# The Portfolio Approach in Public Dutch Projects

## Principles, Actions and Effects explored in Infrastructure Renewal

Construction Management and Engineering
MSc Thesis

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TU Delft

# The Portfolio Approach in Public Dutch Projects

## Principles, Actions and Effects explored in Infrastructure Renewal

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# Preface

This thesis represents the culmination of my Master's program in Construction Management and Engineering. It has been an enriching journey, filled with challenges, discoveries, and growth, both academically and personally. The research explores the implementation of the portfolio approach in infrastructure renewal, a topic that has proven to be both highly relevant and complex within the context of the Dutch infrastructure sector. By combining theoretical insights with empirical findings, I aim to contribute to a deeper understanding of how collaboration between clients and contractors can enhance project outcomes.

This work would not have been possible without the guidance and support of several individuals. I am grateful to my supervisors. I would like to begin by expressing my gratitude to Dr. Ir. Johan Ninan, my mentor, for his support during our bi-weekly meetings. I also extend my thanks to Dr. Ir. Marian Bosch-Rekveldt and Dr. Ir. Ad Straub for their contributions during our progress meetings and more. The constructive feedback and encouragement have been invaluable throughout this process. I also want to thank the professionals and organizations that generously shared their time and insights during the interviews. Their practical perspectives were instrumental in shaping the conclusions of this study.

I would like to express my gratitude to PwC, and especially to my committee member, Ralph, for being so closely involved in this thesis. Not only did they provide me with a workspace and a supportive environment, but they also gave me the opportunity to present my research and contribute my knowledge to their ongoing portfolio practices. Their openness to my constant discussions about this thesis, combined with many enjoyable moments, has been a true source of energy and inspiration. A special thanks goes to my fellow intern, Tom Hoogstede, for the "gezelligheid" that made my days at the office even more enjoyable.

Finally, I would like to thank my boyfriend, friends and family for their support and encouragement. Their belief in me has been a constant source of motivation.

I hope this thesis will serve as a meaningful contribution to the field of infrastructure management and inspire further exploration into the potential of the portfolio approach to address the challenges facing the sector today.

*M.K. van 't Hoen*
*Delft, November 2024*

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# Summary

**Research Focus**
There is a significant issue in the Netherlands, with millions of euros worth of infrastructure projects that need urgent replacement. Dutch Public Commissioners are facing challenges in addressing this issue. Various approaches, including the portfolio approach, have been suggested to expedite the process. This research focuses on one of these measures: the portfolio approach in public infrastructure renewal projects. The goal is to study the characteristics of this approach and the interests of both the public and private sectors. The research objective is to create a framework for public infrastructure that incorporates the perspectives of both the client and the contractor. This framework aims to provide a clear overview of their collaborative actions and their impact.

The main research question is:

*How can the portfolio approach for infrastructure renewal be implemented, considering both client and contractor perspectives?*

**Methodology**
The methodology emphasizes integrating two methods: a literature review and a case study. A literature review is conducted to create a theoretical foundation for managing the renewal of public infrastructure using a portfolio approach. The literature review aims to identify key principles that will serve as the theoretical basis for the case study. The case study is carried out in two phases: the first phase involves preparing the case study, while the second phase focuses on collecting data through interviews with respondents.

The case study focuses on a single portfolio containing two bridges. This begins with document analysis, reviewing all available documents from the grey literature on the portfolio approach in the Netherlands, particularly those related to the case. From this analysis, key points are identified and compared with the principles found in the academic literature. The overlapping points are aligned, and five principles were selected to be carried forward for further examination in the case study. These selected principles were used as a foundation for deeper exploration throughout the remainder of the research. The next phase of the research involved exploring this shortlist of principles within the case study. This is achieved through semi-structured interviews with 14 respondents who are closely involved with the portfolio approach and the case study portfolio. During these interviews, the five selected principles are emphasized, focusing specifically on the actions and effects that arise from the portfolio approach for both the client and the contractor. Following that, four additional expert interviews were conducted to discuss the findings.

**Literature Review**
Public clients face complexities in infrastructure management, including inefficiencies, trust issues, and the need for policy reform. They must balance protecting public values with leveraging contractor expertise, driven by globalization and sustainability needs. This shift requires clients to integrate traditional values (e.g., integrity) with new collaborative roles, relying on trust-based partnerships to foster learning and innovation. As Western infrastructure ages, a portfolio approach—bundling multiple projects under one contractor—enables more efficient renewal, managing resources, and maintaining reliability. This strategy aligns with modern demands for sustainable, adaptable public infrastructure management.

A principle is defined as a set of related thoughts, intentions, and actions that differ from rule-based guidelines. The literature identifies 15 principles of the portfolio approach in public infrastructure man-

agement, categorized into six key topics: (1) **Strategic Management**, focusing on aligning projects with organizational goals, balancing portfolios, and managing resources; (2) **Decision-Making and Evaluation**, highlighting systematic decisions and continuous feedback; (3) **Risk and Change Management**, emphasizing adaptability and risk management; (4) **Communication and Collaboration**, stressing knowledge sharing and stakeholder involvement; (5) **Strategy with Adaptability**, focusing on structured PPM systems and competitive advantage; and (6) **Performance and Benefit Management**, underscoring data-driven improvement of portfolio performance. These principles form the foundation for exploring portfolio management in public infrastructure projects.

**Case-Study**
The case study is grounded in five key principles derived from a comparison between findings in the academic literature and the priorities emphasized by the public commissioner, as identified through grey literature. This focus is essential because public commissioners ultimately serve as the primary decision-makers in public infrastructure renewal projects. Additionally, the study considers the perspectives of market parties, recognizing that the portfolio approach relies on joint production and collaboration between stakeholders. The principles underpinning the case study are: (1) **Improved Decision-Making through Feedback**, enhances decision quality through continuous feedback, enabling data-driven, adaptive management and alignment with strategic goals. (2) **Communication and Knowledge Sharing**, fosters innovation, reduces duplication and enhances portfolio performance by emphasizing collaboration, efficiency, and continuous improvement. (3) **Stakeholder Involvement and Strategy Effectiveness**, improves accountability and project outcomes through active stakeholder engagement, ensuring alignment with societal and operational needs. (4) **Adaptability to Dynamic Environments and Change**, promotes flexibility and responsiveness, enabling portfolios to address uncertainties, foster innovation, and meet evolving demands of the ever-changing environment of infrastructure renewal (5) **Portfolio-Level Benefit Management and Optimization**, maximizes value across projects by aligning with organizational goals, ensuring efficiency, and achieving impactful long-term results.

The principles provide a lens to interpret the case study results. They highlight how certain actions, such as feedback mechanisms and knowledge sharing, could directly contribute to observed improvements in collaboration and project execution. At the same time, the results show that challenges, such as contractor dependency and complexity, could arise when implementing the approach. The results reflect the strengths and limitations of the principles in practice.

**Recommendation**
The recommendations are based on the framework and address several key areas. A primary concern is the rigidity within the public commissioner's organization, affecting not only collaboration methods but also project phasing and contract structures. Interestingly, this issue aligns with the challenges the public commissioner has identified. There is a strong need for interaction and open communication to establish a collaborative environment. This includes transparent discussions on pricing where feasible. Pricing remains a recurring challenge, particularly for repeat assignments that do not follow traditional tendering processes. Without a competitive benchmark, the public commissioner risks relying heavily on contractors for accurate cost estimates, which may create a disadvantage. Stakeholder engagement could also benefit from the portfolio approach. Since stakeholders often overlap within a portfolio, existing relationships can be leveraged strategically to enhance collaboration. Additionally, manpower allocation offers significant advantages for the public commissioner and contractors, as resources can be reserved in advance, improving efficiency and workforce planning. Finally, successful implementation of the portfolio approach requires careful portfolio formation. If this is not executed correctly—for example, if the scope changes excessively—the approach may fail to deliver its intended benefits.

**Conclusion**
In conclusion, the client uses the portfolio approach to accelerate infrastructure renewal and renovation while ensuring quality, time, and sustainability. Key strategies include fostering collaboration with

contractors, establishing clear communication, setting performance KPIs, grouping similar projects, and coordinating project phases. While the approach offers benefits such as fostering innovation and streamlining project delivery, challenges include contractor dependency, strategic pricing risks, and managing complexity. The contractor's objectives differ from the client's focus on national infrastructure needs, as contractors prioritize optimizing their project portfolios and business outcomes. Key actions for contractors include building trust-based relationships, maintaining open communication, and developing knowledge retention strategies to improve collaboration and project efficiency. The portfolio approach offers benefits like fostering innovation and providing long-term work security but also presents challenges such as unfair competition and the complexity of managing rigid contracts.

This research provides PwC with a practical tool to enhance its understanding of the portfolio approach, supporting evidence-based advisory services in infrastructure and beyond, while addressing challenges in public-sector procurement models. The study contributes theoretically by exploring five principles from the literature within the context of Dutch infrastructure projects and introducing new principles relevant to the portfolio approach. By bridging theory and practice, this research lays a foundation for future studies to refine the alignment between theoretical insights and the strategic needs of public infrastructure agencies.

Future research should explore: (1) how project complexity is managed within portfolios, (2) the impact of procurement laws on large-scale portfolios and alternative contracting models, (3) evaluating the portfolio approach post-implementation to compare expected and actual outcomes, (4) relationships between principles, actions, and effects to optimize strategies, and (5) practical applications of modular and standardized methods to enhance predictability.

The framework for implementing the portfolio approach considers **client and contractor perspectives**. The **principles** explored in the case study led to 4 categories of **actions** and 3 categories of **effects**.

**14 Key Actions for Implementing the Portfolio Approach**

| | |
|---|---|
| **Communication and Collaboration** | 1. Create a Shared Vision for Collective Goals<br>2. Encourage Collaborative Decision-Making<br>3. Showcase Long-Term Reliability<br>4. Envision new Collaboration strategy: Working Closer & Longer together |
| **Portfolio – and Tender Strategy** | 5. Apply Phased Approach to Complexity<br>6. Apply Structured Response to Urgency<br>7. Collaborate on Project Phase Alignment<br>8. Ensure Consistency in Project Teams<br>9. Focus on Project Similarity |
| **Knowledge Sharing** | 10. Develop Strategies for Knowledge Retention<br>11. Work on Clear Evaluation Methods<br>12. Lessons Learned<br>13. Share Lessons Learned not only within a portfolio* |
| **Stakeholder Engagement** | 14. Monitor and Adapt Stakeholder Efforts to Strategies |

**7 Key Effects of Implementing the Portfolio Approach**

| | |
|---|---|
| **Management Optimization** | 1. Improved Workforce Stability<br>2. Enhanced Project Visibility and Status Monitoring<br>3. Acceleration Infrastructure Realization |
| **Innovation** | 4. Increased Innovation Potential |
| **Contractor Dependency** | 5. Reduced Client Negotiation Power<br>6. Unbalanced Knowledge Distribution to other Contractors<br>7. Increased Cost Control risks |

Based on **literature and a Dutch case study,** this framework provides an overview of the key actions and effects important for clients and contractors in **public infrastructure projects** in the Netherlands, to be used during the **entire portfolio cycle**.

**Figure 1:** Framework of Actions & Effects behind the Portfolio Approach in Infrastructure Renewal

# Contents

# 1

# Introduction

## 1.1. Background and Significance

This section will provide an overview of the key challenges facing Dutch infrastructure renewal and introduce the portfolio approach as a strategy within to make the renovation task feasible.

### 1.1.1. National Challenges

The management of Dutch infrastructure is a collaborative effort involving several national and regional bodies, along with 12 provinces, 342 municipalities, and 21 water boards. Together, they oversee approximately 141,000 km of roads, 5,700 km of waterways, and 7,000 km of railways, as well as tens of thousands of structures such as bridges, viaducts, tunnels, locks, weirs, and pumping stations. The total value of Dutch infrastructure is estimated at 347 billion euros (Rasker et al., 2023). However, the ageing infrastructure presents a significant problem. Many objects are approaching the end of their technical lifespan, and these structures are often utilized more intensively than expected during their construction. This heavy usage underscores the critical need for maintenance to ensure infrastructure remains reliable, safe, and available. Van Breugel (2017) mentions that the current infrastructure can still be in use, but most of it is beyond its presumed lifespan. Without appropriate infrastructure, economic stability and growth are in danger. In the coming decades, the Netherlands faces the immense challenge of renewing its civil infrastructure and must undertake a nationwide renewal task involving the replacement and renovation of ageing infrastructure to address the anticipated end of its technical lifespan. Failure to address this issue could compromise the safety, livability, and accessibility of the Netherlands (Rasker et al., 2023).

Furthermore, the country is experiencing growing population density, creating additional challenges for the construction sector in meeting demand. VNO-NCW has raised concerns about accessibility to the parliament, emphasizing the need for well-organized maintenance and development efforts to meet increasing demands on infrastructure (Wiesehahn, 2022). This growing population exacerbates spatial limitations and highlights the necessity for a focus on the redevelopment of Dutch infrastructure.

Infrastructure projects worldwide face various challenges. For example, in the Netherlands, projects such as the A4 Delft-Schiedam and the A16 in Rotterdam encounter issues, causing delays and increased expenses. These issues usually stem from complex construction challenges. For example, the A4 project was troubled by historical mistakes and problematic construction techniques, causing long-term difficulties in managing this highway (Omroep Delft, 2023). The A16 project also demonstrates the typical challenges faced in large infrastructure projects, such as supply issues that cause significant delays (van der Klugt, 2024). These instances highlight common problems in Dutch infras-

tructure development and suggest lessons to be learned to improve future projects.

These issues in the construction sector underscore the significant challenges within the Dutch infrastructure landscape. Additionally, difficulties are linked to a lack of expertise and coordination within the national agency for public works and infrastructure management (Ridder, 2024). The public commissioner conducted a study on challenges and potential improvements in infrastructure management. The research emphasizes the need for a shift toward a more efficient and innovative infrastructure market, which would support the achievement of long-term societal objectives set by the Ministry of Infrastructure and Water Management (EIB & PwC, 2020). The public commissioner outlines several priority indicators for future projects within the program 'Towards a Vital Sector.' Key focus areas include fostering innovation in the sector, ensuring financial stability, and managing the inherent risks associated with infrastructure development (EIB & PwC, 2020). A new strategy has been introduced to the Dutch national public infrastructure sector, which the national public commissioner calls: the portfolio approach.

### 1.1.2. Reasons behind Portfolio Approach

In this research, the term *portfolio approach* can be confusing, as a portfolio is often seen as a collection of projects or assets, such as all infrastructure projects in the Netherlands. In this research, the portfolio approach refers to a methodology in which assets with similar characteristics are bundled into a package, referred to as a 'portfolio.' This approach involves renovating or renewing various assets with corresponding features by a contractor in sequence. Some clients also refer to this as a programmatic approach or a 'train approach.' It essentially involves grouping projects into one portfolio with a bottom-up perspective (Public Commissioner, 2022).

The portfolio approach involves managing multiple projects within a single portfolio. Portfolio management is a strategic process that aims to maximize value, maintain a balanced mix, and align company projects with its strategic goals (Cooper et al., 1997). A project portfolio is a group of projects carried out under a particular organisation's sponsorship and/or management (Archer and Ghasemzadeh, 1999). The components should be aligned with the company's strategic goals and objectives. All components typically have distinguishable characteristics that allow the company to cluster. Project Portfolio Management is a term used to describe methods for analyzing and collectively managing a group of current or proposed projects based on numerous key characteristics (Filippov et al., 2010).

An overview of the important themes discussed in this thesis is provided below.

- *Portfolio Management = Portfolio management refers to the centralized oversight of one or more portfolios, involving activities such as identifying, evaluating, prioritizing, authorizing, managing, and controlling projects, programs, and other work to achieve specific strategic business goals* (Aritua et al., 2009).
- *Portfolio = A portfolio is a set of projects sponsored and/or managed by an organization, which share a common objective and are organized to enhance efficiency and performance* (Archer and Ghasemzadeh, 1999).
- *Principle = A principle is a framework of interconnected ideas, intentions, and actions that stands apart from strict rule-based guidance* (Hansen and Svejvig, 2023).

To achieve effects through the repeated execution of similar works by the same (or combination of) contractors, portfolio contracts could be utilized. This involves actively managing, learning and improvement, supported by performance management (Public Commissioner, 2022). Public commissioners highlight this approach, by placing it on the map through the transition monitor. They seems to advocate for and aim to implement this approach in renovation projects through the contractual portfolio approach guideline. These guidelines outline goals such as promoting innovation, performance management for quality, reducing transaction costs, and more (EIB & PwC, 2020).

In a Portfolio Approach, multiple projects are bundled and presented to the market as a sort of "basket"

of works. This approach allows for the selection of the best party for the entire portfolio in one go, rather than seeking a contractor for each project. In the long term, the portfolio approach could bring effects. For example, the contractor can develop a learning curve, which can be taken into account in subsequent projects. Additionally, it could increase the predictability of future work, allowing the contractor to allocate their resources more efficiently. This new form of collaboration can be seen as a long-term partnership, enabling the client and contractor to become better attuned to each other, thus improving the collaboration (Westra and Hoekstra, 2024).

Public construction clients, government agencies, must maintain a delicate balance when engaging with contractors and the broader supply market. While collaborating with contractors, these public organizations need to adapt to the market environment, but they must also stay aligned with their core responsibilities and principles within the public administrative system. This balance is essential because public construction clients are positioned between their internal organization and the broader socio-political environment. The relationship with contractors is key to managing this position, as contractors play a critical role in how public clients fulfill their construction responsibilities. This process, known as commissioning, involves managing interactions both within the organization and externally with the supply market, making the client-contractor relationship central, even with the presence of other stakeholders (Kuitert et al., 2020).

## 1.2. Knowledge Gap

The Netherlands faces the challenge of renewing and maintaining its infrastructure to meet societal goals and promote sustainable development. To tackle this, innovative methods are essential, and the portfolio approach could provide the solution needed for achieving these objectives.

### 1.2.1. Societal Relevance

As explained in the introduction, there is a significant demand for the renewal and maintenance of Dutch infrastructure. A transition to a vital infrastructure market capable of innovation and improvement is necessary, thereby contributing to the long-term realization of the complex societal objectives of the Ministry of Infrastructure and Water Management (IenW). This task is substantial, given the ageing infrastructure, increased usage, the ambition to work climate-neutrally and circularly, and rapid developments in digitalization (EIB & PwC, 2020). Seven measures, trying to to facilitate this transition, have been published under the authority of the national infrastructure public commissioner. This thesis will focus on measure 2: The development of the portfolio approach primarily focused on the replacement and renovation tasks. It is suggested that traditional commissioning is replaced by a model that focuses on collaboration and joint development. This new model emphasizes the importance of partnership between a public commissioner and construction companies, which could lead to better results and more innovation within projects. However, a public works authority mentions they cannot achieve this transition without its contractors within and outside the GWW sector or other commissioning parties (Public Commissioner, 2019).

The Netherlands is currently undertaking extensive replacement and renovation projects, totalling nearly 4 billion euros annually until the end of this century (TNO, 2023). This substantial renewal task serves as a primary motivation for conducting this research, as it underscores the need for effective approaches to managing such a vast undertaking. One promising strategy is to implement a portfolio approach for these projects. However, progress has been slow, as the portfolio approach is still in its early stages within the public sector. Many uncertainties remain about the necessary actions and interactions between the public and private sectors, making this research timely and essential.

### 1.2.2. Scientific Gap

While traditional project management has emphasized managing individual projects with set objectives, the growing complexity of multi-project environments in the construction sector calls for new, adaptable

approaches. Aritua et al. (2009) suggest that the portfolio management approach is suited to these multi-project contexts. However, a significant gap exists in understanding how portfolio management principles can be effectively applied to manage the intricate interdependencies and complexities of these environments. This gap underscores a need for practical frameworks that translate portfolio theory into actionable strategies for multi-project management.

Moreover, Beringer et al. (2013) highlight the importance of stakeholder behaviour and management for effective portfolio management. The impact of stakeholders extends beyond individual projects, influencing outcomes across entire portfolios. There is limited empirical research examining how stakeholder behaviour directly affects portfolio success. This lack of knowledge restricts our understanding of the conditions under which stakeholder engagement contributes positively to portfolio outcomes, suggesting a gap in exploring the mechanisms of effective stakeholder influence within portfolio management.

In public infrastructure, portfolio management has been recognized as a strategic tool for aligning projects with long-term objectives, optimizing resources, and enhancing public value (Roberts and Hamilton Edwards, 2023). Little attention has been given to its application within public administration, despite its potential to help government agencies streamline objectives, assess risks, and make more informed decisions. This gap reveals an opportunity to investigate portfolio management's broader implications and applications in public-sector infrastructure projects.

