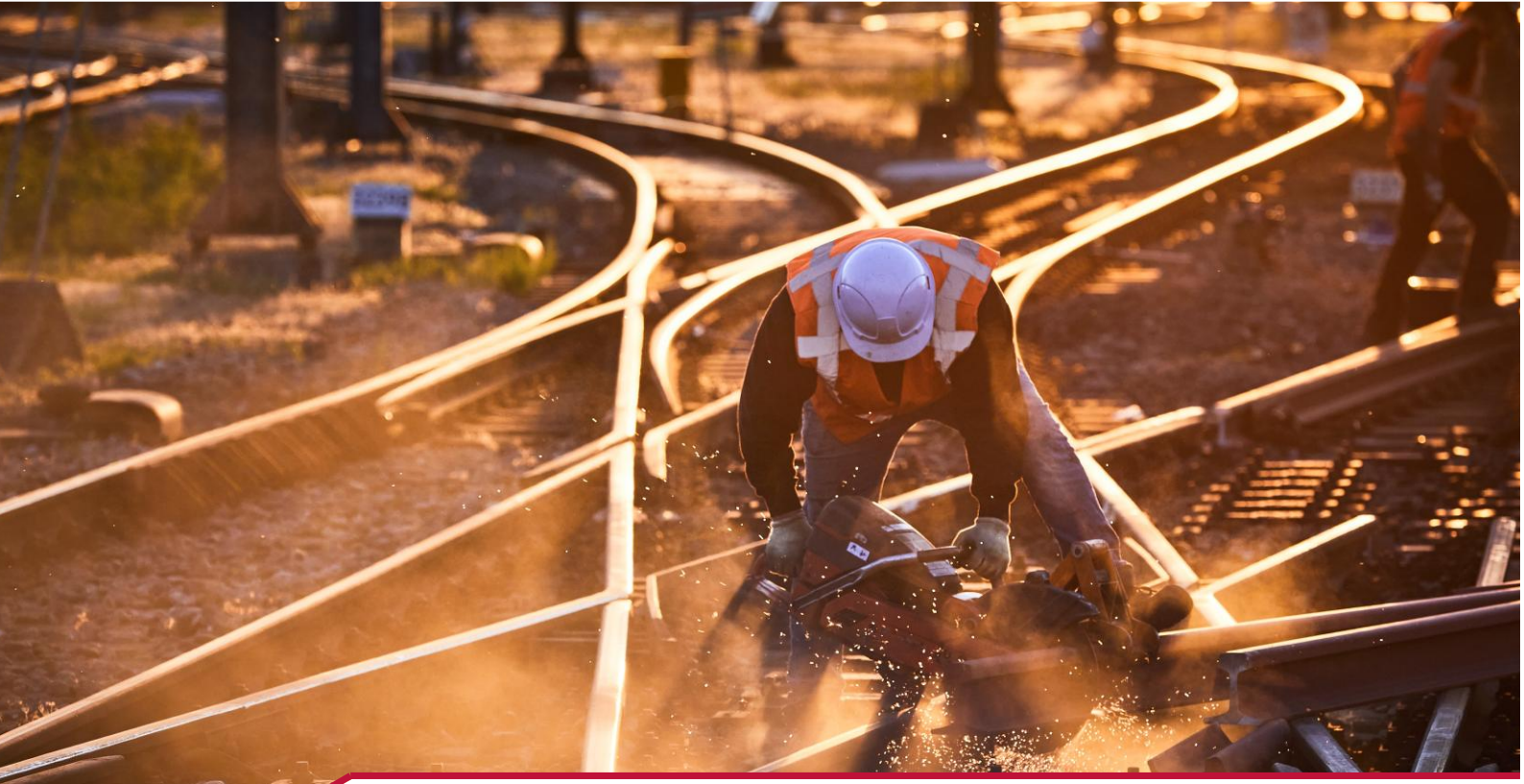

Embracing different perspectives on project complexity

MSc Thesis

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Colophon

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Preface

Dear reader,

This is my master thesis, marking the end of my journey as a student. A journey that was an amazing period of my life. Being a student this past decade brought me so many good memories. The countless nights of good fun with my roommates, first in Delft and later in Rotterdam. All the times chilling on the terrasses in Delft or wherever in the world. Drinking with the lads in the Toko. Trying almost every single sport imaginable. All the holidays to crazy places, from road tripping through Spain for a month, to flying to Colombia and Peru.

A journey that took me past several study programmes to finally find a good fit at the BSc Technisch Bestuurskunde and later the MSc Construction Management. Making tons of new friends at each and every of these programs; making even the programs that in the end were not for me, worthwhile.

A journey that had some setbacks: falling ill for some longer spells, getting a monthslong sabbatical to New Zealand and a minor programme in Hong Kong cancelled due to corona. But non that I could not handle with the help of my friends and family.

A journey that led to me studying abroad. The minor programme in Hong Kong may have fallen through twice, but a year later, I made up for it in tenfold by studying in South Korea where I met some of the most amazing people in my life. A group of people from all over the world with whom we still meet up regularly.

A journey that also led to me working abroad. With a group of six people from different programmes at the TU Delft we went to do an internship in Paris, bringing our expertise together to create a feasibility study on scaling a certain type of floating wind turbine.

A journey that took my past several jobs, from helping in a pharmacy and in construction projects, to working on improving the documentation within one of the biggest factories in the Netherlands. And finally doing my graduation internship at ProRail in the research program for collaboration in construction.

A journey that might have taken more than a third of my life, but a journey that was worth every single second. A journey in which I stand behind every choice that I made, even though some might not have been the best. Without these choices, this journey would not have led to me being me. And I love what I have become. Without these choices, this journey would not have led to me making all the friends I made along the way. And I love every single one of them.

Therefore, I want to thank every single person that made this journey what it is and that incudes you, reader. So, to everyone, to all my roommates over the years, to my family, to the friends stemming from all the studies that I did, to the friends that I made before I started studying, to the friends that I made from sports, to the friends that I made abroad, to the friends that I made from Virgiel, to the friends that I made from festivals and going out, to the friends that I made from friends, to all my colleagues, to all my teachers, to all the lovely random people I met, and to all the people I have not yet mentioned, from the bottom of my heart:

Thank you! Thank you so very much!

Love,

Mark

Abstract

Infrastructure projects are becoming more and more complex. In the Netherlands, the Integral Project Management (IPM) model has, in part, been developed to handle this increasing complexity. The model consists of five main roles: Project Manager, Manager Project Control, Project Environment Manager, Technical Manager and Contract Manager. These roles are mirrored across different companies: Client, Contractor and Engineering Firm.

Different people in different roles, working for different companies could potentially have different perspectives on what makes a project complex. Different perspectives could lead to misunderstanding and even friction. Understanding each others perspective can potentially lead to better collaboration. In previous work, different perspectives on project complexity have been researched between different companies and separately between different roles. This research investigates what perspectives can be found on project complexity within and between large rail infrastructure projects in the Netherlands, considering both project role and company at the same time. It also investigates how understanding and embracing these perspectives can lead to better collaboration.

Method

In the research the Q-methodology was used in combination with the TOE framework. The Q-methodology is a mixed-method approach, correlating persons instead of tests. It can be used to uncover implicit perspectives around a topic. Three large infrastructure projects have been analysed from the Programma Hoogfrequent Spoorvervoer (PHS) during the execution phase. In total 30 project professionals participated, representing all IPM roles and the three company types.

Participants completed Q-sorts by ranking 48 complexity elements on a quasi-normal distribution grid from -5 (adds minimal complexity) to +5 (adds significant complexity). Factor analysis using centroid extraction and varimax rotation identified groups sharing similar perspectives. Statistical factors were interpreted qualitatively using composite Q-sorts, distinguishing statements, consensus statements, and participant elaborations.

Findings

Multiple distinct perspectives emerged within each project. Project A exhibited two perspectives (23% and 22% explained variance): Perspective **A1**: Trust and uncertainty emphasised relational complexity, ranking trust between project team and client and uncertainty about scope high, while Perspective **A2**: Accessibility, availability & dependency focused on logistical constraints, ranking accessibility and construction logistics and availability of capacity and skills high.

Project B revealed two perspectives (35% and 19%): Perspective B1: Discontinuity of stakeholders and Duration emphasised personnel changes over time, ranking discontinuity in stakeholder staffing high, while Perspective **B2**: Contract and trust focused on contractual arrangements and external risks. With less experienced professionals in **B1** and more in **B2**.

In Project C three perspectives (20%, 21%, 21% variance) emerged: Perspective **C1**: Influencing stakeholders emphasised dependencies on external and internal stakeholders, Perspective **C2**: Political & Management, with high influence from politics and management, while Perspective **C3**: Technical & Environment, focused on technical risks and interfaces with other projects.

Trust between the project team and the client and trust between the project team and the contractor were found to be a major influence on project complexity in two of the three projects. Perspectives on one hand with trust and relational aspects and perspectives on the other hand based more on project content. This split of perspectives between Trust and relational and project content is visualised in Figure 1.

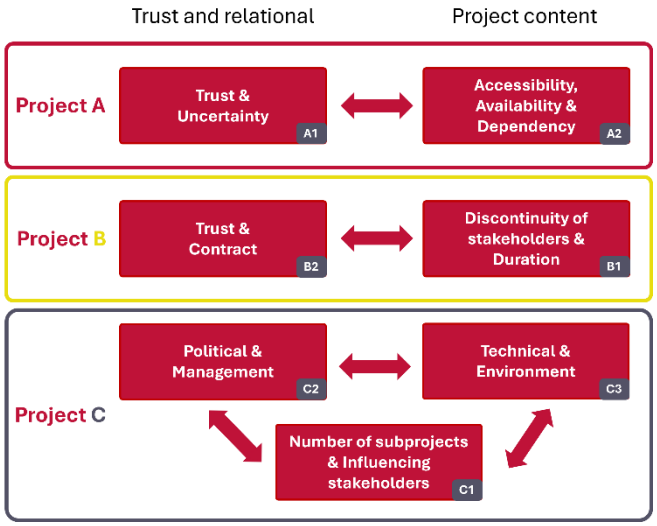

Figure 1: Trust and relational versus project content individual projects

When combining the participants of all three projects, three perspectives emerged. Again, split on one hand with trust and relational, and on the other hand base on project content. But this time, the trust and relational side was split into two. On one hand participants, mostly from the public company, who experienced high complexity from the lack of trust between the team and the contractors. And on the other hand, a perspective, consisting mostly of participants from private companies, that found high complexity stemming from the lack of trust between the team and the client. This is visualised in Figure 2.

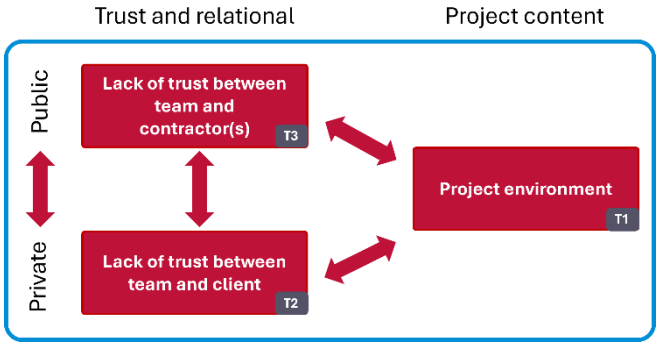

Figure 2: Trust and relational versus project content in overarching

Perspectives did not fully align with the role or organisation. Project A, role-based correlation (39%) exceeded company-based correlation (36%), yet in Project C, company-based correlation (49%) exceeded role-based correlation (40%). In project B, similar correlations were found. The alignment of role and company in perspectives per project is shown in Figure 3.

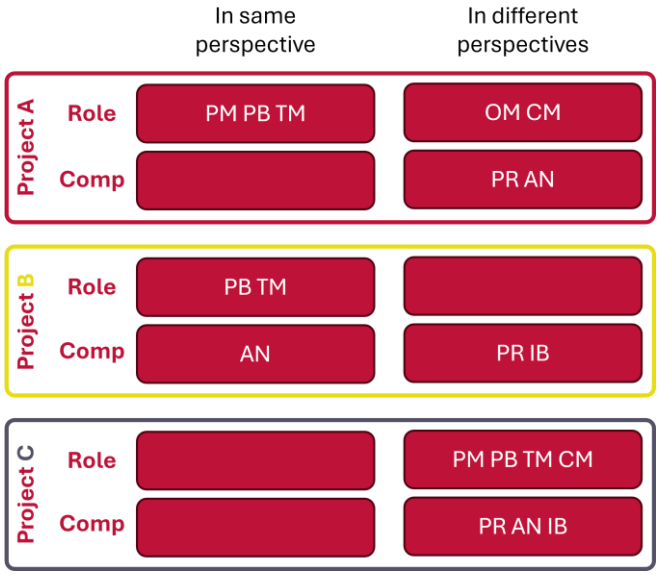

Figure 3: Alignment perspectives role and company

Discussion

Multiple, distinct perspectives on project complexity exist within single teams. In each project, at least two statistically significant perspectives emerged. This is an indication that team members within projects perceive complexity differently. This coincides with the notion by Mikkelsen (2021) that complexity is in the eye of the beholder. It supports the school of perceived complexity as described by Vidal and Marle (2008).
These perspectives are not minor variations on each other but represent significantly different stances on which elements add complexity to the project. For example, in project A, one perspective ranks Onzekerheid over de scope at +5, while the other ranks it at -1. On the flipside, the other perspective ranks Bereikbaarheid en bouwlogistiek at +5, while the first perspective ranks it at 0. This represents fundamentally different ideas about what makes the project complex.
Where Mikkelsen (2021) found role based perspectives, the perspectives found in this research do not neatly align with role. And nor do the identified perspectives align neatly with company, where Kermanshachi and Safapour (2019) found company based perspectives. The identified perspectives seem to be more individual and project based.

Where perspectives in project A and B show high complexity stemming from the lack of trust, this was not the case in project C. This could be because in project C, according to its project manager, a lot of attention has been put on the relationship between the parties from the start.

Q-methodology could be valuable, both as a research tool and as a potential intervention. One of the project managers suggested conducting Q-methodology at project start-up to uncover implicit perspectives. And another would like to do multiple, to reflect on changes throughout the project lifespan. With the methodology, complexity elements can emerge, that were not on the radar. The elements that are uncovered within a project should solicit more attention for that specific project. Participants started informal discussions about different perspectives after the sessions, suggesting that making perspectives explicit trigger productive dialogue. Repeating the exercise during team activities could serve evaluative and teambuilding functions, leading to a better understanding of each other's perspectives on project complexity.

Conclusion

This research shows that multiple, distinct perspectives on project complexity exist within project teams, each reflecting a different understanding of which elements are most complex. These perspectives do not systematically align with project roles nor organisational boundaries.

How can understanding and embracing different perspectives on project complexity help increase collaboration in project teams?

In this research multiple perspectives on project complexity were found per project and between projects. The perspectives do not consistently align with project role, nor with company, nor with experience, but seem to be more individual and project based.
Within projects on one hand perspectives were found that found more complexity from project content, and on the other hand perspectives that found more complexity from relationships. To what extent the lack of trust adds high complexity depends per project, with the only project that ranks this lower expressing that they had put a lot of effort into creating and keeping trust throughout the project. It seems that putting high effort into elements that are ranked high in one or more of the perspectives could lower the perceived complexity of that element. But if this actually is the case, and if this can lead to better project results or collaboration needs to be researched further.

Identifying perspectives on project complexity through (for example) the Q-methodology, can be used to increase collaboration by enabling project professionals to understand each other better. This allows for perspective-taking, enhancing group performance through fostering cooperation and coordination.
Through the different perspectives on project complexity, different complexity elements emerge as adding the most complexity to the project. These emerging elements should be investigated within a team, by directing more attention to them. For example, by focussing on them more during risk analysis sessions. If everyone had thought the same about the complexity, these elements might not emerge and be overlooked. Thus, having different perspectives should be embraced.

The complexity of a project, and the perception thereof are not static, therefore identifying perspectives should be repeated. Over time the perspective of a person could drift away from what others think that person has as a perspective. By systematically repeating the exercise throughout a project lifecycle, (for example) before each project follow-up, helps project professionals to keep understanding each other, keeping perspective-taking possible. Whilst simultaneously identifying new emerging complexity elements that warrant investigation and attention.

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List of abbreviations

Abbrevation	Meaning
AN	AanNemer (Contractor)
CFA	Centroid Factor Analysis
CM	Contract Manager (or Bouwmanager)
IB	IngenieursBureau (Consultancy / Engineering Firm)
IPM	Integral Project Management
OM	Omgevingsmanager (Project Environment Manager) (also PEM)
PB	(Manager) ProjectBeheersing / Project Control Manager (also PCM)
PCA	Principal Component Analysis
PCM	Project Control Manager (also PB)
PEM	Project Environment Manager (also OM)
PHS	Programma Hoogfrequent Spoorvervoer
PM	Project Manager
PMBOK	Project Management Body of Knowledge
PQM	PQMethod Software (name)
PR	ProRail
Q	Q-methodology
RWS	Rijkswaterstaat
TM	Technical Manager
TOE	Technical, Organizational, External
TU	Technische Universiteit
VGM	Veiligheid, Gezondheid, Milieu

1. Introduction

In the last couple of decades, the world has been trending towards becoming more and more projectified (Jacobsson & Jałocha, 2021). This is a development that is especially prevalent in the public sector, where projectification is utilised to cope with increasingly complex societal challenges (Godenhjelm et al., 2015). At the same time, projects themselves tend to become complex (Luo et al., 2017).

To answer the call for professionalisation, consistency, collaboration, and transparency in the field of project management in the Dutch Infrastructure sector, models such as the Integral Project Management (IPM)-model have been introduced. In part to deal with the increase in complexity of public infrastructure projects (Municipality of Amsterdam, 2013; RWS, 2025). The IPM-model identifies five different processes, and each of these processes has a distinct management role within the management team. Each IPM role has its own supporting team. The IPM organisation contains the following five roles:

- Project Manager (PM);
- Project Control Manager (PCM or PB);
- Project Environment Manager (PEM or OM);
- Technical Manager (TM); and
- Contract Manager (CM) (Molaei et al., 2021).

The IPM-model is not the only project management model wherein distinct roles with distinct responsibilities are identified. ProRail, for example, uses a slightly different team composition (ProRail, 2023). However, the commonality between the models is that the roles more or less stay the same between projects.

1.1. Perspectives and project complexity

Inherently with working in a project team with different roles, is that officials with different backgrounds work on the project, each bringing their own perspectives (Oke et al., 2016). Not just stemming from their respective roles, but also from their identity; their experience, knowledge, upbringing, personality or other personality traits. Diversity in backgrounds, however, does not automatically lead to effective collaboration nor does it ensure sound collective decision-making (Baiden et al., 2006; Koolwijk et al., 2020).

Project complexity has been a hot topic in research (Bakhshi et al., 2016). Vidal and Marle (2008) describe two schools of (project) complexity; the descriptive and perceived. The school of descriptive complexity argues that complexity is an intrinsic part of a system, quantifiable, and measurable. The school of perceived complexity, on the other hand, consider that complexity is subjective, the complexity cannot be fully understood through the perspective of an individual.

In a large survey amongst project managers in Denmark, Mikkelsen (2021) found that not only project complexity is in the eye of the beholder, but that this perceived complexity is influenced by the perspective of their project role. Kermanshachi and Safapour (2019), in their research on the perspectives of primary stakeholders in construction projects in the United States, conclude that client, contractor and consultant each have their own perspectives on project complexity.
In the work of Mikkelsen (2021), no distinction is made between the primary stakeholders, and in the construction industry, 68 out of 79 respondents were either project managers or higher management. Within their research, project complexity was not looked at on a project-specific basis, but on a more general level. Mikkelsen also argued that the results are not necessarily applicable to other countries. Hackman et al. (2024), in their research on perceptions of project complexity, suggest that in future research case studies should be done wherein large project teams with stakeholders both inside and outside of the organisation are considered. And mention the construction industry specifically as a potential area of interest.

In short, there has been little research on perspectives on project complexity in the construction industry, where both the role of the individual and at what type of company they work, are considered. This is visualised in Figure 4.

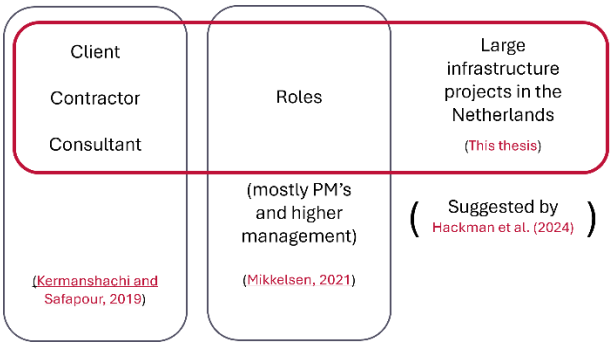


Figure 4: Visualisation of previous and current work on perspectives on project complexity

Van der Krift et al. (2021) state that partners in teams face mismatched perceptions and that this can lead to disputes or even conflicts. In turn, this leads to a decreasing level of trust. They call this disparity in collaborating partners' perceptions, perceptual distance. They research this perceptual distance between contractor and client, and do not take into consideration differences within a single team. Nguyen and Mougenot (2022) see that it is common to have misunderstandings in teams that are multidisciplinary, especially if team members are from different backgrounds. Conflicts can arise from the variation of perspectives of the participants. And when there is more overlap in the mental models of team members, the team can adapt better to changes and coordinate taskwork better.
A key component of creating a shared mental model in a team, is understanding each other's preferences. Knowing and understanding one another can help team members adjust how they act to accrue with their teammates (Lee et al., 2004). Chun and Choi (2014) suggest that open communication helps understand each other's motivations. Uncovering (implicit) perspectives on project complexity and communicating these perspectives could increase group performance and collaboration.

So, in part due to increasing project complexity, more (specialised) roles have been introduced into project teams, each possibly bringing their own perspective into the mix. When people look at the complexity of a project from their own viewpoint or perspective, their perception of complexity can be different. This perceptual distance could lead to miscommunication, or deteriorating collaboration, which could be mediated by open communication and mutual understanding.

1.2. Research Goal

The aim of this research is twofold: the first is to see what perspectives on project complexity can be found when considering both the role of team members and the stakeholders wherein they operate. The second goal is to investigate whether identifying and explaining the perspectives can help team members understand and embrace the differences in perspective. All aiming to aid the ultimate goal of increasing collaboration in project teams. These two research goals are reformulated into the following intended results of this thesis:

R1. Finding an indication for a relation between project role and/or company and perspective on project complexity.
R2. Finding a format for making perspectives explicit, kickstarting discussions, creating mutual understanding, and improving collaboration.

1.3. Research Questions

To reach the goals of the thesis, the following research question is drafted:

How can understanding and embracing different perspectives on project complexity help increase collaboration in project teams?

To fully address the main research question, the following sub-questions have been drafted:

SQ1 What perspectives on project complexity can be found when looking within individual projects?

SQ2 What perspectives on project complexity can be found when looking between multiple projects?

SQ3 Where do the perspectives on project complexity stem from?

SQ4 How can the different identified perspectives be embraced?

1.4. Structure

In Chapter 2 the design of the research is elaborated. Then in Chapter 3, the Q-methodology is executed, in Chapter 4 and 5 the results are interpreted and in Chapter 6 the results are shown. In Chapter 7 the discussion and limitations are given. Finally in Chapter 8, the conclusions are drawn and recommendations for further research and practice are given.

2. Research design

In this chapter, the design of this thesis is explained.

2.1. Research approach

Even though project complexity has been researched often and so has collaboration, different perspectives on project complexity within project teams, when considering both role and company, is relatively new territory. The goals of the research are to find indications of relations between role/company and perspective on project complexity. And to find a way to make perspectives explicit, kickstarting discussion on different complexity elements, creating mutual understanding in hopes of improving collaboration. It could be that there is no actual relation between these aspects, or that the relations need further research. It is also possible that different relations will be uncovered.

2.2. Research Methodology

Figure 5 shows the method used to answer each sub-question. The rest of this chapter will dive deeper into each part of the method.

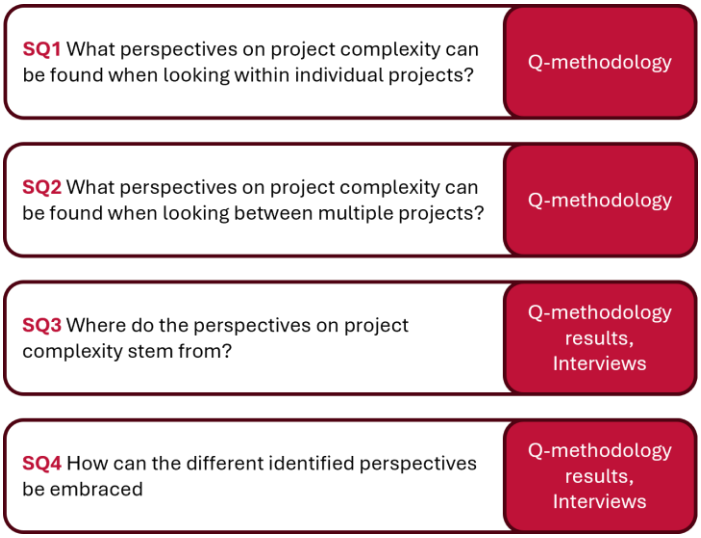


Figure 5: Research method per sub-question

2.3. Q-methodology description

To answer the first and second sub-question the Q-methodology will be conducted. The Q-methodology is used to uncover and describe divergent viewpoints or perspectives in a group (Q method, 2025). The method originates from the notion by Stephenson (1935) that it is possible to correlate persons instead of tests. It incorporates both qualitative and quantitative techniques, as it uses numerical results to support the perspectives that are interpreted (Zabala et al., 2018). The Q methodology excels at uncovering perspectives of groups of participants, even when these perspectives are implicit (Yoshizawa et al., 2016).

In the Q-methodology, usually, respondents (P-set) are asked to rank-order a sample of statements (Q-set) around a certain topic, based on their individual point of view. This process, the Q-sort, lets respondents give their subjective meaning to the statements, which uncovers their personal perception of the topic at hand. Next, factor analysis will be done on these individual rankings (Van Exel & De Graaf, 2005). This is the inversion of regular factor analysis, as Q correlates persons instead of tests. If there is (a high) correlation between the different participants, this is an indication that these participants share a similar viewpoint or perspective.

Usually, the Q-methodology is performed in steps: Defining and building the concourse; developing the Q-set, selecting the P-set, conducting the Q-sorting, analysis, and interpretation (Damio, 2016). Below, these steps will be given a short, general elaboration. The actual application of the Q-methodology in regard to finding perspectives on project complexity will be elaborated on in Chapter 3: Q-Methodology and project complexity.

2.3.1. Concourse and the Q-set

At the start of the Q-methodology, the so-called 'concourse' is made. The concourse is the collection of all statements that participants could state about the research subject. From this concourse, then, a subset will be made, called the Q-set or Q-sample. This Q-set usually contains between 40 and 50 statements and should be representative of the whole concourse (Van Exel & De Graaf, 2005).

2.3.2. Selection of the P-set

The next step in the Q-methodology is to select the participants. The selected group is referred to as the P-set. This group of people is not randomly selected but is a deliberate selection of respondents that are theoretically relevant to the research. This could be people who are

expected to have a distinct perspective on the topic (Van Exel & De Graaf, 2005). The P-set usually consists of less participants than 40 (Brown, 2003). Webler et al. (2009) write that typically even one to three dozen respondents are sufficient. Purposefully sampling respondents to capture a wide range of perspectives is called maximum variation sampling (Moseya et al., 2020) and is used to ensure heterogeneity withing the sample.

2.3.3. Q-sorting and Interviews

Before the participants can sort the Q-set, the Q-grid needs to be prepared. And the condition of instruction, which tells participants how to fill in the grid with the elements (Damio, 2016). The Q-grid is usually a quasi-normal distribution, with a range from most disagree on one side and most agree on the other side. How steep the distribution is, is often based on the expectation of how involved or knowledgeable participants are in the topic at hand; with flatter distributions applied for higher involvement, allowing stronger (dis)agreement with statements (Van Exel & De Graaf, 2005). The vertical position of the elements is irrelevant, only the position on the horizontal axis is taken into consideration. The grid should be symmetrical in the vertical axis, around the zero scores. In Figure 6 an example is shown of a Q-grid with (an arbitrarily chosen) 33 elements for illustration purposes.

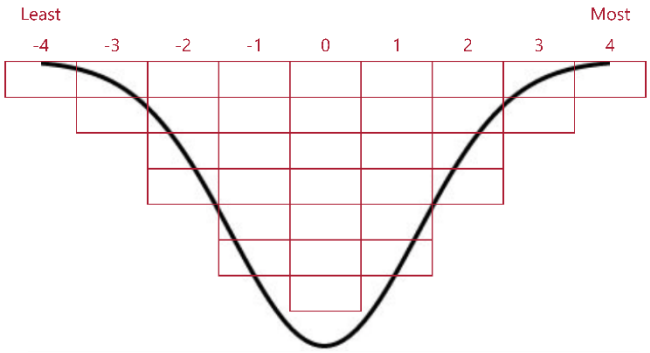


Figure 6: Example of a (steep) Q-grid for a Q-set of 33 statements

Usually, the respondents are asked to keep to the fixed quasi-normalised grid, but other shapes are also possible, such as the rectangular distribution (Hess & Hink, 1959), or a non-forced distribution to allow for more spontaneity in choice (Gaito, 1962). Brown (1980) however, shows that the type of distribution has virtually no influence to the resulting factors. Watts and Stenner (2005), continue that it is then more convenient for both practitioners and participants to have a forced distribution.

During the Q-sorting process, participants are interviewed (or fill in a form). The participants are questioned on why they ranked certain elements high or low. And on other choices they made during the ranking. The answers to these questions are used to interpret the different perspectives.

2.3.4. Analysis

After all participants in a P-set have conducted their Q-sort and are interviewed, the analysis of the sorts can be done. As a first step in the analysis, the correlation matrix between all the Q-sorts is created. This correlation matrix represents how (dis)similar the individual sorts or individual perspectives are (Van Exel & De Graaf, 2005).

The correlation matrix is then factor analysed, this is done to find the number of groups of Q-sorts that form naturally. The participants that have a similar perspective load high on the same factor. The number of factors is dependent on how similar the Q-sorts are. The factors are then rotated to form the factors used for interpretation. This can be done in multiple ways, objective or judgemental. An example of an objective method is the varimax method, where the variance between factors is maximized. In judgemental rotation, the researcher rotates the factors based on for example theories, or notions that are identified through the interviews (Van Exel & De Graaf, 2005).

As the last step of the factor analysis, the factor and difference scores are calculated. The factor score is the normalized average score of an element (Z-score) for participants in that factor. Using this Z-score, all elements can be ranked in the Q-grid, resulting in a composite Q-sort for the group of people in that factor (Van Exel & De Graaf, 2005). This Q-sort represents the shared perspective of that group.

The difference score describes the difference in how much an element scores between factors. When an element exceeds a certain threshold, it is seen as a distinguishing statement for the factor. If a statement does not breach this threshold, it is seen as a consensus statement.
The elements with the highest and lowest factor score, can then be used to interpret a first description of a shared perspective. This description is then refined by the distinguishing and consensus statements, to highlight differences and similarities between perspectives. The interviews can also give insight into the perspectives, and can also be used to better illustrate the perspectives by for example quotes on the elements that score highest/lowest in the group (Van Exel & De Graaf, 2005).

2.4. Research Scope

This research focuses on large rail infrastructure projects in the Netherlands that are in the execution phase. The projects should be large and complex enough to solicit research into different perspectives on project complexity. The study looks at projects that have been in the realisation phase for some time. This ensures that there is already some history of collaboration within the project.

And that respondents have had time to develop their own mental model of the complexity of the project.

If possible, the projects should be at least semi-comparable to minimise the differences in results caused by external factors.

To select these projects, an internal database of ProRail is consulted. This database is filtered to projects currently under construction with a minimum budget of €30 million. The projects should be underway for a while so participants have had time to develop their own perspectives, and the projects should not be almost finished so that the understanding and embracing of perspectives can still make a difference in collaboration. To accomplish this, projects have been filtered by the percentage of the budget spent. This filter was chosen to be between 20% and 80%, based on average S-curves shown in Soliman and Alrasheed (2022), and modelled in Cioffi (2005). Next, these projects are further filtered on whether they have the IPM roles on the ProRail side. In the remaining set of projects, comparable projects are identified. This results in a shortlist of 15 projects; all part of the PHS or *Programma Hoogfrequent Spoorvervoer* (Program for high-frequency rail transport). From the shortlist, three projects are selected, based on availability of interviewees and their similarity in percentage of budget spend (approximately 60%). Table 1 summarizes the scope.

Table 1: Scope

	Scope
Country	Netherlands
Project Type	Rail infrastructure construction
Budget	> €30 million
Budget spent	Between 20% and 80%
Phase	Execution
Program	PHS (program for high-frequency rail transport)

3.

Q-Methodology and project complexity

In this chapter, the execution of the Q-methodology for this research will be explained. First, in section 3.1, the way the Q-set is formed from the concourse is explained. Then, in section 3.2 the theoretical selection of the respondents is elaborated. This is followed by an explanation of how the Q-sorting is done during this research in 3.3 , in 3.4 the final P-sets are shown. In 3.5 the process will be evaluated. Finally, in 3.6, the analysis of the Q-methodology is described.

3.1. Concourse and the Q-set

In this research, the Q-methodology is implemented around the subject of project complexity. The concourse, then, should be a set of statements that together would describe all that can make a project complex.

Multiple frameworks have been developed to measure and quantify project complexity. Obdam (2016), in his thesis, analyses 27 different project complexity models. In these models, a total of 808 aspects are present, albeit with considerable overlap. He states that there might be an unlimited set of project complexity aspects and that aspects are dependent on context. This infinite cloud of aspects or elements could be seen as the concourse around project complexity.
Through his analysis and research, Obdam (2016) synthesises several guidelines to which a project complexity model can be evaluated. Including what elements of project complexity should and should not be included in a model, the notion that the aspects are not mutually independent, and that a model is expected to not fully cover the total concept of project complexity. And recommends that a model should include all complexity dimensions, should include an appropriate ratio of quantifiable/non-quantifiable elements, and should include an adequate number of elements. It could be argued that a project complexity model that lines up well with these guidelines can be a good representation of the concourse and thus could potentially be used as the Q-set.

When applying these guidelines and his findings, Obdam (2016) found two models that align best; the PMCAT tool (Damasiotis & Fitsilis, 2015) and the TOE framework (Bosch-Rekveldt et al., 2011).

The PMCAT tool, or Project Management Complexity Assessment Tool by Damasiotis and Fitsilis (2015) is a framework for assessing software projects through the nine project management knowledge areas defined in the PMBOK (Project Management Body of Knowledge) 4th edition (PMI, 2008). It contains 31 elements, 21 of which are quantifiable. Obdam (2016) see this high ratio as a drawback since objective and quantifiable project complexity elements can never fully explain project complexity, subjective parts are also important. And therefore, the ratio should be balanced.
The current PMBOK (7th edition) has shifted away from the nine project management knowledge areas (where the PMCAT tool is based on) in favour of eight project performance domains to reflect a more systems view based approach to project management (PMI, 2021).
The combination of being slightly imbalanced, being designed around software projects specifically and being based on a classification that is no longer part of the newest PMBOK, makes this model less valid as a Q-set for this research.

