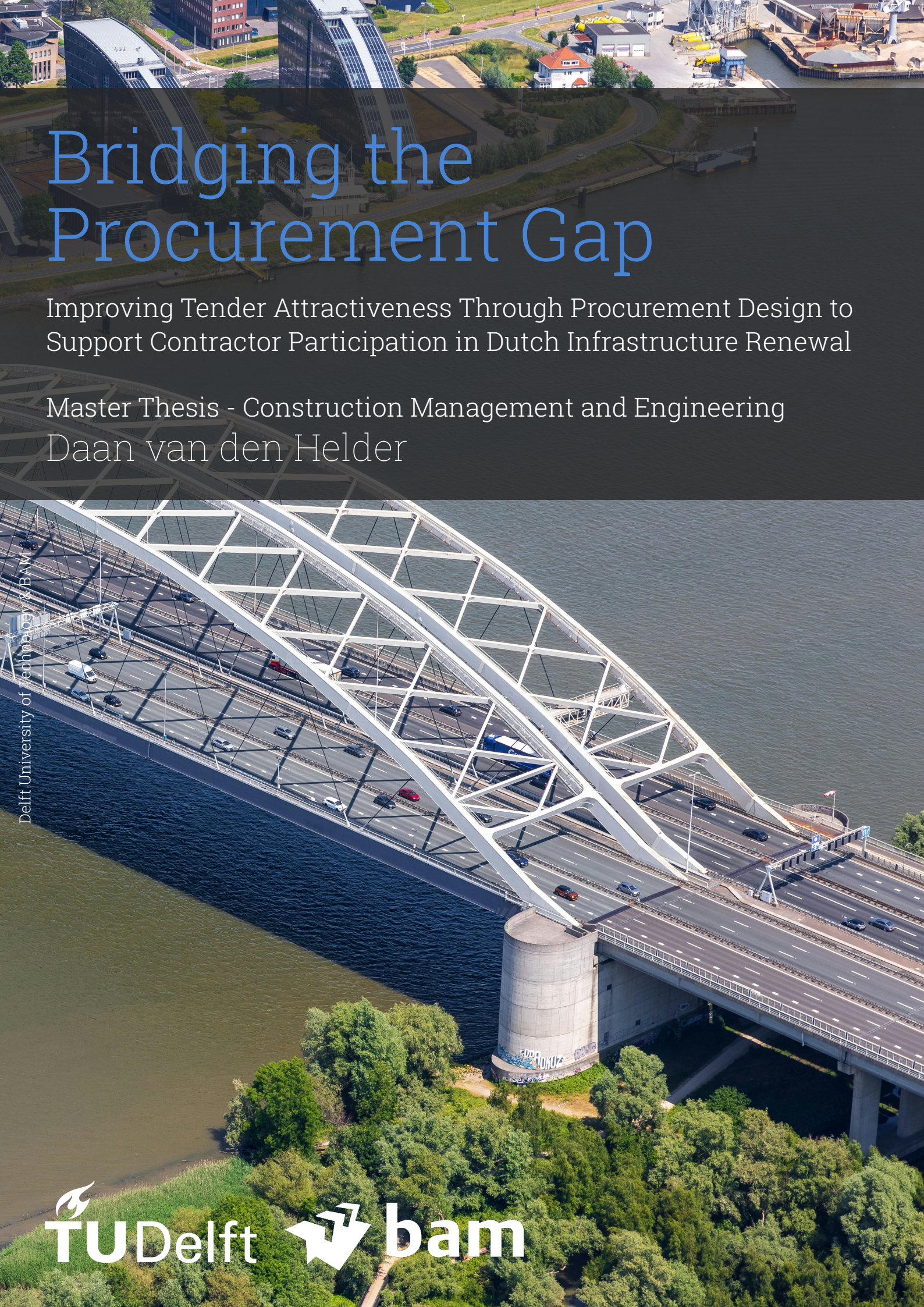




Bridging the Procurement Gap

Improving Tender Attractiveness Through Procurement Design to Support Contractor Participation in Dutch Infrastructure Renewal

Master Thesis - Construction Management and Engineering
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Bridging the Procurement Gap

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Procurement Design to Support Contractor
Participation in Dutch Infrastructure Renewal

by

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Preface

This thesis marks the final stage of my Master's programme in Construction Management and Engineering at Delft University of Technology. The research, conducted in collaboration with BAM Infra Civiël, focuses on procurement and contractor participation in the Dutch infrastructure renewal challenge.

The topic appealed to me because it connects a major societal challenge with the practical realities of project delivery. The renewal of ageing infrastructure is essential for the continued functioning of Dutch society, but the ability to deliver this work depends not only on technical solutions or available budgets. It also depends on whether public clients can bring projects to the market in a way that contractors are willing and able to pursue. This made procurement design an interesting lens through which to study the relation between public objectives and market capacity.

During the research, I gained a better understanding of how infrastructure renewal projects are shaped before they reach the market, and how contractors evaluate whether tender opportunities are worth pursuing. Working with internal tender selection data and discussing procurement choices with practitioners showed me that bid/no-bid decisions are not only commercial decisions, but also reflect broader questions of risk, capacity, workload, collaboration, and organisational fit. Translating these practical insights into an academic analysis has been both challenging and valuable.

I would like to thank the members of my graduation committee at TU Delft: Marcel Hertogh, who chaired the committee, and my supervisors Sander Renes and Erik-Jan Houwing, for their guidance and support throughout the research process. Their reflections helped me sharpen the research scope, improve the structure of the thesis, and connect the practical findings to the broader academic discussion.

I am also grateful to my supervisors and colleagues at BAM Infra Civiël, especially Reinoud Hanlo, and Laurens Koster, for allowing me to conduct this research within the organisation. Their openness, practical knowledge, and willingness to reflect on the tender selection process were essential for this thesis. I would also like to thank the interviewees and experts who contributed their time and insights to this research.

Daan van den Helder
Rotterdam, July 2026

Abstract

Infrastructure renewal projects are urgent, necessary, and publicly valuable, but this does not automatically make them attractive to contractors. In a capacity-constrained construction market, renewal tenders must compete for scarce contractor resources against alternative opportunities. Attracting suitable contractors is therefore essential to addressing the infrastructure renewal challenge, making contractor participation an explicit procurement design concern. This research shows that procurement design can improve their competitive position by making tender opportunities clearer, more manageable, more proportionate, and more commercially viable.

The attractiveness of infrastructure renewal tenders depends on how public clients translate renewal work into a tender opportunity and how contractors subsequently evaluate that opportunity. On the public-client side, policy, budgeting, and asset management decisions shape the renewal projects brought to market. This process is determined by procurement design decisions. These choices concern the object being procured, the form of collaboration, and the market approach. Together, they shape the work and conditions that contractors evaluate when deciding whether an opportunity is attractive enough to pursue through the bid/no-bid decision.

On the contractor side, the bid/no-bid decision reflects the interaction between work and condition attractiveness relative to alternative opportunities. Work attractiveness concerns whether the contractor wants the work, can deliver it, and has a credible chance of winning it. Infrastructure renewal work can be technically appealing and strategically relevant, but its commercial fit is constrained by limited production volume and capacity requirements. Condition attractiveness concerns whether the contractual, financial, technical, and tender conditions make participation manageable and commercially viable. Comparing this contractor evaluation with client-side procurement choices shows how procurement design shapes opportunity attractiveness.

The comparison showed that attractiveness emerges from the combinations of procurement design elements within the specific renewal context. To guide this configuration process, public clients should adopt seven procurement design principles. These principles are structured around context recognition, scope clarity, workload creation, risk alignment, market engagement, proportionate tendering, and strategic balancing (summarised in figure 1).

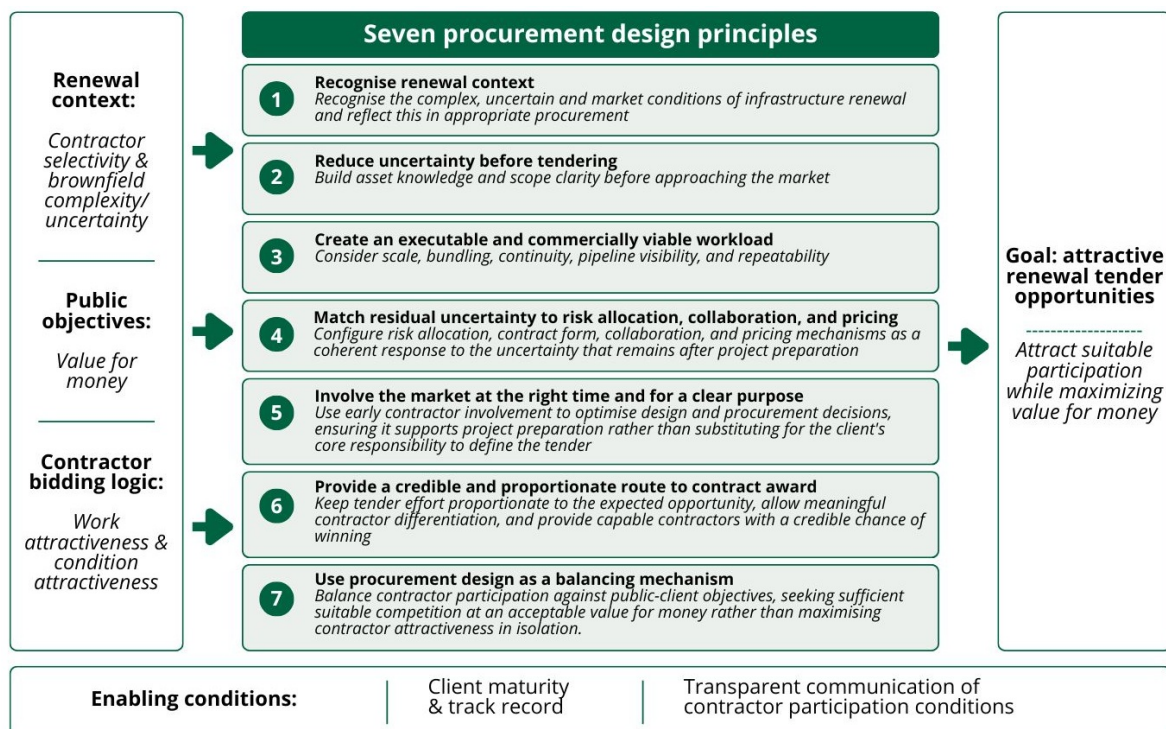


Figure 1: Seven procurement design principles for designing attractive infrastructure renewal tender opportunities.

Rather than aiming to maximise contractor attractiveness, these principles provide guidelines for balancing suitable market participation against public objectives and value for money. Their effective application depends heavily on client maturity and track record. An attractive procurement design only translates into an attractive tender opportunity if the client possesses the institutional capacity to implement it professionally and reliably. At the same time, alignment depends on contractors communicating their participation conditions and tender selection logic through interactions.

To derive these insights, the research followed a sequential mixed-methods design. First, the public infrastructure procurement process was reconstructed using a decision tree and translated into a morphological chart that represents the procurement design space. Second, tender selection data from a case-study contractor were analysed using cross-tabulations and qualitative comparative analysis and interpreted through semi-structured interviews. The client-side procurement design space and contractor-side findings were subsequently combined into a configuration set of attractive and less attractive procurement design elements, from which the final design principles were established.

Ultimately, while procurement design cannot increase total sector capacity or alter brownfield renewal conditions, it shapes how these constraints are reflected in the work and conditions of individual tender opportunities. Its contribution lies in reducing avoidable unattractiveness and improving the fit between what public clients need to procure and what suitable contractors are willing and able to pursue. It therefore serves as an alignment mechanism for developing attractive infrastructure renewal tenders that can compete more effectively for scarce contractor capacity. Achieving this requires a balanced configuration of procurement design choices. Public clients must reduce uncertainty, create executable workloads, allocate residual risks appropriately, align pricing with information maturity, engage the market purposefully, and maintain a proportionate route to contract award.

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Introduction

The Dutch infrastructure renewal challenge is societally urgent, yet societal necessity alone does not guarantee contractor participation. In a capacity-constrained construction market, infrastructure renewal tenders must actively compete with alternative market opportunities for scarce contractor tender and execution capacity. Public clients must therefore consider not only which assets require renewal, but also whether the resulting tender opportunities are sufficiently attractive for suitable contractors to pursue. This thesis examines how procurement design can contribute to enhancing that opportunity attractiveness.

1.1. Societal relevance

The societal relevance of the infrastructure renewal challenge is illustrated by the procurement of the Van Brienenoordbrug. As the bridge is ageing, it is due for renewal. This renewal forms part of the largest renewal task in Dutch infrastructure history, with estimated project costs of €1.5 to €2 billion (Rijkswaterstaat, 2025c). However, initial procurement of the project was unsuccessful due to insufficient bids. The tender was cancelled, and the project had to be re-evaluated to make the risks more acceptable to market parties considering participating (Cobouw, 2024).

The inability to secure such renewal projects is problematic because these assets are essential to the continued functioning of Dutch society. The Van Brienenoordbrug, the busiest bridge in the Netherlands, demonstrates the critical nature of these failing tenders. When procurement for such essential assets fails, network stability and accessibility are directly threatened. This risk becomes larger as the broader infrastructure renewal challenge grows steadily.

1.1.1. The growing Dutch infrastructure renewal challenge

The infrastructure renewal challenge is growing because a significant portion of Dutch infrastructure was built in the 1960s and 1970s. This leads to an increasing number of assets requiring intervention. These structures were built according to the design standards, traffic forecasts, and vehicle loads of that period. Although designed for an approximate technical lifespan of 70 years, they now face higher traffic intensity, heavier vehicles, increased axle loads, and stricter safety requirements (Rijkswaterstaat, 2007), meaning assets reach this technical lifespan sooner than anticipated. Consequently, many assets operate under different conditions from their original specifications, meaning renewal cannot be treated as simple one-to-one replacement. Collectively, these factors increase both the scale and complexity of the renewal task.

This challenge also includes hydraulic structures such as dikes, locks, and weirs, which, due to climate change, must withstand increasing periods of prolonged drought, heavy precipitation, and sea-level rise. Consequently, the requirements for the reliability of hydraulic structures are increasing (Rijkswaterstaat, 2025b; van Groenendaal et al., 2023).

This means that a large part of the existing infrastructure will reach the end of its technical lifespan in the coming decades. As a result, the infrastructure renewal challenge is substantial.

1.1.2. The importance of Dutch infrastructure

The Netherlands possesses over 141 000 kilometres of roads, 5 700 kilometres of waterways, and approximately 7 000 kilometres of railways (Rasker et al., 2023), including tens of thousands of civil structures.

The importance of this infrastructure is most noticeable when part of the network is unavailable. The failure of a single asset may lead to immediate societal and economic consequences.

An example is the partial closure of the Merwedeburg on the A27 in 2016. After cracks were discovered in the steel structure, heavy vehicles, such as trucks and buses, were no longer allowed to use the bridge. As the bridge forms an important connection between Zuid-Holland and Noord-Brabant, the closure immediately caused significant disruption, leading to congestion, delays, and economic losses. The financial impact of the closure is estimated to be at least half a million euros per day (NOS, 2016).

The Ministry of Infrastructure and Water Management estimates that, in the case of asset failure, the costs to consumers and businesses are up to ten times higher than the cost of repairs (van Groenendaal et al., 2023).

A well organised network of roads, railways, waterways, and airports enables healthy and sustainable economic growth. Infrastructure adds between 11.2 % and 17.3 % of gross value to economies of European countries (van Groenendaal et al., 2023).

In addition to its economic contribution, infrastructure contributes to the quality of life and well-being of citizens. It provides access to fundamental services such as healthcare and education (van Groenendaal et al., 2023). Infrastructure is also necessary to maintain the safety and habitability of the Netherlands in the future. It plays an important role in increasing resilience to climate change and ensures safety through accessibility (Rijkswaterstaat, 2025b).

Thus, the infrastructure renewal challenge is growing in scale, while procurement remains difficult, as seen in the Van Brienenoordbrug case. Public clients face practical difficulties in attracting sufficient contractor participation for the renewal of infrastructure, regardless of the societal importance for continued functioning infrastructure. The following section explains the practical difficulties public clients face in attracting sufficient contractor participation for infrastructure renewal tenders.

1.2. Practical relevance

Public clients face growing difficulty in attracting sufficient participation in procurement for infrastructure projects (Aanbestedingscafé, 2023; Harbers, 2024), leading to failing tenders. A tender fails when insufficient contractor participation prevents a public client from successfully awarding a contract.

This trend is reflected in the declining participation numbers across public procurement. Between 2017 and 2022, the share of public tenders receiving only a single bid increased from 12.5% to 22.2%, while tenders attracting more than five bidders became increasingly rare (Aanbestedingscafé, 2023). This drop in participation points to growing contractor selectivity in pursuing large and complex infrastructure projects (Infrasite, 2024).

1.2.1. Competition for implementation capacity

Although the Dutch infrastructure renewal challenge is large and urgent, it is one of several societal challenges. The housing crisis, energy transition, defence task, climate adaptation, and water safety task all depend on the implementation capacity of the construction sector (Rijkswaterstaat, 2025b). These societal challenges compete for labour, budgets, materials, environmental space, permits, and administrative capacity (Baarsma and Kop, 2026).

This competition is driven by scarcity across multiple dimensions. The construction sector faces a projected shortage of 100 000 to 150 000 technical personnel by 2030 (Baarsma and Kop, 2026). In addition, shortages of materials such as concrete, steel, and asphalt cause supply-chain constraints (Koninklijke BAM Groep N.V., 2026). Financial constraints are also substantial: the combined shortfalls in the Mobility Fund and Delta Fund exceed €80 billion, the Rijkswaterstaat maintenance backlog is estimated at €34.5 billion through 2038, and ProRail faces a backlog of €20 billion. Environmental constraints further increase scarcity, as the available nitrogen allowance for new projects is nearly exhausted (Baarsma and Kop, 2026).

In 2023, total infrastructure renewal production was approximately €1.1 billion, whereas the estimated required production level for the period 2021–2030 was approximately €2.4 billion per year, as illustrated in figure 1.1 (Rasker et al., 2023). This difference suggests that the current pace of renewal is insufficient to meet projected demand. Due to insufficient funding, many stakeholders perceive the required infrastructure renewal challenge as a heavy burden (Hertogh et al., 2018).



Figure 1.1: Expected annual investment requirement (Rasker et al., 2023).

The consequences of constrained implementation capacity are already visible in the real world. The Dutch minister for Infrastructure, Vincent Karremans, warned that “decisive choices” are needed for the maintenance of roads, bridges and other infrastructure, because “not everything is possible” under current shortages. Projects affected by these constraints include the Spui and Gemaalcomplex IJmuiden and the Haringvlietbrug. This illustrates that the renewal challenge is already facing challenges in the prioritisation, timing and feasibility of specific infrastructure projects (NOS, 2026).

These constraints affect different stages of infrastructure delivery. Limited funding and environmental space restrict which projects can be commissioned and under which conditions, while shortages of labour, knowledge, materials, and organisational capacity constrain their preparation and execution. For this thesis, the relevant consequence is that infrastructure renewal projects must compete for the allocation of limited contractor tender and execution capacity. Even necessary and prioritised projects can therefore not be assumed to reach execution.

1.2.2. Current response

The current policy response to the implementation capacity increasingly focuses on prioritisation within limited budgets. Since available funding is insufficient to cover the full renewal task, and no substantial additional budget is expected before 2030, the government has announced that a framework for this prioritisation will be developed by the summer of 2026, in which maintaining existing infrastructure takes precedence over new investments (Bouwend Nederland, 2026). PwC similarly argues that clear and substantiated prioritisation is necessary, since it is not realistic to attempt all the projects simultaneously. Rather, clear and substantiated choices should be made about the prioritisation. (Baarsma and Kop, 2026).

Even with this prioritisation and with available funding, a project may still fail to reach execution if contractors are unwilling or unable to participate. Projects still require dedicated implementation capacity. Contractor participation is therefore a critical condition for translating infrastructure priorities into actual project delivery.

1.2.3. Contractor selectivity

However, the construction sector experiences strong competition for implementation capacity. This competition changes the position of contractors in public procurement. Under conditions of capacity scarcity, contractors actively select which opportunities justify the allocation of their tender and execution capacity. Increasingly, contractors determine whether an opportunity is attractive enough to pursue (Nevi, 2024). This indicates a shift from a client-centred market towards a more contractor-centred market characterised by contractor selectivity. While public clients still define most procurement conditions, contractors exercise greater discretion over where to allocate their resources.

Contractors compare infrastructure renewal tenders with alternative opportunities that may offer lower

risk, higher returns, greater predictability, or stronger strategic value. Public clients are therefore no longer only selecting contractors. They are also competing for contractor capacity within the broader competition for implementation capacity. This requires public clients to engage with the market to understand which requirements contractors can realistically meet and to design tenders that are attractive and aligned with market capacity (Infrasite, 2024).

Contractors are thus likely to pursue those tender opportunities they perceive as more attractive relative to available alternatives. Therefore, public clients need to make their tenders more attractive to contractors.

1.2.4. Tender opportunity attractiveness

Opportunity attractiveness is the extent to which a contractor perceives a tender opportunity as worth pursuing relative to available alternatives. Although a tender opportunity has characteristics that influence this evaluation, attractiveness is not a fixed or universally shared property of the tender itself. The same opportunity may therefore be evaluated differently by contractors operating in different market segments. It informs the contractor’s bid/no-bid decision: whether to participate in the tender. In a contractor-selective market, contractors can compare available opportunities and pursue those they consider most attractive.

Importantly, opportunity attractiveness is not an intrinsic or universal property of a tender opportunity. What is attractive to one contractor may be unattractive or inaccessible to another based on differences in scale, corporate overhead, technical specialisation, and risk appetite. A project scale or contract structure that suits a large market party may be unviable for a smaller regional contractor. Therefore, this thesis treats opportunity attractiveness as relative and segment-specific, examining it through the perspective of large civil engineering contractors operating in the Dutch infrastructure renewal market.

In this thesis, opportunity attractiveness consists of two interdependent dimensions, work attractiveness and condition attractiveness. Their relation is depicted in table 1.1. Work attractiveness concerns whether the project itself is worth pursuing, including its scope, client, location, expected return, strategic considerations, and the available capacity. Condition attractiveness concerns the conditions under which the work is brought to market and delivered, including the contractual condition, tender procedure, and financial conditions.

	Attractive work	Unattractive work
Attractive conditions	Attractive opportunity	Potentially attractive opportunity
Unattractive conditions	Potentially attractive opportunity	Unattractive opportunity

Table 1.1: Relationship between work attractiveness, condition attractiveness, and opportunity attractiveness.

Work and condition attractiveness are complementary. Attractive work offered under attractive conditions provides the strongest basis for an attractive opportunity, whereas an opportunity is unlikely to be attractive when both dimensions are unfavourable. When only one dimension is attractive, the opportunity may still be worth pursuing if that dimension is sufficiently strong to compensate for the less attractive one. This does not, by itself, explain why particular infrastructure renewal tenders receive insufficient participation. One possible explanation is that total contractor capacity is simply insufficient to pursue all available tenders. Another is that, within this capacity constraint, contractors prioritise some opportunities over others based on their relative attractiveness. This thesis investigates the latter mechanism.

1.3. Academic relevance and knowledge gap

Although contractors increasingly exercise selectivity, limited public knowledge exists about how contractors evaluate procurement design characteristics when evaluating whether a tender opportunity is worth pursuing. With increased contractor selectivity, understanding of their evaluation is of growing importance to better understand what makes a tender opportunity attractive.

This evaluation is influenced by procurement design, the client-side choices through which a tender opportunity is structured and brought to market. These choices shape both the work offered to contractors and the conditions under which that work must be delivered. Procurement design therefore influences how contractors assess the attractiveness of a tender opportunity.

To summarise, the infrastructure renewal challenge continues to grow, and increasing numbers of re-

new projects require scarce contractor capacity to reach execution. However, contractors can choose where to allocate this capacity and may decide not to pursue infrastructure renewal opportunities that they do not perceive as sufficiently attractive. At the same time, limited knowledge exists about what makes such opportunities attractive to contractors and how this attractiveness can be influenced. This brings us to the central problem of this thesis.

1.4. Problem statement

Infrastructure renewal tenders must compete for scarce contractor capacity in a market where contractors can increasingly choose which projects to pursue. This selectivity may lead contractors to refrain from participating in infrastructure renewal tenders. Securing sufficient implementation capacity for infrastructure renewal therefore requires tender opportunities that contractors consider sufficiently attractive to pursue.

Public clients can influence how infrastructure renewal projects are structured and brought to market through procurement design. Procurement design shapes both the work offered to contractors and the conditions under which that work must be delivered. It may therefore provide levers through which the attractiveness of infrastructure renewal tender opportunities can be improved.

However, there is limited public knowledge about how contractors evaluate the attractiveness of tenders. As a result, it is difficult for public clients to determine which procurement design choices encourage or discourage contractor participation. This limits their ability to design tenders that can successfully compete for scarce contractor capacity.

This thesis does not aim to resolve infrastructure renewal as a whole. Instead, it examines how procurement design can be used to improve the attractiveness of Dutch infrastructure renewal tender opportunities for contractors. Therefore, this thesis aims to examine how procurement design can be aligned with contractors' evaluations of attractiveness by identifying the relevant procurement design dimensions, analysing the interaction between work attractiveness and condition attractiveness, identifying potential misalignments, and determining how procurement design can be adjusted to improve opportunity attractiveness. In this research, improving attractiveness is investigated as a means of increasing the likelihood of participation, not as a guarantee of participation.

This results in the following main research question:

How can procurement design contribute to improving the attractiveness of Dutch infrastructure renewal tender opportunities for contractors?

Answering the main research question requires insight into both the procurement design choices that structure tender opportunities and the way contractors evaluate their attractiveness. Therefore, the following research approach is used.

1.5. Research approach

First, the study maps the ways in which procurement design shapes tender opportunities. In step 2, the research analyses contractors' evaluations of the attractiveness of opportunities. Finally, it combines the two findings to identify, in step 3, procurement design elements that contractors find attractive and to derive, in step 4, procurement design principles for infrastructure renewal tenders.

1.5.1. Step 1: Mapping the procurement design space

In this research, the set of relevant procurement design dimensions and elements is referred to as the procurement design space. This design space represents the different configurations in which a client can structure the procurement of requested work. This, in turn, shapes the work and conditions offered in the resulting tender opportunity.

This is summarised in the first subquestion:

1. *What procurement design dimensions and elements shape the organisation of Dutch infrastructure renewal tenders?*

To derive this design space, the broader procurement process is first mapped to analyse which decisions lead to procurement and which choices can be made in procurement design. Then the procurement design space is presented through a morphological chart. Its construction and application are explained in more detail in chapter 3. This framework is used to examine how contractors evaluate

procurement design choices and to compare which procurement design characteristics are perceived as more or less attractive.

1.5.2. Step 2: Analysing how contractors evaluate tender opportunities

The research subsequently examines how contractors evaluate the attractiveness of infrastructure renewal tender opportunities. This subquestion directly addresses the knowledge gap identified in section 1.3: Limited public knowledge exists about how contractors evaluate procurement design characteristics when evaluating whether a tender opportunity is worth pursuing. The second subquestion therefore examines contractors' evaluations of opportunity attractiveness:

2. How do contractors evaluate the attractiveness of Dutch infrastructure renewal tender opportunities?

This subquestion is answered through an analysis of a contractor's internal selection process for evaluating tender opportunities. This includes the bid/no-bid decision. This decision is the observable outcome of the contractor's evaluation of the tender opportunity, considered alongside available capacity and alternative opportunities.

Internal data on this process are used to identify which characteristics of tender opportunities are evaluated and how these characteristics relate to the procurement design space. While the quantitative data offer insights into statistical patterns, this analysis is supplemented by semi-structured interviews to incorporate qualitative perspectives that reveal how and why these characteristics influence opportunity attractiveness. The methodology is explained in more detail in chapter 3.

1.5.3. Step 3: Identifying attractive procurement design characteristics

The findings from the first and second research steps can subsequently be combined. Comparing the results from the previous research steps enables the research to identify which procurement design characteristics contractors perceive as attractive.

The third subquestion therefore connects procurement design with contractor evaluations:

3. What procurement design characteristics are perceived as attractive by contractors?

This comparison results in a proposed procurement design space for attractive infrastructure renewal tender opportunities. Thus, a more selective version of the design space is established in the first subquestion. The construction of this proposed procurement design space is explained in more detail in the methodology section, chapter 3. It thus presents a synthesis that classifies procurement design elements according to how they relate to the identified attractiveness requirements.

What is important is that the proposed design space does not identify a single optimal procurement model. Instead, it identifies which procurement design elements contribute to opportunity attractiveness. This synthesis forms the basis for Step 4 of the research.

1.5.4. Step 4: Deriving procurement design principles

The design principles developed in this research provide guidance on how public clients can adjust procurement design to improve alignment between renewal work, procurement conditions, and contractor evaluation logic. The aim is not to design procurement solely around contractor preferences, but to identify procurement conditions that may better align the public clients' objectives with contractors' evaluations of tender opportunities.

The fourth subquestion therefore translates the preceding findings into procurement design principles:

4. How can procurement design be adjusted to improve the attractiveness of Dutch infrastructure renewal tender opportunities?

The design principles are illustrated using real-world cases. These cases show how tender opportunities with less attractive conditions could be improved through the principles, or how existing procurement choices correspond with the proposed principles.

1.5.5. Reading guide

Research steps 1 and 2 constitute the analytical part of this thesis. Although the two steps are distinct, they are interdependent. Research step 1 maps the procurement design space and thereby provides the analytical framework used to structure the contractor-side analysis in research step 2. The findings from both steps are subsequently brought together in research step 3 to identify procurement design characteristics associated with opportunity attractiveness. Research step 4 then translates this synthesis into design principles that public clients can use when designing attractive tenders.

Accordingly, the third and fourth research steps synthesise and apply the findings generated through the first two research steps. This connects client-side procurement design choices with contractor-side evaluation logic and develops an informed understanding of how procurement design may contribute to improving opportunity attractiveness.

The research approach can therefore be summarised as follows:

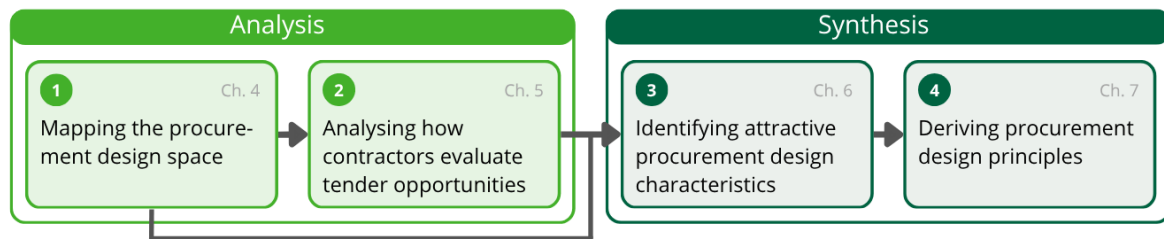


Figure 1.2: Overview of research approach.

