within W+B the word *standardization* is replaced by *the point of inflection*. The point of inflection is defined in math as the point on a curve at which it changes from being concave to convex, or the other way around. To put it in perspective of project management, it is a theoretical point that represents the most effective and efficient way of standardization. This is visualized by the following figure 12.

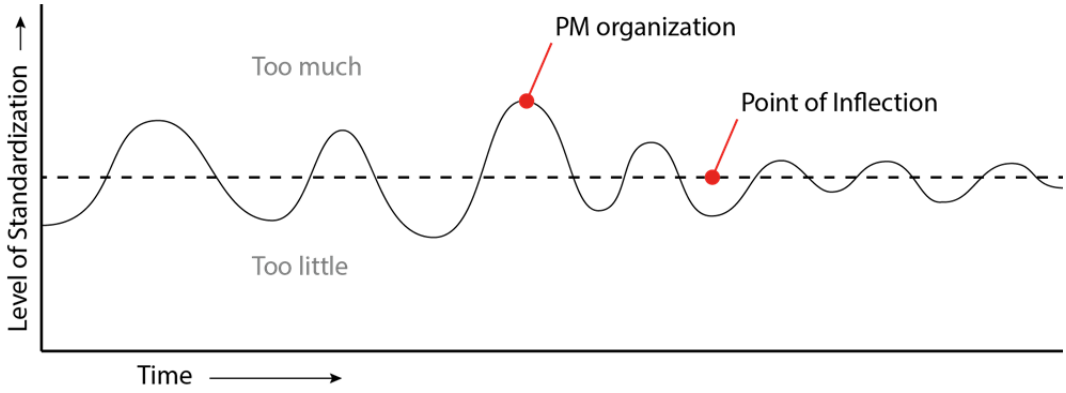


Figure 12 - The Point of Inflection simplified (by author)

Figure 12 give a simplifies representation of the point of inflection, which in reality is not a static line, but changes over time. There is no absolute truth, and therefore the point of inflection is only a theoretically achievable point that gives the most effective and efficient level of standardization. The curve represents an organization that is continuously adapting their level of standardization in search for this point of inflection. Although it can never be achieved, it should always be pursued to prevent the organization to deviate too much from this point. This should be the mind-set of any project manager that aims for project success.

When this theory is applied on the findings of this research, different measures are identified that could help start the search for this point of inflection. The measures are given below:

- ✓ **Consistent Evaluation of Projects**: Part of the search for the point of inflection is acknowledgement of what went wrong and what went right in previous projects. By doing this in a consistent way, with the use of a more standardized form of evaluating, possible structural errors can statistically be proven.

- ✓ **Client Dependent CQF's**: By stating the identified client dependent CQF's as points on the pursued curve of standardization (specified on the type of client), a first approach is initiated towards the point of inflection.

- ✓ **Awareness of Culture**: The point of inflection can never be pursued if the organization is not aware of their own place on the curve. This goes for all aspects of the project management organization, although grasping the value of their culture is a challenge. Through an understanding of their culture, and the effect it has on their project management culture, it becomes possible to pursue the point of inflection instead of deviating due to a rigid liability of an autonomous project management organization.

8.3. REFLECTING ON THIS RESEARCH

Reflecting on this research different limitation can be acknowledged. These limitations are encountered during the execution of this research and are mostly caused by practical constrains. The most striking limitations are given in this chapter.

1. **A case study of W+B**: Only one company was investigated, making this research one big case study of which W+B plays the central role. Due to cultural dependency it is hard to generalize the findings to other companies. This creates a strength for just this research, but from a scientific point of view it can be seen as a limitation. However, the same method would be applicable onto any other company, the findings would only differ significantly.

2. **Used relatively new methodology**: BWM is a relatively new method, which made the method a challenge to execute during the surveys. The most effective way of executing is even not know by Jafar Razaei himself, creating room for sub-optimal result due to misinterpretations. Therefore, since the execution of the method is still under investigation, this can be seen as a limitation. This took an extra effort to find the right application and of which the execution was confirmed by Jafar Razaei.

3. **Inconsistent project evaluations during multiple-case study**: The documents for the case study were somewhat limited in the extend of their description of events affecting the process. It became clear that not all evaluations are executed with the same care. A more effective way (but maybe less efficient) would be to perform interviews with the project managers of certain projects to get a more extensive view of the events that affected the process.

4. **Recordings and interviews during surveys**: The surveys themselves also had some limitations. It would have been better to record and transcript all discussions, due to the richness of information which was not taken into account. This came to be because the discussion was initially seen as a by-product, more than a source of evidence. The reasons for a personal presence was to secure the interpretation of the projects managers, and by that the input of the BWM analysis.

9 Conclusions

This research delivers an exploratory study into a classification of context dependent critical quality factors. This report is built up out of three parts that work together to achieve the main objective. The first part aims to identify general critical quality factors for their contribution to the project management process. The second part identifies and validates a specific context dependent element, being of a set of client dependent critical quality factors. The last part continues the study into context dependent elements by discussing the elements that have not been validated by this research, but show a plausible contribution to project management. This all comes together to find a more effective and efficient way of aligning the perspectives of a client and contractor, while pursuing the point of inflection of a project management organization. The main research question goes as follows:

> *What client dependent critical quality factors can be identified for their contribution to the project management process, and how does this manifest into a classification of other context dependent elements?*

The achievement of 'quality', as one of the classical project success criteria, is differently interpreted by all stakeholders involved. Besides this, it is stated that 'quality' is emphasised during project phases in which any form of influence is ineffective. This created a challenge in stating a clear definition of what a critical quality factor (CQF) is, of which the following definition is formed: *A critical quality factor is a factor that can be influenced by a project manager and thereby steer the project management process to increase the likelihood of achieving both internal- and external objectives concerning the quality of a project*.

While studying the background of CQF's it was found that there is limited known about what their contribution to the project management process is, and which does not concern the actual construction phase. Through identification of these factors a more effective alignment of expectations about the project management process can be initiated to better fit the purpose of a project. Besides the necessity of theoretical knowledge there was a need for practice ingrained identification of CQF's.

Through the execution of a multiple-case study several project evaluations were analysed to identify CQF's that had a certain contribution to the project management process as judged by the evaluating project manager of W+B. Hereby the initial list of CQF's was roughly shaped by through a literature study and a multiple-case study, forming the baseline of this research.

During the multiple-case study it became clear that the perceived effect of the CQF's was dependent on the context, which could therefore not be disregarded. The first encountered contextual element was the *type of client*, which led to the assumption that the client plays a significant role in the eyes of a project manager when determining a project management strategy. So in other words, the type of client represents a notable part of the context in which a project is executed. Most project managers would later confirm that the type of client defines their project management approach significantly. The specific CQF's that are dependent on the type of client were therefore sought through a survey amongst experienced project managers, based on the initial formed set of CQF's. Three major types of clients were identified, which are (1) the *private organization*, (2) the *small-public organization* and (3) the *large-public organization*. Different typologies were possible, as long as it would concern a large enough spread of client characteristics. The main goal of this survey was to receive the project manager's judgement of the CQF's contribution on the process of project management, per type of client. The survey was done according to the Best-Worst Method, which is designed to calculate the weights of the CQF's according to the response of the project managers.

Two conclusions can be drawn from the execution of the survey. The first being that there were no significant differences between the types of clients, which contradicts the stated hypothesis. The second was that although the overall result showed no differences, it did show several CQF's of which their weight was significantly different distributed between the types of clients. These identified CQF's are the ones that can be classified as *client dependent CQF's*. The six CQF's that have been identified are the following:

- ✓ **F3**: Consistent communication guidelines;
- ✓ **F6**: Insight in stakeholder vision and project significance;
- ✓ **F7**: Internal stakeholder commitment;
- ✓ **F8**: External stakeholder commitment;
- ✓ **F15**: Performance of external parties;
- ✓ **F16**: Qualified project team members.

The initial list is adapted after completion of the survey to better represent the definitions they uphold. This list of definite CQF's and the results of the survey are presented in figure 13. The numbers of the client dependent CQF's have been marked.

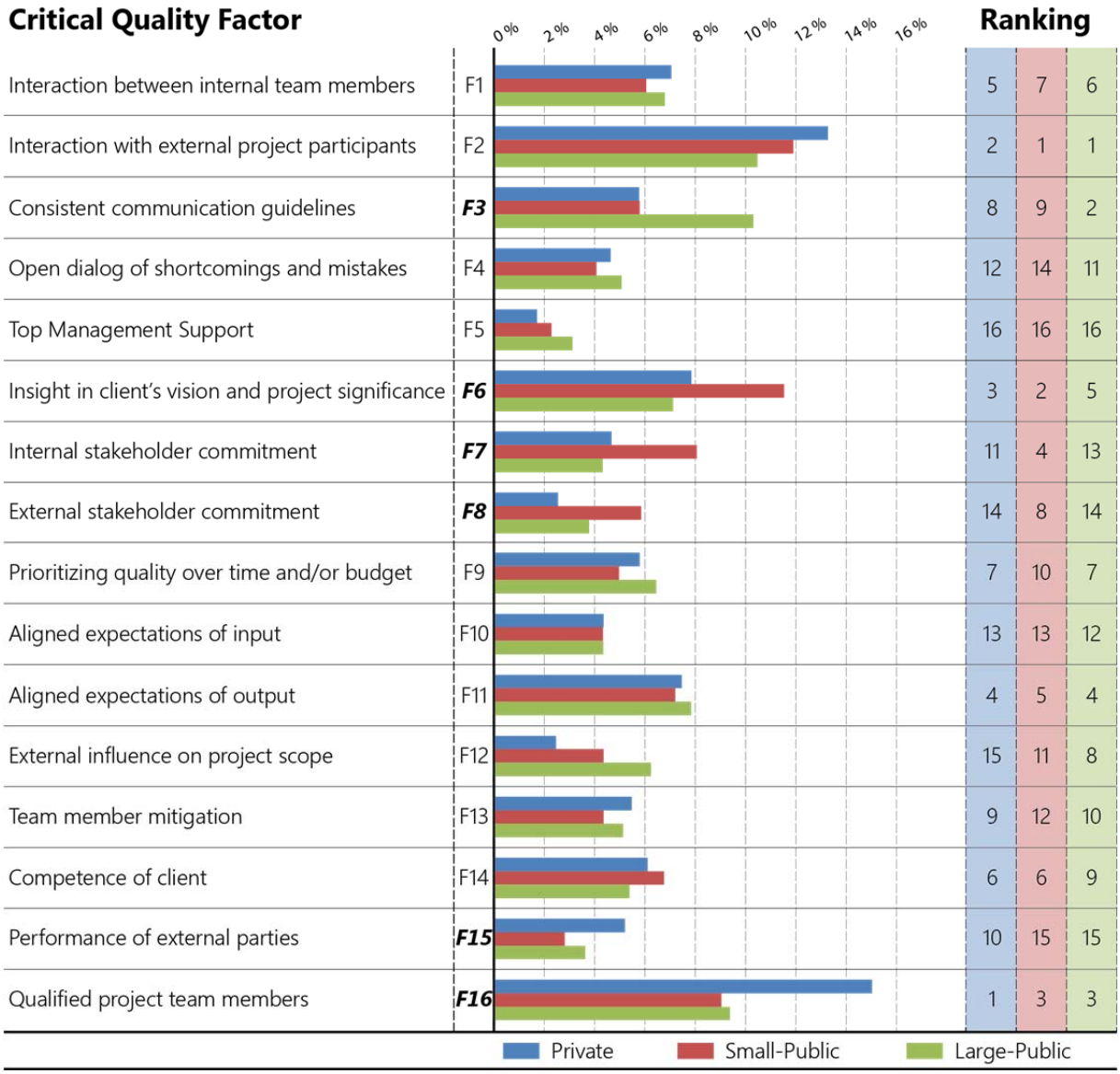
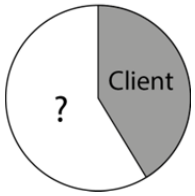


Figure 13 - Final list of CQF's per type of client including their ranks (by author)

Hereby the main objective of this research is achieved. A list is presented of general CQF's for their contribution to the project management process, of which six client dependent CQF's have been identified and subsequently been validated.

From this point on a specific division of types of clients becomes unimportant and only the classification *client dependent CQF* plays a role. So the six identified client dependent CQF's give start to a discussion about classifying the remaining ten CQF's under different *context dependent elements*.



Is can be concluded that two context dependent elements have been identified, in addition to the already found client dependent element. The two elements are *organizational dependent* and *culture dependent*, each consisting of a selection of CQF's. Two organizational dependent CQF's and three culture dependent CQF's have been found based on the literature study, the multiple-case study, and the survey. The identification of these elements and underlying CQF's is not validated in a similar manner as the client dependent CQF's were, meaning that only assumption can be made. Figure 14 shows a layered visualization of the identified context dependent elements.

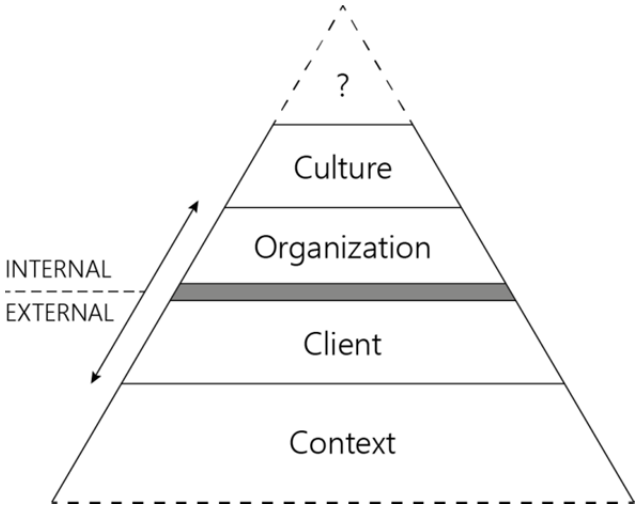


Figure 14 - Classification of Context Dependent Elements (by author)

This figure gives all *context dependent elements* a place relative to each other. The base is formed by the *context dependent CQF's*, which are the CQF's that have not been classified and therefore are still dependent on some other elements of the context. These remaining elements have not been identified yet. On top of this foundation the *client dependent CQF's* are placed, of which the emphasis is on the external perspective. Hereafter the split between the *internal- and external perspective* is drawn, which means that the top layers could be replaced by any other company, with their own specific company related CQF's (and classified by the given elements).

The bottom layer of the internal perspective represents the *organizational dependent CQF's,* which represents the CQF's that are more on the foreground and therefore better observable than the higher layers. On top of this stands the culture dependent CQF's. As they are more subliminal, they tend to be less observable for both the own organization, and even more for the client. The missing top-part represents a higher level of internal perspective, which for instance could be filled in by identifying specific types of project managers.

Per context dependent element the following CQF's have been identified:

- ✓ The two CQF's that have been identified as *organizational dependent* are the following:
    - **F2**: Interaction with external project participants;
    - **F11**: Aligned expectations of output.
- ✓ The three CQF's that have been identified as *culture dependent* are the following:
    - **F1**: Interaction between internal team members;
    - **F5**: Top management support;
    - **F10**: Aligned expectations of input.

The applicability of the knowledge gained is found in the search for the point of inflection. By further identifying the context dependent elements and their corresponding CQF's it becomes possible to better analyse what measures are needed in a specific context. This makes the achievement of a more effective alignment between the perspective of a contractor and client possible, since there is more known about the context and how to fit the project management approach to these elements. This subsequently increases the chance of project success through a focus on quality.

10 Recommendations

10.1. PRACTICAL IMPLEMENTATION BY W+B

During the execution of this research it stood out that this master thesis has become an extensive 'case study' of the project management organization of Witteveen + Bos. Executing this research for a different company could for instance turn into a different set of CQF's and a different judgment of their effect by project managers. Due to this specialization into the W+B way of working it is possible to recommend different applications as a direct result of this research. To make this list of recommendations better applicable for all employees of W+B an article was written that could for instance be published through one of their internal communication lines (website/paper/etc.). This article is presented in Appendix N. The article discusses three major recommendations which are aimed at the search for the point of inflection by developing a better fitting level of standardization. The same discussion is also given in the first paragraph of this chapter.

1. **Consistent project evaluations using the list of 16 CQF's**: The developed list of 16 CQF's, which is partly based on project evaluations of W+B through a multiple-case study, form a solid base for executing evaluations of completed projects. The current project evaluations differ per sector and project manager, and are thereby not consistent enough to come to structural improvements. It only requires a judgement of a general feeling about the project management process, which is a shortcoming when a more effective way of project management is pursued. By initially using the list of CQF's the real structural errors can be pinpointed and transformed into more specific improvements. It delivers a more easy way of proving failed processes instead of a general judgement. This could subsequently be used to display what elements of project management need attention, which could be used for training purposes and subsequently increase the standards of W+B on the long-term.

2. **Application of the client dependent factors as project 'spear-points'**: One of the identified elements of contextual dependency is the existence of client dependent factors. These factors

play a significant role when applied in a project context of the type of client they refer to. By taking these identified CQF's and making them a significant part of the alignment of expectations with the client during the kick-off phase, it is possible to get ahead of some of the bigger struggles during the execution of the project. This could for example be done by promoting the client dependent factors the project 'spear-points'. This would give them the needed attention to create a better adapted mind-set tailored to the needs of a specific type of client.

3. **Awareness of the (W+B) culture dependent aspects**: A 'culture' is something that is mainly present in the background of any type of organization. Within any organizational culture there can be both strengths as well as weaknesses, which would mostly stay unnoticed because 'this is how we do and this is what makes us who we are' without decomposing the actual effect of the culture. So most elements of a culture are not acknowledged by the organization.

   This is also the case for W+B. Creating an awareness of the W+B culture by means of discovering the cultural dependent factors, could give the project managers a more holistic view and better tailor the process to the needs of a project. This study started by acknowledging the existence of cultural dependent factors and showed for example the contradictory between the judgement of *top management support* by the W+B project managers and what was found in literature. Creating an awareness makes people recognize their own way of managing projects and given them control over their own approach.