The TOE framework, or Technical, Organizational, and External framework, was developed originally for the process industry (Bosch-Rekveldt et al., 2011) and was slightly amended Bosch-Rekveldt (2011). In later research, Bosch-Rekveldt et al. (2018) used an updated version of the framework in different industries, including the construction sector. It contains 47 elements, divided into three groups (Technical, Organizational, External), that together describe the complexity of a project.
Obdam (2016) describes the TOE framework as a good model according to his guidelines; the framework includes most of the dimensions, contains the essential elements, and has a reasonable quantifiable/subjective ratio of 23 over 24.

Figure 7 shows the updated TOE framework as used in Bosch-Rekveldt et al. (2018). In that same research, a special version of the TOE framework was used for the Dutch construction and infrastructure sector. This translated version had several extra elements, stemming from interviews with experts from the construction project industry. When respondents had to select their top three elements, only one element specific to the construction industry made the top three in its category. That was *Bereikbaarheid en bouwlogistiek* (*building logistics and accessibility)*. Figure 8 shows the TOE framework translated in Dutch with only *building logistics and accessibility* added.

Technical complexity
High number of project goals
Nonalignment of project goals
Unclarity of project goals
Uncertainties in scope
Strict quality requirements
Project duration
Size in CAPEX
Number of locations
Newness of technology (worldwide)
Lack of experience with technology
High number of tasks
High variety of tasks
Dependencies between tasks
Uncertainty in methods
Involvement of different technical disciplines
Conflicting norms and standards
Technical risks

Organizational complexity
High project schedule drive
Lack of resource & skills availability
Lack of experience with parties involved
Lack of HSSE awareness
Interfaces between different disciplines
Number of financial sources
Number of contracts
Type of contract
Number of different nationalities
Number of different languages
Presence of JV partner
Involvement of different time zones
Size of project team
Incompatibility between pm method/tools
Lack of trust in project team
Lack of trust in contractor
Organizational risks

External complexity
Number of external stakeholders
Variety of external stakeholders' perspectives
Dependencies on external stakeholders
Political influence
Lack of company internal support
Required local content
Interference with existing site
Remoteness of location
Lack of experience in the country
Company internal strategic pressure
Instability of project environment
Level of competition
External risks

Figure 7: Complexity elements from the TOE framework (Bosch-Rekveldt et al., 2018)

Technische complexiteit
Aantal projectdoelstellingen
Incongruentie van projectdoelstellingen
Onduidelijkheid over projectdoelstellingen
Onzekerheid over de scope
Niveau van kwaliteitseisen
Projectduur
Investeringskosten
Aantal locaties
Gebruik nieuwe technologie
Ervaring met toegepaste technieken
Aantal deelprojecten
Diversiteit van deelprojecten
Afhankelijkheid tussen deelprojecten
Onzekerheid over technische methoden
Diversiteit van technische disciplines
Tegenstrijdige normen en standaarden
Technische risico's

Organisatorische complexiteit
Druk op de tijdsplanning
Beschikbaarheid van capaciteit en vaardigheden
Ervaring met projectpartijen
VGM-bewustzijn
Interfaces tussen verschillende disciplines
Aantal financieringsbronnen
Aantal uitvoeringscontracten en interfaces daartussen
Contractvorm
Aantal verschillende nationaliteiten
Aantal verschillende talen
Samenwerking tussen aannemers
Werktijden (verschillende tijdzones)
Bereikbaarheid en bouwlogistiek
Aantal projectmedewerkers
Aansluiting tussen gebruikte PM tools & technieken
Vertrouwen tussen projectteam en opdrachtgever
Vertrouwen tussen projectteam en aannemer(s)
Organisatorische risico's

Externe complexiteit
Aantal externe stakeholders
Diversiteit in belangen van externe stakeholders
Afhankelijkheid van externe stakeholders
Politieke invloed
Management support vanuit eigen organisatie
Verplichte lokale partijen
Interfaces met andere projecten
Aard van de omgeving
Gebrek van ervaring in omgeving/land
Invloed van stakeholders van binnen de organisatie
Discontinuïteit bemensing stakeholders
Marktomstandigheden
Externe risico's

Figure 8: Complexity elements Dutch Construction Sector (adapted from Bosch-Rekveldt et al. (2018))

So, this TOE framework is applicable to the construction industry, is well balanced between quantifiable and subjective, and includes the essential elements. It could be seen as representative of the whole concourse and contains between 40-50 statements as suggested by Van Exel and De Graaf (2005). And thus, the 48 TOE complexity elements as shown in Figure 8 are suitable to be the Q-set used to find perspectives around project complexity.

3.2. Selection of the P-set

In the case of identifying perspectives on project complexity, it is expected that different roles and/or different companies have different viewpoints, based on Mikkelsen (2021) and Kermanshachi and Safapour (2019) respectively. This is why, for the P-set, respondents with different project roles will be selected from ProRail, Contractors and Consultants/Engineering Firms. The roles chosen to be represented are based on the *Handboek projectcoördinatoren* (ProRail, 2023) and the IPM roles (Molaei et al., 2021). These roles are expected to represent a broad range of viewpoints.

For each of the projects that are analysed the roles shown in Figure 9 will be investigated. The roles from ProRail are substitutes for the IPM roles, as ProRail uses a (slightly) different system. Depending on whether the contractors and consultants/engineering firms of the project mirror the roles of ProRail, the mirrored or IPM roles will be used.

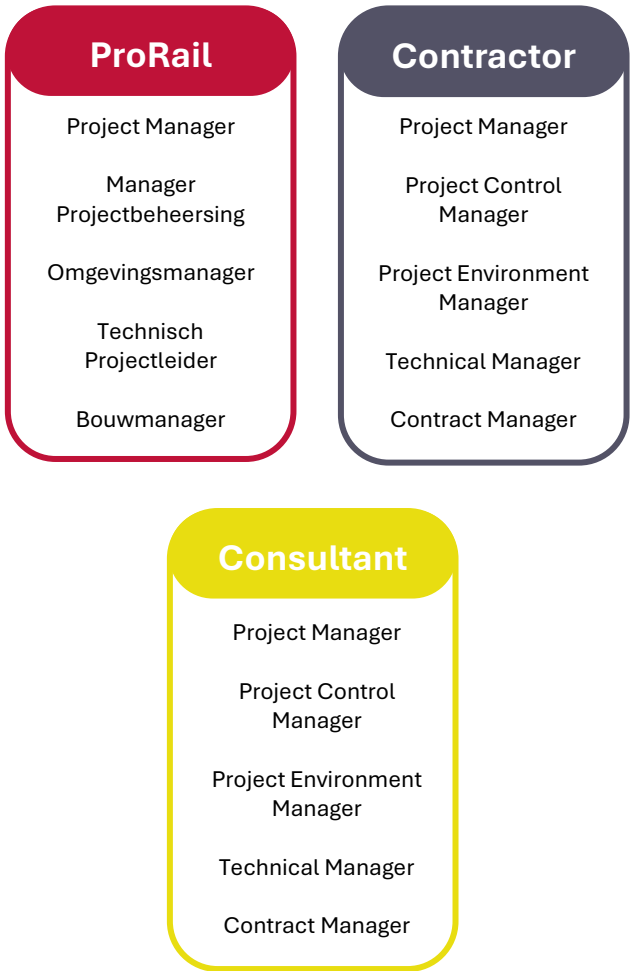


Figure 9: Project roles (Molaei et al., 2021; ProRail, 2023)

To have a big enough sample size the P-set per project should consist of at least 6 participants (Webler et al., 2009). It is also important that the P-set has a wide range of perspectives to ensure diversity and heterogeneity in the sample (Moseya et al., 2020). The five role (types) and three company (types) should thus be sufficiently represented.

The theoretical P-set per project is shown in Table 2. The final P-sets will be adjusted to fit the actual project teams for the three projects.

Table 2: Possible P-set per project

Role	Company
Project Manager	ProRail
Manager Projectbeheersing	ProRail
Omgevingsmanager	ProRail
Technisch Projectleider	ProRail
Bouwmanager	ProRail
Project Manager	Contractor
Project Control Manager	Contractor
Project Environment Manager	Contractor
Technical Manager	Contractor
Contract Manager	Contractor
Project Manager	Consultant
Project Control Manager	Consultant
Project Environment Manager	Consultant
Technical Manager	Consultant
Contract Manager	Consultant

3.3. Q-sorting and forms

Now that the Q-set and P-set are selected, the Q-sorting process is set up. To find perspectives on project complexity in a project, participants are asked to sort the TOE complexity elements from Figure 8 according to the degree to which *they* think the elements adds complexity to the project at *this* moment.

"TOE complexity element X adds ... complexity to the project"

Each of the complexity elements are given on separate cards to be sorted into a grid. All the cards have a *randomly* assigned number which is later used to process the Q-sorts. It is important that participants have been informed that the numbers are not related in any way to how they should sort the elements, they are purely for administrative purposes. The participants should also be reassured that there is no correct sort, the sort of the participant is based on *their* perception of the complexity of the project. Figure 10 shows what one of the cards to be sorted could look like.

Figure 10: Example of TOE complexity element for Q-sort

In this research, a decently flattened quasi-normal distribution from -5 to 5 will be used as grid, to allow for bigger differences in perspectives. Brown (1980) states that it is most common to have this type of distribution. Figure 11 shows the grid for the 48 elements used in this study.

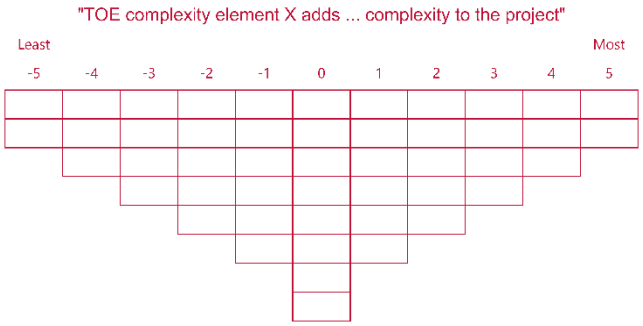


Figure 11: Q-sort grid 48 elements

Respondents will be asked to read the elements and first sort them in three piles: one for elements that add little or no complexity to the project; one for elements that add a lot; and one for elements on which the participant is undecided (or add average complexity). This preliminary sorting makes it easier to then fill in the complete grid. Starting from the outer bounds, the participant will work inwards. It is important that participants are instructed that the row on which an element is placed has no relevance, only the column is considered.

After the Q-sorting process, the participant will fill in a form; to elaborate on the choices made (especially the elements that are at both ends of the distribution). Participants are also asked about what exactly their role entails within the project. Asking respondents about their sort can aid the interpretation later on, by better understanding the motivations of the respondent (Van Exel & De Graaf, 2005).

In this research, the choice was made to let participants fill in a form instead of doing a post-Q-sort interview. This was done due to time constraints. By using forms rather than interviews, multiple participants could complete the Q-sorting simultaneously, reducing the time required for both in-person sessions and the transcription process afterwards. Hosting sessions with multiple participants at once requires the use of forms to reduce the chance that answers of one participant influence those of others. The form used during the sessions is shown in appendix B.
Even though participants filled in a post Q-form, recordings of the audio within the sessions were made. This was done in case participants did say or ask anything that can be used for the research during the session.

3.4. Final P-sets

In this section, the final P-sets of each of the projects are shown. These sets differ from the theoretical P-sets because of circumstances within the projects, these will be elaborated per project. In Table 3 and Table 4 the codes that are used in tables and figures for the different roles and companies are shown. Note that in the role *Bouwmanager* acts as contract manager in the execution phase according to the *Handboek Projectcoördinatoren (*ProRail, 2023*)*. Since this research focuses on projects that are in the execution stage, the code CM will be used. Codes for companies are based on the Dutch names, since contractor and consultancy abbreviated could result in confusion.

Table 3: Role codes

Code	Role ProRail	Role other parties
PM	Project Manager	Project Manager
PB	Manager ProjectBeheersing	Project Control Manager
OM	Omgevingsmanager	Project Environment Manager
TM	Technisch Projectleider	Technical Manager
CM	Bouwmanager	Contract Manager

Table 4: Company codes

Code	Company (type) Dutch	English
PR	ProRail	ProRail
AN	AanNemer	Contractor
IB	IngenieursBureau	Consultancy / Engineering Firm

3.4.1. Project A

In project A, there is currently no consultancy or external engineering firm involved. This means that in this project, only ProRail and the contractor have participated in the Q-sorting. All of the core team members of both ProRail and the contractor were able to do the Q-sorting. The final P-set for Project A is shown in Figure 12.

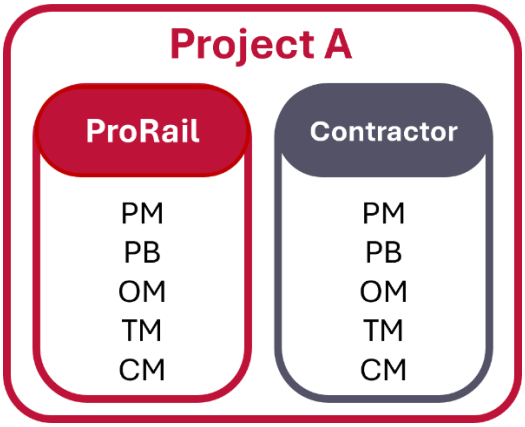


Figure 12: P-set project A

3.4.2. Project B

The contractor for Project B is reorganizing for a new baseline, currently, only two of the IPM roles remain (the Manager Project Control and Technical Manager). The consultancy / engineering firm in question does not have a separate IPM team but fills in two roles of the ProRail team (an additional Project Manager and Contract Manager). There

are no Project Environment Managers involved within Project B. Figure 13 shows the P-set of project B, with the consultancy highlighted in yellow.

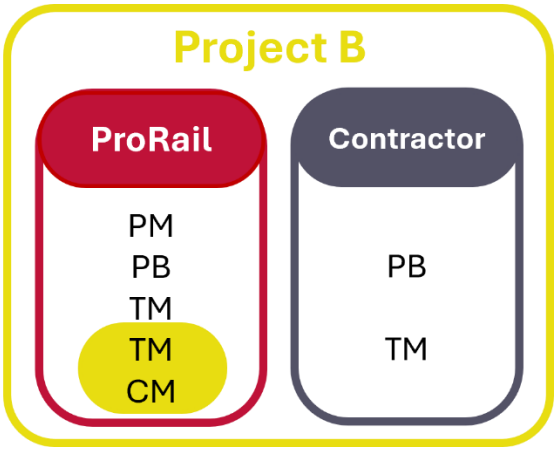


Figure 13: P-set project B

3.4.3. Project C

In project C, all three parties have a separate IPM team. But the engineering firm did not have a Project Environment Manager working on the project, and the Project Environment Manager of the contractor was not available during the duration of the research. This leads to the P-set as depicted in Figure 14.

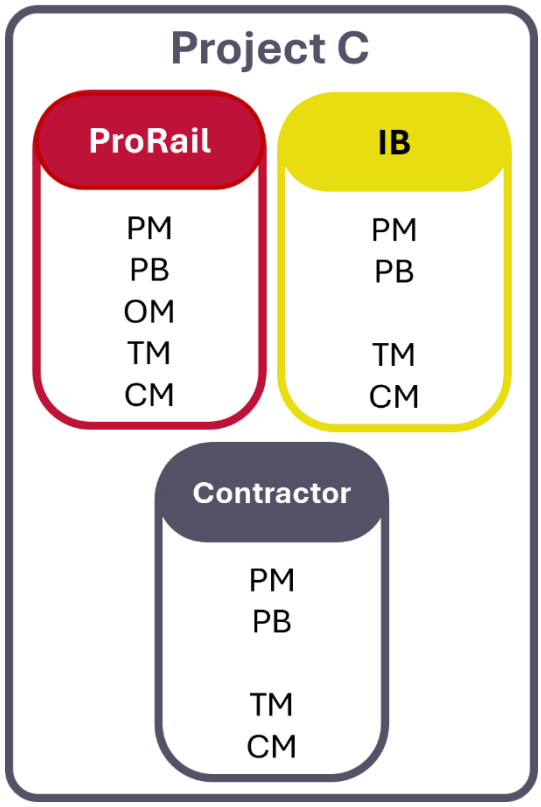


Figure 14: P-set project C

3.5. Sessions and evaluation

The Q-sorting was done in sessions where multiple respondents could participate at once. The sessions were held with a maximum of five participants based on their availability. The sessions were organised in the same manner no matter the number of persons in that session, to minimize differences between sessions that were solo or in a group. This was done with the protocol that is shown in *Appendix C. Protocol for Q-sorting sessions*.

In total, 13 sessions were held. At the offices of ProRail, contractors and consultancies. Six of those sessions were with a single participant, three sessions were with duos, and four were with larger groups. The full list of participants per session is shown in Table 5. It was possible to plan a session for every potential participant, except one.

Table 5: Participants per session

Session	Project	Company	Roles
1	A	PR	TM
2	B	PR/IB	PM, PB, TM, CM(IB)
3	A	AN	PM, PB, OM, TM, CM
4	C	IB	PB, CM
5	C	IB	PM, TM
6	A	PR	PM, PB, OM, CM
7	B	AN	PB, TM
8	C	AN	PB
9	C	AN	PM
10	C	AN	TM
11	C	PR	PM, PB, OM, TM, CM
12	C	AN	CM
13	B	PR/IB	PM(IB)

For each of the sessions an appointment was made for 1,5 hours. Most participants were done after approximately one hour.

After the sessions concluded, some participants were interested in how other participants had ranked the elements, causing impromptu discussions on the project. Some participants expressed that the Q-sorting was an interesting way to look at the project differently. Giving insight to what others thought of the project.

3.6. Setup of analysis

The analysis is done with the help of the PQMethod Software (PQM). This is a free, open-source statistical program, specifically made for analysing data generated by the Q-Methodology. It calculates the correlations between the different Q-sorts, which are then factor-analysed through either the Centroid Factor Analysis (CFA) or Principal Component Analysis (PCA). These factors can then be rotated analytically with the Varimax method or judgementally through manually adjusting rotation with the help of two-dimensional plots (Schmolck, 2014b).

In PQM, the steps described in the following sections, were done for each project as well as the overarching P-set. For using the program, the official PQMethod Manual (Schmolck, 2014a) is used as a guide.

3.6.1. Statements

In the first step of the PQMethod Software, '1-STATES', the statements are added. These statements are the Q-set of the research and in this case are the (Dutch) TOE-elements shown in Figure 8. These elements have been randomly assigned a number as shown in Appendix A. This results in the list of elements shown in Table 6.

Table 6: Elements with random number

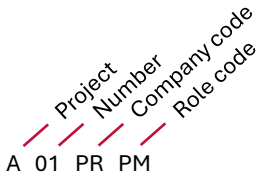
Element	#
Vertrouwen tussen projectteam en aannemer(s)	1
Incongruentie van projectdoelstellingen	2
Onduidelijkheid over projectdoelstellingen	3
VGM-bewustzijn	4
Onzekerheid over technische methoden	5
Aard van de omgeving	6
Beschikbaarheid van capaciteit en vaardigheden	7
Ervaring met projectpartijen	8
Investeringskosten	9
Samenwerking tussen aannemers	10
Druk op de tijdsplanning	11
Politieke invloed	12
Aantal externe stakeholders	13
Projectduur	14
Marktomstandigheden	15
Diversiteit in belangen van externe stakeholders	16
Gebrek van ervaring in omgeving/land	17
Niveau van kwaliteitseisen	18
Onzekerheid over de scope	19
Technische risico's	20
Organisatorische risico's	21
Aantal uitvoeringscontracten en interfaces daartussen	22
Aantal locaties	23
Werktijden (verschillende tijdzones)	24
Diversiteit van technische disciplines	25
Interfaces met andere projecten	26
Aantal deelprojecten	27
Aantal financieringsbronnen	28
Ervaring met toegepaste technieken	29
Tegenstrijdige normen en standaarden	30
Interfaces tussen verschillende disciplines	31
Aantal projectdoelstellingen	32
Afhankelijkheid tussen deelprojecten	33
Diversiteit van deelprojecten	34
Verplichte lokale partijen	35
Vertrouwen tussen projectteam en opdrachtgever	36
Discontinuïteit bemensing stakeholders	37
Gebruik nieuwe technologie	38
Aansluiting tussen gebruikte PM tools & technieken	39
Aantal verschillende nationaliteiten	40
Invloed van stakeholders van binnen de organisatie	41
Bereikbaarheid en bouwlogistiek	42
Managementsupport vanuit eigen organisatie	43
Externe risico's	44
Aantal projectmedewerkers	45
Afhankelijkheid van externe stakeholders	46
Contractvorm	47
Aantal verschillende talen	48

3.6.2. Q-sorts

After the statements have been defined the individual Q-sorts have to be entered using '2-QENTER'. The first time this is done, a title and the details of the Q-sort design must be given. The titles are *projecta*, *projectb*, *projectc*, and *total*. The design of each analysis is the same, this corresponds with the Q-sort grid shown in Figure 11:

Number of statements: 48
Leftmost column value: -5
Rightmost column value: 5
Number of rows per column: 2 3 4 5 6 8 6 5 4 3 2

With the design sorted, the Q-sorts can be entered. Each Q-sort is assigned an identification code (Sort ID), in this research the code is constructed in the following way:



The possible company and role codes are mentioned in Table 4 and Table 3.
Then, for each column, the statements must be entered as shown in Figure 15.

```
 Enter the Sort Values for Subject 11 example

 Enter the Statement Numbers, Separated by Spaces,
   for Column -5:
1 2
 Enter the Statement Numbers, Separated by Spaces,
   for Column -4:
3 4 5
 Enter the Statement Numbers, Separated by Spaces,
   for Column -3:
6 7 8 9
```

Figure 15: Example of entering statements in PQM

After entering all statements, the program gives a visual representation of the Q-sort as shown in Figure 16.

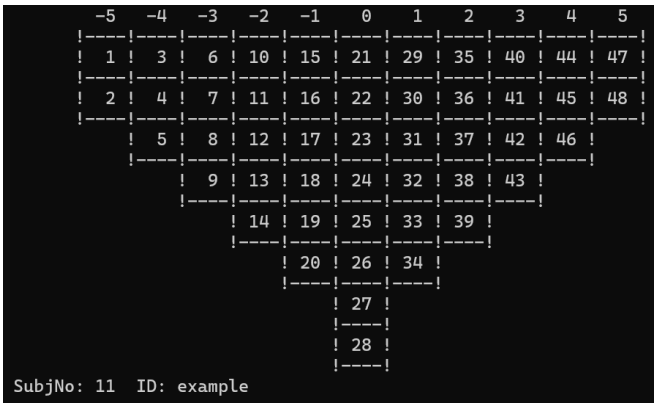


Figure 16: Example of a Q-sort in PQM

This is repeated for all participants; per project and in total.

3.6.3. Factor extracting

The Q-sorts are then used as input to extract unrotated factors. In PQM this can be done in two main ways. The Centroid factor analysis (CFA) or Principal components analysis (PCA).

The PCA can be used to find a best mathematical solution. But Thompson (1962) says this is not necessarily representative for reality. The CFA on the other hand can offer multiple potential solutions. Without a mathematical best solution, it is possible to argue for different rotations based on theories rather than purely mathematical (Ramlo, 2016). The possibility of doing judgemental rotations with CFA and it aligning more with the abductive, interpretive process of Q as described by Stephenson (1953) and Brown (1980), are the reasons that CFA is used to extract factors in this research.

In PQM this is done in '3-QCENT'. Standard is the extraction of 7 factors using the extraction method described in (Brown, 1980). This standard setting is used in this research.

3.6.4. Factor Rotation

Now that the factors are extracted, they can be rotated either by hand or through varimax rotation. It is also possible to first use the varimax rotation followed by a hand-rotation. Hand (Judgemental) rotation is used to align perspectives more with theory.

In this research, first a varimax rotation is executed, followed by a hand rotation to see if better alignment along role or company is possible. This is done with the function '6 – QVARIMAX' in the PQMethod software.

The number of factors that are rotated depends on the number of participants loading on each factor. Starting with seven factors and working back, until each factor represents a distinct viewpoint and has at least two participants loading significantly on it.

3.6.5. Results of analysis

Using the function '7 – QANALYZE' results in a file with multiple tables, including a correlation matrix, the rotated factors with how much each Q-sort loads on it, the composite Q-sort for the factor, what statements are distinguishing per factor, what statements are consensus between the factors, and more. The tables resulting from these analyses are shown in Appendix G, per project and in total. For project A and project B, a two-factor rotation resulted from the analysis, whilst for project C and the overarching or total set, a three-factor solution came out of the analysis. Table 7 shows which participants load on what factor.

Table 7: Participants per factor

Factor	Project	PR	AN	IB
A1		PM PB	PM PB OM CM	
A2		OM TM CM	TM	
B1		PB TM	PB TM	TM
B2		PM		CM
C1		OM CM	CM	PB
C2		PM PB TM	TM*	
C3			PM PB TM*	PM TM CM
T1	A			
	B	TM	PB	TM
	C	PM PB CM	PM PB TM CM	PM PB TM
T2	A	PB	PB OM CM	
	B			
	C			
T3	A	OM TM CM		
	B	PM PB	TM	CM
	C			

3.7. Conclusion of Q-methodology

In this chapter, the q-methodology as used in this research was described, from selecting the Q-set and P-set, through the execution of the sorting sessions and the analysis. This resulted in a total of seven factors within singular projects; two for project A, two for project B, and three for project C. These factors will be interpreted and thereby made into perspectives in chapter 4. In the overarching set, three factors came out of the analysis. These three factors will be analysed in chapter 5.

4.

Interpretation of perspectives within projects

In this chapter, the factors, resulting from the analysis as described in chapter 3 and shown in appendix G are interpreted. After interpretation, the factors will become perspectives. The interpretation will be done using the composite q-sorts as well as the distinguishing and consensus statements for that factor. This will be complemented by statements made by participants from the form they filled out during the Q-sorting sessions. The interpretations will be done on a per-project basis.

For each project a brief description is provided, with a figure showing how the participants were spread on the different perspectives. The titles for the perspectives and the correlation between the perspectives are shown. After the project is introduced, the perspectives are shown per project.

Each perspective is shown on two pages, with the interpreted description of the perspective on the left page and the composite Q-sort for that perspective on the right. In this composite Q-sort, the distinguishing statements of both the perspective in question and the other perspective(s) are highlighted, as well as the consensus statements.

This chapter tries to give a start to answer sub question one:

SQ1 What perspectives on project complexity can be found when looking within individual projects?

4.2. Project A

Project A consists of a new connection between two existing rail lines. It is in close proximity to a highway and buildings.

In project A, two perspectives have been identified:

Perspective **A1**: Trust and uncertainty
Perspective **A2**: Accessibility, availability & dependency

These perspectives have an explained variance of 23% and 22% respectively, accumulating in a total explained variance of 45%. This is relatively low, but not unheard of. Morea and Ghanbar (2024) analysed 65 Q-studies, in which 56 reported on explained variance, 22 of which reported similar (<50%) or lower explained variances.
The correlation between the two perspectives is shown in table Table 8 below. And participants in the two perspectives are shown in Figure 17.

Table 8: Correlation between perspectives in project A

	1	2
1	1	0.44
2		1

Everyone agrees that the contract type adds complexity to this project. Another consensus is held in that the project has a high dependency on external stakeholders.

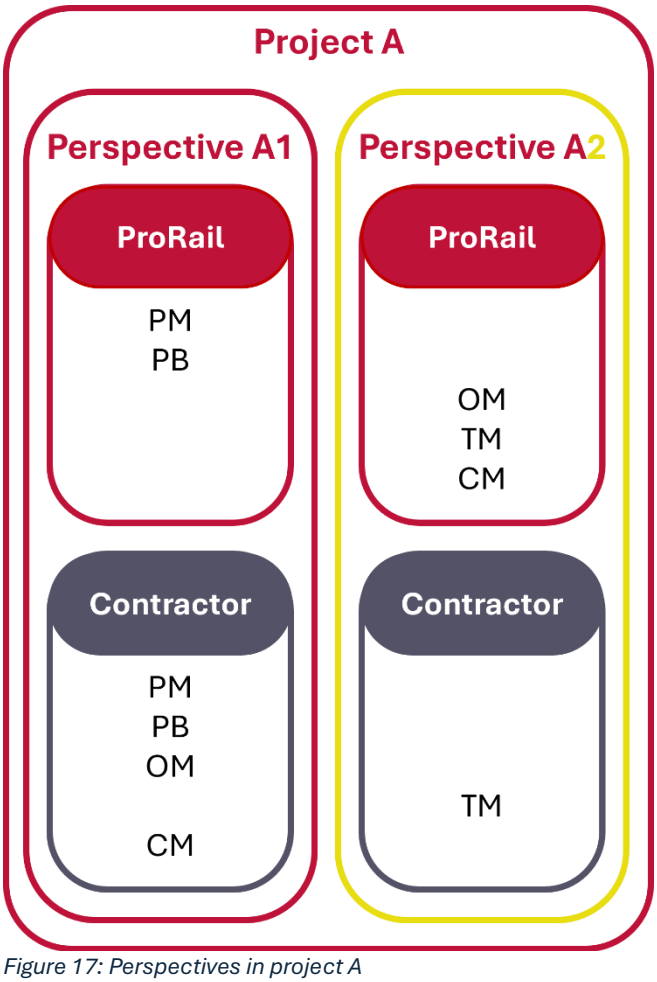


Figure 17: Perspectives in project A

4.2.1. Perspective A1: Trust and Uncertainty

For the participants in perspective **A1**, a (lack of) trust is a big factor in project complexity. Between the project team and both the client and the contractor. Besides trust, uncertainties in scope and conflicting norms and standards bring significant complexity to the mix. On the other hand, participants in this perspective do not see experience with other parties as a significant source of complexity, nor do they see the (lack of) awareness of HSSE as complex.

The perspective has an explained variance of 23%. And six out of ten participants in project A adopt this perspective. Including all project managers and project control managers. Most (4/5), but not all, roles from the contractor load onto this perspective.

The distinguishing statements of this perspective are shown in Figure 18. According to participants in this perspective, the elements in red add significantly more complexity to the project than according to those in perspective **A2**, while the elements in yellow add significantly less. The number on the left represents the column of the Q-sort in this perspective, and the number on the right represents the column of the other perspective.

+	Onzekerheid over de scope	5 | -1
	Vertrouwen tussen projectteam en opdrachtgever	5 | 1
	Vertrouwen tussen projectteam en aannemer(s)	4 | 1
	Tegenstrijdige normen en standaarden	4 | 1
	Aantal externe stakeholders	3 | -3
-	VGM-bewustzijn	-4 | 2
	Ervaring met projectpartijen	-4 | 0

Figure 18: Distinguishing statements perspective A1

Vertrouwen tussen projectteam en opdrachtgever (36) is the element that adds the most complexity, according to the participants in this perspective (Z-score of 2.01). A06ANPM mentions that "trust between the team and the client has been a topic as of late and is being discussed between the teams". A07ANPB adds that "With a lack of trust, the project becomes more complex because each decision is then weighed, which takes an (unnecessarily) long time".

Related to this element is element 1, *vertrouwen tussen projectteam en aannemers(s)* (Z-score 1.49). Which also ranks significantly higher in this perspective than in perspective **A2**. This is specifically addressed by A10ANCM, who says that trust is crucial for a project to succeed, but it is hard to maintain when multiple issues have occurred. Participant A01PRPM summarises why, for them, the lack of trust adds the most complexity: "A lack of trust has an impact on the management of the project, leads to increased risks, increased costs, reduced quality, and is a threat to planning. In short: An increased complexity."

Another high-scoring distinguishing element is *Onzekerheid over de scope (19; Z-score 1.92)*. The uncertainty of scope leads to increased engineering, uncertainty in schedule and costs, and more discussions among parties, according to A01PRPM and A02PRPB. The contract manager of the contractor (A10ANCM) thinks that this element adds the most complexity, for it is the most annoying; one cannot make an efficient schedule, nor does one know where he stands in terms of costs.
A10ANCM continues that *tegenstrijdige normen en warden (30; 1.49)* bring a lot of complexity, as these conflicting norms and standards are among the reasons the scope is uncertain.

The number of external stakeholders (13; Z-score 0.86) also scores higher than in perspective **A2**. According to A06ANPM, this is currently complex, due to direct and indirect influence from both Rijkswaterstaat and the local water authority.

According to the people in this perspective, the *VGM-bewustzijn (4; -1.40)* and *Ervaring met projectpartijen (8; -1.23)* add significantly less complexity than participants in **A2** think. "All parties are very aware of HSSE" (A10ANCM).

The biggest differences between the distinguishing statements of this perspective and **A2** are the *onzekerheid over de scope* (Z-score difference of 2.31) and the VGM-bewustzijn (difference of 2.23).

A visual representation of perspective **A1**: Trust and Uncertainty is given on the next page in Figure 19. In it, the composite Q-grid of the perspective is shown, with the distinguishing statements of **A1** in red, **A2** in yellow, and consensus statements in grey. The participants in the perspective are also shown again for illustration purposes.