Before diving into the research steps, the following chapter, chapter 2, explains the theoretical basis of this study. It defines how design choices in public procurement shape the client-contractor relationship and outlines the complexity and uncertainty of brownfield infrastructure renewal. Finally, it explains how these client-side choices influence the attractiveness of opportunities and govern the contractor's bid/no-bid decision.

The remainder of the thesis follows the four research steps. Chapter 3 presents the research methodology. Research step 1 is presented in chapter 4, research step 2 in chapter 5, research step 3 in chapter 6, and research step 4 in chapter 7. The discussion, conclusions, and recommendations are presented in chapters 8 to 10, respectively.

Procurement design and opportunity attractiveness

This chapter develops the theoretical basis for understanding how procurement design could influence the attractiveness of tender opportunities in the Dutch infrastructure renewal challenge. It positions procurement design as the set of choices through which tender opportunities are structured and brought to market, thereby shaping the relationship between public clients and contractors.

This chapter first defines public procurement and procurement design, explaining how policy objectives and budgets shape the choices that structure tender opportunities and client–contractor relationships. It then discusses the specific characteristics of infrastructure renewal and how they affect procurement. Finally, the chapter explains why procurement design is a relevant lever for investigating tender attractiveness.

2.1. Public procurement and procurement design

Public procurement is the process through which governments acquire public works from private contractors (Regan et al., 2015). Procurement design is the sequence of decisions through which a client selects, governs, and controls the relationship with the contractor. These decisions include specification, bid invitation, bid evaluation, contract formalisation, compensation, and performance evaluation (Eriksson, 2008).

Procurement procedures determine the relative emphasis on price, authority, and trust by combining different forms of output, process, and social control (Eriksson and Laan, 2007). Procurement design therefore shapes how the contractor is selected and how responsibilities, risks, incentives, and collaboration are structured throughout the project.

2.1.1. Client-contractor relations in procurement

Public procurement also concerns how the client structures and governs the relationship with that contractor. In public infrastructure procurement, the client acts as the initiator. The client translates societal goals into a market request and sets the “rules of the game” through procurement design choices (Eriksson, 2008; Eriksson and Laan, 2007). These choices shape the project’s governance structure and influence whether the client-contractor relationship is primarily price- and authority-based or more collaborative.

The client has two roles: the asset owner and the asset manager. The asset owner is responsible for strategic choices regarding the infrastructure network. The asset manager acts as the client, translating strategic goals into requirements, managing infrastructure assets, and assigning work to private companies through procurement (Hertogh et al., 2018).

The contractor is the private party that carries out the work assigned by the asset manager (Hertogh et al., 2018). Contractors engage with the asset manager through procurement, informed by commercial and strategic decision-making. They must balance the client’s interests with the need to maintain the company’s and shareholders’ value (Leendertse, 2015). Contractors therefore assess tender opportunities in relation to commercial, strategic, and operational considerations. As defined in section 1.2.4, opportunity attractiveness refers to the evaluation of whether an opportunity is worth pursuing. This assessment informs a contractor’s decision to participate in the procurement process, referred to in this study as the bid/no-bid decision.

Procurement design is shaped on the client side, whereas contractors respond to it through their

bid/no-bid decision based on opportunity attractiveness. In doing so, contractors also assess the client-contractor relationship anticipated to result from participating in the tender opportunity. The client-contractor relationship is therefore a mechanism through which procurement design affects opportunity attractiveness.

2.1.2. Policy and budgeting

While the client-contractor relation is the result of procurement, budget and policy are the starting point. Policy links broad political or societal ambitions to the work requests being marketed. Policymakers translate societal needs and wishes into political goals and concrete boundary conditions. These choices shape the requested work and therefore the procurement design. Procurement is therefore a mechanism through which policy ambitions are translated into concrete market approaches and resulting projects (Leendertse, 2015).

However, these ambitions are heavily constrained by budgeting. While policy defines objectives, budgets determine the financial boundaries. Especially in infrastructure, public budgets prove insufficient, making infrastructure renewal programmes politically and practically challenging because they require high-performance upgrades while facing tight public budgets (Hertogh et al., 2018). Reduced public investment may intensify price competition among contractors, which can limit innovation and the sustainable development of the market (Leendertse, 2015).

When financial flexibility is limited, project managers may prioritise cost reductions and scope reductions over the original policy ambitions, sometimes at the expense of infrastructure functionality or quality (Hertogh and Westerveld, 2010). Conversely, realistic and sufficient budgets are important for delivering the quality needed to achieve broader policy goals (Larsen et al., 2015). Politics and budgeting therefore operate as upstream conditions that shape the work entering procurement and constrain the procurement design choices available.

2.1.3. Participation and competition

Competition is a fundamental mechanism for achieving value for money and efficiency in public infrastructure procurement (Hanák and Muchová, 2015; Jääskeläinen et al., 2026). A healthy procurement environment can also generate broader societal benefits (Schotanus, 2025). More contractor participation in tenders can strengthen competitive pressure and contribute to lower prices (Jääskeläinen et al., 2026). It can also contribute to a better price-quality ratio, as contractors seek to distinguish themselves through both cost and quality (Leendertse, 2015).

However, competition does not automatically lead to the most positive outcome. When public investment decreases, large contractors may compete more strongly for the remaining turnover, because they need to participate in projects to utilise their implementation capacity. This competition may be fought primarily through price, which can lead contractors to offer only the minimum required quality and accept greater risks to secure work (Leendertse, 2015).

Competition must therefore be governed carefully. Public clients need to design procurement in a way that creates a suitable balance between competition and cooperation. This requires purposeful choices throughout procurement design (Eriksson, 2008).

Participation is therefore a precondition for meaningful competition, but the objective is not to maximise the number of bidders. Rather, public procurement requires sufficient participation from suitable contractors to support an acceptable balance between price and quality. Procurement design should therefore create tender opportunities that are sufficiently attractive for contractors to pursue, while safeguarding value for money and broader public objectives.

2.2. Procurement in infrastructure renewal

Infrastructure renewal requires particular consideration in procurement because its brownfield conditions affect how the work can be defined, priced, and delivered. These characteristics influence which procurement configurations are appropriate and how contractors evaluate the resulting tender opportunities.

2.2.1. Complexity and uncertainty

Infrastructure renewal projects differ fundamentally from new-build projects in several procurement-relevant respects. They are typically brownfield projects, carried out within existing and actively used environments. This increases the number of interfaces with surrounding infrastructure and users (Leen-

dertse, 2015). Project execution must therefore take the existing asset, surrounding land use, and operational traffic flows into account. This strongly constrains physical and organisational possibilities (Arts et al., 2015). In addition, these structures may be 60 to 100 years old, with incomplete or inaccurate documentation, unrecorded previous interventions, and actual conditions that differ from expectations (Bleijenberg, 2021).

A substantial portion of the infrastructure must remain available while physical interventions and renovations are carried out, which is a major technical and logistical challenge (Hertogh et al., 2018). Renewal rarely involves simple one-to-one replacement. Instead, renewal decisions often involve adding new functionalities to meet current and future network needs (Tillema and de Lange, 2016).

Additionally, existing and ageing assets must be adapted to changing societal, environmental, and safety requirements while remaining constrained by the fixed physical conditions of those assets. Works must also be phased around traffic diversions, network availability, and operational continuity (De Mol van Otterloo, 2025). These conditions limit project manageability, as scope, risks, costs, and planning are difficult to control.

Together, these conditions make the scope, risks, costs, and planning of infrastructure renewal projects difficult to predict and price. Contractors may avoid excessive uncertainty, include significant risk premiums, or become more selective in deciding whether to bid (Harbers, 2024). Procurement configurations that rely on scope, risks, costs, and responsibilities being fully defined in advance may therefore be less compatible with renewal projects in which substantial uncertainty remains.

2.2.2. Traditional procurement

Traditional public infrastructure procurement is often characterised as a transaction-based and adversarial approach focused on delivering a physical asset within the constraints of time, budget, and quality (Hertogh et al., 2018). In this thesis, traditional procurement is treated as a recurring configuration of procurement design choices rather than as one uniform contract model. In this approach, the client typically seeks to maximise project scope and quality while minimising time and cost.

Traditional procurement typically combines detailed design specifications, open tendering, price-focused bid evaluation, comprehensive contracts, and fixed-price compensation. Collaborative tools are used only to a limited extent, while performance is controlled through inspections and client monitoring. Together, these choices create a price- and authority-based client-contractor relationship with limited trust (Eriksson and Laan, 2007).

This traditional approach is reflected in public infrastructure procurement more broadly, where open tendering and selection on lowest price have historically played an important role (Boes and Dorée, 2014). The public sector has a long tradition of using the lowest price as the award criterion and generally places stronger emphasis on price than private sector clients (Rönnbäck, 2012). The suitability of this configuration depends, however, on the context of the tender opportunity.

2.2.3. Limits of procurement in infrastructure renewal

Procurement in infrastructure renewal must therefore account for the inherent uncertainty and complexity of these projects. Procurement design shapes how uncertainty, risk, responsibilities, incentives, and collaboration are structured between the client and contractor. The resulting procurement configuration should therefore be aligned with the specific characteristics of the infrastructure renewal project.

Traditional procurement often treats infrastructure delivery as an isolated project governed by a fixed budget and strict schedule. Replacement and renovation tasks, however, are increasingly understood as broader societal challenges that require integration with surrounding spatial and environmental developments (Leendertse et al., 2016).

Procurement shapes how uncertainty and risk are allocated. While for infrastructure renewal projects the uncertainty is higher, traditional procurement is often designed as complete contracts that transfer a substantial share of risk from the client to the contractor (Regan et al., 2015). Fixed-price contracts may create inflexibility by discouraging contractors from adapting to changed circumstances that arise in complex environments (Eriksson and Laan, 2007). Traditional procurement is therefore less suitable when it assumes that scope, risks, costs, and responsibilities can be defined and allocated in advance. In brownfield renewal projects, however, these conditions may not be sufficiently known before market approach.

Collaborative procurement configurations shift the emphasis from price- and authority-based control

towards trust-based cooperation through a different combination of procurement choices (Eriksson and Laan, 2007). However, collaborative procurement also creates tensions. Marketisation and risk-transfer approaches have transferred responsibilities to contractors and other private actors, while public clients have reduced in-house expertise. These approaches still require active client involvement and strong client capabilities, creating tension where responsibilities have increasingly been transferred to private actors (Rosander and Kadefors, 2023).

Neither traditional nor collaborative procurement is therefore inherently suitable for every infrastructure renewal project. Their suitability depends on the fit between the project characteristics and the procurement configuration.

2.3. Procurement design as lever for attractiveness

This chapter has shown that procurement design translates public objectives and upstream constraints into the work offered to the market and the conditions under which it is tendered and delivered. It shapes the client-contractor relationship and the conditions that contractors evaluate when deciding whether to pursue a tender opportunity. Procurement design is not created in isolation, but is shaped by upstream policy objectives and budget constraints.

Sufficient market participation is needed to create meaningful competition and an acceptable price-quality ratio. Procurement design should therefore create tender opportunities that are sufficiently attractive for contractors to pursue. Specifically for renewal projects, this is more challenging because their inherent complexity and uncertainty affect how work, risks, costs, and responsibilities can be defined, allocated, and therefore assessed by the contractors.

Tender opportunities therefore need to be sufficiently attractive for contractors to pursue. Procurement design may provide a lever to improve this attractiveness, as it shapes the work offered to the market and the conditions under which it must be delivered. It is therefore necessary to identify which procurement design choices matter, how contractors evaluate them, and how to adjust these choices to improve the attractiveness of opportunities.

Methodology

This chapter explains the methodology used to answer the main research questions. Building on the research approach, this chapter explains the information and methods used to answer the four sub-questions. For each research step, it specifies the information used and explains how this information was collected, analysed, and/or synthesised to answer the corresponding subquestion. This includes how the procurement design space was constructed, how contractors' evaluation of opportunity attractiveness was analysed, and how the findings of both research steps were synthesised.

3.1. Step 1: Mapping the procurement design space

The first research step identifies the procurement design dimensions through which public clients shape tender opportunities. This requires insight into both how procurement design choices arise within the broader procurement process and which choices are available to public clients.

A decision tree is used to reconstruct the public infrastructure procurement process from policy and budgeting to the resulting tender opportunity. It shows the sequence and interdependencies of relevant decisions, the constraints they create, and the actors that influence them. The procurement design choices identified in this process are then translated into a morphological chart. This chart organises the choices into design dimensions and corresponding elements, thereby representing the procurement design space in a single structured overview. It also provides the framework for comparing individual procurement design elements with contractors' evaluations of opportunity attractiveness in the subsequent research steps.

A literature review serves as the primary source for this analysis. The decision nodes, choice options, design dimensions, and design elements are derived from academic literature, policy documents, public procurement guidelines, and other publicly available sources.

3.1.1. Decision tree

A decision tree visualises a process as a set of decision nodes. Each node consists of a decision point and its corresponding choice options. The branches show how these choices relate to one another.

In this research, the decision tree maps the sequence of decisions through which public infrastructure projects are translated into tender opportunities. It identifies the procurement-related choices that are available, how these choices relate to one another, and which actors influence them. This provides the researcher and reader with a structured overview of the sequence and interdependencies of decisions that shape procurement.

Because the decision tree structures decision-making as a linear sequence of choices, it presents a simplified representation of the procurement process. In practice, these choices are often iterative and more interdependent. The boundaries between decision points, and the order in which decisions are made, are therefore less clear-cut than the decision tree suggests. Decisions made at an earlier stage can influence the options available later in the process. Nevertheless, this simplification enables a systematic comparison of how public clients and contractors operate within the same procurement design space.

These simplifications also affect how the results should be interpreted. The specific simplifications and their implications are explained in more detail in the chapter on the decision tree, chapter 4.

Two versions of the decision tree were constructed. The first version was reviewed by two experts: a TU Delft professor specialised in infrastructure procurement and a senior Rijkswaterstaat official involved

in infrastructure procurement. The experts were asked to assess whether the decision sequence, actors, choice options, and dependencies were recognisable and sufficiently complete. Their comments were compared with the literature-based version, after which supported additions and corrections were incorporated into the second version.

The resulting second version and its content are presented in chapter 4. The first version is included in appendix C.

3.1.2. Morph chart

Based on the decision tree, the morphological chart is constructed, which represents the procurement design space. This consists of procurement design dimensions and elements. The dimensions correspond to the decision nodes from the decision tree, the design elements correspond to the choice options. In this way, the morph chart defines the range of choices through which a public client can design a tender opportunity.

A morphological chart is an engineering design tool used to systematically organise and analyse possible design solutions. It represents a system as a set of categories and means (Schenk, 2024). In this research, the categories correspond to the procurement design dimensions corresponding to the decision nodes identified in the decision tree. The means represent the procurement design elements, the choice options corresponding to the decision nodes of the decision tree.

In this research, the morphological chart is adapted from its conventional application. A standard morph chart commonly represents a design problem as a set of parallel categories from which one means is selected to construct a conceptual solution (Schenk, 2024). Procurement design, however, consists of decisions that may be interdependent, conditional, or combinable. The chart is therefore derived from the decision tree and retains these relationships where relevant. Some dimensions may only become applicable after a preceding decision, while others may allow the selection of multiple design elements rather than a single option. Consequently, the morph chart is not treated as a flat matrix of fully independent choices, but as a structured representation of the procurement design space.

The morph chart is constructed according to two principles. First, the design elements associated with each dimension should collectively cover the relevant options available in practice. Second, where a dimension represents a single procurement decision, the elements should be mutually exclusive, meaning that the available options are clearly distinguishable from one another (Schenk, 2024). Some dimensions are conditional or allow multiple elements to be combined; these dependencies are retained from the decision tree. Together, these principles provide a consistent overview of the procurement design space.

The decision tree shows how procurement decisions relate throughout the procurement process and lead to a tender opportunity. The morphological chart then presents the resulting procurement design space as a set of configurable dimensions and options. Selecting the applicable element or combination of elements for each dimension enables the construction of a conceptual procurement configuration. The chart should therefore be read row by row. For dimensions representing a single decision, one applicable element is selected. For dimensions that permit combined choices, multiple elements may be selected. Conditional dimensions are considered only when the preceding procurement choices make them applicable. The chart does not imply that every theoretically possible combination is coherent or feasible in practice. This function is used in the third research step to relate contractor-side findings on opportunity attractiveness to the procurement design dimensions and elements represented in the chart.

The morphological chart provides the analytical framework for the subsequent research steps. It is used to examine which procurement design elements contractors perceive as attractive. The application of the decision tree and morph chart, however, also involves several simplifications. These simplifications are explained in the section below.

Having established the procurement design space, the next research step shifts the focus from client-side procurement choices to contractor-side evaluation of these choices. It examines how contractors evaluate tender opportunities and which characteristics they consider while determining whether an opportunity is attractive enough to pursue. The procurement design space provides the framework for relating these evaluations to specific procurement design dimensions and elements.

3.2. Step 2: Analysing how contractors evaluate tender opportunities

The second research step uses BAM as a case study of contractor tender selection. BAM is a large contractor operating within the Dutch infrastructure market. The findings therefore provide detailed insight into opportunity evaluation within one contractor and its relevant market segment. Research Steps 3 and 4 use this case-based evidence to derive broader procurement design considerations, while retaining the contextual limitations associated with the BAM case.

BAM evaluates the attractiveness of tender opportunities through a structured tender selection process. Its purpose is to determine whether BAM should pursue a tender opportunity. The process results in a bid/no-bid decision, which represents the observable outcome of BAM's evaluation of the tender opportunity.

The selection process consists of three decision levels, referred to in this study as decision levels 1, 2, and 3.

Each decision level consists of a set of conditions that the evaluation is based on. Each decision level has its own set of evaluation criteria. The process generates internal records on the criteria and case-specific evaluation inputs used at each decision level. The following explains how these records were collected and transformed for analysis.

For confidentiality reasons, this thesis only discusses the selection process at a thematic level. Individual decision rules, thresholds, and commercial considerations are either omitted or presented in an aggregated form. The analysis therefore presents the main themes, decision levels, and evaluation criteria without disclosing individual decision rules, thresholds or terminology.

3.2.1. Data collection and transformation

BAM stores internal data on the selection process. The data was collected in the form of a case-by-attribute matrix. Each row represents a tender opportunity, while each column represents an attribute linked to a decision criterion. Data for decision level 1 was collected separately from the data for decision levels 2 and 3. This distinction was necessary because decision level 1 data is governed at sub-business-unit level within BAM, whereas decision levels 2 and 3 are governed at group level.

As a result, the decision level 1 dataset only includes cases related to BAM Infra Civiël, while the datasets for decision levels 2 and 3 relate to the wider parent company, BAM InfraNL. Because the datasets differ in organisational scope and completeness, they were analysed separately.

The selected time frame runs from January 2024 to the date of data extraction. January 2024 was chosen as the starting point because it marked a significant policy change within BAM. This change entailed a shift in strategic focus on specific tender opportunities. Therefore, tender opportunities before and after this date are assessed differently and are thus not comparable.

For confidentiality and feasibility reasons, the dataset was limited to the records made available for this research. This was influenced by both data accessibility and the support available during data collection. The decision level 1 dataset was relatively complete, as it included all available cases and corresponding attributes for the selected sub-business unit within the defined time frame.

The following transformations were applied to the decision level 1 dataset:

- Cases were filtered by date, after January 1st 2024.
- Identifiable information was removed or adjusted for anonymisation.
- Evaluation criteria were coded into attributes using axial coding based on the procurement design dimensions, determined in chapter 4.
- Irrelevant attributes, not related to the bid/no-bid decision or containing empty inputs, were removed from the dataset.
- Evaluation inputs were coded into attribute values based on the procurement design dimensions.

The data for decision levels 2 and 3 required further transformation before it could be used. The available dataset contained attributes from all decision levels beyond decision level 1, including decision levels that were not relevant to this study. Therefore, the dataset was manually split to create separate files for decision level 2 and decision level 3.

Unlike the decision level 1 dataset, the decision level 2 and 3 data did not include all available cases. Due to confidentiality restrictions, only cases related to tenders cancelled by clients or discontinued by BAM were made available. This introduces a limitation, as the dataset mainly represents opportunities that were not executed by BAM. It therefore provides insight into non-continuation and no-bid-related decisions, but cannot be interpreted as representative of all bid decisions.

The following transformations were applied to the decision level 2 dataset:

- Cases were filtered by date, after January 1st 2024.
- Identifiable information was removed or adjusted for anonymisation.
- Evaluation criteria were coded into attributes using axial coding based on the procurement design dimensions, determined in chapter 4.
- Irrelevant attributes, not related to the bid/no-bid decision or containing empty inputs, were removed from the dataset.

The following transformations were applied to the decision level 3 dataset:

- decision level 3 attributes were separated from the main dataset.
- Cases were filtered by date, after January 1st 2024.
- Identifiable information was removed or adjusted for anonymisation;
- Evaluation criterion were coded into attributes using axial coding based on the procurement design dimensions, determined in chapter 4.
- Irrelevant attributes, not related to the bid/no-bid decision or containing empty inputs, were removed from the dataset.

These transformations produced separate datasets for the three decision levels. Together, they provide insight into the formal criteria and case characteristics recorded during BAM's selection process.

However, the datasets do not provide a complete explanation of contractor bid/no-bid logic. Their limitations must therefore be considered before interpreting the subsequent analyses.

3.2.2. Limits of the selection data

The internal selection data provides insight into where cases drop out of the selection process, but it does not fully explain why these decisions are made. The dataset shows at which decision level opportunities are discontinued, and what factors are considered in each decision level. The data can therefore be used to identify recurring associations, but not to establish causal relationships between the evaluation inputs and bid/no-bid decisions. The underlying reasoning behind these decisions requires further qualitative interpretation. Several limitations should therefore be noted:

1. The data show where cases drop out of the selection process, but not necessarily why. The interpretation of the underlying reasoning is therefore further researched in chapter 5.
2. Most decisions not to participate occur at decision level 1, while only a limited number of attributes are formally connected to this decision level. This indicates that early no-bid decisions and the arguments behind them are not fully represented in the available data.
3. The available information is not always complete or consistent. Some considerations are documented systematically, while others may remain implicit, informal, or dependent on the individual decision maker.
4. Responsibility for data ownership, data entry, and decision authority is dispersed across different parts of the organisation. As a result, the quality and completeness of the available information can vary between decision levels, business units, and individual cases.
5. Early-stage decisions are often made under uncertainty and may rely on incomplete, preliminary, or undocumented information.

The internal selection data should therefore be interpreted as a record of the formal selection process, rather than a complete explanation of contractor bid/no-bid logic.

The resulting datasets form the empirical basis for the following analysis. The datasets are used to identify patterns in the recorded selection data. The following section explains how pivot tables and Qualitative Comparative Analysis were used for this purpose.

3.2.3. Pivot-table and qualitative comparative analysis

Pivot tables and Qualitative Comparative Analysis (QCA) were used to analyse the decision level 1 dataset. The pivot tables compare the values of individual attributes with the recorded bid/no-bid outcome. They show how bid and no-bid decisions are distributed across attribute values.

QCA complements this analysis. It examines combinations of conditions rather than individual attributes in isolation. This is relevant because bid/no-bid decisions may result from configurations of procurement characteristics rather than from a single factor.

The pivot tables were created in Microsoft Excel. The QCA was conducted in RStudio using an R script. A truth table was constructed with the bid decision as the outcome condition. The truth table and corresponding R script are included in appendix F. The identified configurations were assessed based on their empirical frequency and inclusion score. Configurations with a higher empirical frequency were given greater interpretative weight than configurations represented by only one or a few cases.

Together, the pivot tables and QCA identify patterns in the recorded tender selection data. However, they do not explain the reasoning underlying these patterns. Semi-structured interviews were therefore conducted to support their interpretation. The quantitative findings are interpreted as statistical and configurational associations rather than as evidence of causal effects.

3.2.4. Semi-structured interviews

Semi-structured interviews were conducted with eight BAM employees involved in tender evaluation and procurement-related decision-making. The interviews complement the internal decision data. They provide insight into how recorded criteria are interpreted and why particular characteristics influence evaluation of opportunity attractiveness.

An interview guide ensured that all interviews addressed a common set of themes. At the same time, the semi-structured format allowed respondents to explain relevant experiences and considerations in greater depth. The interview guide is included in Appendix D.

The interviews examined:

- how respondents assess the infrastructure renewal challenge and its constraints;
- how they perceive market dynamics within infrastructure renewal;
- which characteristics influence the attractiveness of tender opportunities;
- which procurement design elements are considered relevant during the selection process;
- which considerations fall outside the procurement design space; and
- why particular procurement characteristics influence decisions at different decision levels.

The interview findings are used to interpret the patterns identified through the pivot-table and QCA analyses. Together, the data and interview analyses provide the contractor side perspective required for the second research step. The next step in the research compares this perspective with the procurement design space. It identifies which procurement design characteristics contractors perceive as attractive.

3.3. Step 3: Identifying attractive procurement design characteristics

The third research step brings together the findings from the first two. It addresses the third subquestion by comparing the procurement design space developed in Research Step 1 with the contractor evaluations of opportunity attractiveness identified in Research Step 2.

The morphological chart provides the comparison framework. It contains the procurement design dimensions and their corresponding procurement design elements. The findings from the contractor tender selection process are mapped onto this framework. This comparison identifies which procurement design elements contractors perceive as attractive.

The result is a proposed procurement design space for attractive infrastructure renewal tender opportunities. This is a more selective version of the original procurement design space. It highlights procurement design elements that may contribute to opportunity attractiveness under conditions of infrastructure renewal.

The proposed design space does not prescribe a single optimal procurement model. It does not imply that every attractive procurement design element is suitable for every project. It also does not determine which elements public clients can implement in practice. Instead, it provides a structured overview of the procurement design elements that contractors evaluate as attractive. Public clients can use this overview to configure tender opportunities while balancing contractor participation with public objectives and project-specific conditions.

The proposed procurement design space forms the basis for Research Step 4. The next step in the research translates these findings into procurement design principles.

3.4. Step 4: Deriving procurement design principles

The fourth research step translates the proposed procurement design space into procurement design principles. It addresses the fourth subquestion by identifying how procurement design may be adjusted to improve the attractiveness of infrastructure renewal tender opportunities.

The principles are derived from the synthesis of the preceding research steps. They build on the procurement design elements that contractors evaluate as more or less attractive. The interview findings are used to explain why these elements influence the evaluation of opportunity attractiveness.

The principles are illustrated with real-world examples discussed during the interviews. These examples show how less attractive tender conditions may be reconsidered in relation to the proposed principles. They also show how existing procurement choices may correspond with these principles.

The principles reflect contractor perspectives derived from the BAM reference case. They do not determine which procurement design choices public clients can necessarily implement in practice. Instead, they provide design considerations that may help public clients better align tender conditions with contractors' evaluations of opportunity attractiveness.

Where relevant, the principles distinguish between issues that can be addressed through client-side procurement design and issues that depend on contractor-side choices or wider project conditions.

Together, the four research steps form a sequential methodology that moves from analysis to synthesis. The next chapter begins by presenting the findings of research step 1, which reconstructs the public infrastructure procurement process and presents the resulting procurement design space.

The procurement design space

This chapter presents the results of the first research step: the procurement process analysis, see figure 4.1. It answers the first subquestion:

What procurement design dimensions and elements shape the organisation of Dutch infrastructure renewal tenders?

The procurement process is first mapped through a decision tree. The decision tree visualises the procurement process as a set of decision nodes. It shows the decisions through which public clients shape a tender opportunity, from policy and budgeting to procurement design. These decisions shape the work and conditions offered to contractors before they decide whether to participate.

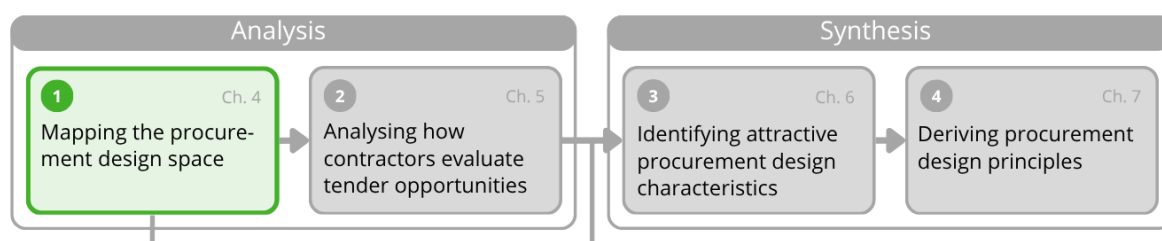


Figure 4.1: Current research step: mapping the procurement design space.

The procurement design part of the decision tree is then translated into a morphological chart. The morphological chart presents the procurement design space as a set of procurement design dimensions and corresponding procurement design elements.

An overview of the decision tree, including only the decision nodes, is provided in figure 4.2. The full decision tree is included in Appendix C. The morph chart, figure 4.10, presents the resulting procurement design space. The following sections explain the decision tree and show how it results in the procurement design space represented in the morphological chart.

4.1. Decision tree

The decision tree maps the procurement process in two main parts. The first part, indicated in green, concerns infrastructure programming. It shows how policy objectives and budgetary conditions inform asset management and result in a defined project that can enter procurement. These upstream decisions constrain procurement design but are not themselves treated as project-level procurement design choices.

The second part, indicated in orange, concerns procurement design. It shows the decisions through which public clients structure the work and delivery conditions of the tender opportunity.

For each decision node, the decision tree presents the available choice options as branches of the decision node. These options are available to the decision authority, the actor formally entitled to make the decision. In most cases, this authority lies with the contracting authority, which is responsible for procuring the project, e.g. the client. However, the decision tree also indicates where decision-making authority lies with other actors.

The decision tree uses Rijkswaterstaat as the reference case for reconstructing how national infrastructure renewal projects emerge from policy, budgetary, and asset-management decisions. Other public clients, including provinces, municipalities, water authorities, and ProRail, may use different institutional

procedures and involve different decision-making actors. The decision tree should therefore not be interpreted as a complete generic representation of all Dutch public clients. The morphological chart abstracts the procurement design dimensions and elements identified through the Rijkswaterstaat-based analysis, but their applicability to other client organisations remains subject to differences in governance, responsibilities, and organisational practice.

Because the decision tree contains several closely related and partly specialised concepts, the renewal of the Van Brienenoordbrug introduced in chapter 1 is used as an illustrative example at the beginning of each main section. The example clarifies how the terminology and decision levels relate to one another but does not constitute a reconstruction of the actual procurement process for the bridge.

The decision tree provides an analytical representation of the procurement process rather than a complete account of public infrastructure decision-making. It focuses on the decision points relevant to the formation of a tender opportunity. Simplifications specific to policy formulation, asset management, and collaboration are explained in the relevant subsections.

In section 4.1.1 & 4.1.2, each decision node and its corresponding choice options are explained in more detail.