10.2. FUTURE RESEARCH

This study offers different subjects for further research, of which the most outstanding ones are discussed in this paragraph.

1. **Further exploring the spectrum of context dependent elements**: With this research four elements of contextual dependency are identified, being (1) context dependent factors, (2) client dependent factors, (3) context independent factors, and (4) culture dependent factors. The first element (context dependent factors) contains all 'other' elements that just have not been identified by this study. This is where potentially more elements can be discovered, which could be the subject of subsequent study. For example factors that have a high degree of uncertainty could form an element of 'uncertainty dependent factors'.

2. **Executing the same study from the perspective of the clients**: The research has now been executed from the perspective of a contractor, which came to different client dependent factors as judged by their project managers. In order to validate this knowledge it would be a valuable research if the perspective of the three different types of clients is studied. Ideally them same methods that are used for this research are applied, which makes it possible to perform a comparative study and validate the identified factors.

3. **The layers of internal dependent factors**: As stated before, culture is a difficult thing to measure, though its effect has been shown by this study. It has also been demonstrated that within the internally aimed element of contextual dependency there are two different layers, being (1) context independent factors, and (2) cultural dependent factors. Taking a closer look at the internally aimed layer of contextual dependent factors, possibly more layers could be found that could indicate a different subdivision of layers that are closely related to the culture of a company. There could be factors that are e.g. part of a more subliminal layers (and therefore difficult to identify), since 'culture' is something that plays a role on the background, but is therefore not less influential on the project management process.

4. **Comparative study at a different company**: As stated before, this research manifested in a specific case study of Witteveen + Bos, which makes the identified CQF's less applicable for other companies. Especially those that are labelled as culture dependent factors are specially bound to the project management organization of W+B. Therefore it would be interesting to see what factors would surface when this study would be applied on another engineering agency, or even any other kind of company that has a project management organization.

11 References

Abbott, L. (1956). Quality and competition: an essay in economic theory.

Abraham, G. L., & Chinowsky, P. (2003). *Critical success factors for the construction industry*. Paper presented at the Proceedings of Construction Research Congress, March.

Alias, Z., Zawawi, E., Yusof, K., & Aris, N. (2014). Determining Critical Success Factors of Project Management Practice: A Conceptual Framework. *Procedia-Social and Behavioral Sciences, 153*, 61-69.

Anttila, J. (1992). Standardization of quality management and quality assurance: a project viewpoint. *International Journal of Project Management, 10*(4), 208-212.

Arditi, D., & Gunaydin, H. M. (1998). Factors that affect process quality in the life cycle of building projects. *Journal of construction engineering and management, 124*(3), 194-203.

Atkinson, R. (1999). Project management: cost, time and quality, two best guesses and a phenomenon, its time to accept other success criteria. *International Journal of Project Management, 17*(6), 337-342.

Avots, I. (1984). Information systems for matrix organisations. *Matrix management systems handbook. New York: Van Nostrand Reinhold*.

Baccarini, D. (1999). The logical framework method for defining project success. *Project management journal*(Volume 30), 25-32.

Baker, B. N., Murphy, D. C., & Fisher, D. (2008). Factors affecting project success. *Project Management Handbook, Second Edition*, 902-919.

Bannerman, P. L. (2008). *Defining project success: a multilevel framework*. Paper presented at the Proceedings of the Project Management Institute Research Conference.

Bosch-Rekveldt, M. (2011). Managing project complexity: A study into adapting early project phases to improve project performance in large engineering projects.

Bosch-Rekveldt, M., Jongkind, Y., Mooi, H., Bakker, H., & Verbraeck, A. (2011). Grasping project complexity in large engineering projects: The TOE (Technical, Organizational and Environmental) framework. *International Journal of Project Management, 29*(6), 728-739.

Bowen, G. A. (2008). Naturalistic inquiry and the saturation concept: a research note. *Qualitative research, 8*(1), 137-152.

Buzzell, R. D., & Gale, B. T. (1987). *The PIMS principles: Linking strategy to performance*: Simon and Schuster.

BZK, M. (2010). *Bestuursakkoord 2011 - 2015: Vereniging van Nederlandse Gemeenten, Interprovinciaal Overleg, Unie van Waterschappen en Rijk*. The Hague.

Chan, D. W., & Kumaraswamy, M. M. (2000). Factors affecting the quality of building projects in Hong Kong. *International Journal of Quality & Reliability Management, 17*(4/5), 423 - 442.

Chua, D. K. H., Kog, Y.-C., & Loh, P. K. (1999). Critical success factors for different project objectives. *Journal of construction engineering and management, 125*(3), 142-150.

Cooke-Davies, T. (2002). The "real" success factors on projects. *International Journal of Project Management, 20*(3), 185-190.

Corbin, J., & Strauss, A. (2014). *Basics of qualitative research: Techniques and procedures for developing grounded theory*: Sage publications.

Cox, A., & Thompson, I. (1997). 'Fit for purpose'contractual relations: determining a theoretical framework for construction projects. *European journal of purchasing & supply management, 3*(3), 127-135.

Crawford, L., Pollack, J., & England, D. (2006). Uncovering the trends in project management: Journal emphases over the last 10 years. *International Journal of Project Management, 24*(2), 175-184.

Daniel, D. R. (1961). Management information crisis. *Harvard business review, 39*(5), 111-121.

Davis, K. (2014). Different stakeholder groups and their perceptions of project success. *International Journal of Project Management, 32*(2), 189-201.

De Bruijn, H., & Ten Heuvelhof, E. (2010). *Process management: why project management fails in complex decision making processes*: Springer Science & Business Media.

De Wit, A. (1988). Measurement of project success. *International Journal of Project Management, 6*(3), 164-170.

DeCarlo, D. (2010). *Extreme project management: Using leadership, principles, and tools to deliver value in the face of volatility*: John Wiley & Sons.

Deck, M. (2001). Managing process diversity while improving your practices. *Software, IEEE, 18*(3), 21-27.

Enshassi, A., Mohamed, S., & Abushaban, S. (2009). Factors affecting the performance of construction projects in the Gaza Strip. *Journal of civil engineering and management, 15*(3), 269-280.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological methods, 4*(3), 272.

Feigenbaum, A. V. (1951). *Quality control: Principles, practice and administration: An industrial management tool for improving product quality and design and for reducing operating costs and losses*: McGraw-Hill.

Fortune, J., & White, D. (2006). Framing of project critical success factors by a systems model. *International Journal of Project Management, 24*(1), 53-65.

Gaddis, P. O. (1959). *The project manager*: Harvard University.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis* (Vol. 6): Pearson Prentice Hall Upper Saddle River, NJ.

Herman, M. W., & Koczkodaj, W. W. (1996). A Monte Carlo study of pairwise comparison. *Information Processing Letters, 57*(1), 25-29.

Highsmith, J. A. (2002). *Agile software development ecosystems* (Vol. 13): Addison-Wesley Professional.

Hutchinson, R., & Wabeke, H. (2006). Opportunity and Project Management Guide. *Shell International Exploration and Production BV INCOSE.(2004). INCOSE Systems Engineering Handbook. Kunz, J., & Fischer, M.(2012). Virtual design and construction: themes, case studies and implementation suggestions. CIFE, Stanford University, Stanford, CA, CIFE Working Paper, Version, 14*, 89-93.

Ika, L. A. (2009). Project success as a topic in project management journals. *Project management journal, 40*(4), 6-19.

Ishikawa, K. (1982). *Guide to quality control*.

Ishizaka, A., & Nemery, P. (2013). *Multi-criteria decision analysis: methods and software*: John Wiley & Sons.

Ito, T. A., Larsen, J. T., Smith, N. K., & Cacioppo, J. T. (1998). Negative information weighs more heavily on the brain: the negativity bias in evaluative categorizations. *Journal of personality and social psychology, 75*(4), 887.

Jha, K., & Iyer, K. (2006). Critical factors affecting quality performance in construction projects. *Total Quality Management and Business Excellence, 17*(9), 1155-1170.

Jugdev, K., & Müller, R. (2005). *A retrospective look at our evolving understanding of project success*.

Juran, J., & Godfrey, A. B. (1999). Quality handbook. *Republished McGraw-Hill*.

Keeney, R. L., & Raiffa, H. (1993). *Decisions with multiple objectives: preferences and value trade-offs*: Cambridge university press.

Kerzner, H. R. (2013). *Project management: a systems approach to planning, scheduling, and controlling*: John Wiley & Sons.

Kjærgaard, A., Kautz, K., & Nielsen, P. A. (2008). Making sense of Project Management. *Software Processes & Knowledge. Beyond Conventional Software Process Improvement*, 71-87.

Kloppenborg, T. J., & Opfer, W. A. (2002). The current state of project management research: trends, interpretations, and predictions.

Koops, L., Coman, L., Bosch-Rekveldt, M., Hertogh, M., & Bakker, H. (2015). Public Perspectives on Project Success–Influenced by National Culture? *Procedia-Social and Behavioral Sciences, 194*, 115-124.

Kwak, Y.-H. (2005). A brief history of Project Management. *The story of managing projects*.

Lim, C., & Mohamed, M. Z. (1999). Criteria of project success: an exploratory re-examination. *International Journal of Project Management, 17*(4), 243-248.

Love, P. E., Huang, J. C., Edwards, D. J., & Irani, Z. (2004). Nurturing a learning organization in construction: a focus on strategic shift, organizational transformation, customer orientation and quality centered learning. *Construction Innovation, 4*(2), 113-126.

Marshall, M. N. (1996). Sampling for qualitative research. *Family practice, 13*(6), 522-526.

Martin, E. A., & Law, J. (1983). A Concise Dictionary of Law: Oxford University Press.

Martinsuo, M., & Lehtonen, P. (2007). Role of single-project management in achieving portfolio management efficiency. *International Journal of Project Management, 25*(1), 56-65.

McLeod, L., Doolin, B., & MacDonell, S. G. (2012). A Perspective-Based Understanding of Project Success. *Project management journal, 43*(5), 68-86.

Meredith, J. R., & Mantel Jr, S. J. (2011). *Project management: a managerial approach*: John Wiley & Sons.

Mikkelsen, H. (1990). Quality of project work and project management. *International Journal of Project Management, 8*(3), 138-143.

Milosevic, D., & Patanakul, P. (2005). Standardized project management may increase development projects success. *International Journal of Project Management, 23*(3), 181-192.

Mir, F. A., & Pinnington, A. H. (2014). Exploring the value of project management: linking project management performance and project success. *International Journal of Project Management, 32*(2), 202-217.

Moore, D. S., McCabe, G. P., & Craig, B. A. (2012). Introduction to the Practice of Statistics.

Müller, R., & Turner, R. (2007). The influence of project managers on project success criteria and project success by type of project. *European Management Journal, 25*(4), 298-309.

Munns, A., & Bjeirmi, B. F. (1996). The role of project management in achieving project success. *International Journal of Project Management, 14*(2), 81-87.

NEN. (2015). Quality management systems - Requirements: NEN-EN-ISO 9001.

Nicholas, J. M., & Steyn, H. (2012). *Project Management for Engineering Business and Technology*: Butterworth-Heinemann.

Olson, D. L. (2004). Comparison of weights in TOPSIS models. *Mathematical and Computer Modelling, 40*(7), 721-727.

Payne, J., & Turner, R. (1999). Company-wide project management: the planning and control of programmes of projects of different type. *International Journal of Project Management, 17*(1), 55-59.

Pinto, J. K., & Slevin, D. P. (1988). *Critical success factors across the project life cycle*.

PMI. (2013). *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*: Project Management Institute, Incorporated.

Reeves, C. A., & Bednar, D. A. (1994). Defining quality: alternatives and implications. *Academy of management Review, 19*(3), 419-445.

Rezaei, J. (2015a). Best-worst multi-criteria decision-making method. *Omega, 53*, 49-57.

Rezaei, J. (2015b). Best-worst multi-criteria decision-making method: Some properties and a linear model. *Omega*.

Rezaei, J. (2016, 13-5-2016). [Discussion to validate of the right use of BWM].

Rockart, J. F. (1978). Chief executives define their own data needs. *Harvard business review, 57*(2), 81-93.

Rose, K. (2005). *Project quality management: why, what and how*: J. Ross Pub.

Saaty, T. L. (1990). How to make a decision: the analytic hierarchy process. *European journal of operational research, 48*(1), 9-26.

Saaty, T. L. (2004). Decision making—the analytic hierarchy and network processes (AHP/ANP). *Journal of systems science and systems engineering, 13*(1), 1-35.

Shenhar, A. J. (2001). One size does not fit all projects: Exploring classical contingency domains. *Management Science, 47*(3), 394-414.

Shenhar, A. J., & Dvir, D. (2007a). Project management research-the challenge and opportunity. *Project management journal, 38*(2), 93.

Shenhar, A. J., & Dvir, D. (2007b). *Reinventing project management: the diamond approach to successful growth and innovation*: Harvard Business Review Press.

Shenhar, A. J., Dvir, D., Levy, O., & Maltz, A. C. (2001). Project success: a multidimensional strategic concept. *Long range planning, 34*(6), 699-725.

Shenhar, A. J., Levy, O., & Dvir, D. (1997). Mapping the dimensions of project success. *Project management journal, 28*(2), 5-13.

Shewhart, W. A., & Deming, W. E. (1939). *Statistical method from the viewpoint of quality control*: Courier Corporation.

Söderland, J., Geraldi, J., Müller, R., & Jugdev, K. (2012). Critical success factors in projects: Pinto, Slevin, and Prescott-the elucidation of project success. *International Journal of Managing Projects in Business, 5*(4), 757-775.

Söderlund, J. (2004). Building theories of project management: past research, questions for the future. *International Journal of Project Management, 22*(3), 183-191.

Tabachnick, B. G., Fidell, L. S., & Osterlind, S. J. (2001). Using multivariate statistics.

Thurstone, L. L. (1927). A law of comparative judgment. *Psychological review, 34*(4), 273.

Tuchman, B. W. (1980). The decline of quality. *New York Times Magazine, 2*(104), 38-41.

Turner, J. R. (2014). *The handbook of project-based management* (Vol. 92): McGraw-hill.

UNESCO. (2016). Sydney Operah House. Retrieved 28-6-2016, 2016, from http://whc.unesco.org/en/list/166

Van Aken, T. (2009). *De weg naar project succes*: Van Haren.

Verschuren, P., Doorewaard, H., & Mellion, M. (2010). *Designing a research project* (Vol. 2): Eleven International Publishing.

Vocht, A. d. (2009). *Basishandboek SPSS 17 Statistics*. Utrecht: Bijleveld Press.

Von Hippel, E., Thomke, S., & Sonnack, M. (1999). Creating breakthroughs at 3M. *Harvard business review, 77*, 47-57.

W+B. (2016a). Mission and Vision. Retrieved 10-2-2016, 2016, from http://www.witteveenbos.com/en/mission-and-vision

W+B. (2016b, 01-2016). Organizational Sceme. Retrieved 4-02-2016, 216, from http://www.witteveenbos.nl/upload/filemanager/DIR1601_Org-liggend_NH.pdf

Wateridge, J. (1998). How can IS/IT projects be measured for success? *International Journal of Project Management, 16*(1), 59-63.

Westerveld, E. (2003). The Project Excellence Model®: linking success criteria and critical success factors. *International Journal of Project Management, 21*(6), 411-418.

Williams, B., Brown, T., & Onsman, A. (2012). Exploratory factor analysis: A five-step guide for novices. *Australasian Journal of Paramedicine, 8*(3), 1.

Wysocki, R. K. (2011). *Effective project management: traditional, agile, extreme*: John Wiley & Sons.

Yin, R. K. (2013). *Case study research: Design and methods*: Sage publications.

Appendix

A. List of CQF's Found in Literature

B. Reliability and Validity of the Multiple-Case Study

C. List of Projects for Multiple-Case Study

D. Background of BWM

E. Converging Theoretical and Practical Baseline

F. List of respondents

G. SPSS – Factor analysis output

H. SPSS – One-Way ANOVA output

I. Discussing the Characteristics of Respondents

J. SPSS – Mann Whitney test

K. SPSS – Kruskal Wallis 1

L. SPSS – Kruskal Wallis 2

M. The Actual Survey

N. Article for W+B with Recommendations

APPENDIX A: LIST OF CQF'S FOUND IN LITERATURE

The full list of CQF's as they were presented in their original studies are given in this appendix. By interpreting their original description they were clustered into the theoretical baseline.

Arditi (1998)		Chua (1999)		Chan (2000)		Jha (2006)		Enshassi (2009)	
Cooperation of parties	11	Realistic obligations/clear objectives	10	Effectiveness of Design Team Leader	6	Top management support	3	Conformance to specifications	6
Teamwork in design firm	5	Construction control meetings	9	Effectiveness of Client's Project Manager	7	Monitoring and feedback by project participants	8	Unavailability of competent staff	6
Management commitment	3	Formal communication	4	Nature of Project	10	Commitment of all project participants	11	Participation of managerial levels with decision making	3
Communication with owner	4	Capability of contractor key person	7	Support from Parent Company	3	Owners competence	7	Management - labour relationship	5
Feedback system	8	Design control meetings	9	Nature of Client	10	Interaction between project participants – internal	5	Information coordination between owner and project parties	4
Personalities	6	Adequacy of plans and specifications	1	Environment	13	Interaction between project participants – external	4	Speed and reliability of service to owner	4
Designer's education	6	Constructability	1	Competency of Client	7	Good coordination between project participants	9	Number of disputes between owner and project parties	8
Designer's training	6	PM commitment and involvement	2	Client's emphasis on Quality	12	Conflict among project participant	8	Number of rework incidents	8
Selection of design firm	14	PM competency	2	Effectiveness of Construction Team Leader	6	Faulty project conceptualization	12	Number of non-compliance events	8
Management leadership	2	Contractual motivation/incentives	0	Project Scope	10	Hostile socio economic environment	13	Employee attitudes	6
Project specifications	1	Site inspections	0	Project Management Actions	2	Owner's incompetence	7	Employee motivation	6
Constructability	1			Complexity	1	Project Specific factors (complexity/characteristics)	1	Belonging to work	6
Design budget	0			Procurement Method	0	Project manager's competence	2	Review of failures and solving them	8
Statistical methods	0			Client's Emphasis on cost	0	PM's ignorance and lack of knowledge	2	Work group	5
Office practices	0			Client's Emphasis on time	0	Aggressive competition during tendering	0	Project complexity	1
Drafting practices	0			Client Size	0			Leadership skills for project manager	2
Codes and standards	0							Recruitment and competence development	0
								Sequencing of work according to schedule	0
								Number of new project / year	0
								Quality of equipment and raw materials	0
								Learning from experience and past history	0
								Learning from best practices and experiences of others	0
								Quality assessment system in organization	0
								Quality training/meeting	0

Table 14 - Appendix A - Literature Study - CQF's clustering

The numbers behind each original factor in table 19 corresponds with the numbers of the presented table in the literature study (table 20). By studying their description they were clustered or disregarded in the case that factor did not comply with the research scope. The final table as given in the literature study is presented here again in table 20 (replica of table 2).