Perspective A1

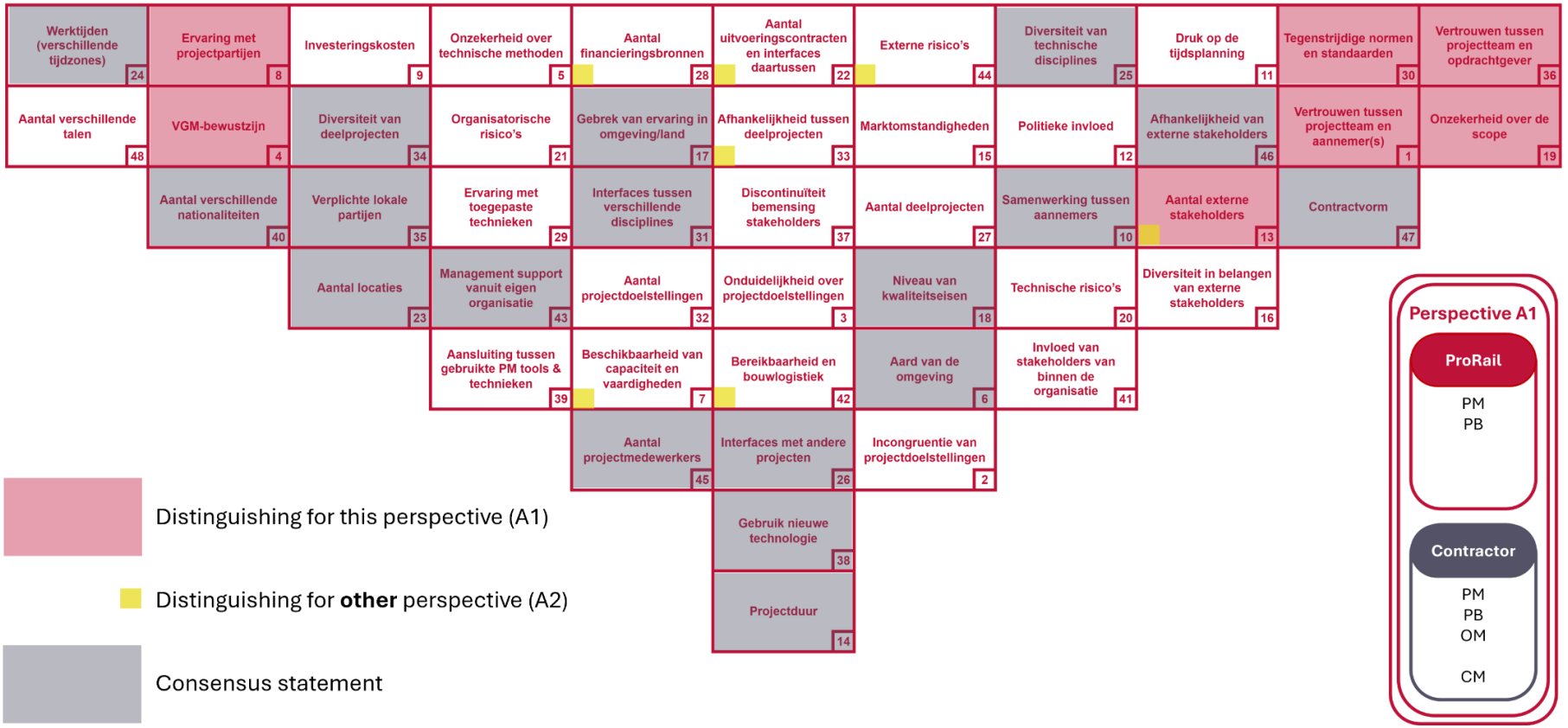


Figure 19: Composite Q-grid perspective A1 with distinguishing statements

4.2.2. Perspective A2: Accessibility, availability & dependency

Participants in perspective **A2** experience more complexity from the accessibility and logistics of the construction site, and how to fill roles for the project. The number of contracts and interfaces between them and dependencies resulting from that also cause complexity, according to **A2**.

The perspective explains 22% of the variance. Four of the participants load most on this perspective. This includes both technical managers on this project.

The distinguishing statements of this perspective are shown in Figure 20. The elements in red add significantly more complexity to the project, according to participants in **A2**, compared to perspective **A1**, while the elements in yellow add significantly less. The number on the left represents the column of the Q-sort in this perspective, and the number on the right represents the column of the other perspective.

+	Bereikbaarheid en bouwlogistiek	5 | 0
	Aantal uitvoeringscontracten en interfaces daartussen	5 | 0
	Beschikbaarheid van capaciteit en vaardigheden	4 | -1
	Afhankelijkheid tussen deelprojecten	4 | 0
	Externe risico's	4 | 1
-	Aantal externe stakeholders	-3 | 3
	Aantal financieringsbronnen	-4 | -1

Figure 20: Distinguishing statements perspective A2

For participants in perspective **A2**, the *Bereikbaarheid en bouwlogistiek (42; Z-score of 1.66)* is the most complex aspect of this project. According to A09ANTM, there is only a limited amount of space, which, combined with poor ground conditions that cause sagging access roads, results in considerable time and money being spent on accessibility. Access roads that are local roads not designed to withstand thousands of truck movements (A04ANTM).

Finding the right people and resources is another element that adds more complexity, according to the people in perspective **A2** (*Beschikbaarheid van capaciteit en vaardigheden; 7; 1.49)*. A03PROM mentions that the specialists needed are currently scarce at contractors, making it difficult to implement control measures. A05PRCM words it as follows: "No resources = no work. No skills = no project."

The project has been divided into several construction contracts, designed by multiple engineering firms (A04PRTM). The integration of all these activities adds a lot of complexity to this project in the perception of these participants (*Aantal uitvoeringscontracten en interfaces daartussen; 22; 1.61)*.
This coincides with the complexity introduced by the *Afhankelijkheid tussen deelprojecten (33; 1.46)*, as multiple contractors continue the work from each other's contracts (A04PRTM).

As for *Externe risico's (44; 1.52)*, both the technical manager (A04PRTM) and the environment manager (A03PROM) of ProRail mention that work that had been completed in the past does not meet current standards. Whilst this previous work is out of scope of the project, the current work cannot be implemented without interacting with it. Adding significant complexity to this project, in the eyes of the participants in this perspective.

For the two distinguishing elements on the low end of **A2**'s spectrum, A*antal externe stakeholders (13; -1.10)* and *Aantal financieringsbronnen (28; -1.52)*, only the number of financial sources was specifically mentioned in the forms. It adds little complexity to the project, since there is only one source for this project according to A04PRTM.

The most distinguishing element for this perspective is the availability of resources and skills, with a Z-score difference of 1.71.

A visual representation of perspective **A2**: Accessibility, availability & dependency is given on the next page in Figure 21. In it, the composite Q-grid of the perspective is shown, with the distinguishing statements of **A1** in red, **A2** in yellow, and consensus statements in grey. The participants in the perspective are also shown again for illustration purposes.

Perspective A2

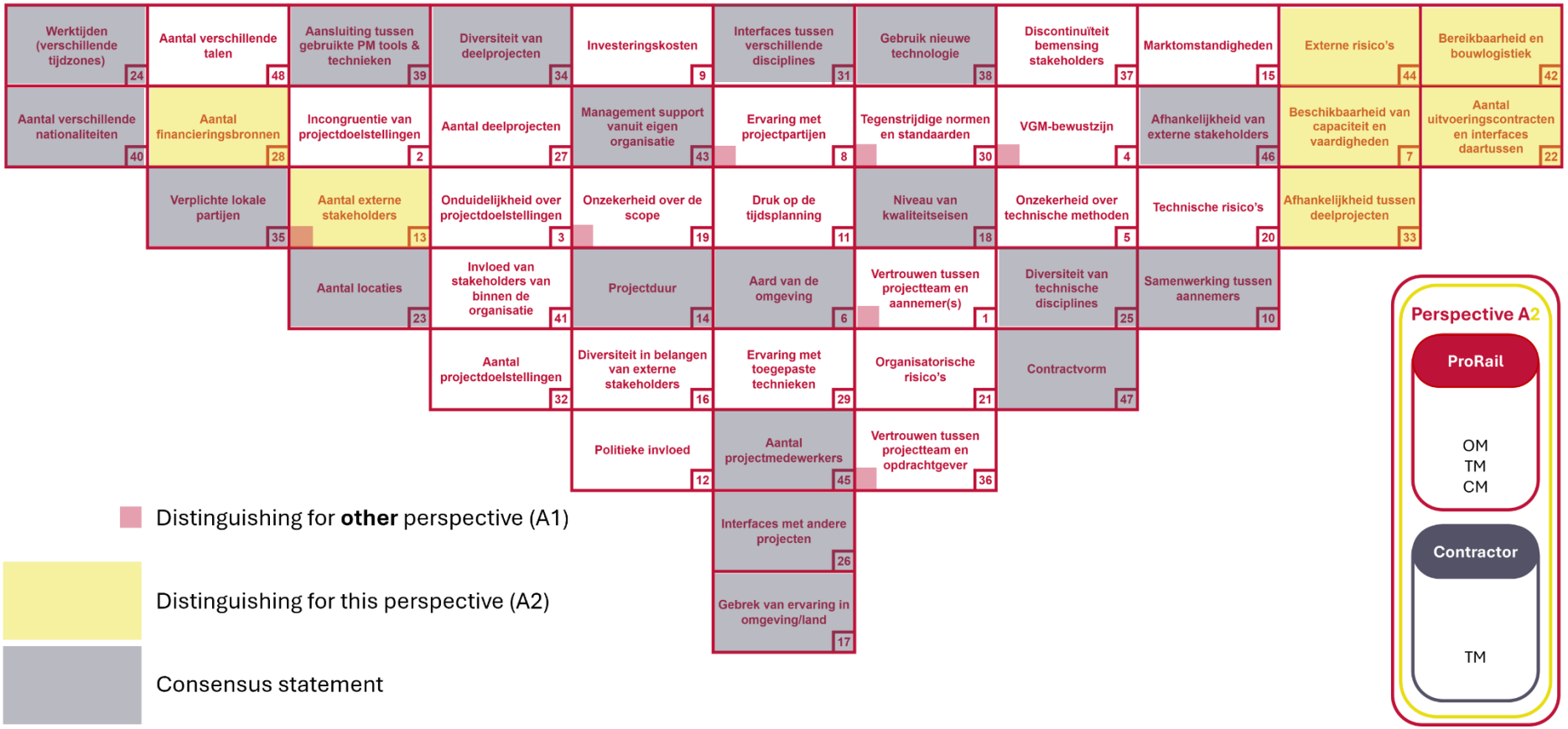


Figure 21: Composite Q-grid perspective A2 with distinguishing statements

4.3. Project B

Project B entails the construction of a new rail track to an existing station in a large city.

In project B, two perspectives have been identified.

Perspective **B1**: Discontinuity of stakeholders and duration
Perspective **B2**: Contract and trust

These perspectives have an explained variance of 35% and 19% respectively, accumulating in a total explained variance of 54%. This is the same as the average explained variance as described by Morea and Ghanbar (2024). Who analysed 65 Q-studies, in which 56 reported on explained variance.
Perspective **B2** has only two Q-sorts loading significantly on it, which is on the low end. However, it has been used as a minimum threshold for a perspective (Zabala & Pascual, 2016).

The correlation between the two perspectives is shown in Table 9 below. And the participants per perspective are shown in Figure 22.

Table 9: Correlation between perspectives in project B

	1	2
1	1	0.55
2		1

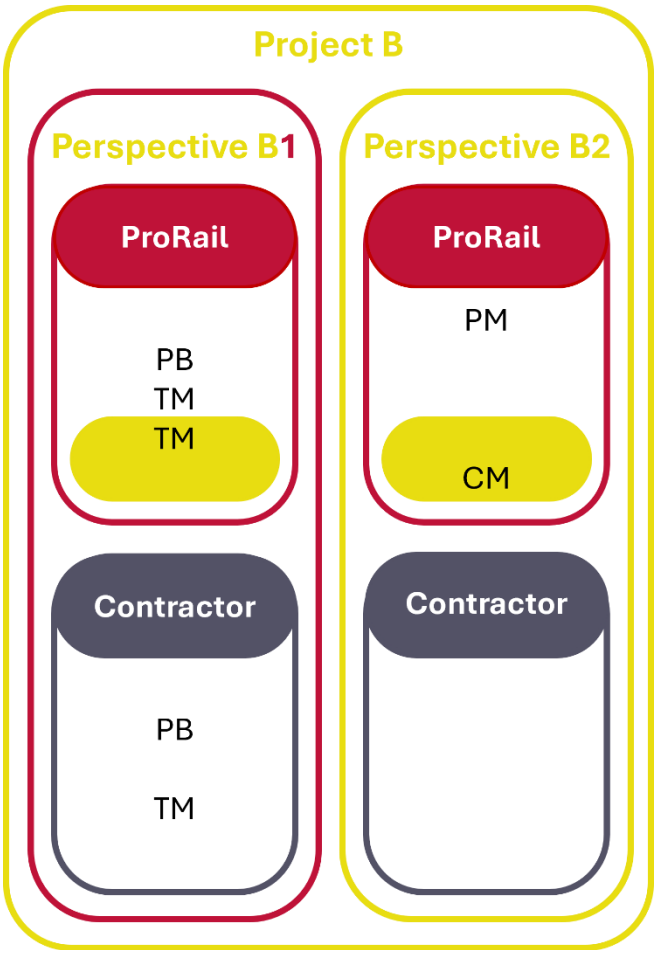


Figure 22: Perspectives in project B

4.3.1. Perspective B1: Discontinuity of stakeholders and Duration

Participants in perspective **B1** perceive complexity through changes in personnel over time. Due to the long duration of the project, the composition of team members among stakeholders fluctuates, bringing uncertainty and decreasing continuity in communication and collaboration. Participants of this perspective are not bothered by implementing new technologies.

Perspective **B1** has an explained variance of 35%. Five out of seven participants load on it, including all project control managers and technical managers. As well as everyone from the contractor (only two in this project). In this perspective, the average experience in the sector is 8.6 years.

The distinguishing statements of this perspective are shown in Figure 23. According to participants in this perspective, the elements in red add significantly more complexity to the project than according to those in perspective **B2**, while the elements in yellow add significantly less. The number on the left represents the column of the Q-sort in this perspective, and the number on the right represents the column of the other perspective.

Figure 23: Distinguishing statements perspective B1

According to B03PRTM, the project has a very long duration (*Projectduur; element 14; Z-score of 1.64),* which leads to *Discontinuïteit bemensing stakeholders (37; 1.73),* changes in scope, and changes in the project environment (like the ecology). B06ANPB adds that "there is a lot of time between the project startup and the (last) execution. Because of that, not everyone feels the urgency to spend a lot of time on the project yet."

Because of the long time between start-up, there have been changes in colleagues, resulting in loss of knowledge in the project (B06ANPB) and agreements made (B03PRTM).
In part due to the long project duration, there have been too few engineers during both preparation and execution (B03PRTM).

When discussing the *Druk op tijdsplanning* (11; 1.15; consensus), B07ANTM notes that if a team member falls away due to illness and needs to be replaced, this could disrupt the schedule.

In the perception of B06ANPB, there are no new technologies used in project B, and B02PRPB does not come into contact with new technologies in his work on the project (*Gebruik nieuwe technologie; -4; 1.41)*.

The most distinguishing element for this perspective is the *Discontinuïteit bemensing stakeholders*, with a Z-score difference of 3.40. Followed by *Gebruik nieuwe technologie* with a Z-Score difference of 2.32. These elements are at the extreme ends for both perspectives, characterising both.

A visual representation of perspective **B1**: Discontinuity of personnel and duration is given on the next page in Figure 24. In it, the composite Q-grid of the perspective is shown, with the distinguishing statements of **B1** in red, **B2** in yellow, and consensus statements in grey. The participants in the perspective are also shown again for illustration purposes.

Perspective B1

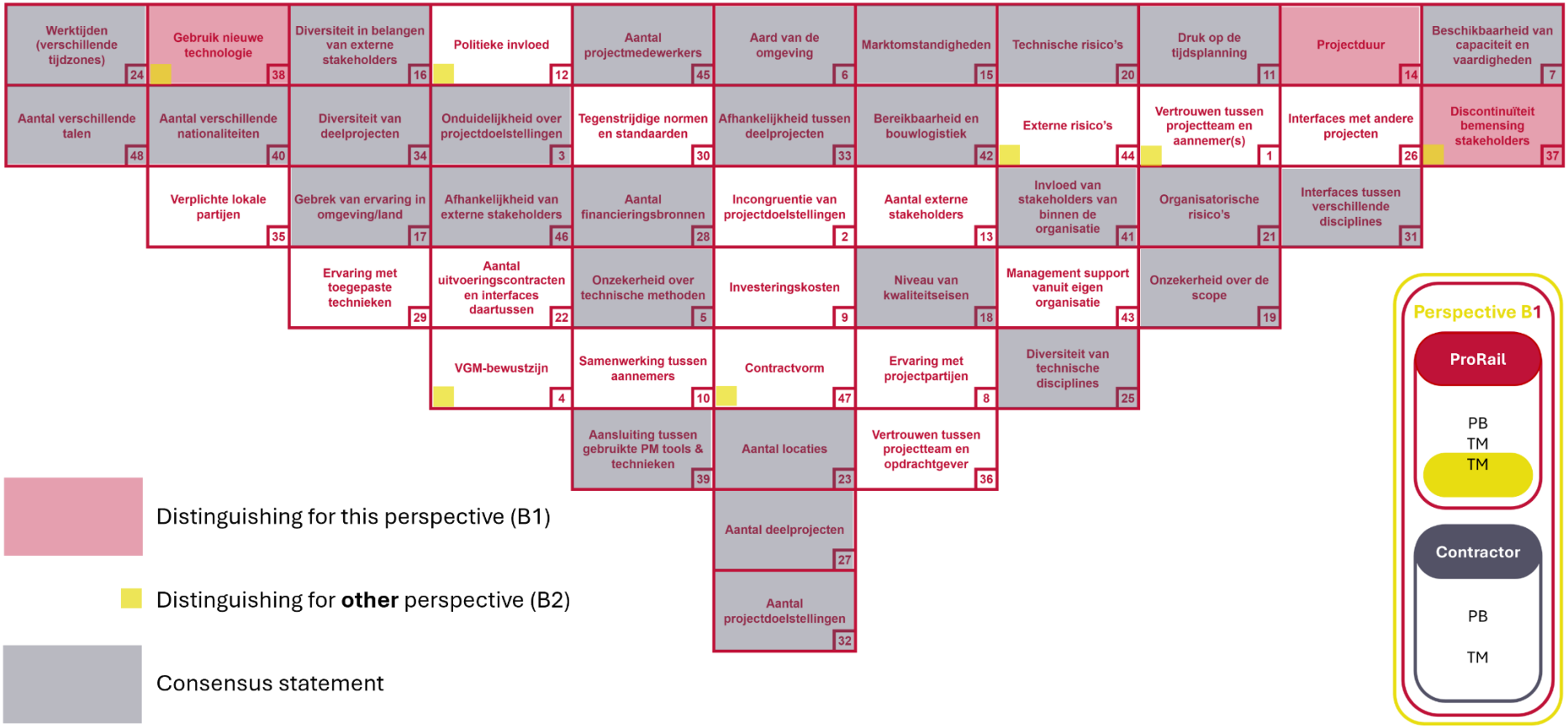


Figure 24: Composite Q-grid perspective B1 with distinguishing statements

4.3.2. Perspective B2: Contract and trust

For B2, the way contracts are set up, including the introduction of new technologies, brings significant complexity to the table. Alongside external risks and trust. The changing nature of teams is less of an issue for this perspective, nor is the influence of politics.

B2 has an explained variance of 19%. The two most experienced project professionals, with an average of 31 years of sector experience, bring this perspective: the project manager from ProRail and the contract manager of the engineering firm (operating within the ProRail team).

The distinguishing statements of this perspective are shown in Figure 25. According to participants in this perspective, the elements in red add significantly more complexity to the project than according to those in perspective B1, while the elements in yellow add significantly less. The number on the left represents the column of the Q-sort in this perspective, and the number on the right represents the column of the other perspective.

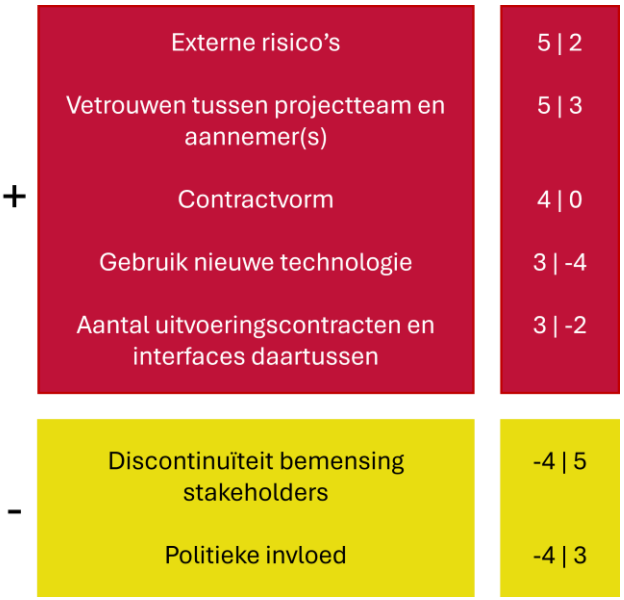


Figure 25: Distinguishing statements perspective B2

In this project, a new type of signpost was used (*Gebruik nieuwe technologie; element 38; Z-score 0.91)*. During the execution phase, this new signal turned out not to meet standards. Resulting in a long delay, extra work, and discussions between ProRail and the contractor (B01PRPM), this was an external risk (*Externe risico's; 44; 1.99)*. Risks like this, according to B05PICM, can have significant consequences, even though one cannot fully influence them. Which adds complexity to the project.

"The chosen *Contractvorm (47; 1.61)* has forced us to place many responsibilities and tasks with the contractor, which means we mainly have indirect control and (too much discussion about the desired result and additional work" (B01PRPM). *Aantal uitvoeringscontracten en interfaces daartussen (22; 1.02)* is not mentioned specifically by any of the participants.

Talking about *Vertrouwen tussen projectteam en aannemer(s) (1; 1.88), B05PICM states that* "In the absence of trust, information is shared too late or not at all. The will to achieve a common goal is then lacking". Trust is therefore vital in order to maintain a workable situation and achieve the best results (B01PRPM).

To the project manager of ProRail (B01PRPM), there was no *Politieke invloed (12; -1.88),* at least not noticeable. B05PICM mentions that they do not have contact with stakeholders, rendering *Discontinuïteit bemensing stakeholders (37; -1.67)* irrelevant to them.

A visual representation of perspective B1: Contract and trust is given on the next page in Figure 26. In it, the composite Q-grid of the perspective is shown, with the distinguishing statements of B1 in red, B2 in yellow, and consensus statements in grey. The participants in the perspective are also shown again for illustration purposes.

Perspective B2

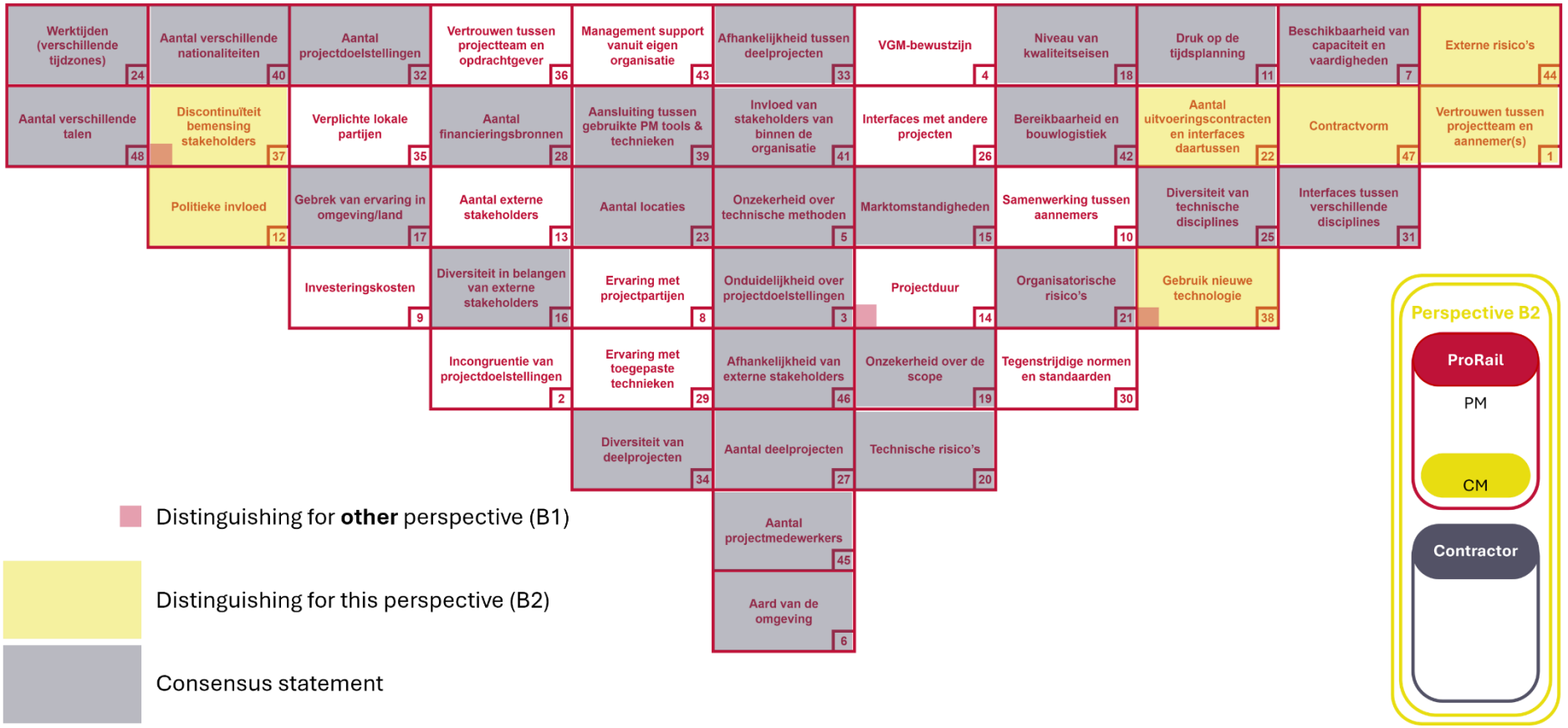


Figure 26: Composite Q-grid perspective B2 with distinguishing statements

4.4. Project C

Project C entails the construction of new bridge sections near a station in a large city.

In project C, three perspectives have been identified.

Perspective C1: Number of sub-projects and influencing stakeholders
Perspective C2: Political & Management
Perspective C3: Technical & Environment

These perspectives have an explained variance of 20%, 21% and 21% respectively, accumulating in a total explained variance of 62%.

The correlation between the two perspectives is shown in Table 10. below. These correlations are quite high, indicating a more shared vision on the complexity of the project, than within the other projects.

Table 10: Correlation between perspectives in project C

	1	2	3
1	1	0.66	0.69
2		1	0.56
3			1

The participants per perspective are shown in Figure 27. This project was the only project with participants not automatically flagged due to loading high onto multiple perspectives. These are marked with an asterisk in the figure.

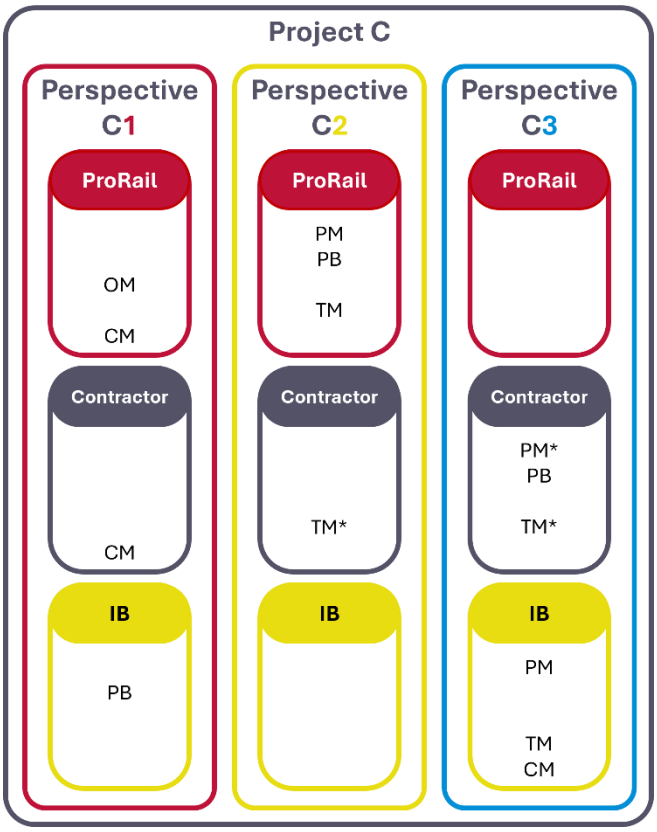


Figure 27: Perspectives in project C

4.4.1. Perspective C1: Number of subprojects and Influencing stakeholders

Participants in **C1** perceive complexity as stemming from both external and internal stakeholders. From the waterboard, municipality and local public transport, to the asset management department. But, unlike **C2**, not from higher up: Politics and higher internal management. The number of subprojects and their dependencies add complexity as well.

Perspective **C1** has an explained variance of 20%. The only project environment manager (PR) is in this perspective, as are two of the contract managers (PR & AN) and the project control manager for the IB, for a total of four participants.

The distinguishing statements of this perspective are shown in Figure 28. According to participants in this perspective, the elements in red add significantly more complexity to the project than according to the other perspectives, the elements in grey are in between, and the elements in yellow add significantly less than the others think. The numbers in **bold** represent the column of the element in the Q-sort from this perspective. The other two numbers represent the other perspectives.

+	Aantal deelprojecten	**3** | -4 | -1
+	Afhankelijkheid van externe stakeholders	**5** | 1 | 2
±	Aantal uitvoeringscontracten en interfaces daartussen	**2** | 5 | -3
-	Interfaces tussen verschillende disciplines	**1** | 4 | 3
-	Aansluiting tussen gebruikte PM tools & technieken	**-3** | 1 | -1

Figure 28: Distinguishing statements perspective C1

C09ANCM states that, because of the significant *Aantal deelprojecten (element 27; Z-score of 1.23),* the project is very complex. Due to the sheer number of interfaces introduced by the number of subprojects.

The participants in **C1** are split on the complexity added by *Aantal uitvoeringscontracten en interfaces daartussen (22; 1.02)*. C03PROM states that the project is experiencing difficulties with executability and schedule due to its division into multiple contracts. Especially the parts of the contracts that overlap. C09ANCM adds that the project has been 'cut' into multiple contracts, which then have to be 'glued' back together in terms of time and space, which is sometimes hard to do in practice. The others in the perspective, however, rank this element as insignificant.

The elements *Interfaces tussen verschillende disciplines (31; 1.18)* and *Aansluiting tussen gebruikte PM tools & technieken (39; -0.59)* rank significantly lower according to participants in **C1**. The first element is not specifically mentioned, but according to C03PROM, "the problem is not in the incompatibility between PM methods and tools, although some colleagues do complain about it sometimes." C09ANCM also sees no complexity added by this element.

Although not a distinguishing statement, the *Afhankelijkheid van externe stakeholders (element 46; Z-score of 1.61)* adds significant complexity, according to participants in this perspective, compared to the others (column 5 versus 1 and 2). It is characterising for this perspective. According to C05PRCM, the project is dependent on the water board and the municipality for the use of the waterways surrounding the project. C03PROM adds that the project is also dependent on the municipality and local public transport companies for road accessibility and that these parties add multiple high demands on the execution methods and schedule.
Besides the influence of external stakeholders, the internal stakeholders also have significant sway, adding complexity to this project *(Invloed van stakeholders binnen de organisatie; 41; 1.03)*. C09ANCM: "The asset management organisation of ProRail has a lot of influence on the project but is not in the project team. However, as the accepting party, it does have considerable influence."

The biggest difference between perspectives **C1** and **C2** is that **C1** sees much more complexity due to the number of subprojects, with a Z-score difference of 2.64. Followed by the (lack of) management support from the own organisation, which **C2** finds significantly more complex (Difference of 1.72).

Between **C1** and **C3**, the biggest differences lie in the influence of stakeholders within the organisation (difference of 2.02), and the number of contracts and interfaces between them (difference of 2.00).

A visual representation of perspective **C1**: Influencing stakeholder is given on the next page in Figure 29. In it, the composite Q-grid of the perspective is shown, with the distinguishing statements of **C1** in red, **C2** in yellow, **C3** in blue, and consensus statements in grey. The participants in the perspective are also shown again for illustration purposes.

Perspective C1

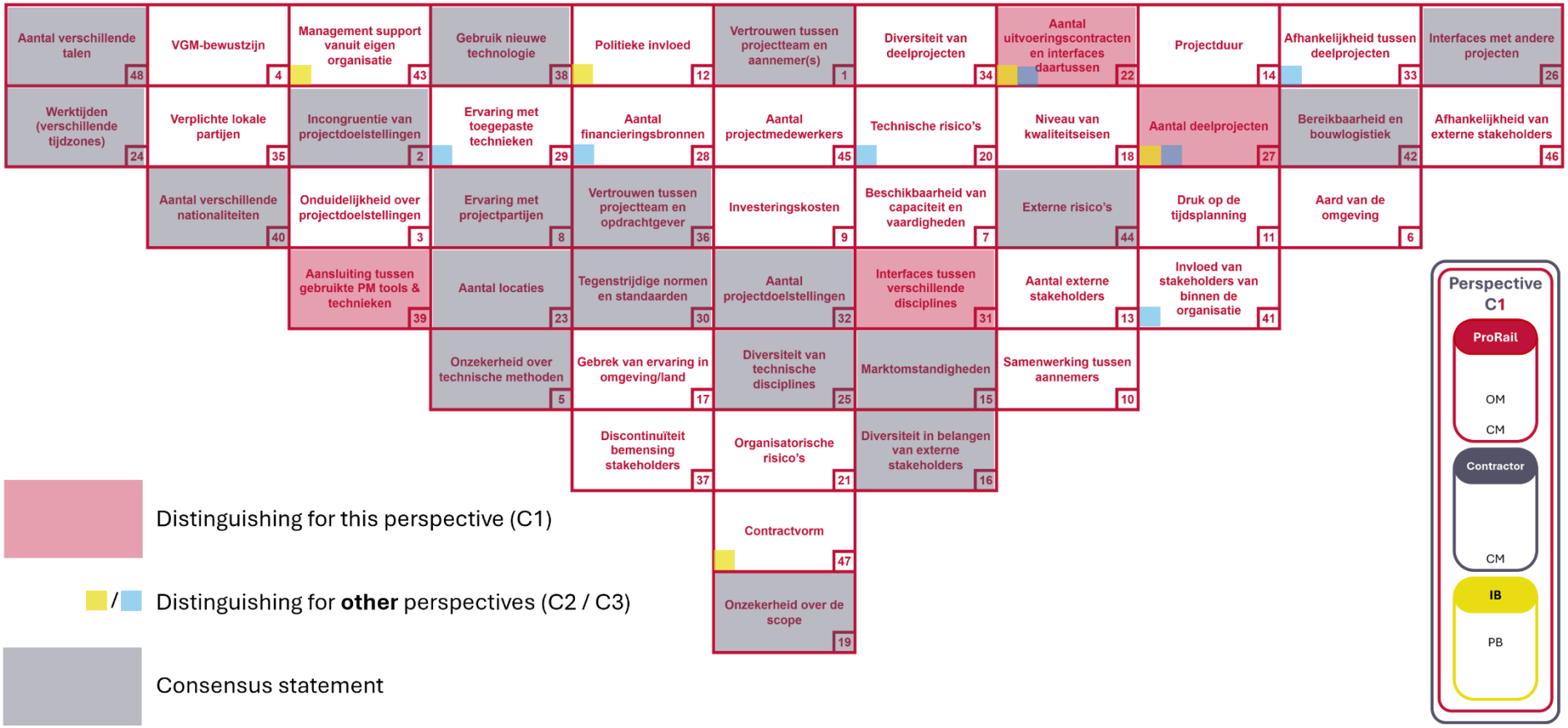


Figure 29: Composite Q-grid perspective C1 with distinguishing statements

4.4.2. Perspective C2: Political & Management

The participants who agree most with the second perspective of project C, find significantly more complexity stemming from politics and the (higher) management of their own organisation. The sheer number of contracts and their interactions lead to complexity across time, technology, and collaboration. The type of contracts, however, is less of an issue.

C2 has an explained variance of 21%. In total, three people fall significantly into this perspective, all from ProRail. The technical manager of the contractor also loads high on this perspective, although they load high on perspective C3 as well.

The distinguishing statements of this perspective are shown in Figure 30. According to participants in this perspective, the elements in red add significantly more complexity to the project than according to the other perspectives, the elements in grey are in between, and the elements in yellow add significantly less than the others think. The numbers in **bold** represent the column of the element in the Q-sort from this perspective. The other two numbers represent the other perspectives.