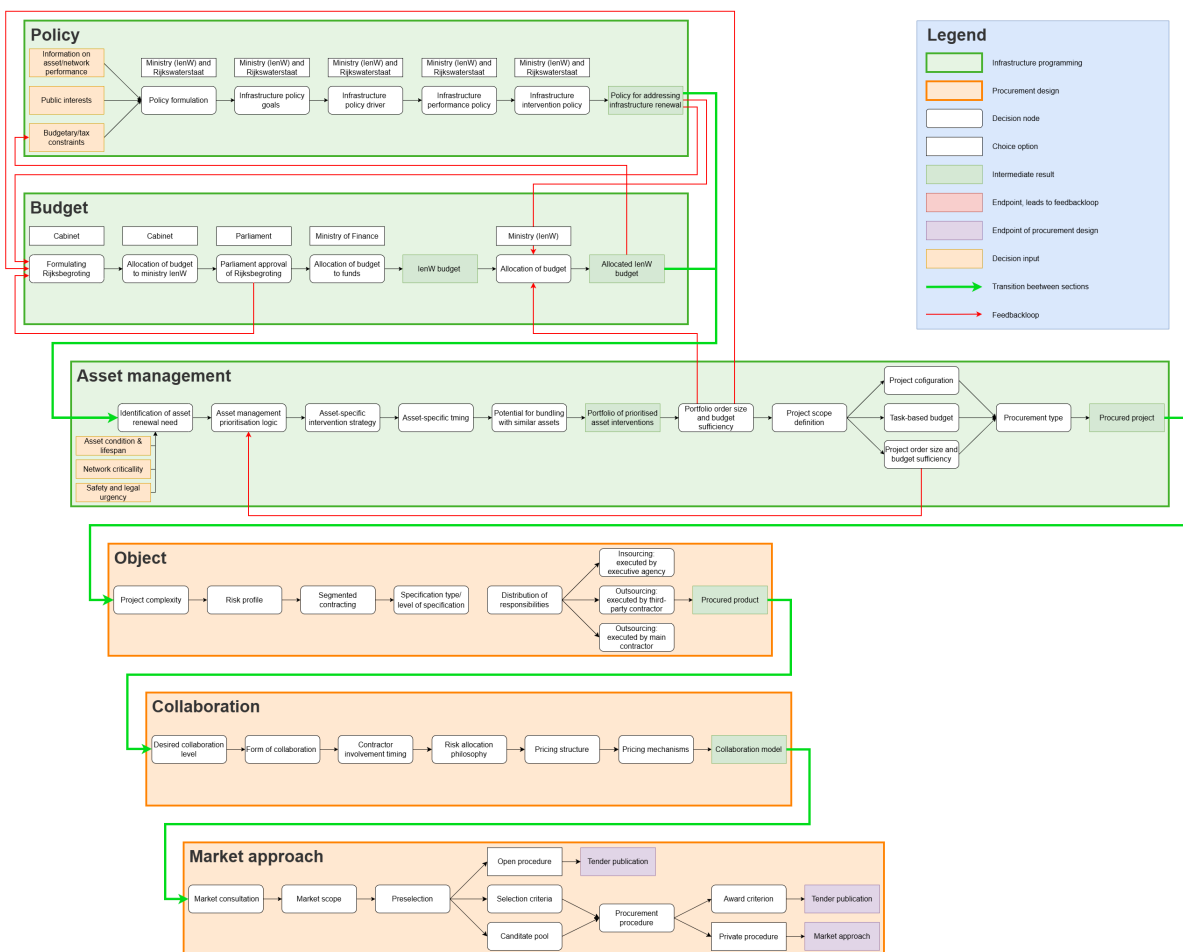


Figure 4.2: Decision tree: overview of the procurement process.

4.1.1. Infrastructure programming: policy, budget, and asset management

The first part of the decision tree focuses on infrastructure programming. It explains how infrastructure policy and budgeting shape the way asset management is put into practice. Policy defines the desired condition and performance of infrastructure in relation to societal needs, while budgeting sets the financial boundaries available to reach these ambitions. Asset management, consequently, seeks to fulfil policy ambitions within available budgetary constraints.

These upstream decisions shape which interventions and projects enter procurement. They also constrain the procurement design space. However, they are not the main analytical focus of this thesis.

The decision tree is based primarily on the Meerjarenprogramma Infrastructuur, Ruimte en Transport (MIRT), the Meerjarenoverzicht Vernieuwingsopgave ("Dealflow"), and Rijkswaterstaat's Meerjarenplan

Instandhouding. Together, these sources describe how policy objectives, funding, infrastructure programming, and maintenance planning are connected (Ministerie van Infrastructuur en Milieu, 2016; Rijkswaterstaat, 2025a, 2025b). Where expert input resulted in additions or changes to the decision tree, this is stated explicitly in the relevant node description.

Policy

In the illustrative example, the Van Brieneoordbrug is an infrastructure asset within the national road network. At the policy level, the decision does not yet concern the detailed renewal project or its procurement. Instead, policy establishes the broader objectives and required network performance that determine why an intervention in the bridge may be necessary and what that intervention should ultimately contribute to.

The policy level defines the strategic context within which infrastructure asset management decisions are made. It establishes the goals of the Dutch government regarding construction, maintenance, and regulation of infrastructure. This results in a policy on how the Dutch infrastructure network should be treated.

The decision tree focuses on the policy-related decision points that shape procurement. It does not model the wider political processes through which policy priorities and budgetary conditions are established.

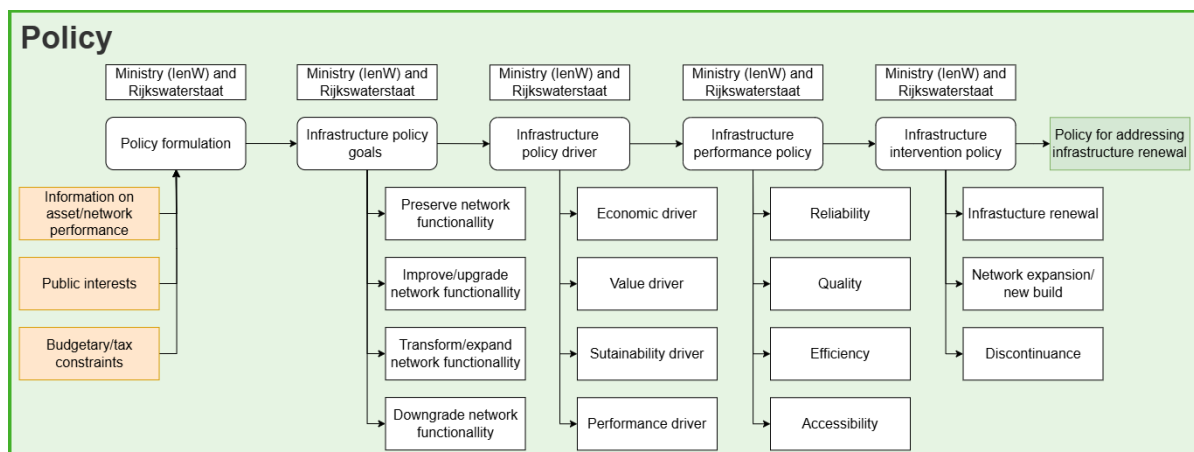


Figure 4.3: Decision tree: policy section.

Policy Formulation

The decision tree starts at the synthesis point, policy formulation. Here the procurement process is initiated based on multiple inputs. These inputs include information on asset and network performance, broader public interests, and budgetary and tax constraints (Neef, 2025).

From the expert involvement, the budgetary constraint has been expanded to include tax constraints as well. Tax constraints entail the political choice about the level of taxation. This directly influences budgetary constraints. The constraints are based on what budget is allocated to it but also how much tax is collected to determine the size of the budget. This shows that budgetary constraints shape infrastructure policy both financially and politically.

Infrastructure policy goals

In determining infrastructure policy goals, the government decides the desired level of network functionality. The decision options range from preserving current functionality, to improving or upgrading the network, transforming or expanding its function, or even downgrading functionality (Tillema and de Lange, 2016). This choice shapes asset management by defining its objective and determining what type of interventions in the network should be made.

Infrastructure policy driver

The infrastructure policy driver determines the primary value prioritised in the choices made throughout infrastructure programming. The choice options are: economic, value, sustainability, or performance driven. This does influence what value the asset interventions selected in asset management should bring. This ultimately influences the conditions under which projects are procured.

Infrastructure performance policy

Infrastructure performance policy defines the required performance level of the network. A performance focus on reliability seeks to minimise downtime, a focus on quality prioritises the user experience, a focus on efficiency aims to reduce travel times, and a focus on accessibility seeks to ensure that the network is available to as many users as possible. These priorities determine which asset interventions are required to achieve the intended level of performance.

Expert involvement, however, noted that performance policy also shapes how interventions should be delivered. Required performance may, however, be assessed differently at the policy, asset management, and societal levels. For example, the asset manager may consider a full road closure acceptable because it enables a more efficient execution, whereas society may consider it unacceptable because it restricts critical accessibility. This illustrates that the delivery of interventions reflects trade-offs between performance objectives and the priorities of involved stakeholders.

Infrastructure intervention policy

The infrastructure intervention policy defines the type of intervention to be applied to the network. At this stage, a choice is made between infrastructure renewal, network expansion or new build, and discontinuance of infrastructure. This decision translates the previously defined policy goals and drivers into a concrete intervention strategy. It determines what asset interventions can be selected in asset management.

Budget

For the Van Brienenoordbrug example, the budget section concerns the financial resources made available for infrastructure and their allocation across programmes and types of intervention. At this level, the bridge competes with other infrastructure needs for public funding. The allocated budget constrains whether and under which financial boundaries the intervention can subsequently be developed into a project.

The budget section defines the financial boundaries within which infrastructure programming is executed. It translates political conditions into concrete budgetary constraints that shape subsequent decision-making.

Budgetary constraints influence decisions throughout the procurement process. Insufficient budgets could lead to adjustments in scope and project prioritisation. Budget constraints may also shift the acceptable balance between cost, time, and network availability, as more disruptive delivery strategies can become acceptable when financial or time pressure increases. The following sections examine how these financial constraints follow from budgetary choices made as well as how they create interdependencies among different choices.

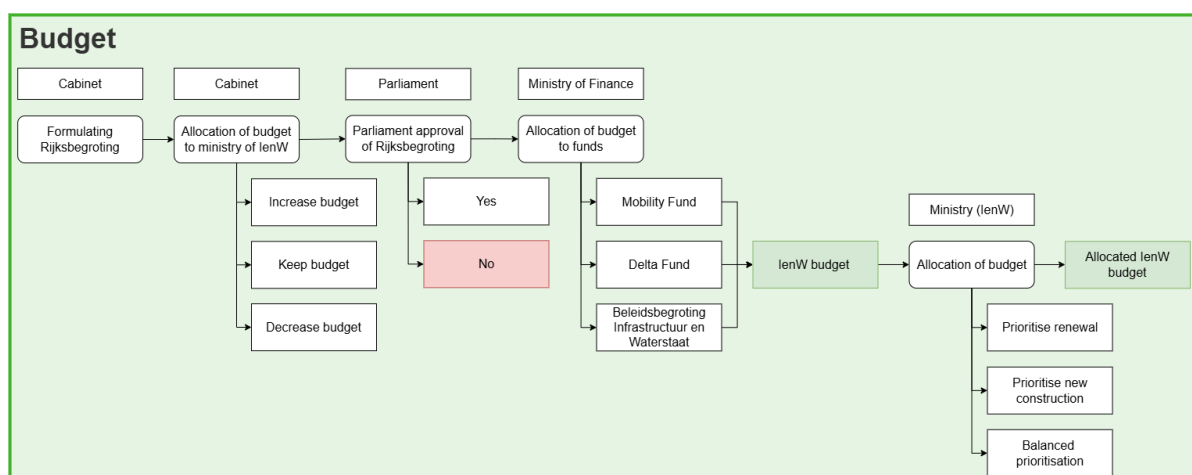


Figure 4.4: Decision tree: budget section.

Formulating Rijksbegroting

The formulation of the Rijksbegroting is, like the policy formulation node, a synthesis point. Here, the national budget proposal is determined based on input from policy formulation, as policy ambitions shape the level of funding required to achieve infrastructure goals. In addition, there is a feedback interaction with asset management, in which budget sufficiency is assessed against what is required to realise the project portfolio.

Allocation of budget to ministry lenW

The allocation of budget to the Ministry of Infrastructure and Water Management determines how much of the national budget is available to the ministry for infrastructure-related activities. The main choice is whether this budget is increased, maintained, or reduced.

This decision affects asset management in two ways. It determines how many asset interventions can be included in the programme. It also affects the available budget and the quality that can be requested for each individual intervention.

Parliament approval of Rijksbegroting

At the parliamentary approval of the national budget (Rijksbegroting), the proposed budget allocation is subject to formal approval by Parliament, resulting in a binary decision: approval or rejection. In the case of approval, the allocated budget provides the financial framework for subsequent programming. If the budget is not approved, revisions of the budget and budget allocation are required.

Allocation of budget to funds

Next, the approved budget is allocated to specific funding streams. At this stage, financial resources are distributed across dedicated funds, such as the Mobility Fund, the Delta Fund, and the policy budget for Infrastructure and Water Management. This results in the composition of the lenW budget.

Each fund serves a distinct purpose and supports specific types of infrastructure investment. This allocation determines how financial resources are distributed across project categories. Funding is therefore not only limited in total volume, but also earmarked for particular policy domains, influencing which interventions can be included in later asset management decisions.

Allocation of budget

At this stage, the budget allocated to the Ministry of Infrastructure and Water Management is distributed across its infrastructure responsibilities. A prioritisation is made between infrastructure renewal, new construction, or a balanced allocation between both.

This decision is influenced by the previously defined policy objectives and by asset management insights on the sufficiency of the available budget for the desired project portfolio. It determines which types of asset interventions receive greater funding and are thus likely to be prioritised in the later asset management decisions.

Asset Management

In the illustrative example, the Van Brienenoordbrug is the asset, while renewing, upgrading, extending the life of, or restricting the use of the bridge are alternative asset interventions. Asset management determines whether an intervention is required, how it is prioritised in relation to other assets, and when it should be undertaken. It subsequently translates the selected intervention into a project by defining which work is included, whether it is combined with other interventions, and which budget is assigned to it.

The asset management section translates policy objectives and budgetary conditions into a portfolio of infrastructure interventions. It consists of two parts.

The first part concerns asset prioritisation. It identifies renewal needs, prioritises interventions, determines intervention strategies, and sets their timing. This results in a portfolio of prioritised asset interventions.

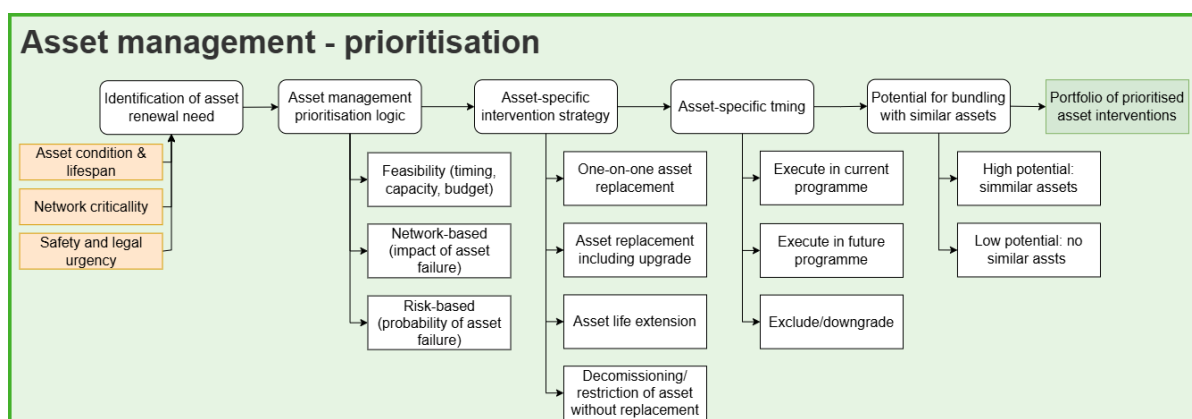


Figure 4.5: Decision tree: asset management prioritisation.

The second part concerns project definition. It translates the portfolio into specific projects with a defined scope, order size, and allocated budget.

The decision tree presents asset management as a logical sequence of decisions. In practice, however, these decisions are iterative, as portfolio composition, budgets, timing, and intervention strategies may be reconsidered throughout the process.

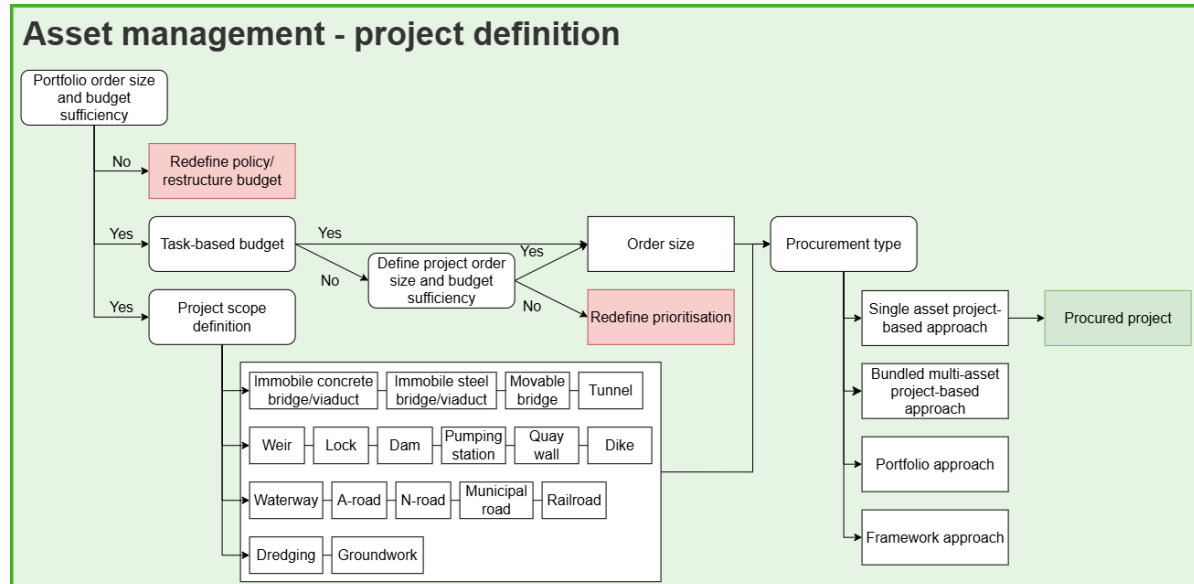


Figure 4.6: Decision tree: asset management - project definition.

Identification of asset renewal need

At this stage, the asset manager determines whether specific infrastructure assets require intervention. This assessment is based on three factors: the technical condition and remaining lifespan of the asset, its criticality within the network, and the safety and legal urgency associated with its performance.

Asset management prioritisation logic

Asset management prioritisation logic explains the possible choice options for prioritising between specific asset interventions. Feasibility based prioritisation refers to maximising the number of interventions that can be delivered within the available time, capacity, and budget. Network based prioritisation focuses on maintaining network availability. Assets with a greater impact on the functioning of the network are prioritised. Risk based prioritisation prioritises safety by prioritising assets where failure would create the greatest risk to safety.

Asset specific intervention strategy

The subsequent node concerns the asset-specific intervention strategy. This strategy defines the specific response selected for an individual asset. The selected assets are translated into concrete intervention types.

At this stage, the asset manager can choose between one-on-one replacement, replacement with functional upgrading, life extension of the existing asset, or decommissioning or restricting the use of the asset without replacement (Tillema and de Lange, 2016). This decision operationalises the earlier policy goals at the level of the individual asset.

Asset specific timing

The timing of asset interventions determines when selected interventions are executed.

At this stage, interventions can be included in the current programme, delayed to a future programme, or excluded or downgraded. This decision reflects the urgency of the intervention, the available resources, and the available implementation capacity.

Potential for bundling with similar assets

This node assesses whether comparable asset interventions can be bundled. Expert involvement emphasised that bundling should be considered early in asset management, as it influences the prioritisation between asset interventions.

Asset managers assess whether similar assets require renewal in the same location or period and

therefore could be executed jointly. Potential bundling can influence prioritisation. Joint delivery may improve efficiency and make interventions more feasible to execute.

Portfolio order size and budget sufficiency

This node assesses whether the portfolio of prioritised asset interventions is financially feasible. It compares the available funding with the budget required to realise the intervention portfolio.

If the available funding is insufficient, the portfolio must be reconsidered. This may require changes to policy ambitions, or a restructuring of the budget. If the portfolio is financially feasible, the scope and corresponding budget of individual projects can be defined.

Project scope definition

The project scope definition node, concerns the composition of individual projects. It builds on the portfolio of prioritised asset interventions. At this stage, asset managers determine which interventions are included in a single project.

A project may concern one asset or combine several similar assets or interventions. This decision builds on the earlier assessment of bundling potential.

Project scope and project budget are determined in parallel. The available budget affects which interventions can be included in the project scope. At the same time, the selected scope determines the budget required for the project.

Task-based budget & Project order size and budget sufficiency

Project scope and order size can be defined in two ways. Under a conventional approach, the required project scope and order size are determined first. In this research, project order size refers to the financial value of the work to be procured. The required order size is then compared with the available budget to assess whether it is sufficient.

Under a task-based budget, the available budget is defined first. The project scope and order size must then be developed within that financial boundary. Expert involvement indicated that the objective is to create as much value as possible within the predetermined budget.

Under the conventional approach, the project proceeds when the available budget is sufficient for the defined scope and order size. If it is insufficient, the project scope, order size, or available budget must be reconsidered.

Procurement type

This node concerns the selection of the procurement type. It determines how the defined project is structured and brought to market.

This decision differs from project scope definition. Project scope definition determines which asset interventions are included in one project. Procurement type determines how this defined work is procured. The available options are a single-asset project, a bundled multi-asset project, a portfolio approach, or a framework approach.

A single-asset project concerns one asset procured through a one-off tender. A bundled multi-asset project combines several assets in a one-off tender. A portfolio approach procures a planned and substantially defined set of renewal tasks as one coherent programme of separate projects. A framework approach concerns recurring asset interventions procured under agreed terms with the same contractor.

Together, these asset management decisions result in a defined project with a set scope and order size. This project forms the starting point for procurement design. The following section explains how public clients design the procurement approach around this defined work and its conditions.

4.1.2. Procurement design: Object, collaboration, and market approach

The second part of the decision tree focuses on how procurement is defined. Object definition, choices on collaboration, and the way the market is approached together shape the procurement design, which determines whether a project is attractive to contractors. This results in the procurement design space.

The elements of procurement design are constrained by both Dutch and European procurement legislation. For the Dutch context, PIANOo is the government's expertise centre for public procurement. It supports public authorities in professionalising purchasing and tendering, with attention to legality, efficiency, and sustainability (PIANOo, n.d.). PIANOo is used as the main source for this part of the decision tree.

More specifically, this part of the decision tree draws on the "Overzicht Aanbevelingen Leidraad Aanbesteden Bouwopdrachten 2009" (Jansen, 2009b) and the "Leidraad Aanbesteden Bouwopdrachten 2009" (Jansen, 2009a). Although these sources date from 2009, PIANOo acknowledges that the guidance is partly outdated. At the same time, PIANOo states that the main principles remain applicable, although they may be incomplete in relation to more recent procurement developments. Therefore, where necessary, the PIANOo guidance is supplemented with additional sources.

The following sections explain how the defined project is brought to market. They examine how the project is transformed into a procurable object, which collaboration approach is selected, and how the market approach is formulated.

Object

In the illustrative example, asset management has now produced a defined project concerning the Van Brienenoordbrug. The object section translates that project into a procured object, the work package that will be presented to the market. This requires decisions about the complexity and risk of the work, whether it is divided into separate contract segments, how precisely it is specified, and which responsibilities remain with the client or are assigned to market parties.

The object section initiates procurement design by translating the project scope from asset management into a procurable object. It defines the characteristics of the work brought to market, including complexity, risk profile, contracted scope, specification level, and responsibility distribution. The following sections examine how these choices shape the object. Establishing the boundary conditions required to select a suitable procurement approach for the procured object.

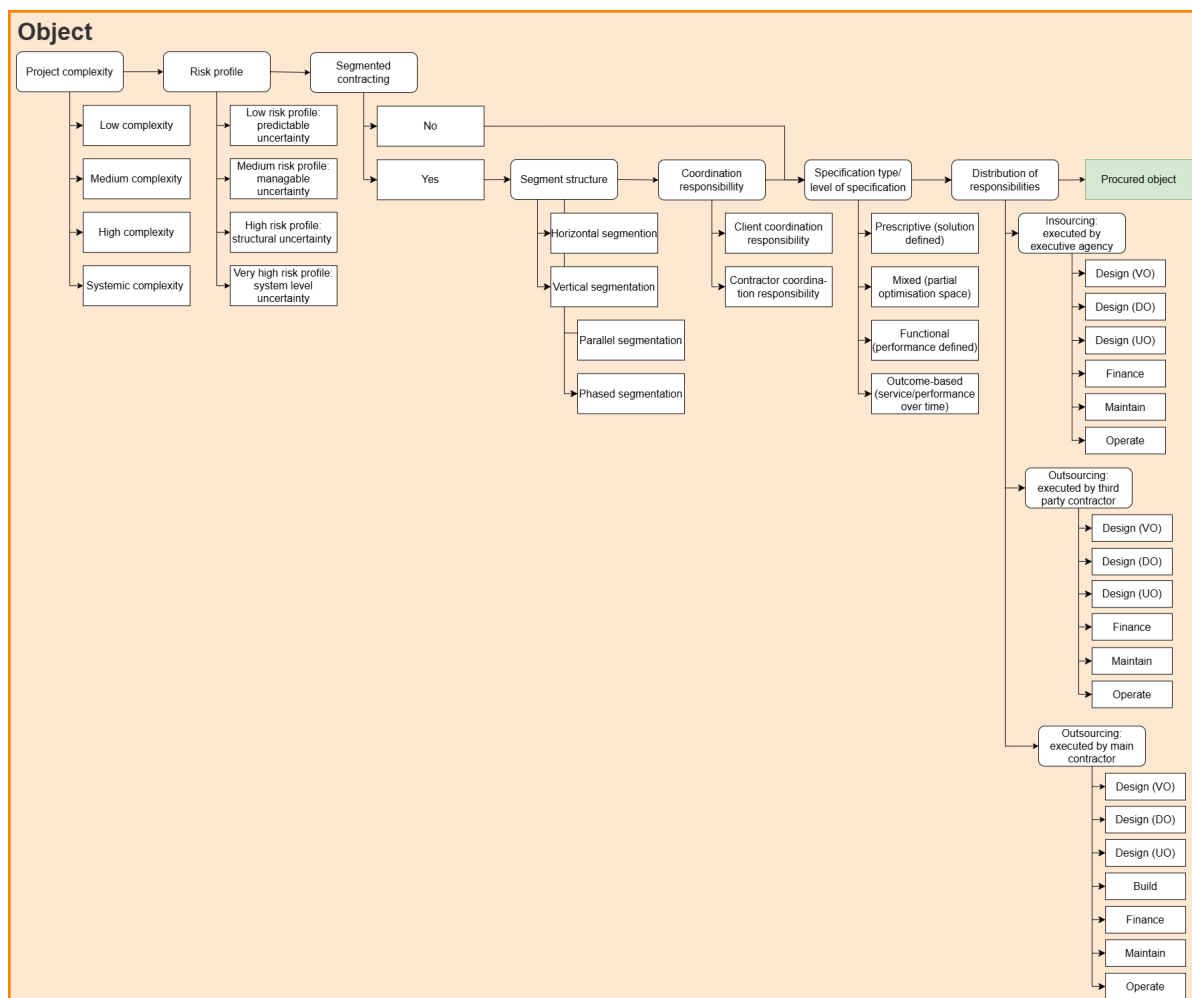


Figure 4.7: Decision tree: object section.

Project complexity

The first node assesses project complexity. Project complexity may range from routine, low-complexity work to medium- or high-complexity projects and, projects characterised by systemic complexity. This assessment is particularly relevant for infrastructure renewal, as renewal projects come with inherent complexity.

The assessed level of complexity constrains subsequent procurement design choices, including the level of specification and the collaboration approach.

Risk profile

This node assesses the project's risk profile. Projects may range from low-risk profiles with predictable uncertainties to medium-risk profiles with manageable uncertainties, high-risk profiles characterised by structural uncertainty, and very high-risk profiles involving system-level uncertainty.

This assessment reflects the extent to which project risks can be identified, quantified, and managed. It constrains subsequent procurement design choices, including the level of specification, the collaboration approach, and the allocation of responsibilities.

Segmented contracting

This node determines whether the defined project is procured through one contract or divided into multiple contract segments. It differs from project scope definition and procurement type. Project scope definition determines which asset interventions and activities are included within the project, while procurement type determines whether the project is procured separately, as part of a bundle or portfolio, or through a framework approach. Segmented contracting subsequently determines how the work within that already defined project is divided across individual contracts.

For example, once the renewal of the Van Brienenoordbrug has been defined as one single-asset project, the client could procure all work through one contract or divide the same project into several segmented contract segments. These segments could, for example, separate civil and structural work from mechanical, electrical, and control-system work. In this segmentation, the project scope remains the same. However, the contractual packaging and coordination of the work change. This example is illustrative and does not represent the actual segmentation used for the Van Brienenoordbrug procurement.

Segmentation may be organised horizontally, for example by geography or asset type, or vertically, by separating lifecycle phases or functions. Segments may be executed in parallel or sequentially. Segmentation also requires a decision on coordination responsibility, which may lie with the client or a contractor (Versantvoort, 2025).

The selected segmentation affects the work included in the final tender opportunity. It therefore influences which contractors are suitable.

Specification type/ level of specification

The specification type determines the degree of design freedom granted to the contractor and the extent to which uncertainty is allocated to the contractor.

The options range from prescriptive specifications, in which the client largely defines the solution, to mixed specifications with limited optimisation space. Functional specifications define the required performance while leaving the solution open. Outcome-based specifications focus on long-term service or performance delivery.

The selected specification type directly influences the distribution of responsibilities and the most suitable collaboration form. The specification type also dictates the level of uncertainty left to be outsourced in the distribution of responsibilities.

Variants

Variants were removed as a separate decision node after expert involvement indicated that they are generally less suitable for infrastructure renewal projects, where controlled and standardised renewal is often preferred over alternative design solutions. Instead, design freedom is captured through the specification type, as a less specified object leaves more undefined design for contractor solutions.

Distribution of responsibilities

The distribution of responsibilities determines which activities are performed by the client and which are assigned to market parties. Three configurations can be distinguished: insourcing, outsourcing to a third-party contractor, and outsourcing to a main contractor.

Under insourcing, the public client or its executive agency performs the activities itself. Under outsourcing, the client assigns specific activities to third-party contractors. Under outsourcing, through a main contractor, the client assigns an integrated package of activities to one contractor, who coordinates their delivery and may subcontract parts of the work.

Responsibilities can be allocated across preliminary design, definitive design, implementation design, construction, financing, maintenance, and operation. The allocation of responsibilities directly influences the suitable collaboration approach.

Collaboration

Once the procurement object has been defined, the collaboration section determines how the client and contractor are intended to organise their relationship during project preparation and delivery. In the Van Brienenoordbrug example, this does not change which bridge or intervention is included in the project. Instead, it concerns when contractors become involved, how responsibilities and risks are shared, which collaborative or contractual arrangement is used, and how the work is priced.

The collaboration section defines how the interaction between the client and market parties is structured during project delivery. Here, decisions are made regarding the form and intensity of collaboration, ranging from transactional relationships to more integrated and cooperative arrangements.