	Critical Quality Factor	**Literature occurrence***				
		1	***2***	***3***	***4***	***5***
1	Project Complexity and constructability	x	x	x	x	x
2	Project Managers Competency/Leadership	x	x	x	x	x
3	Top Management Support	x		x	x	x
4	Interaction between project participants - External	x	x		x	x
5	Interaction between project participants - Internal	x			x	x
6	Qualified project team members	x		x		x
7	Competence of Client		x	x	x	
8	Conflicts and disputes among project participants	x			x	x
9	Consistent communication/meetings		x		x	
10	Project significance, scope and objectives		x	x		
11	Stakeholder commitment of project participants	x			x	
12	Project conceptualization			x	x	
13	Political-/Socio economic stability			x	x	
14	Monitoring performance of external parties	x				

**Note: 1 = Arditi and Gunaydin (1998); 2 = Chua et al. (1999); 3 = Chan and Kumaraswamy (2000); 4 = Jha and Iyer (2006); 5 = Enshassi et al. (2009).*

Table 15 – CQF's found in literature - appendix

APPENDIX B: RELIABILITY & VALIDITY OF THE MULTIPLE-CASE STUDY

Testing for validity is done to establish the quality of an empirical research (Yin, 2013). The tests that are done to achieve this are (1) *Construct validity*: identifying correct operational measures, (2) *Internal validity*: Testing the establishment of a causal relationship, (3) *External validity*: Defining a domain for generalization of study findings, and (4) *Reliability*: demonstrating that the operations can be repeated. The execution of these tests is given below.

Construct Validity

There are three sources of evidence needed to ensure a triangulation of evidence and thereby proof the construct validity, of which two are presented in this part. To close the triangulation of evidence a survey will be held with a panel of experts. The two sources of evidence are initially used to conduct this case study are *Documentation* and *Archival Records (Yin, 2013)*.

- ✓ **Documentation**: The documentation that is used consist of the *internal-, external-, and mid-term evaluations*. These documents are written by the project managers themselves according to a predefined set of questions, and can therefore be compared with a simplified 'structured interview'. However, it is known that not all evaluations are written with the same care, and could therefore be discarded for some cases due to a lack of content.

- ✓ **Archival Records**: Besides evaluation there is the possibility to access other archival record for some of the projects. Again, it depends on what data is made available, and what the quality of this data is. If available, it can be used to strengthen the information that is given in the evaluation reports by confirming what is found.

Internal Validity

The internal validity is assured by showing the causal relationship between the concepts. These relationships are assumptions based on literature research and experience of experts, which are also described in chapter 1. The following line of concepts of figure 15 shows this simplified version of their causal relationship.

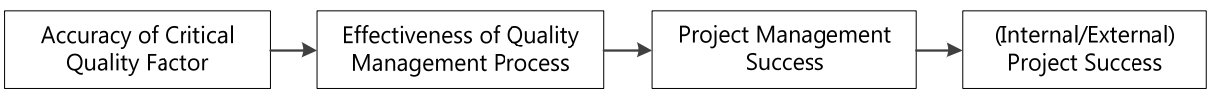


Figure 15 - Internal Validity: Causal Relationship within the Research Context

External Validity

From a practical perspective: the method used in this research, and thereby this case study, could be applicable for any engineering firm within the Netherlands. The output however is specifically meant for W+B, since their data one describes their own project management approach.

From a theoretical perspective: the contribution to science is mainly within the domain of project management in a pre-construction phase. The latter got little attention in current literature, since most publications are on c*ritical success factors* in the context of the actual construction of engineering works.

Reliability

The reliability of the multiple-case study is improved by demonstrating that the operations of the case study can be repeated by any other researcher that would end up with the same results (Yin, 2013). The overall goal of testing the reliability is to ensure that the amount of errors are minimised. A measure to improve the reliability is to use *a case-study protocol* that could guide any other researcher into finding the same results. The case study protocol is given in the second paragraph of this chapter, consisting of a description of what documentation to look for and what exact steps to take during the execution of the case study. The room for error is thereby minimised and the reliability strengthened. A side note must be made that the researcher deals with qualitative data, which is free for interpretation of any researcher, and therefore challenges the exact replication of the direct output.

APPENDIX C: LIST OF PROJECTS FOR MULTIPLE-CASE STUDY

This appendix shows what project have been used for the multiple-case study. Due to privacy reasons the actual evaluations cannot be included with this research.

Project Code: IM	Date of Evaluation	Project Name	Client
EFD16-2	8-10-2015	Traverse Eefde	Privaat
KDL12-1	8-10-2015	Fietspad N831	Privaat
LW341-1	28-10-2015	Kosten Raming Prins Hendrik Brug	Publiek
MDK71-1	14-10-2015	Vrachtautoparkeren Moerdijk	Publiek
RW1929-90	28-5-2015	Onderzoek Colonne vorming A15	Publiek
ZL505-50	18-5-2015	Extra werkzaamheden rotonde N343/N738 te Weerselo	Publiek
RIS200-3	27-10-2015	Deventer, onderdoorgang Colmschate, toonbankvragen	Publiek
ASN1232-3	10-11-2012	Kadoelenbrug over Zijkanaal te Amsterdam Noord	Publiek
IBZ2-136 / IBZ2-4	30-4-2015	Zuidas Amsterdam	Publiek
AMR88-3	21-8-2015	N23 - Westfrisiaweg	Privaat
BRC14-1	12-8-2015	Blaricummermeent - UO brug 6	Privaat
HLM477-95	13-8-2015	Nautische veiligheid Veerpont t Schouw.	Publiek
HLM477-72	28-5-2015	Renovatie Langebalkbruggen	Publiek
RIS190-13	13-5-2015	Blussysteem Botlekbrug A15	Publiek
RW1829-50	13-3-2015	Stuwen Sambeek en Belfeld	Publiek
VW1-1	11-8-2015	Koninginnesluis	Privaat
HRL279-1/2	8-9-2015	Herberekening viaduct Terworm N281	Publiek
FN62-1/2/3	15-10-2015	Frankener Waddenpoort Haalbaarheidsonderzoek zuidelijke vaarroute	Publiek
RW18929-143	28-8-2015	Planstudie Ring Utrecht, diverse aspecten	Publiek
TB185-7	27-8-2015	Transportroutes gemeente Tilburg herberrekening	Publiek
ZD210-5	15-9-2015	Sluishoofden en Sluiskolk Wilhelminasluis Zaandam	Privaat
ZH4-3	20-2-2015	N355 Zuidhorn	Privaat
DV1305-1	9-7-2015	Reconstructie Hanzeweg	Publiek
MP70-1	6-8-2015	EMVI-plan N361	Privaat
MT810-57	30-10-2015	Uitbreiding parkeerplaats Sphinx	Privaat
MT810-68	30-10-2015	Risicoanalyse Parkeerkelder Lindenkruis	Privaat
HLM477-75	16-3-2015	Groot onderhoud Princes Irenebrug	Publiek

Project Code: GOM	Date of Evaluation	Project Name	Client
TB8-30	1-9-2015	Aanvraag omgevingsvergunning bovengrondse tank (belgie)	Privaat
LW289-65/83/86	2-9-2015	Vergunningsmanagement Dijkversterking Lemmer	Publiek
RT801-1	-	MER + Revisie Odfjell Rotterdam	Privaat
HGL193-1/2/3/4	13-1-2015	Twence KVM+ gebouw	Privaat
UT786-1	3-9-2015	Vakkundigontwerp Kruisingen SUNIJ-lijn	Publiek
HT496-1	-	Wegscan N612	Publiek
HT499-1	28-8-2015	Bestek Verande Park - Maliskamp	Publiek
RW1418-8	18-9-2014	Vormvrije MER-beoordeling	Privaat
OTH163-2	21-8-2014	Oostelijke persleiding + rioolgemaal Oosterhout	Publiek
RT864-2	17-11-2014	Gebiedsontwikkeling Maasvlakte Plaza	Privaat
ELT18-1	28-11-2014	Variantenonderzoek Fietspadkruising A325	Publiek
RW1809-117/389/417	9-1-2015	Vergunning Waterweg Reugier	Publiek
ZH4-4	20-9-2013	Vergunningencoordinatie N355 Zuidhorn	Privaat
ASD1228-9	13-11-2014	Ingenieursdiensten Het Gein	Publiek
HLM513-1	20-8-2014	Opstellen beschikkingen Nbwet aanvragen	Publiek
RT667-5	12-6-2014	Off-Shore Kabeltracé Q10	Privaat

Table 16 - List of projects used for the multiple-case study

APPENDIX D: BACKGROUND OF BWM

The subjective context that is studied is the judgement of how project managers experience the influence of the presented list of CQF's in defining an effective process, differentiated per type of client. Within this context it is assumed that by designing an effective process of quality management, the *quality* of the final product is optimized, being one of the leading criteria for project success. All project managers have their own opinion on what process design would fit the goal of a specific project best and which CQF would have the most significant effect on this process. At the start of every project the challenge is to find an optimal initial combination of CQF's that fit a specific goal, as defined at that point in time. Narrowing down the scope of the solution space brought this research to a differentiation of T*ypes of Clients* in order to find a ranking of CQF's that fit the characteristics of each type best. So in a sense a 'decision' has to be made on what ranking of CQF's would optimally fit in a certain environment. Since there is not such a thing as a perfect solution within this subjective context, an optimum should be found that is able to support a project manager in their unique process, which is more than a simple weighted sum of opinions (Ishizaka & Nemery, 2013). This goal can be achieved by performing a different form of MCDM, which is not aimed at 'making' decisions but at 'analysing' the background of the decision, in order to find an optimal solution for the data that is analysed. There is actually little difference between the MCDM and MCDA more than their application. This makes their initial methods of analysis practically the same. Most MCDM or MCDA problems are shown according to the following matrix:

$$A = \begin{array}{c} \\ a_1 \\ a_2 \\ \vdots \\ a_m \end{array} \begin{array}{c} \begin{array}{cccc} c_1 & c_2 & \cdots & c_n \end{array} \\ \begin{pmatrix} p_{11} & p_{12} & \cdots & p_{1n} \\ p_{21} & p_{22} & \cdots & p_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ p_{m1} & p_{m2} & \cdots & p_{mn} \end{pmatrix} \end{array}$$

Figure 16 - Discrete MCDM problem: General decision matrix (Rezaei, 2015)

In this matrix $[a_1, a_2, \dots, a_m]$ is a set of alternatives, $[c_1, c_2, \dots, c_n]$ is a set of decision-making criteria, and p_{ij} is the weight of alternative i with respect to criterion j. Applied to this research, the 'alternatives' can be seen as the 'types of clients' or the categories, and the 'criteria' can be replaced by 'CQF's'. The overall value of each alternative, or the overall ranking of each type of client, is obtained by using additive weighted value function (Keeney & Raiffa, 1993), which is the underlying model of most MCDM methods (Rezaei, 2015a). The formula goes as follows (figure 17), in which the assign weight $w_j \; with \; (w_j \geq 0, \sum w_j = 1)$; V_i = the overall value of alternative i.

$$V_i = \sum_{j=1}^{n} w_j p_{ij}$$

Figure 17 - Calculation of overall Value of alternative *i*

This has been the underlying model for many methods that have been developed for the making and analysing of multi-criteria decisions. Some popular methods are for example AHP (Analytical Hierarchy Process), ANP (Analytical Network Process), TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), and many more. AHP arranges the factors in a hierarchical structure, descending from an overall criteria, sub-criteria, and alternatives in successive levels (Saaty, 1990), ANP which is more a generalized method based on the AHP method (Saaty, 2004), and TOPSIS which is based on simultaneous minimization of distance from an ideal point and maximization of distance from a lowest point (Olson, 2004). They have acquired their place in decision making theory, but room for improvement when talking about their reliability.

The weights that are used in all MCDM methods are derived with the help of the pairwise comparison method, which was first introduced under the law of comparative judgement (Thurstone, 1927). This law involves the use of concepts concerning the ambiguity or qualitative variation with which one *stimulus m* is perceived by the same observer on different occasions. They show the relative preference of *stimulus m* in situation where its meaningless to provide score estimates for the stimuli with respect to the criteria (Rezaei, 2015a). The differentiation between methods is concentrated in their level of consistency of the pairwise comparison matrices, creating a significant challenge to overcome (Herman & Koczkodaj, 1996). The consequence of an inconsistent comparison matrix is that the outcome become less reliable. The pairwise comparison matrix (figure 16) is considered to be perfectly consistent if for each *i* and *j*:

$$A = (a_{ij})n * n \qquad \text{if for each } i \text{ and j} \quad a_{ik} * a_{kj} = a_{ij}$$

There are many factors that influence the level of inconsistency of a pairwise comparison matrix, but according to the developer of the Best-Worst Method the main cause for inconsistency is the unstructured way of comparison (Rezaei, 2015a). In order to bridge this lack of inconsistency the BWM was developed, which derives the weights of the criteria in a different way. The next paragraph will discuss the theory and application of BWM in more detail.

Application of BWM for the ranking of CQF's

The Best-Worst Method is a recent developed method for MCDM, and is promising when studying the improvement of the reliability and understand ability compared to other MCDM methods. The following list presents the improvements of reliability of applying BWM compared to other MCDM methods (Rezaei, 2016):

1. **Data points**: The technique of pairwise comparison has been improved by a more efficient use of *data-points*, compared to AHP. AHP uses n(n-1)/2 data points, in which n is the amount of respondents, and BWM uses 2(n-3) data-points, which is a significant decrease of the room for error.

2. **Structure**: The way that BWM structures the data input has been improved. It is presented more understandable for the respondents due to the identification of the 'best' and 'worst' criteria, instead of having to pairwise compare all individual criteria.

3. **Use of integers**: AHP mixes the use of *factional* and *integer* input, making is harder to understand for respondents when comparing the criteria. BWM on the other hand only uses integers for the input of respondents, increasing the applicability of pair-wise comparison. The difference between 1/4 and 1/5 is not the same as the difference between 1/5 and 1/6,on the other hand the difference between 4 and 5 is the same as the difference between 5 and 6 as used by BWM.

4. **Revising**: Due to the decrease of data-points and the structure it is more easy to revise any inconsistent data input with the respondents. A *matrix* of input data, as used by AHP, has a chain of reactions if one data-point would be revised, while BWM, which uses *vectors*, only has a couple of changes that do not affect the rest of the input.

As said before, this research is not about making a *decision*, but about *analysing* the data that is delivered by BWM. Both options are well suited for applying BWM.

Pair-wise comparison approach in BWM: The added value of BWM is its unique approach towards pair-wise comparison. Within this approach there are two variables that are sought, being the *direction* and the *strength* of the preferences between criteria. There should be no problem in stating the *direction* of a preference, but judging the *strength* of one criteria over the next makes it more difficult. This is the difference between ranking e.g. five criteria from 1 – 5 (which is only a direction), and ranking five criteria on a scale from 1 – 9, in which the differences represent the relative preference

over each other. When such a selected group or criteria is compared using pairwise comparison, it is possible to divide the criteria into two groups, (1) the *reference comparisons*, and (2) the *secondary comparisons*. The comparison a_{ij}n is defined as a reference comparison if *i* is the best element and/or *j* is the worst element $(a_{ij} \geq 1 \; and \; i \neq j)$. The comparison a_{ij} is defined as a secondary comparison if *i* nor *j* are the best or the worst elements $(a_{ij} \geq 1^2)$. When the comparison matrix in considered again, it is obvious that for *n* elements there are n^2 possible comparisons. With *n* comparisons, a_{ii} = 1 and for all others is $n(n-1)$. For the first half of the comparisons is $a_{ij} \geq 1$, and the second half is the reciprocals of the first half. So from the first $n(n-1)/2$ comparisons, $2n-3$ are *reference* comparisons, and the rest is *secondary*.

Summarising this part of the description it can be said that the secondary comparisons are executed with the knowledge of the reference comparisons. An efficient approach would therefore be to first focus on the reference comparisons before prior to the secondary comparisons. Even more efficient would be to carry out only the reference comparisons and subsequently derive the secondary comparisons from this, which is illustrated in figure 18.

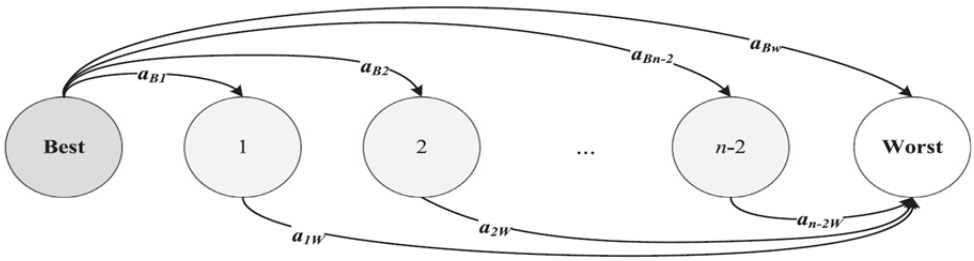


Figure 18 - Reference comparisons BWM

This last statement has been proposed by Rezaei (2015a), and has led to the development of BWM. The following paragraph shows how the weights of the criteria can be derived from only the use of reference comparisons.