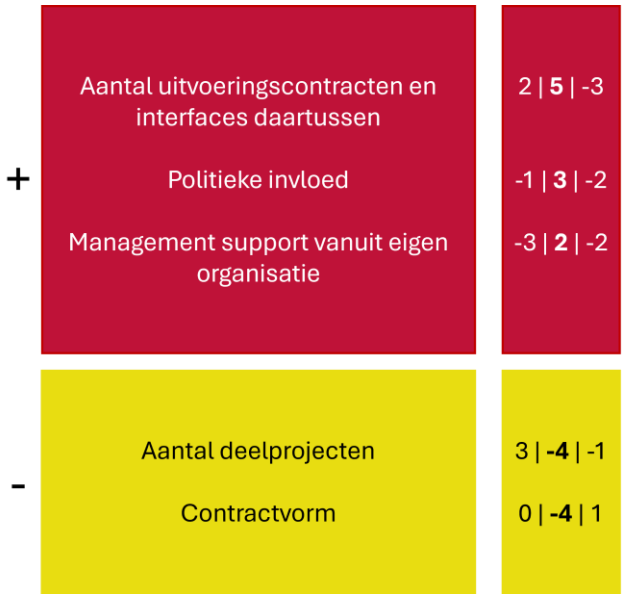


Figure 30: Distinguishing statements perspective C2

The highest loading element in this perspective is the *Aantal uitvoeringscontracten en interfaces daartussen (22; 2.15)*. "*The* complexity of this project is due to too much work, by too many parties, in too little space, in too little time, with too little money. This works through all contracts, including this one", states C02PRPB. "The large scope has been cut into pieces to be able to control the project. However, those who cut must glue as well" (C01PRPM). In the end, C04PRTM says, "all pieces must function as a single system. This requires a great deal of technical coordination and alignment of conflicting interests. Everything is interconnected". This interconnectedness leads to complexity in time, in technology, and in collaboration (C08ANTM).

Politieke invloed (12; 0.86) plays a large role in complexity according to C01PRPM. It is unpredictable and difficult to control. It often is based more on gut feeling than on actual logic, yet it has a profound effect on the project. *Management support vanuit eigen organisatie (43; 0.79)* also adds significantly more complexity according to participants in this project. C04PRTM states that although there is currently support, the risk of losing it is significant enough to warrant consideration. He continues that *Invloed van stakeholders van binnen de organisatie* (41; 1.22), especially asset management, can significantly impact the project by acting inflexibly and unengaged.

C01PRPM mentions that the *Aantal deelprojecten (27; -1.41)* itself does not add complexity. Only due to the interaction and interfaces between these subprojects, the project becomes complex.

The *Contractvorm (47; -1.53)* is well known to all parties involved according to C01PRPM and thus does not add complexity. C04PRTM agrees that the contract form is easy to handle.

As mentioned before, the biggest differences between C1 and C2 are the number of subprojects (a difference of 2.64) and the internal management support (1.72).

The largest difference between C2 and C3 is the *uitvoeringscontracten en interfaces daartussen* (difference of 3.13) on one hand. But perhaps a more striking difference is that C2 sees significantly more complexity stemming from the influence of internal stakeholders (2.20), politics (1.54) and management support (1.50).

A visual representation of perspective C2: Political & Management is given on the next page in Figure 31. In it, the composite Q-grid of the perspective is shown, with the distinguishing statements of C1 in red, C2 in yellow, C3 in blue, and consensus statements in grey. The participants in the perspective are also shown again for illustration purposes.

Perspective C2

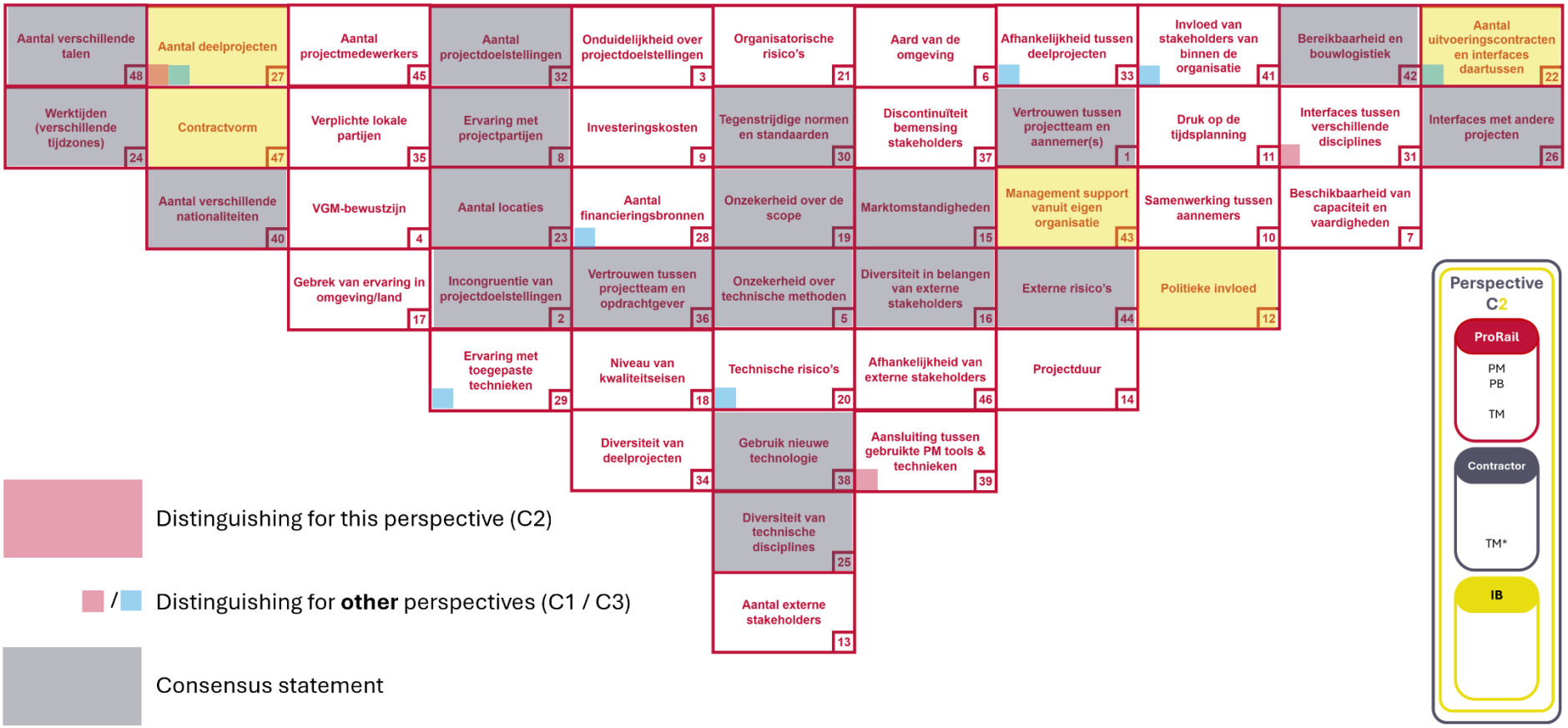


Figure 31: Composite Q-grid perspective C2 with distinguishing statements

4.4.3. Perspective C3: Technical & Environment

People in **C3** find complexity in the technical risks and the busy environment. They concern themselves less with the influence of politics and internal stakeholders, how money flows to the project, and the different contracts.

The final perspective of project C has an explained variance of 21%. Most of the participants from the engineering firm are in this perspective. The manager project control of the contractor also loads on this perspective. The project manager of the contractor loads similarly on all perspectives but coincides most with this perspective. The technical manager of the contractor loads both on this perspective and on **C2**. Only participants from private parties load on this perspective.

The distinguishing statements of this perspective are shown in Figure 32. According to participants in this perspective, the elements in red add significantly more complexity to the project than according to the other perspectives, the elements in grey are in between, and the elements in yellow add significantly less than the others think. The numbers in **bold** represent the column of the element in the Q-sort from this perspective. The other two numbers represent the other perspectives.

+	Technische risico's	1 | 0 | **3**
	Ervaring met toegepaste technieken	-2 | -2 | **2**
±	Aantal deelprojecten	3 | -4 | **-1**
-	Afhankelijkheid tussen deelprojecten	4 | 2 | **0**
	Aantal uitvoeringscontracten en interfaces daartussen	2 | 5 | **-3**
	Invloed van stakeholders binnen de organisatie	3 | 3 | **-3**
	Aantal financieringsbronnen	-1 | -1 | **-4**

Figure 32: Distinguishing statements perspective C3

"The technical risks in this project are quite big in this project, and our role is to assess this aspect and inform the client", says C11IBTM about the element *Technische Risico's (20; 1.37)*. C06ANPM adds that the project is technically complex, as this construction method has never been used in the Netherlands to date. That is why *Ervaring met toegepaste technieken (29; 0.55)* adds complexity to this project according to **C3**.

Even though it is not a distinguishing statement, the *Aard van de omgeving (6; 1.784)* adds significant complexity to the project in the eyes of **C3** (column 5; **C1** is column 4, and **C2** is column 1). It is specifically mentioned by multiple people in this perspective. C07ANPB says that the location makes the execution of this project complex. Local public transport, cars, bikes, pedestrians, all are in close proximity to the site. "The project must be realised in a It is a busy and complex environment", says C12IBTM. Both C07ANPB and C13IBCM call it "building on a post stamp". Every single person in that load most on this perspective has *Interfaces met andere projecten* (26; 2.30) as one of their two most complex elements. "There are many interfaces, not only technically but also in schedule, between this project and other projects in the programme, which have a big impact on all aspects of project management," says C10IBPM. "Monitoring these interfaces is an important part of our work", C12IBTM adds. "The biggest complexity is the interfaces and dependencies between different contractors; multiple projects depend on one big schedule. If one contractor lags behind, everyone does" C07ANPB.

Afhankelijkheid tussen deelprojecten (33; -0.25), however, ranks lower in this perspective. Participants feel that dependencies and interfaces between projects add complexity, but that dependencies between sub-projects add less complexity. The *Aantal deelprojecten (27; -0.42)* is also not that complex.

Aantal uitvoeringscontracten en interfaces daartussen (22; -0.98) is seen as adding relatively less complexity for the participants in **C3**. C12IBTM states that, for them, it does not add complexity, although they recognise it could for the client.

Invloed van stakeholders binnen de organisatie (41; -0.99) is of no issues, it is managed, as per C10IBPM. *Aantal financieringsbronnen (28; -1.41)* adds little complexity for the people in this perspective. C06ANPM mentions that ProRail is the only financier, and C07ANPB states that the contractor did not need to borrow for this project (and contract).

A visual representation of perspective **C3**: is given on the next page in Figure 33. In it, the composite Q-grid of the perspective is shown, with the distinguishing statements of **C1** in red, **C2** in yellow, **C3** in blue, and consensus statements in grey. The participants in the perspective are also shown again for illustration purposes.

Perspective C3

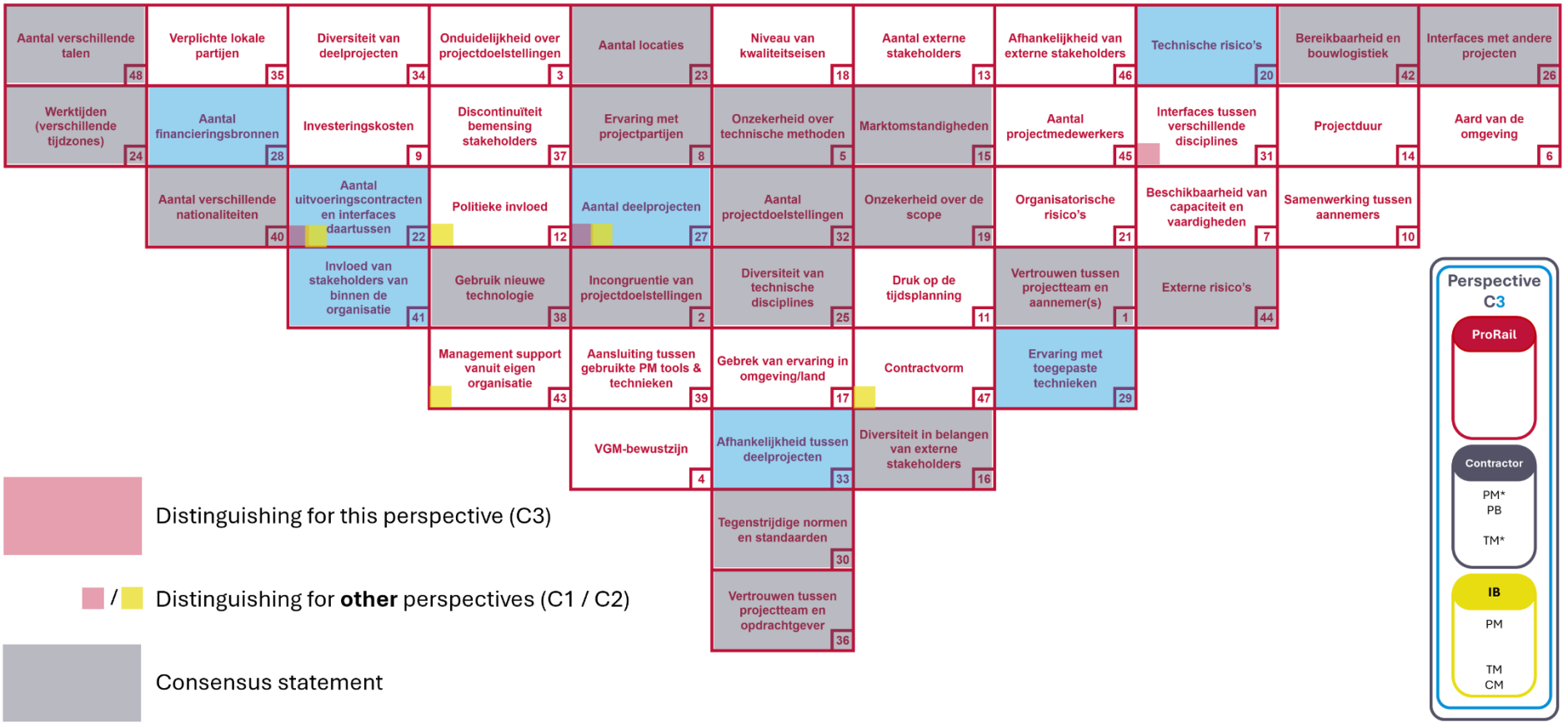


Figure 33: Composite Q-grid perspective C3 with distinguishing statements

4.5. Conclusion of interpretation of perspectives within projects

In this chapter, the factors as identified in chapter 3 have been interpreted. This resulted in seven perspectives. These seven perspectives are a start of the answer to sub question one:

SQ1 What perspectives on project complexity can be found when looking within individual projects?

When looking at individual projects, each project had two or more distinct perspectives emerge. Below, a list of each of these perspectives is given.

Perspective **A1**: Trust and uncertainty
Perspective **A2**: Accessibility, availability & dependency

Perspective **B1**: Discontinuity of stakeholders and duration
Perspective **B2**: Contract and trust

Perspective **C1**: Number of sub-projects and influencing stakeholders
Perspective **C2**: Political & Management
Perspective **C3**: Technical & Environment

Chapter 6 delves deeper into what these different perspectives mean.

5.

Interpretation of perspectives overarching set

In this chapter the perspectives that emerge when considering the participants of all projects at the same time are interpreted. This chapter aims to give a start to answer sub question two:

SQ2 What perspectives on project complexity can be found when looking between multiple projects?

To that end, first an overview is given of the three perspectives in section 5.1. Then, for each of the perspectives, a short interpretation segment is shown in 5.2 through 5.4. Showing the distinguishing statements for each of the three overarching (or total) perspectives. After the perspectives have been shown, the consensus statements are given in 5.5. Finally, in 5.6, a conclusion of this chapter is given.

5.1. Overview of the complexity perspectives of the overarching set

When considering all three projects, three perspectives emerge. First, a quick look is given on a project basis, and then on a perspective basis. The three perspectives and the participants loading on them are shown in Figure 34. Four participants do not load on any perspective.

Project A
No participants from project A load in perspective T1. They are split between T2 and T3. With all participants from the contractor loading in perspective T2, and most ProRail respondents in T3. T2 consists solely of participants from project A. Neither the project managers of project A nor the technical manager of the contractor load significantly on any of the perspectives.

Project B
Project B loads into perspective T1 and T3 quite evenly, with people from each company in either. Also, the roles that are present more than once in this project are split between the two perspectives. All participants in project B load significantly on one of these two perspectives.

Project C
All participants of project C that load significantly on a perspective, load into perspective T1. The project environment manager and technical manager of ProRail, and the contract manager of the contractor, do not load significantly, as they load on two perspectives.

Perspective T1
When looking per perspective, the first thing that comes to mind in perspective T1, is that no one from project A loads on it. The other projects have a mixture of different roles and companies.

Perspective T2
No participants from projects B and C load on perspective T2. Both project control managers and all contractor personnel from project A who load on a perspective load on this one.

Perspective T3
Participants from projects A and B load on this perspective. Almost all people in this perspective are from ProRail, save for the technical manager from contractor of project B.

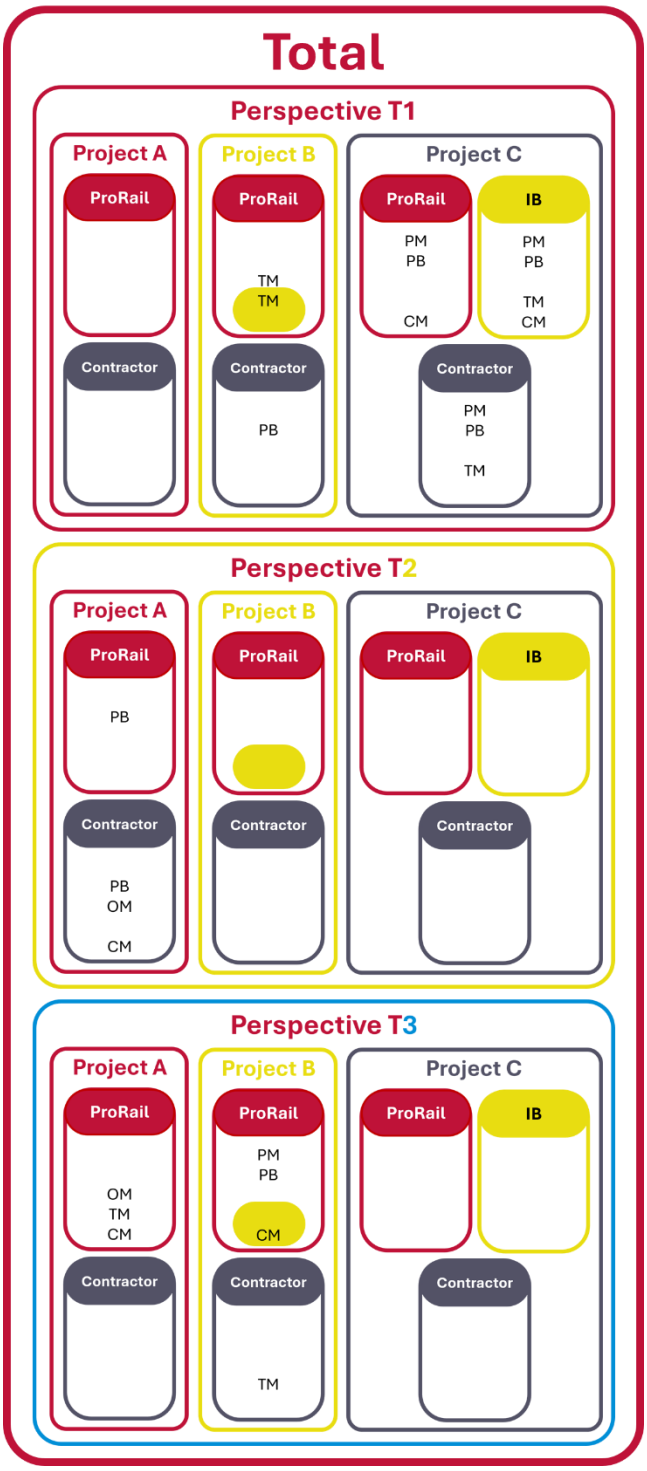


Figure 34: Perspectives in total

5.2. Perspective T1: Project environment and no lack of trust

The participants in this perspective feel significantly less project complexity due to (the lack of) trust between the team and both the client and the contractors. The participants see more complexity stemming from the project surroundings, logistics, duration and other projects.

This perspective is shared amongst all personnel in project C, as well as some from project B. In total, 13 out of 30 participants load on this perspective. It has an explained variance of 24%.

The distinguishing statements of this perspective are shown in Figure 35. According to participants in this perspective, the elements in red add significantly more complexity to the project than according to the other perspectives and the elements in yellow add significantly less than the others think. The numbers in **bold** represent the column of the element in the Q-sort from this perspective. The other two numbers represent the other perspectives.

+	Interfaces met andere projecten	**5** | 1 | 1
	Projectduur	**4** | -1 | 0
	Aard van de omgeving	**4** | 0 | -1
	Bereikbaarheid en bouwlogistiek	**5** | 0 | 3
-	Vetrouwen tussen projectteam en opdrachtgever	**-1** | 5 | 1
	Vertrouwen tussen projectteam en aannemer(s)	**1** | 4 | 5

Figure 35: Distinguishing statements perspective T1

5.3. Perspective T2: High uncertainty and lack of trust

For people in this perspective, the project environment is less of an issue. The greatest source of complexity is the lack of trust, both between the team and the client and between the team and the contractors. Although the lack of trust between the client is more significantly distinguishing for this perspective. Uncertainty about the scope, due in part to conflicting norms and standards and to reliance on external stakeholders, is also attributable.

This perspective is only shared with participants from project A, including all participants from contractor A. In total, 4 out of 30 participants load on this perspective. It has an explained variance of 10%.

The distinguishing statements of this perspective are shown in Figure 36. According to participants in this perspective, the elements in red add significantly more complexity to the project than according to the other perspectives and the elements in yellow add significantly less than the others think. The numbers in **bold** represent the column of the element in the Q-sort from this perspective. The other two numbers represent the other perspectives.

+	Vetrouwen tussen projectteam en opdrachtgever	-1 | **5** | 1
	Afhankelijkheid van externe stakeholders	3 | **5** | 1
	Vertrouwen tussen projectteam en aannemer(s)	1 | **4** | 5
	Onzekerheid over de scope	1 | **4** | 0
	Tegenstrijdige normen en standaarden	-1 | **4** | 1
-	Beschikbaarheid en vaardigheden	3 | **-2** | 5
	Bereikbaarheid en bouwlogistiek	5 | **0** | 3

Figure 36: Distinguishing statements perspective T2

5.4. Perspective T3: Resource scarcity, schedule pressure and lack of trust

Finding the right resources and skills for their projects, combined with pressure on the schedule, adds the most complexity, according to **T3**. As well as the lack of trust between the team and contractors (notably, the trust between the team and client is not seen as that complex). Influence from politics, on the other hand, is irrelevant to the participants in **T3**.

This perspective consists mostly of ProRail professionals from projects A and B, supplemented with the technical manager from project B. In total, 7 of 30 participants adopt this perspective. It has an explained variance of 15%.

The distinguishing statements of this perspective are shown in Figure 37. According to participants in this perspective, the elements in red add significantly more complexity to the project than according to the other perspectives and the elements in yellow add significantly less than the others think. The numbers in **bold** represent the column of the element in the Q-sort from this perspective. The other two numbers represent the other perspectives.

+	Beschikbaarheid van capaciteit en vaardigheden	3 | -2 | **5**
	Vertrouwen tussen projectteam en aannemer(s)	1 | 4 | **5**
	Druk op de tijdsplanning	3 | 1 | **4**
	VGM-bewustzijn	-4 | -4 | **2**
-	Politieke invloed	0 | 1 | **-4**

Figure 37: Distinguishing statements perspective T3

5.5. Consensus between projects

Until now, the differences between the perspectives have been elaborated. But there are also complex elements that everyone agrees on. Figure 38 lists these elements in order of decreasing complexity. Notably, the External and Technical risks are ranked relatively high across all perspectives.

Externe risico's	3 | 3 | 4
Technische risico's	2 | 2 | 3
Marktomstandigheden	2 | 0 | 2
Aantal uitvoeringscontracten en interfaces daartussen	1 | 1 | 2
Samenwerking tussen aannemers	2 | 0 | 1
Discontinuïteit bemensing stakeholders	0 | 1 | 0
Invloed van stakeholders van binnen de organisatie	1 | -1 | 0
Onzekerheid over technische methoden	0 | -2 | 0
Aantal projectmedewerkers	0 | -1 | -1
Ervaring met toegepaste technieken	-1 | -1 | -1
Gebrek van ervaring in omgeving/land	-2 | -1 | -2
Aantal projectdoelstellingen	-2 | -1 | -3
Aantal locaties	-2 | -3 | -2
Aansluiting tussen gebruikte PM tools & technieken	-2 | -3 | -3
Aantal verschillende nationaliteiten	-4 | -4 | -5
Werktijden (verschillende tijdzones)	-5 | -5 | -4
Aantal verschillende talen	-5 | -5 | -5

Figure 38: Consensus statements

5.6. Conclusion of interpretation of perspectives overarching set

This chapter aimed to answer part of sub question two:

SQ2 What perspectives on project complexity can be found when looking between multiple projects?

When looking at all projects at once, three perspectives emerged.

- A perspective that ranks complexity stemming from the lack of trust significantly lower. And elements related to the project environment significantly higher. Everyone on project C loaded on this perspective.
- A perspective that finds more complexity from the lack of trust between the team and both client and contractor, and high uncertainties. Mostly contractors and only people from project A were in this perspective.
- A perspective that finds high complexity from the lack of trust with specifically the contractor, resource scarcity, and pressure on schedule. Mostly ProRail loaded on this perspective.

Chapter 6 delves deeper into what these different perspectives mean.

6.

Results from the different perspectives

In this chapter, the interpreted perspectives from chapter 4 and 5, will be compared. Both within project as well as between projects. First an overview is given of all the perspectives of the individual projects in 6.1. Then these perspectives are compared and reflected upon in 6.2. through 6.8. After these individual projects, an overview is given of the overarching perspectives in 6.9. These perspectives are also analysed in 6.10 through 6.12.

The different perspectives are shown starting from the next page, so that all perspectives of project A and B are shown on the left page in Figure 39 and Figure 40, and the perspectives of project C are shown on the right page in Figure 41.

This chapter aims to give more meaning to the perspectives found in chapter 4 and 5. It adds to the answers to sub question 1 and 2:

SQ1 What perspectives on project complexity can be found when looking within individual projects?

SQ2 What perspectives on project complexity can be found when looking between multiple projects?

The chapter also looks into where the perspectives stem from, answering sub question three:

SQ3 Where do the perspectives on project complexity stem from?

6.1. Overview of Perspectives within individual projects

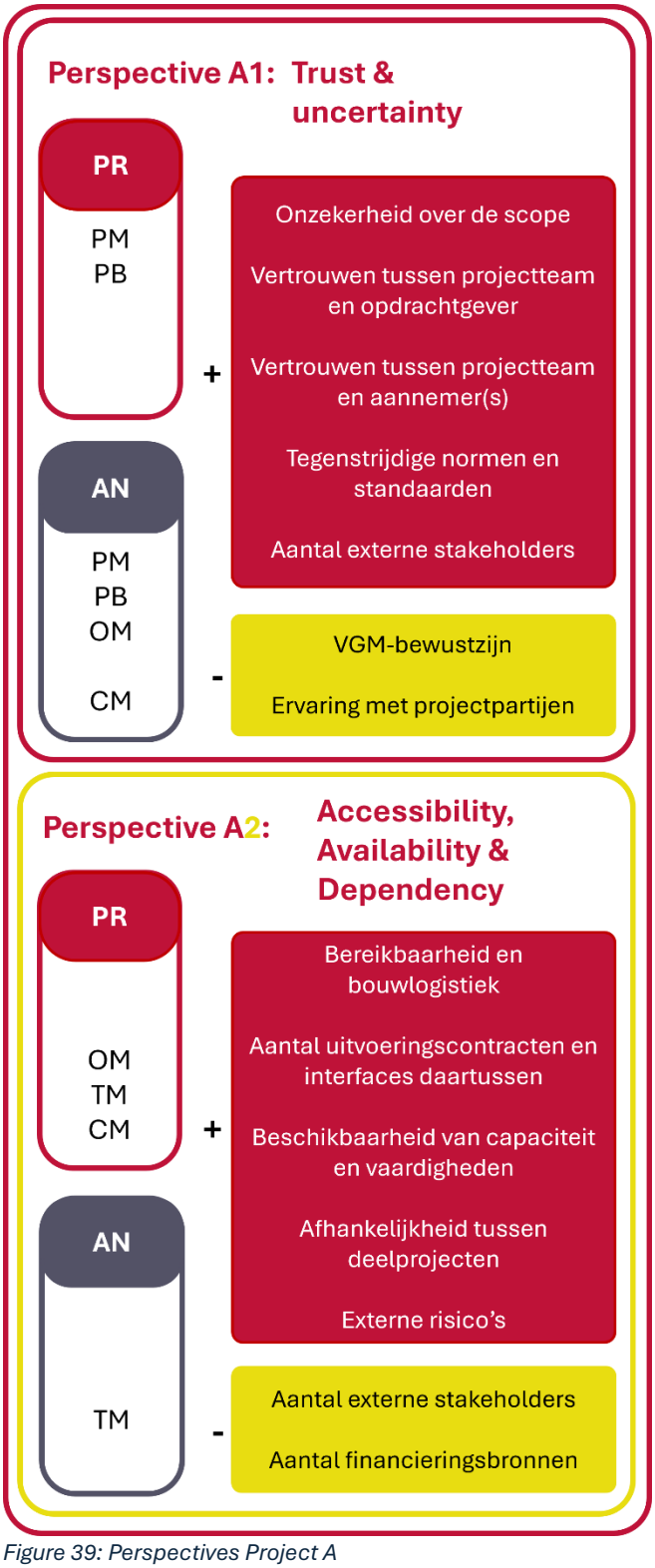


Figure 39: Perspectives Project A

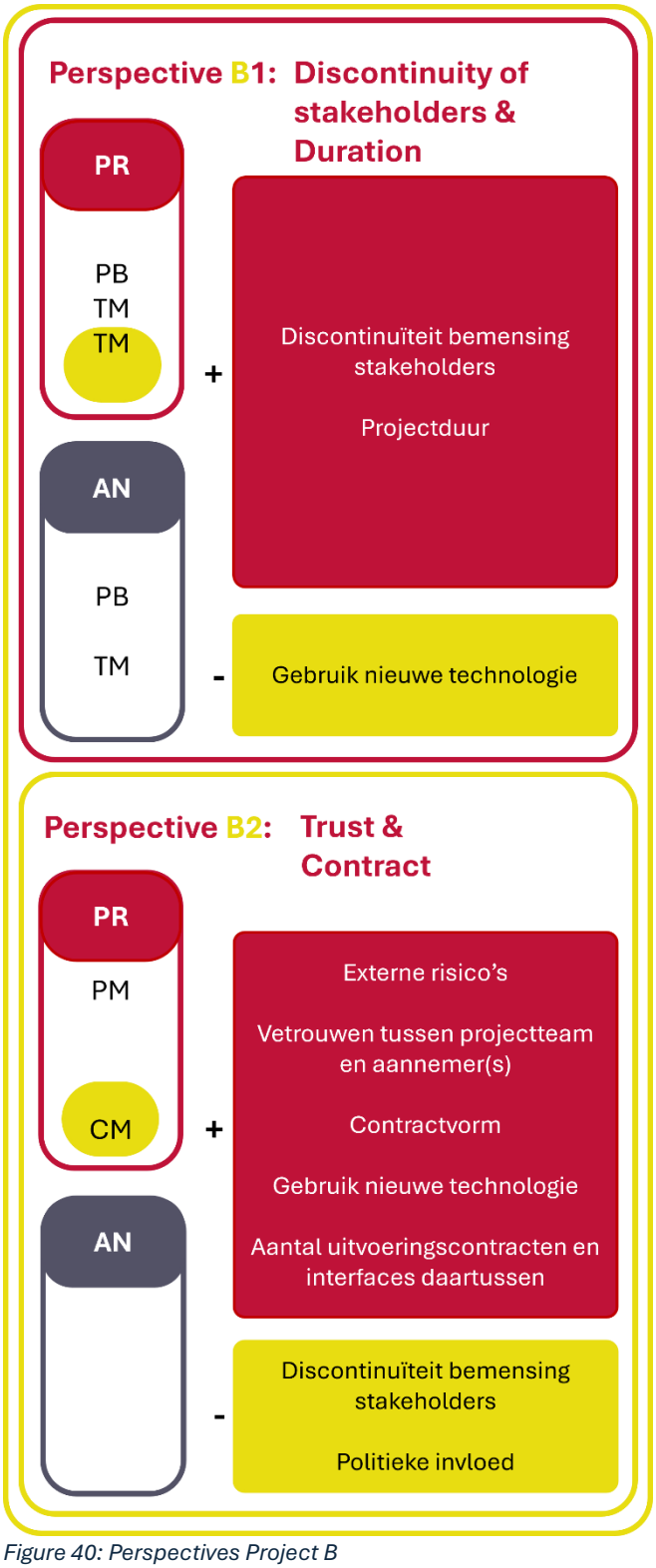


Figure 40: Perspectives Project B

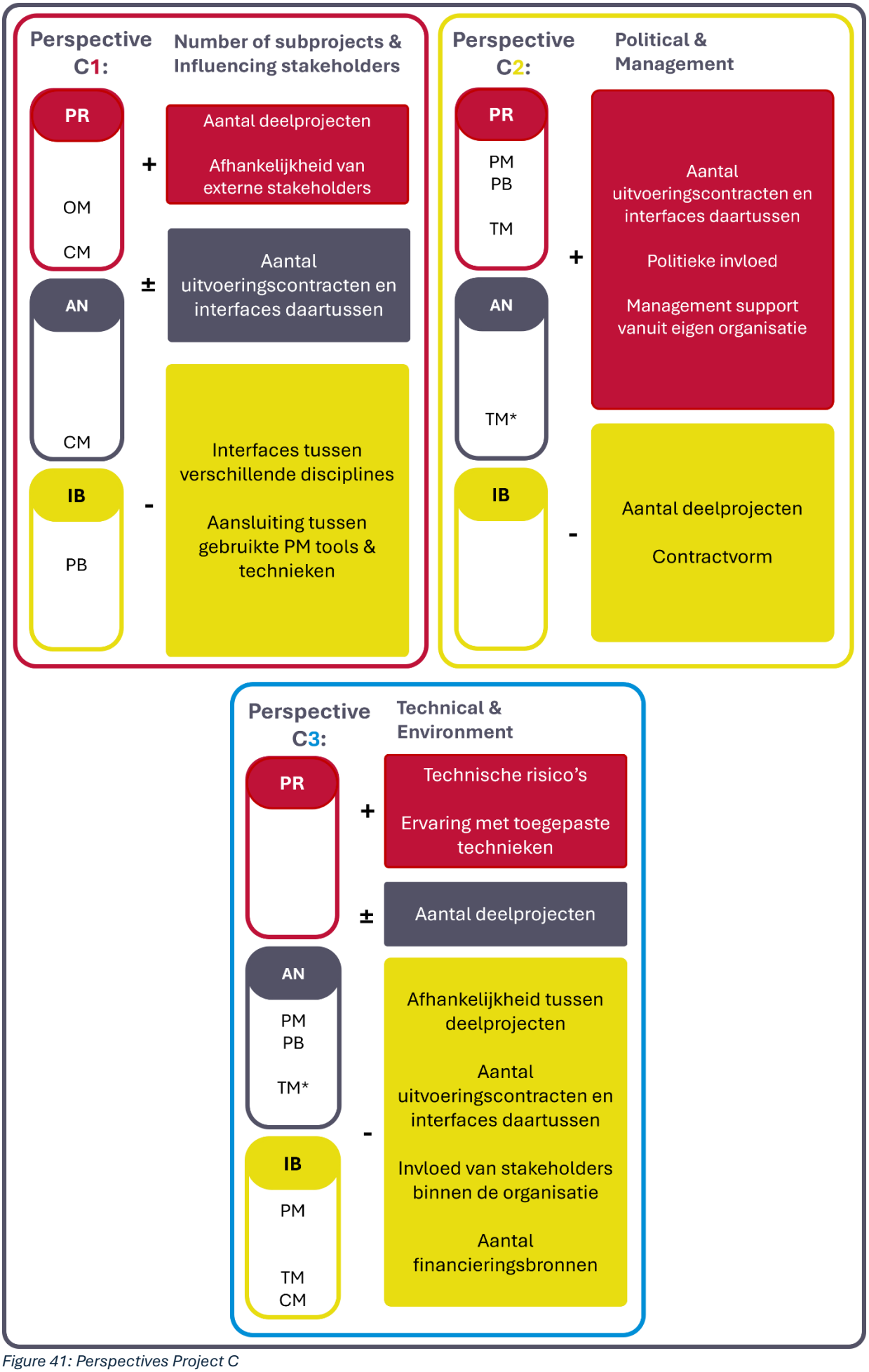


Figure 41: Perspectives Project C

6.2. Multiple perspectives

In each of the analysed projects, multiple perspectives on project complexity were found within single teams. In each project, at least two statistically significant perspectives emerged. This is an indication that team members within projects perceive complexity differently. This coincides with the notion by Mikkelsen (2021) that complexity is in the eye of the beholder. But, where Mikkelsen (2021) asked project professionals about their perspective on project complexity in general, this research asked about the perceived complexity of specific projects. It supports the school of perceived complexity as described by Vidal and Marle (2008).