The decision tree presents collaboration choices as related to project characteristics and procurement design requirements. In practice, however, organisational steering and established procurement preferences may limit the extent to which project managers can select the most suitable collaboration form for each project.

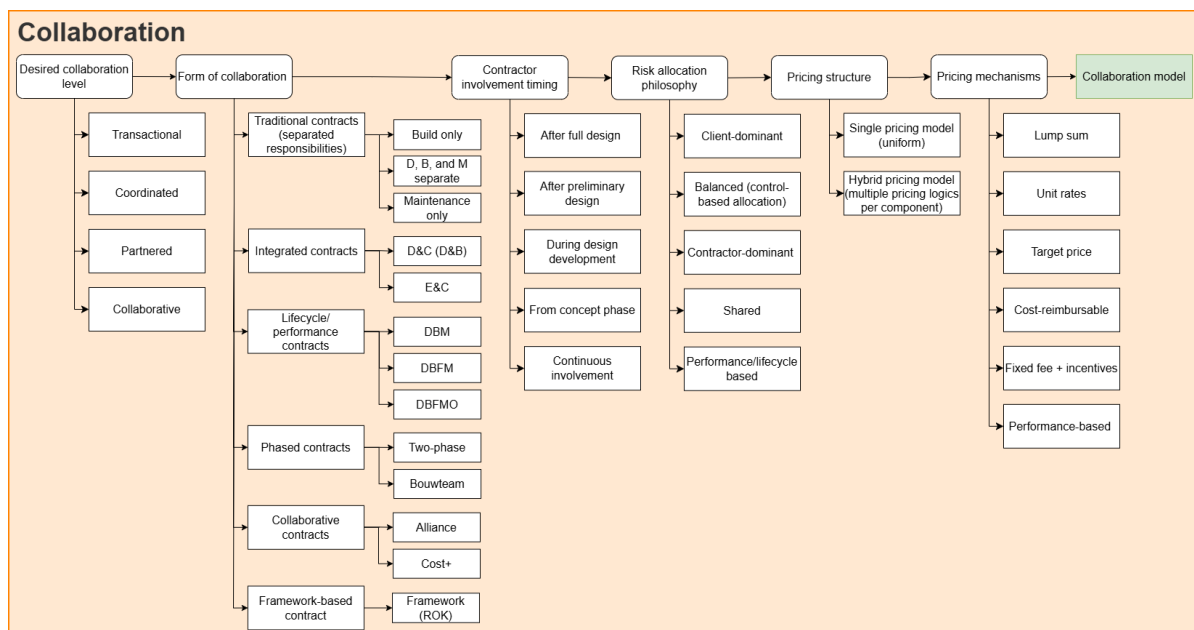


Figure 4.8: Decision tree: collaboration section.

Desired collaboration level

The desired collaboration level determines the intended collaboration, joint problem-solving and shared accountability between the client and contractor throughout the project lifecycle. Collaboration can range from transactional approaches with clearly defined and limited interactions, to coordinated structures with formal alignment, partnered models with shared responsibilities, and fully collaborative arrangements emphasising joint problem-solving and long-term cooperation.

This choice establishes the overall collaboration philosophy for the project. The following node determines the concrete collaboration form used to realise this level of interaction.

Form of collaboration

The form of collaboration determines the concrete contractual arrangement through which the desired collaboration level is realised. It structures the client-contractor relationship and allocates specific responsibilities between the parties.

The options range from traditional arrangements, in which the client specifies the work and the contractor primarily executes it, to integrated contracts in which the contractor is responsible for a broader set

of activities and risks. More collaborative forms include two-phase contracts, bouwteam arrangements, alliances, cost-plus arrangements, and framework approaches.

Contract type is not included as a separate decision node. In this thesis, contract type refers to the specific legal and contractual instrument through which the agreement is formalised, ranging from standardised forms such as UAV-GC or the FIDIC Yellow Book to project-specific contracts. These contract types are too numerous, may be adapted or combined, and cannot be represented as a collectively exhaustive and mutually exclusive set of options. The form of collaboration, by contrast, concerns the higher-level relational arrangement through which the client and contractor intend to organise their cooperation during project delivery. This dimension is included because collaboration forms can be represented as a more manageable set of procurement design alternatives. A selected collaboration form may subsequently be formalised through different contract types.

Expert involvement indicated that the relationship between project characteristics and procurement design choices may be weaker in practice than suggested by the decision tree. Organisational steering can limit the discretion of project managers by prescribing preferred procurement instruments for particular project categories. Some collaboration choices may therefore be institutionally determined rather than selected separately for each project. More fundamental arrangements, such as DBFM, may also require approval beyond Rijkswaterstaat (E.2.30).

The selected form of collaboration provides the basis for the following decisions on contractor involvement, risk allocation, and pricing. Together, these choices further define how the client-contractor relationship is organised during project delivery.

Contractor involvement timing

Contractor involvement timing determines the stage at which market parties are engaged in the project lifecycle. Contractors may be involved after full design, after preliminary design, during design development, from the concept phase, or continuously across multiple phases.

Earlier involvement allows contractors to contribute to design optimisation in relation to execution and risk control. Later involvement provides the client with greater control over the design and execution.

The timing of contractor involvement also affects transaction costs. Earlier involvement requires more interaction and coordination before execution, which may increase transaction costs for contractors. At the same time, it can support earlier identification, control, and allocation of project risks.

Risk allocation philosophy

Risk allocation philosophy determines the principle for distributing project risks between the client and contractor. The options range from client-dominant allocation, in which the contracting authority retains most risks, to contractor-dominant allocation, in which risks are largely transferred to the market.

Intermediate approaches include balanced allocation, shared-risk arrangements, and performance/lifecycle-based arrangements. These approaches seek to allocate risks to the party best able to control or manage them. The selected philosophy is influenced by the collaboration approach and influences the pricing approach.

Pricing structure

This node concerns the pricing structure, in which the overall financial logic of the contract is defined. At this stage, a choice is made between a single pricing model, where one uniform pricing mechanism is applied across the entire project, and a hybrid pricing model, where different components of the project are priced using different mechanisms.

Pricing mechanism

Following this, specific pricing mechanisms are selected for the relevant components, such as lump sum, unit rates, target price, cost-reimbursable arrangements, fixed fee with incentives, or performance-based pricing. These mechanisms differ in how costs and incentives are distributed between client and contractor.

Together, the collaboration decisions define how the client and contractor will work together during project delivery. The following market approach section determines how this procurement opportunity is to market.

Market approach

The market approach section concerns how the defined procurement opportunity is introduced to potential contractors and how one of them is selected. In the illustrative example, this includes deciding which market segment the Van Brienenoordbrug opportunity is intended to reach, whether and how contractors are consulted beforehand, which procurement procedure is used, how candidates are selected, and how their bids are evaluated.

This section defines how the client engages with the market in preparing and executing the tender.

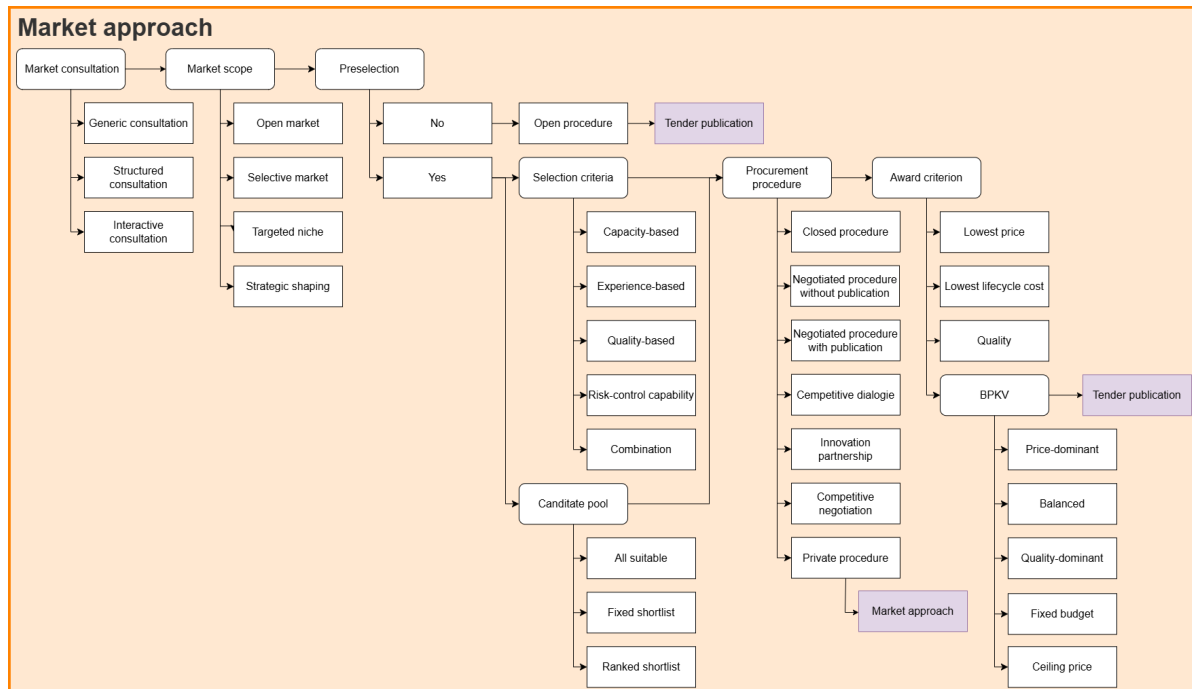


Figure 4.9: Decision tree: market approach section.

Market consultation

Market consultation determines how the contracting authority engages with market parties before and during tender preparation. The options range from no consultation to generic consultation, structured consultation, and interactive bilateral engagement with potential bidders.

Expert involvement indicated that market consultation is commonly used several times, both formally and informally. It may inform decisions at object, portfolio, and contract-strategy level. Market consultation is therefore not necessarily a one-off step, but may take place throughout the development of the procurement approach. However, this node is included here because the decision of whether and how to involve the market through consultation is part of the overall market approach.

Intended market

Intended market determines the intended market and the desired amount of participation in procurement. The client may target an open market, in which all qualified parties may participate. A selective market, in which participation is limited to a subset of candidates. A targeted niche approach, focusing on specialised market segments. Or strategic shaping of the market to attract or develop specific capabilities.

This decision defines which types of market parties the procurement is intended to reach and how broad competition should be. It therefore informs the subsequent market approach decisions, including the procurement procedure and selection criteria.

Procurement procedure

The procurement procedure determines the formal route through which market access, preselection, dialogue, and negotiation are organised. It defines how candidates may participate, how many parties are invited to tender, and the extent to which interaction is possible during the tendering process.

Where preselection is applied, the contracting authority determines the criteria used to assess candidates, such as capacity, experience, quality, or risk-control capability. It also determines the composition of the candidate pool, which may include all suitable candidates, a fixed shortlist, or a ranked

shortlist. These choices inform the selection of the applicable procedure, such as an open procedure, negotiated procedure, competitive dialogue, competitive negotiation, or innovation partnership.

Award criterion

The award criterion determines how bids are evaluated and how the contract is ultimately awarded. The options include award based on lowest price, lowest lifecycle cost, or the Best Value for Money approach (BPKV).

Within BPKV, the contracting authority determines the relative weighting of price and quality. This may result in price-dominant, balanced, or quality-dominant evaluation. Fixed budgets or ceiling prices may also be used to limit price competition and focus the evaluation on quality.

Tender publication

Tender publication formalises the market approach decisions into a concrete procurement package and communicates it to the market. At this point, the choices made in policy, budgeting, asset management, object definition, collaboration, and market approach are translated into the tender opportunity.

Tender publication marks the end of the procurement process as represented in the decision tree. The decision tree answers the first subquestion by showing how upstream policy and budgetary decisions shape asset management and the procurement design dimensions of Dutch infrastructure tenders.

However, its sequential structure does not provide a clear overview of the procurement design elements available for a specific project. The following section therefore translates the procurement design part of the decision tree into a morph chart. This makes the procurement design space useful for the remainder of this research.

4.2. Morphological Chart

The morphological chart is derived from the procurement design part of the decision tree. The decision nodes that concern the object, collaboration, and market approach are translated into procurement design dimensions, while their corresponding choice options are translated into procurement design elements. Upstream policy, budgeting, and asset-management decisions are not included as configurable dimensions, but remain relevant as conditions that constrain available procurement design choices.

The decision tree and morphological chart serve distinct analytical purposes. In standard engineering design, a conventional morphological chart presents a flat matrix of fully independent categories, assuming that exactly one design option is selected per row. Procurement design, however, consists of choices that may be interdependent, combinable, or conditional. While the decision tree models how a tender opportunity emerges through a sequential process of decisions, actor influences, and constraints, the morphological chart abstracts from this temporal sequence to present the available procurement design choices in a single, structured overview. It does not imply that all elements are independent or that every possible combination is feasible.

The chart should be read row by row. For dimensions that represent a single procurement decision, one applicable design element is selected. For dimensions that permit combined choices, multiple elements may be selected. Some dimensions are conditional and only become applicable when a preceding choice makes them relevant. The chart therefore maps the available procurement design elements but does not imply that every element must be selected or that every theoretically possible combination forms a coherent procurement configuration.

To guide the reader in interpreting the design space, the dimensions within the morphological chart (figure 4.10) are categorised into three decision types:

Single-choice dimensions:

Standard dimensions representing mutually exclusive procurement decisions where exactly one design element must be selected. These comprise "Project complexity", "Project risk profile", "Specification type/ level of specification", "Contractor involvement timing", "Risk allocation philosophy", "Intended market", and "Procurement procedure".

Multiple-choice dimensions:

Dimensions where multiple elements within a single configuration can be selected, specifically "Market consultation".

Conditional and relational dimensions:

Dependent dimensions and dimensions constrained by preceding choices:

- "Segmented contract": "Segment structure", "Segment allocation rules", and "Coordination responsibility" become applicable only if "Segmented contract" is set to "Yes".
- Distribution of responsibilities: across "Insourcing: executed by executive agency", "Outsourcing: executed by third party contractor", and "Outsourcing: executed by main contractor", design dimensions are mutually conditional. Each distinct responsibility (e.g., design, build, maintain) must be assigned exactly once across these three dimensions.
- Collaboration alignment: "Desired collaboration level" and "Form of collaboration" are relational, as transactional goals dictate traditional contract forms, whereas collaborative goals necessitate collaborative forms (e.g., Bouwteam or Alliance).
- Pricing structure and mechanisms: "Pricing mechanisms (per component)" functions as a single-choice option under a "Single pricing model", but expands into a multiple-choice option when a "Hybrid pricing model" is selected under "Pricing structure".
- Market approach dependencies: "Selection criteria" and "Candidate pool" are activated only when "Is preselection used?" is set to "Yes". Conversely, if preselection is omitted ("No"), the procedure defaults automatically to an "Open procedure". Furthermore, the selected "Procurement procedure" restricts which "Award criterion" choices are viable, and selecting the "BPKV" award criterion conditionally requires specifying a BPKV weighting (e.g., "Price dominant", "Balanced", or "Quality dominant").

The resulting procurement design space is presented in figure 4.10. The morphological chart and the set of procurement design dimensions and elements provide the analytical framework for the subsequent research steps. It is used to relate contractor evaluations of opportunity attractiveness to specific procurement design dimensions and elements. This comparison supports the identification of procurement design elements that contractors perceive as more or less attractive. These findings are subsequently used to develop a proposed procurement design space and derive procurement design principles in the following chapters.

Morph chart - procurement design space														
Design dimension		Design element												
Object														
Project complexity	Low complexity (routine project)	Medium complexity	High complexity (unique project)	Systemic complexity										
Project risk profile	Low risk profile: predictable uncertainty	Medium risk profile: manageable uncertainty	High risk profile: structural uncertainty	Very high risk profile: system level uncertainty										
Segmented contract	No	Yes												
Segment structure		Horizontal segmentation	Vertical segmentation											
Segment allocation rules		Parallel segmentation	Phased segmentation											
Coordination responsibility		Client coordination responsibility	Contractor coordination responsibility											
Specification type/ level of specification	Prescriptive	Mixed	Functional	Outcome-based										
Insourcing: executed by executive agency	Design (VO)	Design (DO)	Design (UO)	Finance	Maintain	Operate								
Outsourcing: executed by third party contractor	Design (VO)	Design (DO)	Design (UO)	Finance	Maintain	Operate								
Outsourcing: executed by main contractor	Design (VO)	Design (DO)	Design (UO)	Build	Finance	Maintain	Operate							
Collaboration														
Desired collaboration level	Transactional	Coordinated	Integrated	Collaborative										
Form of collaboration	Build only	D, B, and M separate	Maintenance only	D&C	DBM	DBFM	DBFMO	Cost+	Alliance	Bouwteam	Two-Phase	Framework (ROK)		
Contractor involvement timing	After full design	After preliminary design	During design development	From concept phase	Continuous involvement									
Risk allocation philosophy	Contractor-dominant	Balanced	Shared	Performance/lifecycle-based	Client-dominant									
Pricing structure	Single pricing model	Hybrid pricing model												
Pricing mechanisms (per component)	Lump sum	Unit rates	Target price	Cost reimbursable	Fixed fee + incentives	Performance-based								
Market approach														
Market consultation	Generic consultation	Structured consultation	Interactive consultation											
Intended market	Open market	Selective market	Targeted niche											Strategic shaping
Is preselection used?	No	Yes												
Selection criteria		Capacity-based	Experience-based	Quality-based	Risk-control capability	Combination								
Candidate pool		All suitable	Fixed shortlist	Ranked shortlist										
Procurement procedure	Open procedure	Innovation partnership	Negotiated procedure without publication	Negotiated procedure with publication	Competitive dialogue	Competitive negotiation	Private procedure	Closed procedure						
Award criterion	BPKV					Lowest price	Lowest lifecycle cost							
	Price dominant	Balanced	Quality dominant	Fixed budget	Ceiling price									

Figure 4.10: Procurement design Morph Chart.

Contractor evaluation of tender opportunities

This chapter presents the results of the second research step, see figure 5.1. It answers the second subquestion:

How do contractors evaluate the attractiveness of Dutch infrastructure renewal tender opportunities?

The morphological chart introduced in chapter 4 provides the framework for examining how contractors evaluate tender opportunities.

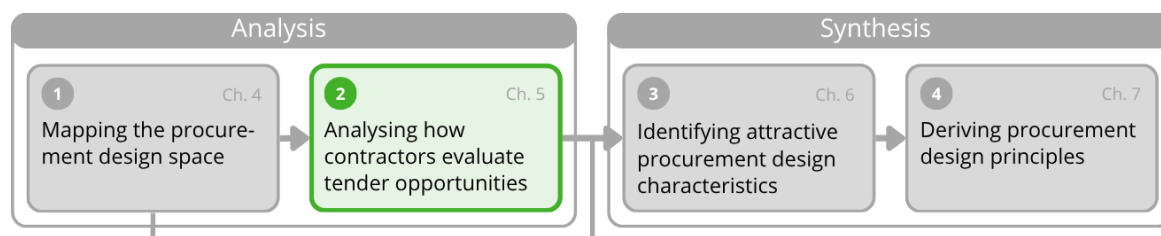


Figure 5.1: Current research step: analysing how contractors evaluate tender opportunities.

The chapter first analyses the tender selection process and compares its evaluation criteria with the procurement design dimensions and elements. It then identifies where contractor selectivity occurs and uses the tender selection data to examine the evaluation inputs and configurations associated with bid and no-bid decisions. Finally, the interviews explain how contractors assess opportunity attractiveness in practice, distinguishing between work attractiveness and condition attractiveness.

5.1. The selection process

The tender selection process structures the evaluation of tender opportunities. It supports consistent decision-making by ensuring that each opportunity is evaluated using the same criteria. The evaluation criteria reflect the contractor's strategic and policy considerations regarding the attractiveness of an opportunity.

To select tender opportunities that are sufficiently attractive to pursue, the process consists of a sequence of decision levels. For this research, the process is represented through three main decision levels. Additional decision levels are not included because they either apply only to specific types of tenders or occur after the bid/no-bid decision. The analysis therefore focuses on the decision levels most directly related to evaluating the attractiveness of tender opportunities.

The evaluation criteria used for the selection process are specific to each decision level. For each opportunity, the relevant decision-makers use the available evaluation inputs to determine whether it should proceed. The actors involved in the evaluation depend on the tender category, which is mainly determined by project size and risk level. Larger or riskier tenders require approval from more senior actors. As a result, the individuals involved may differ across opportunities, while the evaluation criteria remain consistent.

The selection process does not assess all opportunities available in the market. It only evaluates opportunities that have passed an initial screening. This screening evaluates whether a project aligns closely with the core business, as a significant portion of market opportunities is deemed unviable at this

stage. Consequently, the opportunities captured in the dataset are not representative of the broader market environment.

5.1.1. Decision levels

The decision process consists of the following decision levels:

1. **decision level 1: continuation decision:**

This decision level functions as the initial evaluation of a tender opportunity. Opportunities are evaluated based on client profile, scope, distinctive capability, and contractual conditions.

A positive outcome advances the opportunity to decision level 2. From that point, additional resources are committed to further investigating its attractiveness. Decision level 1 therefore assesses whether the opportunity is sufficiently attractive to justify this further investment.

A negative result means a no-bid decision.

2. **decision level 2: commitment decision:**

This level entails evaluating opportunities against a more extensive set of criteria than decision level 1. Core evaluation criteria at this level are risk and liability. The level acts as a fail-safe to prevent the pursuit of unfavourable projects that were evaluated as attractive in Level 1.

A positive decision level 2 outcome formally confirms the decision to formally commit to the tender. It initiates participation in the tender procedure and advances the opportunity to decision level 3.

A negative outcome results in a no-bid decision.

3. **decision level 3: selection decision.** At this level, the opportunity's contractual, liability, and technical risks are assessed in greater detail than at decision level 2. By this stage, most of the formal tender procedure has been completed. More detailed information is therefore available on the expected project outcome. The level serves as a final check before the bid is prepared and submitted. Even at this stage, the tender may still be halted if the additional information reduces confidence that it will result in a financially healthy and profitable project.

The decision level 3 evaluation concerns the definitive bid/no-bid decision. A positive evaluation results in a bid decision, indicating that the tender is considered sufficiently attractive to pursue.

A negative outcome results in a no-bid decision.

In the selection process, decision level 1 is primarily concerned with the attractiveness of the work. Available contractual information also provides an initial indication of condition attractiveness, allowing an early judgement of whether the opportunity could ultimately result in a commercially viable project.

Decision levels 2 and 3 apply a more thorough evaluation of the opportunity's condition and attractiveness as more contractual, technical, and financial information becomes available. Although no-bid decisions can still occur at these later stages, they primarily function as a fail-safe mechanism. Early no-bid decisions are preferred where possible. They prevent capacity and resources from being committed to an opportunity that is unlikely to be sufficiently attractive.

Together, the three decision levels apply a structured set of evaluation criteria to determine whether a tender opportunity should proceed. The following section examines how these formal evaluation criteria relate to the procurement design dimensions and elements identified in chapter 4.

5.1.2. Evaluation criteria and procurement design

The evaluation criteria used across the three decision levels were compared with the procurement design dimensions identified in chapter 4, see figure 4.10. This comparison shows that the selection process only partly reflects the client-side procurement design space.

Some evaluation criteria relate directly to procurement design elements, while others concern upstream asset-management conditions or contractor-specific considerations. Conversely, not all procurement design elements are represented as separate formal evaluation criteria. The distribution of coded attributes across the decision levels is presented in table 5.1.

The differences between the procurement design space and the formal evaluation criteria are explained in more detail below.

Category/code attribute	Decision level 1	Decision level 2	Decision level 3
Asset management			
Project order size and budget sufficiency	1	1	1
Procurement type	1	1	1
Project scope definition	1	3	4
Subtotal	3	5	6
Object			
Distribution of responsibilities	0	1	3
Project complexity	0	0	0
Risk profile	0	0	3
Segmented contracting	0	0	0
Specification type/level of specification	0	0	0
Subtotal	0	1	6
Collaboration			
Contractor involvement timing	0	0	0
Desired collaboration level	0	0	0
Form of collaboration	1	4	3
Pricing mechanisms	0	1	1
Pricing structure	0	0	0
Risk allocation philosophy	0	0	0
Subtotal	1	5	4
Market approach			
Award criterion	1	3	1
Candidate pool	0	0	0
Market consultation	0	0	0
Intended market	0	0	0
Preselection	0	1	1
Procurement procedure	1	2	2
Selection criteria	0	0	0
Subtotal	2	6	4
Contractor specific			
Business structure	4	9	3
Business structure - external	0	9	5
Earnings	1	7	25
Execution	0	3	3
Finance	0	2	3
Procedure	0	11	13
Strategy	6	10	13
Subtotal	13	53	75
Total	19	70	95

Table 5.1: Comparison of decision level criteria and procurement design elements.

Asset management

Several evaluation criteria were found to relate to infrastructure programming rather than the procurement design categories. These are upstream conditions in the procurement process, but their presence in the selection process shows that contractors evaluate them directly when evaluating a tender opportunity.

This category includes project order size and budget sufficiency, procurement type, and project scope definition. Project order size is assessed at all decision levels, although the available data does not show whether this is explicitly compared to the client's budget. Procurement type is evaluated only by whether the tender is part of a framework agreement. Project scope definition refers to the scope composition of the tender opportunity.

Object

The object category is only partly reflected in the selection process. No object-related procurement design elements are represented at decision level 1. Distribution of responsibilities is represented at decision levels 2 and 3, while risk profile is only represented at decision level 3. Project complexity,

segmented contracting, and specification type are not represented in the coded attributes. This does not necessarily mean that these elements are irrelevant to contractor bid/no-bid decisions. Rather, it shows that they are not represented as separate attributes in the formal decision process.

Collaboration

A similar pattern can be observed for the collaboration category. Form of collaboration is represented at all decision levels, while pricing mechanisms are represented at decision levels 2 and 3. Contractor involvement timing, desired collaboration level, pricing structure, and risk allocation philosophy are not represented in the evaluation criteria. This is notable because risk allocation and pricing are considered important factors in tender evaluation.

Market approach

Within the market approach category, award criterion, preselection, and procurement procedure are represented. Candidate pool, market consultation, intended market, and selection criteria are not explicitly represented.

Contractor-specific considerations

The contractor-specific category captures considerations that are not determined by client-side procurement design. These include strategic fit, expected earnings, internal and external business structure, execution requirements, finance, and internal procedural information. Together, these considerations show that the attractiveness of the opportunity is influenced not only by procurement design or upstream procurement choices, but also by contractor-specific arguments about organisation and potential earnings.

The analysis shows that the formal selection process contains recorded criteria from each of the three broad procurement design categories: object, collaboration, and market approach. However, it only partly reflects the detailed procurement design space, because several individual dimensions are not represented as separate attributes. The process also includes upstream asset-management conditions and contractor-specific considerations.

This provides the basis for examining which evaluation criteria are associated with opportunity attractiveness. The following section therefore considers at which decision level no-bid decisions most frequently occur.

5.1.3. Where contractor selectivity is exercised

Most no-bids occur at decision level 1, as seen in figure 5.2. It shows at what decision level the cases in the dataset result in a bid/no-bid decision. The left diagram illustrates initial filtering at decision level 1 (sub-business-unit level), showing that most no-bid decisions (47%) occur at the front end of the process.

Later no-bid decisions also occur at decision levels 2 and 3, but less frequently. The right diagram displays the tender selection at decision levels 2 and 3 (group level), showing how opportunities proceed to a definitive bid (53%) or no-bid (21% total). Together, the diagrams demonstrate that contractor selectivity is concentrated at the front end of the decision process.

However, decision level 1 contains the fewest formally recorded evaluation criteria, see table 5.1. This suggests that most no-bid decisions are based on only a small set of evaluation criteria, or that some criteria are implicitly evaluated.

Although most of the selectivity occurs early in the selection process, tenders may still be carried forward to decision levels 2 or 3. Early no-bid decisions are preferred over late decisions. The interviews suggest that this continuation can be opportunistic: the work is sufficiently attractive, the required investment is still limited, and the conditions are not yet fully known. Opportunities may therefore continue, as conditions may still improve or the client can be persuaded to adopt an alternative approach.

Passing decision level 1 therefore does not necessarily mean that the conditions have already been assessed as attractive. The interviews indicate that opportunities may be kept open until more decisive information regarding contract conditions becomes available. As information becomes clearer and tender costs increase, the assessment becomes stricter. If the conditions prove unacceptable and cannot be changed, the tender may still be discontinued around decision level 3. Even though the preferred no-bid decision point is as early as possible in the process, opportunities may be continued when the conditions remain uncertain but may still become sufficiently attractive.

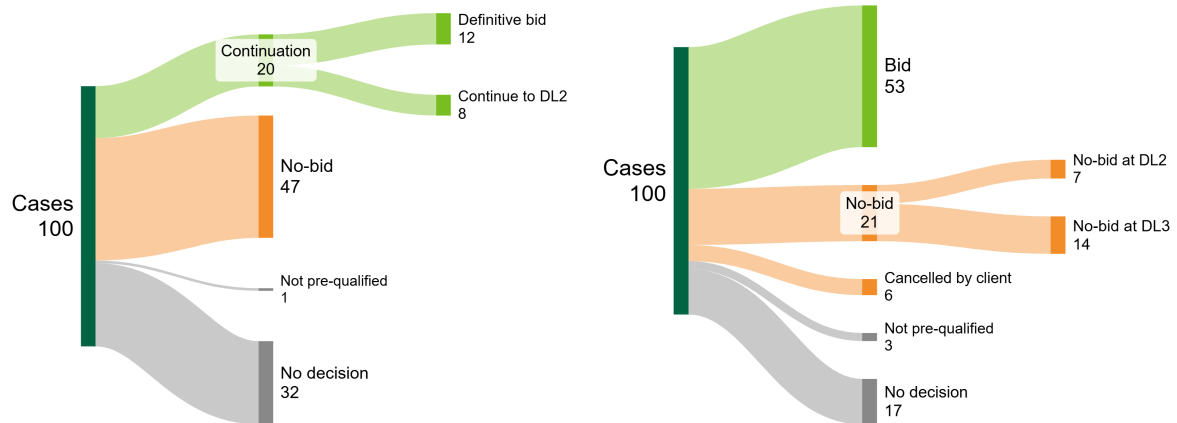


Figure 5.2: Where bid/no-bid decisions are taken: comparison of tender progression at decision level 1 (left) versus decision levels 2 and 3 (right) [%].

Together, these findings show that BAM evaluates tender opportunities through three main decision levels, with the greatest recorded selectivity occurring at the beginning of the process. The formal evaluation criteria only partly correspond with the client-side procurement design space: upstream project characteristics and contractor-specific considerations are also evaluated, while several procurement design dimensions remain implicit or unrecorded. Because most no-bid decisions occur at Decision Level 1, the following section examines which recorded inputs at this level are associated with continuation and no-bid outcomes.

5.2. Insight into decision level 1

Pivot tables and Qualitative Comparative Analysis (QCA) were used to analyse the dataset corresponding to this decision level, as described in chapter 3. In this way, the evaluation inputs of the specific cases could be compared to the resulting bid/no-bid decision.