Finally, Hansen and Svejvig (2023) discuss the guiding principles of portfolio management as a conceptual framework that equips practitioners to handle uncertainties and future challenges. These principles provide a foundation for decision-making rather than prescribing specific actions. Yet, the practical integration of these principles in real-world projects, particularly for public infrastructure, remains largely unexplored. Further research could address this gap by developing actionable guidelines for applying portfolio principles to effectively navigate multi-project environments.

## 1.3. Research Objectives

Exploring a portfolio approach framework within the renewal of Dutch infrastructure could meet intended goals and contribute positively to the renovation and renewal tasks. This research seeks to develop a simple framework that incorporates the principles of portfolio management. The focus lies on which principles, actions, and effects, are important for both the client and contractor when implementing the portfolio approach. Ultimately, a straightforward framework will be created for use by both the client and the contractor when implementing or assessing the portfolio approach, integrating both viewpoints. The framework is designed to be applicable at every stage of all project cycles within the portfolio. The aim is to thoroughly explore the portfolio approach by first examining existing knowledge and identifying all related principles. Next, analyse the principles outlined in a document study related to the case and create a shorter list of principles applied to the case. Then, the effects and actions related to these principles will be examined through the same case study, taking into account both the client and contractor perspectives. The insights gained will then be organized into a framework outlining the principles, effects, and actions associated with the portfolio approach. In this research, various methods are used to gather information on the principles, actions, and effects.

This framework is designed for both the public and private sectors involved in infrastructure projects. It specifically targets decision-makers at the levels responsible for implementing actions that can drive meaningful change. The focus is on providing these key individuals with the tools and insights necessary to make informed decisions, facilitating improvements in project execution and collaboration between the sectors. In one sentence, the objective can be described as:

*To create a framework for the implementation of the portfolio approach in public infrastructure that merges both the client and contractor perspectives into a single, simple model, providing an overview of their combined actions and effects.*

The overarching goal is to address the challenges posed by the renewal and renovation demands of the ageing infrastructure in the Netherlands. The objective of creating this framework is to offer a structured overview, enabling both the client and contractor to understand the essential elements when exploring or implementing the portfolio approach. By establishing this conceptual framework, both parties gain a shared understanding of what is important, providing clarity and alignment that supports a smoother, more effective implementation. This high-level overview acts as a foundational reference, ensuring that both market parties and contracting authorities can approach the portfolio method with greater coherence and readiness. In this research, we differentiate between two parties: the contracting party and the contractor. The contracting party, in this context, refers specifically to a public commissioner.

## 1.4. Research Questions

Based on the previously identified research gap, specific research questions have been formulated. The primary question serves as the central focus of the entire study, guiding the research towards its conclusion.

The main research question is:

*How can the portfolio approach for infrastructure renewal be implemented, considering both client and contractor perspectives?*

This research question aims to identify the key components of a framework that supports the implementation of the portfolio approach in infrastructure projects while considering the perspectives of both the client (public sector) and the contractor (private sector). This research question is addressed through four sub-questions.

1. *What are the principles of a portfolio approach in public infrastructure projects according to existing literature?*

This first research question aims to examine the fundamental aspects of a portfolio approach in infrastructure projects. This includes investigating the definitions and principles used in its application. Additionally, this seeks to identify and understand the advantages and challenges documented in existing literature regarding implementing a portfolio approach in the infrastructure sector.

2. *What actions support the adoption of a portfolio approach, and what effects arise from it from the client's perspective?*

Investigating from the client's perspective, this question examines the actions and effects that can be or should be expected when adopting a portfolio approach in public infrastructure projects. By highlighting these effects, the research aims to provide support to government bodies in their decision to shift towards this project management approach. The insights gained here aim to help tailor the portfolio framework.

3. *What actions support the adoption of a portfolio approach, and what effects arise from it from the contractor's perspective?*

Investigating from the contractor's perspective, this question examines the effects and actions that can be or should be expected when adopting a portfolio approach in infrastructure projects. By highlighting these effects, the research aims to help contractors understand how they can benefit from engaging in projects managed under this approach. The findings aim to refine the portfolio framework to better suit the needs and advantages of contractors.

4. *How can insights on actions and effects from the portfolio approach be structured into a framework for Dutch public infrastructure projects?*

This question seeks to understand how insights, can be organized into a framework that guides Dutch

public infrastructure projects. The goal is to create a structured overview, allowing both clients and contractors to see which actions are important and what effects can be expected, thus facilitating a better-informed approach to implementing the portfolio method in these projects.

## 1.5. Perspective

PwC supports this research project. The knowledge, people, and opportunities available there provide me access to valuable information that I wouldn't have access to otherwise. This thesis is written from the perspective of a consultancy firm, which may give it a certain predetermined perception. Furthermore, the team I am part of is the Capital Projects and Infrastructure team, which is employed by public services. PwC has been working as a strategic advisor for the public sector for over 15 years. They guide in areas such as collaboration between the government and the market (public-private partnerships), financial and economic services, procurement and market strategies, and project and contract management. In 2022, PwC conducted a study on the overruns and underruns in the major investment projects of public parties (AT Osborne et al., 2022). The research extensively addresses the relationship and collaboration between public commissioners and the market, as well as portfolio management.

## 1.6. Outline Thesis

The remainder of this thesis is structured as follows. Chapter 2 details the methodology, focusing on literature review and data analysis techniques. The literature framework in Chapter 3 discusses existing research and principles of portfolio management, examining client and contractor perspectives. Chapter 4 presents a case study on two bridges Bridge, exploring theoretical principles to practical scenarios. This leads to Chapter 5, which synthesizes the findings. Chapter 6 focuses on the framework development, followed by a discussion in Chapter 7 that evaluates implications and addresses limitations. The thesis concludes in Chapter 8, summarizing key insights and offering strategic recommendations. References and appendices provide supplementary materials and sources supporting the research.

| **Part I** | **Part II** | **Part III** |
|---|---|---|
| Ch1: Introduction | Ch4: Preparing the Case Research | Ch7: Discussion |
| Ch2: Research Methodology | Ch5: Findings | Ch8: Conclusion |
| Ch3: Literature Review | Ch6: Framework Development | |

# 2

# Methodology

## 2.1. Research Design

This chapter will explore each step of the research in detail. The process begins with a literature review to answer sub-question 1. Next, a case study is initiated, involving the identification of a suitable case, preparatory research on its documentation, and interviewing respondents. The results are analyzed to address questions 2 and 3. Finally, a qualitative analysis of all methods is conducted, resulting in a framework focusing on three aspects: principles, effects, and actions, to answer question 4. The end of an arrow does not preclude the possibility of revisiting it, as iteration occurs constantly throughout the process. A visual representation is shown in Figure 2.1

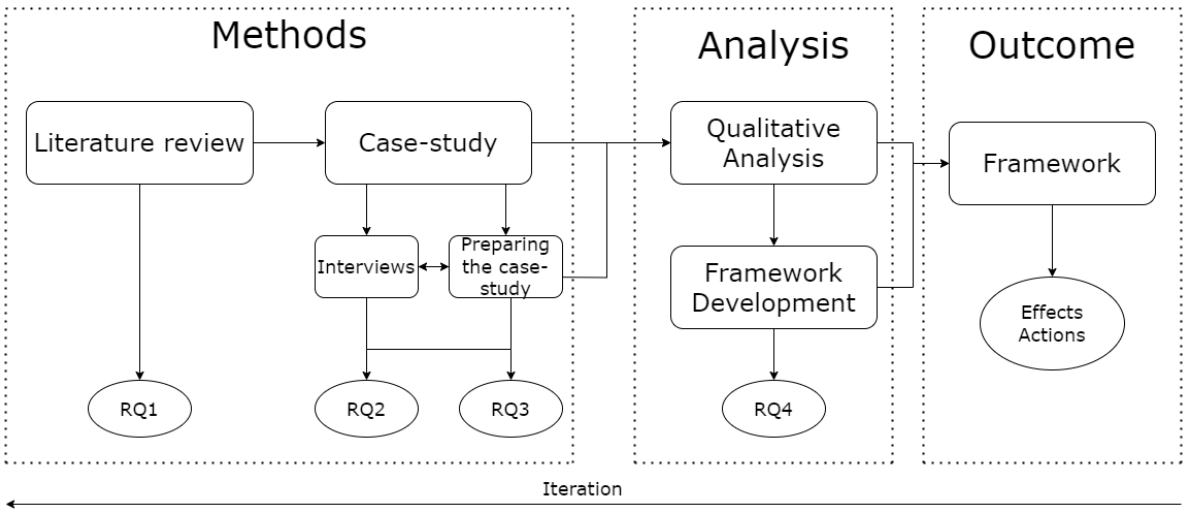


**Figure 2.1:** Research design - Answering sub-questions through a literature review and a qualitative case study.

### 2.1.1. Literature Review

The literature review starts by assessing the literature on the portfolio approach and the important objectives of this research. It is structured around the objectives of the research questions and the overall research aim and concludes with a list of key principles related to the portfolio approach. The client and contractor perspectives section details both sides of the projects. This includes the public client's asset management plans and the market side's capacity considerations. The literature review aims to help understand the essential terminology accurately and form a scientific ground for the case study.

A literature review in this context serves two purposes. Firstly, it identifies existing knowledge gaps. Secondly, it creates a theoretical framework (Miles, 2017). Access to relevant literature is crucial for any research project and across all research disciplines. Conducting a literature review offers several advantages. It provides a general overview of a research area that may be unfamiliar. It highlights areas where significant work has already been accomplished, helping researchers avoid duplicating efforts. Additionally, it can inspire new ideas for further research and identify problems or flaws in existing studies. A literature review also allows researchers to place their work within a broader context, showing how their findings might contribute to new conclusions (Knopf, 2006).

Relevant papers for this research have been selected using keyword searches in titles, abstracts, and keyword lists. Papers matching these criteria have been chosen for further reading. For snowball sampling, titles, abstracts, and keywords have been examined to assess relevance. Abstracts have been reviewed to determine if papers warrant further analysis or should be discarded. References have been managed and accessed using Mendeley software.

### 2.1.2. Case-Study

A qualitative study for the second and third questions is performed. Yin (2009) explains that a case-study allows for an in-depth exploration of a specific phenomenon within its real-life context. This depth of understanding can be particularly valuable when studying complex issues or unique situations. Yin (2009) highlights the significance of understanding the interconnections between a phenomenon and its context. Case studies allow researchers to analyse the entire system or situation, taking into account diverse factors and their interactions. The purpose of a case study is to elucidate, depict, exemplify, scrutinize, or appraise the phenomenon that has captured the attention, and to answer questions that begin with ”How” and ”Why”. This thesis will focus on a single case study. While this might seem confusing, it is important to clarify that the case study focuses on one portfolio. However, this portfolio contains two projects, meaning that although it is a single case, it involves the examination of several projects within that portfolio. Therefore, this qualifies as an embedded case study, as it explores both the broader portfolio and the individual projects within it. It is possible to generalize from a single case, despite the common belief that this is not. Case studies can be important in scientific development, serving as a supplement or even an alternative to other research methods. However, while formal generalization is often considered the most reliable source of scientific development, the power of example is often underestimated (Flyvbjerg, 2006). This definition captures that case studies are intended to provide a level of detail and understanding, unlike more superficial and generalizing methods (Willis, 2014).

Willis (2014) emphasizes that research goals should dictate methodological choices, rather than rigid and dogmatic predetermined approaches. He mentioned several benefits of a single case-study, two of which are highly relevant to this research: (1) Depth and Nuance: Single-case studies provide a detailed, holistic view of a specific phenomenon. This depth allows for a rich, nuanced understanding that is often not possible through broader, quantitative approaches. Such studies are valuable when dealing with complex issues that require deep understanding rather than superficial measures. (2) Potential for Generalization: Even though these studies focus on a single instance, they can still contribute to broader knowledge. They can be designed as nomothetic studies, which aim to build and test general theories, or as ideograph studies, focusing on the unique aspects of the case. The case is a single-case study of a portfolio that includes multiple projects.

**Case-Selection** A case is selected that significantly reflects the portfolio approach and is considered measurable. Keeping this in mind several criteria have been used to determine which case best fits within the research, these are shown in Table 2.1.

**Table 2.1:** Criteria for Selecting the Case-Study

| Aspect | Requirement |
|---|---|
| Project Status | The case has at least started or completed for effects to be visible |
| Use of Approach | The case is part of a portfolio approach |
| Scalability and Replicability | The case is replicable and not a unique megaproject |
| Impact on Practice | The case will have an impact on future portfolio approach practices |

**Preparation of Case-Study**

The selected case study focuses on a national portfolio of two major bridge renovation projects. One of these renovations has been completed, marking it as one of the initial experiments by a public commissioner to apply the portfolio approach. This project is among the first of its kind, involving two large-scale bridges, and meets all the specified requirements for the case study. The preparation of the case study involves an exploration of grey literature related to the topic, aiming to identify key insights and priorities as outlined by the public commissioner.

**Interviews**

The goal of the study is to engage multiple respondents through a case study by involving both the client and the contractor in the embedded case study. Guest et al. (2006) highlights that the number of interviews should be adjusted depending on the specific needs of the study, the timeframe, and the perspectives being examined. In this case, both client and contractor perspectives are considered, and the number of interviews is adjusted to ensure that theoretical saturation is achieved. Baker and Edwards (2012) mention: 'In general, the old rule still applies: keep asking questions as long as you're getting different answers.' The goal is to conduct interviews until no new information emerges, ensuring a broad range of responses.

Weiss (1995) outlined general steps for conducting an interview. These steps are used to create data. (1) Getting started: establish the role of the interview in the research (approach). (2) Selecting respondents: sampling criteria. (3) Crafting protocol: preparing the interview. (4) Entering the field: conducting interviews. (5) Analysing interview data.

*Criteria to search Respondents*

Respondents are selected based on specific criteria to gather the most relevant information. These criteria represent both the public and private sides and ensure that respondents know the portfolio approach and the relevant projects. The selection criteria are listed in Table 2.2.

**Table 2.2:** Criteria for Selecting the Respondents

| Aspect | Requirement |
|---|---|
| Public and Private Representation | Respondents should represent both the client (public) and contractor (private) sides to ensure a balanced perspective. |
| Knowledge of Relevant Projects | Participants must have direct knowledge or involvement in the case study to provide accurate insights. |
| Familiarity with Portfolio Approach | Experience or understanding of the portfolio approach in infrastructure projects is essential. |
| Involvement in Multiple Projects | Ideal candidates have participated in multiple projects, preferably within a portfolio, to grasp inter-project connections. |

*Interviewees*

Table 2.3 provides an overview of the interviewees, detailing the number of interviews, the organizations involved, and their relevance to the case study. To maintain confidentiality, all data is anonymized. Interviewees are recommended by others, a technique known as snowball sampling. This method involves existing study subjects recruiting future subjects from among their acquaintances. In this approach, the researcher selects a few initial participants and asks if they can refer others with similar views or experiences to join the study. The snowball sampling method is both time-efficient and allows

the researcher to build stronger rapport with participants, as the recruits are often acquaintances of the original sample, fostering a sense of trust and connection (Naderifar et al., 2017). This approach is instrumental in identifying key stakeholders and experts who are directly involved or have significant insights into the case-study.

**Table 2.3:** Roles, Organisation & Involvement of Interviewees

| No. | Interviewee Role | Organisation | Involvement with the Project | Duration (minutes) |
|---|---|---|---|---|
| 1 | Project manager | Client | Portfolio initiator Case-Study | 60 |
| 2 | Ex-Portfolio manager | Client | Portfolio guidelines initiator | 75 |
| 3 | Tendering manager | Contractor | Tender manager Case-Study | 70 |
| 4 | Ex-Program manager V&R | Client | Portfolio initiator Case-Study | 35 |
| 5 | Project director | Contractor | Project director Case-Study | 60 |
| 6 | Environmental manager | Client | Environmental manager Case-Study | 60 |
| 7 | Manager planning-phase WNL | Client | Project director Case-Study | 60 |
| 8 | Project manager | Client | Project manager Case-Study | 55 |
| 9 | Advisor portfolio management | Client | Overall manager Portfolio West-Netherlands | 55 |
| 10 | Portfolio director | Client | Initiator of Portfolio Approach public sector | 70 |
| 11 | Policymakers Portfolio Projects | Client | Three policymakers | 60 |
| 12 | Division Director | Contractor | Portfolio & Asset Management | 60 |

## 2.2. Data Analysis and Gathering

**Data Gathering**

When conducting research that involves personal data, it is critical to prioritize the protection of an individual's privacy and confidentiality. The TU Delft provided general guidelines. (1) Minimize Data Collection: Only collect the personal data that is necessary for your research objectives. (2) Limit Data Sharing: Share personal data with as few researchers or collaborators as possible to reduce the risk of unauthorized access or misuse. (3) Remove Identifying Information: After collecting personal data, remove or anonymize identifying information as soon as possible without compromising the research objectives. This may involve anonymizing interview transcripts, summarizing data, or obscuring identifiable features in multimedia materials. (4) Secure Data Deletion: Once personal data are no longer needed for the research project, ensure their deletion. (5) Obtain Informed Consent: Obtain explicit consent from participants for any data-sharing activities, even if the data are anonymized. Participants should be fully informed about the purposes of data collection and any potential sharing arrangements.

In this research, this concretely means the following: a Data Management Plan has been prepared and approved by a data steward at TU Delft. This plan specifies the type of data to be collected: interview data related to a project. Personal data will be anonymized and only shared with the thesis committee when necessary. Informed consent forms will be signed by all interviewees, explaining how their data will be handled. The data will be stored in the personal TU Delft OneDrive until the completion of the thesis. Other data collected during the preparatory research will be reviewed. This data will also be anonymized and securely stored.

**Data Analysis**

Each interview is transcribed using either Microsoft Teams or Microsoft Word. While transcribing may seem straightforward, it is the first step in data interpretation (Bailey, 2008). Recordings are transcribed into a written form so that they can be studied in detail, and linked with analytic notes and/or codes. Intelligent transcription converts spoken language into clear, contextually accurate written text. Unlike verbatim transcription, this method refines content by omitting fillers, false starts, and irrelevant details while correcting errors to capture the speaker's intended meaning (Nestel et al., n.d.). Data collection in a case study requires a thoughtful approach that shapes the research process. Coding and qualitative content analysis are used to structure the data. Open codes are generated from interview data, grouping relevant segments into codes and organizing them into themes. This qualitative analysis seeks to understand phenomena rather than make broad generalizations, categorizing data through close

reading (Forman and Damschroder, 2007).

This process consists of several steps in which segments of material are categorized into main and sub-categories within a coding framework. The first step involved preparing the data, which included transcribing the interviews, familiarizing with the content, and identifying quotes - segments containing information relevant to the research. The second step involved organizing and describing the data by assigning codes to these quotes. Coding enables the retrieval of data segments by topic or subject in later stages, facilitating their grouping. Code creation was carried out in a data-driven manner, involving four main steps:

1. Summarizing each quote by reading and assigning it to relevant concepts.
2. Reviewing each quote to determine whether an existing code covers its concept. If a code exists, adding the summary of the concept or idea to that code; if not, generating a new code to cover it.
3. Repeating these steps until all quotes are summarized and assigned to a concept, resulting in a list of codes.

**First-Order Concepts**: These are direct codes that emerge from the raw data, representing specific statements or ideas mentioned by the participants. They serve as the foundational elements of the analysis.
**Second-Order Themes:** These themes are more abstract. They group the first-order codes into meaningful categories that reflect broader ideas or themes, helping to organize the data into a more coherent structure.
**Aggregate Dimensions:** At the highest level of abstraction, these dimensions synthesize the second-order themes into overarching objectives that directly relate to the research questions. They are used to draw conclusions and to formulate answers to the research objectives.
The content of these concepts and themes can be found in Figure 2.2.

## 2.3. Validity

Validity ensures that a study measures what it intends to measure. As outlined by Borsboom et al. (2004), research is considered valid if it accurately measures the attribute it claims to, with variation in the attribute causing corresponding variation in the results. This suggests that the link between the research findings and the attribute studied is causal, not merely correlational. Therefore, the validity of this research confirms that the studied attributes, such as the effects and actions of the portfolio approach, are accurately represented through the chosen methods.