These perspectives are not minor variations on each other but represent significantly different stances on which elements add complexity to the project. For example, in project A, one perspective ranks Onzekerheid over de scope at +5, while the other ranks it at -1. On the flipside, the other perspective ranks *Bereikbaarheid en bouwlogistiek* at +5, while the first perspective ranks it at 0. This represents fundamentally different ideas about what makes the project complex.

An implication of the differences in perspective, is that individuals might not realise that certain aspects are deemed complex by others. After some of the sessions, participants asked others how they had ranked the elements, causing impromptu discussions on the project.

6.3. Role

When looking at the different perspectives with the project roles in mind, each project paints a different picture.

In project A, the project managers, managers project control and technical managers, loaded in the same perspective as their counterpart, whilst the project environment managers and contract managers were split in both perspectives.

Project B, all roles that were present more than once (only the managers project control and technical managers) aligned with the others with the same role.

In project C, none of the roles fully aligned with a single perspective. For example, the PB of the IB loaded on perspective C1, PBPR on C2, and PBAN on C3.

In project A and B, the more content driven roles, PB and TM align with each other. This is not always the case however, since in project C the PBs are spread through all perspectives, and the TM across two perspectives.
In each of the projects where the lack of trust was considered as adding a lot of complexity by one perspective (A and B), all project managers load onto that perspective.

Figure 42 visualises the alignment of role and perspective.

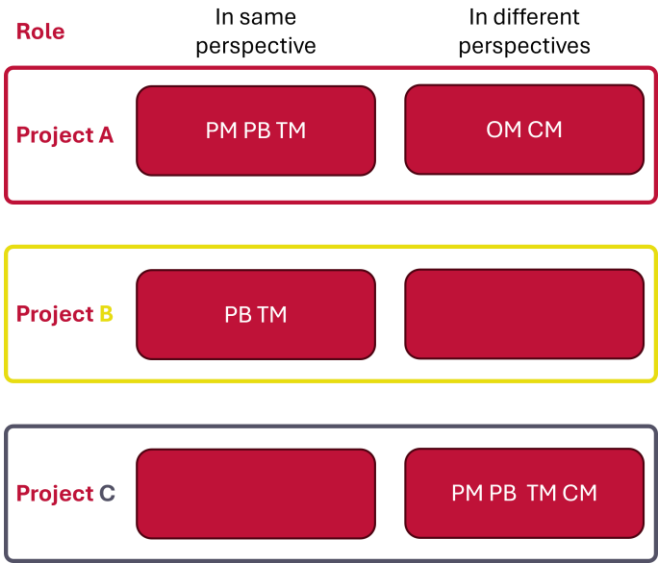


Figure 42: Alignment of Role and perspective

6.4. Company

In all but one case, participants of a company load on multiple different perspectives. The only exception are the participants from the contractor of project B. However, there were only two participants in that category. Figure 43 shows the alignment of company and perspective. The level of unalignment might be a bit exaggerated in this figure as in project C, the second perspective Political & Management, consists of mostly professionals from ProRail. Whilst the third perspective, Technical & Environment, exists solely of professionals from private companies (AN and IB).

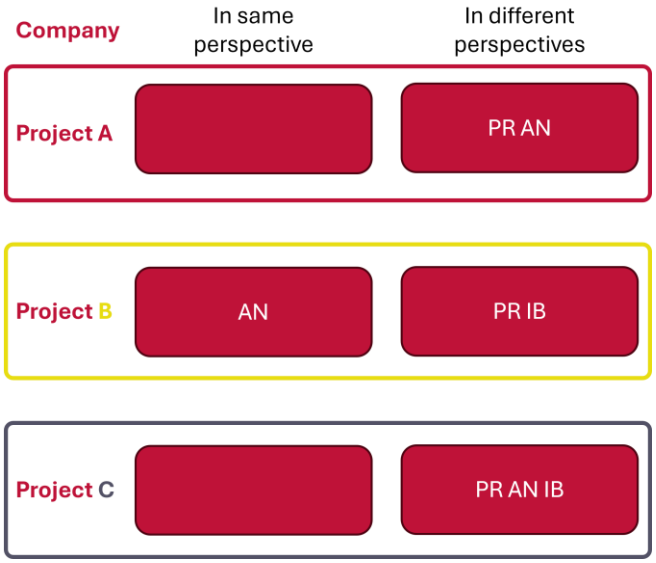


Figure 43: Alignment of Company and perspective

6.5. Role versus Company

Taking into account both role and company at the same time, each project is different.

Project A
- PM, PB and TM are in same perspective
- Most of contractor in perspective **A1**

Project B
- Roles are in same perspective
- Contractor is in same perspective

Project C
- Roles are spread
- **C3** is private companies only
- **C2** is mostly public

When looking at the correlations of the individual Q-sorts, an indicator to how (dis)similar the individual perspectives are (Van Exel & De Graaf, 2005), the points above seem to be supported. Table 11 shows the average correlation between the Q-sorts of participants within role and company per project.

Table 11: Correlation within Role and Company per project

Project	Role/Company	Correlation
A	Role	40
	Company	37
B	Role	43
	Company	44
C	Role	49
	Company	57

Project A shows a tad more similarity of the individual Q-sorts within role than within company. Project B have similar correlations. Project C shows more alignment in company versus role.

6.6. ProRail versus private

When comparing the individual Q-sorts, the participants from ProRail show less correlation than the private companies in each of the analysed projects. The correlations are shown in Table 12.

Table 12: Correlation ProRail, Contractor and Consultant

Project	Company	Correlation
A	ProRail	34
	Contractor	40
B	ProRail	30
	Contractor	51
	Consultant	52
C	ProRail	52
	Contractor	60
	Consultant	59

6.7. Experience

Taking into consideration the experience of project professionals as a potential source for the perspectives. Project B shows a clear distinction between project professionals with more experience and less experience. The participants in **B1** had an average of 8,6 years of experience, whilst the participants in **B2** had an average of 31 years of experience. Within the other projects, this distinction is less prevalent. With standard deviations two times as high.

6.8. Lack of trust

In two of the three projects (project A and B) one of the perspectives thought that the lack of trust adds high complexity to the project. In perspective **A1** *Vertrouwen tussen projectteam en opdrachtgever* is the highest complexity element at +5, whilst *Vertrouwen tussen projectteam en aannemer(s)* is at +4. The other perspective in A experiences less complexity from trust. In project B, perspective **B2** has *Vertrouwen tussen projectteam en aannemer(s)* at +5. These projects show a distinction of a perspective experiencing more complexity from the lack of trust and relational components versus a perspective more based on complexity from project content. In project C, the lack of trust is seen as adding relatively less complexity and shows a more nuanced difference. This is visualised in Figure 44.

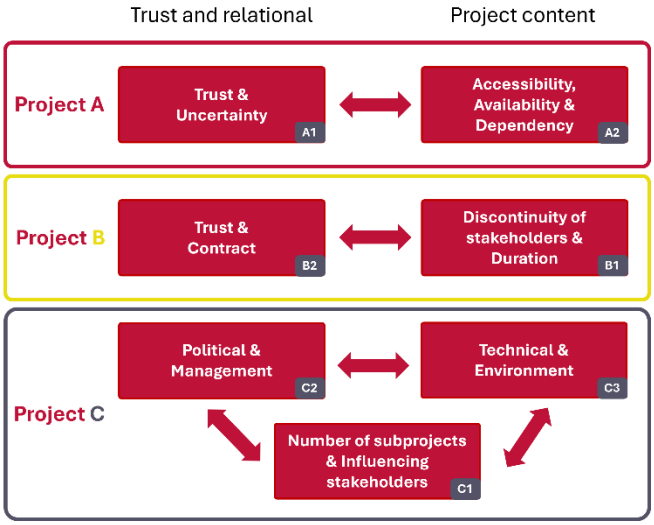


Figure 44: Trust and relational vs project content

According to the project manager of project C, a lot of attention has been paid to increase trust between parties from the start. The project has a project office where all parties can work together. They invested more resources into the relationship between parties than most projects. For example, by organising an 'estafette' (relay) multiple times a year. This is a meeting wherein all parties are present, and everyone is asked about their view on the project. To better align the stakeholders.

6.9. Overview of perspectives overarching

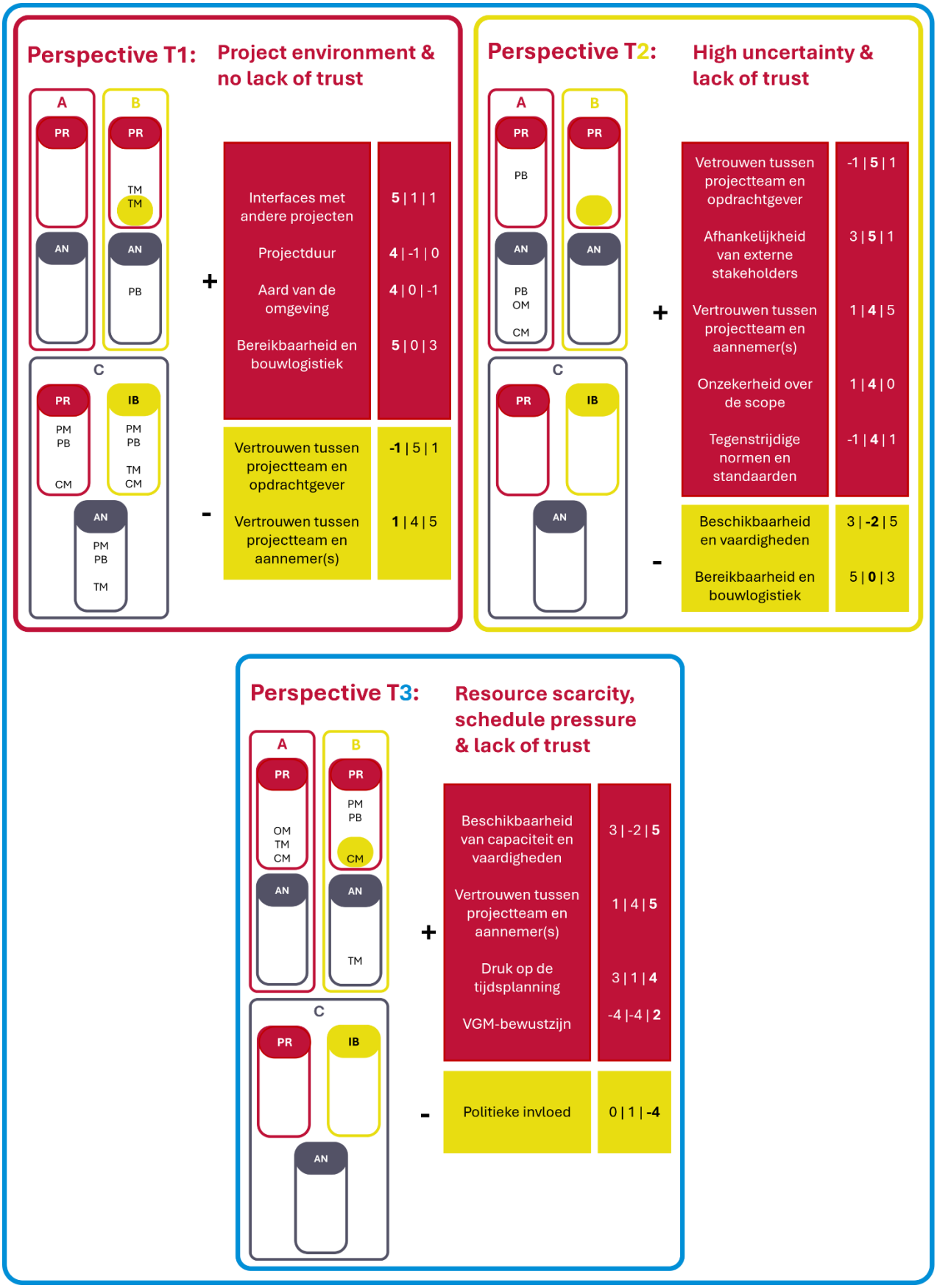


Figure 45: Perspectives of total

6.10. Perspectives from projects

When looking at the perspectives that emerge from combining the P-sets from all projects, shown in Figure 45, the project that someone works at seems to be the prevalent factor in explaining where perspectives stem from.

All participants from project C that load significantly, load on perspective T1. No participants of project A load on that perspective. Perspective T2 consists solely of participants from project A. A visualisation of this is made in Figure 46.

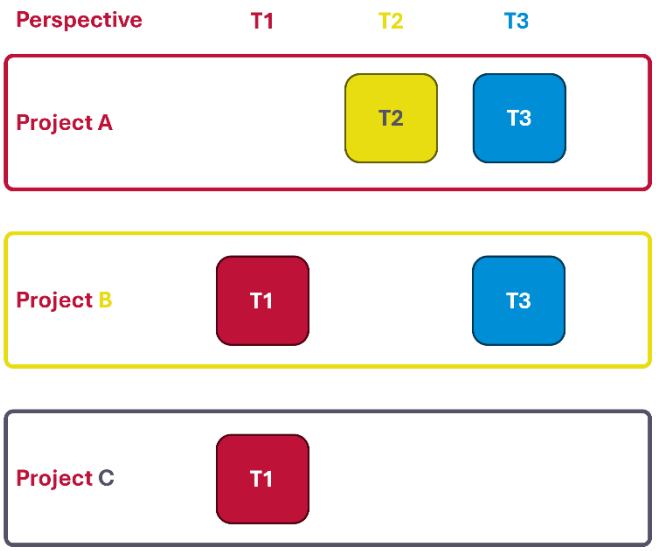


Figure 46: Perspectives per project

6.11. Lack of trust in overarching

Like in project A and B, lack of trust between team and contractor, and team and client are complexity elements that come forward in some of the perspectives. But in this overarching analysis, there are two different perspectives where this lack of trust is ranked as adding high complexity.

Perspective T2 ranks both *Vertrouwen tussen projectteam en aannemer(s)* and *Vertouwen tussen projectteam en opdrachtgever* high. Whilst perspective T3 only ranks *Vertrouwen tussen projectteam en aannemer(s)* high. In both of these perspectives none of the participants of project C are represented. This coincides with that in project C none of the perspectives ranked the lack of trust elements highly. Figure 47 shows perspective T2 and T3, without project C.

Perspective T2, where the lack of trust between the team and client ranks high, consists mostly of participants from a contractor. On the other hand, perspective T3, where the lack of trust between the team and contractors ranks high, consists mostly of participants of the client.

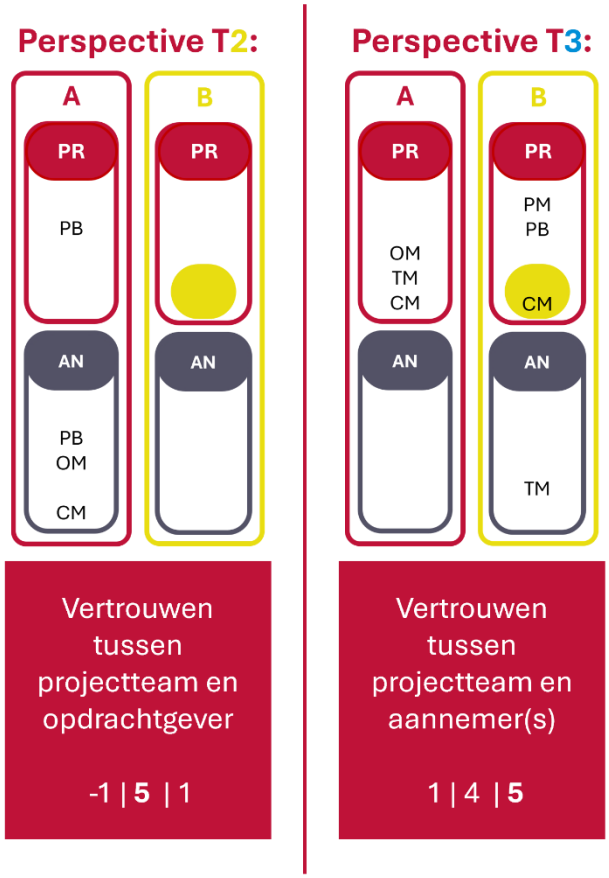


Figure 47: Lack of trust in client and contractor

6.12. Consensus in overarching

Whilst the perspectives differed significantly, the consensus statements of the overarching P-set reveal some shared understanding.

The external (+3 | +3 | +4) and technical risks (+2 | +2 | +3) were ranked relatively high across all overarching perspectives.

On the other hand, the consensus statements reveal several elements that are deemed irrelevant in the context of Dutch rail infrastructure projects: *Aantal verschillende nationaliteiten (-4 | -4 | -5)*, *Werktijden (verschillende tijdzones) (-5 | -5 | -4)*, and *Aantal verschillende talen (-5 | -5 | -5)*.

6.13. Conclusions of results

In this chapter the perspectives, interpreted in chapter 4 and 5 have been compared and insights have been drawn from them. These insights add context to the answers of sub question one and two, that were given in chapter 4 and 5.

SQ1 What perspectives on project complexity can be found when looking within individual projects?

To some, the experienced lack of trust between the team and the client/contractor was seen as adding high complexity to the project. In two projects, this led to a split on one hand with people that saw high complexity from this lack of trust, and another perspective finding more complexity from the content of the project.
In the third project, this was not repeated, and a more nuanced set of perspectives emerged. The team had put a lot of effort in establishing and maintaining trust between parties.

SQ2 What perspectives on project complexity can be found when looking between multiple projects?

In the overarching set, again, two perspectives ranked the lack of trust as highly complex. The third perspective did not experience high complexity from the lack of trust. On one hand the perspectives were focussed on trust and relational and on the other side was the perspective seeing more complexity from project content.

Besides adding to **SQ1** and **SQ2**, this chapter also starts to answer **SQ3**:

SQ3 Where do the perspectives on project complexity stem from?

The perspectives on project complexity do not neatly align with project role or company. In project A the perspectives align better with role, in project B perspectives align similar with role and company, and in project C perspectives align more with company. In project B, experience of the project professionals was a factor explaining the perspective. But this connection was not repeated for the other projects. When looking at the overarching set, the project in which participants operate seems to be the main explain factor. So, perspectives are influenced by the project. And finally, the lack of trust seems to be a factor where the perspectives stem from.

7. Discussion and limitations

In this chapter, first, the results presented in chapter 6 are discussed in section 7.1. Then the implications of the research are given in 7.2 and the limitations in 7.3.

7.1. Discussion on the perspectives found

This research was a study into different perspectives on project complexity within and between large rail infrastructure projects in the Netherlands, considering both project role and company. This was done using the Q-methodology in combination with the TOE framework. Three projects were analysed, with multiple roles across ProRail, contractors and engineering firms. The aim was to uncover whether the perspectives align with project roles, company affiliations, or other factors. In the next few paragraphs, the most striking findings will be discussed.

7.1.1. Perspectives do not align with roles or companies (fully)

One of the findings is that perspectives on project complexity within project teams do not necessarily align fully with role or company. Mikkelsen (2021) identified role-based differences and Kermanshachi and Safapour (2019) found company-based differences. This research poses a more nuanced view. In Table 13 the roles and parties per perspective are shown.

Table 13: Role and company per perspective

Perspective	Party	Role				
A1: Trust & uncertainty	PR AN	PM PM	PB PB	OM		CM
A2: Accessibility, availability & dependency	PR AN			OM	TM TM	CM
B1: Discontinuity of stakeholders & duration	PR AN IB		PB PB		TM TM TM	
B2: Contract & trust	PR AN IB	PM				CM
C1: Number of sub-projects & Influencing stakeholders	PR AN IB		PB	OM		CM CM
C2: Political & Management	PR AN IB	PM	PB		TM TM*	
C3: Technical & Environment	PR AN IB	PM PM	PB		TM* TM	CM

Role

In project A, the PMs, PBs and TMs share the same perspective, but the OMs and CMs load on different perspectives.
In project B, the PBs and TMs have the same perspective. The other roles were only represented by one participant.
In project C, each of the roles load onto multiple perspectives (except OM, but only one OM participated).
Mikkelsen (2021) found perspectives on project complexity based on role. In this research, role seems to be of influence on perspective, but roles do not neatly align with role. The perspective seems to be more individual.

Company

In project C, perspective **C2** consists of mostly of participants from ProRail, save the multiloading TM from the contractor. In this perspective, Political and Management support from the own organisation add more complexity than according to the other perspectives. Client organizations are significantly influenced by political factors and management processes, due to the necessity of securing funds and mandate (Gasik, 2024). As the PM of ProRail (loading in this perspective) states, Politics are unpredictable and difficult to control. Keeping support from higher management is vital, according to C04PRTM, and thus deserves attention (even though the project currently does have support).
Perspective **C3** consists entirely of participants of private companies. This perspective sees more complexity in the technical and environmental aspects of the project, and less from internal stakeholders and politics. According to Nikolić and Cerić (2022), socio-political complexity has been mentioned less than environmental and technical complexity in prior research.
Bryde and Robinson (2005) say that contractors put more emphasis on project content, while clients say they have more emphasis on stakeholders. **C2** and **C3** concur with this statement.

7.1.2. ProRail less aligned

Within ProRail, internal stakeholders have a lot of influence. There are different divisions that each deliver different, sometimes contradicting requirements, according to A01PRPM. The roles sometimes are filled from different departments. The asset management department is mentioned by multiple participants as having a large impact on projects.

7.1.3. Project context influences perspective

Looking at the overarching analysis, perspective T2 consists entirely of participants from project A. While all participants from project C load on T1. This suggests that the project-specific context is more influential in shaping complexity perspectives than role and company. This was to be expected, as each project is unique and brings its own challenges and history.

7.1.4. Lack of trust

In the research, the perceived complexity stemming from the experienced lack of trust is high for some project professionals. With the overarching set, this is split into two perspectives. One perspective with mostly personnel from ProRail, that finds high complexity from the lack of trust between the team and the contractors. And another, consisting of mostly private personnel, that finds complexity from the lack of trust between the team and the client. This split is interesting since this was not prevalent when looking at the individual projects.

7.2. Implications of the research

In this section the implications of the research for project complexity and perceived complexity are given. As well as practical implications.

7.2.1. Q-methodology as a basis for project complexity research

In this research, Q-methodology as a valuable asset in project complexity research is shown. It can uncover implicit perspectives in teams. Participants do not always know what adds complexity until they have sorted the statements.
And different perspectives emerge per project. Another possible contribution is showing that Q-methodology can be used at multiple tiers. Within projects to identify perspectives between team members and across projects to identify broader patterns. This approach could be repeated for other project complexity research.

7.2.2. Perceived complexity research

This research contributes towards the school of perceived complexity research (Vidal & Marle, 2008). It provides empirical evidence on different perspectives on project complexity within projects. The finding that perspectives do not fully align with project role(s) or companies suggests that participants do not necessarily have a role-based mental model, as Mikkelsen (2021) suggests. Several participants also mention that if the research were to be repeated, their perspective might change as well, suggesting a time-based component in perceived complexity as well.

7.2.3. Practical implications

Because multiple perspectives per project have been found, it could be that individuals do not realise that certain complexity elements add a lot of complexity according to others. This could create blind spots in the perception of the project.

With the Q-methodology, it is possible to identify how different team members look at the complexity of the project. This can be used to kick-start discussions on how everyone experiences the project. The elements that are experienced as high complexity, in any of the perspectives, should be considered to be looked into or discussed further. The team can then focus on why these specific elements add so much complexity to the project and if the elements pose a risk on successful project execution and or the collaboration. The results of the discussions can be used as input for risk sessions.

At the same time, knowing how other people think about the project can enable perspective-taking. This is adopting the viewpoint of another, which has been found to enhance group performance by fostering cooperation and coordination (Halfmann & Thürmer, 2025).

Multiple participants acknowledged that the sorting is very moment specific and can change over time. Repeating the Q-methodology, could be beneficial, since new complexity elements can emerge as being most (or highly) complex. This would warrant extra emphasis on these new elements for the next risk session. This could be done by implementing the sorting process into a project startup and follow-up pipeline. Participants expressed that they found the sorting process, interesting to do. And some unplanned discussions started after sessions, showing that participants were interested in the perspectives of others.

7.3. Limitations of the research

This section describes the limitations of this research.

7.3.1. Small sample size

In total, 30 participants across three projects have completed the Q-sorting process. Whilst this group does provide insights in this exploratory research, it is not large enough to yield quantitative conclusions. Both within the projects themselves and, more generally, to a wider range of projects. The finding that perspectives do not align fully with roles or companies might not hold if more projects are added to the mix.

Within projects, the number of respondents were also quite low. Especially in project B. This resulted in one of the perspectives only having two respondents. This is on the low end, but has been used as a minimum criteria in the past (Zabala & Pascual, 2016)

7.3.2. Singular project type

Within this research, three projects were analysed. All with ProRail as a client, and within the PHS program. Different perspectives and findings might emerge if projects varied more in size or were not part of the construction of Dutch railway infrastructure. As Mikkelsen (2021) argued, their research was only applicable in the Danish context; this research might only be applicable for Dutch rail infrastructure construction projects.

7.3.3. Singular project phase

Each of the projects examined was in the execution phase. With approximately half of the budget spent. Perspectives could change over the course of a project. The perspectives identified in this research could therefore potentially be unapplicable during FEED, procurement, design, start-up, closure or maintenance.

Furthermore, the Q-sorts reflect the complexity participants perceived at that moment. The perceived complexity could change over time, even during the execution phase itself. Unexpected events occur during project execution, altering dynamics and potentially changing perceived complexity.

7.3.4. Focus on IPM teams

In the research, IPM project teams were asked to complete a Q-sort. This is a selection of roles within these projects. This research assumes that the IPM team is representative of the entire project team. This might not be the case, and other perspectives could have emerged if other roles had been considered as well.

7.3.5. Dutch TOE-elements

The TOE framework used in this research is based on the Dutch version for construction projects, as described by Bosch-Rekveldt et al. (2018). Some elements, however, do not fully translate from the original English framework.

7.3.6. Subjectivity

In the Q-methodology, there is inherent subjectivity. Every participant might interpret the complexity elements slightly differently. This was mitigated by providing participants with a list of longer descriptions/definitions of the elements, along with the option to ask the researcher questions about the elements. However, not every participant may have used these aids to the same extent.
The interpretation of the perspectives also involves a certain level of uncertainty. The researcher attempts to limit bias in interpretation, but some bias may remain.

7.3.7. Chosen analysis method

In the end, the choice was made to use centroid factor analysis to extract factors, to enable hand rotation and adhere to classic Q-methodology standards. In the end, no significantly aligning hand rotations were found, and varimax was used instead. But no switch to principal component analysis was made, possibly leading to different outcomes.

7.3.8. Similarity of projects

The projects were chosen in a way that they were quite similar. All were part of the PHS, during construction, approximately 60% of the budget was spend. But still, every project is unique. So, each project has its own history. And this history influences the perspectives on project complexity. This is why, even though the projects were selected for their similarity, the perspectives in the overarching set aligned mostly with the individual projects, rather than for example role or company.

8. Conclusions and recommendations

In this chapter, the conclusions of this research are given in section 8.1., first by answering the four sub questions in 8.1.1, followed by answering the main research question in 8.1.2. The thesis ends with some recommendations for further research in 8.2.1. and practice in 8.2.2.

8.1. Conclusion

This research was an exploratory study into different perspectives on project complexity within and between large rail infrastructure projects in the Netherlands, considering both project role and company. This was done using the Q-methodology in combination with the TOE framework. Three projects were analysed, each with multiple roles across ProRail, contractors and engineering firms.

It demonstrates that multiple distinct perspectives can be found within project teams, and that these perspectives differ from project to project. It also suggests that these perspectives do not simply stem from the role or the company of an individual. In the next subsection, the sub-questions are answered, followed by answering the main research question.

8.1.1. Answers to sub-questions

SQ1 What perspectives on project complexity can be found when looking within individual projects?

Multiple perspectives on project complexity can be found within project teams. In two of the three projects analysed, two perspectives emerged. On one hand a group of participants that found more complexity from the lack of trust between parties, and on the other hand a group of participants that found more complexity in elements focussed on project content.
The third project did not have this divide between lack of trust and content. This could be explained by the fact that this project team had invested a lot of time on the relationship from the get-go. Within this third project, perspectives revolved around 1) the number of sub-projects and external stakeholders, 2) influence from politics and higher management, and 3) more technical and environmental content.

When participants experience a lack of trust, they rank this high in adding complexity to the project.
The split in projects with on one hand perspectives finding more complexity from trust and relational and on the other hand perspectives finding more complexity in project content is visualised in Figure 48.

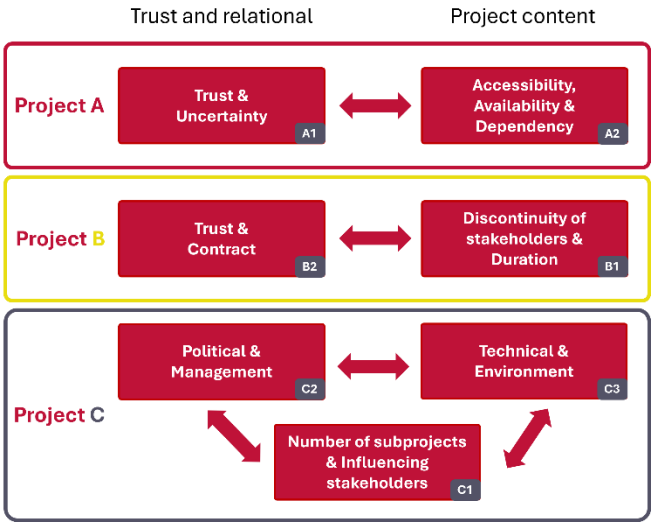


Figure 48: Trust and relational vs project content

SQ2 What perspectives on project complexity can be found when looking between multiple projects?

When looking at all projects at once, three perspectives emerged.

- A perspective that ranks complexity stemming from the lack of trust significantly lower. And elements related to the project environment significantly higher. Everyone on project C loaded on this perspective.
- A perspective that finds more complexity from the lack of trust between the team and both client and contractor, and high uncertainties. Mostly contractors and only people from project A were in this perspective.
- A perspective that finds high complexity from the lack of trust with specifically the contractor, resource scarcity, and pressure on schedule. Mostly ProRail loaded on this perspective.

So, like the perspectives within singular projects, the experienced lack of trust of participants plays a major role in their perspective on project complexity. Figure 49 shows this.

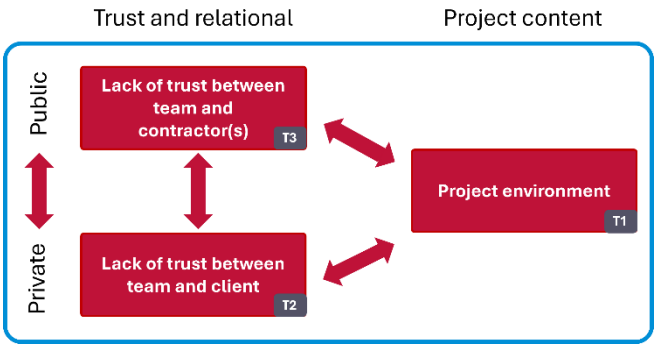


Figure 49: Trust and relational vs project content overarching

SQ3 Where do the perspectives on project complexity stem from?

The perspectives on project complexity do not neatly align with project role or company. In project A the perspectives align better with role, in project B perspectives align similar with role and company, and in project C perspectives align more with company. In project B, experience of the project professionals was a factor explaining the perspective. But this connection was not repeated for the other projects.

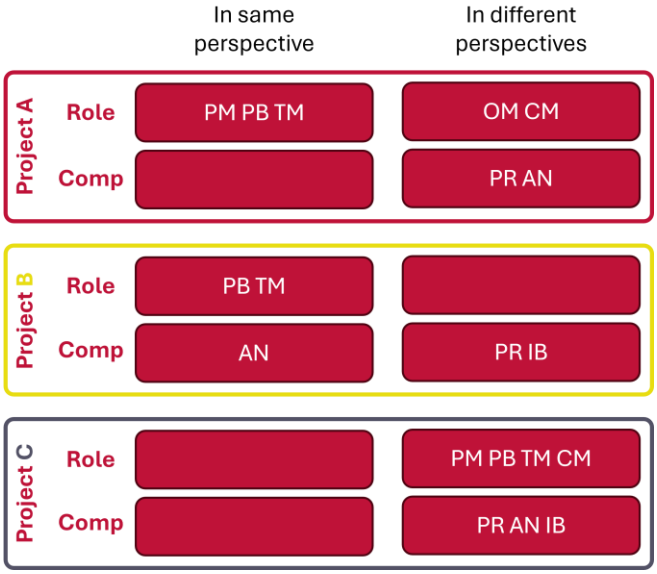


Figure 50: Alignment of perspective with role or company

Figure 50 shows how different roles and companies aligned in the same perspective. In project A, only some roles aligned, in project B both roles and a company aligned. In C everything was spread over multiple perspectives. However, in project C, one perspective existed mostly of participants of ProRail, and another consisted only of participants from private parties.