The views resulting from the pivot table analysis illustrate which inputs of each criterion are most likely to correspond to bid or no-bid decisions. Complementarily, the QCA identifies specific input configurations that most likely relate to bid or no-bid decisions.

After anonymising and coding the evaluation criteria and inputs, the analysis was able to provide insight into the following criteria:

- **Bid/no-bid decision:** outcome condition of the selection process.
- **Project order size:** indicates the size of the project.
- **Procurement type:** indicates whether the opportunity is part of a framework agreement.
- **Project scope:** describes the scope elements of the procured tender opportunity.
- **Form of collaboration:** describes the form of collaboration of the tender. Early Contractor Involvement is used here as a broad category for collaborative approaches such as alliances and bouwteams, because the data did not allow for a more detailed distinction.
- **Award criterion:** indicates the award criterion used in the tender.
- **Procurement procedure:** describes the procurement procedure.
- **Client type:** describes the type of client.
- **Region:** was derived from the business structure attribute and indicates the region in which the project is procured.
- **Joint venture:** was derived from the project share data and indicates whether the opportunity was pursued independently or in cooperation with other parties.
- **Priority:** indicates the priority of the opportunity compared to other opportunities.
- **Win chance:** indicates the expected size of competition per case.

5.2.1. Pivot tables

The decision level 1 data contains five possible outcomes: *bid*, *continuation*, *no-bid*, *not pre-qualified*, and *no decision*. In this analysis, *bid* and *continuation* are combined into a single *continuation* category, as both represent a positive outcome that leads to the next phase, either proceeding to decision level 2 or resulting directly in a definitive bid. The analysis includes *no-bid* decisions to evaluate contractor filtering at this stage. By contrast, cases marked as *not pre-qualified* and *no decision* are excluded from the analysis, as the contractor was either not pre-qualified during the tender process or had not yet recorded a definitive decision outcome.

In each pivot table, the evaluation inputs are expressed as percentages of the column total. This made it possible to compare how frequently specific inputs of each criterion are associated with a specific outcome. The full tables are included in appendix E. In the main text, only the most relevant patterns are discussed.

Missing evaluation inputs are associated with no-bid outcomes

For several criteria, no evaluation input information was available for a significant number of cases, as indicated by the "(leeg)" or "0" columns in the tables. What stands out is that, for most criteria, the cases with missing data correspond to cases that resulted in a no-bid decision. One possible explanation is that these cases were discontinued before further information was collected or documented. However, the recorded data cannot distinguish this mechanism from incomplete data entry or genuine uncertainty about the opportunity. Missing inputs should therefore be interpreted as a characteristic of the recorded selection process rather than as evidence of one specific cause of the no-bid decision.

Bid/no-bid decision against project order size

Opportunities below €5 million show a distinctly lower continuation rate than larger opportunities (table 5.2). Above this threshold, continuation rates fluctuate rather than increase consistently with project order size. The finding therefore indicates that very small projects are relatively unattractive to the studied contractor. This is likely because the organisational effort required to tender and manage small projects does not decrease proportionally with order size. This interpretation is specific to the market segment of large civil engineering contractors, smaller or more specialised contractors may evaluate project order size differently.

Bid decision	0	≤ 5 mln	5–10 mln	10–25 mln	25–50 mln	50–100 mln	> 100 mln	Total
Continuation	10%	24%	40%	32%	39%	40%	46%	28%
No-bid	90%	76%	60%	68%	61%	60%	54%	72%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Table 5.2: Bid decision percentages by project order size ($p < .001$).

Bid/no-bid decision against project scope

Projects with energy, A-road and railroad scope are associated with relatively high bidding rates. This indicates that these scope types are perceived as attractive. Movable bridges, quay walls and tunnels show relatively low bidding rates. This indicates that these project types are perceived as less attractive, possibly due to technical complexity or the required expertise. This relation is shown in table 5.3. Scope types with very low representation were removed.

Bid decision	Energy	A-Road	N-Road	Municipal R.	Railroad	Quaywall	Dike	Imovables br.	Movable br.	Tunnel	Building	(leeg)	Eindtotaal
Continuation	47%	53%	33%	27%	56%	13%	26%	37%	12%	15%	38%	0%	28%
No-bid	53%	47%	67%	73%	44%	87%	74%	63%	88%	85%	62%	100%	72%
Eindtotaal	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 5.3: Bid decision percentages by scope ($p < .001$).

Bid/no-bid decision against form of collaboration

Collaborative approaches, including Early Contractor Involvement, are associated with relatively high bidding rates, of 83%. Cost-plus contracts show a bidding rate of 100%, yet this pattern is based on only two cases. Framework agreements also appear relatively attractive. DBFMO and DBM cases show exclusively no bid outcomes in the dataset. This indicates that these integrated contract forms are less attractive at decision level 1. The relationship is displayed in table 5.4

Bid decision	Build only	Maint.	D&C	E&C	DBM	DBFMO	ECI	ROK	Cost plus	Other (leeg)	Total
Continuation	33%	0%	37%	25%	0%	0%	83%	64%	100%	8%	28%
No-bid	67%	100%	63%	75%	100%	100%	17%	36%	0%	92%	72%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 5.4: Bid decision percentages by form of collaboration ($p < .001$).**Bid/no-bid decision against award criterion**

Cases awarded primarily on quality show a very high bidding rate, indicating that tenders with a stronger emphasis on quality are more attractive than tenders dominated by price.

However, this criterion is strongly affected by missing values. The empty-cell effect is particularly visible here: in many no-bid cases, the award criterion was not recorded, see table 5.5.

Bid decision	Lowest price	Quality	BPKV	Unknown	Total
Continuation	67%	100%	60%	0%	28%
No-bid	33%	0%	40%	100%	72%
Total	100%	100%	100%	100%	100%

Table 5.5: Bid decision percentages by award criterion ($p < .001$).**Bid/no-bid decision against procurement procedure**

The procurement procedure variable contains a substantial number of empty cells and represents only a limited number of the procurement procedure elements included in the procurement design space. This limits the extent to which conclusions can be drawn from this attribute. The missing information may indicate that the procurement procedure was not yet known, was not yet relevant, or was not documented at decision level 1. The full table is, however, included in appendix E.

Bid/no-bid decision against client type

The bid/no-bid decision rate varies between public and private clients. Private clients exhibit a higher bidding rate than most public client categories, suggesting that private clients are more attractive to contractors than public clients. Although, as displayed in table 5.6, the difference is minimal.

Bid decision	BAM	Drink.	Energy	Hoogh.	Mun.	Nat. Gov.	Port	Priv.	ProRail	Prov.	Rijkswat.	Schip.	Trans.	Water.	Total
Continuation	92%	9%	30%	0%	32%	33%	25%	40%	21%	17%	16%	38%	50%	35%	28%
No-bid	8%	91%	70%	100%	68%	67%	75%	60%	79%	83%	84%	63%	50%	65%	72%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 5.6: Bid decision percentages by client type ($p < .001$).**Bid/no-bid decision against region**

The regional distribution, shown in table 5.7, suggests that cases in the south region are relatively more often associated with bidding.

Bid decision	Regio Centraal	Regio Oost	Regio West	Regio Zuid	Total
Continuation	25%	21%	31%	46%	28%
No-bid	75%	79%	69%	54%	72%
Total	100%	100%	100%	100%	100%

Table 5.7: Bid decision percentages by region ($p < .001$).**Bid/no-bid decision against priority**

High-priority cases have a higher bidding rate, while average-priority cases have a lower bidding rate, and low-priority cases are almost always rejected. This indicates a strong relation between the priority of a tender opportunity and the bid/no-bid decision. The relation is explained in table 5.8.

Bid decision	High	Average	Low	Unknown	Total
Continuation	49%	17%	2%	0%	28%
No-bid	51%	83%	98%	100%	72%
Total	100%	100%	100%	100%	100%

Table 5.8: Bid decision percentages by project priority ($p < .001$).

Bid/no-bid decision against win chance

Higher win chances are more often associated with bid decisions. All cases with a recorded win chance of 20% or higher, corresponding to an expected competition of five bidders or fewer, resulted in a bid decision. No-bid decisions were only observed in the 0% category.

However, the 0% category is most common and also appears to represent empty values. Moreover, some cases with a recorded win chance of 0% still resulted in a bid decision. table 5.9 shows that tenders with a low chance of winning, and thus a high level of competition, are less attractive.

Bid decision	0	20	33	50	75	90	95	100	Total
Continuation	14%	100%	100%	100%	100%	100%	100%	100%	28%
No-bid	86%	0%	0%	0%	0%	0%	0%	0%	72%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 5.9: Bid decision percentages by estimated win chance ($p < .001$).

Bid/no-bid decision against joint venture

The cross-tabulation shows a slightly higher bidding rate for cases involving joint ventures. However, the difference is limited, as shown in table 5.10. Joint-venture involvement was the only examined characteristic for which no statistically significant association with the bid/no-bid decision was found ($p = .260$). The observed data therefore provide insufficient evidence to conclude that joint-venture involvement was systematically related to the recorded decision outcome.

Bid decision	JV	No JV	Total
Continuation	35%	27%	28%
No-bid	65%	73%	72%
Total	100%	100%	100%

Table 5.10: Bid decision percentages by joint-venture status ($p = 0.260$).

5.2.2. Qualitative Comparative Analysis (QCA)

This Qualitative Comparative Analysis examines whether bid/no-Bid outcomes are associated with specific combinations of evaluation inputs at decision level 1.

Because the original dataset contained a relatively large number of conditions, the number of conditions was reduced before running the QCA. The following adjustments were made:

- **Project size** was included as a fuzzy-set condition, with the crossover point set below €10 million.
- **Framework agreement** was included as a crisp set factor.
- **Project scope** was grouped into conditions representing waterworks, road works, railroad, civil structures, and non-infrastructure. These were included as separate crisp set conditions.
- **Form of collaboration** was grouped into conditions representing integrated, traditional, performance-based, collaborative and cost-plus contracts. These were included as separate crisp set conditions.
- **Award criterion** was included through a crisp set condition of lowest-price.
- **Procurement procedure** was excluded because of the high number of missing values.
- **Client type** was included as a crisp set condition representing all public client types.
- **Region** was excluded.
- **Joint venture** was retained as a crisp set condition.
- **Priority** was included as a fuzzy-set condition, with a crossover point above 50%.
- **Win chance** was also included as a fuzzy-set condition, with a crossover point above 50%.

The truth tables provide further insight into the combinations of conditions associated with Bid and No-Bid decisions. The full truth table is included in appendix F. The most frequent configurations with high bid consistency are listed in table 5.11. The most frequent configurations with low bid consistency are included in table 5.12. An inclusion threshold of 80% was used.

The truth table contains 243 observed configurations across 1 011 cases. Only 33 configurations are classified as bid configurations, covering 69 cases. This indicates that bid-consistent configurations have limited empirical support and that the bid outcome is relatively rare within the decision level 1 dataset.

The role of priority and win chance

Among the 69 cases allocated to bid-consistent configurations, high priority was present in 68 cases, and a high win chance in 65 cases. Both conditions are therefore highly recurrent in bid-consistent configurations, although neither is present in every configuration. This suggests that priority and win chance are important considerations in the tender selection process. However, the results indicate that priority alone is insufficient to explain a bid decision. High priority also occurs in no-bid configurations.

Most empirically supported bid configurations

Table 5.11 presents the most frequent configurations (n) with high bid consistency.

Evaluation-input configuration	n	Bid consistency
Energy project + traditional collaboration + high priority + high win chance	14	0.961
Energy project + traditional collaboration + lowest-price criterion + high priority + high win chance	6	0.954
Energy project + collaborative procurement + lowest-price criterion + high priority + high win chance	5	0.808
Framework contract + Energy project + collaborative procurement + high priority + high win chance	4	1.000
Energy project + integrated collaboration + lowest-price criterion + high priority + high win chance	4	0.970
Building project + traditional collaboration + lowest-price criterion + high priority + high win chance	3	0.980
Larger project + Energy project + integrated collaboration + lowest-price criterion + high priority + high win chance	3	0.953

Table 5.11: Frequent procurement configurations with high bid consistency.

The table shows that most of the configurations associated with a bid decision are energy-scope projects. Within these energy projects, traditional collaboration is associated with bid decisions. This contrasts with the cross-tabulation analysis, section 5.2.1, in which collaborative forms were identified as more attractive. The most empirically supported bid configuration combines an energy project scope, traditional collaboration, high priority, and high win chance. This configuration covers 14 cases and has a bid consistency of 0.961.

The lowest-price criterion appears in several bid-consistent configurations. This contrasts with the cross-tabulation analysis, in which lowest-price was associated with more no-bid decisions than award criteria based on BPKV or quality.

Most frequent no-bid configurations

Table 5.12 presents the most frequent configurations (n) with low bid consistency.

Evaluation-input configuration	n	Bid consistency
High priority, without the other active characteristics and without high win chance	91	0.000
Civil-structures project + integrated collaboration + public client + high priority, without high win chance	63	0.070
Civil-structures project + traditional collaboration + public client + high priority, without high win chance	59	0.000
Energy project + high priority, without high win chance	31	0.000
Larger project + civil-structures project + integrated collaboration + public client + high priority, without high win chance	26	0.071
Public client only, without priority or high win chance	25	0.000
Energy project + traditional collaboration + high priority, without high win chance	25	0.002
Civil-structures project + high priority, without high win chance	23	0.000

Table 5.12: Frequent configurations with low bid consistency.

The no-bid configurations show that high priority without a high chance of winning is associated with a no-bid outcome. This pattern occurs across projects with energy and civil-structure scope, and both traditional and integrated collaboration forms.

The contrast is particularly clear for energy projects with traditional collaboration. When high priority and high win chance are both present, this configuration is associated with a bid decision. When the same configuration has high priority but a low win chance, it is associated with a no-bid decision. This indicates that high win chance is an important condition.

5.2.3. Interpretation

To summarise, the cross-tabulations identify several individual inputs that are associated with bid or no-bid decisions at decision level 1:

More often associated with bid decisions:

- project order sizes above €5 million
- energy, A-road, N-road, and railroad projects
- collaborative forms of collaboration
- quality-oriented award criteria
- private clients
- southern-region opportunities
- high priority
- higher win chances

More often associated with no-bid decisions:

- missing or unrecorded evaluation inputs
- project order sizes below €5 million
- movable bridges, quay walls, and tunnels
- DBM and DBFMO contracts
- price-oriented award criteria
- lower priority
- low win chances

The QCA shows that bid decisions are most consistently associated with configurations combining high priority and high win chance, particularly for energy projects with traditional collaboration. High priority alone is insufficient: otherwise similar configurations are predominantly associated with no-bid outcomes when win chance is low.

The contrasting findings regarding the form of collaboration and the award criterion further demonstrate that their relationship with the bid/no-bid outcome depends on the broader configuration in which they occur. In the QCA, traditional collaboration and lowest-price award mechanisms are included in several bid-consistent configurations, whereas the individual cross-tabulations associate these inputs with relatively lower attractiveness. This further supports a configurational interpretation of opportunity attractiveness.

However, these findings are based on recorded selection data and do not explain why these patterns occur in practice. The following section, therefore, builds on the distinction between work attractiveness and condition attractiveness to explain how contractors interpret the considerations within the selection process.

5.3. Opportunity attractiveness: work and condition attractiveness

Tender selection data alone does not explain how contractors interpret these inputs when assessing opportunity attractiveness. Therefore, building on the distinction introduced in chapter 1, this section explains how contractors evaluate the attractiveness of an opportunity. This explanation is based on how the interviews reflect on what determines work attractiveness (5.3.1), and condition attractiveness (5.3.2).

5.3.1. Work attractiveness

The interviews suggest that work attractiveness is assessed through three practical questions:

- **Do we want this?** Which is based on organisational, strategic, commercial and client fit.
- **Can we do this?** Which is based on capacity of people, expertise and equipment both in-house and with partners
- **Can we win this?** Which is based on win chance, competitive advantage and distinctive capabilities.

This distinction helps to structure how the contractor assesses whether the work itself is attractive enough to pursue. The role of these practical questions is explained in more detail in the sections below.

Do we want this?

The first question concerns whether the project aligns with the contractor's organisational, strategic, commercial, and client-related interests.

Organisational fit

Organisational fit increases work attractiveness when a project is both professionally appealing to the people expected to deliver it and feasible to organise within the contractor's existing regional capacity. The interviews indicate that technically interesting or complex work, such as infrastructure renewal, can be attractive because it appeals to the professional interests of the people involved: it is work "the team becomes happy about" (2.52).

Location further shapes this assessment. Opportunities located close to the relevant regional organisation, or "in their backyard", are more attractive because people, equipment, and delivery capacity can be organised more easily.

Both factors can only be influenced to a limited extent through procurement design. The intrinsic professional appeal of infrastructure renewal is primarily related to the nature of the work itself, while location depends on the geographical distribution of the contractor's people, equipment, and partners. These factors are not directly represented in the procurement design space. However, the work of infrastructure renewal is attractive due to the professional appeal.

Strategic fit

Strategic fit increases work attractiveness when an opportunity fits the markets and types of work the contractor wants to prioritise. The interviews indicate that before opportunities enter the formal tender selection process, the contractor filters them based on this preference. Work is therefore more attractive when it contributes to the contractor's long-term strategic direction. Specific clients can also form part of this strategic focus, although this relation is explained under client fit.

The interviews suggest that infrastructure renewal is strategically relevant for the contractor. Renewal is described as a large and socially relevant market, and the contractor is expected to increase its attention to this market segment in the coming years. The current renewal portfolio is still limited, but there is an ambition to grow the portfolio substantially. As new-build opportunities become scarcer, attention within the infrastructure market naturally shifts towards replacement and renovation. The types of enlarge and market segment associated with infrastructure renewal therefore fit the contractor's strategic focus.

This aspect of strategic fit can only be influenced to a limited extent through procurement design, as it is primarily determined by company-specific strategy. However, a strong strategic fit does not make every individual renewal opportunity attractive. Unattractive tender conditions can still reduce the overall opportunity attractiveness of a specific tender.

Commercial fit

Commercial fit increases work attractiveness when an opportunity contributes sufficient volume, continuity, and expected return to the contractor's portfolio. An opportunity may be commercially attractive when it provides a sufficiently stable workload and return over time relative to the invested capital and working hours.

The interviews indicate that energy-transition work has appeared commercially attractive in recent years because it was often offered through repetitive framework contracts, continuity and strategic volume. These contracts provided stable work volume and return over a longer period, even when the return on individual projects was not particularly high and the organisational fit of the work was lower because

it was considered less technically interesting. Long-term framework contracts are therefore attractive because they create certainty and continuity over several years.

Providing sufficient stability in returns for infrastructure renewal can be challenging because individual projects are often labour-intensive and generate relatively limited production volume. However, the interviews suggest that increasing project budgets is not the only way to improve commercial fit. The procurement approach and form of collaboration can also influence whether the available revenue can be earned under acceptable conditions. Procurement design can therefore improve commercial fit by creating conditions under which renewal work provides a more stable and acceptable return over time.

Client fit

An attractive tender opportunity requires an attractive client. Client fit strongly affects the attractiveness of the work because the contractor evaluates whether the client has a sufficiently positive track record, is familiar to the contractor, and can be expected to prepare and manage the infrastructure project predictably.

The contractor evaluates this track record through both historical project data and relationship-based considerations. Previous project performance indicates whether a client's projects have generated sufficient revenue and return, while selection evaluations assess whether the client has been a reliable partner. It concerns whether the client has demonstrated that it can offer workable conditions, communicate openly, pay reliably, and recognise the commercial realities of project delivery.

Client fit also increases the attractiveness of work when a client offers potential for future workload or aligns with the contractor's strategic direction. Some clients form part of the contractor's strategic focus because they provide continuity or contribute to a preferred market position.

Client maturity is central to this evaluation. Clients with sufficient in-house knowledge, experience from previous similar projects, and reliable asset information are more predictable and easier to work with. The interviewees illustrated this through semi-private clients, which are associated with greater continuity, better preparation, and more experience with collaborative and portfolio-based approaches. By contrast, some public clients lack sufficient asset information or operate with rigid and politically constrained budgets, making the expected work and financial conditions less predictable.

Client fit therefore helps explain why some clients appear more attractive than others in the cross-tabulation in section 5.2. Although client fit is not itself a procurement design element, client maturity directly affects the quality of procurement design. A mature client is better able to define the required work, provide reliable information, allocate risks appropriately, organise meaningful collaboration, and create tender conditions that are sufficiently attractive for contractors.

Can we do this?

Capacity and capability increase work attractiveness. The 'can we do this?' question is answered based on whether the contractor can mobilise the required people, expertise, equipment, and partners in the right form and at the right location. The interviews explain that location is part of this evaluation because capacity is not evenly distributed across the country. Work close to the contractor's regional organisation is easier to organise, while work in remote parts of the region becomes more complicated.

The capacity evaluation is particularly challenging for infrastructure renewal, as renewal projects require relatively many people for the turnover they generate. Bundling capacity can partly address this problem. Rather than bringing infrastructure renewal projects to market individually, the interviews suggest that speed and efficiency can improve when a fixed team delivers multiple projects. This enables learning, standardisation, and higher production speed with the same group of people. Projects that provide production continuity are therefore more attractive because they help secure people, partners, and equipment capacity over a longer period.

The availability of the required expertise within the contractor and its partners also affects whether the work can be delivered. The interviews suggest that the contractor currently has substantial experience with complex renewal projects. However, continued renewal projects are needed to retain this expertise. The opportunity to maintain or further develop specialist knowledge can therefore increase the work attractiveness of infrastructure renewal projects.

These capacity and capability challenges can partly be mitigated through procurement design. As with commercial fit, procurement approaches that create continuity, repetition, and predictable project volume can help the contractor organise and retain the required people and expertise more effectively.

Can we win this?

Work attractiveness is influenced by whether the contractor perceives a realistic chance of winning the tender. The question 'Can we win this?' therefore concerns whether the contractor has a realistic prospect of winning the work. This depends on the contractor's competitive position in relation to the specific tender.

The win probability itself is affected by competitive advantage and distinctive capability. A project is more attractive when the contractor can offer something that fits the tender and differentiates it from competitors, such as technical expertise, client knowledge, previous experience or local presence. Competitive advantage is also affected by the expected number and quality of competing bidders. If the contractor has little chance of winning, even attractive work may be rejected because scarce tender capacity must be allocated to opportunities with a credible probability of success.

Procurement design can directly influence this evaluation by prioritising award criteria that emphasise quality and BPKV. This enables contractors to differentiate themselves and assess whether they can develop a sufficient competitive advantage.

The interviews also stress that transparency regarding competitors is largely absent during the tender process. Greater transparency could help contractors assess their chances more accurately and select opportunities where they are best positioned to add value. This may not necessarily increase competition or reduce prices, but it could improve the quality of bids and help contractors make more informed bid/no-bid decisions.

5.3.2. Condition attractiveness

Condition attractiveness is determined by whether the opportunity can be converted into a commercially and operationally acceptable project. It concerns whether the conditions under which a tender opportunity is procured and delivered provide sufficient scope certainty, manageable risks, acceptable financial exposure, and a proportionate tender effort. The interviews indicate that condition attractiveness is shaped by four factors:

- contract form and collaboration approach
- risk allocation
- financial conditions and pricing mechanism
- tender procedure, award logic, and transaction costs

The following sections explain how these factors influence condition attractiveness in more detail.

Contract form and collaboration approach

An attractive opportunity begins with contractual terms that suit the work. The interviews indicate that an opportunity involving attractive work can become unattractive when the contractual conditions or collaboration approach are unsuitable. Large DBFM projects, for example, may involve substantial and attractive work, while the contractual conditions attached to them can make participation problematic.

The interviews indicate a preference for collaborative approaches in which responsibilities, risks, and decision-making are aligned with the capacities of both parties. Conversely, integrated contract forms that place disproportionate responsibility or risk on the contractor can reduce the attractiveness of opportunities.

Procurement design can directly influence contractual attractiveness by choosing more collaborative approaches. This only increases attractiveness when collaboration is organised on a sufficiently equal basis. This requires the client to have the knowledge, mandate, and preparation needed to participate effectively, rather than using collaboration primarily to transfer responsibility to the contractor.

Risk allocation

The interviews indicate that condition attractiveness increases when the risks allocated to the contractor are manageable. This is especially important for infrastructure renewal, where uncertainty is inherent. Risks should be allocated to the actor best able to manage them. Risks that are difficult to price, manage, or mitigate should not simply be transferred to the contractor, but should be addressed jointly or largely covered by the client.

Scope certainty and asset information increase the attractiveness of the condition when they enable the contractor to sufficiently estimate technical risks, price the tender, and identify what remains uncertain.

This is particularly important for infrastructure renewal, where asset conditions are often uncertain in brownfield settings.

Client maturity contributes to this assessment. Clients who invest sufficiently in asset information and thus have a clear understanding of the required work are better able to prepare a tender opportunity and define its scope. By contrast, incomplete asset information or an unclear scope makes it more difficult for the contractor to determine which risks can be estimated and which uncertainties remain, thereby reducing attractiveness.

Procurement design can directly influence this through both the underlying risk-allocation philosophy and the selected form of collaboration. Traditional and integrated contracts may place substantial risks with the contractor, potentially reducing project attractiveness where these risks are disproportionate or difficult to manage. Collaborative approaches, by contrast, allow for a more shared approach to risk management and were generally preferred by interviewees for dealing with the uncertainty inherent in renewal work.

Financial conditions and pricing mechanisms

Financial conditions concern whether a tender offers a sufficiently predictable and acceptable return in relation to the invested capital and working hours. The interviews indicate that these conditions can be decisive in bid/no-bid decisions and can outweigh a project's attractiveness as work. Contractors therefore seek reliable returns and limits on financial exposure. However, this does not mean that projects must offer the highest possible margin. The interviews indicate that a stable return can be more attractive than a potentially higher but uncertain one. Framework approaches are valued for providing continuity, volume, and predictable revenue.

The interviews indicate that price-only and strict lump-sum contracts become unattractive when scope and risks are uncertain. Cost-plus and open-book arrangements are considered more attractive because they provide greater financial flexibility for both parties to address unforeseen circumstances. Although these mechanisms do not necessarily create high returns, they can provide more reliable returns while limiting the risk of major financial losses. Strict budget caps, disproportionate fines, unlimited liabilities, delayed payment, and long unpaid engineering phases are described as financial no-go conditions.

Cash flow and client reliability also influence financial attractiveness. Infrastructure projects require substantial upfront investment in labour, materials, and equipment. Delayed payment or a financially inflexible client can therefore create significant exposure, even when the expected project return is acceptable. Financially mature clients are more attractive because they can provide greater certainty about payment, budget availability, and the ability to respond to unforeseen conditions.

Additionally, financial flexibility is crucial for infrastructure renewal projects. Clients require sufficient room within their budget to address unexpected conditions without repeatedly needing additional approval within their own organisation. When this flexibility is available, project managers can respond to unforeseen issues more autonomously. Without it, additional work may result in work stoppages, delays, and therefore higher costs.

Financial conditions can be influenced through procurement design. Realistic budgets, appropriate pricing mechanisms, proportionate liabilities, reliable payment arrangements, and sufficient flexibility for unforeseen work can make renewal tenders more conditionally attractive.

Procurement design should align the pricing mechanism with the maturity of the available information: fixed pricing becomes more suitable as the renewal task is clarified, while earlier phases may require more flexible arrangements for dealing with uncertainty.

Tender procedure, award logic, and transaction costs

Tender procedure, award logic, and transaction costs affect opportunity attractiveness by determining whether the contractor has a realistic prospect of winning the work and whether the required tender effort is proportionate. Tendering requires substantial time, financial resources, and scarce tender capacity before there is any certainty of obtaining the work. These transaction costs become particularly problematic when the chance of winning is uncertain or when contractor involvement continues for an extended period without a commitment that the contractor will ultimately deliver the project.

The interviews indicate that arrangements such as early contractor involvement or bouwteams may become unattractive when they require prolonged input without sufficient certainty that the contractor

will ultimately realise the work. Procurement design can therefore improve opportunity attractiveness by balancing early contractor involvement against clear commitments, decision points, and realistic prospects of contract award.

A tender is also more attractive when the procedure allows the contractor to compete on quality, expertise, and distinctive capability rather than primarily on price. The interviews suggest that the contractor values a clear scope and recognition of distinctive capability, rather than a purely price-driven outcome where value must be recovered later during implementation. Procurement design influences this through the award criteria. Quality- and BPKV-based criteria give the contractor scope to demonstrate distinctive capability, whereas price-dominant procedures limit differentiation and may reduce opportunity attractiveness.

5.3.3. Relationship between work and condition attractiveness

Work attractiveness and condition attractiveness are distinct but interdependent dimensions of opportunity attractiveness. Their relationship is best described as a set of “communicating vessels” (6.58–6.60). Ideally, both the work and the conditions are attractive. However, attractive work can compensate for less favourable conditions to some extent, while attractive conditions can make less attractive work acceptable.

Work attractiveness can create initial interest in a tender opportunity, whereas condition attractiveness determines whether that interest can be converted into a commercially viable bid. This distinction also helps explain why work-related considerations are assessed prominently at decision level 1, while contractual, financial, and risk-related conditions receive greater scrutiny later in the tender selection process.

Renewal work is therefore not inherently unattractive. Opportunity attractiveness results from the interaction between the characteristics of the work and the conditions under which it is procured. Procurement design cannot create all sources of attractiveness, because strategic fit, capacity, client familiarity, and competitive position remain contractor- or context-specific. It can, however, reduce avoidable barriers and make the conditions of renewal work more manageable, predictable, and commercially viable.

The findings show that procurement design does not directly determine all aspects of opportunity attractiveness. Strategic fit, organisational capacity, client familiarity, and competitive position remain contractor-specific or context-dependent considerations. Procurement design is nevertheless highly relevant because it can shape the conditions under which infrastructure renewal work is offered. Through contract form, collaboration approach, risk allocation, pricing mechanism, financial conditions, tender procedure, award logic, and transaction costs, procurement design can make a tender opportunity more predictable, manageable, and commercially acceptable for contractors.

5.4. Conclusion

To summarise the findings presented in this chapter, the tender selection data identifies several evaluation inputs that are more often associated with bid decisions at decision level 1:

- project order sizes above €5 million
- energy, A-road, N-road, and railroad projects
- collaborative forms of collaboration
- quality-oriented award criteria
- private clients
- high priority
- higher win chances

The QCA shows that these inputs should not be interpreted independently. Bid decisions are most consistently associated with configurations combining high priority and high win chance, with win chance appearing particularly important. Traditional collaboration and lowest-price award mechanisms are also included in several bid-consistent configurations, despite being associated with relatively lower attractiveness in the individual cross-tabulations. Opportunity attractiveness should therefore be understood as configurational: the relevance of individual evaluation inputs depends on the wider combination of characteristics within a tender opportunity.

The findings indicate that infrastructure renewal work is relatively attractive in its own right.

- **Organisational fit:** the work is organisationally sound because technically complex renewal projects appeal to the intrinsic professional motivation of the delivery personnel.
- **Strategic fit:** the work aligns with the contractor's growth strategy to expand within the infrastructure renewal market segment as new-build opportunities decline, thereby increasing long-term market relevance.
- **Capability development:** engaging in infrastructure renewal supports the retention and continuous development of specialised technical knowledge within the organisation.