The five steps of BWM: BWM is executed by the help of *five consecutive steps*. These are followed during the execution of a survey in order the get the data needed subsequently derive the weights of the criteria. The direct input that is delivered by the respondents during the survey is limited by a single Likert scale. This can be any scale as long as it is finite. So for example, 0.1 – 1 is possible, or 1 – 100, it depends on what is found appropriate for the study that is undertaken. The developer of BWM does recommend a Likert scale from 1 – 9, for it is being seen as the most optimal scale (Rezaei, 2016). The following description of BWM-steps is fully extracted from Rezaei (2015a).

- ✓ **Step 1 – The set of decision criteria:** The first step is executed by determining *the criteria* that are considered to derive at a decision that is to be taken. These criteria demarcate the scope of the survey. The following criteria are considered:

  Set of criteria $[c_1, c_2, \dots, c_n]$,

- ✓ **Step 2 – The best and worst criteria:** Determine the *best criteria*, or the most desirable, and the *worst criteria*, or least desirable, taken the situation as demarcated by the scope. In this stage there is no comparison made, but a general judgement of the best and worst criteria.

  Best criteria a_b,

  Worst criteria a_w,

- ✓ **Step 3 – Preference of best over all others:** Determine the preference of the best criteria over all other criteria by using the a Likert scale of 1 – 9 for each criteria. So per criteria that has not been determined as 'best', this comparison is made. The 'Best-to-Others' vector would be:

  Best-to-Others vector $a_b = (a_{b1}, a_{b2}, \dots, a_{bn})$,

  Comparing the best to the best (a_{bb}) would automatically result in $a_{bb} = 1$.

- ✓ **Step 4 – Preference of all others over the worst**: Determine the preference of all other criteria over the best criteria, also using the Likert scale of 1 – 9 for each criteria being judged. So per criteria that has not been determined as the 'worst', this comparison is made. The 'Others-to-Worst' vector would be:

  'Others-to-Worst' vector $a_w = (a_{1w}, a_{2w}, \dots, a_{nw})$,

  Comparing the worst to the worst (a_{ww}) would automatically result in $a_{ww} = 1$.

- ✓ **Step 5 – Finding the optimal weights:** Finding the optimal weights $(w_1^*, w_2^*, \dots, w_n^*)$ for each criteria is the one where, for each pair of $w_b/w_j \; and \; w_j/w_w$, there is $w_b/w_j = a_{bj}$ and $w_j/w_w = a_{jw}$. To satisfy all conditions there should be a solution where the maximum absolute difference, for all j is minimized. The following problem is resulted:

  $$\min \max \left\{ \left| \frac{w_B}{w_j} - a_{Bj} \right|, \left| \frac{w_j}{w_W} - a_{jW} \right| \right\}, \qquad s.t. \qquad \sum_j w_j = 1; \qquad w_j \geq 0, \text{ for all } j$$

  Or as transferred to the following problem:

  $$\left| \frac{w_B}{w_j} - a_{Bj} \right| \leq \xi, \text{ for all } j, \; \left| \frac{w_j}{w_W} - a_{jW} \right| \leq \xi \text{ for all } j, \; \sum_j w_j = 1; \; w_j \geq 0, \text{ for all } j$$

  By multiplying the first set of constrains by w_j, and the second set of constrains with w_w, the solution space of the model becomes an intersection of $4n - 5$ linear constrains. This gives a large enough ξ that the solution space is not empty (Rezaei, 2015b). By solving this problem, the optimal weights $(w_1^*, w_2^*, \dots, w_n^*)$ can be found.

- ✓ ***Step 5 - A Linear model of BWM**: As addition to the first published article on BWM, a new linear model has been developed (Rezaei, 2015b). This model is based on the same BWM principles, but is aimed at a *unique solution* instead of a *multi-optimal solution*, which would be delivered by the previous model. For this linear model it is only necessary to replace step 5 with a new model to that is used to find the optimal weights of the criteria. This new model would be:

  $$\left| w_B - a_{Bj} w_j \right| \leq \xi^L, \text{ for all } j, \quad \left| w_j - a_{jW} w_W \right| \leq \xi^L, \text{ for all } j, \quad \sum_j w_j = 1; \quad w_j \geq 0, \text{ for all } j$$

  For this model ξ^{L*} can be directly considered as an indicator of the consistency of the comparison. This problem is linear and therefore delivers a unique solution for the optimal weights, which is pursued in this research. Therefore this linear model is applied.

Validity and Reliability of BWM

Part of the analysis is to check its own validity and reliability. As stated in the introduction of this chapter, BWM was partly developed due to the lack of reliability of other methods.

The consistency of the BWM output: The output of BWM increases its reliability for further analysis by its level of consistency. A high level of consistency decreases the chance of weights to be contradictory. A comparison can be considered as fully consistent in the following situation:

Full consistency $a_{bj} * a_{jw} = a_{bw},\ for\ all\ j$

a_{bj} = preference of the best criteria over criterion j

a_{jw} = preference of criterion j over the worst criterion

a_{bw} = preference of the best criterion over the worst criterion

a_{bw}	1	2	3	4	5	6	7	8	9
Consistency index (max ξ)	0.00	0.44	1.00	1.63	2.30	3.00	3.73	4.47	5.23

The table shows maximum values of ξ (consistency index) for different values of a_{bw}. This is used to calculate the consistency ratio, in which values close to 0 show a high level of consistency and values close to 1 show a low level of consistency, using the following formula:

$$Consistency\ Ratio = \frac{\xi^*}{Consistency\ Index}, \qquad \epsilon\ [0,1]$$

Validation with BWM developer: The method of BWM is rather new, and its rising popularity shows that many researchers have adopted the ideas of BWM, but not yet published papers following the BWM method. Rezaei did publish a paper that follows up on his original publication on BWM (Rezaei, 2015a, 2015b), presenting some new insights and adaptations, but to really increase the validity of application of BWM an extra step had to be taken. Therefore to validate the interpretation of BWM, and the subsequent application of BWM during this research, an check-up will be held with the developer himself.

Further statistical analysis in addition to BWM

The Best-Worst Method is focussed on delivering weighted criteria in order to subsequently make reliable decisions between a predetermined set of alternatives. When these weights are ordered by their rank per alternative, a comparative study can be done. Analysing the outcome of this study can initially result in enough input to make a decision dependent on its purpose, but is mostly based on statistical invalid assumptions when not subdued to certain tests that supports the reliability of the results. Therefore it is useful to perform a statistical analysis on the BWM data output. This will be done using the program SPSS Statistics 22, developed by IBM. This program offers a wide arrange of statistical tests to analyse the relationship between data sets, which in this case is the BWM data output of weighted CQF's analysed per category.

The BWM data output has to be validated for statistical analysis itself in order to perform the right tests. This validation would influence the choice between e.g. a *parametric* test or a *non-parametric* test. There is one overall dataset for this research, but there are different ways in which this can be analysed dependent of the purpose. This might cause different tests to apply for the specific selection of data. The following criteria of a dataset are considered (Moore, McCabe, & Craig, 2012; Vocht, 2009):

- ✓ **The assumed distribution**: Normal (parametric) vs. Any other distribution (non-parametric);
- ✓ **The assumed variance**: Equal (parametric) vs. Any other variance (non-parametric);
- ✓ **Level of measurement**: Nominal (non-parametric), Ordinal (non-parametric), Interval (parametric), or Ratio (parametric);
- ✓ **Dataset Relationship**: Independent (parametric) vs. Any other relationship (non-parametric);
- ✓ **Central Measure**: Mean (parametric) vs. Median (non-parametric);
- ✓ **The sample size**: Sample > 30 (parametric) vs. Sample < 30 (non-parametric).

First, bases on some early assumptions of the dataset a couple of the criteria can be handled in advance. The first criterion is the *assumed distribution*, which is for this dataset is assumed to be *normal* (Gaussian distributed). The weights of BWM are measured between 0 and 1, and should present a normal distribution between these constraints centred around a central weight.

Secondly the test for *equality of variance*, which is tested by performing a Levene's Test (SPSS output). This test assumes the dataset to be equally distributed, and is found by performing an *Independent Samples Test* (SPSS test) between all categories. The test for significance states that if the outcome is significant ($p < 0.05$), the assumption should be refuted and no equality of variance can be assumed. This was not that case, since the majority of the data tested to be not significantly loaded. It can thereby be concluded that *equality of variance* can be assumed.

Thirdly, the *level of measurement* of 'weight' in general is of a *ratio scale*, since there is an absolute zero and with the weights all mathematical calculations are possible (Rezaei, 2016). This is also the case for the BWM output.

Fourthly, the *relationship of the data* is assumed to be *independent*. The initial data is qualitative and based on interpretation, which means that there will always be some sort of overlap between the

CQF's. By assuming that the relation between them is independent, it can be tested to what extend this independency exists.

Fifthly, the *centrality of the measure* that is used by the test is checked fir its conformance with the dataset. A parametric test uses the *mean* of the dataset for its analysis, and a non-parametric test uses the *median*. The *mean* is sensitive for outliers, so for example when many outliers are expected it would be best to perform a non-parametric test to increase the reliability. For the dataset of this research it depends on the part of the research that is executed, which will be described in chapter 7.

Sixthly, the *sample size* differs per part of the research. For example, when all CQF's are tested independent of their category there are three responses per respondent, which theoretically makes the total sample size to be 90 (in the case all samples are applicable). On the other side, when the characteristics of the respondents are studied dependent on their category it will me much lower. With three categories and e.g. 2 characteristics, theoretically the sample size would become $(90/3)/2 = 15$. What test is performed is further described in chapter 7.

Finally, it is *up to the respondent* to choose what test is most applicable. All tests will deliver a certain output, but the respondent decides the level of reliability that is needed for the purpose of a study. The statistical tests that are used for this research are described in the following paragraphs. The reason for their use and their outcomes are presented in chapter 7, in which the results are discussed.

Pearson's Correlation Coefficient: The *Pearson's Correlation Coefficient* (or *Pearson's r*) is a *parametric test* that measures the linear correlation between two variables, meaning both the *strength* as the *direction* of the relation between them (Moore et al., 2012; Vocht, 2009). The output of the test, the correlation coefficient, falls between -1 and +1, in which +1 means that two variables are perfectly correlated, and -1 means that the two variables are perfectly negative correlated. The robustness of this test is however limited due to the sensitivity for outliers, which means that the context always should be taken into account when conclusions are drawn. A scatterplot is one of the measures to counter this effect and see what data points are off.

- ✓ **Null-hypothesis:** 'The variables show no statistical correlation'. Meaning that with a significant loading, the assumption of this hypothesis is rejected, after which it is likely that a correlation exists.

- ✓ **Level of significance**: The outcome has a significant loading if the p-value is less than $\alpha = 0.05$. This level is chosen on forehand, which states that a 5% probability that the null-hypothesis is rejected given that it is true.

Exploratory Factor Analysis: An *exploratory factor analysis* is a multivariate approach that describes the correlation of the individual factors and searches for their joint variations that could stay unobserved if not statistically measured. A high *factor loading* would mean that the analysed set of factors have a low level of independence and would therefore partly measure the same effect (Williams et al., 2012). It thereby established underlying dimensions between measured variables and latent constructs. The test is executed using SPSS. The rule of thumb is that a correlation coefficient of > 0.3 qualifies for further analysis (Tabachnick, Fidell, & Osterlind, 2001), and a correlation coefficient of > 0.5 is practically significant (Hair, Black, Babin, Anderson, & Tatham, 2006). The program SPSS has higher requirements for significance, which will be used to define any *underlying explanatory factors* for this research.

- ✓ **Null-hypothesis**: 'The variables show no shared variance and thereby no underlying explanatory factor'. Meaning that with a significant loading, the assumption of this hypothesis is rejected, after which it is likely that an underlying explanatory factor exists.

- ✓ **Level of significance**: The outcome has a significant loading if the p-value is less than $\alpha = 0.05$. This level is chosen on forehand, which states that a 5% probability that the null-hypothesis is rejected given that it is true.

One-Way ANOVA Test: The One-Way ANOVA Test is a statistical test to analyse the variance of the data among different group means. The goal of an ANOVA Test is to study the unilateral relationship between an *independent categorical variable* and a *dependent interval or ratio variable*. So it simple compares different group means and tests if they significantly differ from each other. For this research it is applicable as exploratory tool to explain certain observed differences in the weights of CQF's between the categories (Moore et al., 2012; Vocht, 2009).

- ✓ **Null-hypothesis**: 'The means of the groups show no statistical differentiation'. Meaning that with a significant loading, the assumption of this hypothesis is rejected, after which it is likely that the variable differs from the mean.

- ✓ **Level of significance**: The outcome has a significant loading if the p-value is less than $\alpha = 0.05$. This level is chosen on forehand, which states that a 5% probability that the null-hypothesis is rejected given that it is true.

Mann-Whitney Test & Kruskal Wallis Test: The final statistical analyses are the *Mann-Whitney Test* and the *Kruskal Wallis Test*. These are non-parametric tests to see if a certain amount of *independent samples* originate from the *same population* (Moore et al., 2012; Vocht, 2009). The *Mann Whitney Test*

assumes that there are *two independent samples* in the same population, and the *Kruskal Wallis Test* assumes there are *more than two independent samples*. This means that both tests compare the medians between certain independent samples to determine if they are statistically different from each other.

- ✓ **Null-hypothesis**: 'The median of the independent samples are statistically equal'. Meaning that with a significant loading, the assumption of this hypothesis is rejected, after which it is likely that the samples originate from different populations.

- ✓ **Level of significance**: The outcome has a significant loading if the p-value is less than $\alpha = 0.05$. This level is chosen on forehand, which states that a 5% probability that the null-hypothesis is rejected given that it is true.

APPENDIX E: CONVERGING THEORETICAL AND PRACTICAL BASELINE

Both the practical- and theoretical baseline converge in this paragraph, forming one single set of representative CQF's. This set will represent the final list of CQF's for which the survey will be executed, aiming to uncover the assumed differences between the types of clients as judged by a group of project managers of W+B. In order to maximize the outcome of the initial convergence, the following criteria are designed to test the applicability of the CQF's for the intended survey:

C4. *The amount of overlap in terminology must be minimalized;*

C5. *The levels of abstraction in terminology must be comparable with other factors;*

C6. *The factor must be able to be influenced by a project manager or its team members.*

Testing CQF's from Literature: Theoretical Baseline

The starting point of this paragraph is the subset of CQF's that were found to contribute to the project management process, according to literature. This subset of CQF's is discussed and presented in this research as part of the theoretical baseline (part I). The pursued output of this paragraph is a final set of CQF's that is tested among the list of criteria as stated in the previous paragraph. The last column of table 22 below shows if the CQF's are in compliance with all criteria. If this is not the case, the number is given of the criterion that it does not comply with. The possible exclusion of CQF's will subsequently be discussed.

List of CQF's from Literature: Theoretical Baseline		
	Critical Quality Factor - Theory	**Compliance?**
T-F1	Project Complexity and Constructability	No: C3
T-F2	Project Managers Competency/Leadership	No: C3
T-F3	Top Management Support	Yes
T-F4	Interaction between project participants - External	Yes
T-F5	Interaction between project participants - Internal	Yes
T-F6	Qualified project team members	Yes
T-F7	Competence of Client	Yes
T-F8	Conflicts and disputes among project participants	Yes
T-F9	Consistent communication/meetings	Yes
T-F10	Project significance, scope and objectives	Yes
T-F11	Stakeholder commitment of project participants	No: C1
T-F12	Project conceptualization	Yes
T-F13	Political-/Socio economic stability	Yes
T-F14	Monitoring performance of external parties	Yes

Table 17 – Theoretical Baseline: Initial list of CQF's from Literature

Almost all CQF's have been found to comply with the criteria, meaning that their formulation was satisfactory enough to opt for convergence with the practical baseline. The ones that were not are discussed hereunder:

- ✓ **Excluding T-F1**: *Project complexity and constructability*, does not comply with the third criterion, stating that the CQF must be able to be influenced by the project managers or the project team. Project complexity is a decisive factor, as is seen by the many references in literature, but for this research not applicable. The survey is aimed at those CQF's that a project manager can apply to steer the process. Although it is a significant characteristic of the context, project complexity cannot be influenced directly by the project manager.

- ✓ **Excluding T-F2**: *Project manager's competence/leadership*, did not comply with the third criterion. This states that the factor must be able to be influenced by a project manager or its team members. This incompliance came to light while testing the initial concept of the survey. Since the respondent takes on the perspective of a project manager during the survey, a judgment of their own contribution to the process could not be done in a reliable manner. So taking this factor out of the subset is assumed necessary. This is noted as one of the limitations of this research, since literature pointed out the significance of this CQF.

- ✓ **Adjusting T-F11**: *Stakeholder commitment of project participants* was not specific enough to be included into the final set. There are two 'entities' included in this description, namely the *stakeholder* and the *project participant*, which could lead to inconsistent interpretation of the CQF. This overlap in terminology within the same CQF caused it to not comply with the first criterion. This factor could be transformed into 'stakeholder commitment' or 'commitment of project participants' without losing the meaning of the factor.

Testing CQF's from Multiple-Case Study: Practical Baseline

The subset of CQF's coming from the practical baseline (part II) is handled in this paragraph. Just like the previous paragraph, these CQF's will be judged for their applicability during the survey. The last column given the judgement of their compliance with the stated criteria.