Using the overarching analysis, the participants of projects loaded on only one or two different perspectives. Project A only on perspective T2 and T3. Project B only on T1 and T2. And project C loaded only on T1. This suggests that perspective is influenced by project. This is visualised in Figure 51.

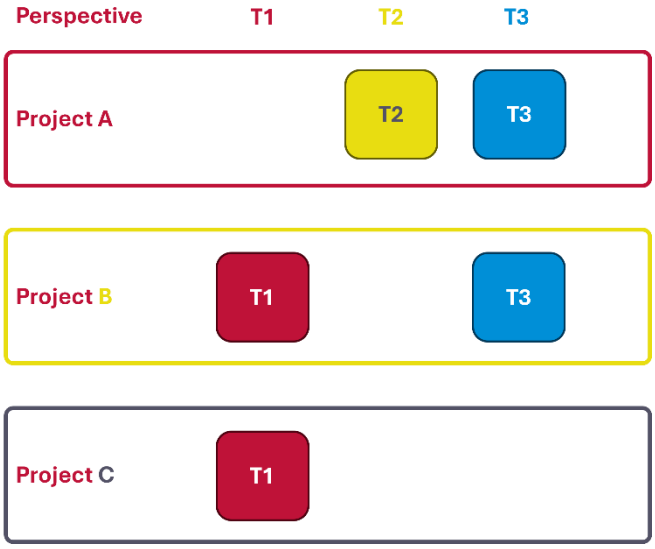


Figure 51: Perspectives per project

Perspectives seem to be influenced both by role and company. Depending on the project, alignment is more with role or with company. Experience was only explanatory in one project. Perspective seems to be influenced by project. If participants experience a lack of trust, this seems to be an influence on their perspective of the complexity of their project.

SQ4 How can the different identified perspectives be embraced?

In the research, lack of trust between the team and the contractors/client emerges as an element that some people find to add high complexity to the project. This was the case in two of the three projects. The project manager of the third project explained that they had put a lot of effort on building and keeping trust from the get-go. Putting a lot of effort on elements that rank high in perceived complexity seems to potentially lower perceived complexity. The effectiveness of this should be researched further.

Without applying the Q-methodology, perspectives on project complexity could stay implicit. Uncovering the perspectives, allows discussions about the different perspectives in a team. This enables perspective-taking, which can lead to enhance group performance through fostering cooperation and coordination.

Another benefit of this method is that it can uncover elements that add a lot of complexity to the project, that an individual did not think of. The elements that load high in any of the perspectives in a project should be considered for more thorough analysis and more emphasis in project teams. This could be input for risk sessions for example.

8.1.2. Main research question

How can understanding and embracing different perspectives on project complexity help increase collaboration in project teams?

In this research multiple perspectives on project complexity were found per project and between projects. Within projects on one hand perspectives were found that found more complexity from project content, and on the other hand perspectives that found more complexity from relationships. To what extent the lack of trust adds high complexity depends per project, with the only project that ranks this lower expressing that they had put a lot of effort into creating and keeping trust throughout the project.

Identifying perspectives on project complexity through (for example) the Q-methodology, can be used to increase collaboration by enabling project professionals to understand each other better. This allows for perspective-taking, enhancing group performance.
People in projects think differently about what elements add more complexity to the project. For other individuals, these elements might not come up as complex for the project. If this stays implicit, it is possible that elements are not taken into account as a risk for successful project execution and/or a risk for the collaboration.

The complexity of a project and the perception of that complexity can change over time. So, identifying the different perspectives should not be a one-off event. When repeated for example at every project follow-up, new complexity elements can emerge. New elements that warrant more attention at that moment. Elements that might not have emerged, had everyone had the same perspective on project complexity.

8.2. Recommendations

In this section, several recommendations are made for future research and for ProRail and practice in general. These are, in part, based on the limitations described in 7.3.

8.2.1. Recommendations for future research

Trust

The project wherein the lack of trust was not ranked high in perceived complexity, expressed that they had put a lot of effort into building and keeping trust. It could be worthwhile to research whether putting high effort in this relationship, consistently leads to lower perceived complexity stemming from the lack of trust.

Focus on perceived high complexity elements

Another potentially interesting avenue for future research is whether putting high effort on elements that rank high in perceived complexity, is beneficial for project outcomes.

Time-based research

Perspectives could change over time. This current research takes a snapshot of time. For subsequent research, the same method using Q-methodology for identifying perspectives on project complexity could be done multiple times. This could track how perspectives on project complexity evolve throughout the lifecycle of a project. Either in multiple sessions within a single phase, for example, twice per year. Or during different phases, for example, at each phase gate.

More projects within the same sector

The research could be repeated, including several more similar projects, to see if similar results emerge, enabling generalisation of the conclusions. Or, if different results emerge, to expand the range of possible perspectives. This is to validate whether the identified perspectives, only are applicable to projects within PHS, or generally.

Projects in different sectors or cultures

The study could also be replicated across different sectors, such as the sectors mentioned in Bosch-Rekveldt et al. (2018): Process, IT, high tech or food. Or in different types of construction projects, such as buildings or non-rail infrastructure. Or projects that take place in other countries.

Research into origins of perspectives

It could be interesting to delve deeper into individual perspectives, and what shapes them; experience from previous projects, study programmes followed, personality, or something else.

Testing of interventions

Another potential avenue for future research is to test whether identifying perspectives, making them explicit, discussing them, and fostering mutual understanding within a project team help improve collaboration satisfaction. This should be done by measuring collaboration satisfaction before an intervention, then executing the intervention (such as the Q-workshop described by Yoshizawa et al. (2016)), and measuring again afterwards. Or if doing this repeatedly also has impact.

Optimal diversity in perspectives

Finally, it could be interesting to investigate if there is an optimal balance of disparity in perspectives. If everyone has the same perspective on project complexity, it could lead to blind spots. But if everyone thinks completely differently, it could lead to ineffective collaboration or miscommunication.

8.2.2. Recommendations for practice

Project start-up

Two of the project managers from ProRail mentioned that using the Q-methodology at the start of a project could potentially benefit the team by uncovering potential implicit perspectives. This works twofold: it can uncover complexity elements that are considered complex by some, but not by others. If these complexity elements remain implicit, they might not gather attention, possibly being missed during risk assessment.
And it could reveal differences in thinking that could remain hidden until they cause conflict. By understanding how others sit in the game, project professionals could potentially tolerate one another better.

After some sessions, participants expressed interest in the Q-sort of colleagues, which led to informal discussions about the perspectives. This suggests that making perspectives explicit can trigger productive discussions.

Project follow-up

This should be repeated during project follow-ups. Project complexities and perspectives can change over time. When people do not know each others current perspective anymore, expectations could misalign. Updating perspectives throughout the project should be done. To both uncover what new project complexity elements warrant more emphasis in control or the next risk session. And to keep everyone informed about the mental models of each other.
The ProRail project manager of project B notes that it would be a fun exercise to do the sorting a second time, a year later. During a team activity, reflect on the perspectives: “How we looked at the project back then, has that changed now, or not?”

Let sessions have consequences

When implementing these sessions during startup and follow-up, actions should be assigned on the results. If certain complexity elements are deemed as adding most/significant complexity to the project by some, this should be an indication that these elements warrant more close attention, both during regular project execution, and as input for the next risk management session.

Do not assume that roles think alike

Project professionals should not assume that others in the same role share a similar stance on the project. A contract manager of one company might share more common ground with a project environment manager of another company than with another contract manager from their own company.

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APPENDECES

A.

TOE-element descriptions

In this appendix the 48 elements in the Q-set are shown in three tables. The list of elements is based on the TOE complexity framework by (Bosch-Rekveldt et al., 2018). The Dutch elements for construction projects are used. These descriptions were translated and where needed changed to fit the Dutch element name. The numbers are randomly assigned using the following function in Excel:

=SORTBY(SEQUENCE(48); RANDARRAY(48))

The elements in this appendix are shown in the same sequence as in Figure 8 and grouped by TOE category for clarity. During the sessions participant are given a different version, sorted by the randomly assigned numbers, and without the TOE designation, to avoid unnecessary bias.

Table 14: Description Technical complexity elements

Technische Complexiteit		
Element	**#**	**Uitleg**
Aantal projectdoelstellingen	32	Denk hierbij aan de hoeveelheid "strategische" projectdoeleinden (enkele - vele)
Incongruentie van projectdoelstellingen	2	Alleen indien er meer dan één strategisch doel aanwezig is; de mate waarin deze doelen samenvallen (op één lijn - volledig tegenstrijdig)
Onduidelijkheid over projectdoelstellingen	3	Onduidelijkheid van projectdoelstellingen onder teamleden (totaal duidelijk - totaal onduidelijk)
Onzekerheid over de scope	19	Aanwezigheid van onzekerheden in overeengekomen scope (geen onzekerheden - veel onzekerheden)
Niveau van kwaliteitseisen	18	Denk hierbij aan hoe strikt de kwaliteitseisen zijn van project deliverables (normaal - buitengewoon hoog)
Projectduur	14	Hoe lang is het project, vergeleken met andere projecten (kort - zeer lang)
Investeringskosten	9	Totale investering voor de realisatie van het project (klein voor het bedrijf - zeer groot voor het bedrijf)
Aantal locaties	23	Het aantal verschillende sites/ locaties betrokken bij het project, inclusief locaties van aannemers (één - veel)
Gebruik nieuwe technologie	38	Maakt het project gebruik van nieuwe technologie, bijvoorbeeld niet-bewezen technologie (technologie die nieuw is in de wereld voor deze toepassing) (geen nieuwe technologie - zeer innovatief)
Ervaring met toegepaste technieken	29	Hebben de betrokken partijen ervaring met de technologie gebruikt in het project (veel ervaring - geen ervaring)
Aantal deelprojecten	27	Heeft het project veel taken, tel bijvoorbeeld werkpakketen of deelprojecten (enkele - vele)
Diversiteit van deelprojecten	34	Heeft het project veel verschillende soorten taken? (zeer vergelijkbare taken - zeer verschillende taken)
Afhankelijkheid tussen deelprojecten	33	Wat zijn het aantal en de aard van afhankelijkheden tussen de verschillende taken? (klein - veel & ingewikkeld)
Onzekerheid over technische methoden	5	Zijn er veel onzekerheden in technologische methoden te verwachten (nee - ja)
Diversiteit van technische disciplines	25	Wat is het niveau van multidisciplinariteit? (laag - zeer multidisciplinair)
Tegenstrijdige normen en standaarden	30	Zijn er conflicterende ontwerpstandaarden en (land)specifieke normen opgenomen in het project (weinig - veel)
Technische risico's	20	Beschouwt u het project als hoog risico (aantal, waarschijnlijkheid en/of impact) in termen van technische risico's (geen risico - zeer hoog risico)

Table 15: Description Organizational complexity elements

Organisatorische complexiteit

Element	#	Uitleg
Druk op de tijdsplanning	11	Hoe hoog is de druk op de planning? (helemaal niet - had gisteren al af moeten zijn)
Beschikbaarheid van capaciteit en vaardigheden	7	Zijn er problemen in de beschikbaarheid van de middelen (materialen, personeel) en vaardigheden vereist voor het project (alles beschikbaar - grote problemen in beschikbaarheid)
Ervaring met projectpartijen	8	Heeft u eerder gewerkt met de partijen betrokken bij het project, zoals aannemers, leveranciers, opdrachtgevers (vele malen - geen ervaring)
VGM-bewustzijn	4	Zijn de betrokken partijen bewust van het belang van Veiligheid, Gezondheid, Milieu (VGM)? (volledig bewust - helemaal niet bewust)
Interfaces tussen verschillende disciplines	31	Zijn er veel interfaces tussen de verschillende disciplines betrokken (zoals civiel, omgeving, financieel, juridisch, communicatie, etc.) die tot interfaceproblemen kunnen leiden? (weinig interfaces - veel interfaces)
Aantal financieringsbronnen	28	Hoeveel verschillende financieringsbronnen heeft het project, zoals eigen investeringen, leningen, subsidies, klant(en)? (enkele bron - meerdere bronnen)
Aantal uitvoerings-contracten en interfaces daartussen	22	Hoeveel verschillende (deel)contracten zijn onderdeel van het project, denk aan contracten met de klant, de aannemers, leveranciers, etc. (enkel contract - meerdere contracten)
Contractvorm	47	Zijn deze allemaal verschillend of allemaal hetzelfde en is het gekozen contracttype adequaat voor het project? (allemaal hetzelfde/ goed, allemaal verschillend / niet adequaat)
Aantal verschillende nationaliteiten	40	Wat is het aantal verschillende nationaliteiten betrokken bij het project? (enkele - meerdere)
Aantal verschillende talen	48	Hoeveel verschillende talen worden gebruikt in de projectcommunicatie? (enkele - meerdere)
Samenwerking tussen aannemers	10	Is/Zijn de aannemer(s) onderdeel van een joint venture? / Zijn er meerdere aannemers betrokken? (nee - ja)
Werktijden (verschillende tijdzones)	24	Zijn er verschillende tijdzones betrokken bij het project, waardoor bijvoorbeeld het plannen van gezamenlijke vergaderingen moeilijker wordt? (enkele tijdzone of beperkte impact - meerdere tijdzones, grote impact)
Bereikbaarheid en bouwlogistiek	42	Hoe bereikbaar is de locatie van het project en/of hoe lastig is de logistiek? (goed bereikbaar / makkelijk - slecht bereikbaar / moeilijk)
Aantal projectmedewerkers	45	Hoeveel personen zijn binnen het projectteam (weinig (1-5) - veel (>200))
Aansluiting tussen gebruikte PM tools & technieken	39	Verwacht u compatibiliteitsproblemen betreffende projectmanagementmethodologie of projectmanagementtools tussen betrokken partijen? (geen compatibiliteitsproblemen verwacht - grote problemen verwacht)
Vertrouwen tussen projectteam en opdrachtgever	36	Vertrouwt de (interne) opdrachtgever? (volledig - helemaal niet)
Vertrouwen tussen projectteam en aannemer(s)	1	Vertrouwt u de betrokken aannemer(s)? (volledig - helemaal niet)
Organisatorische risico's	21	Beschouwt u het project als hoog risico (aantal, waarschijnlijkheid en/of impact) in termen van organisatorische risico's (geen risico - zeer hoog risico)

Table 16: Description External complexity elements

Externe complexiteit		
Element	**#**	**Uitleg**
Aantal externe stakeholders	13	Hoeveel externe (buiten het projectteam) stakeholders zijn betrokken bij het project (zoals NGO's, (lokale) overheden, verschillende afdelingen, leveranciers, lokale bewoners, etc.); de partijen die het project kunnen beïnvloeden of erdoor worden beïnvloed? (weinig - veel)
Diversiteit in belangen van externe stakeholders	16	In hoeverre verschillen de belangen van de verschillende stakeholders? (weinig verschil - volledig verschillend)
Afhankelijkheid van externe stakeholders	46	Hoe afhankelijk is het project va externe stakeholders? (geen afhankelijkheid - heel afhankelijk)
Politieke invloed	12	In hoeverre beïnvloedt de politieke situatie het project (geen politieke invloed - sterke politieke invloed)
Management support vanuit eigen organisatie	43	Is er voldoende steun vanuit het (hoger) management binnen het eigen bedrijf? (genoeg steun - te weinig steun)
Verplichte lokale partijen	35	In hoeverre zijn er verplichtingen om gebruik te maken van lokale partijen om het project uit te mogen voeren? (geen lokale partijen vereist - groot deel van het project moet door lokale partijen worden uitgevoerd)
Interfaces met andere projecten	26	In hoeverre heeft het project invloed / wordt het project beïnvloed door andere projecten? (weinig - veel)
Aard van de omgeving	6	In hoeverre heeft de omgeving waarin het project ligt invloed op de uitvoering van het project? (weinig - veel)
Gebrek van ervaring in omgeving/land	17	Hebben de betrokken partijen al eerder in het land / de omgeving gewerkt? (ja, verschillende keren - helemaal geen ervaring)
Invloed van stakeholders van binnen de organisatie	41	Hoe groot is de invloed van stakeholders binnen de organisatie? Denk bijvoorbeeld aan andere afdelingen of management. (weinig - veel)
Discontinuïteit bemensing stakeholders	37	Hebben de betrokken partijen een vast team, of veranderd de samenstelling voortdurend?
Markt-omstandigheden	15	Wat is het niveau van concurrentie gerelateerd aan huidige marktomstandigheden (geen concurrentie - zeer sterke concurrentie)
Externe risico's	44	Beschouwt u het project als hoog risico (aantal, waarschijnlijkheid en/of impact) in termen van externe risico's (geen risico - zeer hoog risico)

B.

Q-sort instruction and form

In this appendix, the Q-sort instruction and form that is given to all participants is shown. It starts on the next page to show the exact form that was presented to the participants.

Perspectieven op projectcomplexiteit

Participant nummer .....

Dank u wel voor uw deelname aan dit onderzoek. Het doel van dit onderzoek is het vinden, begrijpen en expliciet maken van verschillende perspectieven op projectcomplexiteit binnen projectteams.

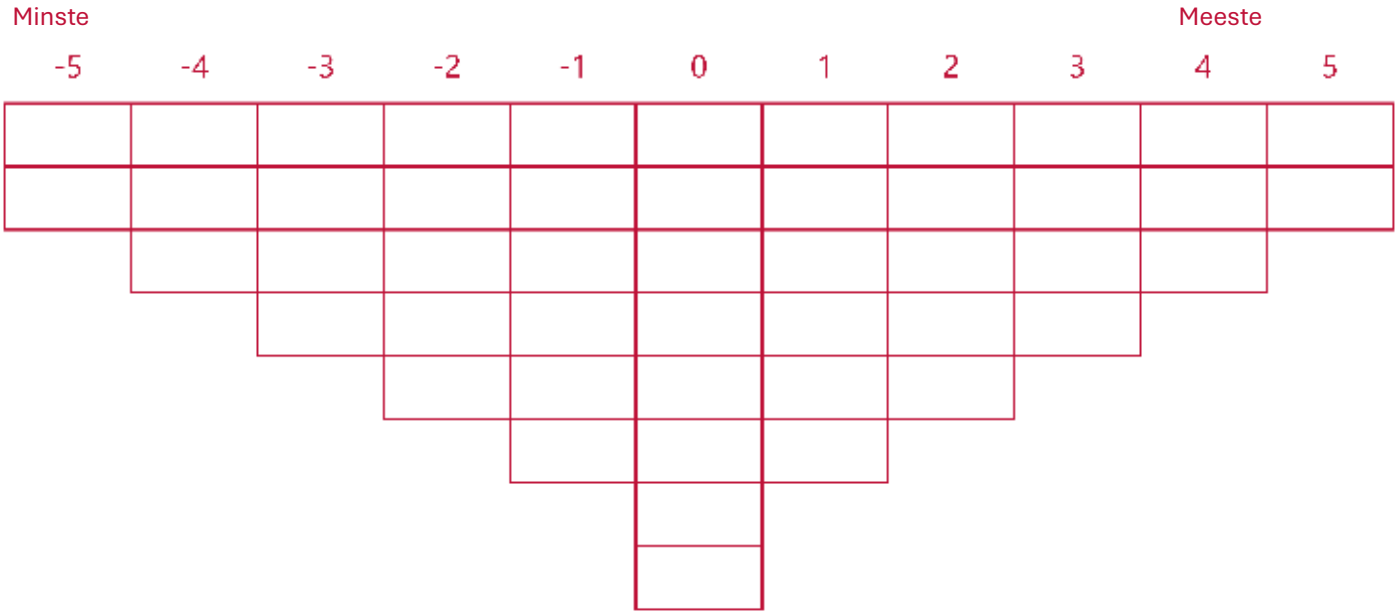
De perspectieven worden opgehaald met de Q-methodologie. Deze methode wordt gebruikt om verschillende perspectieven rond een bepaald onderwerp te vinden en te beschrijven. Dit gebeurt door het rangschikken van een aantal elementen op basis van een vraag. Achteraf moet u een aantal vragen invullen op dit antwoordformulier. Het is belangrijk om te weten dat het gaat om uw perceptie van de volgorde, hierin zijn dus geen foute keuzes te maken. Omdat het gaat over uw perceptie, is het niet de bedoeling om met de anderen te overleggen, dit kan namelijk invloed hebben op uw rangschikking.

De rangschikking in dit onderzoek is op basis van de volgende instructie:

"Complexiteit element X voegt ... complexiteit toe aan dit project"

U krijgt zo 48 kaartjes met complexiteitselementen. Deze kaartjes zijn genummerd, maar de nummering is willekeurig gekozen, ze dienen enkel voor de latere administratie. De nummers zijn dus ook niet een indicatie van een 'goede' volgorde.

Deze 48 kaartjes moeten gerangschikt worden in een matrix, op de volgorde van hoeveel complexiteit de elementen toevoegen aan het project **in uw perceptie.** Hieronder is een plaatje van hoe deze matrix er uit ziet. **Alleen de kolom** waarin een kaartje staat **is van belang**. De rij waarin een kaartje wordt geplaatst, is irrelevant.



Instructie rangschikken

Participant nummer .....

Bekijk alle 48 complexiteitselementen.

Maak drie stapels en verdeel de elementen in de stapels.

Element voegt **weinig**/ geen complexiteit toe	Element voegt een **beetje** complexiteit toe	Element voegt **veel** complexiteit toe

Begin met de stapel met elementen die **VEEL** complexiteit toevoegen.

- Lees deze stapel nogmaals door.
- Neem de twee elementen die het meeste complexiteit toevoegen en plaats deze in kolom (+)5.
- Pak de volgende drie elementen die het meeste complexiteit toevoegen en plaats deze in kolom (+)4.
- Ga door tot er geen elementen meer over zijn.
- U moet zich aan de matrix houden, er mogen geen kaartjes buiten de aangegeven vakken liggen.

Loop vervolgens dezelfde stappen door met de stapel met elementen die **WEINIG** complexiteit toevoegen.

Kijk hoeveel van de matrix al is ingevuld. Afhankelijk van welke kant verder is ingevuld, moet de andere kant eerst worden aangevuld. Voorbeeld: Als aan de rechter (meeste) kant de matrix is ingevuld tot halverwege kolom (+)3 en de linker (minst) kant is ingevuld tot het eerste element in kolom -2, kijk dan naar welk van de overgebleven elementen de meeste complexiteit toevoegen, en vul kolom (+)3 aan.
Werk van buiten naar binnen alle elementen in de laatste stapel af.

Controleer of alle elementen **in uw perceptie** logisch in de ingevulde matrix liggen, herschik indien gewenst.

Laat de onderzoeker weten dat u klaar bent het rangschikken.

Noteer de nummers van de elementen in de matrix op pagina 1.

Vul de rest van dit formulier in.

Informatie participant

Participant nummer .....

1. Wat is uw geslacht?

☐ Man
☐ Vrouw
☐ Anders
☐ Zeg ik liever niet

2. Wat is uw leeftijd?

☐ 18-24 jaar
☐ 25-34 jaar
☐ 35-44 jaar
☐ 45-54 jaar
☐ 55-64 jaar
☐ 65+ jaar

3. Wat is uw hoogst behaalde opleidingsniveau?

4. Bij welke organisatie werkt u?

5. Over welk project heeft u de rangschikking gemaakt?

6. Wat is de titel van uw rol binnen dit project?

7. Wat houdt uw rol precies in binnen dit project? (Geef een korte beschrijving van uw werk binnen dit project)

8. Hoe lang is uw ervaring met deze rol? ____ Jaar

9. Hoe lang is uw ervaring bij uw huidige bedrijf? ____ Jaar

10. Hoe lang is uw ervaring binnen de sector? ____ Jaar

11. Hoe lang bent u actief binnen dit project? ____ Maanden

Sorteren

Participant nummer .....

12. Als u kijkt naar de complexiteitselementen in kolom **(+)5**, waarom heeft u deze daar geplaatst?

Element nummer ....., uitleg:

Element nummer ....., uitleg:

13. Als u kijkt naar de complexiteitselementen in kolom **(+)4**, waarom heeft u deze daar geplaatst?

Element nummer ....., uitleg:

Element nummer ....., uitleg:

Element nummer ....., uitleg:

14. Als u kijkt naar de complexiteitselementen in kolom **-5**, waarom heeft u deze daar geplaatst?

Element nummer ....., uitleg:

Element nummer ....., uitleg:

15. Als u kijkt naar de complexiteitselementen in kolom **-4**, waarom heeft u deze daar geplaatst?

Element nummer ....., uitleg:

Element nummer ....., uitleg:

Element nummer ....., uitleg:

16. *Als u een element later verplaatst heeft:* Waarom paste u de volgorde aan?

17. Zijn elementen die (net) buiten de uiterste kolommen vielen die u nog wil uitlichten, en zo ja welke?

Element nummer ....., uitleg:

Element nummer ....., uitleg:

18. Waren er nog complexiteitselementen onduidelijk, en zo ja welke?

Element nummer ....., uitleg:

Element nummer ....., uitleg:

19. Zou u nog complexiteitselementen toe willen voegen, en zo ja welke?

Elementnaam ....., uitleg:

Elementnaam ....., uitleg:

20. Zijn er complexiteitselementen die volgens u nooit relevant zijn bij projecten in de (rail)infrastructuur?

Element nummer ....., uitleg:

Element nummer ....., uitleg:

Participant nummer .....

Gebruik onderstaand vlak als er niet genoeg ruimte was bij een van de vragen of als u nog andere opmerkingen of aanbevelingen heeft. Voeg het vraagnummer toe ter verduidelijking.

Hartelijk dank voor uw medewerking. Uw antwoorden worden meegenomen in het *onderzoek Embracing different perspectives on project complexity*.

Mark Lonissen

C.

Protocol for Q-sorting sessions

In this appendix, the protocol used for the Q-sorting sessions is shown. The protocol describes the steps taken within a session. This is done to ensure that each session is executed in similar fashion, to reduce external influences on results.

Voorbereiding eerder

- Stuur uitnodigingen voor sessie;
- Reserveer ruimte, zorg dat ruimte groot genoeg is om iedereen die meedoet ongeveer een A2-papierformaat aan ruimte voor zich kan hebben. (Groot genoeg voor het A3-formaat Q-grid en het A4-formaat invulformulier naast elkaar). Ruimte liefst met microfoon. Reserveer ruimte 15 minuten voor aanvang sessie voor voorbereiding;
- Print invulformulier en consentformulier;
- Stop invulformulier, consentformulier, participant nummer en set van 48 complexiteitselementen in een insteekhoes.
- Maak een Teamsmeeting aan parallel aan de sessie (voor opname), nodig alleen onderzoeker uit.

Voorbereiding dag zelf

- Neem koker mee met Q-grids;
- Neem voldoende insteekhoezen met inhoud mee (Aantal verwachte participanten +2, mocht er iets mis zijn of een extra persoon aansluiten);
- Pennen;
- Laptop + oplader;
- Extra papier.

Voorbereiding op locatie

- Klaarleggen volgende papieren per participant:
    - A3 Q-grid voor 48 elementen;
    - 48 TOE-complexiteit element kaartjes;
    - Consentformulier;
    - Invulformulier;
    - Pen.
- Klaarleggen in midden tafel:
    - TOE-complexiteit element uitleg.
- Laptop klaarzetten:
    - Open teams, start meeting, check microfoon en geluid. Start opname en transcriptie nog niet.

Sessie

- Welkom heten;
- Korte uitleg onderzoek in general;
- Wijzen op consentformulier en laten ondertekenen door iedereen. Zelf ook ondertekenen;
- Kort voorstelrondje;
- Aangeven dat vragen gedurende de hele sessie gesteld mogen worden;
- Uitleg sessie:

- Sorteren van elementen naar **eigen** perceptie van projectcomplexiteit van **dit project** op **dit moment**;
- Geen goede of foute volgorde;
- Nummers zijn willekeurig gekozen en hebben geenszins te maken met een juiste volgorde;
- Niet naar elkaars sortering kijken, dat kan de resultaten beïnvloeden;
- Geen wedstrijd;
- Als er een element onduidelijk is, is er een lijst met uitgebreidere beschrijving, als dat nog steeds niet duidelijkheid geeft, vraag het aan onderzoeker;
- Lees eerst de elementen door en sorteer voor in drie stapels: Element voegt erg veel complexiteit toe, element voegt (vrijwel) geen complexiteit toe, en een reststapel;
- De rij waarin een element ligt maakt niet uit, de kolom wel. Dus bijvoorbeeld alle elementen in kolom +4 voegen even veel complexiteit toe aan het project;
- Begin bij stapel met 'voegt veel complexiteit toe' en begin bij de uiterste kolom. Doe hetzelfde bij de stapel met 'voegt weinig toe'. Werk van buiten naar binnen;
- Ga na of de sortering klopt naar uw **eigen** perceptie van projectcomplexiteit van **dit project** op **dit moment;**
- Deze uitleg staat ook op pagina's 1 en 2 van het antwoordformulier. Lees die nog door;
- Geef aan als u klaar bent.

- Als participant klaar is met sorteren:
  - Neem foto van de sortering (zorg dat participant nummer op Q-grid ligt en zichtbaar is);
  - Scheur pagina 1 en 2 van invulformulier en geef de rest aan de participant om in te vullen;
  - Noteer de sortering van de participant in het grid op pagina 1 tijdens dat participant rest van formulier in aan het vullen is.

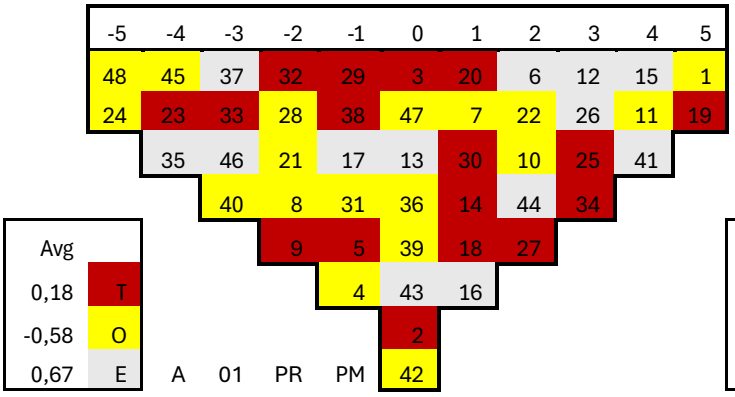
- Als alle participanten klaar zijn met invullen invulformulier:
  - Dank participanten voor het meedoen;
  - Vertel vervolgstappen;
  - Geef, indien tijd het toelaat, participanten ruimte om na te bespreken.

- Als alle participanten weg zijn:
  - Opruimen;
  - Zorg dat invulformulier, consentformulier, set met 48 elementen en participantnummer weer in insteekhoes zitten;
  - Afsluiten ruimte;
  - Scan de invulformulieren en consentformulieren in. Zet in desbetreffende mappen.

D.