However, several work-attractiveness considerations remain challenging and depend partly on the conditions under which the work is procured.

- **Commercial fit:** Commercial viability is inherently low due to high labour intensity and low production volumes relative to the required effort. However, this can be managed through procurement conditions that secure sufficient volume, continuity, and predictable portfolio returns.
- **Capacity constraints:** Organisational capacity is constrained by highly specialised, labour-intensive work, but allocating a well-structured portfolio of projects to a single contractor improves efficiency, retains specialist knowledge, and reduces resource pressure.
- **Competitive differentiation:** Contractors require award logic based on quality and Best Price-Quality Ratio (BPKV) to effectively leverage their distinctive capabilities and establish a clear competitive advantage.
- **Competition transparency:** The current lack of competitor transparency restricts accurate assessments of win probability, whereas greater market transparency would enable contractors to optimise bid quality and make informed bid/no-bid decisions based on where they add the most value.

Condition attractiveness determines whether this initial work attractiveness can be converted into a bid. The findings show that infrastructure renewal tender opportunities become more attractive when procurement design provides:

- **Manageable collaboration and risk allocation:** Responsibilities, risks, and decision-making are aligned with the capacities of both client and contractor. Collaborative approaches can support a more shared approach to risk management, whereas traditional and integrated contracts can reduce opportunity attractiveness when they place disproportionate or unmanageable risks with the contractor.
- **Sufficient scope certainty and asset information:** Enabling the contractor to estimate technical risks, price the work, and identify what remains uncertain. This is particularly important under brownfield conditions.
- **Pricing mechanisms and financial conditions that fit the remaining uncertainty:** Fixed-price and strict lump-sum arrangements become less attractive when scope and risks are uncertain, whereas more flexible arrangements can provide greater scope to address unforeseen conditions.
- **Financial flexibility:** Realistic budgets, proportionate liabilities, reliable payment arrangements, and sufficient room to address unforeseen work without repeated approval processes, stoppages, or delays.
- **Tender procedures and award logic that support differentiation:** Allowing contractors to compete on quality, expertise, and distinctive capabilities while requiring a proportionate tender effort. Quality- and BPKV-based award criteria can support this, whereas price-dominant procedures can limit it.

Client fit is important throughout this assessment. It is not itself a procurement design element, but an opportunity cannot be fully attractive without a client with a sufficiently positive track record, maturity, and familiarity. Client maturity affects whether asset information is reliable, budgets are realistic, payment is predictable, and unforeseen conditions can be addressed in practice. Attractive work and conditions may therefore still result in an unattractive tender opportunity when the contractor lacks confidence in the client's ability to prepare, manage, and honour these conditions.

The next chapter builds on these findings to identify how procurement design can address the conditions that limit the attractiveness of opportunities. It examines which procurement design elements can make infrastructure renewal tender opportunities sufficiently manageable and commercially viable for contractors to pursue.

Configuring attractive procurement design

This chapter presents the results of the third research step, see figure 6.1. It answers the third sub-question:

What procurement design characteristics are perceived as attractive by contractors?

This chapter builds on the procurement design space defined in chapter 4 and the contractor evaluation of opportunity attractiveness analysed in chapter 5. First, the findings on contractor selectivity are translated into procurement design requirements for designing attractive tenders in the infrastructure renewal challenge. It then applies these requirements to the design dimensions and elements of the procurement design space. Finally, these findings are synthesised into a set of procurement design configurations for attractive infrastructure renewal tender opportunities based on the morphological chart framework.

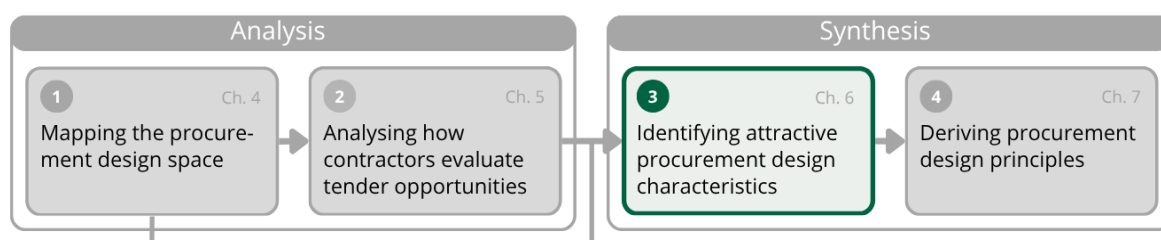


Figure 6.1: Current research step: identifying attractive procurement design characteristics.

Because the contractor-side evidence is derived from a case study of a large civil engineering contractor, the classifications in this chapter primarily reflect this market segment and should be interpreted in relation to the contractor market targeted by the tender.

The configuration set represents an adaptation of the procurement design space derived from the contractor evaluations in chapter 5. Rather than prescribing a single, universally attractive procurement configuration, it outlines how individual design elements influence perceived opportunity attractiveness. The figure 6.2 should therefore be interpreted as a framework for configuring tender opportunities. A coherent configuration can be created using the framework by combining suitable elements in response to project complexity, uncertainty, scope maturity, and the targeted market segment.

6.1. Requirements for attractive procurement design

The requirements for attractive procurement design are derived from findings on tender selection data and insights into work and condition attractiveness, summarised in section 5.4. This results in the following requirements:

The central aim of these requirements is to build on the work attractiveness of infrastructure renewal by reducing avoidable barriers and creating conditions that are sufficiently attractive for contractors to participate. The objective is not to maximise opportunity attractiveness, but to create tender opportunities that attract sufficient suitable participation at an acceptable price and risk for the public client.

1. **Appropriate project sizing:** avoid small project order sizes below €5 million, as they offer insufficient turnover relative to project overhead. This requirement is derived from the decision level

- 1 selection data and cross-tabulation analysis (section 5.2.1).
2. **Scope composition:** group scope elements into coherent packages by grouping similar assets, where possible, or assets in close proximity to one another. This requirement is derived from interview insights regarding capacity and bundling (section 5.3).
3. **Asset information and scope clarity:** invest in gathering as much asset information as possible and establishing a clear scope definition before approaching the market. This enables contractors to estimate technical risks more accurately and identify the uncertainty that remains. This requirement is derived from interviewee perspectives on brownfield risk management and client preparation capabilities (section 5.3).
4. **Collaborative approach:** adopt collaborative, phased, or framework forms of collaboration rather than integrated contract forms such as DBM or DBFMO. Early contractor involvement should, however, be timed appropriately, and both parties should be able to participate on an equal basis. This requirement is derived from the decision level 1 selection data (section 5.2.1) and interviewee perspectives on joint risk management (section 5.3).
5. **Equitable risk allocation:** establish a risk-allocation philosophy that assigns uncertainties to the party best able to manage them. Risks that are difficult to price or mitigate should be addressed jointly or covered by the client, rather than simply transferred to the contractor. This requirement is derived from interviewee perspectives on unmanageable brownfield risk transfers (section 5.3).
6. **Pricing mechanisms:** align pricing mechanisms with information maturity. Use fixed-price arrangements where uncertainty is low, and use open-book, cost-plus, or other flexible pricing mechanisms where uncertainty remains high. This requirement is derived from interviewee perspectives on financial risk exposure and pricing predictability (section 5.3).
7. **Portfolio-based continuity:** address low production volumes and returns from individual infrastructure renewal projects by applying portfolio- or framework-based procurement approaches. This helps provide sufficient volume, repetition, and continuity. This requirement is derived from the decision level 1 selection data (section 5.2.1) and interviewee perspectives on commercial fit and repeatable workload (section 5.3).
8. **Pipeline visibility:** support dedicated contractor implementation capacity by providing long-term transparency regarding the expected project pipeline and future work-allocation mechanisms. This requirement is derived from interviewee perspectives on long-term capacity allocation and commercial volume predictability (section 5.3).
9. **Credible award logic:** use award criteria that give capable contractors a realistic opportunity to differentiate themselves where quality, expertise, or distinctive capabilities are relevant. Quality- and BPKV-based award criteria can support such differentiation. This requirement is derived from the decision level 1 selection data (section 5.2.1) and interviewee perspectives on competitive differentiation (section 5.3).
10. **Proportionate tender effort:** design procurement procedures that require a proportionate tender effort relative to project value and the chance of winning. Avoid prolonged early contractor involvement or engineering phases without a clear outlook to contract award. This requirement is derived from interviewee perspectives on transaction costs, uncompensated early involvement, and resource allocation constraints (section 5.3).
11. **Competition transparency:** provide greater transparency regarding the competitive landscape, the expected number of bidders, and relative win chances during the tender phase. This can help contractors make more informed bid/no-bid decisions and optimise bid quality. This requirement is derived from the decision level 1 selection data (section 5.2.1), qualitative comparative analysis (section 5.2.2), and interviewee perspectives on competitive position assessment (section 5.3).

These requirements are translated in the following section into adjusted procurement design dimensions. These dimensions form the procurement design configurations of client-side choices most closely associated with attractive tender opportunities. Their classification as attractive does not, by itself, imply that public clients should always select these options. Procurement choices must also protect public objectives, value for money, accountability, and manageable client exposure. The contractor-side findings are therefore translated into balancing principles for procurement design in chapter 7.

6.2. Procurement design configuration set

The configuration set distinguishes between attractive, less attractive, relevant, irrelevant, and open choice options. Attractive options are supported by the findings as likely to improve opportunity attractiveness. Relevant options reflect conditions typical of infrastructure renewal, but do not constitute attractive or less attractive choices in themselves. Open options are retained where the study provides insufficient evidence to determine their attractiveness or relevance.

6.2.1. Asset management

Asset management dimensions are integrated into the procurement design space. The selection process analysis demonstrates that contractors evaluate project order size and procurement type when evaluating tender opportunities. These are client-side decisions in the procurement process. Therefore, these variables directly influence work attractiveness and, consequently, they must be included in the procurement design space.

Project scope, however, is not included as a separate dimension in the configuration set. Although the findings indicate that it influences opportunity attractiveness, the physical scope of existing infrastructure assets cannot simply be altered. Consequently, the project's scope is treated as a given constraint determined by the upstream procurement process.

However, requirement 2 states that scope composition can be optimised through bundling to enhance attractiveness. This strategic bundling is achieved through the adoption of portfolio and framework procurement approaches, which will be addressed in their respective design dimension.

Project order size and budget sufficiency

Project order size is included within the configuration set as a continuous scale. Project order sizes below €5 million are classified as less attractive, in accordance with requirement 1 (Appropriate project sizing). Above this threshold, the order sizes are classified as attractive. Importantly, this €5 million threshold reflects the perspective of a large civil engineering contractor and should not be interpreted as universally applicable to smaller or more specialised market parties.

Budget sufficiency requires embedding financial flexibility within the contract structure to effectively manage brownfield uncertainties during project execution. Infrastructure renewal projects become less attractive when there is no financial room to address additional work, undermining requirement 5 (Equitable risk allocation). Transparency regarding the available budget and the financial room for unforeseen expenses is therefore essential. Therefore, a budget-type dimension is added to the design space with three distinct choice options:

- **Fixed capped budget:** no additional budget is available beyond the stated ceiling.
- **Fixed budget with predefined contingency:** the total budget remains fixed, but a specified contingency may be utilised under agreed conditions.
- **Adjustable budget:** the budget may be formally revised when unforeseen conditions arise during execution.

The fixed budget with predefined contingency and the adjustable budget are marked as attractive, as they provide budget transparency and financial manoeuvrability.

Procurement type

Portfolio and framework approaches directly fulfil requirements 7 (Portfolio-based continuity) and 8 (Pipeline visibility) by increasing workload continuity, repetition, and volume. One-off renewal projects, particularly single-asset projects, are less attractive because they are insufficiently aligned with the required tender effort, risk exposure, and capacity investment, violating requirement 7. Therefore, the framework and portfolio approaches are considered attractive.

6.2.2. Object

Project complexity

The project complexity design elements low, medium, high, and systemic complexity do not represent attractive or less attractive choices themselves. However, the dimension describes the characteristics of the procured object that subsequent procurement decisions must address. High and systemic complexity are dominant in infrastructure renewal due to the brownfield conditions. Therefore, they are marked as relevant.

The complexity dimension, however, influences subsequent procurement choices and their contribution to opportunity attractiveness. Overall attractiveness depends on whether the procurement design responds appropriately to these conditions. This dynamic makes project complexity the primary contextual trigger for invoking requirements 3 (Asset information and scope clarity) and 4 (Collaborative approach), yet these are addressed in later design dimensions.

Project risk profile

Like the complexity dimension, the project risk profile options, low, medium, high, and very high, do not in themselves create attractive or less attractive projects. Instead, they represent a condition, with high and very high risk profiles being common in brownfield infrastructure renewal conditions. They are therefore marked as relevant.

Projects become less attractive if these risks cannot be sufficiently investigated, priced, or managed, thereby violating requirement 5 (Equitable risk allocation). Correctly identifying the risk profile allows public clients to design balanced risk-sharing mechanisms so that uncertainties are addressed by the party best able to manage them. Ultimately, the project risk-profile dimension establishes a project's structural uncertainty to guide subsequent choices regarding responsibility allocation, collaboration, and pricing.

Segmented contracting

Segmented contracting elements are marked as open in the configuration set. This includes the specific design dimensions for segment structure, allocation rules, and coordination responsibilities. Contract segmentation was not recorded as a factor considered in the selection process.

While these elements are marked as open, contract segmentation must still be deliberately configured by the client to align with the physical and financial bounds of requirement 1 (Appropriate project sizing) and requirement 2 (Scope composition). Furthermore, coordination responsibility should be assigned to the actor best positioned to do so, aligning with the core intent of requirement 5 (Equitable risk allocation).

Specification level

Mixed and functional specifications are identified as the most attractive options as they balance information clarity with flexibility. While the specification level was not directly coded in the quantitative data, interview findings indicate that renewal work becomes less attractive when the scope and the condition of existing assets are unknown. Mixed or functional specifications successfully fulfil requirement 3 (Asset information and scope clarity) by establishing sufficient clarity. However, a fully fixed, prescriptive specification leaves too little room to optimise the technical and implementation aspects.

Distribution of responsibilities

The construction and implementation design options are classified as attractive because they align with the contractor's core capabilities. Transferring preliminary and definitive design responsibilities is considered less attractive when incomplete asset data exposes contractors to unmanageable brownfield risks, violating requirement 5 (Equitable risk allocation). Financing is similarly less attractive as it increases long-term liability beyond operational control. Maintenance and operation options are classified as open choices within the configuration set, as the findings do not demonstrate a direct relationship with opportunity attractiveness.

6.2.3. Collaboration

Desired collaboration level

Coordinated, integrated, and collaborative approaches are identified as attractive options for infrastructure renewal, whereas transactional approaches are less suitable. Transactional collaboration is inappropriate because it provides limited contractual collaborative room to address unforeseen brownfield conditions beyond the initial risk allocation. Conversely, the more collaborative approaches enable the client and contractor to exchange knowledge, manage uncertainty, and jointly resolve execution problems, thereby directly fulfilling requirement 4 (Collaborative approach) and supporting requirement 5 (Equitable risk allocation). However, this is conditional on the collaboration being structured on an equal basis.

Form of collaboration

Collaborative, phased, and framework-based contracts are classified as attractive. Traditional, integrated, and lifecycle forms are considered less attractive under brownfield conditions because they rely on rigid transactional control or transfer extensive design, financing, and operational risks before asset conditions can be verified, thereby violating requirement 5 (Equitable risk allocation). However,

this classification remains context-dependent: when scope certainty is low, flexible models are preferred, whereas a clear and predictable scope enables traditional or integrated forms to be applied effectively without imposing unmanageable risk.

However, this choice depends heavily on scope clarity. When the project scope is highly uncertain, collaborative or flexible models are preferred by both parties, whereas a clear and predictable scope makes mechanisms like cost-plus contract forms an inefficient choice for everyone.

Contractor involvement timing

Involvement after preliminary design and during design development is identified as the most attractive timing. This maximises the contractor's technical contribution while limiting the early dedication of too many resources. Engaging contractors after full design is less attractive because key design and scope decisions are already fixed, preventing the market from contributing to optimising the design and controlling risk. Conversely, engaging contractors from the concept phase or through continuous involvement becomes less attractive when firms must invest substantial overhead capacity before there is a realistic prospect of contract award, creating a direct violation of requirement 10 (Proportionate tender effort). The design space therefore favours early involvement to inform design decisions under requirement 4 (Collaborative approach), but only once the client establishes a credible route to award to satisfy requirement 10.

Risk allocation philosophy

Balanced (control-based) and shared risk allocations are the only attractive risk allocation philosophies that directly meet requirement 5 (Equitable risk allocation). Condition attractiveness decreases when public clients choose a contractor-dominant allocation to transfer unquantifiable or uncontrollable risks to the market. This could lead to increasingly large risk premiums, which are also less attractive to clients. Conversely, client-dominant allocation can be inappropriate if contractors lack sufficient control over the risks associated with their execution responsibilities. Fulfilling requirement 5 requires a philosophy where risks are distributed to the party best equipped to control and manage them, or handled jointly through shared risk.

Pricing structure & pricing mechanism

The pricing structure dimension, with elements such as single and hybrid pricing structures, is not decisive on its own. Hybrid pricing models support requirement 6 (Pricing mechanisms) by separating predictable project components from uncertain elements. Lump-sum pricing, unit rates, and target prices are less attractive when applied to uncertain tasks because scope and risks cannot be reliably estimated in advance, violating requirement 6. Yet they are attractive when assigned to clear scope elements, where open pricing is less attractive. More flexible, open-book mechanisms, such as cost-reimbursable and fixed-fee-with-incentives models, are attractive in contexts of substantial uncertainty.

Single pricing structures are marked as less attractive because they are difficult to apply effectively across complex renewal projects with varying degrees of risk. Conversely, hybrid pricing models are classified as attractive as they support requirement 6 (Pricing mechanisms) by separating predictable project components from uncertain elements. Fixed pricing methods are not inherently less attractive; rather, they become problematic when applied as the sole pricing structure for highly uncertain scopes. Individual choices within the pricing mechanism dimension remain open options because their suitability depends on how effectively they match the underlying certainty of specific project components.

6.2.4. Market approach

Market consultation

Market consultation options are classified as attractive because they provide a structured mechanism to address commercial and technical concerns before procurement conditions are finalised, supporting requirement 10 (Proportionate tender effort). By allowing contractors to highlight unworkable contract terms and aiding clients in scope clarification under requirement 3 (Asset information and scope clarity), consultation mechanisms consistently enhance opportunity attractiveness.

Intended market

Selective, targeted, and strategically shaped intended markets are marked as attractive because they manage the competitive field and improve the perceived probability of winning. Unrestricted, open-intended markets are classified as less attractive as they dilute win probabilities and fail to satisfy requirement 11 (Competition transparency).

Preselection

The use of formal preselection is identified as an attractive design element because it directly fulfils requirement 10 (Proportionate tender effort) and requirement 11 (Competition transparency). Preselection improves the perceived chance of winning. It ensures a credible and proportionate route for qualified market parties to compete. However, the study provides insufficient evidence to rank the individual efficacy of capacity, experience, or risk-control selection criteria, meaning all candidate-pool elements remain open.

Procurement procedure

Open procurement procedures are classified as less attractive because they preclude preselection, increasing transaction costs relative to win probability and conflicting with requirement 10 (Proportionate tender effort) and requirement 11 (Competition transparency). Non-open procedures that incorporate preselection or structured dialogue, such as negotiated procedures or competitive dialogue, are classified as attractive options.

Award criteria

Best Price-Quality Ratio (BPKV) and quality-based award criteria are identified as attractive elements, whereas the lowest-price criterion is less attractive. The results demonstrate that quality- and BPKV-based criteria correlate with high bidding rates, while price-dominant approaches frequently correspond with no-bid decisions. Emphasising quality over price dominance gives contractors a credible opportunity to leverage their distinctive capabilities and establish a clear competitive advantage through differentiation rather than forcing high-risk price competition, satisfying requirement 9 (Credible award logic).

6.3. Procurement design configurations

The configuration set builds on the morphological chart framework by introducing two structural adjustments. First, the asset-management decisions regarding project order size, budget sufficiency, and procurement type are added as additional design dimensions. Second, it implements a systematic classification system that maps individual procurement design elements to their demonstrated impact on opportunity attractiveness.

6.3.1. Element classification

The original morphological chart provides an overview of the available procurement design elements. The configuration set adds an evaluative classification of these elements based on their relationship with opportunity attractiveness. The classification distinguishes between:

- **Attractive elements:** procurement design elements that are supported by the findings as likely to improve opportunity attractiveness.
- **Less attractive options:** procurement design elements that are associated with lower opportunity attractiveness.
- **Relevant elements:** a contextual condition that must be considered when configuring procurement design but is neither attractive nor less attractive in itself.
- **Irrelevant elements:** elements that fall outside the scope of contractor opportunity attractiveness in this study. This will probably apply to few, if any, elements.
- **Open elements:** procurement design elements that are retained because the findings provide insufficient evidence to classify their relationship with opportunity attractiveness.

The resulting procurement design configuration, presented in figure 6.2, does not identify one optimal procurement configuration. It provides a structured overview of which procurement design elements are attractive, relevant, open, less attractive, or irrelevant in relation to contractor opportunity attractiveness. This transforms the morphological chart from a descriptive overview of the available procurement design space into an evaluative framework for configuring infrastructure renewal tenders in line with contractor bid/no-bid logic.

Morph chart - configuration set														
design dimension	Design element													
Asset Management														
Project order size	Under €5 million	€5 million			€100 million	Above €100 million								
Budget-type	Fixed capped budget	Fixed budget with predefined contingency	Adjustable budget											
Procurement type	Single asset project-based approach	Bundled multi-asset project-based approach	Framework approach	Portfolio approach										
Object														
Project complexity	Low complexity	Medium complexity	High complexity	Systemic complexity										
Project risk profile	Low risk profile: predictable uncertainty	Medium risk profile: manageable uncertainty	High risk profile: structural uncertainty	Very high risk profile: system level uncertainty										
Segmented contract	No	Yes												
Segment structure		Horizontal segmentation	Vertical segmentation											
Segment allocation rules		Parallel segmentation	Phased segmentation											
Coordination responsibility		Client coordination responsibility	Contractor coordination responsibility											
Specification type/ level of specification	Prescriptive	Mixed	Functional	Outcome-based										
Insourcing: executed by executive agency	Design (VO)	Design (DO)	Design (UO)	Finance	Maintain	Operate								
Outsourcing: executed by third party contractor	Design (VO)	Design (DO)	Design (UO)	Finance	Maintain	Operate								
Outsourcing: executed by main contractor	Design (VO)	Design (DO)	Design (UO)	Build	Finance	Maintain	Operate							
Collaboration														
Desired collaboration level	Transactional	Coordinated	Integrated	Collaborative										
Form of collaboration	Build only	D, B, and M separate	Maintenance only	D&C	DBM	DBFM	DBFMO	Cost+	Alliance	Bouwteam	Two-Phase	Framework (ROK)		
Contractor involvement timing	From concept phase	During design development	After preliminary design	After full design	Continuous involvement									
Risk allocation philosophy	Contractor-dominant	Balanced	Shared	Performance/lifecycle-based	Client-dominant									
Pricing structure	Single pricing model	Hybrid pricing model												
Pricing mechanisms (per component)	Lump sum	Target price	Unit rates	Cost-reimbursable	Fixed fee + incentives	Performance-based								
Market approach														
Market consultation	Generic consultation	Structured consultation	Interactive consultation											
Intended market	Open market	Selective market	Targeted niche	Strategic shaping										
Is preselection used?	No	Yes												
Selection criteria		Capacity-based	Experience-based	Quality-based	Risk-control capability	Combination								
Candidate pool		All suitable	Fixed shortlist	Ranked shortlist										
Procurement procedure	Open procedure	Innovation partnership	Negotiated procedure without publication	Negotiated procedure with publication	Competitive dialogue	Competitive negotiation	Private procedure	Closed procedure						
Award criterion	BPKV					Quality	Lowest price							
	Price dominant	Balanced	Quality dominant	Fixed budget	Ceiling price									

Figure 6.2: Adjusted morph chart: set of procurement design configurations.

6.4. Client maturity

The established procurement design configurations provide a structured framework for enhancing opportunity attractiveness. However, the client's maturity and track record remain critical determinants of the attractiveness of a tender opportunity. An attractive design only translates into an attractive opportunity if the client itself possesses the institutional capacity to execute it in a professional and reliable way.

Client maturity is excluded as a configurable dimension within the configuration set, as it represents an institutional capability rather than an isolated procurement choice. While results from the data analysis show varying bid/no-bid ratios across distinct client categories, the interviews attribute these outcomes to underlying variations in asset maturity and financial predictability rather than to the client type itself.

The interviews indicate that a mature client enhances attractiveness through several institutional capabilities:

- **Track record and familiarity:**
Contractors rely on historical project data and track records to evaluate whether a client acts as a predictable and reliable partner. Clients with a proven history are prioritised in tender selection. Additionally, a contractor will prioritise familiar clients over unfamiliar ones.
- **Asset information and preparation capabilities:**
Mature clients, exemplified in the analysis by semi-private clients, are better at preparing their projects. Their internal knowledge and complete asset data allow them to define scope precisely, and deliver predictable tendering conditions. Conversely, public clients constrained by incomplete asset data increase contractor exposure to unquantifiable technical risks.
- **Financial maturity and payment reliability:**
Financially mature clients provide structural certainty regarding payment timing, capital availability, and cash flow management.
- **Budgetary flexibility:**
Client maturity manifests as the capacity to embed financial flexibility within internal budgets, allowing project managers to autonomously approve change orders and address unforeseen conditions without inducing work stoppages, administrative delays, or uncompensated cost overruns.

Ultimately, client maturity acts as the operational foundation for procurement design. A mature client possesses the organisational expertise to properly design a procurement, while a client with a good track record is familiar and reliable to the contractor and may therefore be preferred where contractors have a positive prior experience of the client. Consequently, an otherwise ideal procurement configuration may still result in a no-bid decision if the contractor lacks confidence in the client's capacity to manage the project professionally.

6.5. Conclusion

This chapter answered the third subquestion by relating the contractor-side attractiveness findings to the procurement design space. From the perspective of the large civil engineering contractor examined in this study, attractive procurement design characteristics include sufficient and commercially viable scale, workload continuity, reliable asset information, scope clarity, proportionate tender effort, a credible route to award, and alignment among residual uncertainty, responsibility allocation, collaboration, risk allocation, and pricing.

These characteristics do not combine into a single, universally preferred procurement model. Their contribution to opportunity attractiveness depends on project complexity, risk profile, scope certainty, the targeted market segment, and the specific combination of procurement choices. Therefore, figure 6.2 should be interpreted as an evaluative framework for configuring tender opportunities rather than a set of pre-packaged attractive configurations. Client maturity and track record serve as critical enabling conditions, as contractors ultimately evaluate whether the contracting authority can prepare, manage, and honour the chosen procurement conditions in practice.

The following chapter translates these findings into actionable procurement design principles for public clients.

Designing attractive tenders

This chapter presents the results of the fourth research step, see figure 7.1. It answers the fourth subquestion:

How can procurement design be adjusted to improve the attractiveness of Dutch infrastructure renewal tender opportunities?

The findings in chapters 5 and 6 are based on tender selection data and the evaluation logic of a single case-study contractor. This chapter abstracts these findings into procurement design principles by focusing on the underlying mechanisms rather than on contractor-specific thresholds or preferences. The principles are intended to inform infrastructure renewal procurement more broadly.

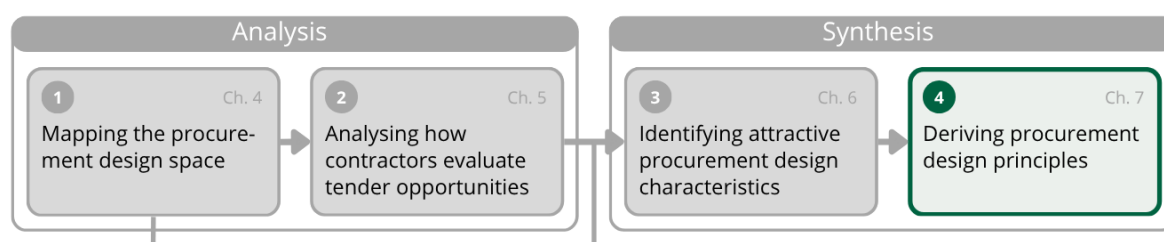


Figure 7.1: Current research step: deriving procurement design principles.

To connect the findings to the wider infrastructure sector, this chapter translates the configuration set into procurement design principles. The principles explain how public clients can combine procurement design elements to reduce avoidable barriers, improve alignment with contractor evaluation logic, and create conditions under which suitable contractors are willing and able to participate.

The chapter first explains how the principles should be used and who is responsible for configuring procurement design. It then presents the design principles and illustrates their application through real-world infrastructure renewal examples.

7.1. Attractive procurement

Improving opportunity attractiveness requires interaction between public clients and contractors, but their roles differ. Public clients hold formal responsibility for configuring the tender opportunity and determining the conditions under which work is brought to market. Contractors evaluate the resulting opportunity and can contribute market knowledge concerning capacity, risk, commercial viability, and delivery constraints.

Contractors do not determine procurement design, but their input can help clients identify where proposed conditions conflict with market capabilities or create avoidable barriers to participation. Where contractors express their selectivity only through non-participation, clients receive limited opportunity to reconsider these conditions before a tender fails. Dialogue is therefore most useful before key scope, budgetary, contractual, and market-approach choices become difficult to change.

The responsibility for procurement attractiveness nevertheless lies primarily with the client. The objective is not to maximise attractiveness for contractors, but to secure sufficient suitable participation while protecting public objectives under acceptable conditions of value for money and risk.

The following design principles should therefore be read as balancing principles rather than as a contractor-oriented checklist. They indicate how public clients can improve the fit between what they need to procure and what contractors are willing and able to pursue. This does not necessarily require paying more. Market participation can also be improved through procurement design. In this sense, procurement design is not merely an administrative route to contract award, but a client-side instrument for mobilising the contractor capacity required to deliver infrastructure renewal projects.

7.2. Improving attractiveness of procurement

To use this instrument effectively, the design principles presented below translate the path to attractive procurement design into concrete considerations. Together, these principles provide a structured basis for configuring procurement in response to the specific uncertainty, complexity, and market conditions of infrastructure renewal. They do not prescribe a single standardised procurement model, but rather support choices about what must be clarified, adjusted, or balanced to improve the attractiveness of opportunities.

Overview of procurement design principles

1. **Recognise renewal context:** recognise the complex, uncertain and market conditions of infrastructure renewal and reflect this in appropriate procurement.
2. **Reduce uncertainty before tendering:** build asset knowledge and scope clarity before approaching the market.
3. **Create an executable and commercially viable workload:** consider scale, bundling, continuity, pipeline visibility, and repeatability.
4. **Match residual uncertainty to risk allocation, collaboration, and pricing:** configure risk allocation, contract form, collaboration, and pricing mechanisms as a coherent response to the uncertainty that remains after project preparation.
5. **Involve the market at the right time and for a clear purpose:** use early contractor involvement to optimise design and procurement decisions, ensuring it supports project preparation rather than substituting for the client's core responsibility to define the tender.
6. **Provide a credible and proportionate route to contract award:** keep tender effort proportionate to the expected opportunity, allow meaningful contractor differentiation, and provide capable contractors with a credible chance of winning.
7. **Use procurement design as a balancing mechanism:** balance contractor participation against public-client objectives, seeking sufficient suitable competition at an acceptable value for money rather than maximising contractor attractiveness in isolation.