To strengthen validity, expert evaluation sessions will be conducted, intentionally expanding the assessment beyond the specific case study. In these sessions, the findings will be presented to experts who will provide evaluative feedback and insights. This expert evaluation is designed to critically examine whether the results are consistent with professional perspectives and practical applications, thereby testing their robustness and applicability in broader contexts. The primary purpose of this evaluation is not only to validate but also to refine the findings, ensuring they align closely with real-world conditions and maintain relevance beyond the case setting. Any adjustments based on expert input will be incorporated to further enhance the accuracy and applicability of the results.

**Table 2.4:** Roles, Organisation & Involvement of Experts

| No. | Interviewee Role | Organisation | Involvement with the Portfolio Approach | Duration (minutes) |
|---|---|---|---|---|
| 1 | PhD Candidate | TU Delft | Researcher of innovation within repetitive tasks | 45 |
| 2 | Assistant Professor | TU Delft | Involved in strategy and innovation in procurement and contracting | 60 |
| 3 | Postdoctoral Researcher | TU Delft | Researcher of portfolio and programmatic approaches | 60 |
| 4 | Director Public Sector Consultancy | PwC | Involved in applying the portfolio approach in practice | 40 |

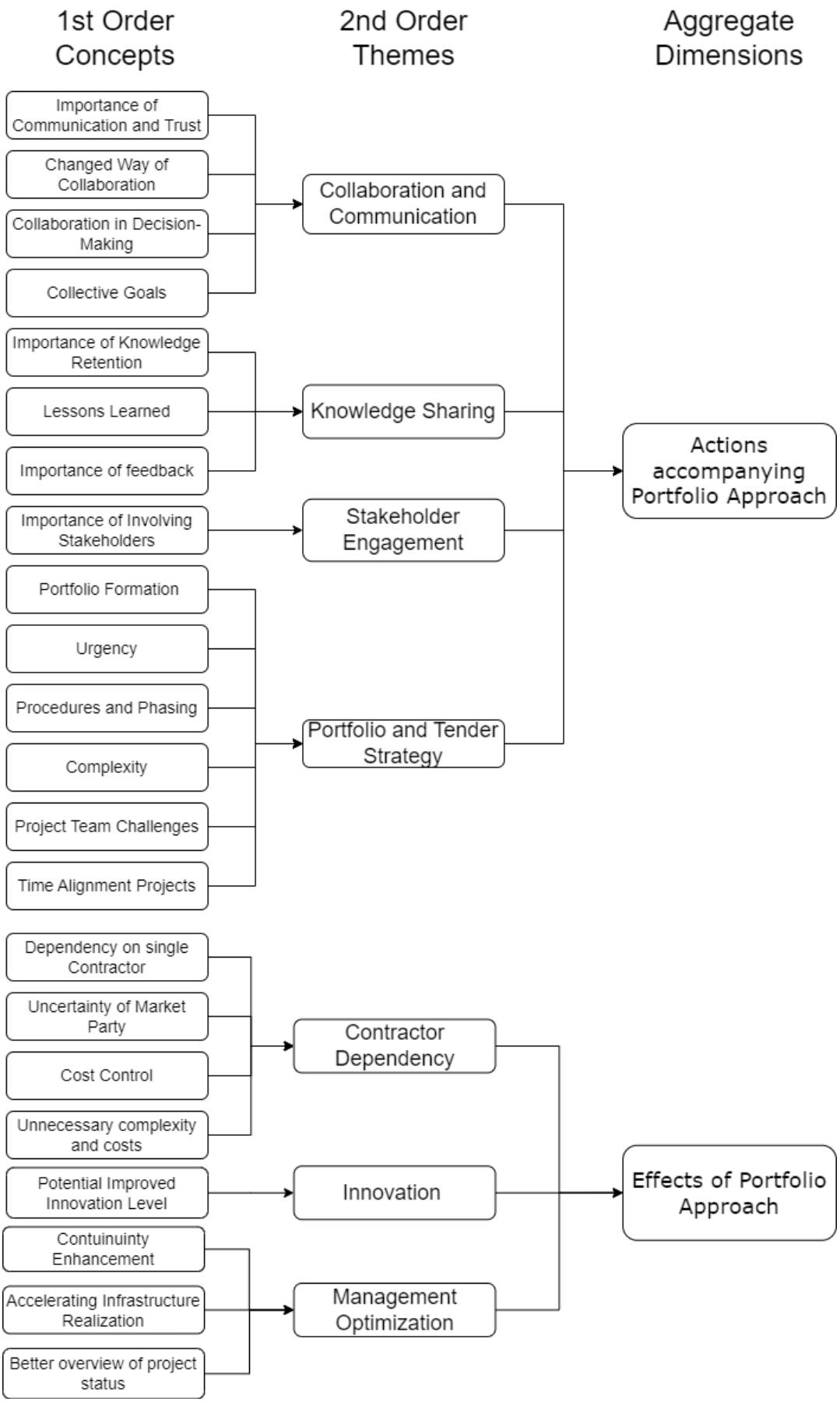


**Figure 2.2:** First order Concepts, Second order Themes & Aggregate Dimensions of Empirical Data

# 3

# Literature Review

## 3.1. Purpose and Outline

This chapter addresses research question 1: *What are the principles of a portfolio approach in public infrastructure projects according to existing literature?*. It outlines the objectives to be achieved as part of the overall thesis research. Specifically, the chapter investigates and describes the principles and effects of the portfolio approach as discussed in the literature. Subsequent steps involve understanding the actions required to achieve these effects, which is explored through a case study addressing the other sub-questions.

This literature review provides foundational knowledge and highlights key aspects of the portfolio approach, which also informed the development of interview questions for SQ2 and SQ3. By defining and summarizing relevant research findings, this approach builds a solid theoretical framework, positioning the study within the broader academic context and demonstrating an understanding of the subject area (Ridley, 2012). The main concepts discussed in this literature chapter are derived from the research questions. The chapter begins by examining the implications in public infrastructure management, followed by a discussion on the relationship between client and contractor and their differing views on project success. Following this, a brief discussion on the topic of infrastructure renewal is presented. Furthermore, it delves into the characteristics of the portfolio approach and emphasizes the connection between the portfolio approach and principles. Lastly, it highlights the benefits of the approach and common themes.

## 3.2. Policy Implications in Public Infrastructure Management

Schraven et al. (2011) explores the complexities and challenges faced by public agencies in managing infrastructure assets, particularly in the context of budgetary constraints and diverse stakeholder interests. The research highlights the critical need for clearly defined infrastructure objectives, the development of essential skills among public agents, and the alignment of stakeholder interests. The findings suggest several practical implications for public agencies in managing infrastructure assets:

1. **Clear Definition of Objectives**: Clearly defined objectives serve as a roadmap for decision-making and resource allocation. They help ensure that all stakeholders are aligned and working towards common goals. Agencies should engage in stakeholder consultations to identify and prioritize objectives that reflect the needs and expectations of various user groups, political bodies, and private sector organizations. This process should involve setting measurable performance indicators that can guide daily operations and long-term planning.
2. **Skill Development**: The complexity of managing public infrastructure assets requires a diverse

skill set beyond technical knowledge. Public agents must be equipped to navigate the multi-faceted challenges they face, including political, social, and economic factors. Agencies should invest in training programs that cover a range of competencies, including project management, stakeholder engagement, risk assessment, and communication strategies. Collaborating with universities to incorporate asset management into curricula can also help build a knowledgeable workforce.

3. **Alignment of Interests**: Infrastructure assets often serve multiple functions and are impacted by various stakeholders. Misalignment of interests can lead to conflicts and inefficiencies in asset management. Agencies should adopt a collaborative approach to decision-making, involving stakeholders in the planning and prioritization processes. This can be achieved through workshops, public consultations, and stakeholder forums that facilitate dialogue and consensus-building. Additionally, agencies should regularly review and adjust objectives to reflect changing stakeholder needs and environmental conditions.
4. **Adoption of Asset Management Principles**: Effective asset management principles can help agencies optimize their operations, improve service delivery, and extend the lifespan of infrastructure assets, especially in times of budget constraints. Agencies should adopt a systematic approach to asset management that includes regular condition assessments, performance monitoring, and data-driven decision-making. This may involve implementing asset management software and tools that allow for better tracking of asset conditions and maintenance needs. Furthermore, agencies should establish clear criteria for project selection and prioritization based on the defined objectives and available resources.

The construction industry delivers various projects, such as buildings, roads, or bridges. Construction companies usually have multiple projects in progress and continuously plan for future projects to ensure business continuity, including large infrastructure projects. These projects and the planning for such projects generally have the following characteristics (Flyvbjerg, 2007):

1. Such projects are inherently risky due to long planning horizons and complex interfaces.
2. Technology is often not standard.
3. Decision-making and planning are often multi-actor processes with conflicting interests.
4. The project scope or ambition level often changes significantly over time.
5. Statistical evidence shows that such unplanned events are often unaccounted for, leaving budget contingencies sorely inadequate.
6. As a result, misinformation about costs, benefits, and risks is common.
7. The majority of projects suffer from cost overruns and/or benefit shortfalls.

**Policy Implications** Flyvbjerg (2007) highlight the problematic characteristics and outline the policy implications that arise from them. The policy implications of the results presented above are:

1. Lawmakers, investors, and the public cannot trust information about the costs, benefits, and risks of large infrastructure projects produced by promoters and planners of such projects.
2. The current approach to planning large infrastructure projects is ineffective in traditional economic terms, leading to Pareto-inefficient investments. This current approach refers to traditional project management.
3. There is a strong need for reform in policy and planning for large infrastructure projects. Thus, two main measures of reform are:
   (1) better forecasting methods, and
   (2) improved incentive structures, with the latter being the more important.
4. Compare the specific project with the reference-class distribution to establish the most likely outcome for the particular project.

Flyvbjerg (2007), shows risks and inefficiencies linked to current project management practices. This study highlights the common occurrence of cost overruns, benefit shortfalls, and general mistrust in

project reporting. This implies a new approach in several ways:

1. **Complexity and Risk:** Infrastructure projects are known to be complex and risky due to their large scale, long timelines, intricate technology requirements, and the involvement of multiple stakeholders. The nature of these projects requires strong and comprehensive management strategies to deal with the high levels of uncertainty and complexity.
2. **Inadequacies in Current Planning and Management Methods:**The discussion highlights the deficiencies of conventional planning and management approaches, especially in their capacity to predict changes in project scope and manage unpredictable events successfully. The text contends that these methods frequently result in Pareto-inefficient outcomes, where resources could have been utilized more effectively in other areas, emphasising the economic inefficiencies inherent in current practices.
3. **Misinformation and Trust Issues:** Frequently, there are differences between the expected outcomes and the actual outcomes of projects. This results in lawmakers, investors, and the general public losing confidence in the information provided by project promoters and planners. This loss of trust highlights the importance of accurate and transparent reporting of project information.
4. **Policy and Reform Needs:** Given these issues, there is a clear call for reform in policy and planning for infrastructure projects.

These discussions show the importance of updating portfolio management practices to better address the challenges of modern multi-project environments. They promote a systemic and integrative approach that incorporates complexity theory, aligns closely with strategic business objectives, and adaptively manages interdependencies and external influences. This requires a shift away from conventional project management methodologies towards a flexible, collaborative, and dynamic portfolio approach.

## 3.3. Relationship Client and Contractor

**Need for interaction**

Trends like globalization, privatization, and servitization are changing how public construction clients interact with society and market entities. Additionally, modern construction challenges such as population growth, CO2 reduction, and urban development require public construction clients to focus on values like sustainability, circularity, and smart technology. To ensure these values are upheld, clients rely on the expertise of market parties. This reliance has led to a stronger emphasis on building trust and value-based management between the public and private sectors. Consequently, there is a greater need for collaboration with both the market and society to deliver and maintain public values. This shift affects the role of public bodies in managing public values, moving away from traditional values like integrity and lawfulness to prioritize serviceability and sustainability. The main challenge for public commissioners is to find a balance between relying on external partners and maintaining their own responsibility in protecting public values. This involves managing conflicts between traditional internal administrative values and new values that arise from collaborating with external networks. Balancing these differing values is essential for effectively fulfilling their role (Kuitert et al., 2020).

”Finding this balance is rather delicate, as a public party as a network collaborator, has to ‘lean in’ to the values of the network, but not ‘tilt’ and lose connection to the traditional public administrative system” (Kuitert et al., 2020). According to Kuitert et al. (2020) public construction clients are positioned between their organization and the social-political environment. The relationship between the client and the contractor is central to this role. They define commissioning as how a public organization handles its construction responsibilities by managing interactions with the supply market both internally and externally. This paper by Kuitert et al. (2020) highlights the complex role of public clients, and these takeaways are valuable for this research. This involves specifically the need for cooperation and the importance of more informal ways of working. Joint competencies are needed for adequate service delivery; there is a certain interdependency between client and contractor, and a need to cooperate to come to the best solution. The way public clients handle value conflicts, by taking on different roles

in a situation, affects the outcome. They suggest that public clients should focus more on balancing different values in a collaborative role, rather than making trade-offs in a directive role, especially when dealing with multiple value systems.

**Collaboration**
As mentioned in the preceding paragraph, collaboration is an important aspect of the client-contractor relationship. Suijkerbuijk et al. (2019) define collaboration as ”Inter-organizational collaboration is about joint production by two or more interdependent organizations, which is mutually beneficial through uncertainty reduction or performance improvement. Collaborations exist under conditions of trust and commitment, and by collaborating, organizations improve mutual learning, innovation, and problem-solving.” There are many ways to work together, and multiple approaches can be effective. While ”collaboration” is a popular and positive term, bSuijkerbuijk et al. (2019) suggest recognizing different ways of working together. The type of collaboration should be chosen based on what is best for the project. This could include cooperation, coordination, or different forms or levels of collaboration. It’s important to understand that each project has unique needs and may require a different approach. Within a portfolio approach, collaboration takes on a new form. Each project has unique needs, which the portfolio approach should address.

## 3.4. Infrastructure Renewal
Infrastructure planners in Western countries face new challenges as mature transport networks, like waterways, railways, and highways, age. These networks, mostly built in the early 20th century, are now essential to society but are becoming ”structurally deficient” and impacting competitiveness, as seen in Germany and the U.S. Consequently, the condition of existing infrastructure has become a major concern. From a Large Technical System perspective, infrastructure networks are entering a renewal phase. This perspective views infrastructure as a co-evolving system of social and technical components that progresses through four stages: establishment, expansion, maturity, and renewal. Large technical systems, like bridges, are essential for everyday life and serve multiple purposes, such as freight transport. Given their public importance, the state is often responsible for these systems through ownership or regulation. Their success relies on reliability, convenience, and low entry costs. These systems are capital-intensive with long-lasting assets and consist of interconnected social and technical components. Effective management and suitable institutional arrangements are necessary to coordinate public and private actors for successful operation (Willems et al., 2016).

## 3.5. Characteristics of the Portfolio Approach
Aritua et al. (2009) mention a challenge in project management. The lack of consistency and uniformity in understanding and use of terminology was the reason for defining Portfolio Management. Their research defines this as:

*’Portfolio management is the centralized management of one or more portfolios, which includes identifying, evaluating, prioritizing, authorizing, managing and controlling projects, programs, and other related work, to achieve specific, strategic business objectives.’*

Archer and Ghasemzadeh (1999) describe a project portfolio as: ’*A project portfolio is a group of projects that are carried out under the sponsorship and/or management of a particular organization. These projects must compete for scarce resources available from the sponsor, since there are usually not enough resources to carry out every proposed project which meets the organization’s minimum requirements on certain criteria such as potential portability, etc.’*

### 3.5.1. Complex Systems connected to Portfolio Management
Aritua et al. (2009) likewise highlight that there is a need for new approaches and techniques suitable for multi-project management. The management of multiple projects poses unique challenges that differ

from managing a single project. This literature explains the characteristics of the relationship between complex systems and a portfolio approach. According to the authors, managing multiple projects is not simply an aggregation of individual project efforts, but rather requires unique approaches, techniques, and tools. The portfolio approach is one of these tools.

The paper mentions two types of systems:

1. **Closed-Systems**: These are isolated systems that don't interact with their surroundings. These operate independently.
2. **Open-Systems**: These systems constantly interact with their environment. These take in inputs from the environment and produce outputs that are sent back into the environment.

Businesses, particularly those in the construction industry, are open-systems of interconnected elements that work together and respond to external influences. This concept applies to multi-project environments, part of larger systems such as government entities. In these cases, an organization's strategies are closely tied to the broader business environment, and the success of multi-project approaches depends on their ability to remain adaptable and responsive to changes in the external environment. Effective approaches rely on their capacity to navigate and leverage the dynamic interactions between various elements within the organization and its external environment. Project interdependencies can cause unexpected outcomes when delays or changes occur in other projects. Knowing the dependencies between projects is crucial for organizations to make informed decisions for better portfolio outcomes. There are different types of interdependencies such as resource, technical, learning, and organizational structures. Understanding these interdependencies is important as they can affect the entire portfolio, resulting from decisions or issues related to individual projects (Killen, 2017).

Aritua et al. (2009) defines a programme as: *'A programme is a framework for grouping existing projects or defining new projects, and focusing all activities required to achieve a set of major benefits. These projects are managed in a coordinated way, either to achieve a common goal or to extract benefits which would otherwise not be realised if they were managed independently.'*

Cooper et al. (1997) describes portfolio management as *a process that aims to manage and organize a company's portfolio of new product projects in a way that maximizes value, maintains a balanced mix, and ensures alignment with the company's strategic goals*. It emphasizes the integration of three elements: 1. Business Strategy: The company's overarching goals and direction drive portfolio management decisions. 2. New Product Process: A structured process that guides projects from idea to launch, often including stages and gates. 3. Portfolio Review: A periodic assessment that evaluates all projects together to ensure they align with the company's strategy and meet the goals of maximizing value and maintaining balance. Cooper et al. (1997) expands on this by emphasizing the critical goals of portfolio management, including maximizing portfolio value, achieving a balanced mix, and ensuring strategic alignment. Project Portfolio Management is mainly concerned with selecting the appropriate projects for a company or organization. They note the need to effectively integrate strategy, project processes, and portfolio reviews to manage resources efficiently.

Managing projects as portfolios allows organizations to handle risks and create value more holistically, as noted by Aritua et al. (2009). Complex adaptive systems, guided by complexity theory, consist of six components that, when applied to multi-project management, provide significant benefits. Table 3.1 summarizes these. Adopting a complexity perspective in portfolio management encourages a shift away from over-controlling individual project details. Instead, increased information sharing enables projects to self-organize and respond adaptively to change, which requires a high level of team trust. Project managers should continuously align their projects with evolving portfolio strategies and incorporate feedback to respond to external influences. Rigidly controlled environments may limit a project's ability to address real-world needs like innovation, sustainability, safety, and security (Aritua et al., 2009).

**Table 3.1:** Characteristics of Multi-Project Environments (based on: Aritua et al., 2009)

| Characteristic | Short Description | Connection to Portfolios |
|---|---|---|
| Inter-relationships | Individual components affect each other and influence actions. Projects in a portfolio are often interdependent and exhibit interrelatedness. | Coordinated management of resources, schedules, costs, and maximizing value while managing risks. |
| Adaptability | Open systems continuously adapt to new information from the environment. Program/portfolio management benefits from managing risk and obtaining value in response to changing business environments. | Deliberate effort to manage risk and obtain value in response to changing business environments and evolving project needs. |
| Self-organisation | Some systems tend towards order or self-organisation, where individuals act in similar ways in proximity to each other. Program/portfolio management should not be viewed as scaled-up versions of single project management. | Encourages competent project managers to act creatively and autonomously while maintaining necessary control and accountability. |
| Emergence | The whole is greater than the sum of its parts. Group behavior is distinct from individual behavior. Better risk and value management is achieved by multi-project management than by delivering single projects autonomously. | Reinforces the implications of self-organisation and supports better risk and value management. |
| Feedback | Information circulates, is modified, and influences behavior positively or negatively. Influences organizational structures, information management frameworks, and communication channels. | Requires multi-project management to react to changing business environments while providing relative stability for project delivery. |
| Non-linearity | Small changes in initial conditions or external environment can have large and unpredictable consequences. Different tools and techniques are needed for managing multi-projects compared to linear assumptions. | Necessitates different management tools and techniques to handle unpredictable outcomes in multi-project environments. |

### 3.5.2. Project Portfolio Succes

Organizations adopt Portfolio Project Management (PPM) to align their project portfolios with strategic goals and enhance the long-term value of their projects (Ginger et al., 2014). PPM is not merely a process but an organizational capability that relies on structure, culture, and people working together effectively. For PPM to succeed, support from top management is essential. In Ginger et al. (2014), PPM is introduced along with typical processes, which, while varying across organizations, generally include key steps: (1) gathering information from all projects, (2) organizing it, (3) presenting it to a decision-making team, and (4) establishing a framework for implementing those decisions. These steps are shown in Figure 3.1

As explained in subsection 3.5.1, construction projects occur in open systems, which are constantly changing. The environment in which these reside can be described as dynamic. Ginger et al. (2014) approaches this environmental dynamism. In Figure 3.2, is shown how this dynamic concept looks like connected to the portfolio approach, Learning and change are key components of the PPM approach, as shown in Figure 3.2

”The essence of portfolio management is decision making. The organization, through its key executives, needs to decide what projects, programs, and other initiatives to invest in, delay, defer, terminate, change, or modify to meet its strategic objectives.” (Ward, 2014, cited in, Ginger et al., 2014). This phrase is from their book. They stress the importance of asking ”Why establish portfolio management and what do we hope to gain?” In their book, a project portfolio is described as a group of projects that are conducted within the same business unit and share common strategic objectives and resources. Portfolio management is an ongoing and dynamic decision-making process that involves constantly updating and revising a business’s list of active projects. In a company that operates on a project basis, project portfolio management focuses on identifying the potential opportunities and risks associated with project initiatives and their impact on future business success.