Individual Q-sorts

Project A ProRail



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	35	46	21	17	13	30	10	25	41	
		40	8	31	36	14	44	34		
			9	5	39	18	27			
				4	43	16				
					2					

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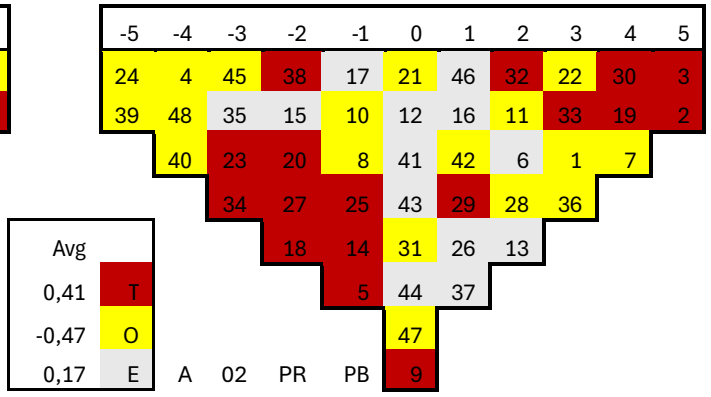
0,67	E					



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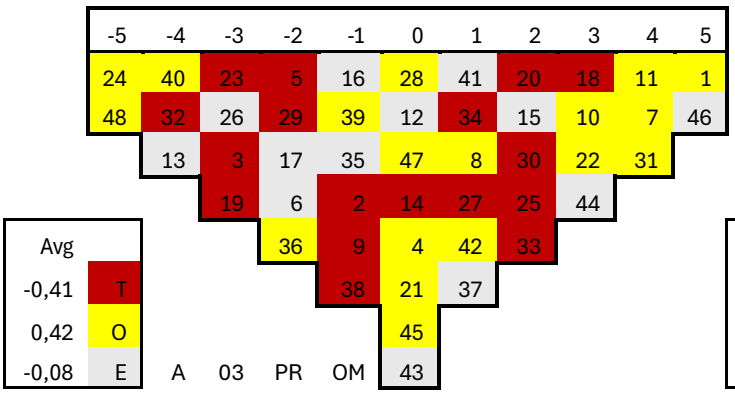
		34	27	25	43	29	28	36		
			18	14	31	26	13			
				5	44	37				
					47					
					9					

Avg						
0,41	T	A	02	PR	PB	9
-0,47	O					
0,17	E					



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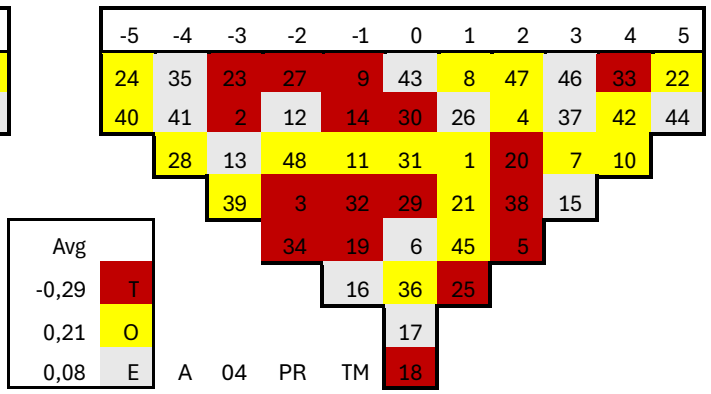
	13	3	17	35	47	8	30	22	31	
		19	6	2	14	27	25	44		
			36	9	4	42	33			
				38	21	37				
					45					
					43					

Avg						
-0,41	T	A	03	PR	OM	43
0,42	O					
-0,08	E					



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	28	13	48	11	31	1	20	7	10	
		39	3	32	29	21	38	15		
			34	19	6	45	5			
				16	36	25				
					17					
					18					

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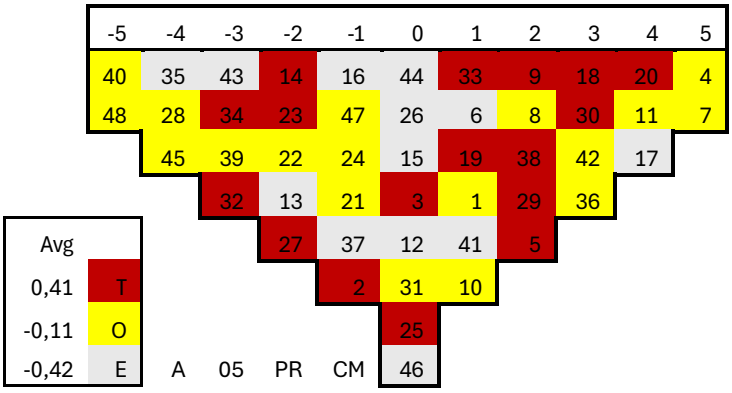
0,21	O					
0,08	E					



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	45	39	22	24	15	19	38	42	17	
		32	13	21	3	1	29	36		
			27	37	12	41	5			
				2	31	10				
					25					
					46					

Avg						
0,41	T	A	05	PR	CM	46
-0,11	O					
-0,42	E					

Project A Contractor

-5	-4	-3	-2	-1	0	1	2	3	4	5
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12	28	29	17	4	31	32	19	11	42	47
	24	9	43	3	21	33	10	41	15	
		35	34	27	7	20	14	6		
			5	23	2	18	16			
				39	46	44				
					1					
					38					

Avg					
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-0,05	O				
0,17	E	A	06	AN	PM

-5	-4	-3	-2	-1	0	1	2	3	4	5
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	4	22	17	47	16	13	9	20	46	
		14	31	21	15	30	6	19		
			23	8	2	18	37			
				29	27	38				
					3					
					39					

Avg					
0,35	T				
-0,89	O				
0,92	E	A	07	AN	PB

-5	-4	-3	-2	-1	0	1	2	3	4	5
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48	8	7	39	3	45	19	30	25	46	44
	5	21	28	9	29	14	2	18	22	
		11	17	6	4	15	26	16		
			43	37	10	31	33			
				34	13	32				
					42					
					23					

Avg					
0,76	T				
-0,84	O				
0,25	E	A	08	AN	OM

-5	-4	-3	-2	-1	0	1	2	3	4	5
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	10	32	23	43	47	13	30	33	20	
		28	38	2	9	29	46	21		
			3	16	44	39	37			
				12	34	41				
					11					
					4					

Avg					
0,18	T				
-0,37	O				
0,33	E	A	09	AN	TM

-5	-4	-3	-2	-1	0	1	2	3	4	5
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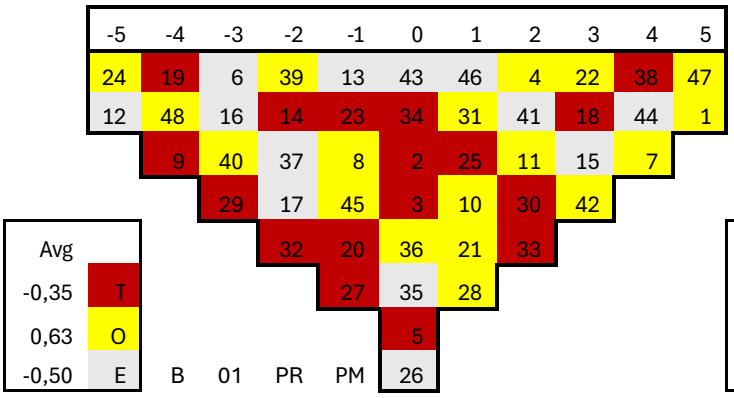
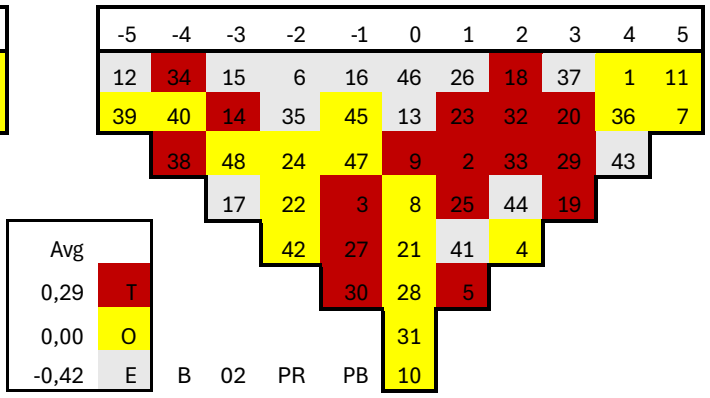
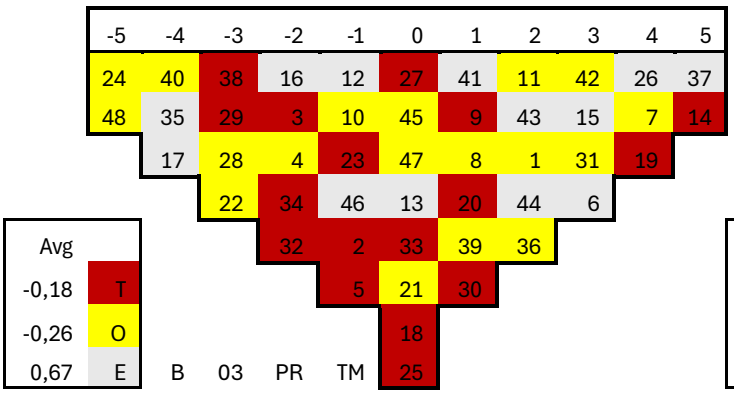
48	4	42	29	6	5	38	28	17	12	30
	34	23	44	40	15	25	27	46	36	
		8	32	2	3	20	13	10		
			26	21	22	11	16			
				33	45	41				
					14					
					31					

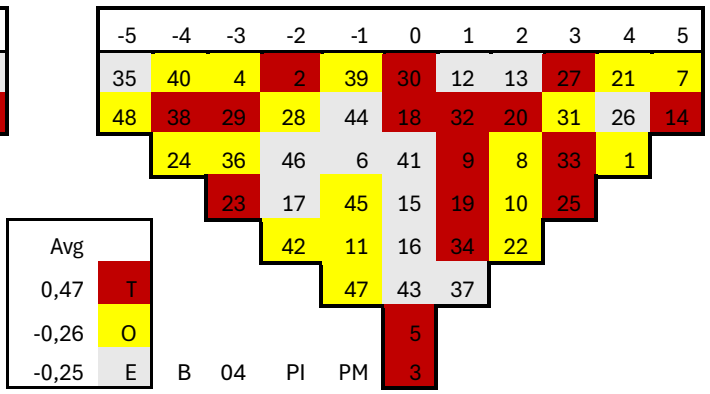
Avg					
-0,12	T				
-0,37	O				
0,75	E	A	10	AN	CM

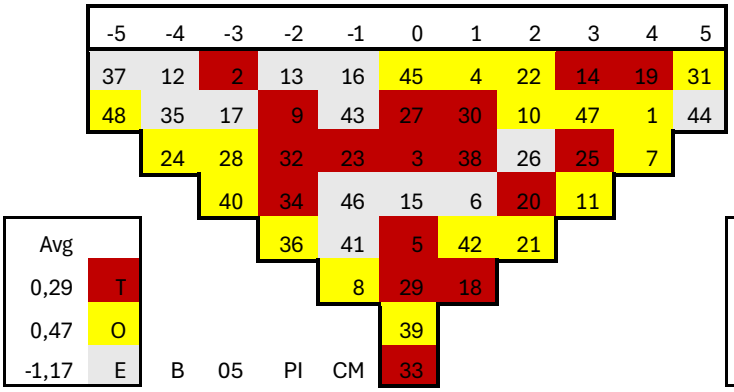
Project B ProRail (PR) + (integrated) Consultant (PI) + Contractor (AN)

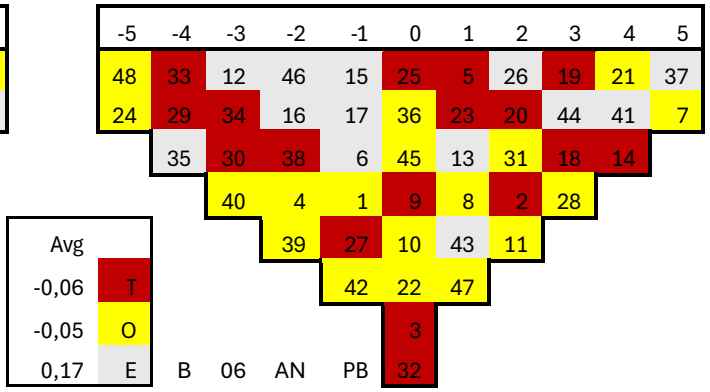


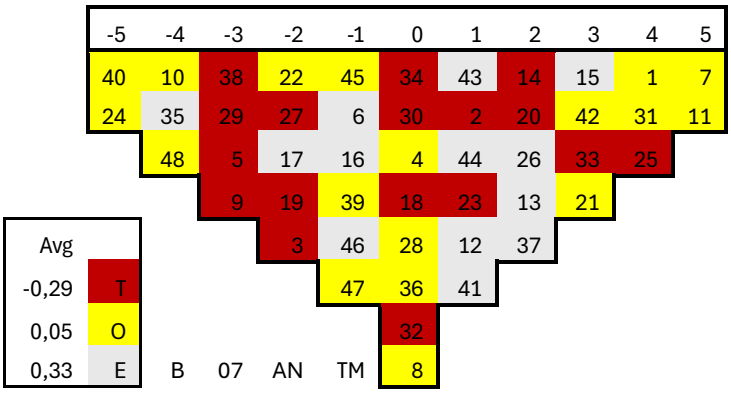












Project C ProRail

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		35	20	2	34	46	37	31		
			36	19	1	23	44			
				21	32	33				
					8					
					43					

Avg						
-0,65	T	C	01	PR	PM	
-0,37	O					
1,50	E					

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	17	2	23	29	20	36	16	43	1	
		4	27	38	39	12	41	21		
			34	6	37	33	7			
				35	15	30				
					18					
					19					

Avg						
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0,42	O					
0,83	E					

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	39	3	38	23	12	18	7	27	11	
		2	21	43	8	16	15	10		
			5	29	37	1	34			
				19	20	32				
					36					
					28					

Avg						
-0,18	T	C	03	PR	OM	
-0,21	O					
0,58	E					

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	29	40	3	45	35	38	42	43	22	
		27	28	17	39	10	1	41		
			9	36	2	6	5			
				34	8	25				
					18					
					15					

Avg						
0,18	T	C	04	PR	TM	
-0,37	O					
0,33	E					

-5	-4	-3	-2	-1	0	1	2	3	4	5
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4	48	47	43	38	34	28	11	9	42	14
	24	3	39	30	33	25	31	41	46	
		8	10	2	16	7	20	27		
			23	29	5	15	13			
				22	17	32				
					37					
					12					

Avg						
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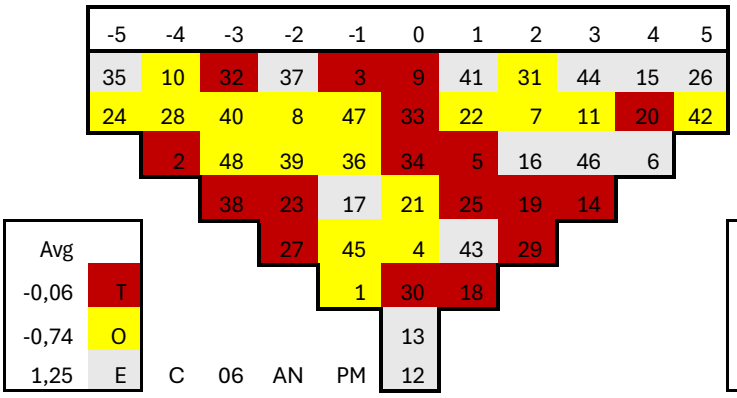
1,33	E					

Project C Contractor



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24	28	40	8	47	33	22	7	11	20	42
	2	48	39	36	34	5	16	46	6	
		38	23	17	21	25	19	14		
			27	45	4	43	29			
				1	30	18				
					13					

Avg						
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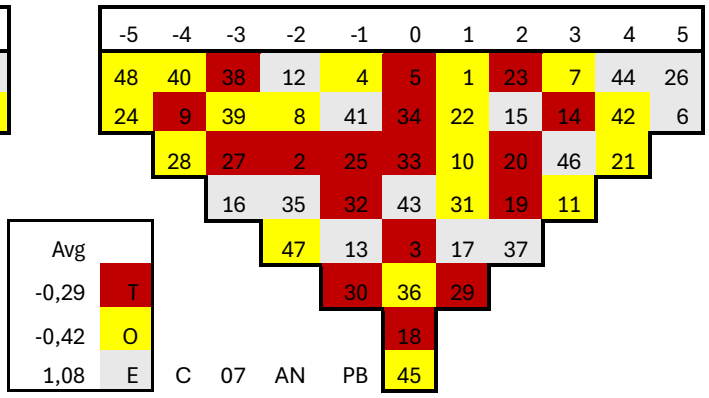
-0,74	O					
1,25	E	C	06	AN	PM	12



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	28	27	2	25	33	10	20	46	21	
		16	35	32	43	31	19	11		
			47	13	3	17	37			
				30	36	29				
					18					

Avg						
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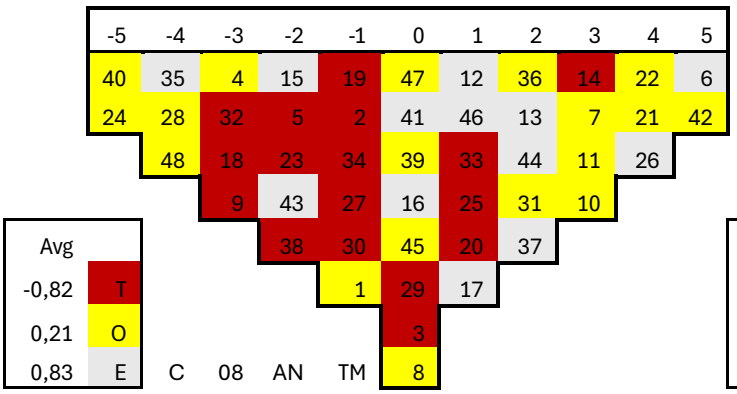
-0,42	O					
1,08	E	C	07	AN	PB	45



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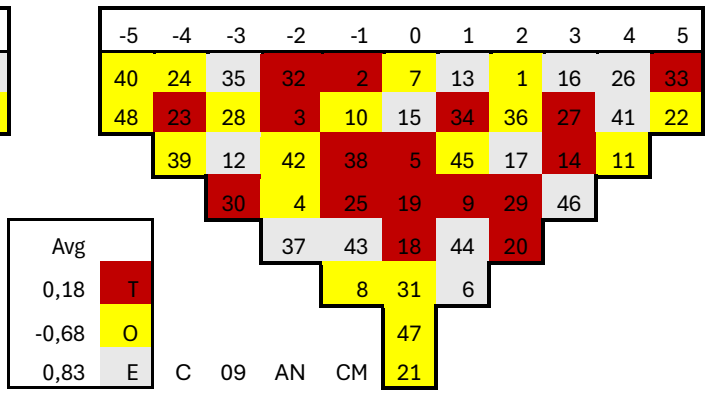
24	28	32	5	2	41	46	13	7	21	42
	48	18	23	34	39	33	44	11	26	
		9	43	27	16	25	31	10		
			38	30	45	20	37			
				1	29	17				
					3					

Avg						
-0,82	T					
0,21	O					
0,83	E	C	08	AN	TM	8



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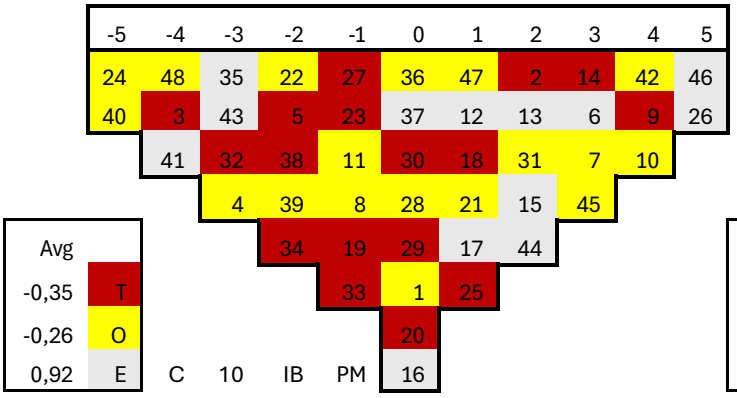
48	23	28	3	10	15	34	36	27	41	22
	39	12	42	38	5	45	17	14	11	
		30	4	25	19	9	29	46		
			37	43	18	44	20			
				8	31	6				
					47					

Avg						
0,18	T					
-0,68	O					
0,83	E	C	09	AN	CM	21

Project C Engineering Firm



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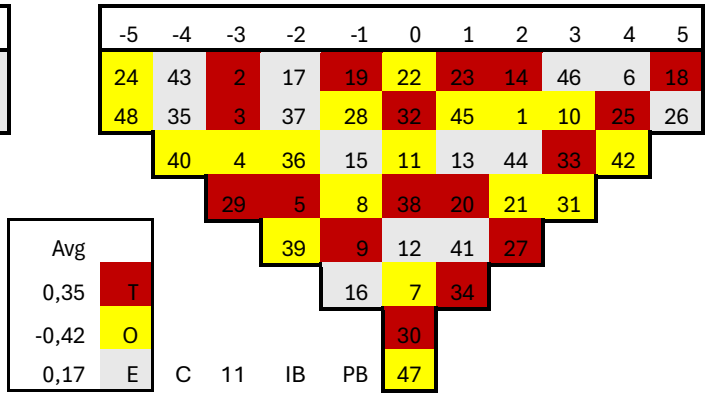
	41	32	38	11	30	18	31	7	10	
		4	39	8	28	21	15	45		
			34	19	29	17	44			
				33	1	25				
					20					

Avg						
-0,35	T					
-0,26	O					
0,92	E	C	10	IB	PM	16



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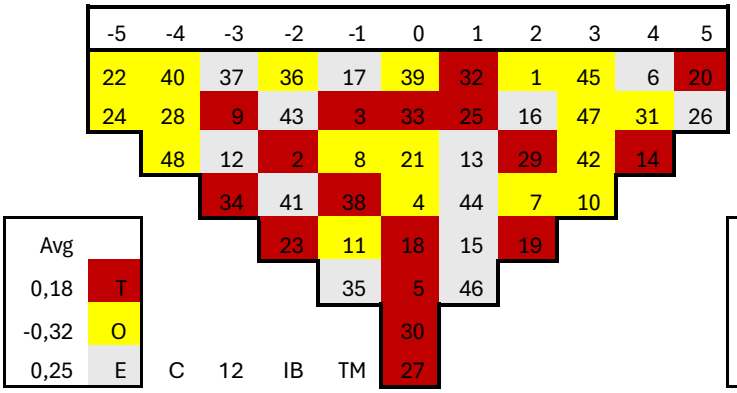
	40	4	36	15	11	13	44	33	42	
		29	5	8	38	20	21	31		
			39	9	12	41	27			
				16	7	34				
					30					

Avg						
0,35	T					
-0,42	O					
0,17	E	C	11	IB	PB	47



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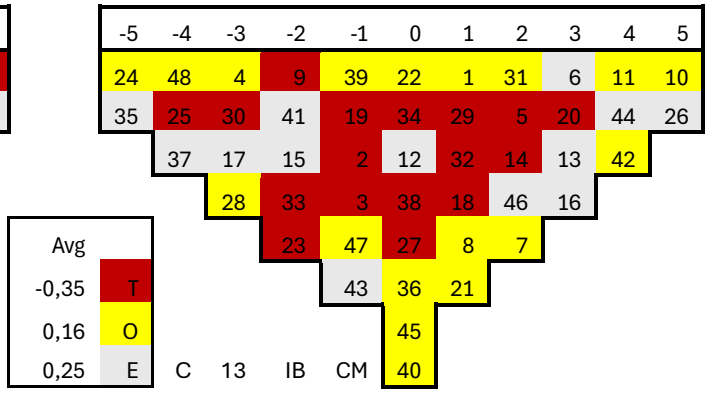
22	40	37	36	17	39	32	1	45	6	20
24	28	9	43	3	33	25	16	47	31	26
	48	12	2	8	21	13	29	42	14	
		34	41	38	4	44	7	10		
			23	11	18	15	19			
				35	5	46				
					30					

Avg						
0,18	T					
-0,32	O					
0,25	E	C	12	IB	TM	27



-5	-4	-3	-2	-1	0	1	2	3	4	5
24	48	4	9	39	22	1	31	6	11	10
35	25	30	41	19	34	29	5	20	44	26
	37	17	15	2	12	32	14	13	42	
		28	33	3	38	18	46	16		
			23	47	27	8	7			
				43	36	21				
					45					

Avg						
-0,35	T					
0,16	O					
0,25	E	C	13	IB	CM	40

E.

Answer forms and interviews

In this appendix, the answers on the forms, filled in by participants after the sorting process are shown. For those participants that have had reactions, their reactions are also shown at the end. The answers have been anonymised.

This appendix is not available in the repository version of this MSc Thesis. Ask the researcher for more information.

F.

Role and experience of participants

This appendix is not available in the repository version of this MSc Thesis. Ask the researcher for more information.

G.

Tables from data analysis

G.1. Project A

Table 17: Correlation matrix Project A

	PR PM	PR PB	PR OM	PR TM	PR CM	AN PM	AN PB	AN OM	AN TM	AN CM
PR PM	100	35	40	18	33	41	39	34	27	41
PR PB		100	20	22	29	32	48	33	29	42
PR OM			100	57	37	30	28	37	37	29
PR TM				100	45	37	31	43	54	9
PR CM					100	30	43	14	45	19
AN PM						100	39	55	54	39
AN PB							100	38	49	41
AN OM								100	34	38
AN TM									100	12
AN CM										100

Table 18: Correlation within party and roles Project A

Averages	Correlation
Total	35
ProRail	34
Contractor	40
Avg	37
PM	41
PB	48
OM	37
TM	54
CM	19
Avg	40

Table 19: Factor matrix Project A

Q-sort\ Loading	Factor 1	Factor 2
PR PM	0,5185 X	0,2713
PR PB	0,5636 X	0,1867
PR OM	0,2693	0,5590 X
PR TM	0,1148	0,8672 X
PR CM	0,2279	0,5467 X
AN PM	0,5429 X	0,3788
AN PB	0,5432 X	0,3858
AN OM	0,5495 X	0,2903
AN TM	0,3146	0,5913 X
AN CM	0,7384 X	0,0501

Since there are only two factors rotated in project A, all distinguishing statements are shown in one table since differences are both ways for bipolar factor solutions.

Table 20: Distinguishing statements Project A

Element	#	Rank 1	Z-score 1	Rank 2	Z-score 2	Significant
Vertrouwen tussen projectteam en aannemer(s)	1	4	1,45	1	0,43	*
Incongruentie van projectdoelstellingen	2	1	0,40	-3	-0,99	*
Onduidelijkheid over projectdoelstellingen	3	0	0,25	-2	-0,86	*
VGM-bewustzijn	4	-4	-1,40	2	0,83	*
Onzekerheid over technische methoden	5	-2	-0,53	2	0,81	*
Beschikbaarheid van capaciteit en vaardigheden	7	-1	-0,22	4	1,49	*
Ervaring met projectpartijen	8	-4	-1,23	0	0,31	*
Investeringskosten	9	-3	-1,08	-1	-0,21	*
Druk op de tijdsplanning	11	3	0,97	0	0,22	
Politieke invloed	12	2	0,54	-1	-0,60	*
Aantal externe stakeholders	13	3	0,86	-3	-1,10	*
Marktomstandigheden	15	1	0,49	3	1,27	
Diversiteit in belangen van externe stakeholders	16	3	0,85	-1	-0,46	*
Onzekerheid over de scope	19	5	1,92	-1	-0,39	*
Technische risico's	20	2	0,52	3	1,18	
Organisatorische risico's	21	-2	-0,60	1	0,42	*
Aantal uitvoeringscontracten en interfaces daartussen	22	0	0,39	5	1,61	*
Aantal deelprojecten	27	1	0,45	-2	-0,80	*
Aantal financieringsbronnen	28	-1	-0,11	-4	-1,52	*
Ervaring met toegepaste technieken	29	-2	-0,61	0	0,06	
Tegenstrijdige normen en standaarden	30	4	1,49	1	0,44	*
Aantal projectdoelstellingen	32	-1	-0,22	-2	-0,90	
Afhankelijkheid tussen deelprojecten	33	0	0,33	4	1,46	*
Vertrouwen tussen projectteam en opdrachtgever	36	5	2,01	1	0,33	*
Discontinuïteit bemensing stakeholders	37	0	0,26	2	0,94	
Invloed van stakeholders van binnen de organisatie	41	2	0,51	-2	-0,88	*
Bereikbaarheid en bouwlogistiek	42	0	0,21	5	1,66	*
Externe risico's	44	1	0,51	4	1,52	*
Aantal verschillende talen	48	-5	-2,60	-4	-1,49	*

Table 21: Consensus statements Project A

Element	#	Q-SV	Z-score 1	Q-SV	Z-score 2	Significant
Aard van de omgeving	6	1	0,44	0	0,14	*
Samenwerking tussen aannemers	10	2	0,53	3	1,04	*
Druk op de tijdsplanning	11	3	0,97	0	0,22	
Projectduur	14	0	-0,01	-1	-0,46	*
Marktomstandigheden	15	1	0,49	3	1,27	
Gebrek van ervaring in omgeving/land	17	-1	-0,13	0	-0,02	*
Niveau van kwaliteitseisen	18	1	0,45	1	0,43	*
Technische risico's	20	2	0,52	3	1,18	
Aantal locaties	23	-3	-1,22	-3	-1,25	*

Werktijden (verschillende tijdzones)	24	-5	-2,37	-5	-2,05	*
Diversiteit van technische disciplines	25	2	0,82	2	0,53	*
Interfaces met andere projecten	26	0	0,05	0	0,01	*
Ervaring met toegepaste technieken	29	-2	-0,61	0	0,06	
Interfaces tussen verschillende disciplines	31	-1	-0,14	0	0,32	*
Aantal projectdoelstellingen	32	-1	-0,22	-2	-0,90	
Diversiteit van deelprojecten	34	-3	-1,12	-2	-0,65	*
Verplichte lokale partijen	35	-3	-1,20	-4	-1,65	*
Discontinuïteit bemensing stakeholders	37	0	0,26	2	0,94	
Gebruik nieuwe technologie	38	0	0,00	1	0,45	*
Aansluiting tussen gebruikte PM tools & technieken	39	-2	-0,95	-3	-0,97	*
Aantal verschillende nationaliteiten	40	-4	-1,67	-5	-2,16	*
Management support vanuit eigen organisatie	43	-2	-0,78	-1	-0,25	*
Aantal projectmedewerkers	45	-1	-0,52	0	0,03	*
Afhankelijkheid van externe stakeholders	46	3	0,96	3	1,25	*
Contractvorm	47	4	1,08	2	0,47	*

G.1.1. Factor A1

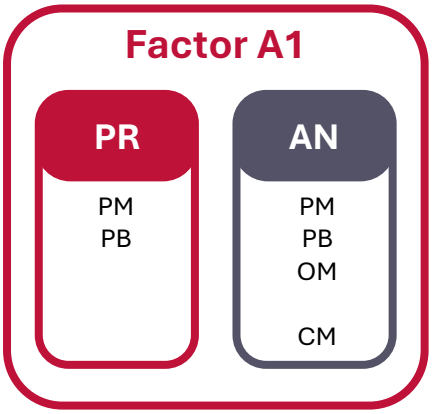


Figure 52: Participants in Factor A1

Table 22: Composite Q-sort Factor A1

-5	-4	-3	-2	-1	0	1	2	3	4	5
24	8	9	5	28	22	44	25	11	30	36
48	4	34	21	17	33	15	12	46	1	19
	40	35	29	31	37	27	10	13	47	
		23	43	32	3	18	20	16		
			39	7	42	6	41			
				45	26	2				
					38					
					14					

Avg	
0,12	T
-0,63	O
0,83	E

Table 23: Z-score for elements Factor A1

Element	#	Z-score
Vertrouwen tussen projectteam en opdrachtgever	36	2,02
Onzekerheid over de scope	19	1,92
Tegenstrijdige normen en standaarden	30	1,49
Vertrouwen tussen projectteam en aannemer(s)	1	1,45
Contractvorm	47	1,09
Druk op de tijdsplanning	11	0,97
Afhankelijkheid van externe stakeholders	46	0,96
Aantal externe stakeholders	13	0,86
Diversiteit in belangen van externe stakeholders	16	0,85
Diversiteit van technische disciplines	25	0,82
Politieke invloed	12	0,54
Samenwerking tussen aannemers	10	0,53
Technische risico's	20	0,52
Invloed van stakeholders van binnen de organisatie	41	0,51
Externe risico's	44	0,51
Marktomstandigheden	15	0,49
Aantal deelprojecten	27	0,45
Niveau van kwaliteitseisen	18	0,45
Aard van de omgeving	6	0,44
Incongruentie van projectdoelstellingen	2	0,40
Aantal uitvoeringscontracten en interfaces daartussen	22	0,39

Afhankelijkheid tussen deelprojecten	33	0,33
Discontinuïteit bemensing stakeholders	37	0,26
Onduidelijkheid over projectdoelstellingen	3	0,25
Bereikbaarheid en bouwlogistiek	42	0,21
Interfaces met andere projecten	26	0,05
Gebruik nieuwe technologie	38	0,00
Projectduur	14	-0,01
Aantal financieringsbronnen	28	-0,12
Gebrek van ervaring in omgeving/land	17	-0,13
Interfaces tussen verschillende disciplines	31	-0,14
Aantal projectdoelstellingen	32	-0,22
Beschikbaarheid van capaciteit en vaardigheden	7	-0,22
Aantal projectmedewerkers	45	-0,52
Onzekerheid over technische methoden	5	-0,53
Organisatorische risico's	21	-0,60
Ervaring met toegepaste technieken	29	-0,61
Management support vanuit eigen organisatie	43	-0,78
Aansluiting tussen gebruikte PM tools & technieken	39	-0,95
Investeringskosten	9	-1,08
Diversiteit van deelprojecten	34	-1,12
Verplichte lokale partijen	35	-1,20
Aantal locaties	23	-1,22
Ervaring met projectpartijen	8	-1,23
VGM-bewustzijn	4	-1,40
Aantal verschillende nationaliteiten	40	-1,68
Werktijden (verschillende tijdzones)	24	-2,37
Aantal verschillende talen	48	-2,60

G.1.2. Factor A2:

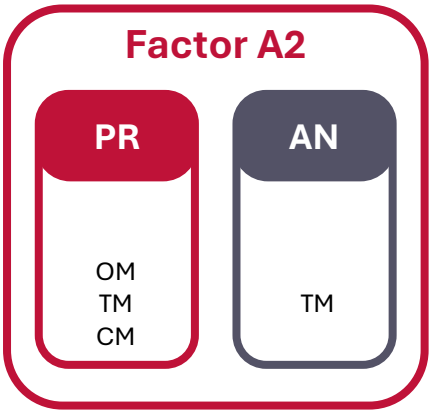


Figure 53: Participants in Factor A2

Table 24: Composite Q-sort Factor A2

-5	-4	-3	-2	-1	0	1	2	3	4	5
24	48	39	34	9	31	38	37	15	44	42
40	28	2	27	43	8	30	4	46	7	22
	35	13	3	19	11	18	5	20	33	
		23	41	14	6	1	25	10		
			32	16	29	21	47			
				12	45	36				
					26					
					17					

Avg	
-0,18	T
0,16	O
0,00	E

Table 25: Z-score for elements Factor A2

Element	#	Z-score
Bereikbaarheid en bouwlogistiek	42	1,66
Aantal uitvoeringscontracten en interfaces daartussen	22	1,61
Externe risico's	44	1,52
Beschikbaarheid van capaciteit en vaardigheden	7	1,49
Afhankelijkheid tussen deelprojecten	33	1,46
Marktomstandigheden	15	1,27
Afhankelijkheid van externe stakeholders	46	1,25
Technische risico's	20	1,18
Samenwerking tussen aannemers	10	1,04
Discontinuïteit bemensing stakeholders	37	0,94
VGM-bewustzijn	4	0,83
Onzekerheid over technische methoden	5	0,81
Diversiteit van technische disciplines	25	0,53
Contractvorm	47	0,48
Gebruik nieuwe technologie	38	0,45
Tegenstrijdige normen en standaarden	30	0,44
Niveau van kwaliteitseisen	18	0,44
Vertrouwen tussen projectteam en aannemer(s)	1	0,43
Organisatorische risico's	21	0,42

Element	#	Z-score
Vertrouwen tussen projectteam en opdrachtgever	36	0,33
Interfaces tussen verschillende disciplines	31	0,32
Ervaring met projectpartijen	8	0,31
Druk op de tijdsplanning	11	0,22
Aard van de omgeving	6	0,14
Ervaring met toegepaste technieken	29	0,06
Aantal projectmedewerkers	45	0,03
Interfaces met andere projecten	26	0,01
Gebrek van ervaring in omgeving/land	17	-0,03
Investeringskosten	9	-0,21
Management support vanuit eigen organisatie	43	-0,25
Onzekerheid over de scope	19	-0,39
Projectduur	14	-0,46
Diversiteit in belangen van externe stakeholders	16	-0,46
Politieke invloed	12	-0,60
Diversiteit van deelprojecten	34	-0,65
Aantal deelprojecten	27	-0,80
Onduidelijkheid over projectdoelstellingen	3	-0,86
Invloed van stakeholders van binnen de organisatie	41	-0,88
Aantal projectdoelstellingen	32	-0,90
Aansluiting tussen gebruikte PM tools & technieken	39	-0,97
Incongruentie van projectdoelstellingen	2	-0,99
Aantal externe stakeholders	13	-1,10
Aantal locaties	23	-1,25
Aantal verschillende talen	48	-1,49
Aantal financieringsbronnen	28	-1,52
Verplichte lokale partijen	35	-1,65
Werktijden (verschillende tijdzones)	24	-2,05
Aantal verschillende nationaliteiten	40	-2,16

G.2. Project B

Table 26: Correlation matrix Project B

	PR PM	PR PB	PR TM	PI TM	PI CM	AN PB	AN TM
PR PM	100	28	22	18	56	28	45
PR PB		100	40	26	34	49	44
PR TM			100	59	52	62	66
PI TM				100	52	50	58
PI CM					100	41	45
AN PB						100	51
AN TM							100

Table 27: Correlation within party and roles Project B

Averages	Correlation
Total	44
ProRail	30
Contractor	51
Consultant	52
Avg	44
PM	18
PB	49
OM	-
TM	61
CM	-
Avg	43

Table 28: Factor matrix Project B

Q-sort\ Loading	Factor 1	Factor 2
PR PM	0.1761	0.6335X
PR PB	0.4532X	0.2572
PR TM	0.8087X	0.2328
IB TM	0.6042X	0.2661
IB CM	0.3750	0.7556X
AN PB	0.7337X	0.2140
AN TM	0.7035X	0.3682

Since there are only two factors rotated in project B, all distinguishing statements are shown in one table since differences are both ways for bipolar factor solutions.