List of CQF's from the Multiple-Case Study: Practical Baseline		
	Critical Quality Factor - Practice	**Compliance?**
P-F1	Direct Interaction between project participants	No: C1
P-F2	Consistent communication guidelines	Yes
P-F3	Output expectation management	Yes
P-F4	Input expectation management	Yes
P-F5	Qualified project team members	Yes
P-F6	Stakeholder commitment in kick-off phase	Yes
P-F7	Team mitigation policy	Yes
P-F8	Review of stakeholder commitment	No: C2
P-F9	Involvement of client with mandate	Yes
P-F10	Insight in stakeholder vision and project significance	Yes
P-F11	Display of misunderstandings and mistakes	No: C1
P-F12	Review consequences of change	No: C1
P-F13	Display of shortcomings of info and knowledge	No: C1
P-F14	Consistent pattern of evaluations	No: C2

Table 18 - Practical Baseline - List of Critical Quality Factors from Practice

Within this subset of CQF's a different level of abstraction was expected than that within the subset of CQF's from literature. This assumption is upheld when for instance the CQF's T-F13 (political-/socio economic stability) and P-F2 (consistent communication guidelines) are compared. This comes due to the generalizability of those factors named in literature (Part I), and on the other side due to a direct encounter with practice in the analysed project evaluations (Part II). This is not uncommon when qualitative and subjective data is analysed, but should not transcend the balance between a *factor* and the higher *category* (Corbin & Strauss, 2014). Imagine that 'flight' is of a higher level of abstraction than 'plane' or 'bird', and comparing these entities would disrupt the survey, create an incorrect understanding of the interrelationship between the CQF's.

- ✓ **Adjusting P-F1**: *Direct Interaction between project participants,* did not comply with the first criterion. After completing the multiple-case study (part II) it became clear that for this CQF the internal- and external perspective of the 'project participant' should separately be represented as different factors. The overlap between perspectives is therefore split between the 'internal direct interaction' and 'external direct interaction', creating two CQF's.

- ✓ **Joining P-F6 , P-F8***: The latter, Review of stakeholder commitment*, had low level of abstraction. A 'review' is a direct action that can be taken, more than it is a comparable CQF that can be steered upon. On top of that, the factor *P-F6, Stakeholder commitment in kick-off phase,* looks like a good enough categorisation of P-F8, and both factors are therefore combined.

- ✓ **Joining P-F11, P-F12, P-F13***:* Respectively *Display of misunderstandings and mistakes*, *Review consequences of change*, and *Display of shortcomings of info and knowledge* show too much overlap, and therefore do not comply with the first criterion. All three factors can be categorized under one single factor that represents the displaying, and reviewing of mistakes, changes, and shortcomings during execution. It is a factor that does not need any differentiation for it focusses on the promotion of an open an honest environment with the client. The factor that comes out of this categorization is 'review and acceptance of shortcomings and mistakes', which will be presented in the following paragraph.

- ✓ **Joining P-F2, P-F14**: The latter*, Consistent pattern of evaluations*, which showed a lower level of abstraction than the factor *P-F2: Consistent communication guidelines*. Therefore is was decided to include factor P-F14 under the factor P-F2, since a pattern of evaluations is simply a form of communication guidelines.

APPENDIX F: LIST OF RESPONDENTS

This appendix gives the used information of the respondents, without presenting their names.

Resp. Nr.	Sector	Working location	Years of PM experience	Professional Background	Experience with (1= yes; 0 = no)		
					Private	Small-Public	Large-Public
1	IM	SP	20,0	PRV	1	1	1
2	DKR	RT	15,0	PRV	1	0	0
3	IM	SP	14,0	WB	1	1	1
4	EWM	TW	20,0	WB	1	0	1
5	IM	SP	8,0	PRV	1	1	1
6	GOM	AS	9,0	WB	1	1	1
7	IM	HV	10,0	WB	0	1	1
8	EWM	SP	15,0	GP	1	1	1
9	IM	HV	5,0	WB	1	1	1
10	GOM	HV	9,0	WB	1	1	1
11	IM	LB	2,0	WB	1	1	1
12	DKR	TW	15,0	WB	1	1	1
13	EWM	BR	15,0	WB	1	0	1
14	IM	SP	18,0	KP	1	1	1
15	IM	AS	21,0	PRV	1	1	1
16	IM	AS	23,0	PRV	1	1	1
17	DKR	AS	13,0	WB	1	1	1
18	GOM	AS	15,0	WB	1	1	1
19	IM	HV	8,0	WB	0	1	1
20	EWM	TW	17,0	WB	1	0	0
21	EWM	SP	11,0	WB	1	1	1
22	GOM	DH	20,0	PRV	1	1	0
23	GOM	DH	3,0	WB	1	1	1
24	GOM	AS	19,0	WB	1	1	1
25	IM	AS	3,0	PRV	0	1	1
26	IM	AS	20,0	PRV	0	1	1
27	IM	SP	20,0	PRV	1	1	1
28	GOM	LB	8,0	GP	0	1	1
29	GOM	DH	10,0	PRV	1	1	1
30	IM	DH	10,0	WB	1	1	1
				Sum	25	26	27

Table 19 - List of respondents and their characteristics

The following three tables show the raw data as extracted from the BWM calculation method. They are divided by the three types of clients; Private, Small-Public, and Large Public.

Resp. Nr	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
1_Prv	0,133	0,211	0,066	0,031	0,036	0,058	0,018	0,006	0,010	0,025	0,042	0,099	0,048	0,017	0,063	0,137
2_Prv	0,087	0,062	0,041	0,017	0,047	0,155	0,093	0,016	0,005	0,012	0,018	0,023	0,026	0,182	0,087	0,130
3_Prv	0,157	0,028	0,067	0,051	0,003	0,032	0,006	0,013	0,076	0,023	0,046	0,008	0,145	0,032	0,072	0,242
4_Prv	0,116	0,200	0,116	0,021	0,015	0,081	0,039	0,058	0,019	0,030	0,013	0,003	0,084	0,056	0,015	0,136
5_Prv	0,033	0,065	0,121	0,019	0,007	0,050	0,019	0,019	0,064	0,019	0,112	0,043	0,095	0,071	0,040	0,222
6_Prv	0,079	0,230	0,158	0,024	0,003	0,011	0,011	0,029	0,038	0,096	0,155	0,015	0,034	0,034	0,009	0,074
7_Prv																
8_Prv	0,085	0,149	0,018	0,034	0,020	0,036	0,010	0,005	0,089	0,236	0,134	0,041	0,041	0,010	0,020	0,071
9_Prv	0,068	0,113	0,034	0,023	0,017	0,110	0,067	0,045	0,014	0,012	0,008	0,062	0,130	0,065	0,023	0,210
10_Prv	0,091	0,204	0,068	0,045	0,018	0,140	0,043	0,058	0,072	0,027	0,125	0,036	0,011	0,017	0,017	0,028
11_Prv	0,086	0,057	0,121	0,036	0,003	0,023	0,008	0,016	0,084	0,053	0,053	0,011	0,135	0,023	0,090	0,203
12_Prv	0,042	0,139	0,056	0,028	0,011	0,053	0,021	0,032	0,090	0,025	0,050	0,012	0,029	0,125	0,062	0,225
13_Prv	0,047	0,111	0,020	0,036	0,024	0,080	0,016	0,008	0,051	0,015	0,025	0,006	0,151	0,027	0,151	0,233
14_Prv	0,015	0,048	0,085	0,024	0,023	0,057	0,014	0,009	0,039	0,077	0,127	0,017	0,034	0,137	0,055	0,240
15_Prv	0,093	0,126	0,017	0,093	0,003	0,027	0,012	0,004	0,118	0,059	0,258	0,027	0,037	0,037	0,008	0,081
16_Prv	0,038	0,350	0,108	0,086	0,008	0,082	0,036	0,022	0,004	0,027	0,041	0,013	0,027	0,103	0,009	0,046
17_Prv	0,145	0,215	0,028	0,097	0,005	0,047	0,028	0,011	0,061	0,046	0,131	0,016	0,023	0,097	0,011	0,038
18_Prv	0,063	0,063	0,021	0,104	0,008	0,056	0,037	0,024	0,069	0,104	0,178	0,025	0,053	0,040	0,022	0,135
19_Prv																
20_Prv	0,044	0,114	0,012	0,066	0,049	0,238	0,098	0,026	0,050	0,031	0,031	0,006	0,015	0,071	0,048	0,101
21_Prv	0,009	0,076	0,045	0,030	0,009	0,038	0,006	0,023	0,106	0,068	0,027	0,012	0,032	0,067	0,169	0,281
22_Prv	0,018	0,027	0,004	0,009	0,022	0,043	0,174	0,071	0,203	0,064	0,128	0,030	0,014	0,055	0,055	0,083
23_Prv	0,069	0,232	0,038	0,138	0,011	0,054	0,091	0,036	0,004	0,014	0,024	0,006	0,089	0,030	0,020	0,148
24_Prv	0,103	0,031	0,062	0,010	0,025	0,085	0,033	0,012	0,056	0,007	0,014	0,017	0,048	0,069	0,114	0,314
25_Prv																
26_Prv																
27_Prv	0,069	0,102	0,046	0,013	0,024	0,048	0,076	0,006	0,066	0,013	0,104	0,048	0,022	0,128	0,051	0,183
28_Prv																
29_Prv	0,042	0,272	0,084	0,112	0,024	0,146	0,087	0,043	0,039	0,010	0,016	0,005	0,038	0,007	0,011	0,064
30_Prv	0,042	0,103	0,016	0,025	0,022	0,223	0,134	0,053	0,031	0,007	0,015	0,049	0,015	0,035	0,088	0,141

Table 20 - Responses of the survey for the private client

Resp. Nr	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
1_S-P	0,144	0,096	0,019	0,048	0,059	0,073	0,059	0,015	0,015	0,015	0,036	0,006	0,126	0,179	0,026	0,084
2_S-P																
3_S-P	0,071	0,248	0,026	0,095	0,009	0,053	0,088	0,026	0,068	0,016	0,027	0,007	0,133	0,038	0,016	0,077
4_S-P																
5_S-P	0,014	0,018	0,062	0,009	0,026	0,248	0,144	0,048	0,037	0,013	0,095	0,028	0,036	0,072	0,022	0,128
6_S-P	0,125	0,280	0,093	0,037	0,008	0,073	0,049	0,033	0,015	0,051	0,114	0,038	0,011	0,051	0,006	0,016
7_S-P	0,120	0,067	0,045	0,027	0,048	0,120	0,217	0,080	0,030	0,045	0,080	0,018	0,011	0,048	0,018	0,027
8_S-P	0,070	0,260	0,140	0,040	0,022	0,075	0,038	0,140	0,019	0,070	0,038	0,011	0,011	0,045	0,005	0,018
9_S-P	0,051	0,085	0,026	0,017	0,019	0,124	0,075	0,050	0,012	0,010	0,006	0,053	0,143	0,072	0,025	0,232
10_S-P	0,118	0,029	0,029	0,074	0,018	0,061	0,010	0,036	0,059	0,123	0,047	0,021	0,027	0,179	0,056	0,113
11_S-P	0,077	0,077	0,122	0,022	0,003	0,018	0,026	0,012	0,040	0,060	0,089	0,010	0,034	0,075	0,101	0,235
12_S-P	0,041	0,068	0,165	0,021	0,010	0,044	0,018	0,075	0,044	0,013	0,026	0,005	0,064	0,106	0,041	0,261
13_S-P																
14_S-P	0,036	0,121	0,014	0,072	0,022	0,193	0,114	0,076	0,016	0,055	0,032	0,006	0,038	0,115	0,016	0,075
15_S-P	0,074	0,111	0,037	0,037	0,006	0,024	0,036	0,058	0,086	0,040	0,189	0,129	0,014	0,021	0,041	0,097
16_S-P	0,011	0,112	0,049	0,030	0,028	0,238	0,102	0,061	0,016	0,045	0,074	0,169	0,015	0,036	0,003	0,009
17_S-P	0,132	0,194	0,088	0,025	0,017	0,143	0,076	0,057	0,035	0,053	0,089	0,018	0,005	0,038	0,009	0,022
18_S-P	0,032	0,048	0,016	0,032	0,032	0,182	0,103	0,103	0,015	0,035	0,106	0,070	0,043	0,043	0,031	0,110
19_S-P	0,024	0,107	0,155	0,107	0,016	0,144	0,064	0,048	0,030	0,013	0,013	0,004	0,017	0,122	0,053	0,080
20_S-P																
21_S-P	0,028	0,191	0,120	0,080	0,012	0,071	0,107	0,036	0,017	0,099	0,066	0,044	0,007	0,025	0,037	0,060
22_S-P	0,021	0,033	0,010	0,005	0,018	0,048	0,149	0,095	0,198	0,029	0,125	0,062	0,016	0,032	0,064	0,095
23_S-P	0,017	0,060	0,009	0,017	0,011	0,115	0,067	0,067	0,045	0,074	0,045	0,009	0,225	0,087	0,024	0,130
24_S-P	0,038	0,101	0,017	0,023	0,066	0,263	0,033	0,110	0,011	0,007	0,040	0,023	0,036	0,054	0,018	0,161
25_S-P	0,105	0,140	0,105	0,035	0,070	0,099	0,047	0,015	0,063	0,042	0,105	0,021	0,072	0,016	0,027	0,040
26_S-P	0,032	0,078	0,019	0,007	0,029	0,172	0,286	0,086	0,141	0,033	0,033	0,019	0,009	0,038	0,004	0,015
27_S-P	0,041	0,166	0,041	0,025	0,024	0,258	0,064	0,107	0,019	0,019	0,046	0,007	0,013	0,030	0,022	0,116
28_S-P	0,010	0,067	0,031	0,047	0,004	0,017	0,024	0,011	0,077	0,097	0,260	0,045	0,020	0,193	0,030	0,067
29_S-P	0,084	0,226	0,050	0,126	0,023	0,141	0,085	0,042	0,028	0,012	0,065	0,041	0,011	0,038	0,006	0,023
30_S-P	0,069	0,118	0,027	0,011	0,005	0,011	0,027	0,044	0,168	0,067	0,037	0,281	0,008	0,016	0,040	0,070

Table 21 - Responses of the survey for the small-public client

Resp. Nr	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16
1_L-P	0,094	0,069	0,046	0,016	0,061	0,086	0,016	0,061	0,026	0,006	0,035	0,017	0,128	0,128	0,032	0,176
2_L-P																
3_L-P	0,084	0,221	0,126	0,038	0,015	0,129	0,077	0,077	0,022	0,044	0,074	0,009	0,043	0,012	0,006	0,024
4_L-P	0,104	0,174	0,104	0,046	0,071	0,118	0,047	0,071	0,009	0,034	0,015	0,003	0,060	0,060	0,024	0,060
5_L-P	0,038	0,063	0,162	0,023	0,008	0,063	0,036	0,036	0,022	0,006	0,054	0,013	0,079	0,079	0,040	0,278
6_L-P	0,047	0,093	0,128	0,017	0,040	0,060	0,010	0,080	0,101	0,033	0,061	0,234	0,006	0,022	0,051	0,016
7_L-P	0,120	0,080	0,217	0,048	0,018	0,045	0,080	0,030	0,120	0,045	0,067	0,027	0,027	0,011	0,018	0,048
8_L-P	0,039	0,251	0,068	0,135	0,008	0,028	0,014	0,052	0,148	0,023	0,080	0,040	0,016	0,009	0,032	0,059
9_L-P	0,026	0,044	0,013	0,009	0,012	0,077	0,047	0,031	0,077	0,064	0,041	0,336	0,067	0,034	0,012	0,109
10_L-P	0,016	0,063	0,063	0,109	0,163	0,033	0,033	0,022	0,102	0,045	0,034	0,068	0,056	0,021	0,056	0,116
11_L-P	0,058	0,058	0,090	0,011	0,024	0,016	0,034	0,007	0,013	0,071	0,109	0,024	0,026	0,095	0,143	0,222
12_L-P	0,025	0,045	0,141	0,061	0,018	0,009	0,018	0,045	0,089	0,027	0,054	0,012	0,120	0,080	0,053	0,201
13_L-P	0,091	0,072	0,189	0,033	0,022	0,130	0,030	0,049	0,020	0,033	0,086	0,015	0,066	0,016	0,033	0,115
14_L-P	0,013	0,076	0,034	0,050	0,020	0,046	0,029	0,008	0,069	0,139	0,231	0,026	0,047	0,123	0,018	0,071
15_L-P	0,079	0,118	0,202	0,056	0,018	0,027	0,042	0,004	0,081	0,023	0,128	0,041	0,012	0,054	0,027	0,089
16_L-P	0,011	0,104	0,067	0,045	0,020	0,007	0,075	0,033	0,044	0,174	0,284	0,070	0,012	0,036	0,004	0,015
17_L-P	0,141	0,193	0,094	0,026	0,022	0,121	0,052	0,078	0,047	0,031	0,085	0,019	0,006	0,046	0,016	0,024
18_L-P	0,009	0,037	0,024	0,024	0,021	0,099	0,068	0,068	0,020	0,069	0,069	0,098	0,096	0,043	0,096	0,160
19_L-P	0,035	0,057	0,276	0,113	0,010	0,084	0,025	0,035	0,010	0,004	0,016	0,028	0,094	0,018	0,038	0,157
20_L-P																
21_L-P	0,108	0,108	0,195	0,043	0,056	0,121	0,083	0,013	0,042	0,017	0,026	0,005	0,029	0,010	0,057	0,086
22_L-P																
23_L-P	0,144	0,050	0,050	0,015	0,010	0,076	0,034	0,052	0,190	0,063	0,085	0,127	0,007	0,013	0,026	0,056
24_L-P	0,063	0,113	0,042	0,025	0,019	0,051	0,009	0,029	0,189	0,042	0,070	0,105	0,020	0,065	0,044	0,115
25_L-P	0,100	0,100	0,040	0,180	0,066	0,103	0,044	0,012	0,063	0,042	0,104	0,016	0,039	0,068	0,013	0,008
26_L-P	0,034	0,034	0,089	0,015	0,008	0,059	0,024	0,012	0,060	0,021	0,045	0,133	0,216	0,133	0,028	0,089
27_L-P	0,115	0,161	0,115	0,046	0,019	0,029	0,010	0,013	0,018	0,058	0,087	0,133	0,044	0,094	0,014	0,044
28_L-P	0,104	0,069	0,035	0,010	0,044	0,231	0,165	0,082	0,100	0,012	0,070	0,035	0,003	0,025	0,004	0,011
29_L-P	0,100	0,185	0,057	0,100	0,040	0,074	0,040	0,023	0,055	0,020	0,030	0,012	0,063	0,113	0,025	0,063
30_L-P	0,047	0,200	0,129	0,086	0,022	0,011	0,034	0,008	0,013	0,035	0,085	0,052	0,013	0,055	0,082	0,128