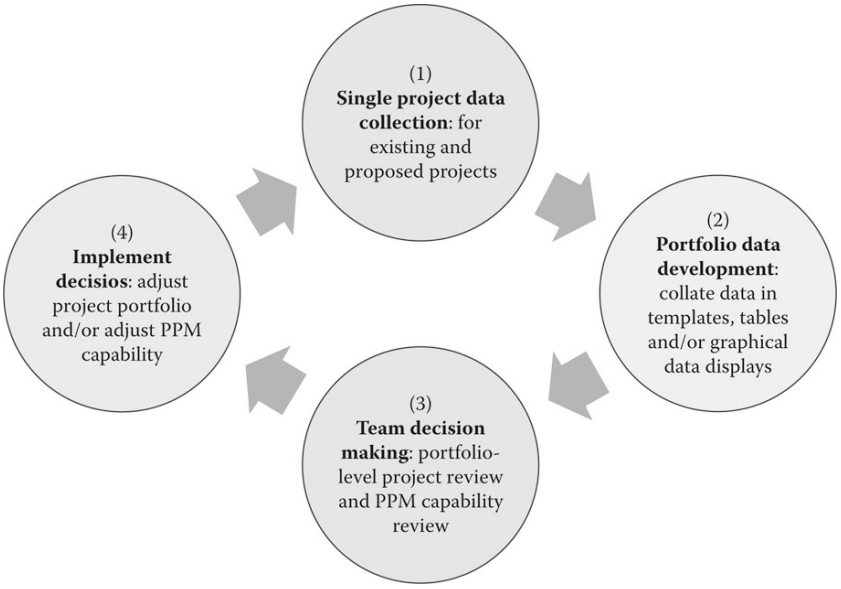


**Figure 3.1:** Outine Dynamic PPM Approach: (based on: Ginger et al. (2014))

According to Kendall and Rollins (2003), portfolios may fail due to several reasons. Four major reasons for such failure are: (1) having too many projects in the portfolio, (2) inclusion of inappropriate projects, (3) lack of alignment between the portfolio projects and the organisation's strategy, and (4) an unbalanced portfolio. The success of a portfolio is determined by the benefits that it delivers. Every project and program included in a portfolio has a corresponding business case that outlines the benefits expected from it. These benefits can only be realized after the completion of the project or program, and it is the responsibility of the portfolio to ensure that they are achieved.

Project portfolio success is determined by Teller and Kock (2013) as six dimensions: (1) average project success, (2) average product success, (3) strategic fit, (4) portfolio balance, (5) preparing for the future, and (6) economic success. The authors discuss the importance of managing risks at the portfolio level, as opposed to considering risks independently at the project level. They emphasize that this approach can lead to more effective risk management. The objectives of project portfolio management include maximizing portfolio value, balancing the portfolio, and ensuring alignment with strategic goals.

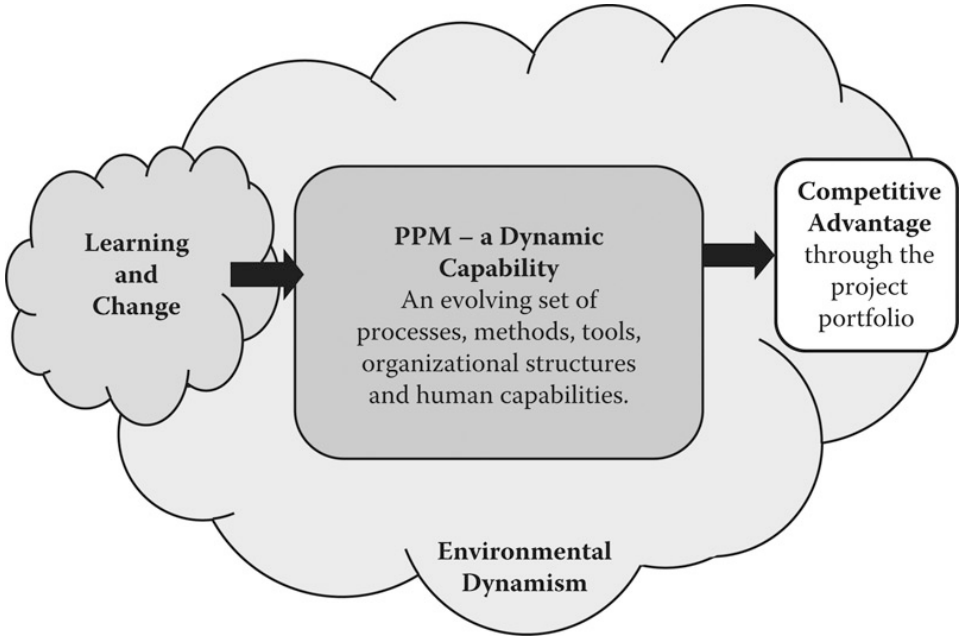


**Figure 3.2:** Learning and change: Competitive Advantage through the Evolution of PPM in Dynamic Environments.

### 3.5.3. Principles in Portfolio Management

As per the research by Hansen and Svejvig (2023), project portfolio management has provided principles to guide actions in portfolio-related situations. Management systems are built on the foundation of principles that help individuals react and respond in related conditions. Principles can be considered fundamental truths or propositions that establish a system of behaviour or reasoning. These principles are resilient over time and provide broader guidance on how to think and act in situations that have not occurred before.

The definition of a principle in this research, based on Hansen and Svejvig (2023) is:

*Principles are sophisticated constructs of interrelated thoughts, intentions, and practices that differ from rule-based guidelines. Although abstract, principles can be converted into actions.*

Hansen and Svejvig (2023) provide 17 principles among portfolio management, within four categories:

1. **Balance the Portfolio**: This category is centred around the process of selecting projects for an organization. It highlights the significance of establishing priority criteria, formalizing selection methods, utilizing decision-making tools, managing portfolios in complex project environments, and comprehending the limitations of computed methods. The main goal is to ensure that the portfolio is well-balanced and aligned with the organizational objectives.
2. **Build a Coherent PPM System**: This category highlights the importance of improving Project Portfolio Management (PPM) practices by adopting best practices. It involves taking a process-oriented approach, focusing on governance structures, and developing a supportive organizational culture. The aim is to enhance the overall effectiveness and efficiency of project portfolio management.
3. **Secure Strategy Effectiveness and Stakeholder Involvement**: This category emphasizes the importance of prioritizing strategic effectiveness by adopting a value approach that takes into account non-commercial factors such as ecological and societal values. It involves giving priority to stakeholder involvement, roles, and responsibilities, and being open to alternative perspectives to improve decision-making and outcomes.
4. **Create Readiness to Change and Deal with Paradoxes**: This category focuses on addressing the challenges of coping with uncertainty in project portfolio management. It aims to establish

the necessary conditions for innovation and change, promote agility beyond individual projects, and navigate paradoxes that arise during transitional periods. The ultimate goal is to prepare organizations to adapt to changing environments and effectively manage challenges that arise during the project portfolio management process.

17 principles are categorized into three perspectives: the technical, the understanding, and the emancipatory perspectives. From the technical perspective, 'Balancing the portfolio' and 'Building a Coherent PPM system' are categorized. Under the understanding perspective, 'Ensuring strategy effectiveness and stakeholder management' falls. Lastly, 'Creating readiness to change and dealing with paradoxes' falls under the emancipatory perspective. Below, the different perspectives are explained briefly. In table 3.2, all the 17 principles are listed with their explanations by Hansen and Svejvig (2023)

1. **Technical Perspective**: The technical perspective in Project Portfolio Management (PPM) emphasizes the control and prediction of the environment using natural science as an ideal. It is prevalent in categories like balancing the portfolio and building a coherent PPM system. The focus is on rational reasoning and revealing regularities to achieve key PPM goals. While this perspective is essential for guiding practice, relying solely on technical aspects may limit practitioners to being trained technicians and overlook contextual nuances.
2. **Understanding Perspective**: The perspective of understanding in PPM is based on the goal of interpreting and comprehending social interactions. This approach is particularly relevant in categories such as ensuring effective strategies and involving stakeholders. It encourages practitioners to develop a mutual understanding of contexts and relationships. By linking actions to the reality of PPM, this perspective enables practitioners to reflect and apply a more comprehensive conceptualization, beyond the technical aspects.
3. **Emancipatory Perspective**: The emancipatory perspective in Portfolio Management is focused on preparing organizations for change and helping them deal with complex situations. This approach involves addressing uncertainty, promoting innovation, facilitating adaptability, and managing paradoxes during times of transition.

**Table 3.2:** Principles and Explanations of PPM (based on: Hansen and Svejvig, 2023)

| Category | Principles and Explanations |
|---|---|
| **Priority Setting and Resource Allocation** | |
| Setting priority criteria | Establishing clear criteria helps in prioritizing projects effectively, ensuring that resources are allocated to projects that align best with organizational goals and objectives. |
| Formalize selection | Using computed models and formal methodologies help streamline the project selection process, making it more systematic and transparent. |
| Using tools to support decision-making | Employing portfolio matrices, decision support systems, and governance mechanisms aids in informed decision-making, ensuring that choices align with strategic objectives. |
| Deal with multiple project challenges | Address challenges inherent in managing multiple projects concurrently ensuring effective resource allocation and project coordination. |
| Comprehending the deficiencies of computed methods | Understanding the limitations and potential biases of computed selection models is crucial for making informed decisions and avoiding pitfalls in project selection and resource allocation. |
| **Raise Maturity** | |
| Increase maturity by adopting best practices | Incorporating and implementing industry best practices elevates the maturity level of project, program, and portfolio management processes, leading to improved performance and outcomes. |
| Apply a process view | Utilizing stage-gate models provides a structured approach to project management, ensuring that projects progress through defined stages with clear decision points. |
| Develop governance mechanisms | establish governance structures to ensure alignment between project activities and strategic objectives, facilitating effective resource allocation and project prioritization. |
| Create a supportive culture | Foster a culture that values innovation and effective project management and encourages collaboration, learning, and continuous improvement within the organization. |
| Learning from the best performers | Studying and adopting practices from top-performing organizations allows for the identification and implementation of strategies that lead to success in project and portfolio management. |
| Adapting decision-making style to the needs of the organization | Recognizing and adjusting decision-making styles to suit the unique characteristics and requirements of the organization ensures that decisions are made effectively and in alignment with organizational goals. |
| **Strategical Orientation** | |
| Focus on strategic effectiveness | Aligning project management practices with business strategy ensures that projects contribute directly to organizational goals and objectives, maximizing strategic effectiveness. |
| Apply a holistic value approach | Considering both commercial and non-commercial dimensions of value creation in project portfolios ensures that strategic objectives are met while also addressing broader societal and environmental concerns. |
| Focus on stakeholder involvement, roles, and responsibilities | Engaging stakeholders at all levels of the organization and clarifying roles and responsibilities ensures alignment with strategic objectives and fosters collaboration and accountability. |
| **Cope with Uncertainty** | |
| Establish preconditions for innovation and change | Foster response to change through structural and cultural components like the clarity of strategic goals, the formality of IPM processes, controlling intensity, innovation climate, and risk climate. |
| Enable agility outside of individual projects | Integrate elements of agile IT product development method into traditional gating (stage gates) through agile stage-gate models. |
| Deal with paradoxes in transitional times | Develop knowledge management capabilities combined with capabilities to obtain greater ambidexterity performance. |

### 3.5.4. Contextual Principles and Effects

Project Portfolio Management (PPM) is a vital component for companies managing multiple projects (Martinsuo, 2013). Her paper explores the practice and context of the PPM approach, as well as its benefits and basic principles.

Portfolio management is designed to coordinate and control multiple projects within an organization, ensuring they align with strategic goals. The core principles include:

- **Strategic Alignment**: Emphasizes aligning all projects with the organization's strategic goals.

This alignment ensures that each project contributes to the company's overall vision, maximizing the portfolio's strategic impact.

- **Rational Decision-Making**: Traditional PPM frameworks are built on a rational decision-making approach, where projects are evaluated and selected based on specific criteria, such as strategic fit, potential returns, and portfolio balance. This systematic evaluation helps in prioritizing projects and allocating resources effectively.
- **Portfolio Balance**: A balanced portfolio is a key principle of PPM, ensuring a mix of projects with varying risk levels, timelines, and objectives. This balance helps mitigate risks and ensures a steady stream of benefits, both in the short and long term.
- **Project Control and Evaluation**: PPM frameworks include control mechanisms to monitor project progress, evaluate performance, and make adjustments as needed. This ensures that projects remain on track and deliver expected effects.

Martinsuo (2013) outlines several positive effects associated with portfolio practices:

- **Resource Optimization**: It helps optimize resource allocation across projects. By prioritizing projects based on strategic importance, managers can allocate resources efficiently, reducing conflicts and ensuring projects have the necessary support to succeed.
- **Enhanced Communication and Knowledge Sharing**: The approach encourages communication and knowledge sharing between projects. This sharing can lead to technology and capability synergies, reducing duplication of effort and enhancing overall portfolio performance.
- **Improved Decision-Making**: The rational approach to PPM, combined with regular evaluation and control mechanisms, leads to more informed decision-making. Managers can base their decisions on data and objective criteria, minimizing the influence of biases or political factors.
- **Adaptability to Change**: He highlights the need for continuous adjustment in Portfolio management, particularly in dynamic business environments. This adaptability helps portfolios stay relevant, respond to market shifts, and accommodate new customer requests or requirements.
- **Competitive Advantage**: By aligning projects with strategic goals and optimizing resources, portfolio management can provide a competitive advantage. Projects can deliver products and services quickly, enhancing market positioning and potentially leading to greater market share.

### 3.5.5. Benefits as a Goal

Bai et al. (2022) describes the ultimate goal of a company's production and operation activities is to achieve corporate success, which is closely associated with project portfolio (PP) success. They mention that the definition of PP success was first introduced by Cooper et al. (1997), who identified three key objectives of project portfolio management (PPM) (as mentioned in 3.5.1): maximizing portfolio value, aligning the portfolio with the company's overall strategy, and maintaining portfolio balance. Building on Cooper et al. (1997), Bai et al. (2022) have further refined these objectives into eight more specific dimensions: (1) strategic implementation, (2) portfolio balance, (3) average product success, (4) synergy exploitation, (5) average project success, (6) strategic fit, (7) preparing for the future, and (8) economic success.

When discussing the benefits of a project, "benefit" often refers to financial gains. This can be considered from both financial and non-financial perspectives. Financial benefits typically focus on profitability and the direct income generated by a project for the market party. Popular methods for assessing these financial benefits include cost-benefit analysis, which compares the costs of a project against the financial gains it offers, and net present value analysis, which determines the value of a project's future cash flows in today's dollars. Non-financial benefits, although not directly measurable in monetary terms, may include enhancements in customer satisfaction, environmental impact, social value, or

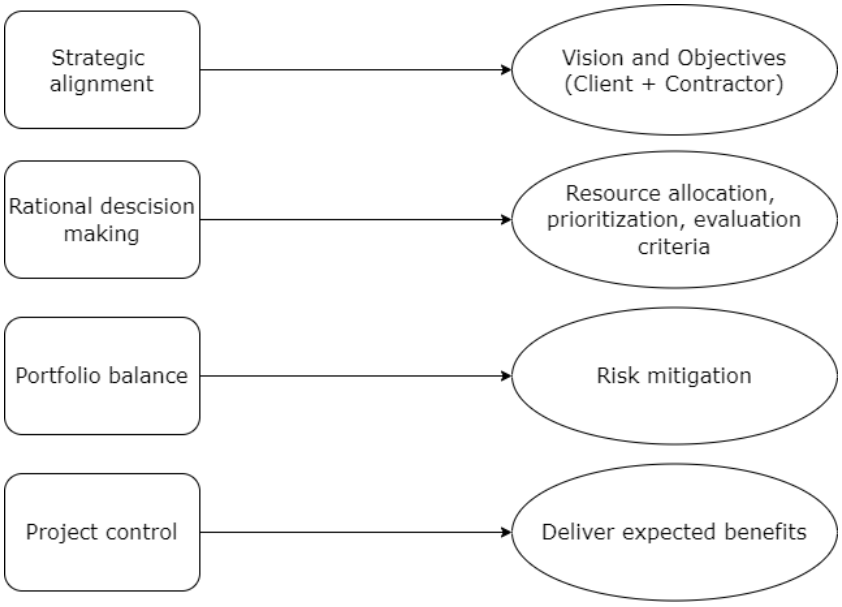


**Figure 3.3:** Portfolio Goals linked to Portfolio Principles (based on Martinsuo, 2013)

contributions to knowledge and innovation. These benefits are also valuable, but they require different evaluation approaches that go beyond simple financial calculations. These financial and non-financial assessments provide a comprehensive view of a project's overall benefits.(Bai et al., 2022).

Bai et al. (2022) essentially refer to four benefits including:

1. **Improved project portfolio performance**: Dynamic assessment modelling is a method that helps organizations improve their project portfolio performance by assigning resources efficiently, managing risks, and making informed decisions. By using advanced modelling techniques, organizations can identify opportunities for improvement and streamline processes, resulting in enhanced portfolio efficiency and effectiveness. This approach enables organizations to optimize their performance and achieve their goals more effectively.
2. **Enhanced benefit evaluation**: When evaluating project benefits, it is important to consider different perspectives, such as financial and non-financial aspects. Organizations can use cost-benefit analysis, net present value analysis, Bayesian methods, emergy analysis, and political economic theory. By using these methods, organizations can better understand the benefits of their projects. This helps them make better decisions and allocate resources more effectively, which leads to improved project outcomes and increased value creation.
3. **Benefit optimization**: Researchers have found that studying projects with different attributes and strategies can be more beneficial. For instance, it is important to evaluate the costs and benefits of projects transparently and trustworthy after their completion to enhance their benefits. Properly managing risks within and among projects can also help maximize their benefits. Furthermore, exploring opportunities beyond the original plan of a project can lead to unexpected benefits for stakeholders, increasing its overall value. By implementing these optimization strategies, organizations can make the most of their projects and improve their overall performance.
4. **Portfolio-level benefit management**: The authors emphasize the significance of effectively managing the benefits of a project portfolio at a strategic level. It discusses the challenges and opportunities involved in guiding benefit management at the portfolio level, such as the utilization of historical data for portfolio selection, considering project interactions for optimization, and evaluating risks to ensure that project portfolio benefits are realized. By focusing on benefit management at the portfolio level, organizations can align their project portfolios with strategic objectives, improve decision-making processes, and achieve greater value creation across their project portfolio.

Another study, which builds further on Bai et al. (2022), focuses on aligning project portfolios with an enterprise's strategic objectives, considering synergies between existing and potential new projects. This study by Ma et al. (2022) provides both theoretical frameworks for project selection and practical guidelines for managing project portfolios in business. The most important takeaways from their research, concerning project portfolios are:

1. **Strategic Alignment**: It is important to ensure that the projects included in a portfolio align with the company's overall strategic objectives. Whenever new projects are added, they must be assessed based on their potential to bring the portfolio back in line with these strategic objectives, particularly in cases of internal conflicts or external emergencies that can cause deviations.
2. **Synergistic Relationships**: Understanding and evaluating the synergies between projects in a portfolio is crucial. These synergies can significantly impact the portfolio's overall performance by improving the efficiency of resource allocation, technology utilization, and information flow among projects.
3. **Project Portfolio Change (PPC)**: Project Portfolio Calibration (PPC) is a technique employed to regulate any deviations in the project portfolio from the strategic objectives of an organization. This method involves selecting and incorporating new projects that can counterbalance these deviations, thus ensuring that the portfolio stays on target to achieve its objectives.