Table 29: Distinguishing statements Project B

Element	#	Rank 1	Z-score 1	Rank 2	Z-score 2	Significant
Vertrouwen tussen projectteam en aannemer(s)	1	3	1,02	5	1,88	
Incongruentie van projectdoelstellingen	2	0	0,06	-2	-0,81	
VGM-bewustzijn	4	-2	-0,66	1	0,59	*

Element	#	Rank 1	Z-score 1	Rank 2	Z-score 2	Significant
Ervaring met projectpartijen	8	1	0,4	-1	-0,43	
Investeringskosten	9	0	-0,06	-3	-1,18	*
Samenwerking tussen aannemers	10	-1	-0,41	2	0,7	*
Politieke invloed	12	-2	-0,52	-5	-1,88	*
Aantal externe stakeholders	13	1	0,43	-2	-0,7	*
Projectduur	14	4	1,64	1	0,48	*
Aantal uitvoeringscontracten en interfaces daartussen	22	-2	-0,62	3	1,02	*
Interfaces met andere projecten	26	4	1,36	1	0,54	
Ervaring met toegepaste technieken	29	-3	-1,29	-1	-0,48	
Tegenstrijdige normen en standaarden	30	-1	-0,21	1	0,59	
Verplichte lokale partijen	35	-4	-1,87	-3	-1,07	
Vertrouwen tussen projectteam en opdrachtgever	36	1	0,28	-2	-0,54	
Discontinuïteit bemensing stakeholders	37	5	1,73	-4	-1,67	*
Gebruik nieuwe technologie	38	-4	-1,41	3	0,91	*
Management support vanuit eigen organisatie	43	2	0,68	-1	-0,27	
Externe risico's	44	2	0,76	5	1,99	*
Contractvorm	47	0	-0,09	4	1,61	*

Table 30: Consensus statements Project B

Element	#	Q-SV 1	Z-score 1	Q-SV 2	Z-score 2	Significant
Vertrouwen tussen projectteam en aannemer(s)	1	3	1,02	5	1,88	
Incongruentie van projectdoelstellingen	2	0	0,06	-2	-0,81	
Onduidelijkheid over projectdoelstellingen	3	-2	-0,55	0	0	*
Onzekerheid over technische methoden	5	-1	-0,3	0	0	*
Aard van de omgeving	6	0	0,13	0	-0,22	*
Beschikbaarheid van capaciteit en vaardigheden	7	5	2,19	4	1,72	*
Ervaring met projectpartijen	8	1	0,4	-1	-0,43	
Druk op de tijdsplanning	11	3	1,15	3	1,13	*
Marktomstandigheden	15	1	0,54	1	0,48	*
Diversiteit in belangen van externe stakeholders	16	-3	-0,68	-2	-0,75	*
Gebrek van ervaring in omgeving/land	17	-3	-1,19	-3	-1,13	*
Niveau van kwaliteitseisen	18	1	0,41	2	0,75	*
Onzekerheid over de scope	19	3	0,96	1	0,43	*
Technische risico's	20	2	0,82	1	0,38	*
Organisatorische risico's	21	3	0,99	2	0,7	*
Aantal locaties	23	0	-0,11	-1	-0,43	*
Werktijden (verschillende tijdzones)	24	-5	-2,17	-5	-1,88	*
Diversiteit van technische disciplines	25	2	0,62	3	0,97	*
Interfaces met andere projecten	26	4	1,36	1	0,54	
Aantal deelprojecten	27	0	-0,14	0	-0,16	*
Aantal financieringsbronnen	28	-1	-0,29	-2	-0,64	*
Ervaring met toegepaste technieken	29	-3	-1,29	-1	-0,48	
Tegenstrijdige normen en standaarden	30	-1	-0,21	1	0,59	

Interfaces tussen verschillende disciplines	31	4	1,28	4	1,5	*
Aantal projectdoelstellingen	32	0	-0,18	-3	-0,86	*
Afhankelijkheid tussen deelprojecten	33	0	0,13	0	0,32	*
Diversiteit van deelprojecten	34	-3	-0,74	-2	-0,54	*
Verplichte lokale partijen	35	-4	-1,87	-3	-1,07	
Vertrouwen tussen projectteam en opdrachtgever	36	1	0,28	-2	-0,54	
Aansluiting tussen gebruikte PM tools & technieken	39	-1	-0,42	-1	-0,32	*
Aantal verschillende nationaliteiten	40	-4	-1,87	-4	-1,29	*
Invloed van stakeholders van binnen de organisatie	41	2	0,73	0	0,05	*
Bereikbaarheid en bouwlogistiek	42	1	0,45	2	0,75	*
Management support vanuit eigen organisatie	43	2	0,68	-1	-0,27	
Aantal projectmedewerkers	45	-1	-0,2	0	-0,16	*
Afhankelijkheid van externe stakeholders	46	-2	-0,61	0	-0,11	*
Aantal verschillende talen	48	-5	-2,18	-5	-1,99	*

G.2.1. Factor B1

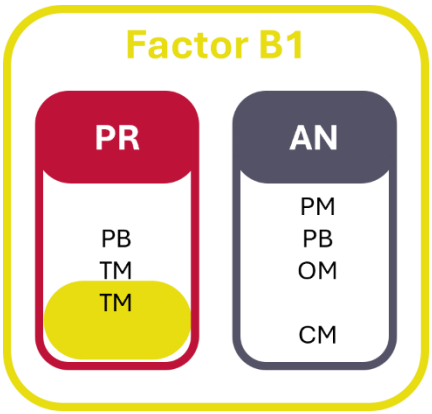


Figure 54: Participants in Factor B2

Table 31: Composite Q-sort Factor B1

-5	-4	-3	-2	-1	0	1	2	3	4	5
24	38	16	12	45	6	15	20	11	14	7
48	40	34	3	30	33	42	44	1	26	37
	35	17	46	28	2	13	41	21	31	
		29	22	5	9	18	43	19		
			4	10	47	8	25			
				39	23	36				
					27					
					32					

Avg	
-0,12	T
-0,05	O
0,25	E

Table 32: Z-score for elements Factor B1

Element	#	Z-score
Beschikbaarheid van capaciteit en vaardigheden	7	2,194
Discontinuïteit bemensing stakeholders	37	1,727
Projectduur	14	1,644
Interfaces met andere projecten	26	1,356
Interfaces tussen verschillende disciplines	31	1,282
Druk op de tijdsplanning	11	1,151
Vertrouwen tussen projectteam en aannemer(s)	1	1,015
Organisatorische risico's	21	0,988
Onzekerheid over de scope	19	0,964
Technische risico's	20	0,82
Externe risico's	44	0,759
Invloed van stakeholders van binnen de organisatie	41	0,734
Management support vanuit eigen organisatie	43	0,684
Diversiteit van technische disciplines	25	0,619
Marktomstandigheden	15	0,543
Bereikbaarheid en bouwlogistiek	42	0,451
Aantal externe stakeholders	13	0,432
Niveau van kwaliteitseisen	18	0,407
Ervaring met projectpartijen	8	0,401
Vertrouwen tussen projectteam en opdrachtgever	36	0,282

Aard van de omgeving	6	0,133
Afhankelijkheid tussen deelprojecten	33	0,125
Incongruentie van projectdoelstellingen	2	0,062
Investeringskosten	9	-0,061
Contractvorm	47	-0,091
Aantal locaties	23	-0,113
Aantal deelprojecten	27	-0,144
Aantal projectdoelstellingen	32	-0,178
Aantal projectmedewerkers	45	-0,201
Tegenstrijdige normen en standaarden	30	-0,207
Aantal financieringsbronnen	28	-0,286
Onzekerheid over technische methoden	5	-0,3
Samenwerking tussen aannemers	10	-0,413
Aansluiting tussen gebruikte PM tools & technieken	39	-0,416
Politieke invloed	12	-0,524
Onduidelijkheid over projectdoelstellingen	3	-0,553
Afhankelijkheid van externe stakeholders	46	-0,607
Aantal uitvoeringscontracten en interfaces daartussen	22	-0,622
VGM-bewustzijn	4	-0,659
Diversiteit in belangen van externe stakeholders	16	-0,676
Diversiteit van deelprojecten	34	-0,742
Gebrek van ervaring in omgeving/land	17	-1,194
Ervaring met toegepaste technieken	29	-1,287
Gebruik nieuwe technologie	38	-1,408
Aantal verschillende nationaliteiten	40	-1,871
Verplichte lokale partijen	35	-1,871
Werktijden (verschillende tijdzones)	24	-2,172
Aantal verschillende talen	48	-2,181

G.2.2. Factor B2

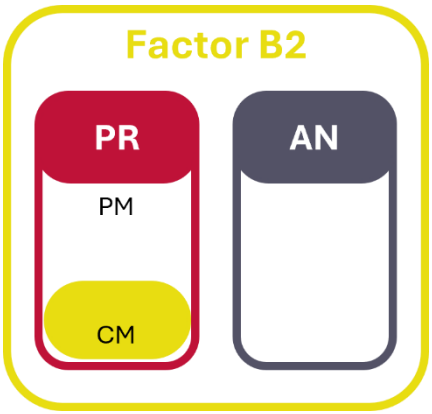


Figure 55: Participants in Factor B2

Table 33: Composite Q-sort Factor B2

-5	-4	-3	-2	-1	0	1	2	3	4	5
24	40	32	36	43	33	4	18	11	7	44
48	37	35	28	39	41	26	42	22	47	1
	12	17	13	23	5	15	10	25	31	
		9	16	8	3	14	21	38		
			2	29	46	19	30			
				34	27	20				
					45					
					6					

Avg	
0,12	T
0,53	O
-1,00	E

Table 34: Z-score for elements Factor B2

Element	#	Z-score
Externe risico's	44	1,988
Vertrouwen tussen projectteam en aannemer(s)	1	1,881
Beschikbaarheid van capaciteit en vaardigheden	7	1,719
Contractvorm	47	1,612
Interfaces tussen verschillende disciplines	31	1,504
Druk op de tijdsplanning	11	1,128
Aantal uitvoeringscontracten en interfaces daartussen	22	1,021
Diversiteit van technische disciplines	25	0,967
Gebruik nieuwe technologie	38	0,914
Niveau van kwaliteitseisen	18	0,753
Bereikbaarheid en bouwlogistiek	42	0,753
Samenwerking tussen aannemers	10	0,698
Organisatorische risico's	21	0,698
Tegenstrijdige normen en standaarden	30	0,591
VGM-bewustzijn	4	0,591
Interfaces met andere projecten	26	0,537
Marktomstandigheden	15	0,484
Projectduur	14	0,483
Onzekerheid over de scope	19	0,429
Technische risico's	20	0,376
Afhankelijkheid tussen deelprojecten	33	0,323
Invloed van stakeholders van binnen de organisatie	41	0,054

Onzekerheid over technische methoden	5	0
Onduidelijkheid over projectdoelstellingen	3	0
Afhankelijkheid van externe stakeholders	46	-0,107
Aantal deelprojecten	27	-0,161
Aantal projectmedewerkers	45	-0,161
Aard van de omgeving	6	-0,216
Management support vanuit eigen organisatie	43	-0,269
Aansluiting tussen gebruikte PM tools & technieken	39	-0,323
Aantal locaties	23	-0,43
Ervaring met projectpartijen	8	-0,43
Ervaring met toegepaste technieken	29	-0,484
Diversiteit van deelprojecten	34	-0,537
Vertrouwen tussen projectteam en opdrachtgever	36	-0,537
Aantal financieringsbronnen	28	-0,644
Aantal externe stakeholders	13	-0,698
Diversiteit in belangen van externe stakeholders	16	-0,753
Incongruentie van projectdoelstellingen	2	-0,806
Aantal projectdoelstellingen	32	-0,86
Verplichte lokale partijen	35	-1,074
Gebrek van ervaring in omgeving/land	17	-1,128
Investeringskosten	9	-1,182
Aantal verschillende nationaliteiten	40	-1,29
Discontinuïteit bemensing stakeholders	37	-1,665
Politieke invloed	12	-1,881
Werktijden (verschillende tijdzones)	24	-1,881
Aantal verschillende talen	48	-1,988

G.3. Project C

Table 35: Correlation matrix Project C

	PR PM	PR PB	PR OM	PR TM	PR CM	AN PM	AN PB	AN TM	AN CM	IB PM	IB PB	IB TM	IB CM
PR PM	100	60	54	48	46	52	55	65	34	39	44	21	49
PR PB		100	57	61	47	53	54	60	47	45	53	34	48
PR OM			100	42	58	52	50	58	68	47	64	32	53
PR TM				100	44	47	50	50	43	26	43	38	36
PR CM					100	68	52	51	56	64	68	46	51
AN PM						100	72	59	55	49	52	58	56
AN PB							100	74	44	54	57	57	56
AN TM								100	53	60	59	50	61
AN CM									100	36	47	35	44
IB PM										100	64	59	52

IB PB											100	59	56
IB TM												100	61
IB CM													100

Table 36: Correlation within party and roles Project C

Averages	Correlation
Total	**52**
ProRail	52
Contractor	60
Consultant	59
Avg	**57**
PM	47
PB	55
OM	-
TM	46
CM	50
Avg	**49**

Table 37: Factor matrix Project C

Q-sort\ Loading	Factor 1	Factor 2	Factor 3
PR PM	0.2012	0.7145X	0.2443
PR PB	0.4033	0.6422X	0.2053
PR OM	0.7032X	0.4233	0.1548
PR TM	0.3007	0.5946X	0.1601
PR CM	0.6082X	0.2886	0.4249
AN PM	0.4157	0.4382	0.4985*
AN PB	0.1654	0.5541	0.6458X
AN TM	0.3303	0.5674*	0.5202*
AN CM	0.5164X	0.3592	0.2428
IB PM	0.4440	0.1783	0.5842X
IB PB	0.6623X	0.2392	0.4736
IB TM	0.1788	0.1488	0.7645X
IB CM	0.3783	0.3154	0.5518X

Consensus project C

Table 38: Consensus statements Project C

Element	#	Rank 1	Rank 2	Rank 3	Significant
Vertrouwen tussen projectteam en aannemer(s)	1	0	2	2	*
Incongruentie van projectdoelstellingen	2	-3	-2	-1	*
VGM-bewustzijn	4	-4	-3	-1	
Onzekerheid over technische methoden	5	-2	0	0	*
Beschikbaarheid van capaciteit en vaardigheden	7	1	4	3	
Ervaring met projectpartijen	8	-2	-2	-1	*
Samenwerking tussen aannemers	10	2	3	4	
Druk op de tijdsplanning	11	3	3	1	
Aantal externe stakeholders	13	2	0	1	
Projectduur	14	3	2	4	
Marktomstandigheden	15	1	1	1	*
Diversiteit in belangen van externe stakeholders	16	1	1	1	*
Onzekerheid over de scope	19	0	0	1	*
Organisatorische risico's	21	0	0	2	

Aantal locaties	23	-2	-2	-1	*
Werktijden (verschillende tijdzones)	24	-5	-5	-5	*
Diversiteit van technische disciplines	25	0	0	0	*
Interfaces met andere projecten	26	5	5	5	*
Tegenstrijdige normen en standaarden	30	-1	0	0	*
Aantal projectdoelstellingen	32	0	-2	0	*
Vertrouwen tussen projectteam en opdrachtgever	36	-1	-1	0	*
Gebruik nieuwe technologie	38	-2	0	-2	*
Aantal verschillende nationaliteiten	40	-4	-4	-4	*
Bereikbaarheid en bouwlogistiek	42	4	4	4	*
Externe risico's	44	2	2	3	*
Aantal verschillende talen	48	-5	-5	-5	*

G.3.1. Factor C1

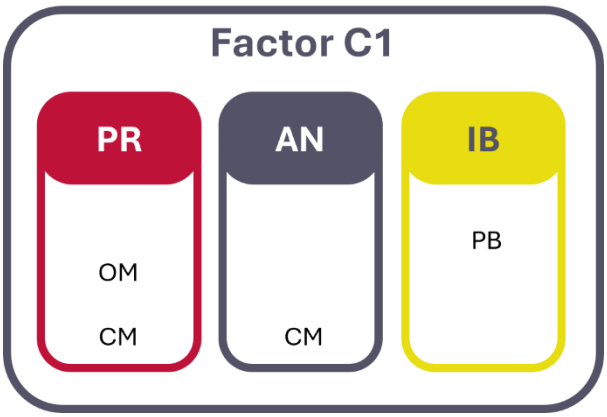


Figure 56: Participants in Factor C1

Table 39: Composite Q-sort Factor C1

-5	-4	-3	-2	-1	0	1	2	3	4	5
48	4	43	38	12	1	34	22	14	33	26
24	35	2	29	28	45	20	18	27	42	46
	40	3	8	36	9	7	44	11	6	
		39	23	30	32	31	13	41		
			5	17	25	15	10			
				37	21	16				
					47					
					19					

Avg	
-0,06	T
-0,63	O
1,08	E

Table 40: Z-score for elements Factor C1

Element	#	Z-score
Interfaces met andere projecten	26	1,893
Afhankelijkheid van externe stakeholders	46	1,611
Afhankelijkheid tussen deelprojecten	33	1,498
Bereikbaarheid en bouwlogistiek	42	1,361
Aard van de omgeving	6	1,335
Projectduur	14	1,291
Aantal deelprojecten	27	1,233
Druk op de tijdsplanning	11	1,102
Invloed van stakeholders van binnen de organisatie	41	1,034
Aantal uitvoeringscontracten en interfaces daartussen	22	1,016
Niveau van kwaliteitseisen	18	0,985
Externe risico's	44	0,591
Aantal externe stakeholders	13	0,556
Samenwerking tussen aannemers	10	0,543
Diversiteit van deelprojecten	34	0,499
Technische risico's	20	0,483
Beschikbaarheid van capaciteit en vaardigheden	7	0,4
Interfaces tussen verschillende disciplines	31	0,287
Marktomstandigheden	15	0,274
Diversiteit in belangen van externe stakeholders	16	0,248
Vertrouwen tussen projectteam en aannemer(s)	1	0,242
Aantal projectmedewerkers	45	0,201

Investeringskosten	9	0,11
Aantal projectdoelstellingen	32	0,101
Diversiteit van technische disciplines	25	0,086
Organisatorische risico's	21	-0,148
Contractvorm	47	-0,161
Onzekerheid over de scope	19	-0,172
Politieke invloed	12	-0,226
Aantal financieringsbronnen	28	-0,249
Vertrouwen tussen projectteam en opdrachtgever	36	-0,308
Tegenstrijdige normen en standaarden	30	-0,329
Gebrek van ervaring in omgeving/land	17	-0,399
Discontinuïteit bemensing stakeholders	37	-0,403
Gebruik nieuwe technologie	38	-0,476
Ervaring met toegepaste technieken	29	-0,48
Ervaring met projectpartijen	8	-0,511
Aantal locaties	23	-0,53
Onzekerheid over technische methoden	5	-0,549
Management support vanuit eigen organisatie	43	-0,935
Incongruentie van projectdoelstellingen	2	-1,003
Onduidelijkheid over projectdoelstellingen	3	-1,284
Aansluiting tussen gebruikte PM tools & technieken	39	-1,354
VGM-bewustzijn	4	-1,49
Verplichte lokale partijen	35	-1,886
Aantal verschillende nationaliteiten	40	-1,991
Aantal verschillende talen	48	-2,014
Werktijden (verschillende tijdzones)	24	-2,087

Table 41: Distinguishing statements Factor C1

Element	#	Rank 1	Z-score 1	Rank 2	Rank 3	Significant
Beschikbaarheid van capaciteit en vaardigheden	7	**1**	**0,4**	4	3	
Niveau van kwaliteitseisen	18	**2**	**0,99**	-1	0	
Aantal uitvoeringscontracten en interfaces daartussen	22	**2**	**1,02**	5	-3	*
Aantal deelprojecten	27	**3**	**1,23**	-4	-1	*
Interfaces tussen verschillende disciplines	31	**1**	**0,29**	4	3	*
Diversiteit van deelprojecten	34	**1**	**0,5**	-1	-3	
Verplichte lokale partijen	35	**-4**	**-1,89**	-3	-4	
Aansluiting tussen gebruikte PM tools & technieken	39	**-3**	**-1,35**	1	-1	

G.3.2. Factor C2

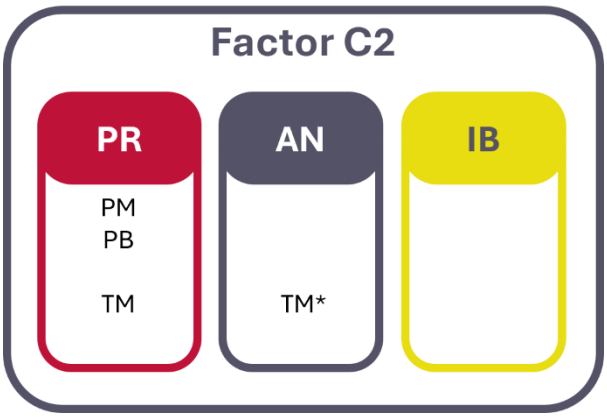


Figure 57: Participants in Factor C2

Table 42: Composite Q-sort Factor C2

-5	-4	-3	-2	-1	0	1	2	3	4	5
48	27	45	32	3	21	6	33	41	42	22
24	47	35	8	9	30	37	1	11	31	26
	40	4	23	28	19	15	43	10	7	
		17	2	36	5	16	44	12		
			29	18	20	46	14			
				34	38	39				
					25					
					13					

Avg	
-0,71	T
-0,11	O
1,17	E

Table 43: Z-score for elements Factor C2

Element	#	Z-score
Aantal uitvoeringscontracten en interfaces daartussen	22	2,146
Interfaces met andere projecten	26	1,813
Bereikbaarheid en bouwlogistiek	42	1,715
Interfaces tussen verschillende disciplines	31	1,502
Beschikbaarheid van capaciteit en vaardigheden	7	1,267
Invloed van stakeholders van binnen de organisatie	41	1,217
Druk op de tijdsplanning	11	1,12
Samenwerking tussen aannemers	10	0,977
Politieke invloed	12	0,855
Afhankelijkheid tussen deelprojecten	33	0,813
Vertrouwen tussen projectteam en aannemer(s)	1	0,811
Management support vanuit eigen organisatie	43	0,788
Externe risico's	44	0,764
Projectduur	14	0,743
Aard van de omgeving	6	0,739
Discontinuïteit bemensing stakeholders	37	0,381
Marktomstandigheden	15	0,381
Diversiteit in belangen van externe stakeholders	16	0,356
Afhankelijkheid van externe stakeholders	46	0,258
Aansluiting tussen gebruikte PM tools & technieken	39	0,19
Organisatorische risico's	21	0,117
Tegenstrijdige normen en standaarden	30	-0,069

Onzekerheid over de scope	19	-0,07
Onzekerheid over technische methoden	5	-0,093
Technische risico's	20	-0,141
Gebruik nieuwe technologie	38	-0,213
Diversiteit van technische disciplines	25	-0,213
Aantal externe stakeholders	13	-0,24
Onduidelijkheid over projectdoelstellingen	3	-0,287
Investeringskosten	9	-0,335
Aantal financieringsbronnen	28	-0,336
Vertrouwen tussen projectteam en opdrachtgever	36	-0,358
Niveau van kwaliteitseisen	18	-0,381
Diversiteit van deelprojecten	34	-0,405
Aantal projectdoelstellingen	32	-0,428
Ervaring met projectpartijen	8	-0,571
Aantal locaties	23	-0,575
Incongruentie van projectdoelstellingen	2	-0,619
Ervaring met toegepaste technieken	29	-0,623
Aantal projectmedewerkers	45	-0,692
Verplichte lokale partijen	35	-0,714
VGM-bewustzijn	4	-1,169
Gebrek van ervaring in omgeving/land	17	-1,262
Aantal deelprojecten	27	-1,408
Contractvorm	47	-1,528
Aantal verschillende nationaliteiten	40	-2,026
Aantal verschillende talen	48	-2,076
Werktijden (verschillende tijdzones)	24	-2,123

Table 44: Distinguishing statements Factor C2

Element	#	Rank 2	Z-score 2	Rank 1	Rank 3	Significant
Politieke invloed	12	**3**	**0,86**	-1	-2	*
Aantal externe stakeholders	13	**0**	**-0,24**	2	1	
Gebrek van ervaring in omgeving/land	17	**-3**	**-1,26**	-1	0	
Aantal uitvoeringscontracten en interfaces daartussen	22	**5**	**2,15**	2	-3	*
Aantal deelprojecten	27	**-4**	**-1,41**	3	-1	*
Discontinuïteit bemensing stakeholders	37	**1**	**0,38**	-1	-2	
Aansluiting tussen gebruikte PM tools & technieken	39	**1**	**0,19**	-3	-1	
Management support vanuit eigen organisatie	43	**2**	**0,79**	-3	-2	*
Aantal projectmedewerkers	45	**-3**	**-0,69**	0	2	
Afhankelijkheid van externe stakeholders	46	**1**	**0,26**	5	2	
Contractvorm	47	**-4**	**-1,53**	0	1	*

G.3.3. Factor C3

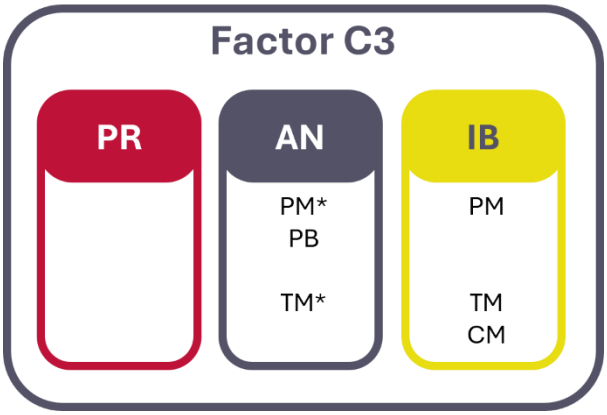


Figure 58: Participants in Factor C3

Table 45: Composite Q-sort Factor C3

-5	-4	-3	-2	-1	0	1	2	3	4	5
48	35	34	3	23	18	13	46	20	42	26
24	28	9	37	8	5	15	45	31	14	6
	40	22	12	27	32	19	21	7	10	
		41	38	2	25	11	1	44		
			43	39	17	47	29			
				4	33	16				
					30					
					36					

Avg	
-0,18	T
-0,11	O
0,42	E

Table 46: Z-score for elements Factor C3

Element	#	Z-score
Interfaces met andere projecten	26	2,301
Aard van de omgeving	6	1,784
Bereikbaarheid en bouwlogistiek	42	1,658
Projectduur	14	1,485
Samenwerking tussen aannemers	10	1,406
Technische risico's	20	1,372
Interfaces tussen verschillende disciplines	31	1,176
Beschikbaarheid van capaciteit en vaardigheden	7	1,119
Externe risico's	44	1,115
Afhankelijkheid van externe stakeholders	46	1,112
Aantal projectmedewerkers	45	0,813
Organisatorische risico's	21	0,608
Vertrouwen tussen projectteam en aannemer(s)	1	0,555
Ervaring met toegepaste technieken	29	0,555
Aantal externe stakeholders	13	0,486
Marktomstandigheden	15	0,422
Onzekerheid over de scope	19	0,419
Druk op de tijdsplanning	11	0,375
Contractvorm	47	0,338
Diversiteit in belangen van externe stakeholders	16	0,272
Niveau van kwaliteitseisen	18	0,167
Onzekerheid over technische methoden	5	-0,019

Aantal projectdoelstellingen	32	-0,113
Diversiteit van technische disciplines	25	-0,154
Gebrek van ervaring in omgeving/land	17	-0,221
Afhankelijkheid tussen deelprojecten	33	-0,246
Tegenstrijdige normen en standaarden	30	-0,347
Vertrouwen tussen projectteam en opdrachtgever	36	-0,366
Aantal locaties	23	-0,392
Ervaring met projectpartijen	8	-0,413
Aantal deelprojecten	27	-0,419
Incongruentie van projectdoelstellingen	2	-0,489
Aansluiting tussen gebruikte PM tools & technieken	39	-0,586
VGM-bewustzijn	4	-0,611
Onduidelijkheid over projectdoelstellingen	3	-0,615
Discontinuïteit bemensing stakeholders	37	-0,644
Politieke invloed	12	-0,681
Gebruik nieuwe technologie	38	-0,69
Management support vanuit eigen organisatie	43	-0,709
Diversiteit van deelprojecten	34	-0,725
Investeringskosten	9	-0,795
Aantal uitvoeringscontracten en interfaces daartussen	22	-0,981
Invloed van stakeholders van binnen de organisatie	41	-0,987
Verplichte lokale partijen	35	-1,062
Aantal financieringsbronnen	28	-1,409
Aantal verschillende nationaliteiten	40	-1,613
Aantal verschillende talen	48	-1,951
Werktijden (verschillende tijdzones)	24	-2,301

Table 47: : Distinguishing statements Factor C3

Element	#	Rank 3	Z-score 3	Rank 1	Rank 2	Significant
Druk op de tijdsplanning	11	**1**	**0,37**	3	3	
Technische risico's	20	**3**	**1,37**	1	0	*
Aantal uitvoeringscontracten en interfaces daartussen	22	**-3**	**-0,98**	2	5	*
Aantal deelprojecten	27	**-1**	**-0,42**	3	-4	*
Aantal financieringsbronnen	28	**-4**	**-1,41**	-1	-1	*
Ervaring met toegepaste technieken	29	**2**	**0,55**	-2	-2	*
Afhankelijkheid tussen deelprojecten	33	**0**	**-0,25**	4	2	*
Aansluiting tussen gebruikte PM tools & technieken	39	**-1**	**-0,59**	-3	1	
Invloed van stakeholders van binnen de organisatie	41	**-3**	**-0,99**	3	3	*

G.4. Total

Table 48: Correlation table of the total

	A01PRPM	A02PRPB	A03PROM	A04PRTM	A05PRCM	A06ANPM	A07ANPB	A08ANOM	A09ANTM	A10ANCM	B01PRPM	B02PRPB	B03PRTM	B04PIPM	B05PICM	B06ANPB	B07ANTM	C01PRPM	C02PRPB	C03PROM	C04PRTM	C05PRCM	C06ANPM	C07ANPB	C08ANTM	C09ANCM	C10IBPM	C11IBPB	C12IBTM	C13IBCM
A01PRPM	100	35	40	18	33	41	39	34	27	41	31	16	48	48	55	29	41	45	43	44	47	39	52	37	39	45	22	41	32	39
A02PRPB		100	20	22	29	32	48	33	29	42	24	47	35	35	25	34	37	39	41	41	39	27	25	34	43	37	28	18	15	24
A03PROM			100	57	37	30	28	37	37	29	66	29	39	44	54	28	54	35	60	50	48	30	35	37	37	41	39	51	25	27
A04PRTM				100	45	37	31	43	54	9	55	27	37	33	52	19	31	37	43	48	44	24	47	56	53	39	46	43	41	37
A05PRCM					100	30	43	14	45	19	31	43	31	16	40	18	30	22	17	23	29	20	43	37	33	32	28	23	30	25
A06ANPM						100	39	55	54	39	44	26	52	22	47	35	44	18	32	45	30	34	40	41	48	38	36	46	52	32
A07ANPB							100	38	49	41	14	36	49	17	21	20	40	38	43	41	23	51	46	37	40	36	41	41	24	36
A08ANOM								100	34	38	41	23	26	21	42	15	22	11	33	41	21	37	33	27	29	50	39	49	39	23
A09ANTM									100	12	32	22	51	27	33	27	48	37	44	39	40	42	68	53	53	39	38	37	31	24
A10ANCM										100	18	11	17	19	18	18	10	-3	31	23	14	12	3	10	21	23	20	21	20	8
B01PRPM											100	28	22	18	56	28	45	16	46	35	42	8	20	31	22	27	18	39	22	19
B02PRPB												100	40	26	34	49	44	8	29	19	26	12	22	36	14	32	9	10	21	19
B03PRTM													100	59	52	62	66	46	51	43	60	56	61	63	57	32	53	47	53	39
B04PIPM														100	52	50	58	39	45	47	59	45	38	39	52	47	40	57	43	39
B05PICM															100	41	45	29	50	32	55	34	56	56	49	41	36	57	66	52
B06ANPB																100	51	28	35	22	44	46	28	47	39	25	33	32	25	31
B07ANTM																	100	44	54	40	51	43	51	54	51	31	38	50	36	27
C01PRPM																		100	60	54	48	46	52	55	65	34	39	44	21	49
C02PRPB																			100	57	61	47	53	54	60	47	45	53	34	48
C03PROM																				100	42	58	52	50	58	68	47	64	32	53
C04PRTM																					100	44	47	50	50	43	26	43	38	36
C05PRCM																						100	68	52	51	56	64	68	46	51
C06ANPM																							100	72	59	55	49	52	58	56
C07ANPB																								100	74	44	54	57	57	56
C08ANTM																									100	53	60	59	50	61
C09ANCM																										100	36	47	35	44
C10IBPM																											100	64	59	52
C11IBPB																												100	59	56
C12IBTM																													100	61
C13IBCM																														100

Table 49: Correlation within party and roles total

Averages	Correlation
Total	**39**
ProRail	36
Contractor	36
Consultant	49
Avg	**40**
PM	35
PB	38
OM	43
TM	47
CM	32
Avg	**39**

Table 50: Factor matrix total

Q-sort\ Loading	Factor 1	Factor 2	Factor 3
A01PRPM	0.3994	0.3442	0.3115
A02PRPB	0.2727	0.4283X	0.2468
A03PROM	0.3134	0.2893	0.5164X
A04PRTM	0.3187	0.2221	0.5422X
A05PRCM	0.0791	0.2721	0.5606X
A06ANPM	0.2791	0.4294	0.4273
A07ANPB	0.3396	0.5437X	0.1834
A08ANOM	0.1530	0.6540X	0.2562
A09ANTM	0.3868	0.2505	0.4286
A10ANCM	0.0170	0.6190X	0.0901
B01PRPM	0.0596	0.2923	0.6094X
B02PRPB	0.0936	0.1223	0.5388X
B03PRTM	0.6432X	0.0543	0.4874
B04PITM	0.6022X	0.0741	0.3058
B05PICM	0.4360	0.1186	0.6262X
B06ANPB	0.4150X	0.0226	0.3987
B07ANTM	0.4885	0.0681	0.5536X
C01PRPM	0.6626X	0.1382	0.1099
C02PRPB	0.5608X	0.3143	0.3522
C03PROM	0.5486	0.5513	0.1299
C04PRTM	0.4925	0.0933	0.4925
C05PRCM	0.7706X	0.2379	0.0533
C06ANPM	0.6238X	0.2251	0.3678
C07ANPB	0.6799X	0.1002	0.4317
C08ANTM	0.7334X	0.2583	0.2493
C09ANCM	0.4607	0.4396	0.2357
C10IBPM	0.6430X	0.2264	0.1613
C11IBPB	0.6856X	0.2917	0.2265
C12IBTM	0.5206X	0.1881	0.3042
C13IBCM	0.6523X	0.2004	0.1359