Table 22 - Responses of the survey for the large-public client

Table 23 - SPSS Factor Analysis Output Correlation Coefficients

Correlation Matrix[a,b]

Correlation

	F1_avg	F2_avg	F3_avg	F4_avg	F5_avg	F6_avg	F7_avg	F8_avg	F9_avg	F10_avg	F11_avg	F12_avg	F13_avg	F14_avg	F15_avg	F16_avg
F1_avg	1,000	,246	,108	,036	,047	-,089	-,142	-,157	-,060	-,104	-,086	-,144	-,048	-,090	-,167	-,215
F2_avg	,246	1,000	,122	**,406**	-,120	-,004	-,095	,037	-,275	-,055	-,067	-,163	-,243	-,235	-,381	-,443
F3_avg	,108	,122	1,000	,083	-,100	-,225	-,274	-,102	-,223	-,165	-,115	-,160	-,029	-,168	-,017	,043
F4_avg	,036	**,406**	,083	1,000	,116	-,114	-,143	-,251	-,115	-,033	,016	-,254	-,052	-,059	-,208	-,264
F5_avg	,047	-,120	-,100	,116	1,000	,266	,137	,072	-,087	-,155	-,223	-,061	-,042	-,013	-,007	-,146
F6_avg	-,089	-,004	-,225	-,114	,266	1,000	**,522**	**,512**	-,329	-,355	-,344	-,127	-,145	-,085	-,234	-,201
F7_avg	-,142	-,095	-,274	-,143	,137	**,522**	1,000	**,427**	,070	-,158	-,104	-,104	-,241	-,142	-,222	-,335
F8_avg	-,157	,037	-,102	-,251	,072	**,512**	**,427**	1,000	-,002	-,170	-,211	,023	-,180	-,244	-,303	-,254
F9_avg	-,060	-,275	-,223	-,115	-,087	-,329	,070	-,002	1,000	,157	,239	,288	-,201	-,214	,067	-,117
F10_avg	-,104	-,055	-,165	-,033	-,155	-,355	-,158	-,170	,157	1,000	**,575**	,115	-,181	,002	-,084	-,224
F11_avg	-,086	-,067	-,115	,016	-,223	-,344	-,104	-,211	,239	**,575**	1,000	,047	-,308	,019	-,216	-,273
F12_avg	-,144	-,163	-,160	-,254	-,061	-,127	-,104	,023	,288	,115	,047	1,000	-,098	-,198	-,076	-,185
F13_avg	-,048	-,243	-,029	-,052	-,042	-,145	-,241	-,180	-,201	-,181	-,308	-,098	1,000	,153	,113	**,430**
F14_avg	-,090	-,235	-,168	-,059	-,013	-,085	-,142	-,244	-,214	,002	,019	-,198	,153	1,000	,111	,228
F15_avg	-,167	-,381	-,017	-,208	-,007	-,234	-,222	-,303	,067	-,084	-,216	-,076	,113	,111	1,000	**,672**
F16_avg	-,215	-,443	,043	-,264	-,146	-,201	-,335	-,254	-,117	-,224	-,273	-,185	**,430**	,228	**,672**	1,000

a. Determinant = ,000

b. This matrix is not positive definite.

APPENDIX H: SPSS – ANOVA OUTPUT

Multiple Comparisons

Bonferroni

(J) Type_Client: Private

Dependent Variable	(I) Type_Client	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
F1_avg	Small_Public	-,009957	,011465	1,000	-,03803	,01812
	Large_Public	-,002616	,011361	1,000	-,03044	,02520
F2_avg	Small_Public	-,013773	,020694	1,000	-,06445	,03690
	Large_Public	-,027999	,020505	,529	-,07821	,02222
F3_avg	Small_Public	,000224	,015146	1,000	-,03687	,03731
	Large_Public	,045380*	,015008	,010	,00863	,08213
F4_avg	Small_Public	-,005657	,010527	1,000	-,03144	,02012
	Large_Public	,004324	,010431	1,000	-,02122	,02987
F5_avg	Small_Public	,005744	,006395	1,000	-,00992	,02141
	Large_Public	,014105	,006337	,087	-,00141	,02962
F6_avg	Small_Public	,036854	,017809	,126	-,00676	,08047
	Large_Public	-,007317	,017647	1,000	-,05053	,03590
F7_avg	Small_Public	,033917*	,013514	,043	,00082	,06701
	Large_Public	-,003514	,013391	1,000	-,03631	,02928
F8_avg	Small_Public	,033090*	,007552	,000	,01460	,05158
	Large_Public	,012416	,007483	,304	-,00591	,03074
F9_avg	Small_Public	-,008183	,013638	1,000	-,04158	,02521
	Large_Public	,006578	,013513	1,000	-,02651	,03967
F10_avg	Small_Public	-,000255	,011094	1,000	-,02742	,02691
	Large_Public	-,000140	,010993	1,000	-,02706	,02678
F11_avg	Small_Public	-,002526	,016915	1,000	-,04395	,03890
	Large_Public	,003787	,016760	1,000	-,03726	,04483
F12_avg	Small_Public	,018925	,016565	,771	-,02164	,05949
	Large_Public	,037727	,016414	,073	-,00247	,07792
F13_avg	Small_Public	-,011122	,013739	1,000	-,04477	,02252
	Large_Public	-,003337	,013614	1,000	-,03667	,03000
F14_avg	Small_Public	,006556	,012772	1,000	-,02472	,03783
	Large_Public	-,007180	,012655	1,000	-,03817	,02381
F15_avg	Small_Public	-,023891*	,009396	,039	-,04690	-,00088
	Large_Public	-,015691	,009311	,288	-,03849	,00711
F16_avg	Small_Public	-,059945*	,020524	,014	-,11021	-,00968
	Large_Public	-,056523*	,020337	,021	-,10633	-,00672

*. The mean difference is significant at the 0.05 level.

Table 24 - SPSS ANOVA Output for private client

Multiple Comparisons

Bonferroni

(J) Type_Client: Small_Public

Dependent Variable	(I) Type_Client	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
F1_avg	Private	,009957	,011465	1,000	-,01812	,03803
	Large_Public	,007341	,011247	1,000	-,02020	,03488
F2_avg	Private	,013773	,020694	1,000	-,03690	,06445
	Large_Public	-,014226	,020299	1,000	-,06394	,03548
F3_avg	Private	-,000224	,015146	1,000	-,03731	,03687
	Large_Public	,045156*	,014857	,010	,00877	,08154
F4_avg	Private	,005657	,010527	1,000	-,02012	,03144
	Large_Public	,009982	,010327	1,000	-,01531	,03527
F5_avg	Private	-,005744	,006395	1,000	-,02141	,00992
	Large_Public	,008361	,006273	,560	-,00700	,02372
F6_avg	Private	-,036854	,017809	,126	-,08047	,00676
	Large_Public	-,044171*	,017470	,041	-,08695	-,00139
F7_avg	Private	-,033917*	,013514	,043	-,06701	-,00082
	Large_Public	-,037431*	,013257	,018	-,06989	-,00497
F8_avg	Private	-,033090*	,007552	,000	-,05158	-,01460
	Large_Public	-,020674*	,007408	,020	-,03881	-,00253
F9_avg	Private	,008183	,013638	1,000	-,02521	,04158
	Large_Public	,014761	,013378	,820	-,01800	,04752
F10_avg	Private	,000255	,011094	1,000	-,02691	,02742
	Large_Public	,000115	,010883	1,000	-,02653	,02677
F11_avg	Private	,002526	,016915	1,000	-,03890	,04395
	Large_Public	,006313	,016592	1,000	-,03432	,04694
F12_avg	Private	-,018925	,016565	,771	-,05949	,02164
	Large_Public	,018802	,016250	,753	-,02099	,05859
F13_avg	Private	,011122	,013739	1,000	-,02252	,04477
	Large_Public	,007785	,013477	1,000	-,02522	,04079
F14_avg	Private	-,006556	,012772	1,000	-,03783	,02472
	Large_Public	-,013736	,012528	,829	-,04442	,01694
F15_avg	Private	,023891*	,009396	,039	,00088	,04690
	Large_Public	,008200	,009217	1,000	-,01437	,03077
F16_avg	Private	,059945*	,020524	,014	,00968	,11021
	Large_Public	,003422	,020133	1,000	-,04588	,05272

*. The mean difference is significant at the 0.05 level.

Table 25 - SPSS ANOVA Output for small-public client

Multiple Comparisons

Bonferroni

(J) Type_Client: Large_Public

Dependent Variable	(I) Type_Client	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
F1_avg	Private	,002616	,011361	1,000	-,02520	,03044
	Small_Public	-,007341	,011247	1,000	-,03488	,02020
F2_avg	Private	,027999	,020505	,529	-,02222	,07821
	Small_Public	,014226	,020299	1,000	-,03548	,06394
F3_avg	Private	-,045380*	,015008	,010	-,08213	-,00863
	Small_Public	-,045156*	,014857	,010	-,08154	-,00877
F4_avg	Private	-,004324	,010431	1,000	-,02987	,02122
	Small_Public	-,009982	,010327	1,000	-,03527	,01531
F5_avg	Private	-,014105	,006337	,087	-,02962	,00141
	Small_Public	-,008361	,006273	,560	-,02372	,00700
F6_avg	Private	,007317	,017647	1,000	-,03590	,05053
	Small_Public	,044171*	,017470	,041	,00139	,08695
F7_avg	Private	,003514	,013391	1,000	-,02928	,03631
	Small_Public	,037431*	,013257	,018	,00497	,06989
F8_avg	Private	-,012416	,007483	,304	-,03074	,00591
	Small_Public	,020674*	,007408	,020	,00253	,03881
F9_avg	Private	-,006578	,013513	1,000	-,03967	,02651
	Small_Public	-,014761	,013378	,820	-,04752	,01800
F10_avg	Private	,000140	,010993	1,000	-,02678	,02706
	Small_Public	-,000115	,010883	1,000	-,02677	,02653
F11_avg	Private	-,003787	,016760	1,000	-,04483	,03726
	Small_Public	-,006313	,016592	1,000	-,04694	,03432
F12_avg	Private	-,037727	,016414	,073	-,07792	,00247
	Small_Public	-,018802	,016250	,753	-,05859	,02099
F13_avg	Private	,003337	,013614	1,000	-,03000	,03667
	Small_Public	-,007785	,013477	1,000	-,04079	,02522
F14_avg	Private	,007180	,012655	1,000	-,02381	,03817
	Small_Public	,013736	,012528	,829	-,01694	,04442
F15_avg	Private	,015691	,009311	,288	-,00711	,03849
	Small_Public	-,008200	,009217	1,000	-,03077	,01437
F16_avg	Private	,056523*	,020337	,021	,00672	,10633
	Small_Public	-,003422	,020133	1,000	-,05272	,04588

*. The mean difference is significant at the 0.05 level.

Table 26 - SPSS ANOVA Output for large-public client

APPENDIX I: DISCUSSING THE CHARACTERISTICS OF RESPONDENTS

The final part will discuss the results per *characteristic* of the group of respondents, as introduced in chapter 6.3. The characteristics of the respondents are divided by (1) their *professional background*, (2) their *experience as a project manager*, and (3) their *sector within W+B*. The goal of this part is to discuss the influence of the respondent's characteristics on their perception of the effectiveness of all CQF's. These insights could identify any *explanatory external factors* that are not directly linked to the general ranking of weighted CQF's as judged by the project managers. This could subsequently lead to additional insights and possible future research. Important to notice is that the input is divided per category, which comes down to a list of 3 x 16 = 48 CQF's that have been analysed for significance.

Due to the relative small sample size per characteristic, two non-parametric tests are done, namely the Mann-Whitney Test (chapter 5.4.4.) and the Kruskal Wallis test (chapter 5.4.5.). The only difference between the two is the amount of *independent variables,* or the sub-groups per characteristic that are studied.

Discussing their Professional Background

The company W+B is characterized by a large amount of employees that never had a different employer than W+B. The management approach of a project manager is shaped by their experiences. Their approach would therefore be a good representation of a company's project management culture if that employee had no other previous employer. This makes it interesting to see what the difference is between these project managers and the employees that did have a different previous employer, other than W+B.

To study the effect of their professional background the Mann Whitney Test is performed. The total group of respondents was divided in two sub-groups: the ones who had other previous employees (1: "Other", with 13 respondents), and the ones who have always works for W+B (2: "W+B", with 17 respondents). For these two sub-groups all their weighted CQF's have been analysed in order to locate any significant distribution of the response. Table 32 shows the statistics of the two CQF's that showed a significant loading. This table shows the *client specific CQF*, the level of significance, and the amount of respondents of who the response was eligible for analysis.

Client Specific CQF	Sig. (p < 0,05)	Resp.
F14_Large-Public	0,020	27
F15_Large_Public	0,030	27

Table 27 - Professional Background: Mann Whitney Test SPSS data output

The first CQF that showed a significant different distribution (*p = 0.020*) is **F14_Large-Public** (*competence of client*). Following the results it can be stated that group 1, those who had a different professional background, weighted the influence of a competent large-public client significantly higher than group 2, those who have always worked at W+B. The following figure presents the direct SPSS output, which visualizes the final distribution between the two groups.

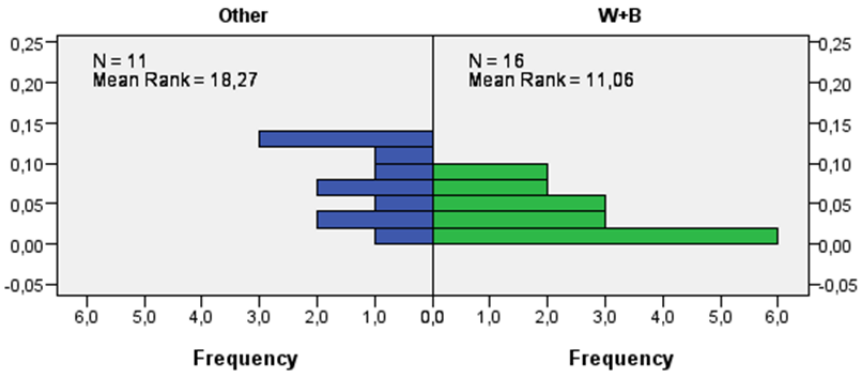


Figure 19 - Mann Whitney Test SPSS Output: F14 Large-Public Client vs. Professional Background

Project managers of a large-public client are usually judged as being competent, but with an exaggerated focus in rules and regulations (chapter 7.1.4.). The fact that sub-group 2 gave a relative low weight to **F14_Large-Public** might be explained by their self-reliant attitude that focusses more on their own capabilities than that of others. This can have an amplifying effect when they have to deal with a client that has a strong focus on rules and regulations. So in this sense it could mean that sub-group 2 gave relative a low weight to **F14_Large-Public** due to their annoyance of this rigid focus during the process of quality management.

The only other client specific CQF that showed a significant distribution (*p = 0.030*) between these two sub-groups is **F15_Large-Public** (*monitoring performances of external parties*). It seemed that sub-group 2 weighted the monitoring of the performance of external parties significantly higher than sub-group 1. The following figure presents the direct SPSS output, which visualizes the final distribution between the two groups.

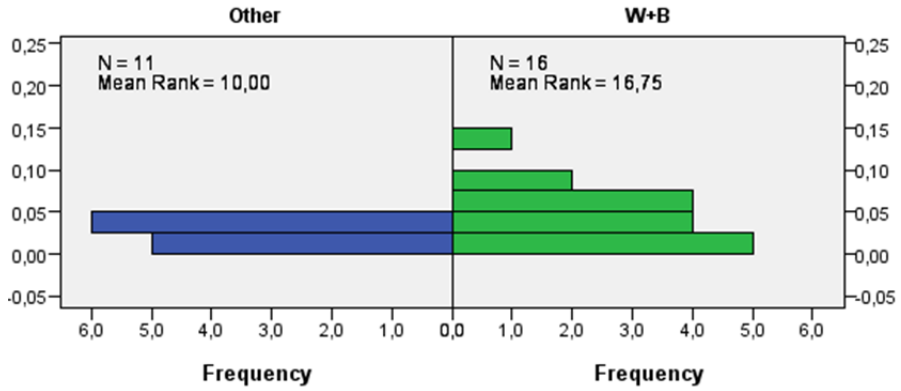


Figure 20 - Mann Whitney Test SPSS Output: F15 Large-Public Client vs. Professional Background

This distribution could be explained by the lack trust that sub-group 2 has in the performances of external parties, especially when dealing with large-public clients. This could be amplified by the knowledge that their own output is checked thoroughly due to the focus on law and regulation of the large-public client. The respondents of sub-group 1 originate from these 'external parties', which could cause their trust, is their performance to be higher and therefore weighted **F15_Large-Public** significantly lower than sub-group 2.

Project Manager Experience

The group of respondents was quite divers when talking about their years of experience as a project manager, which gave a good symmetric representation (chapter 6.3.). Through the years their perception of what an effective process should look like changes due to all sorts of influences. The main idea is that with more experience, a better judgement can be made about this process.

To get to the following results a Kruskal Wallis test was done, which makes it possible to study more than two *independent variables*, which are in this case four sub-groups with different years of experience. It was relatively easy to divide the group in four smaller sub-groups, which are (1) *2 - 8 year experience*, (2) *9 – 13 year experience*, (3) *14 – 20 year experience*, and (4) *18 and more year experience*. Table 33 shows the *client specific CQF*, the level of significance, and the amount of respondents of who the response was eligible for further analysis.