## 3.6. Actions & Effects

In this research, the objectives include identifying the necessary actions to effectively investigate and apply the portfolio approach within the Dutch public sector. Another goal is to explore the effects of the portfolio approach through a case study. Since this constitutes a significant part of the research objectives, this literature section briefly addresses what constitutes an action and what defines an effect.

### 3.6.1. Actions

Wang et al. (2016) mention that an action is a transformation that changes the state of the environment from precondition to effect, with the true meaning of an action lying in the change or transformation it brings. The precondition of an action refers to the state of the environment before the action occurs.

In the portfolio approach, an "action" is an intervention within a management system or object that changes its state. The precondition, or initial state, serves as a reference to assess the impact of the action. When an action is applied, it results in a new post-action state, which affects system outcomes in ways that would differ without the intervention. This approach focuses on strategically applying actions to achieve desired effects, with success depending on the pre-and post-action conditions. A key concept is the link between behaviour and action. For an action to be effective, the individual's role is vital, as behaviour—shaped by motivation, experience, and context—influences how the action is executed. Ajzen (1991) outlines three factors that impact behaviour: attitude toward the action, subjective norms (perceived expectations of others), and perceived control (confidence in one's ability to act). In the portfolio approach, those involved, such as project managers, must not only understand an action but also feel motivated and capable of carrying it out.

### 3.6.2. Effects

An effect is the result or change brought about by a specific action, intervention, or variable, which is used to evaluate the relationships among different factors in research, effects can be the outcomes (Y) that researchers are interested in understanding, which are affected by a causal variable (X) (Montoya and Hayes, 2017).

An effect, in the context of the portfolio approach, is the result or change brought about by specific actions or interventions applied to project management systems. These effects are used to evaluate the relationships among various factors within the portfolio, such as performance, efficiency, and innovation. In portfolio management, the outcomes (Y) that organizations aim to achieve—like improved project

delivery or reduced costs—are directly influenced by the actions or strategies (X) implemented across multiple projects.

## 3.7. Wrap-up Chapter

To address Research Question 1 (SQ1), which seeks to understand the principles of a portfolio approach in infrastructure projects based on existing literature, identifying and summarizing the common themes from the literature review could provide insights into the portfolio approach and its fundamental principles in the context of infrastructure management.

### 3.7.1. Emergent definitions

Common definitions used in this research are based on the literature. These definitions are aligned with the interpretation of the portfolio approach and provide not only theoretical value but also practical applicability, making it easier to apply the theory in practice during case studies.

- *Portfolio Management = Portfolio management is the centralized management of one or more portfolios, which includes identifying, evaluating, prioritizing, authorizing, managing and controlling projects, programs, and other related work, to achieve specific, strategic business objectives* (Aritua et al., 2009).
- *Portfolio = A portfolio is a collection of projects sponsored and/or managed by an organization, sharing a common theme to increase efficiency and performance* (Archer and Ghasemzadeh, 1999).
- *Principle = A principle is a set of related thoughts, intentions, and actions that differ from rule-based guidelines* (Hansen and Svejvig, 2023).

### 3.7.2. Combined Overarching principles

The principles found in this chapter have been cited and summarized in Appendix A. As a result, 28 principles have been identified, which resemble each other and can be categorized under designated sub-themes to clarify their relationships. To make the research more concrete, all the principles have been compared and consolidated into 15 principles under 6 themes. The result is shown in table 3.3 and will be used as a basis for the case study and the interviews within the case study. The comparison of the principles and how the result of the 15 principles is obtained is shown in Appendix A. The broad topics are (1) Strategic Management, (2 )Decision-Making and Evaluation, (3) Risk and Change Management, (4) Communication and Collaboration, (5) Risk and Change Management, (6) Performance and Benefit Management.

In this chapter, a literature review was initiated to explore various objectives associated with the portfolio approach in public infrastructure. The collected information has been categorized into 15 principles that can serve as an exploratory framework for analyzing a public infrastructure case. Furthermore, this chapter has developed a definition of the subject matter. To answer SQ1: *What are the principles and effects of a portfolio approach in infrastructure projects according to existing literature?* The principles and effects of a portfolio approach consist of many characteristics, labelled under five broad topics: (1) Strategic Management, (2) Decision-Making and Evaluation, (3) Risk and Change Management, (4) Communication and Collaboration, (5) Performance and Benefit Management. These topics can be seen as the basis of exploring a portfolio approach in public infrastructure management. The specifics that belong to each topic are shown in Table 3.3.

The next step involves examining the principles within a case study. The subsequent chapter builds on this by refining the principles identified in this chapter, reducing them to a more focused set that can be specifically analyzed in a case study. This approach allows for a deeper exploration and practical application of the most relevant principles to a real-world public infrastructure project.

**Table 3.3:** Refined Overarching Principles of Project Portfolio Management

| | | |
|---|---|---|
| | **Strategic Management** | |
| 1 | Strategic Alignment and Goal Alignment | Combines principles of strategic alignment and goal orientation across studies to emphasize the importance of aligning project outputs with organizational objectives, capturing the synergy of strategic directives from different frameworks.<br>Aritua et al. (2009), Ginger Levin et al. (2014), Martinsuo (2013) |
| 2 | Portfolio Balance and Diversity | Merges insights on the necessity of maintaining a portfolio that is both balanced in risk and diversified in project types, underscoring the parallel emphasis on balance to optimize performance and mitigate risks in multiple studies.<br>Ginger Levin et al. (2014), Martinsuo (2013) |
| 3 | Resource Optimization and Allocation | Synthesizes principles focused on efficient resource management, reflecting a common theme across sources that highlight the critical nature of resource allocation in ensuring project support and conflict reduction.<br>Martinsuo (2013) |
| | **Decision-Making and Evaluation** | |
| 4 | Rational Decision Making and Benefit Evaluation | Integrates systematic approaches to decision-making with the thorough evaluation of benefits, emphasizing the dual focus on logical processes and comprehensive benefit assessments found in multiple sources.<br>Martinsuo (2013), Bai et al. (2022) |
| 5 | Improved Decision-making through Feedback | Consolidates the principle of utilizing feedback to enhance decision-making quality, aligning with multiple sources that recognize the dynamic nature of managing projects through continuous adaptation and feedback.<br>Aritua et al. (2009) |
| 6 | Project Control and Evaluation | Encapsulates the continuous monitoring and iterative evaluation of projects, merging principles that highlight the need for ongoing adjustments to achieve project and strategic goals.<br>Martinsuo (2013) |
| | **Risk and Change Management** | |
| 7 | Adaptability to Dynamic Environments and Change | Aggregates principles focusing on adaptability and responsiveness, reflecting the critical consensus on the need for portfolios to quickly respond to external pressures and internal dynamics.<br>Aritua et al. (2009), Ginger Levin et al. (2014), Hansen and Svejvig (2023) |
| 8 | Managing Risks at the Portfolio Level | Highlights the unified approach to risk management advocated across studies, emphasizing the importance of a strategic, holistic risk management strategy within the portfolio context.<br>Ginger Levin et al. (2014) |
| 9 | Readiness to Change and Handling Paradoxes | Combines readiness for change with the management of paradoxical situations, underlining the agility and proactive strategies needed to navigate complex, uncertain project environments effectively.<br>Hansen and Svejvig (2023) |
| | **Communication and Collaboration** | |
| 10 | Communication and Knowledge Sharing | Highlights the convergence of communication strategies across studies, emphasizing the role of information exchange and knowledge sharing in fostering innovation and efficiency within projects.<br>Martinsuo (2013) |
| 11 | Stakeholder Involvement and Strategy Effectiveness | Synthesizes the engagement of stakeholders with the effectiveness of strategic planning, showcasing the collective emphasis on inclusive and engaged decision-making processes to enhance project outcomes.<br>Hansen and Svejvig (2023), Martinsuo (2013) |
| | **Strategy with Adaptability** | |
| 12 | Building a Coherent PPM System and Organizational Culture | Links the development of structured governance to fostering a supportive organizational culture, emphasizing the intertwined nature of systematic management and cultural alignment in achieving effective portfolio management.<br>Hansen and Svejvig (2023) |
| 13 | Competitive Advantage through Strategic Projects | Merges strategic project alignment with the pursuit of competitive advantage, stressing the direct impact of strategic alignment on enhancing market position and achieving business success.<br>Martinsuo (2013) |
| | **Performance and Benefit Management** | |
| 14 | Portfolio-Level Benefit Management and Optimization | Discusses the strategic management and optimization of collective benefits, aligning with studies that emphasize the importance of holistic benefit management for organizational alignment and value creation.<br>Bai et al. (2022) |
| 15 | Dynamic Portfolio Performance Management | Advocates the use of advanced modelling techniques for continuous improvement, aligning with the emphasis on dynamic, data-driven approaches to refine portfolio performance and decision-making processes.<br>Bai et al. (2022) |

# 4

# Preparing the case study

## 4.1. Chapter overview

This chapter serves as a transitional segment in preparation for the case study, bridging the gap between the theoretical exploration of principles and their practical application. The answer to Sub-Question 1 is evaluated here to set the foundation for the case study, providing a clear view of which principles are essential to further explore in order to answer Sub-Questions 2 and 3. This section aims to compare the academic literature with grey literature, which is focused on principles that matter to the public commissioner. This focus is crucial because public commissioners are the primary decision-makers in public infrastructure renewal projects, and the contractor must ultimately comply with these decisions. The purpose is to identify whether the case study documents align with the findings from the literature. The key aspects from the document analysis, or the points of alignment, will be carried forward into the interviews for further investigation. In short, the principles from Table 3.3 are compared with the documents under investigation. Matching principles are identified and further explored in the interviews related to the case study. The end of this chapter shows a table with the 'tailored principles', these are the remainder of the 15 after the exploration of the case-study documents.

By refining the principles identified in previous chapters, this section will streamline and focus the approach, ensuring a more targeted and effective analysis in the upcoming case study. Figure 4.1 shows an overview of the case-study research.

## 4.2. Documents Shaping the Portfolio Approach in Dutch Infrastructure Projects

In this section of the thesis, relevant documents of the case study will be examined. These documents include:

1. Information on the bridges (Commissioner [Public], 2024, Public Commissioner, 2024).
2. 'Towards a vital infrastructure sector' (EIB & PwC, 2020)
3. 'Handreiking portfolio aanpak', guidelines portfolio approach (Public Commissioner, 2022)
4. Tender documents from Tenderned. ("TenderNed", n.d.)

By analysing these documents, the aim is to gather insights and contextual information to inform and support the upcoming case study analysis, while also reducing the number of principles and creating a list of 'tailored principles', showing the needs of a commissioner using the Portfolio Approach in the Netherlands.

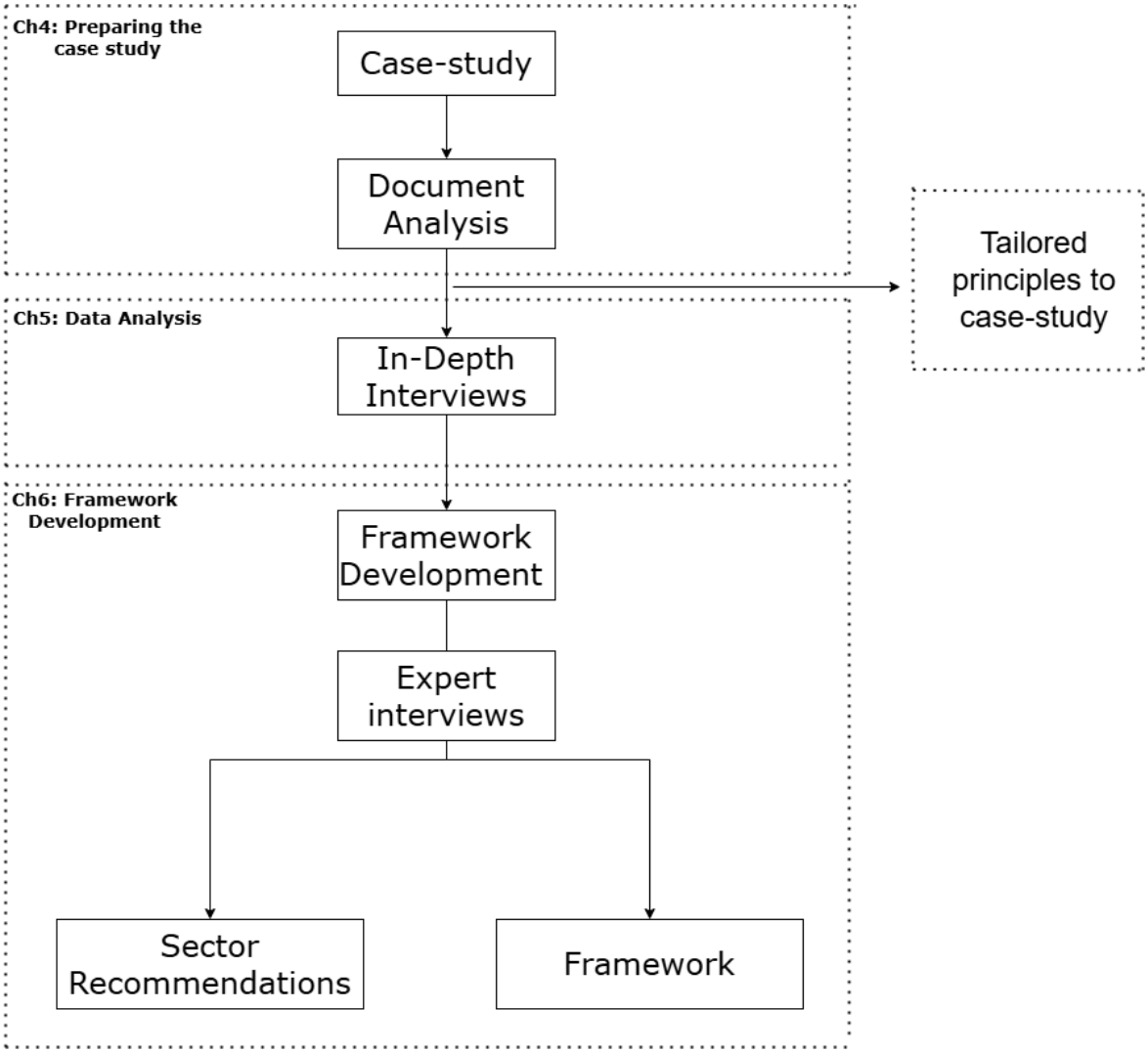


**Figure 4.1:** Conceptual Overview Case-study Methodology & Framework Development

### 4.2.1. Case-study Renovation Projects

The first documents that are reviewed are the documents related to the renovations of the bridges, and the portfolio (Public Commissioner, 2024). The tender for these projects was issued using a portfolio approach, whereby a contractor that performs well on the renewal of one bridge is subsequently awarded additional projects within the portfolio. The contractor consortium responsible for these renovations has completed one bridge renovation.

The first object in the portfolio is a critical link across a major waterway, requiring extensive updates, including the replacement of movement mechanisms and technical installations. The renovation began with partial closures for high shipping traffic, followed by a full closure to road traffic for several weeks to allow for key upgrades. The newly installed systems underwent extensive testing, and operator training was conducted to ensure smooth operations. The bridge has now resumed operation for high shipping traffic, managed remotely from an alternative location (Public Commissioner, 2024). All technical documentation, including manuals and maintenance plans, has been finalized, and the CE marking was obtained to certify compliance with European safety and environmental standards. This certification has enabled the bridge to resume nearly regular operations.

### 4.2.2. Towards a Vital Infrastructure Sector

The public commissioner of the case-study has emphasized the necessity for a shift towards a resilient infrastructure market capable of innovation and enhancement, as outlined in the published document 'Towards a Resilient Infrastructure Sector ' (EIB & PwC, 2020). This transition is important for addressing the complex societal challenges in the long term. The program's core involves targeted experimentation in various projects using different procurement and project approaches. The goal is to gradually adjust market policies based on the outcomes of these experiments. One of these measures is as follows: *The development of the portfolio approach primarily focused on the replacement and renovation challenge* .

The conclusion of this report highlights several recommendations:

1. Collaboration: Advocate for a broad attitude of collaboration among stakeholders.
2. Financially healthy sector: Immediate financial returns are unlikely, and diversification is essential. The two-phase and portfolio approaches cover a limited project range, with some facing delays or adjustments due to factors like emissions or budget limits. The public commissioner is managing more of these projects than initially planned, so financial monitoring should consider all projects experimenting with these approaches.
3. Implementation: Measures should address innovation, requiring adequate time and budgetary allowances. A consideration is the concern, expressed by both internal and external parties, regarding whether sufficient time and resources are allocated for innovation and learning. Many stakeholders have highlighted a prevailing culture focused on minimizing the risk of time and budget overruns, creating tension with the pursuit of innovation.
4. Effective monitoring requires sufficient capacity from the public commissioners.
5. Continuous monitoring of progress on conditions: The impact of the transition program on the conditions for a healthy infrastructure sector will require a considerable amount of time to manifest fully.

### 4.2.3. Guidelines Portfolio Approach

A public commissioner has issued guidelines for the portfolio approach, marking the first step towards implementing this method in public infrastructure in the renewal and renovation projects in the Netherlands (Public Commissioner, 2022). The emphasized goals are:

1. Identify where a portfolio approach can be applied in the replacement and renovation challenge.
2. Create a methodology for learning across projects together with the market.
3. Determine how a performance management system can be linked to such an approach.

The goal of the portfolio approach is to achieve the following objectives:

1. Learn
2. Innovate
3. Invest

The goal is to achieve benefits through portfolio contracts by consistently executing similar projects with the same or a combination of contractors. The public commissioner outlines two specific objectives they aim to achieve with these guidelines.

1. Providing practical tools: with this, the aim is to apply the portfolio approach uniformly.
2. A theoretical framework: this is intended to provide information about considerations for the use of portfolio contracts.

Through repetition, there is potential for learning, innovation, and investment across projects—objectives the market acknowledges and supports. Beyond efficiency, the focus should also be on qualitative progress (Public Commissioner, 2022). Alongside the goals for portfolio contracts, additional focus areas include asset management, sustainability, data provision, smart mobility, environmental law, cli-

mate adaptation, and collaborative approaches. These areas remain critical when tailoring portfolio contract objectives to specific projects, such as using sustainability goals to drive innovation (Public Commissioner, 2022). Figure 4.2 illustrates the portfolio contract scope, where each project is connected through key performance indicators (KPIs). The ”reward space” concept implies that successful performance in Project 1, based on these KPIs, qualifies the contractor for follow-up projects within the portfolio. However, winning Project 1 does not automatically secure the entire portfolio; the contractor must continually prove their capability to advance through subsequent projects.

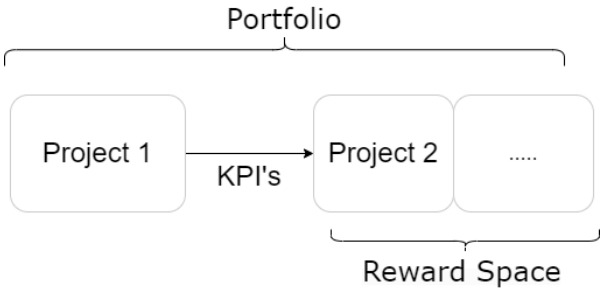


**Figure 4.2:** Scope of a Portfolio Contract (based on:(Public Commissioner, 2022))

Within the portfolio approach, Public Commissioner (2022) mentions certain essentials in their guidelines. These are listed below.

1. **Selection of a compilation of works for a portfolio contract**: The portfolios (i.e., the combination of projects) must be thoughtfully composed to be assigned in a logical order. One of the rules of thumb is that works are combined if the combination best achieves the objectives of the contractual portfolio approach. The portfolio must be composed so that through performance management, timely decisions can be made about whether or not to attribute subsequent projects. Concerning table 4.1, a decision must be made on the logical assembly of projects. This involves comparability of works, sufficient subsequent works, certainty for follow-up work, time/planning, geographical location, and fulfilling objectives.
2. **Design of the portfolio contract**: This can be achieved through revision clauses, repeat orders, frameworks with a single contractor, or frameworks with multiple contractors.
3. **Enhancement of collaboration**: It is important that public commissioners, together with the market party(ies), strive for good cooperation, and that the chances for a follow-up order are increased. There must be a predictable insight into repetition. The market must have sufficient certainty about the likelihood of a follow-up order.
4. **Conditions for obtaining follow-up work**: The principle is that a contractor qualifies for follow-up work if the conditions for it are met.
5. **Application of performance management**: Through performance management, learning, development, and improvement across works must be stimulated and made measurable. In this way, performances are encouraged to exceed the minimal contractual basis.
6. **Intended Purpose**: The intended purpose of the portfolio must be contractually established, with the general goals Table 4.1 being the starting point. The specific objectives are often a specification of the general objectives, sharpened based on the context of the intended contract and the nature of the project composition. Thus: Based on the bundling, specific goals are added, starting with the general goals which then lead to specific goals.