To demonstrate how these principles operate in practice, illustrative examples from the broader infrastructure renewal context are included within each description. These examples do not serve as additional empirical evidence or stand-alone case studies. Instead, they serve strictly to clarify the practical implications and real-world applications of each design principle.

1: Recognise the actual renewal context

Recognise the inherent complexity and uncertainty of renewal work, including brownfield, market, and commercial conditions. Procurement design must reflect the specific circumstances under which these projects are executed. This also means that infrastructure renewal work can be appealing to contractors because of its professional appeal. Procurement design can actively build on this inherent interest, but success requires establishing the right conditions to suit the complex circumstances that accompany the work.

Applying this principle requires public clients to recognise that established procurement routines may not fit every renewal task. The procurement approach should therefore be selected in response to the asset condition, operational environment, remaining uncertainty, relevant contractor market, and commercial characteristics of the work.

The Van Brienenoordbrug illustrates how a procurement approach may need to be reconsidered when the initial allocation of risks does not attract sufficient participation. After the initial tender failed, the procurement approach was re-evaluated and restarted under more collaborative and financially flexible conditions, including a cost-plus arrangement (Cobouw, 2024). The case therefore illustrates how procurement conditions can be adjusted to improve the alignment between project uncertainty and market acceptability; it does not establish that the revised approach is universally optimal.

2: Reduce uncertainty before tendering

Clients should reduce uncertainty before formal tendering as much as reasonably possible. This can be achieved through stronger asset information, clearer scope definition, technical preparation, and realistic budgetary room. The aim is not to eliminate all uncertainty, but to ensure that contractors are asked to price and manage only those uncertainties that genuinely remain after reasonable preparation. Crucially, providing better asset information and a sharper scope definition may benefit the contractor by significantly reducing risk premiums and improving pricing predictability.

While these pre-tender diagnostics require upfront investments of financial resources and engineering capacity, they may contribute to efficiencies during implementation. Technical preparation on the client side provides the basis for subsequent collaboration on an equal basis. This preparation allows for realistic budgetary room, within which the client must have the mandate to autonomously allocate budgets to unforeseen circumstances when necessary. It demands organisational maturity to conduct comprehensive pre-tender research.

The Zeesluis Farmsum pilot illustrates how uncertainty can be reduced before formal tendering. In the ten-week pilot, Rijkswaterstaat and market parties jointly bounded the scope and then discussed the relevant assets, requirements, execution constraints, risks, phasing, and contract conditions. By sharing available asset information from the start, the discussion shifted from assumptions under incomplete information to the technical substance of the renewal task (Rijkswaterstaat, 2025d).

This reduced uncertainty in two ways. Clearer asset information and scope definition made the work easier to predict and price. Early discussion of risks, environmental constraints, applicable standards, and risk allocation helped distinguish between uncertainties that could still be resolved and residual uncertainties that had to remain part of the project.

The broader relevance lies in the underlying logic: clients can improve opportunity attractiveness by reducing avoidable uncertainty, clarifying residual risks, and creating a more predictable basis for pricing and collaboration.

3: Create an executable and commercially viable workload

Work should create a commercially attractive workload. The tenders should offer sufficient scale, continuity, and predictability to be commercially and organisationally worthwhile for contractors. Portfolios, frameworks, and bundled scopes can help create this continuity where appropriate, allowing contractors to invest in capacity, knowledge, and delivery arrangements over a longer period rather than assessing each project as an isolated opportunity.

The appropriate scale of a tender depends on the contractor market segment it is intended to reach. In the case-study data, projects below €5 million were less attractive to a large civil engineering contractor because they generated limited turnover relative to tender and project overhead costs. This threshold should not be interpreted as universally applicable to smaller or more specialised market parties. The design implication is therefore not that projects should always be made larger, but that project scale, bundling, and continuity should be aligned with the intended contractor market.

To execute this effectively, the client organisation requires the strategic mandate and freedom to bundle asset components across time and geography. Where individual projects do not provide sufficient scale or continuity, public clients can consider bundling, portfolio, or framework approaches. Long-term pipeline visibility can further help contractors assess whether investment in dedicated capacity, knowledge, and delivery arrangements is justified.

The "Zeeuwse Bruggen" case illustrates this principle by bundling six regional movable bridges into one framework agreement with an estimated value of €60–100 million. This illustrates how regional bundling and a multi-year framework can provide scale, continuity, and predictability that may justify contractor investment in tendering, capacity, and delivery arrangements. In this way, the case illustrates how bundling across assets, time, and geography can create a more commercially viable workload for infrastructure renewal (Rijkswaterstaat Programma's, Projecten en Onderhoud, 2025).

4: Match residual uncertainty to risk allocation, collaboration, and pricing

After uncertainty has been reduced as far as reasonably possible, the remaining uncertainty should inform the selection of risk allocation, collaboration model, and pricing mechanism.

Priceable execution risks can be allocated to the contractor when the scope, conditions, and required activities are sufficiently clear. Risks that cannot reasonably be defined, priced, or managed in advance should either remain with the client or be managed jointly.

The collaboration model and pricing mechanism should follow the same distinction. Where scope is clear and uncertainty is limited, more traditional arrangements and fixed pricing can be appropriate. Where uncertainty remains high, more collaborative approaches or flexible pricing structures are more suitable because they allow the parties to further develop the design, clarify interfaces, and jointly manage unforeseen circumstances. Clearly defined components can therefore be priced rigidly, while uncertain components require more flexible pricing mechanisms.

Applying this principle requires client-side commercial and technical maturity. Clients must be able to distinguish between priceable execution risks and uncertainties that remain insufficiently defined or uncontrollable. They must also accept that reducing rigid risk transfer may reduce upfront price certainty. In return, appropriate risk allocation, collaboration, and pricing can create a more realistic basis for pricing, risk control, and delivery. This also requires mutual trust between client and contractor.

The market consultation for Gemaal IJmuiden illustrates a proposed application of this principle (Rijkswaterstaat Grote Projecten en Onderhoud, 2026). Rijkswaterstaat considered separating the specialised pump package from the civil and systems-integration work. In the proposed model, both packages would use a Bouwteam approach during the design phase, based on reimbursable framework rates.

The stepped pricing (getrapte prijsvorming) approach from Rijkswaterstaat illustrates the pricing side of the same principle (Taskforce Infra, 2026). Clearly defined elements can be priced upfront, while pricing for uncertain elements is postponed until uncertainty has been reduced. This can reduce the need for contractors to include large risk premiums for work that cannot yet be estimated reliably. If assumptions about asset condition or technical requirements prove incorrect, prices can be adjusted transparently based on newly available information. This provides a transparent mechanism for revising prices when the original assumptions prove incorrect. This provides a transparent mechanism for revising prices when the original assumptions prove incorrect.

5: Involve the market at the right time and for a clear purpose

Early involvement of contractors can help clients understand contractor capabilities, practical constraints, and the implications of proposed procurement choices. Contractors should be involved early enough to influence relevant technical and procurement decisions, but not before the client can provide a sufficiently bounded question, a clear purpose for market involvement, and an initial understanding of the asset, scope, and available budget. Early involvement should supplement client preparation rather than substitute for it. This timing requires public clients to have clear internal governance and distinct decision gates to verify scope maturity before inviting market participation. Clients must retain sufficient technical knowledge and governance to ensure that early involvement functions as an optimisation mechanism rather than as a substitute for basic client-side preparation.

The Prinses Irenesluis experiment illustrates this principle. In this experiment, Rijkswaterstaat organised a paid market consultation to engage market parties prior to the realisation contract, while maintaining a bounded scope and client-side technical governance (Rijkswaterstaat Grote Projecten en Onderhoud, 2025). Rijkswaterstaat therefore did not approach the market with an undefined problem. The collaboration started from a clearly bounded technical scope, and exploratory alternative studies were deliberately excluded.

Within this bounded setting, contractors contributed specific expertise in realisation. Because the market consultation was paid, early involvement was also kept proportionate and meaningful: contractors were asked to contribute substantive knowledge without turning early engagement into uncompensated tender work.

Rijkswaterstaat also retained technical governance. The case therefore illustrates that early market involvement is intended to support client-side capability. Used in this way, it can reduce execution uncertainty and improve pricing predictability without replacing the client's responsibility for scope definition.

6: Provide a credible and proportionate route to contract award

Tender procedures should provide a credible and proportionate route to contract award. The effort required from contractors should be proportionate to the expected opportunity, and capable contractors should have a credible chance of winning. This concerns tender effort, award logic, differentiation, pre-selection, win probability, and meaningful commitment points. Award criteria should enable contractors to compete on the capabilities most relevant to successful delivery.

For public clients, this requires a willingness to use formal preselection and non-open procedures where appropriate, so that the competitive field is narrowed to qualified participants. It also requires sufficient procurement knowledge to design qualitative, BPKV-based award criteria that reward meaningful contractor differentiation, rather than relying primarily on price-dominant assessment models.

The case of the procurement of the ROK Zeeuwse Bruggen contract illustrates how tender procedures can provide a more credible and proportionate route to contract award (Rijkswaterstaat Programma's, Projecten en Onderhoud, 2025). In the Zeeuwse Bruggen example, Rijkswaterstaat uses a closed procurement approach and a maximum of three participants. This limits competition to qualified contractors and gives participants a more credible chance of winning.

The tender effort is also kept proportionate. Six objects are procured through one four-year framework, rather than through separate tenders, and BPKV submissions are limited to five A4 pages per qualitative criterion, limiting tender effort while offering a credible reward. This illustrates how public clients can reduce unnecessary tender effort, limit competition to suitable parties, and make participation more credible for contractors.

7: use procurement design as a balancing mechanism

Recognise procurement design as a balancing mechanism rather than a maximisation tool. The overarching goal of procurement design is not to maximise opportunity attractiveness at all costs, but to establish balanced conditions that secure an adequate pool of qualified bidders at an acceptable price and risk level for the public client. Each individual design principle functions as a separate weight on a scale rather than an absolute, decisive factor on its own.

This principle requires the client to maintain commercial oversight to assess whether the tender structure in relation to specific constraints, such as a rigid project budget or an inherently complex asset scope, can be offset by adjusting other elements on the scale, such as introducing flexible pricing mechanisms, offering long-term pipeline volume, or utilising balanced risk-sharing models.

The Van Brienenoordbrug illustrates why procurement design should be understood as a balancing mechanism. The first procurement attempt did not attract sufficient bids and was subsequently reconsidered, indicating that the offered conditions did not provide a workable basis for sufficient market participation (Cobouw, 2024). The case does not establish that one individual procurement element caused the failure, but it illustrates the need to consider the combined effect of scope, uncertainty, risk allocation, pricing, and market capacity.

The revised procurement approach represents an attempt to rebalance these conditions rather than to maximise contractor attractiveness. The relevant threshold is not the most attractive possible tender, but rather a tender opportunity that attracts sufficient suitable participation, remains acceptable to the public client, and enables a meaningful contract award.

7.3. Conclusion

This chapter answered the fourth subquestion by translating the procurement design findings into seven principles for adjusting Dutch infrastructure renewal tenders. Together, the principles form a contextual design logic: recognise the renewal context, reduce avoidable uncertainty, create an executable and commercially viable workload, align residual uncertainty with risk allocation, collaboration, and pricing, involve the market early enough but not prematurely, and provide a credible and proportionate route to contract award. These choices must ultimately be balanced against public-client objectives and value for money.

Procurement design should therefore not be adjusted through one universally preferred element or model. Its contribution lies in combining mutually coherent choices that reduce avoidable barriers and provide sufficient suitable participation under conditions acceptable to both the client and the contractor.

Discussion

This chapter discusses what the findings of this research mean, how far they can be generalised, and under which organisational conditions they can be applied. The research shows that procurement design can enhance the attractiveness of opportunities, but it cannot solve the infrastructure renewal challenge on its own. Its relevance lies in its role as a lever which public clients can use to align renewal objectives and contractors' decisions to participate.

The discussion therefore first positions procurement design within a broader set of response strategies to capacity scarcity. It then reflects on opportunity attractiveness as a balancing problem, discusses the organisational conditions that affect the application of procurement design, and finally addresses the limitations of the research. Together, these reflections clarify the conditions and limits under which procurement design can help improve the attractiveness of infrastructure renewal tenders.

8.1. Procurement design within a broader set of response strategies

The findings show that procurement design can improve opportunity attractiveness. However, it does not address all underlying conditions that make the infrastructure renewal challenge difficult to procure. These conditions are shaped by different actors at different levels, including policy choices, client-side preparation, and contractor-side capacity constraints. Procurement design does not remove these root causes. Rather, it determines how public clients handle these conditions when translating renewal work into tender opportunities.

Procurement design therefore functions as the interface between these constraints and the tender opportunity that contractors evaluate. It cannot increase total sector capacity or independently resolve shortages of funding, labour, materials, or environmental space. It can, however, influence how these constraints are reflected in project scope, risk allocation, pricing, collaboration, and market approach. Procurement design is therefore not a stand-alone response to the infrastructure renewal challenge, but a bounded mechanism for reducing avoidable barriers between public renewal objectives and contractor participation.

8.2. Procurement design in a capacity market

As this research has shown, the Dutch infrastructure market is increasingly moving from a traditional client-oriented structure towards a capacity market. This shift should not be understood as a simple transfer of market power from public clients to contractors. Public clients still define many of the parameters under which contractors are asked to participate.

However, the interviews suggest that procurement now takes place in a market where both clients and contractors operate under scarcity and must make deliberate choices about where they deploy limited resources. This shared capacity constraint affects both sides, but in different ways. Public clients seek to maximise public value with limited budgets, organisational capacity. Contractors, as commercial organisations, must create value for their owners or shareholders. Under conditions of scarce tender and execution capacity, their bid/no-bid decisions become more selective, aligned with the most attractive opportunities.

This does not mean that contractors hold all market power. Contractor selectivity is not absolute and does not apply equally across all market segments, clients, or project types. Some clients, however, do not yet fully recognise this changed reality and still bring contracts to the market that large contractors perceive as commercially or operationally unattractive.

Procurement design is the mechanism through which public clients can respond to this capacity market. Capacity-sensitive procurement requires clients to design tenders not only around the project's technical and public objectives but also around the conditions under which contractors are willing and able to participate.

This does not make clients solely responsible for solving the infrastructure renewal procurement problem. The formal responsibility for establishing attractive procurement conditions remains primarily with the public client. At the same time, contractors can contribute through the available consultation channels by communicating which conditions enable or discourage participation. Procurement design in a capacity market therefore requires mutual recognition: clients must respond to contractor selectivity, while contractors must make their participation logic more transparent.

8.3. Opportunity attractiveness as a balancing problem

The findings show that improving opportunity attractiveness is not only a monetary issue. Increasing project budgets or compensation may make a tender more attractive, but procurement design can also affect participation through other mechanisms. Opportunity attractiveness, therefore, depends on the overall balance among the several procurement design dimensions.

This also means that opportunity attractiveness should not be maximised in isolation. Public clients do not need to make every tender as attractive as possible for contractors. They need to create a tender opportunity that is sufficiently attractive to generate suitable participation, while still protecting public objectives.

The same balancing logic applies to individual procurement design dimensions. Collaboration, for example, can enhance attractiveness by creating room to manage uncertainty, align expectations, and develop a more realistic approach to execution. However, collaboration is not automatically attractive. If it is combined with unsuitable pricing logic, or an uncertain route to award, it may increase tender effort and uncertainty rather than reduce them.

Opportunity attractiveness should therefore be understood as a configuration problem. Individual procurement design elements do not determine attractiveness on their own. Their effect depends on how they are combined to respond to the conditions of the renewal task. Procurement design, therefore, cannot rely on a single preferred model, such as greater collaboration or greater compensation, but requires a balanced configuration of design choices, as represented in the design principles.

8.4. Organisational conditions for applying procurement design

Implementing an attractive procurement design extends beyond selecting elements from a formal framework. Its application depends on the mandate, judgement, routines, and institutional readiness of both client and contractor organisations.

8.4.1. Human judgement and organisational routines

How attractive procurement design is operationalised in practice depends on how human judgement and established organisational routines on both the client and contractor side are considered.

The tender selection process for the case-study contractor is structured into three formal decision levels, but the decisions are not based solely on the formal criteria included in the process. They also rely on professional judgement, experience, qualitative interpretation, and a broadly shared organisational understanding of which opportunities are worth pursuing. However, the reasoning behind early no-bid decisions is not always documented consistently. This limits the traceability of individual decisions and reduces the organisation's ability to compare cases, evaluate the consistency of its selection logic, and learn systematically from previous tender decisions. Data quality is therefore not only a methodological limitation of this research, but also an organisational development issue for the case-study contractor.

On the client side, formal procurement choices are similarly shaped by individual interpretations, risk attitudes, and operational mandates. Because these organisational mechanisms were not investigated through an equivalent client-side empirical analysis, their precise influence cannot be established in this study. Nevertheless, they help explain why theoretically available procurement options may not always be considered or adopted in practice.

8.4.2. The internal adaptation challenge for contractors

The infrastructure renewal market requires strategic and structural adaptation within contractor organisations. Traditional business models may not be sufficient for delivering infrastructure renewal work effectively under current market conditions. This makes contractor-side adaptation an organisational condition for the proposed procurement approaches to work in practice.

Renewal projects are often labour-intensive and generate smaller production volumes and lower revenue profiles. The renewal tasks require substantial engineering expertise and technical capacity, but offer limited absolute turnover. To operate sustainably in this market segment, contractors should adapt internally. They must develop greater administrative and operational efficiency to manage technical complexity, brownfield risks, and extensive personnel requirements without eroding their financial margins.

Standardised and repeatable structures, such as multi-year framework agreements and portfolio approaches, can support this internal adaptation. Aggregating individual renewal tasks into a predictable, recurring portfolio allows contractors to spread high tendering overhead costs over a longer period. These continuous project structures also allow firms to maintain dedicated and specialised teams across multiple projects over time. This continuity supports learning and standardisation, helping contractors manage the labour intensity of renewal work more efficiently.

However, these structures only strengthen opportunity attractiveness if organisations are prepared to work around them. Framework agreements and portfolio approaches do not automatically create efficiency when clients and contractors continue to approach each project as a separate, transactional assignment. Their effect depends on whether organisations adapt their routines, maintain knowledge across projects, and develop the capability to use repetition as a basis for learning and standardisation.

8.4.3. Collaboration as an organisational capability

Collaborative arrangements, such as bouwteams or two-phase contracts, highlight the importance of institutional capability. Public clients may deploy collaborative models because they lack the internal asset information or engineering capacity to fully define complex brownfield scopes before tendering. Early contractor involvement is then used to access market expertise and reduce baseline uncertainty.

Nevertheless, early involvement is not automatically attractive. When used primarily to compensate for insufficient client-side preparation, it may introduce new operational risks for contractors. Clients ask for collaborative problem-solving while simultaneously introducing control mechanisms to manage internal budget uncertainty and ensure public accountability.

To maintain opportunity attractiveness, collaborative procurement must be supported by client-side preparation, clear decision gates, sufficient budget mandate, and appropriate risk allocation. Without these institutional conditions, collaboration may increase tender overhead, blur responsibilities, and create pricing uncertainty. Collaboration should therefore be treated not merely as a contract choice, but as an organisational capability.

Organisational capability is not exclusively a client-side requirement. Contractors must also be able and willing to contribute knowledge, participate in joint decision-making, and organise continuity across collaborative project phases. However, this research examined organisational client maturity primarily as a characteristic evaluated by contractors. It did not independently analyse or compare the organisational capabilities required from contractors.

8.5. Limitations

The mixed-methods approach provided an empirical basis for analysing procurement design and contractor bid/no-bid logic in infrastructure renewal. However, the research also has several limitations related to empirical scope, data structure, and analytical simplification. These limitations affect the generalisability of the findings and the extent to which causal claims can be made.

8.5.1. Empirical scope and generalisability

The empirical analysis is grounded in a single case organisation: a large Dutch civil engineering contractor. This provides detailed insight into the tender selection logic of a large Dutch contractor, but it also limits generalisability. Smaller contractors, specialised niche firms, and other large contractors may evaluate tender opportunities differently because they operate with different overhead structures, capital constraints, strategic priorities, and risk appetites.

The research also mainly reflects a contractor-side perspective on procurement design. Although the design principles are formulated for broader sector relevance, the institutional, legal, and organisational feasibility of implementing these choices from the public client side was not empirically assessed in the same depth. The findings should therefore primarily be interpreted as an analysis of how procurement design is evaluated by the case-study contractor and abstracted to the market segment of large contractors, rather than as a complete representation of the contractor market.

The client-side reconstruction in chapter 4 relies on Rijkswaterstaat as the reference organisation, while the illustrative applications in chapter 7 predominantly concern Rijkswaterstaat projects. Provinces, municipalities, water authorities, ProRail, and other public clients may operate with different governance structures, budgetary processes and procurement routines. The applicability and feasibility of the procurement design principles were not independently examined across these organisations. This, however, does not mean that these principles are restricted to this single context. Rather, this means that applying them across other public-client environments might require context-specific adjustment.

A further limitation concerns the composition of the data across the decision levels. Due to commercial confidentiality restrictions, data at later decision levels primarily included tenders that were cancelled by clients or discontinued by BAM. This creates a negative selection bias because later-stage data cannot be compared with a balanced set of successful bid submissions. As a result, the analysis provides stronger insight into reasons for discontinuation.

8.5.2. Data structure and causal interpretation

The reliability of the empirical analysis is also constrained by variation in data recording within the case organisation. The research found no single uniform data governance structure for recording and managing selection data across BAM. Different business units use different registration practices, which limits the comparability of data points across projects and over time.

This is especially relevant at decision level 1, where many early no-bid decisions are recorded with limited evaluation information. Empty cells indicate no-bid outcomes, but the data do not reveal whether the information was absent because the opportunity was rejected before further investigation, was genuinely unavailable, or was not recorded. This limits the explanatory depth of the quantitative analysis, because some relevant evaluation inputs are absent from the dataset.

Consequently, the quantitative findings should be interpreted as diagnostic rather than causal proof. They identify recurring patterns in the tender selection data and indicate which criteria are associated with no-bid decisions.

Additionally, the QCA required that the original evaluation inputs be grouped and calibrated into a smaller number of conditions. This made configurational analysis possible but reduced the detail of the original data. Moreover, the observed cases were distributed across many configurations, whereas only a limited number belonged to bid-consistent configurations. The QCA therefore identifies recurrent combinations within the case-study dataset, but does not demonstrate that these configurations are causally sufficient or transferable to other contractor organisations.

8.5.3. Analytical simplification

The analytical models used in this research simplify a more iterative and interdependent reality. The decision tree represents infrastructure programming and procurement design as a structured sequence, while practical project development may involve feedback loops, parallel decisions, and revisions to earlier choices. Similarly, the morphological chart separates procurement design into individual dimensions even though these choices interact and cannot always be configured independently.

The configuration set further simplifies contractor evaluation by classifying individual elements as attractive, less attractive, relevant, irrelevant, or open. These classifications indicate the direction of the case study findings but cannot capture every interaction among project context, contractor characteristics, and procurement choices. They should therefore be interpreted as an evaluative framework rather than as a predictive model.

Finally, the infrastructure examples used to explain the design principles illustrate how similar mechanisms appear in practice. They were not analysed as independent case studies and do not validate the effectiveness of the principles. The application of the principles also depends on organisational maturity, technical preparation, decision-making mandate, and budgetary flexibility, which were not independently tested across multiple client organisations.

Overall, this discussion has clarified the conditions and limits under which procurement design can contribute to improving the attractiveness of infrastructure renewal tenders. Procurement design is a relevant lever because it shapes how renewal work is translated into tender opportunities that contractors decide whether to pursue. However, its effect is bounded by wider capacity constraints, the need to balance contractor participation with public objectives, organisational readiness on both sides of the market, and the empirical limitations of this research.

These reflections provide the basis for the following chapter, which draws the findings back to the research questions and presents the conclusions of the thesis.

Conclusions

This chapter concludes the thesis by answering the four subquestions and the main research question. The research aimed to explain how procurement design can contribute to improving the attractiveness of Dutch infrastructure renewal tender opportunities for contractors. The chapter first summarises the answers to the subquestions and then brings these findings together to answer the main research question.

9.1. Answer to the subquestions

9.1.1. Procurement design dimensions and elements

The first part of the research addressed the question: *What procurement design dimensions and elements shape the organisation of Dutch infrastructure renewal tenders?*

This question is answered by showing that Dutch infrastructure renewal tenders are shaped not by isolated procurement choices, but by a configuration of interdependent design dimensions. These dimensions determine how renewal projects are translated into a tender opportunity and provide the basis for understanding how procurement design influences contractor participation.

This research found that an interdependent set of procurement design dimensions and elements shapes infrastructure renewal tenders. The decision tree showed how renewal projects move from upstream asset-management choices shaped by policy and budgeting to concrete procurement design choices. The morphological chart then translated this process into a structured design space that makes the available procurement options explicit.

The main procurement design dimensions identified in this research concern the object being procured, the form of collaboration, and the market approach. These dimensions include choices about project scope, complexity, specification type, distribution of responsibilities, contract and collaboration form, risk allocation, pricing, market consultation, procurement procedure, preselection, and award criteria. The research further showed that upstream project-shaping decisions, including project order size, budget sufficiency, and procurement type, are part of the contractor's evaluation of tender opportunities. Therefore, they affect contractor evaluation and were consequently included in the configuration set.

9.1.2. Contractor evaluation of tender opportunities

The second step in the research addressed the question: *How do contractors evaluate the attractiveness of Dutch infrastructure renewal tender opportunities?*

The second subquestion is answered by showing that opportunity attractiveness results from a configurational evaluation in which work attractiveness and condition attractiveness are considered together.

The research found that contractors evaluate tender opportunities through a staged assessment of work attractiveness and condition attractiveness. Work attractiveness concerns whether the contractor wants the work, possesses the capacity and capability to deliver it, and perceives a credible chance of winning it. Condition attractiveness concerns whether the contractual, financial, technical, and tender conditions make participation and delivery commercially and operationally viable.

This evaluation is formalised through successive decision levels, with most recorded selectivity occurring at the beginning of the process. As more information becomes available, later decision levels assess contractual, liability, financial, and technical conditions in greater detail. The bid/no-bid decision therefore results from the interaction among the characteristics of the work, the conditions under which it is offered, and the contractor's organisational circumstances.

9.1.3. Attractive procurement design characteristics

This part of the research addressed the question: *What procurement design characteristics are perceived as attractive by contractors?*

The third subquestion is answered by showing that attractive procurement design is configurational and context-dependent. It depends on the fit between the renewal task, the procurement design requirements, the available design options, and the contractor's bid/no-bid logic. Attractive procurement design is therefore not a fixed model, but a configuration of client-side choices that improves the conditions under which suitable contractors are willing and able to participate.

The research found that attractive procurement design characteristics are those that make infrastructure renewal tender opportunities sufficiently manageable and commercially viable. More specifically, these characteristics include sufficient and commercially viable scale, workload continuity, reliable asset information, scope clarity, proportionate tender effort, a credible route to award, and alignment among residual uncertainty, responsibility allocation, collaboration, risk allocation, and pricing.

These characteristics were translated into requirements for attractive procurement design. These requirements show that attractiveness depends on how procurement design elements are configured. The resulting configuration set identifies which procurement design options are attractive, less attractive, relevant, irrelevant, or open regarding contractor participation. It does not prescribe one universally optimal procurement model, but shows that different combinations of procurement design elements may be attractive depending on the specific project context.

Client maturity and track record remain important conditions for the effectiveness of an attractive procurement configuration. Even where the procurement design elements are well aligned, a tender opportunity may still be perceived as less attractive when contractors lack confidence in the client's ability to implement the chosen configuration professionally and reliably.

9.1.4. Procurement design adjustments

The final research step addressed the question: *How can procurement design be adjusted to improve the attractiveness of Dutch infrastructure renewal tender opportunities?*

The fourth subquestion is answered by showing that procurement design can be adjusted by reducing avoidable uncertainty, creating executable workloads, matching remaining uncertainty to suitable risk allocation, collaboration, and pricing, purposefully involving the market, and providing a credible route to contract award.

The research translated the findings into seven procurement design principles for improving opportunity attractiveness. Public clients can increase the attractiveness of opportunities by applying these principles. However, procurement design should be approached as a balancing mechanism. Public clients do not need to make every tender as attractive as possible for contractors. They need to create tender opportunities that are sufficiently attractive to generate suitable participation, while still protecting public objectives and value for money.

9.2. Answer to the main research question

This research addressed the question: *How can procurement design contribute to improving the attractiveness of Dutch infrastructure renewal tender opportunities for contractors?*

Procurement design can help improve opportunity attractiveness by aligning public renewal objectives with contractors' bid/no-bid logic. Public clients define how an infrastructure renewal project is brought to market through procurement design. Contractors then evaluate whether the resulting opportunity is worth pursuing. Procurement design is therefore the mechanism through which renewal work is translated into tender opportunities that contractors decide whether to enter.

The central finding of this research is that contractor participation should be treated as an explicit procurement design concern. Infrastructure renewal projects may be urgent, necessary, and publicly valuable, but this does not automatically make them attractive to contractors. In a capacity market, tender opportunities compete for scarce contractor tender and execution capacity. Procurement design can improve this position by making the opportunity clearer, more manageable, more proportionate, and more commercially viable.

The research contribution lies in demonstrating how public clients can coherently configure procurement design choices to improve the attractiveness of tender opportunities. This configuration involves reducing avoidable uncertainty; creating executable and commercially viable workloads; matching residual uncertainty to appropriate responsibility allocation, collaboration, risk allocation, and pricing; engaging the market purposefully; and offering a credible, proportionate route to contract award. These choices should be balanced against public objectives and value for money

At the same time, alignment cannot be achieved by public clients alone. Contractors must communicate the conditions under which they are willing and able to participate and make their tender selection logic sufficiently transparent through market interaction. Procurement design is therefore a client-side responsibility, but improving its alignment with the conditions of contractor participation requires interaction with contractors. Procurement design can reduce avoidable unattractiveness and improve the fit between what public clients need to procure and what suitable contractors are willing and able to pursue.

The overall conclusion is therefore that procurement design can enhance the attractiveness of Dutch infrastructure renewal tender opportunities when used as an alignment mechanism. Better alignment between public-client objectives and contractor participation conditions enables infrastructure renewal tenders to compete more effectively for scarce contractor capacity. The following chapter translates this conclusion into practical and academic recommendations.

Recommendations

This chapter translates the research conclusions into practical and academic recommendations. The practical recommendations are directed at public clients and contractors engaged in Dutch infrastructure renewal procurement, focusing on optimising procurement design to enhance opportunity attractiveness and establishing the institutional conditions required to implement these approaches successfully. The academic recommendations identify areas where further research is needed to validate, extend, or refine the findings of this thesis.