Client specific CQF	Sig. (p < 0,05)	Resp.
F13_Private	0,030	25
F8_Small-Public	0,036	26
F13_Small-Public	0,009	26
F14_Large-Public	0,045	27

Table 28 - Project Manager Experience: Kruskal Wallis SPSS data output

The client specific CQF **F13_Private** (*team mitigation policy*) showed a significant different distribution (*p = 0.030*) according to the SPSS output. Since this test only indicates that a significant distribution exists, and not which group stands out, the visualisation of the output (figure 21) shows the conclusive distribution by comparing the medians. By the look of the box-plot, is shows that group 1 with 2 – 8 years of experience weighted **F13_Private** significantly higher than the other three groups.

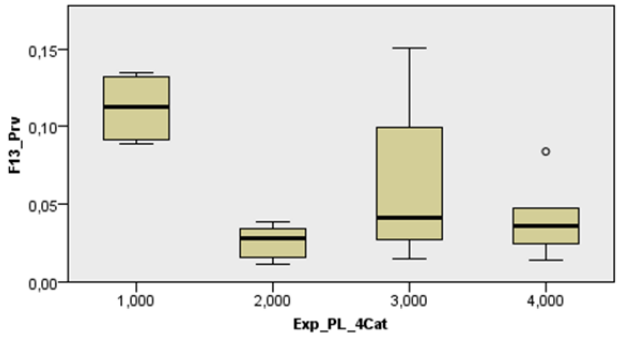


Figure 21 – Kruskal Wallis SPSS Output: F13 Private Client vs. Experience of PM

These results show that the relatively inexperienced project managers feel more for the development of a policy for team mitigation when it concerns a client from a private organization. Three different explanations could be found for this, based on the discussions during the surveys. The first one is that the less experienced project managers (group 1) are used to manage projects with a relatively small scope; more years of experience (group 2, 3, 4) would results in the management of larger projects. And as said before, the effect of a member leaving a small project team (group 1) has more negative consequences than someone leaving a large team (group 2, 3, 4).

The second possible explanation strengthens the assumed explanation as discussed in 7.2.4., in which it was stated that a self-reliant attitude of the project managers could cause them to disregard the effort for a team mitigation policy. This was classified as a *cultural dependent* CQF, of which the effect is amplified the longer someone works within that culture. So according to this line of reasoning the results of this test seems logical. The third explanation could be that at first (the early years) it seems like a sensible and logical plan to develop such a policy, but the more experienced project managers would have found it to be a waste of time.

The client specific CQF **F8_Small-Public** (*Stakeholder commitment during kick-off phase*) showed a significant different distribution (*p = 0.036*) according to the SPSS output. Since this test only indicates that a significant distribution exists, and not which group stands out, the visualisation of the output (figure 22) shows the conclusive distribution by comparing the medians. By the look of the box-plot, is

shows that both group 3, those with 14 – 20 years of experience, and group 4, those with 18+ years of experience, weighted **F8_Small-Public** significantly higher than the other two groups.

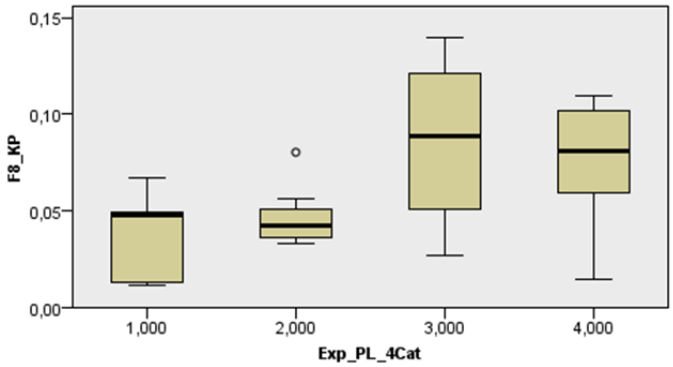


Figure 22 - Kruskal Wallis SPSS Output: F18 Small-Public Client vs. Experience of PM

The results show a significant increase of the weighted CQF for a small-public client, with the amount of project management experience. The small-public client was characterized by the extra effort that has to be done to involve the external stakeholders, compared to the other type of clients. This knowledge is assumed to come by the years, which would explain this particular distribution between the less experiences project managers and the most experienced. This would suggest that the worth of external stakeholders in combination with a small-public client is only uncovered by an experience that would prove this.

The client specific CQF **F13_Small-Public** (*Team mitigation policy*) showed a significant different distribution ($p = 0.009$) according to the SPSS output. Since this test only indicates that a significant distribution exists, and not which group stands out, the visualisation of the output (figure 23) shows the conclusive distribution by comparing the medians. By the look of the box-plot, is shows that both group 1, those with 2 – 8 years of experience, and group 3, those with 14 – 20 years of experience, weighted **F13_Small-Public** significantly higher than the other two groups.

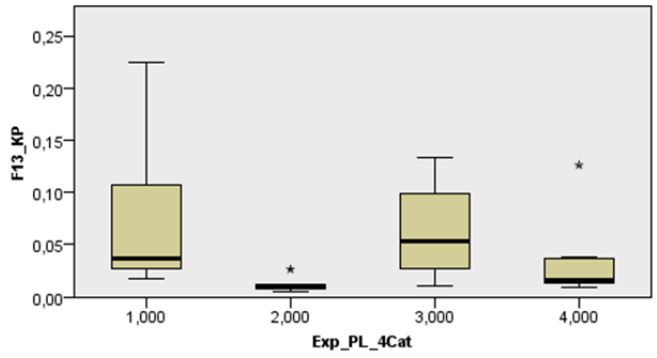


Figure 23 - Kruskal Wallis SPSS Output: F13 Small-Public Client vs. Experience of PM

This particular results shows that at first a mitigation policy seems important (group 1), then it assumed effect is would decrease according to the next group (group 2), then rise again (group 3) and finally fall for the most experienced project managers (group 4).

The client specific CQF **F14_Large-Public** (*Competence of client*) showed a significant different distribution ($p = 0.045$) according to the SPSS output. Since this test only indicates that a significant distribution exists, and not which group stands out, the visualisation of the output (figure 24) shows the conclusive distribution by comparing the medians. By the look of the box-plot, is shows that group 4, those with 18+ years of experience, weighted **F14_Large-Public** significantly higher than the other three groups.

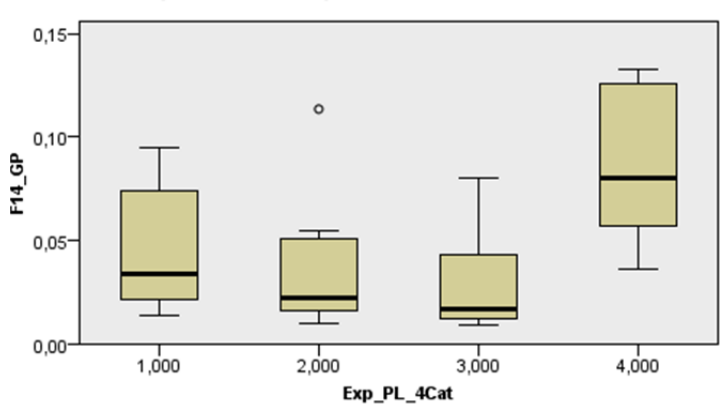


Figure 24 - Kruskal Wallis SPSS Output: F14 Small-Public Client vs. Experience of PM

According to the presented results the most experienced project managers (group 4) judged the competence of a large-public client significantly higher than all other groups. This could be explained by the fact that especially a client of a large-public organization (like RWS) has a strong focus on keeping control of the process, as said during the surveys. The statistical trend of figure 24 can be explained by an acknowledgement of the value of a competent client that is only seen after a significant amount of experience

Sector within W+B

The final characteristic of the project managers is their sector within W+B, which are the following four: (1), *GOM – Built Environment*, (2) *IM – Infrastructure and Mobility*, (3) *DKR – Deltas Coasts and Rivers*, and (4) *EWM – Energy Water and Environment*. These sectors are for a large part autonomous operating business-units, but still have to comply with the standards that have been prescribed by Top Management. Each sector also serves a different industry, which is reflected by the diversity of their project portfolios. For instance, the sector EWM has more to do with private clients than the sector IM,

which is understandable since advice about large infrastructure project is more a concern for the government than it is for private parties. Table 34 shows the *client specific CQF*, the level of significance, and the amount of respondents of who the response was eligible for further analysis.

Client specific CQF	Sig. (< 0,05)	Resp.
F3_Small-Public	0,035	25

Table 29 - Sector within W+B: Kruskal Wallis SPSS data output

The client specific CQF **F3_Small-Public** (*consistent communication guidelines*) showed a significant different distribution (*p = 0.035*) according to the SPSS output. Since this test only indicates that a significant distribution exists, and not which group stands out, the visualisation of the output (figure 25) shows the conclusive distribution by comparing the medians. By the look of the box-plot, is shows that both group 3, those from sector DKR, and group 4, those from sector EWM, weighted **F3_Small-Public** significantly higher than the other two groups.

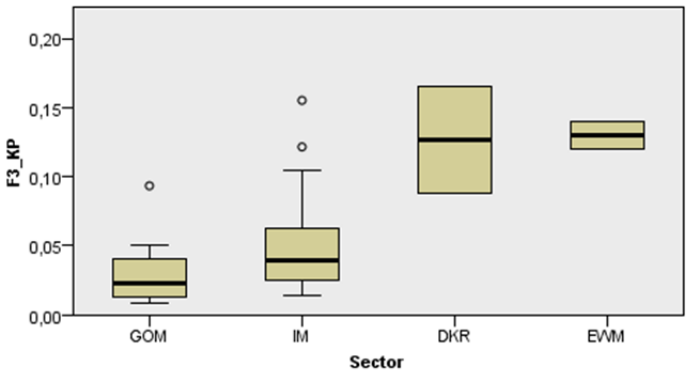


Figure 25 - Kruskal Wallis SPSS Output: F13 Small-Public Client vs. Sector within W+B

The results show a clear split between two groups, which could be related to two explanations belonging to the development of consistent communication guidelines. The first is that a small-public party is usually seen as less competent than both private and large-public parties (this is found independent of their sector), which could results is the arrangement of consistent guidelines to counter the risk of communication errors. The second is that the project managers that have more experience with small-public parties could acknowledge the fact that a more ad-hoc policy is needed since the clients itself usually does not oversee everything, in contrast to the other parties. The latter would best fit the sectors of (1) GOM and (2) IM, which are the parties that mostly work with small-public clients (chapter 6.3.).

Concluding

Besides the differentiation per type of client, the project managers themselves have certain personal preferences related to the CQF's. This paragraph shows the intention to approach a first identification of their preferences by studying their characteristics. These shared characteristics between the project managers are (1) their *professional background*, (2) their *project management experience*, and (3) the *sector within W+B* for which they work. These insights could identify any *explanatory external factors* that are not directly linked to the general ranking of weighted CQF's. The following table shows the CQF's for which the sub-groups within the characteristics gave a significantly different weight.

Influence of Characteristics			
Professional Background			
F14_Large-Public	Different background	**>**	Always worked at W+B
F15_Large_Public	Always worked at W+B	**>**	Different background
Project management Experience			
F13_Private	2-8 year	**>**	9-13 year & 14-20 year & 18+ year
F8_Small-Public	14-20 year & 18+ year	**>**	2-8 year & 9-13 year
F13_Small-Public	2-8 year & 14-20 year	**>**	9-13 year & 18+ year
F14_Large-Public	18+ year	**>**	2-8 year & 9-13 year & 14-20 year
Sector Within W+B			
F3_Small-Public	DKR & EWM	**>**	GOM & IM

APPENDIX J: SPSS: -MANN WHITNEY TEST – PROFESSIONAL BACKGROUND

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of F1_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,338[1]	Retain the null hypothesis.
2	The distribution of F2_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	1,000[1]	Retain the null hypothesis.
3	The distribution of F3_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,892[1]	Retain the null hypothesis.
4	The distribution of F4_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,397[1]	Retain the null hypothesis.
5	The distribution of F5_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,261[1]	Retain the null hypothesis.
6	The distribution of F6_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,849[1]	Retain the null hypothesis.
7	The distribution of F7_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,765[1]	Retain the null hypothesis.
8	The distribution of F8_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,062[1]	Retain the null hypothesis.
9	The distribution of F9_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,935[1]	Retain the null hypothesis.
10	The distribution of F10_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,849[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1]Exact significance is displayed for this test.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
11	The distribution of F11_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,216[1]	Retain the null hypothesis.
12	The distribution of F12_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,071[1]	Retain the null hypothesis.
13	The distribution of F13_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,338[1]	Retain the null hypothesis.
14	The distribution of F14_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,567[1]	Retain the null hypothesis.
15	The distribution of F15_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,311[1]	Retain the null hypothesis.
16	The distribution of F16_Prv is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,216[1]	Retain the null hypothesis.
17	The distribution of F1_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,347[1]	Retain the null hypothesis.
18	The distribution of F2_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,781[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1]Exact significance is displayed for this test.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
19	The distribution of F3_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,667[1]	Retain the null hypothesis.
20	The distribution of F4_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,899[1]	Retain the null hypothesis.
21	The distribution of F5_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,106[1]	Retain the null hypothesis.
22	The distribution of F6_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,432[1]	Retain the null hypothesis.
23	The distribution of F7_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,322[1]	Retain the null hypothesis.
24	The distribution of F8_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,667[1]	Retain the null hypothesis.
25	The distribution of F9_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,432[1]	Retain the null hypothesis.
26	The distribution of F10_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,631[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1]Exact significance is displayed for this test.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
27	The distribution of F11_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,252[1]	Retain the null hypothesis.
28	The distribution of F12_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,631[1]	Retain the null hypothesis.
29	The distribution of F13_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,742[1]	Retain the null hypothesis.
30	The distribution of F14_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,374[1]	Retain the null hypothesis.
31	The distribution of F15_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,176[1]	Retain the null hypothesis.
32	The distribution of F16_KP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,131[1]	Retain the null hypothesis.
33	The distribution of F1_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,790[1]	Retain the null hypothesis.
34	The distribution of F2_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,512[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Exact significance is displayed for this test.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
35	The distribution of F3_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,212[1]	Retain the null hypothesis.
36	The distribution of F4_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,544[1]	Retain the null hypothesis.
37	The distribution of F5_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,645[1]	Retain the null hypothesis.
38	The distribution of F6_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,422[1]	Retain the null hypothesis.
39	The distribution of F7_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,610[1]	Retain the null hypothesis.
40	The distribution of F8_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,272[1]	Retain the null hypothesis.
41	The distribution of F9_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,716[1]	Retain the null hypothesis.
42	The distribution of F10_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,251[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1] Exact significance is displayed for this test.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
43	The distribution of F11_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,178[1]	Retain the null hypothesis.
44	The distribution of F12_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,904[1]	Retain the null hypothesis.
45	The distribution of F13_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,865[1]	Retain the null hypothesis.
46	The distribution of F14_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,020[1]	Reject the null hypothesis.
47	The distribution of F15_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,030[1]	Reject the null hypothesis.
48	The distribution of F16_GP is the same across categories of TypeOG_VoorWB.	Independent-Samples Mann-Whitney U Test	,251[1]	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

[1]Exact significance is displayed for this test.

Table 30 - SPSS Mann Whitney Output for Professional Background of Respondents

APPENDIX K: SPSS - KRUSKAL WALLIS : PROJECT MANAGEMENT EXPERIENCE

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of F1_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,952	Retain the null hypothesis.
2	The distribution of F2_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,339	Retain the null hypothesis.
3	The distribution of F3_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,331	Retain the null hypothesis.
4	The distribution of F4_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,379	Retain the null hypothesis.
5	The distribution of F5_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,349	Retain the null hypothesis.
6	The distribution of F6_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,930	Retain the null hypothesis.
7	The distribution of F7_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,984	Retain the null hypothesis.
8	The distribution of F8_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,253	Retain the null hypothesis.
9	The distribution of F9_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,783	Retain the null hypothesis.
10	The distribution of F10_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,772	Retain the null hypothesis.
11	The distribution of F11_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,847	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
12	The distribution of F12_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,675	Retain the null hypothesis.
13	The distribution of F13_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,030	Reject the null hypothesis.
14	The distribution of F14_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,500	Retain the null hypothesis.
15	The distribution of F15_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,599	Retain the null hypothesis.
16	The distribution of F16_Prv is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,289	Retain the null hypothesis.
17	The distribution of F1_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,094	Retain the null hypothesis.
18	The distribution of F2_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,298	Retain the null hypothesis.
19	The distribution of F3_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,139	Retain the null hypothesis.
20	The distribution of F4_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,532	Retain the null hypothesis.
21	The distribution of F5_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,360	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
22	The distribution of F6_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,451	Retain the null hypothesis.
23	The distribution of F7_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,677	Retain the null hypothesis.
24	The distribution of F8_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,036	Reject the null hypothesis.
25	The distribution of F9_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,925	Retain the null hypothesis.
26	The distribution of F10_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,281	Retain the null hypothesis.
27	The distribution of F11_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,652	Retain the null hypothesis.
28	The distribution of F12_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,535	Retain the null hypothesis.
29	The distribution of F13_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,009	Reject the null hypothesis.
30	The distribution of F14_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,335	Retain the null hypothesis.
31	The distribution of F15_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,493	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
32	The distribution of F16_KP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,154	Retain the null hypothesis.
33	The distribution of F1_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,444	Retain the null hypothesis.
34	The distribution of F2_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,102	Retain the null hypothesis.
35	The distribution of F3_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,462	Retain the null hypothesis.
36	The distribution of F4_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,363	Retain the null hypothesis.
37	The distribution of F5_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,255	Retain the null hypothesis.
38	The distribution of F6_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,505	Retain the null hypothesis.
39	The distribution of F7_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,429	Retain the null hypothesis.
40	The distribution of F8_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,243	Retain the null hypothesis.
41	The distribution of F9_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,912	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
42	The distribution of F10_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,912	Retain the null hypothesis.
43	The distribution of F11_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,548	Retain the null hypothesis.
44	The distribution of F12_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,588	Retain the null hypothesis.
45	The distribution of F13_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,349	Retain the null hypothesis.
46	The distribution of F14_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,045	Reject the null hypothesis.
47	The distribution of F15_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,384	Retain the null hypothesis.
48	The distribution of F16_GP is the same across categories of Exp_PL_4Cat.	Independent-Samples Kruskal-Wallis Test	,774	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 31 - SPSS Kruskal Wallis Output for Project management Experience of Respondents