The public commissioner’s guidelines note that portfolio contracts foster a longer-term relationship between client and contractor, spanning multiple projects with a focus on collaboration and shared learning outcomes. These contracts highlight trust-building, effective communication, collaborative problem-solving, long-term incentives, and adaptability as core relational elements. Contract managers are encouraged to prioritize contractors’ performance outcomes over individual tasks when evaluating scores

**Table 4.1:** Public Commissioner (2022)'s Objectives for the Portfolio Approach

| Goals market | Joint objectives | Public Goals |
|---|---|---|
| Reduce multiple project risks | Lower transaction costs | Tender multiple works simultaneously |
| Reduce failure costs | Increase production capacity | More uniformity in execution |
| Increase innovation | More innovation | Reward well-performing companies |
| | | Performance management as an additional incentive for quality |

for future work awards. The commissioner's measurement plan specifies intervals and milestones for performance reviews, with contract managers ensuring that contractors conduct evaluations as scheduled. Results are then discussed jointly by the contract manager and contractor (Public Commissioner, 2022).

### 4.2.4. Tender documents

The tender for the bridge renovations and renewal was published on Tenderned, where various documents outline the project's connection to the portfolio approach. The tender guidelines specify that the Contracting Authority intends to award the renovation of a second bridge to the contractor(s) handling the first, within three years of the initial award, using a negotiated procedure without public announcement under the Dutch Public Procurement Act 2012. However, the authority reserves the right to end this process without compensation ("TenderNed", n.d.),.

Additionally, a Risk List highlights potential issues that could prevent achieving the portfolio approach's objectives, such as insufficient collaboration, lack of implemented improvements, or unsuccessful negotiations, which may lead to the repeat assignment not being awarded. As noted in the guidelines, this bridge project is one of the first contractual portfolio approach implementations, emphasizing a long-term collaborative relationship aimed at continuous improvement across multiple projects. This approach allows contractors to secure future assignments based on quality performance, reinforcing consistent cooperation ("Tenderned", 2021).

The project-specific goals, as published on "Tenderned" (2021) are:

1. Experiment with, and learn from one tender involving multiple objects with one contractor through a portfolio contract.
2. Work in collaboration with the market on the process and issues, so that an optimized approach can be achieved and scaling up of the approach is possible.
3. Encourage process and substantive improvements, innovations, and the achievement of sustainability ambitions.

The public commissioner specifies in an appendix of the tender guidelines that, to qualify for the second project, the Contractor must develop an approach plan that addresses "Collaboration, Lessons Learned, and Performance Management." This plan must include:

1. The performance and measures already offered in the Best Price-Quality Ratio (BPKV) of the initial project, which will be re-offered in the repeat assignment;
2. The measurable performance improvements being proposed;
3. The methods the Contractor will use to meet the specified criteria.

## 4.3. Selection of principles

### 4.3.1. Selection process

The fundamentals of implementing the portfolio approach are rooted in the public sector, beginning with the public commissioner as the client. Ultimately, the public commissioner holds the determining role in decision-making processes, guiding the direction of both exploration and future implementation of

the portfolio approach. While contractors can provide input during market consultations, their influence remains limited to these early stages. The focus on the public commissioner is essential because they are responsible for defining the strategic goals, requirements, and conditions for the portfolio approach. As the initiator of the planning process, the public commissioner shapes the framework and ensures alignment with public interests, while seeking market feedback to refine this approach. By involving contractors from the outset, the public commissioner incorporates industry insights while maintaining the leadership needed to implement the portfolio approach effectively in public infrastructure projects. Their priorities include:

1. **Collaboration and Knowledge Sharing:** Public comissioners value collaboration among all stakeholders. Cooperation between client, contractors, and other involved parties plays a significant role in project execution. Trough the portfolio approach, the aim is to promote a collaborative environment where repeated interactions with the same contractors facilitate better knowledge sharing and collective problem-solving. This ongoing collaboration should help refine processes and achieve consistent improvements across projects (EIB & PwC, 2020, Public Commissioner, 2022 , “TenderNed”, n.d.).
2. **Feedback Mechanisms:** Robust feedback mechanisms are central to continuous improvement. Performance management systems measure and highlight improvements, motivating contractors to go beyond baseline requirements. Regular feedback sessions, such as monthly progress meetings, discuss key performance indicators (KPIs), assess development progress, and address any obstacles. These mechanisms help should align client and contractors in their goals and promptly tackle arising issues (Public Commissioner, 2022).
3. **Adapting to Changing Environments:** The ability to adapt to changing environments and maintain flexibility is a part of the renewal project. The need to innovate and experiment with different procurement and project methods to tackle complex societal challenges is seen as a priority. This adaptability could allows for continuous adjustments in market policies and project strategies based on experimental outcomes and changing external conditions, such as environmental regulations or budget constraints (Public Commissioner, 2022).
4. **Benefits Achievable Through Proper Management:** Proper management of the portfolio approach can lead to various benefits, including reduced project risks, lower failure and transaction costs, and improved overall project quality. By tendering multiple works simultaneously and promoting uniformity in execution, public commissioners can achieve cost savings and enhance project outcomes. Effective performance management also incentivises contractors to deliver high-quality work, which may result in rewards such as follow-up projects (Public Commissioner, 2022).
5. **Effective Stakeholder Management:** Managing stakeholder relationships effectively is vital for the success of infrastructure projects. The aim is to build long-term, trust-based relationships with contractors and other stakeholders. This involves clear communication strategies, collaborative problem-solving, and shared responsibility for project outcomes. Creating a predictable environment for contractors, with the possibility of follow-up work based on performance, contributes to a stable and motivated market (Public Commissioner, 2022).

By focusing on these principles, the public commissioner aims to develop a resilient, innovative, and high-quality infrastructure sector. These important notes are the basis of the 5 principles chosen and displayed in Table 4.2.

### 4.3.2. Summary tailored principles

The conclusion of the literature chapter identifies 15 principles related to the portfolio approach, covering various principles. To align with the scope of the case study, these principles are reduced to a more manageable number, focusing on those most relevant to the public commissioner. This selection process involves an assessment of each principle based on its applicability, relevance to the objectives of the case study, and alignment with the values and priorities identified in the document analysis. The

table's last column gives a rationale for choosing this principle. Principles deemed less relevant or impactful within this specific case context are eliminated. The final selection is presented in Table 4.2.

**Table 4.2:** Result Document Analysis: Five Tailored Principles for the Case Study: a Portfolio of two Bridges.

| | Principle | Description | Linkage Case - Goals Public Commissioner |
|---|---|---|---|
| 1 | Improved Decision-making through Feedback (Aritua et al., 2009) | Enhances decision quality by incorporating continuous feedback and adapting to changes, allowing for data-driven, objective decisions and effective management in dynamic environments. | This principle aligns with the commissioner's emphasis on structured performance management systems and feedback mechanisms, which are designed to track project progress and allow for adjustments based on current information. By integrating regular feedback, the approach allows for data-driven decisions that may support more effective management and align with evolving project needs. This focus on feedback is noted in the commissioner's guidelines, where regular progress assessments are encouraged to ensure that projects remain on track and can adapt as needed. |
| 2 | Communication and Knowledge Sharing (Martinsuo, 2013) | Effective communication and knowledge sharing across projects foster innovation and efficiency, leading to technology and capability synergies, reducing duplication of effort, and enhancing overall portfolio performance. | This principle aligns with the focus of the public commissioner on creating synergies within a series of projects, where effective communication can help avoid duplication of effort and support more efficient use of resources. Knowledge sharing is viewed as a means of enabling continuous improvement and facilitating the transfer of lessons learned, which can enhance project execution and support portfolio objectives. This emphasis is reflected in the commissioner's guidelines as well as the tender documents, which advocate for collaborative problem-solving and information exchange.. |
| 3 | Stakeholder Involvement and Strategy Effectiveness (Hansen and Svejvig, 2023, Martinsuo, 2013) | Prioritizing active stakeholder engagement in decision-making enhances strategic effectiveness, fosters collaboration, and ensures alignment with strategic objectives, thereby improving project outcomes and accountability. | By involving stakeholders directly in decision-making processes, the commissioner seeks to improve accountability and ensure that project goals reflect broader societal and operational needs. This emphasis is rooted in the commissioner's guidelines, which highlight the value of collaborative problem-solving and shared responsibility, especially within the portfolio approach. By prioritizing stakeholder involvement, the public commissioner aims to foster a transparent and cohesive working environment, which is expected to support more consistent project outcomes and facilitate long-term relationships that are integral to the success of infrastructure projects managed under this approach. |
| 4 | Adaptability to Dynamic Environments and Change (Aritua et al., 2009, Ginger et al., 2014, Hansen and Svejvig, 2023) | Adaptability to dynamic environments and change emphasizes flexibility and responsiveness, enabling project portfolios to cope with uncertainty, promote innovation, and continuously adjust to stay relevant and meet new demands. | Infrastructure projects often face evolving regulatory, environmental, and societal conditions, requiring the commissioner to adjust strategies as new demands and challenges arise. This adaptability aligns with the commissioner's guidelines, which stress the importance of innovative approaches and readiness to refine project methods as part of the portfolio approach. By prioritizing adaptability, the public commissioner aims to ensure that projects can respond to changing conditions, thus supporting the ongoing relevance, resilience, and effectiveness of public infrastructure investments. |
| 5 | Portfolio-Level Benefit Management and Optimization (Bai et al., 2022) | Portfolio-level benefit management and optimization focus on the strategic management and maximization of collective benefits, ensuring alignment with organizational goals, improving decision-making processes, and achieving greater value creation across the project portfolio. | By focusing on benefit management at the portfolio level, the commissioner can ensure alignment with organizational goals and prioritize projects that collectively contribute to greater public value. This approach is consistent with the commissioner's guidelines, which emphasize efficient resource use, value-driven outcomes, and informed decision-making across multiple projects. By managing benefits at the portfolio level, the public commissioner aims to enhance the effectiveness of each project within the larger strategy, helping to achieve long-term, impactful results for public infrastructure development. |

This chapter has provided a document analysis of the case study, examining the values and priorities of the client. The selected principles derived from this analysis reflect what is considered important for the portfolio approach in this context. These principles will serve as the foundation for further exploration and discussion. In the following chapter, these tailored principles will be analysed in greater depth through interviews, allowing for a more detailed understanding of their practical implications.

### 4.3.3. Key Areas of Focus for the Interview Protocol

The principles identified from the preparatory research form the foundation of the interview protocol. The interviews aim to explore how these principles interact with the real-life case study and identify actions that could enhance positive effects or mitigate negative ones. The interview questions are added in Appendix B.

1. The interviews will start with focusing on feedback and its influence on decision-making, seeking to understand how the feedback process occurs or should occur within the portfolio approach, including examples and methods.
2. Next, the focus will shift to communication and knowledge sharing, aiming to gain insights into current practices, the mechanisms involved, and those that should be involved.
3. Thirdly, stakeholder involvement and strategic effectiveness will be discussed. This involves understanding how the portfolio approach engages stakeholders, and the differences compared to approaches without it.
4. Following this, the dynamics of the environment in construction projects will be examined, with specific examples from case-study The aim is to understand how the portfolio approach affects project dynamics.
5. Finally, the subject of portfolio-level benefit management and optimization will be addressed, focusing on collective and project goals and how they can be improved.

A series of questions are developed to provide consistency throughout the interviews. This approach ensures that the input gathered is comparable and that the discussions remain focused. Additionally, the interviews allow for open dialogue on topics, leveraging the advantage of interviews over surveys. The standardized list of questions is listed in Appendix B. Before the interviews, an invitation letter is sent to each participant, as detailed in Appendix D, along with a consent form. The consent form is signed before the interview commences, ensuring that the data collected can be used with the participant's consent, as described in chapter 2.

# 5

# Interview Findings

## 5.1. Chapter and Coding Structure

As outlined at the end of chapter 4, five principles are discussed in the case study. To return to the foundation of this research, the objective is to explore the principles, effects, and actions underlying the public application of the portfolio approach in infrastructure renewal challenges in the Netherlands. The principles guiding this research are drawn from literature and then, in this chapter, specifically used to explore the case study, these principles are shown in Table 4.2 and below.

1. Improved Decision-making through Feedback
2. Communication, Trust and Knowledge sharing
3. Adaptability to Dynamic Environments and Change
4. Stakeholder Involvement and Strategy Effectiveness
5. Portfolio-Level Benefit Management and Optimization

The coding process resulted in 21 open codes, each encompassing the content of multiple quotes These open codes are organized under the five principles. This chapter is structured as follows: the codes are organized under the corresponding principles, with the justification for this provided in the Appendix D. The information for each code is presented under its name, and categorized by the relevant principle. Since this research focuses on the actions that both the client and contractor need to consider when applying the portfolio approach and the effects that come with this approach, the aggregate dimensions are defined as 'Actions Accompanying the Approach' and 'Effects of the Approach.' This is further elaborated at the end of his chapter.

## 5.2. Interview Insights structured under Codes

### 5.2.1. Improved Decision-making through Feedback

**1 - Importance of Feedback**

*Respondent 2 - Client*: "Through this approach, we ensure continuous improvement and innovation. It enables us to learn from our mistakes and apply this knowledge to future projects, thereby reducing the likelihood of repeating the same errors. This creates a cyclical process of learning and adapting, which is crucial for the development and success of our designs."

*Respondent 3 - Contractor* : "Where evaluations always took place after a project, this has become even more intensive with the portfolio approach. This is definitely a very positive development."

*Respondent 8* underscores the critical role of feedback in portfolio renewal assignments, highlighting that feedback is even more essential in these contexts due to the continuity of follow-up projects. The

focus on feedback in repeat assignments is necessary for maximizing gains and applying lessons learned. Both client and contractor value feedback's role in knowledge sharing and evaluation, as it helps avoid repeated mistakes and fosters continuous improvement. This cyclical feedback process strengthens knowledge retention and transfer, ultimately enhancing the effectiveness of the portfolio approach.

**2 - Lessons Learned**
The idea of "lessons learned" is often discussed in the empirical data in relation to the portfolio approach and is recognized as a significant factor that influences its results. The data indicates that understanding and integrating lessons learned is crucial for stakeholders to gain knowledge about successful practices and areas needing improvement. This process can potentially improve the portfolio approach's effectiveness in the long run. Both the client and contractor value learning from past projects to improve future ones. However, the client stresses formal knowledge sharing, while the contractor focuses more on practical learning during execution.
*Respondent 6 - Client*: "Knowledge sharing is an important part of the portfolio approach. The contractor must carry forward the knowledge and lessons learned from one project to the next. However, this does not always happen as it should. The impact of knowledge sharing is significant because it can contribute to greater efficiency and effectiveness in future projects. However, if the contractor does not adhere to the agreed-upon knowledge sharing and fails to properly internalize the lessons learned, the system works against us. Instead of learning and improving, we sometimes see contractors exploiting the situation to demand more money for additional work."

Respondents emphasize the importance of knowledge retention and transfer within the portfolio approach. *Respondent 1* highlights that lessons learned from the initial renewal project help both parties retain knowledge, while *Respondent 7* notes that applying insights from previous renewal projects has led to more efficient and safer execution by avoiding past mistakes. *Respondent 5* adds that incorporating lessons from earlier projects can save costs and improve efficiency through better risk management. While both parties value this concept, the client expresses concern about contractors not fully sharing lessons. This underscores the portfolio approach's role in capturing and transferring lessons learned, enhancing collaboration and ensuring valuable knowledge is applied across projects.

### 5.2.2. Communication, Trust and Knowledge sharing

**3 - Importance of Communication and Trust**
The importance of communication and trust is a recurring theme in the context of the portfolio approach. The data indicates that effective communication and mutual trust between involved parties are significant factors that can influence the success of the approach. This concept is often linked to enhanced collaboration, better risk management, and more transparent decision-making processes. It highlights the role of early information sharing and openness in achieving aligned objectives and avoiding misunderstandings. The client and the contractor seem to agree on this matter, communication and trust are important factors. Respondents emphasize that trust, transparency, and good communication are essential for successful project execution. By sharing information early and aligning on expectations, both contractors and clients can manage risks, optimize solutions, and achieve collective goals more efficiently.

*Respondent 4 - Client*: "Trust and pricing: Trust between market parties and the public commissioner is essential. Pricing should not be too stringent, and higher prices should be considered. Transparency and engaging in dialogue are crucial for successful collaboration."
*Respondent 8 - Client*: "It is people's work, and it has to click with each other. An open attitude is important. The more open you are with each other, the better it works. This can vary per team."

This concept is embedded within the theme of Communication and Collaboration. Respondents emphasize the importance of reliability and effective communication between all parties involved, as these are key to building trust.

**4 - Importance of Knowledge Retention**
*Respondent 6 - Client* highlights the crucial role of knowledge sharing in the portfolio approach but expresses concern over contractors' inconsistent follow-through. While knowledge transfer can improve efficiency in future projects, issues arise when contractors do not fully commit to this process. Instead of leveraging lessons learned for project improvement, contractors may use gaps in knowledge sharing to justify higher costs for additional work, ultimately undermining the intended benefits of the portfolio approach. *Respondent 7 - Client*: "Each renewal project offers new insights and lessons. What we learn from one project can be applied to future projects. For example, the renovations of the Velsertunnel and the Heinenoordtunnel provided us with a lot of knowledge, which we are now using in current projects. This knowledge transfer is crucial. It ensures that we do not have to reinvent the wheel each time and that we can avoid past mistakes. By continuously learning and improving, we can execute future projects more efficiently and safely."

From these quote examples by *respondents 6 and 7* can be noted that knowledge transfer from past projects prevents repeated mistakes, enhances efficiency, and ensures safer, more effective execution of future projects. The takeaway is that systematic learning and applying insights across projects is essential for continuous improvement and optimal performance. *Respondent 5*, a contractor, highlights the importance of retaining knowledge by keeping the same project teams in place. This concept highlights the importance of knowledge retention and the actions required to achieve it. It is closely linked to the theme of communication and knowledge sharing, as effective communication is essential for transferring and preserving knowledge across projects within the portfolio approach.

**5 - Definition**
This code falls under the category of defining the portfolio approach. It is considered important because the more uniform the definition, the greater the mutual understanding of the approach. Clearly defining what the portfolio approach involves is essential to ensure that the entire project team and all stakeholders are on the same page, facilitating more effective communication and knowledge sharing. When terms are clearly defined, everyone understands each other better.

*Respondent 10 - Client*: "In portfolio approaches, the idea was to tender similar objects, like bridges, in sequence. The market party that performs well on the first project will be awarded the second one at a comparable price. This approach allows for optimizations, learning from previous projects, and applying those lessons to the next."

*Respondents 12 and 5*, both contractors, explain that the portfolio approach involves tendering similar projects in sequence, allowing lessons learned and optimizations from one project to be applied to the next. While this may not necessarily reduce costs, it facilitates knowledge transfer and improves future project execution. The respondents emphasize the importance of defining the portfolio approach in terms of learning from past experiences and applying these lessons to future projects. While the approach may not always lead to cost reductions, its value lies in the potential for continuous improvement and knowledge transfer across similar projects. The concept applies to both clients and contractors equally. Having a clear understanding of the portfolio approach and how different parties perceive it is closely related to ensuring that all parties have access to the same information from the start. This is directly linked to the theme of communication and knowledge sharing, as sharing accurate and consistent information is crucial for aligning perspectives and fostering collaboration throughout the project.