10.1. Recommendations for public clients

1. Use the procurement design principles and configuration set to design attractive infrastructure renewal tenders.

Public clients should deploy the seven design principles and the configuration set established in this study as tools to optimise procurement design and attract suitable participation. Integrating these principles and the configuration set enables clients to translate complex brownfield conditions into a suitable tender approach that adequately responds to market capacities.

2. Invest in reliable asset information and scope clarity before tendering.

Public clients should thoroughly gather asset information and define the project scope before approaching the market. Although this requires upfront client-side effort, it enables clients and contractors to accurately assess and price residual risks. Sharper scope definition makes remaining risks explicit so they can be matched to appropriate collaboration, risk allocation, and pricing structures.

3. Invest in in-house experience to increase the ability to create equal collaboration.

To move away from adversarial procurement routines, public clients must actively build internal capability and relational expertise. True condition attractiveness relies on public client organisations possessing the mature expertise necessary to manage a collaborative interface on an equal footing.

4. Invest in the maturity of client-contractor relationships and track records.

Contractors evaluate client maturity and track records as important criteria during early-stage screening. Developing a mature institutional reputation for honouring contract conditions helps public clients to successfully attract competition for their projects when competing for scarce market resources.

5. Treat procurement attractiveness as a balancing mechanism, not a maximisation goal.

Public clients must recognise that procurement design functions as a strategic scale to mobilise market capacity under acceptable conditions of price, quality, and risk, rather than a checklist to maximise contractor preferences.

6. Drive institutional and personal adaptation to infrastructure renewal work.

Public authorities must structurally adjust their internal organisational routines, governance structures, and individual risk tolerances to align with the unique commercial profile of renewal work. Project managers require strategic mandates and decentralised budget autonomy to utilise the needed procurement strategies. Individuals should be motivated to change procurement habits and adapt their practices where needed, as well as dare to use alternative solutions.

10.2. Recommendations for contractors

1. **Communicate participation conditions explicitly and proactively.**

Contractors may perceive infrastructure renewal as an attractive and strategically relevant market segment, yet decide not to participate in specific tenders because the procurement conditions are unattractive. If contractors want public clients to improve these conditions, they should not only exercise selectivity by making no-bid decisions after tenders are published. They should also use formal market consultations and other available dialogue channels to explain which procurement conditions enable or discourage participation. This includes communicating capacity limitations, risk tolerance, pricing constraints, and tender-effort thresholds before procurement strategies are finalised.

2. **Improve data governance around early-stage tender selection.**

Contractors should improve the recording and management of bid/no-bid information, especially at decision level 1. Most no-bid decisions are made at this stage, while the fewest criteria are formally evaluated and documented. Because early-stage tender selection is partly judgement-based and often documented inconsistently, important evaluation inputs and decision rationales may be lost. Reducing missing information in the selection data would allow contractors to learn more systematically from no-bid decisions and develop a stronger empirical basis for explaining which procurement conditions reduce opportunity attractiveness.

3. **Adapt internal routines to the infrastructure renewal market.**

For large civil engineering contractors, infrastructure renewal work may require different organisational routines from those used for new-build projects. Renewal projects can be labour-intensive and offer smaller production volumes and returns. To participate sustainably in this market segment, contractors may need to organise tender effort, technical expertise, and execution capacity more efficiently. Repetitive portfolio structures, multi-year frameworks, and collaborative agreements can support this adaptation when contractors are organisationally prepared to work with them.

10.3. Recommendations for future research

1. **Expand empirical generalisability beyond large contractors.**

Future research should test the findings of this study across other contractors, including larger, smaller and specialised niche firms within the Dutch civil engineering sector. This research was based on a single large-contractor case, which limits the extent to which the findings can be generalised to other market parties. Other contractors may evaluate tender opportunities differently because they operate with different constraints or strategies. Expanding the empirical scope would help clarify how opportunity attractiveness differs across contractor types.

2. **Validate the procurement design principles from the public client side.**

Future research should examine how the procurement design principles can be applied by different types of public clients, including national infrastructure agencies, provinces, municipalities, water authorities, and ProRail. These organisations may differ in governance, internal expertise, budgetary flexibility, project scale, procurement routines, and decision-making mandates. Comparative research could therefore clarify which principles are broadly transferable and which require adaptation to the client context.

3. **Study the application of attractive procurement design.**

Future research should test and refine the procurement design principles through live or recently completed infrastructure renewal tenders. This could be complemented by fictive case testing with active expert involvement, in which practitioners assess how the principles would apply to realistic but controlled tender situations. Such studies could show how procurement design choices develop over time and how they affect contractor participation, tender effort, pricing, collaboration, and project execution.

Together, these recommendations translate the findings of this research into directions for practice and further study. Public clients can use the procurement design principles to assess and improve the attractiveness of infrastructure renewal tender opportunities. At the same time, contractors can contribute by making their participation conditions more explicit and by improving their internal tender selection data. Future research can further test and refine these insights across different market segments, client organisations, and real procurement settings.

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AI statement

Parts of this report were supported by AI tools, including ChatGPT, Perplexity, NotebookLM, Gemini, and Grammarly, for language editing, spelling and grammar correction, and the summarisation of documents. All substantive content, analysis, interpretations, and conclusions are my own. AI was used critically as a supporting tool to facilitate reflection and improve the presentation of original work, not to replace independent analysis or academic judgement. I remain fully responsible for the accuracy and integrity of the report.

Argumentation scheme

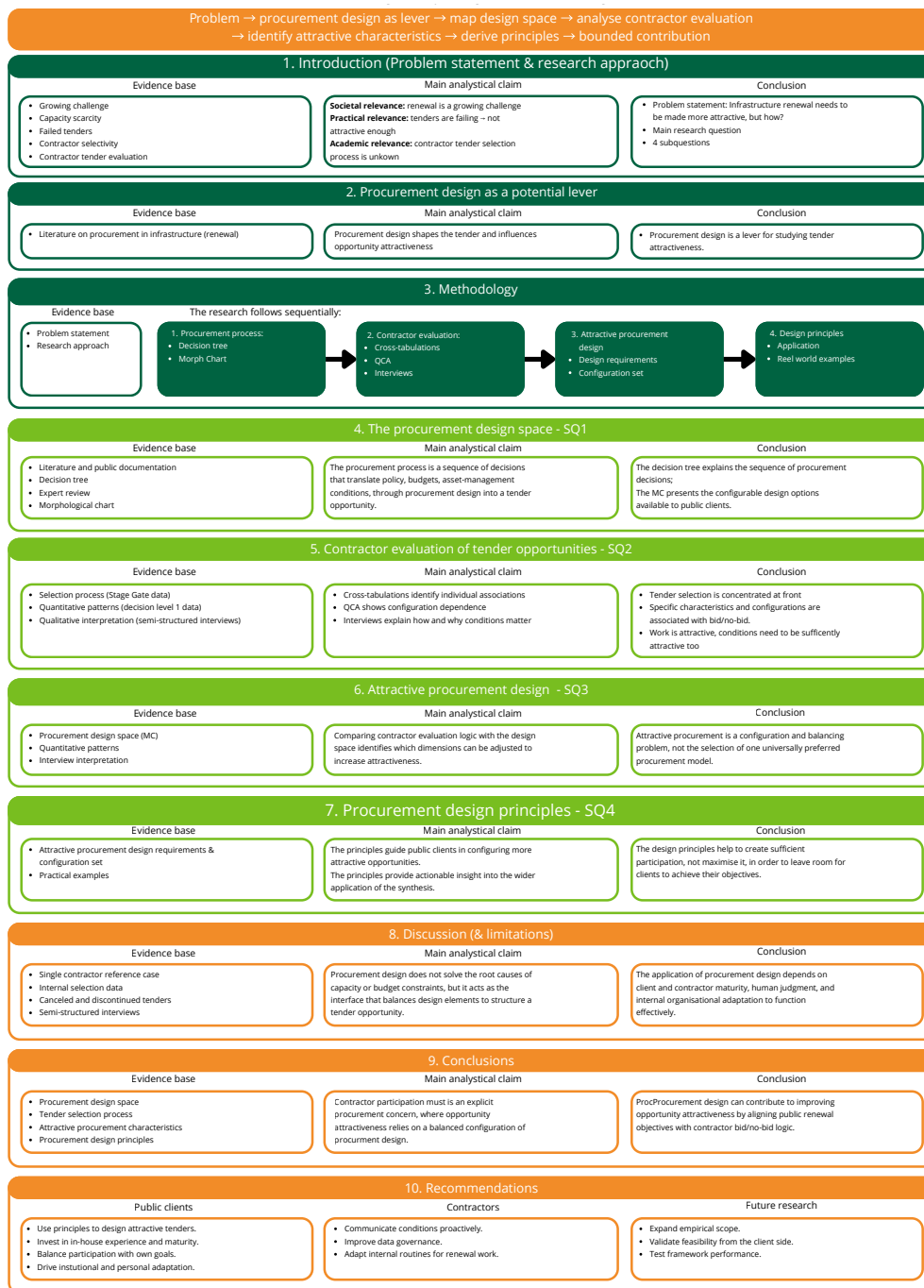


Figure B.1: Argumentation scheme used in this report

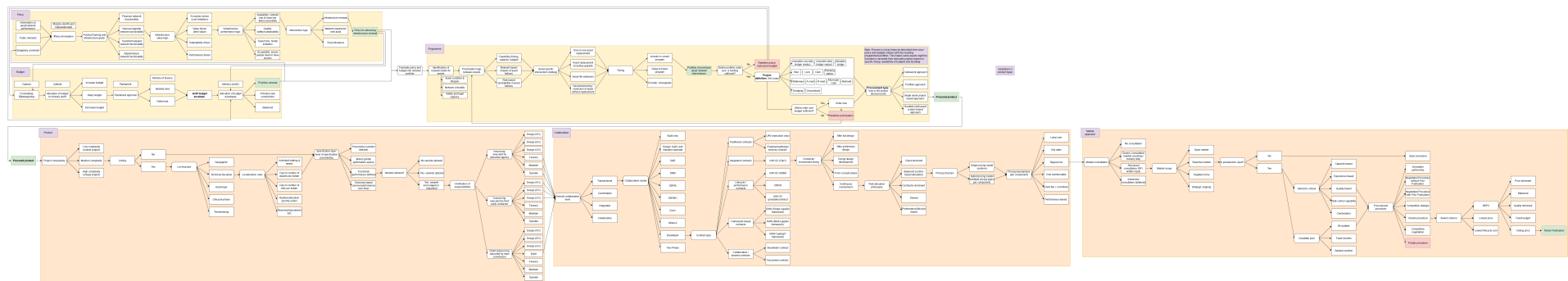


Figure C.2: First version of decision tree: public procurement process before iteration.



Interview Guide

D.1. Opening

Thank you for participating in this research.

During this interview, I would like to discuss my graduation research. We will start with a short introduction, after which I will ask several open-ended questions related to the research topic.

Before we begin, do you have any questions about the interview?

D.2. Introduction

Researcher introduction

- Study background: Civil Engineering and Construction Management and Engineering.
- Interest in infrastructure and the way organisations behave within this market.
- Motivation for the research: frequent media attention to societal challenges facing the sector, such as climate change, the housing crisis, defence investments, the energy transition, and the replacement and renovation challenge.
- Focus of the research: public procurement within the replacement and renovation challenge.
- Research aim: to understand why these tenders receive few bids or sometimes fail completely.
- Central interest: how the procurement design of public clients influences contractor behaviour and bidding strategies, and how these can be better aligned.

Interviewee Background

1. Could you briefly introduce yourself?
2. What is your role within BAM?
 - (a) How are you involved in the prospect phase and tendering?
 - (b) How are you involved in the replacement and renovation challenge?

D.3. Problem Definition

3. Where do you see the main challenges within the infrastructure renewal challenge?
 - (a) How do these challenges relate to other societal challenges, such as defence, the housing crisis, and the energy transition?
 - (b) How does this manifest itself within BAM?
4. How do you experience the shift from a client market to a contractor market?
 - (a) How does this influence BAM's behaviour in the market?
 - (b) Which aspects lie within BAM's sphere of influence, and which aspects lie within the sphere of influence of public clients?
5. How does BAM decide whether or not to bid for a tender?
 - (a) Which factors play a role in this decision?
 - (b) Does procurement design influence the decision to bid or not to bid?

D.4. Stage-Gate Procedure and Process Analysis

6. What are the primary reasons for a no-bid decision in the sales opportunity phase, Stage Gate 0?
 - (a) Can you describe a recent sales opportunity that was deliberately not continued to Stage Gate 1? What was the exact trigger for that decision?
 - (b) In no-bid decisions at this stage, how often do strategic arguments play a role, such as win probability, client relationship, or business model?
 - (c) In no-bid decisions at this stage, how often do softer arguments, such as location, play a role?
7. Which specific factors most often lead to a no-bid decision in Stage Gates 1 and 3?
 - (a) How often does procurement design play a role?
 - (b) What role is played by win probability, profitability, strategy, and execution?
 - (c) How are different opportunities prioritised?
 - (d) What role do softer factors, such as location, play?
 - (e) What influence does the client relationship have? Which clients are preferred, and why?
8. Which specific factors most often lead to a bid decision in Stage Gates 1 and 3?
 - (a) Which specific tender characteristics does BAM look for?
 - (b) What is the ideal composition of a tender from BAM's perspective?
 - (c) Does BAM actively choose to pursue more replacement and renovation work, or not?
9. To what extent is the rejection of a tender influenced by the personal insights and interpretations of the individuals involved?
 - (a) How much room is there within the formal procedure to discuss or negotiate a doubtful score?
 - (b) Can a no-bid decision become a bid decision through the persuasive power of an individual?
 - (c) Does the quality of completing the stage-gate documentation influence the outcome of the stage-gate procedure?

D.5. CRM Data

10. Tenders are discontinued by BAM at Stage Gates 0, 1, and 3, as shown in the diagram. Why does this happen?

D.6. Closing Questions

If time allows, the following questions will be discussed:

11. Can BAM influence the procurement strategy of public clients?
 - (a) In what way?
 - (b) Is BAM willing to do so?
 - (c) Who should take responsibility for change?

Cross-tabulations

1. Project Order Size

Bid decision	0	≤ 5 mln	5–10 mln	10–25 mln	25–50 mln	50–100 mln	>100 mln	Total
Continuation	10%	24%	40%	32%	39%	40%	46%	28%
No-bid	90%	76%	60%	68%	61%	60%	54%	72%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Table E.1: Bid decision percentages by project order size ($p = 0.00068$).

2. Scope

Bid decision	Water	Energy	A-Road	N-Road	Mun.	Rail	Wat.way	Break.	Quay	Lock	Dam	Dike	Dredg.	Immov.	Mov.	Tun.	Build.	Total
Continuation	100%	47%	53%	33%	27%	56%	0%	100%	13%	50%	0%	26%	0%	37%	12%	15%	38%	28%
No-bid	0%	53%	47%	67%	73%	44%	100%	0%	87%	50%	100%	74%	100%	63%	88%	85%	62%	72%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table E.2: Bid decision percentages by scope ($p = 1.97 \times 10^{-17}$).

3. Form of Collaboration

Bid decision	Build only	Maint.	D&C	E&C	DBM	DBFMO	ECI	ROK	Cost plus	Other	Unknown	Total
Continuation	33%	0%	37%	25%	0%	0%	83%	64%	100%	8%	0%	28%
No-bid	67%	100%	63%	75%	100%	100%	17%	36%	0%	92%	100%	72%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table E.3: Bid decision percentages by form of collaboration ($p = 2.39 \times 10^{-37}$).

4. Award Criterion

Bid decision	Lowest price	Quality	BPKV	Unknown	Total
Continuation	67%	100%	60%	0%	28%
No-bid	33%	0%	40%	100%	72%
Total	100%	100%	100%	100%	100%

Table E.4: Bid decision percentages by award criterion ($p = 2.39 \times 10^{-72}$).

5. Procurement Procedure

Bid decision	Closed	Internal	Negotiated	Private	Overig	Unknown	Total
Continuation	69%	100%	64%	25%	24%	0%	28%
No-bid	31%	0%	36%	75%	76%	100%	72%
Total	100%	100%	100%	100%	100%	100%	100%

Table E.5: Bid decision percentages by procurement procedure ($p = 2.53 \times 10^{-45}$).

6. Client

Bid decision	BAM	Drink.	Energy	Hoogh.	Mun.	Nat. Gov.	Port	Priv.	ProRail	Prov.	Rijkswat.	Schip.	Trans.	Water.	Total
Continuation	92%	9%	30%	0%	32%	33%	25%	40%	21%	17%	16%	38%	50%	35%	28%
No-bid	8%	91%	70%	100%	68%	67%	75%	60%	79%	83%	84%	63%	50%	65%	72%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table E.6: Bid decision percentages by client type ($p = 2.03 \times 10^{-6}$).

7. Region

Bid decision	Regio Centraal	Regio Oost	Regio West	Regio Zuid	Total
Continuation	25%	21%	31%	46%	28%
No-bid	75%	79%	69%	54%	72%
Total	100%	100%	100%	100%	100%

Table E.7: Bid decision percentages by region ($p = 8.64 \times 10^{-5}$).

8. Priority

Bid decision	High	Average	Low	Unknown	Total
Continuation	49%	17%	2%	0%	28%
No-bid	51%	83%	98%	100%	72%
Total	100%	100%	100%	100%	100%

Table E.8: Bid decision percentages by project priority ($p = 1.71 \times 10^{-24}$).

9. Win Chance

Bid decision	0	20	33	50	75	90	95	100	Total
Continuation	14%	100%	100%	100%	100%	100%	100%	100%	28%
No-bid	86%	0%	0%	0%	0%	0%	0%	0%	72%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table E.9: Bid decision percentages by estimated win chance ($p = 1.87 \times 10^{-68}$).

10. Joint-Venture

Bid decision	JV	No JV	Total
Continuation	35%	27%	28%
No-bid	65%	73%	72%
Total	100%	100%	100%

Table E.10: Bid decision percentages by joint-venture status ($p = 0.25988$).

QCA truth table and R script

	collab_A								collab_B								collab_C								collab_D								collab_E								collab_F								collab_G								collab_H								collab_I								collab_J								collab_K								collab_L								collab_M								collab_N								collab_O								collab_P								collab_Q								collab_R								collab_S								collab_T								collab_U								collab_V								collab_W								collab_X								collab_Y								collab_Z								collab_AA								collab_AB								collab_AC								collab_AD								collab_AE								collab_AF								collab_AG								collab_AH								collab_AI								collab_AJ								collab_AK								collab_AL								collab_AM								collab_AN								collab_AO								collab_AP								collab_AQ								collab_AR								collab_AS								collab_AT								collab_AU								collab_AV								collab_AW								collab_AX								collab_AY								collab_AZ								collab_BA								collab_BB								collab_BC								collab BD								collab_BE								collab_BF								collab_BG								collab_BH								collab BI								collab BJ								collab BK								collab BL								collab BM								collab BN								collab BO								collab_BP								collab_BQ								collab_BR								collab_BS								collab_BT								collab_BU								collab BV								collab BW								collab BX								collab_BY								collab_BZ								collab_CA								collab_CB								collab_CC								collab_CD								collab_CE								collab_CF								collab CG								collab_CH								collab_CI								collab_CJ								collab CK								collab_CL								collab_CM								collab_CN								collab_CO								collab_CP								collab_CQ								collab_CR								collab_CS								collab_CT								collab_CU								collab_CV								collab_CW								collab CX								collab_CY								collab_CZ								collab_DA								collab_DB								collab_DC								collab_DD								collab_DE								collab_DF								collab DG								collab_DH								collab_DI								collab DJ								collab DK								collab_DL								collab_DM								collab DN								collab_DO								collab_DP								collab_DQ								collab_DR								collab_DS								collab_DT								collab_DU								collab_DV								collab_DW								collab_DX								collab_DY								collab_DZ								collab_EA								collab_EB								collab_EC								collab_ED								collab_EE								collab_EF								collab EG								collab_EH								collab_EI								collab EJ								collab_EK								collab_EL								collab_EM								collab_EN								collab EO								collab_EP								collab_EQ								collab_ER								collab_ES								collab_ET								collab_EU								collab_EV								collab_EW								collab_EX								collab_EY								collab_EZ								collab_FA								collab_FB								collab_FC								collab_FD								collab_FE								collab_FF								collab FG								collab_FH								collab FI								collab FJ								collab_FK								collab_FL								collab_FM								collab_FN								collab 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[illegible]

Figure F.2: QCA truth table for bid decision, page 2.

F.2. R script

The following R script was used to calibrate the tender selection data, construct the truth table, and perform the qualitative comparative analysis presented in Chapter 6. The script is included to improve the transparency and reproducibility of the analysis. The underlying contractor tender selection dataset is not included because it contains confidential organisational information. Only the code used for the final reported analysis is presented.

```

1 # 1. Environment initialization
2 if (!require("QCA")) install.packages("QCA")
3 if (!require("SetMethods")) install.packages("SetMethods")
4 library("QCA")
5 library("SetMethods")
6
7 # 2. Data importation
8 # Select the file: "Fuzzysset - QCA.csv", col_names=TRUE
9 raw_data <- read.csv("Fuzzysset - QCA.csv", sep = ";", check.names = FALSE, stringsAsFactors = FALSE)
10
11 # 3. Fuzzy-set calibration phase
12 # Initialize an empty dataframe to hold calibrated fuzzy values
13 qca_df <- data.frame(row.names = make.unique(as.character(1:nrow(raw_data))))
14
15 # Outcome: Successful bid intent (Crisp Set)
16 # Maps actual "Bid" choices to 1, while non-bids or pending statuses become 0
17 qca_df$outcome_bid <- ifelse(raw_data$bid_decision == "Bid", 1, 0)
18 qca_df$outcome_nobid <- ifelse(raw_data$bid_decision == "No-Bid", 1, 0)
19
20 # Condition 1: project size:
21 qca_df$cond_size <- NA
22 qca_df$cond_size[raw_data$size == "0"] <- 0.00
23 qca_df$cond_size[raw_data$size == " 5 mln"] <- 0.16
24 qca_df$cond_size[raw_data$size == "-510 mln"] <- 0.33
25 qca_df$cond_size[raw_data$size == "-1025 mln"] <- 0.51 # Cross-over point
26 qca_df$cond_size[raw_data$size == "-2550 mln"] <- 0.67
27 qca_df$cond_size[raw_data$size == "-50100 mln"] <- 0.83
28 qca_df$cond_size[raw_data$size == "100 mln"] <- 1.00
29
30 # Condition 2: framework
31 qca_df$cond_framework <- ifelse(raw_data$framework == "Ja", 1, 0)
32
33 # Condition 3: project scope
34 qca_df$scope_water_works <- ifelse(raw_data$scope %in% c("Dike", "Breakwater", "Water Management", "Waterway", "Dredging",
35   "Quay Wall", "Lock"), 1, 0)
36 qca_df$scope_Building <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Building (non-infrastructure)", 1, 0)
37 qca_df$scope_Civil_structures <- ifelse(raw_data$scope %in% c("Imovable bridge", "Movable bridge", "Tunnel"), 1, 0)
38 qca_df$scope_Energy <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Energy", 1, 0)
39 qca_df$scope_Road <- ifelse(raw_data$scope %in% c("A-Road", "N-Road", "Municipal Road"), 1, 0)
40 qca_df$scope_Railroad <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Railroad", 1, 0)
41
42 qca_df$scope_Water_man <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Water Management", 1, 0)
43 qca_df$scope_Bridge_Im <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Imovable bridge", 1, 0)
44 qca_df$scope_Bridge_Mov <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Movable bridge", 1, 0)
45 qca_df$scope_Dike <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Dike", 1, 0)
46 qca_df$scope_Tunnel <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Tunnel", 1, 0)
47 qca_df$scope_Road_A <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "A-Road", 1, 0)
48 qca_df$scope_Road_N <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "N-Road", 1, 0)
49 qca_df$scope_Road_Mun <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Municipal Road", 1, 0)
50 qca_df$scope_Waterway <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Waterway", 1, 0)
51 qca_df$scope_Breakwater <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Breakwater", 1, 0)
52 qca_df$scope_Dam <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Dam", 1, 0)
53 qca_df$scope_Dredging <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Dredging", 1, 0)
54 qca_df$scope_Lock <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Lock", 1, 0)
55 qca_df$scope_Quay_Wall <- ifelse(!is.na(raw_data$scope) & raw_data$scope == "Quay Wall", 1, 0)
56
57 # Condition 4: form of collaboration
58 qca_df$collab_Integrated <- ifelse(raw_data$collaboration %in% c("E&C", "D&C (D&B)"), 1, 0)
59 qca_df$collab_Traditional <- ifelse(raw_data$collaboration %in% c("Build only", "Maintenance only"), 1, 0)
60 qca_df$collab_Performance <- ifelse(raw_data$collaboration %in% c("DBM", "DBFMO"), 1, 0)
61 qca_df$collab_Collaborative <- ifelse(raw_data$collaboration %in% c("Early Contractor Involvement (ECI)", "Framework (ROK)"), 1, 0)
62 qca_df$collab_Cost_Plus <- ifelse(!is.na(raw_data$collaboration) & raw_data$collaboration == "Cost Plus", 1, 0)
63
64
65 # Condition 5: award criterion
66 qca_df$crit_BKPV <- ifelse(!is.na(raw_data$award_criterion) & raw_data$award_criterion == "BKPV", 1, 0)
67 qca_df$crit_LowestPrice <- ifelse(!is.na(raw_data$award_criterion) & raw_data$award_criterion == "Lowest Price", 1, 0)
68 qca_df$crit_Quality <- ifelse(!is.na(raw_data$award_criterion) & raw_data$award_criterion == "Quality", 1, 0)
69
70
71 # Condition 6 procurement procedure
72 qca_df$proc_Private <- ifelse(!is.na(raw_data$procedure) & raw_data$procedure == "Private Procedure", 1, 0)
73 qca_df$proc_Negotiated <- ifelse(!is.na(raw_data$procedure) & raw_data$procedure == "Negotiated without prior publication", 1, 0)
74 qca_df$proc_Closed <- ifelse(!is.na(raw_data$procedure) & raw_data$procedure == "Closed Procedure", 1, 0)
75
76

```

```

77 # condition 7: client type
78 qca_df$client_Public <- ifelse(raw_data$client %in% c("Municipality", "Province", "Rijkswaterstaat", "ProRail", "
    National Government", "Waterschap", "Hoogheemraadschap"), 1, 0)
79 #qca_df$client_EnergyCo <- ifelse(raw_data$client == "Energy Company", 1, 0)
80 #qca_df$client_Muni <- ifelse(raw_data$client == "Municipality", 1, 0)
81 #qca_df$client_Province <- ifelse(raw_data$client == "Province", 1, 0)
82 #qca_df$client_Private <- ifelse(raw_data$client == "Private", 1, 0)
83 #qca_df$client_RWS <- ifelse(raw_data$client == "Rijkswaterstaat", 1, 0)
84 #qca_df$client_ProRail <- ifelse(raw_data$client == "ProRail", 1, 0)
85 #qca_df$client_Water <- ifelse(raw_data$client == "Waterschap", 1, 0)
86 #qca_df$client_Hoog <- ifelse(raw_data$client == "Hoogheemraadschap", 1, 0)
87
88 # condition 8: region
89 #qca_df$region_Central <- ifelse(raw_data$region == "Regio Centraal", 1, 0)
90 #qca_df$region_West <- ifelse(raw_data$region == "Regio West", 1, 0)
91 #qca_df$region_Oost <- ifelse(raw_data$region == "Regio Oost", 1, 0)
92 #qca_df$region_Zuid <- ifelse(raw_data$region == "Regio Zuid", 1, 0)
93
94 # Condition 9: Joint venture
95 qca_df$cond_jv <- ifelse(raw_data$jv == "JV", 1, 0)
96
97
98 # Condition 10: High strategic priority (Multi-value Fuzzy Set)
99 qca_df$cond_priority <- NA
100 qca_df$cond_priority[raw_data$priority == "Low"] <- 0.00
101 qca_df$cond_priority[raw_data$priority == "Average"] <- 0.51 # Cross-over point
102 qca_df$cond_priority[raw_data$priority == "High"] <- 1.00
103
104 # Condition 11, win chance
105 # 20% or less = fully out, 50% = cross-over, 75% or higher = fully in
106 qca_df$cond_win_chance <- calibrate(
107   raw_data$win_chance,
108   type = "fuzzy",
109   method = "direct",
110   thresholds = c(20, 50, 75)
111 )
112
113 # --- DATA CLEANING ---
114 # Omit rows that contain missing data (NA) across your selected configurations
115 qca_clean <- na.omit(qca_df)
116
117 cat("--- FULLY CALIBRATED FUZZY-SET DATASET EXCERPT ---\n")
118 print(head(qca_clean, 5))
119
120
121 #####
122
123 # Truth tables:
124
125 # 1. Define a subset of 4 conditions from the options above
126 my_model_variables <- c("client_Public", "collab_Integrated", "collab_Traditional", "collab_Performance", "collab_
    Collaborative", "collab_Cost_Plus")
127
128 # 2. Build the truth table (Setting n.cut to 2 due to your large dataset size)
129 my_truth_table <- truthTable(
130   data = qca_clean,
131   outcome = "outcome_bid",
132   conditions = my_model_variables,
133   complete = TRUE,
134   show.cases = TRUE,
135   incl.cut = 0.01,
136   n.cut = 1
137 )
138
139 # 3. View your truth table configuration details
140 print(my_truth_table)
141
142 # 4. Minimize the configuration matrix
143 print(minimize(my_truth_table, include = "1", details = TRUE, use.tilde = TRUE))
144
145 #####
146
147 ## QCA on Bid decision
148 #switch bid decision aon as variable
149
150 # 1. Automatically grab all column names EXCEPT your target outcome
151 cond_cols <- setdiff(names(qca_clean), "outcome_bid")
152
153 tt_bid <- truthTable(qca_clean, outcome = "outcome_bid", conditions = cond_cols,
154   incl.cut = 0.8, n.cut = 1, show.cases = TRUE)
155 print(tt_bid)
156
157 sol_bid <- minimize(tt_bid, include = "?")
158 print(sol_bid)
159
160 # 2. Exports truth table rows directly to a clean spreadsheet file
161 write.csv2(tt_bid$tt, file = "QCA_Truth_Table_Bids4.csv", row.names = TRUE)
162
163 #####

```

```
164
165 ## QCA on No_Bid_decision
166 #switch no bid decision aon as variable
167
168 # 1. Automatically grab all column names EXCEPT your target outcome
169 cond_cols <- setdiff(names(qca_clean), "outcome_nobid")
170
171 tt_bid <- truthTable(qca_clean, outcome = "outcome_nobid", conditions = cond_cols,
172                     incl.cut = 0.8, n.cut = 1, show.cases = TRUE)
173 print(tt_bid)
174
175 sol_bid <- minimize(tt_bid, include = "?")
176 print(sol_bid)
177
178 # 2. Exports truth table rows directly to a clean spreadsheet file
179 write.csv2(tt_bid$tt, file = "QCA_Truth_Table_NoBid2.csv", row.names = TRUE)
```