APPENDIX L: SPSS - KRUSKAL WALLIS: SECTOR WITHIN W+B

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of F1_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,876	Retain the null hypothesis.
2	The distribution of F2_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,827	Retain the null hypothesis.
3	The distribution of F3_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,532	Retain the null hypothesis.
4	The distribution of F4_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,948	Retain the null hypothesis.
5	The distribution of F5_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,628	Retain the null hypothesis.
6	The distribution of F6_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,944	Retain the null hypothesis.
7	The distribution of F7_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,378	Retain the null hypothesis.
8	The distribution of F8_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,170	Retain the null hypothesis.
9	The distribution of F9_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,934	Retain the null hypothesis.
10	The distribution of F10_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,549	Retain the null hypothesis.
11	The distribution of F11_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,806	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
12	The distribution of F12_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,134	Retain the null hypothesis.
13	The distribution of F13_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,454	Retain the null hypothesis.
14	The distribution of F14_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,064	Retain the null hypothesis.
15	The distribution of F15_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,640	Retain the null hypothesis.
16	The distribution of F16_Prv is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,477	Retain the null hypothesis.
17	The distribution of F1_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,719	Retain the null hypothesis.
18	The distribution of F2_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,201	Retain the null hypothesis.
19	The distribution of F3_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,035	Reject the null hypothesis.
20	The distribution of F4_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,435	Retain the null hypothesis.
21	The distribution of F5_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,773	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
22	The distribution of F6_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,880	Retain the null hypothesis.
23	The distribution of F7_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,665	Retain the null hypothesis.
24	The distribution of F8_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,854	Retain the null hypothesis.
25	The distribution of F9_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,810	Retain the null hypothesis.
26	The distribution of F10_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,220	Retain the null hypothesis.
27	The distribution of F11_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,281	Retain the null hypothesis.
28	The distribution of F12_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,279	Retain the null hypothesis.
29	The distribution of F13_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,248	Retain the null hypothesis.
30	The distribution of F14_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,565	Retain the null hypothesis.
31	The distribution of F15_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,948	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
32	The distribution of F16_KP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,575	Retain the null hypothesis.
33	The distribution of F1_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,692	Retain the null hypothesis.
34	The distribution of F2_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,434	Retain the null hypothesis.
35	The distribution of F3_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,124	Retain the null hypothesis.
36	The distribution of F4_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,655	Retain the null hypothesis.
37	The distribution of F5_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,334	Retain the null hypothesis.
38	The distribution of F6_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,347	Retain the null hypothesis.
39	The distribution of F7_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,991	Retain the null hypothesis.
40	The distribution of F8_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,080	Retain the null hypothesis.
41	The distribution of F9_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,110	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
42	The distribution of F10_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,612	Retain the null hypothesis.
43	The distribution of F11_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,451	Retain the null hypothesis.
44	The distribution of F12_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,052	Retain the null hypothesis.
45	The distribution of F13_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,688	Retain the null hypothesis.
46	The distribution of F14_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,136	Retain the null hypothesis.
47	The distribution of F15_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,583	Retain the null hypothesis.
48	The distribution of F16_GP is the same across categories of Sector.	Independent-Samples Kruskal-Wallis Test	,943	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is ,05.

Table 32 - SPSS Kruskal Wallis Output for Sector within W+B of Respondents

Enquête Kwaliteitsmanagement

Inleiding

Terry DP van Roode [ROOT2]
TU Delft - MSc Construction Management & Engineering

Datum: _____
Tijd: _____
Respondent: _____
Locatie: _____

Het onderzoek in het kort

Voor dit onderzoek heb ik toegang gekregen tot 43 interne- en externe projectevaluaties van verschillende type projecten. De meest opvallende elementen die een significant effect hebben gehad op het kwaliteitsmanagement proces zijn hieruit gefilterd en vervolgens geclusterd. Deze elementen zijn herkend als zogenaamde 'kwaliteitsfactoren'. Hiernaast heb ik een literatuuronderzoek gedaan als aanvulling op de lessen uit de praktijk. Vanuit beide onderzoeken is een enkele set van 16 kwaliteitsfactoren gekomen. Buiten deze factoren om is opgevallen dat elk type opdrachtgever een andere aanpak vraagt. De opdrachtgevers zijn verdeeld in drie groepen, namelijk (1) Privaat (aannemer/private org/semi-publiek/etc.), (2) Klein-publiek (gemeente/waterschap/provincie/etc.), en (3) Groot-publiek (RWS/Ministeries). Per groep wil ik onderzoeken welke factoren een significant effect hebben gehad op het proces, om uiteindelijk een referentiekader te vormen die in toekomstige projecten kan worden gebruikt voor een vroegtijdig ontwerp van het kwaliteitsmanagement proces.

Kwaliteitsfactoren begrippenlijst

	Beschrijving
C1 Openheid en Communicatie	
F1: Directe interactie – Intern	Dit betreft alle vormen van interactie tussen de teamleden (incl. PM) van een enkele partij.
F2: Directe interactie – Extern	Dit betreft alle vormen van interactie tussen de interne teamleden en de klant.
F3: Consistente communicatie richtlijnen	Het ontwerpen en controleren van richtlijnen ter bevordering van gestructureerde communicatie stromen.
F4: Review & acceptatie van tekortkomingen/fouten	Het presenteren en bespreken van gemaakte fouten en/of tekortkomingen met de betrokken externe partijen.
C2 Betrokkenheid	
F5: Topmanagement ondersteuning	Het ondersteunende vermogen en de actieve betrokkenheid van het topmanagement voor een specifiek project.
F6: Inzicht in project significantie/visie klant	Het actief nastreven van begrip voor de siginficantie van het project en daarmee de visie van de klant.
F7: Betrokken klant met mandaat	Het actief betrokken zijn (van een vertegenwoordiger) van de klant met mandaat.
F8: Stakeholder commitment (in de start fase)	Het actief betrokken zijn van stakeholders bij het project, waarbij voornamelijk de startfase wordt bedoeld.
C3 Voorspelbaarheid	
F9: Project conceptualisatie	Het prioritiseren van activiteiten die bijdragen aan kwaliteit, boven budget en/of planning.
F10: Afstemming verwachting inkomende informatie	Verwachtingen afstemmen van het projectteam over informatie geleverd door de klant.
F11: Afstemming verwachting uitgaande informatie	Verwachtingen afstemmen van de klant over informatie geleverd door het projectteam.
F12: Politieke-/Sociaal economische stabiliteit	Het bevorderen van een stabiele werkomgeving, zowel op individueel- als op organisatorisch niveau.
C4 Bekwaamheid	
F13: Project-team mitigatiebeleid	Het effect van wisselende teamleden controleren en opvangen door het ontwerpen van mitigatiebeleid.
F14: Competente Klant	De bijdrage van de klant door middel van het voldoen aan de gestelde verantwoordelijkheden.
F15: Prestaties monitoren van externe partijen	Het controleren van externe prestaties die van invloed kunnen zijn op het afgesproken kwaliteitsniveau.
F16: Gekwalificeerde project team leden	Het selecteren van gekwalificeerde teamleden die in staat zijn om te kunnen voldoen aan de gestelde kwaliteitseisen.

Op de volgende drie pagina's worden de drie groepen opdrachtgevers gepresenteerd. Per opdrachtgever zijn de vragen identiek aan elkaar. Om deze survey zo effectief mogelijk te maken wordt gevraagd om een zo goed mogelijke inbeelding te maken van de opdrachtgever aan de hand van uw ervaring als PL. Het gaat erom hoe u de kwaliteitsfactoren beoordeelt in het geval u te maken krijgt met één van deze type opdrachtgevers.

Enquête Kwaliteitsmanagement

Opdrachtgever: Privaat

Terry DP van Roode [ROOT2]
TU Delft - MSc Construction Management & Engineering

Datum: _____
Tijd: _____
Respondent: _____
Locatie: _____

De opdracht

Voer eerst de stappen uit voor de kwaliteitsfactoren (per cluster) en doorloop de stappen vervolgens nogmaals voor een vergelijking van de clusters. Het doel van deze enquête is om tot een totale rangschikking te komen van kwaliteitsfactoren.

STAP 1: Geef een 1 aan het element dat het MEEST belangrijk wordt geacht = Fmax/Cmax

'Een toename van [Fmax/Cmax] heeft het meest positieve effect op de kwaliteit van projecten.'

STAP 2: Geef per element aan hoe de MEEST belangrijke factor wordt beoordeeld t.o.v. deze.

'Een toename van [Fmax/Cmax] waardeer ik [1-9] ten opzichte van [Fn/Cn].'

STAP 3: Geef een 1 aan het element dat het MINST belangrijk wordt geacht = Fmin/Cmin

'Een toename van [Fmin/Cmin] heeft het minst positieve effect op de kwaliteit van projecten.'

STAP 4: Geef per factor aan hoe belangrijk deze factor is t.o.v. de MINSTE.

'Een toename van [Fn/Cn] waardeer ik [1-9] ten opzichte van [Fmin/Cmin].'

Gebruik enkel de cijfers 1 - 9

Kwaliteitsfactoren waarderen

		Stap 1 & 2	Stap 3 & 4
C1	**Openheid en Communicatie**		
	F1: Directe interactie – Intern	[ ]	[ ]
	F2: Directe interactie – Extern	[ ]	[ ]
	F3: Consistente communicatie richtlijnen	[ ]	[ ]
	F4: Review & acceptatie van tekortkomingen/fouten	[ ]	[ ]
C2	**Betrokkenheid**		
	F5: Topmanagement ondersteuning	[ ]	[ ]
	F6: Inzicht in project significantie/visie klant	[ ]	[ ]
	F7: Betrokken klant met mandaat	[ ]	[ ]
	F8: Stakeholdercommitment (in de startfase)	[ ]	[ ]
C3	**Voorspelbaarheid**		
	F9: Projectconceptualisatie	[ ]	[ ]
	F10: Afstemming verwachting inkomende informatie	[ ]	[ ]
	F11: Afstemming verwachting uitgaande informatie	[ ]	[ ]
	F12: Politieke-/Sociaal economische stabiliteit	[ ]	[ ]
C4	**Bekwaamheid**		
	F13: Projectteam mitigatiebeleid	[ ]	[ ]
	F14: Competente Klant	[ ]	[ ]
	F15: Prestaties monitoren van externe partijen	[ ]	[ ]
	F16: Gekwalificeerde project teamleden	[ ]	[ ]

Clusters waarderen

C1	Openheid en Communicatie	[ ]	[ ]
C2	Betrokkenheid	[ ]	[ ]
C3	Voorspelbaarheid	[ ]	[ ]
C4	Bekwaamheid	[ ]	[ ]

Enquête Kwaliteitsmanagement

Opdrachtgever: Klein-Publiek

Terry DP van Roode [ROOT2]
TU Delft - MSc Construction Management & Engineering

Datum: _____
Tijd: _____
Respondent: _____
Locatie: _____

De opdracht

Voer eerst de stappen uit voor de kwaliteitsfactoren (per cluster) en doorloop de stappen vervolgens nogmaals voor een vergelijking van de clusters. Het doel van deze enquête is om tot een totale rangschikking te komen van kwaliteitsfactoren.

STAP 1: Geef een 1 aan het element dat het MEEST belangrijk wordt geacht = Fmax/Cmax

'Een toename van [Fmax/Cmax] heeft het meest positieve effect op de kwaliteit van projecten.'

STAP 2: Geef per element aan hoe de MEEST belangrijke factor wordt beoordeeld t.o.v. deze.

'Een toename van [Fmax/Cmax] waardeer ik [1-9] ten opzichte van [Fn/Cn].'

STAP 3: Geef een 1 aan het element dat het MINST belangrijk wordt geacht = Fmin/Cmin

'Een toename van [Fmin/Cmin] heeft het minst positieve effect op de kwaliteit van projecten.'

STAP 4: Geef per factor aan hoe belangrijk deze factor is t.o.v. de MINSTE.

'Een toename van [Fn/Cn] waardeer ik [1-9] ten opzichte van [Fmin/Cmin].'

Gebruik enkel de cijfers 1 - 9

Kwaliteitsfactoren waarderen

		Stap 1 & 2	Stap 3 & 4
C1	**Openheid en Communicatie**		
	F1: Directe interactie – Intern	[ ]	[ ]
	F2: Directe interactie – Extern	[ ]	[ ]
	F3: Consistente communicatie richtlijnen	[ ]	[ ]
	F4: Review & acceptatie van tekortkomingen/fouten	[ ]	[ ]
C2	**Betrokkenheid**		
	F5: Topmanagement ondersteuning	[ ]	[ ]
	F6: Inzicht in project significantie/visie klant	[ ]	[ ]
	F7: Betrokken klant met mandaat	[ ]	[ ]
	F8: Stakeholdercommitment (in de startfase)	[ ]	[ ]
C3	**Voorspelbaarheid**		
	F9: Projectconceptualisatie	[ ]	[ ]
	F10: Afstemming verwachting inkomende informatie	[ ]	[ ]
	F11: Afstemming verwachting uitgaande informatie	[ ]	[ ]
	F12: Politieke-/Sociaal economische stabiliteit	[ ]	[ ]
C4	**Bekwaamheid**		
	F13: Projectteam mitigatiebeleid	[ ]	[ ]
	F14: Competente Klant	[ ]	[ ]
	F15: Prestaties monitoren van externe partijen	[ ]	[ ]
	F16: Gekwalificeerde project teamleden	[ ]	[ ]

Clusters waarderen

C1	Openheid en Communicatie	[ ]	[ ]
C2	Betrokkenheid	[ ]	[ ]
C3	Voorspelbaarheid	[ ]	[ ]
C4	Bekwaamheid	[ ]	[ ]

Enquête Kwaliteitsmanagement

Opdrachtgever: Groot-Publiek

Terry DP van Roode [ROOT2]
TU Delft - MSc Construction Management & Engineering

Datum: _____
Tijd: _____
Respondent: _____
Locatie: _____

De opdracht

Voer eerst de stappen uit voor de kwaliteitsfactoren (per cluster) en doorloop de stappen vervolgens nogmaals voor een vergelijking van de clusters. Het doel van deze enquête is om tot een totale rangschikking te komen van kwaliteitsfactoren.

STAP 1: Geef een 1 aan het element dat het MEEST belangrijk wordt geacht = Fmax/Cmax

'Een toename van [Fmax/Cmax] heeft het meest positieve effect op de kwaliteit van projecten.'

STAP 2: Geef per element aan hoe de MEEST belangrijke factor wordt beoordeeld t.o.v. deze.

'Een toename van [Fmax/Cmax] waardeer ik [1-9] ten opzichte van [Fn/Cn].'

STAP 3: Geef een 1 aan het element dat het MINST belangrijk wordt geacht = Fmin/Cmin

'Een toename van [Fmin/Cmin] heeft het minst positieve effect op de kwaliteit van projecten.'

STAP 4: Geef per factor aan hoe belangrijk deze factor is t.o.v. de MINSTE.

'Een toename van [Fn/Cn] waardeer ik [1-9] ten opzichte van [Fmin/Cmin].'

Gebruik enkel de cijfers 1 - 9

Kwaliteitsfactoren waarderen

		Stap 1 & 2	Stap 3 & 4
C1	**Openheid en Communicatie**		
	F1: Directe interactie – Intern	[ ]	[ ]
	F2: Directe interactie – Extern	[ ]	[ ]
	F3: Consistente communicatie richtlijnen	[ ]	[ ]
	F4: Review & acceptatie van tekortkomingen/fouten	[ ]	[ ]
C2	**Betrokkenheid**		
	F5: Topmanagement ondersteuning	[ ]	[ ]
	F6: Inzicht in project significantie/visie klant	[ ]	[ ]
	F7: Betrokken klant met mandaat	[ ]	[ ]
	F8: Stakeholdercommitment (in de startfase)	[ ]	[ ]
C3	**Voorspelbaarheid**		
	F9: Projectconceptualisatie	[ ]	[ ]
	F10: Afstemming verwachting inkomende informatie	[ ]	[ ]
	F11: Afstemming verwachting uitgaande informatie	[ ]	[ ]
	F12: Politieke-/Sociaal economische stabiliteit	[ ]	[ ]
C4	**Bekwaamheid**		
	F13: Projectteam mitigatiebeleid	[ ]	[ ]
	F14: Competente Klant	[ ]	[ ]
	F15: Prestaties monitoren van externe partijen	[ ]	[ ]
	F16: Gekwalificeerde project teamleden	[ ]	[ ]

Clusters waarderen

C1	Openheid en Communicatie	[ ]	[ ]
C2	Betrokkenheid	[ ]	[ ]
C3	Voorspelbaarheid	[ ]	[ ]
C4	Bekwaamheid	[ ]	[ ]

Enquête Kwaliteitsmanagement

Controle vragen

Terry DP van Roode [ROOT2]
TU Delft - MSc Construction Management & Engineering

Datum: _____
Tijd: _____
Respondent: _____
Locatie: _____

Heeft u werkervaring als projectleider met alle drie de type opdrachtgevers?

.....
.....
.....

Hoeveel jaar werkervaring heeft u als projectleider?

.....
.....
.....

Hoeveel jaar werkervaring heeft u binnen de constructie-industrie?

.....
.....
.....

Wie was uw vorige werkgever?

.....
.....
.....

Welke opleiding(en) heeft u afgerond? (naam opleiding + niveau)

.....
.....
.....

Aan welke opdrachtgever(s) denk u per categorie? (noem min. 1 per categorie)

Privaat .....
Klein-Publiek .....
Groot-Publiek .....

APPENDIX N: ARTICLE OF RECOMMENDATION