**6 - Changed Way of Collaboration**
The data suggests that changing the method of collaboration, such as through a portfolio approach, can have significant implications for project execution and outcomes. The emphasis is placed on coordinated teamwork, shared risk management, and continuous feedback. This approach appears to encourage a more collaborative and trust-based environment, moving away from traditional adversarial dynamics. Respondents discuss the importance of centralized coordination, open communication, and a mutual focus on achieving shared goals, which can enhance the effectiveness of project delivery. *Respondent 5*, a contractor, stresses the importance of a central coordination team to monitor projects

and ensure clear communication and alignment, noting its success in the PTZ tunnels but not in the first bridge. The respondent also highlights that the portfolio approach fosters collaboration and trust, enabling quicker resolution of unforeseen problems through joint risk management and knowledge sharing, leading to smoother project execution and better results. Other respondents also highlight this new view on collaboration.

*Respondent 3 - Contractor*: ”The portfolio approach is about striving together towards a common goal, where both the public commissioner and market parties work together to deliver a successful project. Instead of seeing each other as opponents, both parties collaborate to achieve the set goals. Through longer-term collaboration within the portfolio approach, teams get to know each other better and can work together more efficiently and effectively. This reduces traditional ’us versus them’ thinking and fosters a more collegial approach.”
*Respondent 8- Client*: ”In a portfolio assignment, feedback is even more important because you have a follow-up assignment. In every regular assignment, you always have feedback to improve processes. In a repeat assignment, you need to pay even more attention to the feedback to gain benefits. An open attitude and good communication are crucial. It is people’s work, and it has to click with each other. An open attitude is important. The more open you are with each other, the better it works. This can vary per team.” This concept is also tied to the theme of communication and collaboration, as respondents recommend envisioning a new collaboration strategy. By clearly defining how parties will work together, this approach strengthens teamwork and fosters better communication.

### 5.2.3. Adaptability to Dynamic Environments and Change

**7 - Issues with Too Much Time between Projects**
*Respondent 2 - Client*: ”If there is a gap between the projects, the team falls apart and many lessons learned are lost. Therefore, you need to ensure that they align well with each other”
*Respondent 6 - Client*: ”The realization team finished work on the first Bridge around February or March of this year and had to immediately move on to the contract tender for the second bridge. The planning phase teams had prepared 90% of the contract, but the realization team still had to quickly review and adjust all the details based on their experiences with the first Bridge. Finalizing and adjusting the contract in just four months is a massive task and often leads to suboptimal solutions, which in turn creates discussion points and potential cost increases.”
*Respondent 12 - Contractor*: ”The first bridge was already opened last summer, and we are still in the pricing phase of the second bridge. You could see this as an example of maximum discontinuity.”

This concept can be summarized from the collected data as stating that too much time between projects poses a risk. If there is too much time between the execution phase of Project 1 and the design phase of Project 2, this can lead to a loss of knowledge or loss of project team members. This showcases that the bridges in the case study are suboptimal aligned, which might influence the effects. Its is notable both parties mention this effect. This concept is linked to actions associated with the portfolio approach, specifically portfolio and tender strategy. These actions can be viewed as part of the collaboration needed for effective phase alignment, ensuring that the different project phases are well-coordinated. This alignment between phases helps maintain smooth progress and proper synchronization throughout the project.

**8 - Urgency**
Several respondents indicate that the first bridge is an unusual case when it comes to the portfolio approach. Firstly, according to Respondent 9: ”it is too complex and too large a project”. Additionally, the tendering process for the first bridge was accelerated, and the decision to apply a portfolio approach was made at the last minute.

*Respondent 1 - Client*: ”The first bridge was in a very poor condition, often referred to as a ’drama bridge,’ which necessitated a significant renovation by the project team. Due to the severe state of the bridge, the renovation process had to be accelerated—a task that would normally take longer under

the protocols of the public commissioner. The project adopted a portfolio approach, linking the base project to a follow-up assignment."
*Respondent 8 - Client*: "The planning phase for the first bridge was already underway when it was decided to adopt a portfolio approach. This meant that the planning phase for the second bridge had to be started quickly. If this had been known in advance, the team working on the planning phase for the first bridge could have also handled the planning phase for the second bridge. This would have allowed for shared gains and knowledge, which would also benefit the execution. Unfortunately, this was not the case here. The execution phases were so closely scheduled that the focus was entirely on the first bridge. The first bridge was prioritized due to the tight schedule and urgency."

This concept is linked to an action within the theme of Portfolio and Tender Strategy. The data indicates that respondents emphasize that urgency when selecting projects for a portfolio is not advisable. They suggest that careful planning and thoughtful selection are crucial for the success of the portfolio approach, rather than rushing the process.

**9 - Dependency on Contractor**
The concept of contractor dependency highlights the potential risks and dynamics that arise when a project relies heavily on a single contractor or a limited pool of contractors. This dependency can impact decision-making, cost efficiency, and the balance of power between the contractor and the client, such as the public commissioner. The data shows that while this arrangement can offer stability and reduce the complexity of procurement, it also raises concerns about pricing, risk management, and the ability to choose alternative methods or solutions.

*Respondent 6* describes how thorough evaluation processes enhance collaboration and trust between the public commissioner and contractor, leading to better outcomes. However, challenges arise when contractors face difficulties they cannot resolve alone, as the public commissioner must step in. *Respondent 4* adds that reduced competition can increase contractor prices, potentially impacting project quality and the overall budget for future projects. *Respondent 8* notes that while fewer tenders provide market stability and encourage optimization, they also carry financial risks due to less competition. Conversely, *Respondent 9* sees pricing as manageable within the portfolio approach, which offers cost and time efficiency, especially through modular construction, benefiting simpler projects.

This suggests that contractors (the "market") are well aware of their own strengths, limitations, and what they can realistically deliver. Both clients and contractors are experienced in navigating this dynamic ("playing that game"), implying familiarity with managing expectations and project scopes. "Therefore, pricing is not a major issue within the portfolio approach." Because of this established understanding between clients and contractors, pricing does not become a contentious issue. It indicates that there is less concern about cost overruns or price disputes within the portfolio approach, likely due to the transparency and trust developed over time. "The biggest advantage we have experienced is the efficient use of contracts through reduced tendering costs and time. We achieve this through modular construction, which is especially useful for less complex projects." The respondent is highlighting a benefit of the portfolio approach: the use of modular construction techniques. Modular construction involves pre-fabricating sections of a project off-site and then assembling them on-site. This approach reduces the time and costs associated with traditional tendering processes for each individual project. This efficiency is particularly beneficial in simpler, less complex projects where such methods can be easily applied. This information is collected from the interview data with respondent 9.

This concept represents an effect of the portfolio approach and serves as a first-order theme that links several effects under the broader outcome of contractor dependency. It highlights how multiple factors within the portfolio approach contribute to the reliance on contractors, shaping the dynamics between the client and contractor.

**10 - Procedures and Phasing Public Commissioner**
The data reveals some concerns among respondents about internal procedures. Two key issues stand

out: first, the tender process is frequently mentioned; second, the portfolio approach cannot be fully utilized due to laws and regulations requiring the second project to begin within three years of the first.

*Respondent 3 - Contractor*: ”Currently, we find that the internal procedures for approvals and budget requests at the public commissioner are time-consuming and complex, especially when working within a portfolio approach. For each new project, even if it is part of an already approved portfolio, we still have to go through extensive approval processes and budget requests. These lengthy procedures cause delays and can disrupt team continuity. For example, after completing the design for the first bridge, there may be a period of inactivity before we can start on the second bridge. During this time, team members may need to work on other projects, making it difficult to retain knowledge and expertise.
*Respondent 6 - Client*: ”What I would like to see is that we include less in the dossier than in a standard contract. This would help because it would save a lot of work. We could describe things more functionally, such as the requirements for a bridge over water, rather than specific technical details. It is important to think in advance about which bridges fit into the portfolio. If the bridges are not similar enough, you need to consider whether they should be separate projects.”

The respondents identify several challenges in the portfolio approach related to internal procedures and project documentation. Complex approval processes and detailed requirements can lead to delays, disrupt team continuity, and complicate knowledge retention. To address this, they suggest streamlining approval processes and using functional descriptions in project dossiers. Selecting projects with enough similarities to be grouped in a portfolio may also improve efficiency and reduce redundant work. A key challenge is aligning project phases within the public commissioner’s schedule to avoid gaps that can disrupt team cohesion. *Respondent 10* underscores this, explaining that ideally, the design of one project would start as the previous one enters execution. However, they face limitations, such as a regulation requiring the second project’s execution within three years of the first, making it difficult to handle more than two complex projects in a portfolio. The legislative constraint posed by Article 2.36 of the Dutch Public Procurement Act (2012), requires that a second project contract within a portfolio be awarded within three years of the first. This restricts the tendering of large, cohesive portfolios—such as multiple major bridges—complicating streamlined planning and resource allocation. However, this limitation doesn’t fully block the portfolio approach; alternatives like framework agreements or flexible contracting methods, already used in certain provinces and public-private companies, could still enable its application within legal boundaries.

This concept is linked to the theme of Portfolio and Tender Strategy and relates to actions such as collaboration in phase alignment and the avoidance of urgency, particularly when there is no established foundation within the public commissioner to build upon. Respondents also highlighted the importance of ensuring consistency in project teams, as maintaining the same teams across projects helps retain knowledge and improve project execution within the portfolio approach.

### 5.2.4. Stakeholder Involvement and Strategy Effectiveness

**11 - Importance of Involving Stakeholders**

*Respondent 2 - Client*: ”During the execution of this project, there were significant challenges due to the variety of opinions and demands from the involved parties. One specific requirement, for example, was that two lanes had to remain open at all times.”

*Respondent 6 (Client)* highlighted that more stakeholders were involved than anticipated, including safety regions, local governments, the maritime sector, schools, agricultural traffic, and people with disabilities. For instance, a special ferry was arranged for a girl with autism due to her needs. A key lesson learned for future projects is the need for a more adaptive disruption approach, as the current one is too static. Instead of minimal solutions, realistic and adequate measures that account for all stakeholders are necessary, particularly in complex replacement and renovation projects.

The first renewal project faced challenges due to diverse stakeholder demands, such as keeping two

lanes open at all times, with more parties involved than expected, including maritime, schools, and special needs groups (e.g., a ferry for a girl with autism). A key lesson for future projects, like the second bridge, is adopting a more flexible approach to managing disruptions. Rather than minimal solutions, realistic measures that address all stakeholder needs are essential.

Notably, stakeholders are already familiar with each other within a portfolio of assets sharing similar characteristics, particularly in the case study where the bridges are also geographically close. This underscores the importance of active stakeholder engagement as both an action and a theme within the portfolio approach, promoting alignment and collaboration throughout the project.

**12 - Collaboration in Decision-making**
*Respondent 12 - Contractor*: ”The portfolio approach requires changes in processes, and this can be quite challenging. As I see it government bodies, often have rigid internal processes, with limited mandates and strict rules regarding budgets. A portfolio approach demands significant flexibility, requiring one to step away from established routines. This raises two key questions: Is the individual willing to embrace the change, and is the company’s structure flexible enough to adapt, or will the change be blocked? Something is potentially happening here, but traditionally, it could take up to six years for these processes to fully develop. How are we going to implement this? How are we going to bring it to market? How much budget are we willing to allocate? What kind of contracting strategy is appropriate? After this, it takes another two to three years for the project to become a reality. By that point, so much has already been established that it can be difficult to deviate from. Therefore, a portfolio approach also requires a different mandate and structure within the organization.”

The code describes how the portfolio approach demands more flexibility than traditional approaches, which can be difficult for organizations like government bodies. These organizations typically follow rigid processes, and adapting to a portfolio approach would require changes in mindset, internal structure, and processes. The challenge lies not only in implementing the approach but also in ensuring that the organization and its people are willing and able to adapt. This concept is connected to the theme and actions of communication and collaboration, specifically within the collaboration aspect. It emphasizes the importance of working together effectively to achieve shared goals and foster strong partnerships.

**13 - Buffer for Managing Risks**
*Respondent 7 - Client*:”Another major advantage of the portfolio approach is that we can better assess and manage risks. By introducing an in-depth analysis phase, we can identify and address potential problems early on. This helps to prevent surprises during execution. It also fosters better collaboration between the public commissioner and contractors, as we sit down together to discuss and mitigate these risks. As a result, we can work much more effectively, avoiding delays or additional costs.”

**14 - Uncertainty of Market Party**
*Respondent 3 - Contractor*:” In addition, as a market party, we face uncertainty about whether we should invest in a new approach to our collaboration. We don’t know if this approach will be continued in the future.”
*Respondent 2 - Client*: ”It is important to empathize with the perspective and experience of the market party. For them, the biggest challenge is committing to a large-scale project. This can be particularly risky for a family-owned business, where the director may have a lot to lose personally. A few failed projects can quickly lead to severe financial problems.”

The two quotes emphasize the market party’s uncertainty about committing to new approaches and the risks involved, particularly for family-owned businesses and renewal projects. Key concerns include the potential financial impact of failed projects and the uncertainty about whether collaborative approaches will continue in the future. This is connected to the concept of contractor dependency because the uncertainty expressed by the market party about committing to new approaches, combined with the potential financial risks, especially for family-owned businesses, highlights the vulnerabilities contractors face. When a contractor is heavily dependent on long-term projects or a specific collaboration model,

failed projects or changes in the approach can have severe financial impacts. This uncertainty and risk underscore the delicate balance of contractor-client relationships, where both parties rely on each other, making contractor dependency a key effect of the portfolio approach.

### 5.2.5. Portfolio-Level Benefit Management and Optimization

**15 - Continuity Enhancement**

*Respondent 3 - Contractor*: "Continuity enhancement is achieved through multiple aspects: firstly, it allows the public party to allocate manpower in advance, and secondly, it provides the contractor with a clear vision of upcoming projects." This respondent also mentions: "At the public commissioner, they also deal with people who prefer to work on large, interesting projects, such as the Van Brienenoord Bridge. Smaller projects can sometimes be less appealing. In the infrastructure sector, we are seeing an entire generation retiring, and this also applies to engineering firms. We need to ensure that younger generations can step in. Infrastructure projects sometimes take 3-4 years, making it difficult to plan a proper training program. Younger generations often want to progress more quickly, so smaller projects can be valuable for their development. For younger people, working on something new and innovative, like the portfolio approach, is attractive. They learn a lot, and it offers them the opportunity to experiment and grow in their role."

*Respondent 7 - Client*: "By bundling multiple projects into a portfolio, continuity is provided to the market. This means contractors have long-term work security, allowing them to plan and allocate their resources more effectively. Instead of jumping from one project to another with uncertainty about their next job, contractors now have a stable flow of work. This stability makes it easier for them to manage personnel and materials efficiently, ultimately leading to higher productivity and lower costs."

The concept of continuity enhancement connects to the effect of management optimization, particularly in improved workforce stability and accelerating infrastructure realization. It ensures that contractors have long-term work security, allowing for better resource allocation and higher productivity. Additionally, it offers opportunities for younger generations to gain experience and contribute to faster project completion through innovation and experimentation.

**16 - Portfolio Formation**

Portfolio formation refers to the decisions behind the establishment and management of a portfolio. It appears to be an important concept. Respondent 6 mentions that there are many criteria, specifically: geographical closeness, the same type of bridge (in the case of a movable bridge), and the same scope.

*Respondent 12 - Contractor*: "These are large-scale projects involving significant financial investments, and the works must be comparable. If they are not, the portfolio becomes more of a collection of diverse projects, rather than a cohesive program with the idea that everything will be carried out efficiently and within a set timeframe."

This respondent mentions that the case-study portfolio are significant projects, and they must be somewhat similar. This respondent is not negative on the combination of the portfolio. However, some respondents are. *Respondents 9 and 6*, both clients, suggest that unique projects are not well-suited for the portfolio approach. They propose focusing on more similar projects to minimize the need for frequent scope changes and ensure better alignment within the portfolio. This concept of portfolio formation connects to the theme of portfolio and tender strategy as the respondent highlights the importance of emphasizing the formation of the portfolio and focusing on project similarity within it.

**17 - Collective Goals**

The concept of collaborative goal-setting in the portfolio approach emphasizes the importance of mutual understanding, clear communication, and shared objectives between clients and contractors. By focusing on joint interests and aligning goals from the outset, parties can foster a more cooperative environment that benefits project outcomes.

*Respondent 5 - Client*: ”To improve collaboration in the Netherlands, both sides need to consider actions and interests. The baggage from the past is always carried into new projects, influencing the behavior and interests of both parties. For the first bridge within the portfolio, there was a genuine dialogue about the interests of both sides. As a contractor, we could have easily said it was their problem, but we chose to collaborate and find solutions. This underscores the importance of mutual understanding and cooperation for a project’s success.”

*Respondent 8*, a client, emphasizes the importance of setting clear, measurable goals between the public commissioner and the contractor early in the project to create a shared vision and alignment. *Respondent 3*, a contractor, highlights that the portfolio approach fosters collaboration between the public commissioner and market parties, shifting from an adversarial mindset to a cooperative one. Long-term collaboration allows teams to work more efficiently and effectively, promoting a collegial approach to achieving common objective. The respondents highlight that fostering a shared vision, establishing measurable goals, and maintaining open dialogue are important for overcoming traditional adversarial dynamics. By prioritizing mutual understanding and collaboration, both parties can achieve more effective and harmonious project delivery.

Collective goals connect to the theme of communication and collaboration, as respondents emphasize the importance of creating a shared vision. This ensures that all parties are aligned and working toward common objectives, enhancing cooperation and project success.

**18 - Accelerating Infrastructure Realization**
The motivation for this research is the acceleration of infrastructure renewal realization, as this is a significant problem in the Netherlands. Respondent 8 emphasized this by mentioning that the portfolio approach arose from the desire to accelerate infrastructure renewal and make the market more attractive for this purpose. The portfolio approach helps accelerate the replacement and renovation tasks by reducing the need for multiple tenders and allowing for quicker, more efficient project execution:

*Respondent 8 - Client*: ”Now you can see that the portfolio approach is more accepted and comes into play earlier in projects. This helps to better achieve the acceleration goals.”
*Respondent 4 - Client*: ”Major advantage of the portfolio approach: A key benefit is that two full tender processes are not required, which saves time and costs. Additionally, it provides the market with more certainty, allowing companies to invest in innovations and improvements.”

This is an effect that is influenced by many other effects and is also a major goal of the public commissioner. The respondents mention that the portfolio approach could help achieve this goal through improved collaboration and efficiency.

**19 - Innovation**
Innovation is highlighted as an important theme within the portfolio approach. Respondents note that increased freedom for contractors and a stable environment provided by the client can foster innovation and continuous improvement, allowing contractors to develop more efficient methods and processes.

*Respondent 10*, a client, notes that the portfolio approach gives contractors more freedom in how they work, encouraging innovation. *Respondent 9*, also a client, highlights that while the portfolio approach brings structure and efficiency to smaller, similar projects, it can limit innovation in larger, more complex projects due to rigid contracts and time pressure. They emphasize the need for effective collaboration, knowledge sharing, and allowing room for innovation to leverage the portfolio approach’s benefits fully.

*Respondent 2*, a client, stresses the importance of providing stability and predictability to allow contractors to optimize their learning experiences and innovate. They note that many companies, including family businesses, are open to innovation and improvement, offering ideas for more efficient methods. *Respondent 5*, a contractor, highlights that contractors benefit from continuity, as it helps retain knowledge by deploying the same teams on follow-up projects, though this can be challenging.

Innovation is a key theme within the portfolio approach, with the concept focusing on the potential for

increased innovation as an effect of the approach. Respondents highlight that the freedom provided to contractors, along with stability and predictability from the client, fosters innovation

**20 - Pricing**
In this research, pricing falls under communication, trust, and knowledge sharing. This is because, within the portfolio approach, respondents expressed concerns about pricing, which are rooted in three key factors: effective communication, established trust, and proper knowledge sharing.

*Respondent 6* highlights the issue of limited alternatives when a contractor insists on a specific method, raising financial and planning risks if options cannot be properly compared. This can lead to inflated costs when contractors add ”modifications” after the contract is awarded. *Respondent 3*, a contractor, mentions that the portfolio approach fosters collaboration and transparency with early cost-sharing, though this involves risks. *Respondent 10* points to market pressures, especially in single-bid scenarios, which can strain trust. Pricing within the portfolio approach is complex, extending beyond initial bids to ongoing adjustments influenced by project dependencies. While early cost estimates aid in transparency, they also risk price escalation, complicating budget control and altering power dynamics. Managing pricing effectively is key for maintaining trust, cost control, and collaborative stability in long-term projects.

Pricing is an effect linked to contractor dependency, as respondents indicate that dependency on a single contractor can lead to pricing issues. This dependency can limit competition and influence cost efficiency, which can result in higher prices.

**21 - Better Overview of Project Status**
*Respondents 2 and 7*, both clients, highlight that the portfolio approach offers a better overview of project and maintenance status. *Respondent 2* explains that managing objects within a portfolio provides clearer insight into their condition, allowing for proactive maintenance planning, which helps prevent issues and extends the lifespan of the objects. *Respondent 7* adds that the portfolio approach requires creating and updating evaluation documents, which capture lessons learned from each project and ensure knowledge is transferred to future projects. This means that the portfolio approach not only improves monitoring of project conditions but also supports continuous improvement by documenting and applying insights from previous projects, leading to more efficient management and better long-term outcomes.

This concept matches the overall theme of management optimization. *Respondents 2 and 7*, both clients, mention that the portfolio approach improves the overview of project and maintenance status. It allows for proactive maintenance and ensures that lessons learned from each project are documented and applied to future projects, leading to better management and long-term results.

## 5.3. Structuring Insights from Interview Data

The data analysis has identified several key themes central to understanding the dynamics and challenges of the portfolio approach in infrastructure projects. These findings reflect a range of perspectives from respondents, highlighting issues such as the importance of knowledge sharing, the complexity of internal procedures, the need for effective communication and trust, challenges with project team continuity, contractor dependency, pricing strategies, and considerations of project complexity. Together, these insights reveal factors that influence the actions and effects within the portfolio approach. To address sub-questions 2 and 3, findings must be structured into specific actions and effects rather than general codes. Therefore, in the next chapter, the interview data is reorganized to group codes according to actions and effects observed during the interviews, as outlined in the coding methodology in section 2.2. This approach ensures the findings are directly relevant to the analysis, providing a view of how these actions and effects operate within the portfolio approach.

The concepts of the first, themes of the second, and aggregate dimensions are shown in Figure 2.2. The methodology section, explains that first-order concepts are directly tied to quotes. These concepts

represent groups of codes related to specific topics, all of which are emphasized within the identified principles. The first-order concepts are then categorized into broader second-order themes. The themes associated with actions accompanying the portfolio approach include:

- Collaboration and communication
- Knowledge sharing
- Stakeholder engagement
- Portfolio and tender strategy

These second-order themes are meant to connect to the actions that should be taken when applying the portfolio approach. On the other hand, the remainder of the second-order themes connected to the effects of the portfolio approach are:

- Contractor dependency
- Innovation and optimization
- Management optimization

These concepts affect the portfolio approach. All the information in the conceptual model is collected from the analysis of the interview data in this chapter. The structure distinguishes between the actions implemented within the portfolio approach and the effects that these actions produce.

# 6

# Framework Development

## 6.1. Structuring the Framework Development

The objective of this chapter is to develop a simple framework for implementing the portfolio approach, considering both client and contractor perspectives. This framework aims to provide an overview of actions and effects. With this goal in mind, this chapter addresses sub-questions two, three and four. The structure of this chapter is as follows: It starts with an expert evaluation of the interview findings and an initial framework outline. Next, the actions and effects from the empirical research are evaluated against expert opinions and relevant literature, forming the foundation of the framework. At the end of the chapter, the framework is shown.

## 6.2. Expert Exploration

As explained in the methodology section, four expert interviews are conducted to discuss the results of the empirical findings. Key comments are gathered, and the framework is adjusted accordingly. All the points that the expert mentioned are shown in Appendix E. The feedback obtained from four experts provides insights and suggestions to enhance the framework and implementation of the portfolio approach in Dutch public infrastructure projects. These recommendations encompass various topics, including language clarity and the technical aspects of portfolio formation and evaluation.

## 6.3. Exploration of Effect and Actions

This research aims to investigate the principles, effects, and actions involved in the public implementation of the portfolio approach in the Netherlands. The guiding principles for this research are drawn from the literature and explored in a case study. The actions and effects discussed in this chapter are based on empirical findings, literature, and expert evaluations, all of which can be traced back to Figure 2.2. To have an overview of which effects and actions are interesting to include in a framework, this chapter answers SQ2 and SQ3: 'What actions support the adoption of a portfolio approach, and what effects arise from it from the client's perspective?' & 'What actions support the adoption of a portfolio approach, and what effects arise from it from the contractor's perspective?'

In the case study, the client has a specific task: they are trying to accelerate through the portfolio approach: the renewal and renovation task. This task is intended to solve the issues outlined in chapter 1. The contractor views projects differently from the client, focusing primarily on the business case. For contractors, a project aims to be a viable business opportunity, where profitability, efficiency, and long-term value are key considerations. Unlike the public client, whose priorities may include broader public interests and long-term infrastructure goals, contractors are driven by the need to ensure that

the project makes financial sense and supports their business strategy.

The remainder of the chapter is structured as follows: each component of the framework is discussed, beginning with the actions and then moving on to the effects. For each action or effect theme, the findings from the interviews are presented first. These findings are then connected to the relevant literature and expert interviews to validate the case-study results.

## 6.4. Actions for the Implementation of the Portfolio Approach

### 6.4.1. Collaboration and Communication


**Figure 6.1:** Data Visual - Communication and Collaboration

**Findings Client** *Create a Shared Vision for Collective Goals*: Collaborate with contractors to develop shared goals and performance indicators. Ensure these objectives are clearly defined, measurable, and consistently communicated, allowing all parties to focus on collective success rather than individual agendas.
*Encourage Collaborative Decision-Making*: Involve contractors early in the decision-making process, especially during the planning and design phases. This collaborative approach will ensure that both parties align on project objectives, reducing the risk of misunderstandings and enabling more efficient execution.
*Establish Clear Communication Channels*: Develop structured and open communication pathways with contractors from the start of the project. This includes regular feedback loops to ensure that both parties can share progress, concerns, and improvements, enhancing transparency and trust throughout the project lifecycle.
*Change collaboration method*: The client must move away from the traditional ”us versus them” mindset and shift towards a more strategic method of collaboration. This requires changes within the public institution, including retraining staff and fostering an openness to change and new ways of working.

**Findings Contractor** *Invest in Relationship Building:* Contractors should proactively focus on developing trust-based relationships with clients and other contractors. This may involve informal meetings or team-building exercises aimed at nurturing mutual respect and understanding. The primary goal should be to eliminate the divisive ”us versus them” mentality often present in traditional project management relationships. Contractors should adopt a more collaborative mindset, moving away from traditional adversarial dynamics. This involves actively seeking feedback from the client and other contractors, being open to adjusting project methods based on this feedback and emphasizing shared project success rather than individual outcomes.
*Promote a Shared Vision for Success*: Contractors should advocate for a shared vision of success that

benefits both parties. This means focusing on delivering the immediate project outcomes and thinking long-term about the overall impact of the portfolio approach on both the contractor's business and the client's infrastructure goals.
*Showcase Long-Term Reliability:* Contractors should not only fulfill immediate project goals but also demonstrate their reliability by committing to a long-term partnership and continuous improvement. They can reinforce their trustworthiness and solidify their role as a reliable partner to the client by maintaining open communication and transparency, especially with the pricing issue.
*Pricing Transparency:* Contractors are expected to provide transparent pricing from the start, which helps build trust with the client. This requires contractors to have strong cost management practices in place to avoid future disputes over costs and ensure pricing remains aligned with project requirements over time.
*Change collaboration method*: The contractor needs to move away from the traditional "us versus them" mindset and adopt a more collaborative approach with the client. This requires adapting their internal processes, investing in skill development, and being open to new methods of cooperation to foster a more effective working relationship.

These actions align with existing literature. Flyvbjerg (2007) notes that misinformation and trust issues often result from discrepancies between expected and actual project outcomes, highlighting the need for transparent reporting and clear communication—both essential to effective portfolio management. Additionally, Hansen and Svejvig (2023) emphasizes the role of supportive cultures in fostering collaboration and adapting decision-making styles to suit organizational needs, which supports findings on the importance of collaborative approaches over traditional adversarial methods. Martinsuo (2013) underscores the value of strategic alignment to ensure all projects contribute to broader organizational goals, reinforcing the portfolio action of creating a shared vision for collective goals.

The experts highlight the importance of communication and collaboration within the portfolio approach, emphasizing key areas such as creating a shared vision for collective goals, encouraging collaborative decision-making, showcasing long-term reliability, and fostering a new collaboration strategy of working closer and longer together. They note that aligning the client and contractor's individual goals with overall portfolio objectives is critical for success, while also pointing out that procurement regulations and competitive concerns can complicate the process. Transparency, especially in pricing, is essential for building trust, and mutual evaluation throughout the project cycle is recommended to strengthen collaboration. Additionally, long-term reliability is fostered through continuous communication and collaboration.

### 6.4.2. Portfolio and Tender Strategy

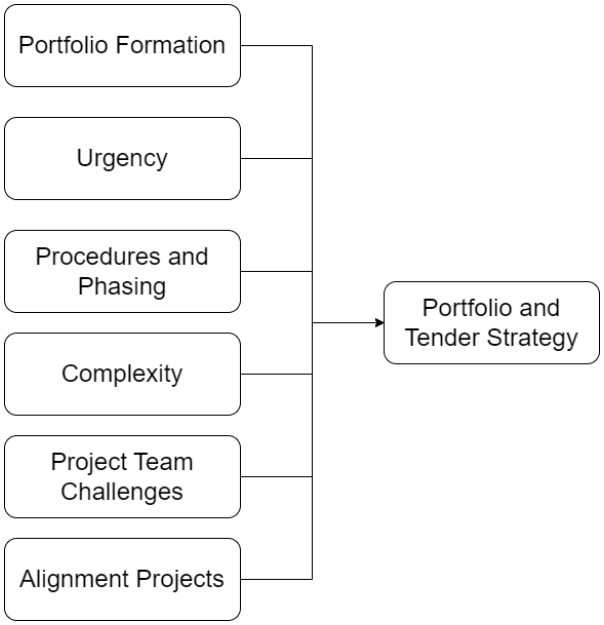


**Figure 6.2:** Data Visual - Portfolio and Tender Strategy

**Findings for Client** *Focus on Project Similarity*: Ensure future portfolios are composed of similar projects (e.g., scope, size, and complexity) to minimize scope changes that could trigger additional tender processes. For example, projects involving similar types of bridges or infrastructure should be grouped to streamline planning and reduce the risk of tender re-initiations.
*Broaden Regional Collaboration*: Explore ways to extend portfolios across regions, allowing for greater flexibility in project selection. This could involve setting new regional cooperation agreements to allow cross-regional project portfolios that maximize efficiency and reduce the limitations of regionally bound projects.
*Create Clear Approval Timelines within Phasing*: Establish specific, well-communicated timelines for internal approvals and budget requests to avoid delays. This could include setting deadlines for each stage of the approval process, helping teams stay on track and maintaining continuity between project phases, and discussing this in an early stage with contractors.
*Develop Phased Project Planning*: Coordinate the planning and execution phases of different projects more closely to avoid long gaps that can lead to knowledge loss and misalignment. For example, the design phase of a follow-up project should begin while the first project is still in its execution phase to maintain team momentum and cohesion.
*Ensure Early Decision-Making*: Remember to make portfolio formation decisions earlier in the project timeline to avoid rushed implementation, as seen in the first bridge of the case. Establish clear protocols for assessing whether a project fits within a portfolio before project planning begins, reducing the risk of last-minute decisions that could derail project timelines.
*Approach for Piloting in Urgent Projects*: Urgent projects present challenges for piloting new approaches, especially in the infrastructure sector, where the portfolio approach is still in its early stages. While urgency itself is not necessarily a negative factor, testing a new methodology under urgent conditions can introduce risks. As the approach matures and is proven effective, it may be possible to apply it to urgent projects. However, for now, priority should be given to fully developing and understanding the portfolio approach in less time-sensitive settings.
*Maintain Consistent Teams*: Where possible, assign the same teams to multiple projects within a portfolio to ensure continuity, quality, and knowledge retention. Consider introducing incentives for team members to remain on the same project series, particularly during long-term portfolio execution.

*Adapt Internal Processe*: Implement more flexible and streamlined internal procedures that allow for quicker approvals and budget allocations. By doing so, the client can better support the sequential and dynamic nature of portfolio projects, minimizing delays that disrupt continuity and knowledge retention.

**Findings for Contractor** *Advocate for Better Project Sequencing:* Contractors should emphasize the importance of proper sequencing of projects within the portfolio to avoid long gaps between phases. By highlighting the risks of knowledge loss and team disruption, contractors can encourage better alignment between project phases. Contractors can also suggest ways to maintain engagement with the same teams across projects, which can help in preserving institutional knowledge and reducing inefficiencies.
*Develop Strategies for Knowledge Retention*: Contractors can take responsibility for ensuring that knowledge gained from one project is captured and carried over to the next. This could involve creating detailed project reports or hosting debriefing sessions that document lessons learned, ensuring that valuable insights are not lost due to project delays or team disruptions.
*Ensure Consistency in Project Teams*: Contractors should strive to maintain consistent project teams across projects to ensure continuity and knowledge retention. This could involve proposing contracts that allow for team members to remain involved in follow-up projects within the same portfolio. Consistent teams ensure smoother transitions between projects and allow contractors to build on existing knowledge.
*Collaborate on Project Phase Alignment*: Contractors should work closely with the client to ensure that project phases are better aligned, minimizing gaps between design and execution phases. Contractors can propose strategies for optimizing resource allocation and scheduling to keep teams engaged and minimize downtime, improving overall project efficiency.

In this framework, the findings are categorized under 'Portfolio and Tender Strategy'. The recommendations emphasize the importance of avoiding complexity, addressing urgency, and focusing on project similarity when building a portfolio. Additionally, it is essential to prioritize project phase alignment and ensure consistency within project teams. Ma et al. (2022) supports these findings by emphasizing the importance of synergistic relationships when creating a portfolio. They highlight that understanding and evaluating the synergies between projects is essential for portfolio success. Furthermore, they stress the need to ensure that all projects within a portfolio align with the company's overarching strategic goals. When new projects are added, they must be carefully assessed to determine whether they help realign the portfolio with these objectives.

Experts recommend managing complex projects separately to streamline portfolio management, as handling complexity requires specialized teams. Second, avoiding urgency in initial projects is advised, allowing for solid groundwork before introducing time-sensitive elements. Experts stress the importance of coordinating project phases between client and contractor to prevent misunderstandings and ensure smooth execution. Consistency in project teams is recommended for better knowledge retention and collaboration. Lastly, selecting similar projects within a portfolio supports efficient management, enabling easy application of lessons learned across projects, and fostering continuous improvement. These findings align with ongoing developments within the public commissioner's organization, where there is a focus on redevelopment and reorganization. As the public commissioner considers new approaches to streamline project delivery, implementing strategies that prioritize simplicity, phase alignment, and consistent team collaboration will support these organizational changes. The emphasis on modular portfolio design and strategic alignment reflects a broader shift towards creating an adaptable and resilient infrastructure management framework that can better respond to future demands.

### 6.4.3. Knowledge Sharing

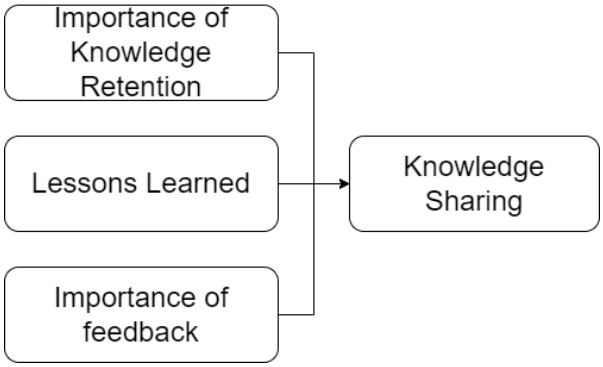


**Figure 6.3:** Data Visual - Knowledge Sharing

**Findings for Client** *Develop Strategies for Knowledge Retention:* Implement a knowledge management system that ensures all learnings and insights from one project are captured and easily accessible for future projects, even if there is a significant time gap. This system could include mandatory debriefings, documented lessons learned, and centralized digital storage of project information.
*Work on Clear Evaluation Methods*: To properly evaluate the contractor's performance, the client must set clear guidelines and Key Performance Indicators before the project begins. These criteria should be well-defined and measurable, ensuring that both parties understand the expectations.
*Lessons Learned Importance*: Establish a structured process for the client to document lessons learned from each project and ensure these insights are consistently shared with relevant stakeholders and contractors. This helps to prevent recurring issues in future projects, both within and outside the portfolio. Leveraging modular methods can help codify these insights, making it easier to apply them consistently across various projects and prevent recurring issues in future projects, both within and outside the portfolio. *Share lessons outside of Portfolio*: Share knowledge not only within the portfolio or with the parties involved in the project, but also beyond. For the client, this means creating incentives for the contractor to encourage knowledge sharing.

**Findings for Contractor** *Lessons Learned*: Contractors must create a structured process for documenting lessons learned from each project and ensure these are consistently shared with the client and stakeholders to improve efficiency and prevent recurring issues in future projects, both within and outside the portfolio. Leveraging modular methods can help codify these insights, making it easier to apply them consistently across various projects and prevent recurring issues in future projects, both within and outside the portfolio.
*Evaluation Methods*: Contractors should collaborate with clients to set clear guidelines and Key Performance Indicators before the project begins. These criteria must be well-defined and measurable, ensuring that both parties have a mutual understanding of performance expectations.
*Strategies for Knowledge Retention*: Ensure contractors establish a shared knowledge management system to capture and document all learnings and insights from each project through mandatory debriefings and centralized storage within their own company. *Share lessons outside of Portfolio*: Share knowledge not only within the portfolio or with the parties involved in the project, but also beyond. For the contractor, this means not being afraid to share information and actively utilizing the expertise of other contractors.

In the framework, this theme of ”Knowledge Sharing” also supports modularity and standardization. Sharing knowledge between projects facilitates the development of modular approaches and standardized solutions that can be reused across various projects, leading to more efficient processes and consistent execution. Martinsuo (2013) emphasizes that knowledge transfer creates synergies in technology and capabilities, allowing projects to not only achieve greater efficiency but also to implement

standardized and modular solutions more effectively. Martinsuo (2013) highlights knowledge sharing as a means to foster communication between projects, generate technology and capabilities synergies, minimise duplicated efforts, and enhance portfolio performance. As noted by Martinsuo (2013), control mechanisms play a key role in tracking project progress, assessing performance, and enabling timely adjustments. Aritua et al. (2009) further emphasizes feedback as vital for adaptation within evolving business environments, supporting both flexibility and stability in project execution. Similarly, the Public Commissioner (2022) stresses creating lessons-learned documents and sharing insights to drive continuous improvement across projects in the portfolio approach.

Experts stress the importance of knowledge sharing, highlighting key points: incentivizing contractors to share lessons learned within and beyond the portfolio, distinguishing between generic and specific knowledge to prevent competitive issues, and documenting insights to support continuous improvement. They also recommend clear, flexible evaluation methods using KPIs, with mutual evaluations throughout the project cycle to capture and apply knowledge effectively.

### 6.4.4. Stakeholder Engagement

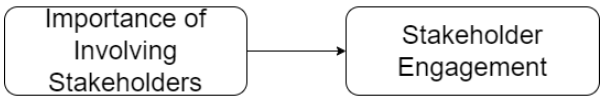


**Figure 6.4:** Data Visual - Stakeholder Engagement

**Findings for Client and Contractor** *Monitor and Adapt Stakeholder Management Efforts*: In the portfolio approach, a consistent stakeholder engagement strategy across projects can simplify coordination, as many stakeholders are already familiar with each other. This familiarity supports more cohesive management and smoother communication, minimizing the need to re-establish relationships or reintroduce processes with each new project. As the portfolio evolves, insights from one project may naturally transfer to the next, promoting continuity. Adapting the approach for regional or national contexts helps keep engagement relevant across different locations.

Hansen and Svejvig (2023) emphasize this point by stating that engaging stakeholders at all levels of the organization and clarifying roles and responsibilities ensures alignment with strategic objectives, while also fostering collaboration and accountability. Similarly, Martinsuo (2013) highlight the connection between the portfolio management approach and the pursuit of competitive advantage, stressing that strategic alignment directly impacts market position and contributes to achieving business success.

Experts note the importance of effective stakeholder engagement, particularly in coordinating national and regional strategies within the public commission. They emphasize the need to clearly define roles and responsibilities and tailor stakeholder efforts to support portfolio goals. Engaging stakeholders at different levels within the organization can help ensure that strategic objectives are met and collaboration among parties remains efficient. Additionally, experts point to the value of ongoing communication with stakeholders throughout project phases to support alignment. However, involving a higher number of stakeholders may increase project complexity. Each stakeholder's specific needs and goals introduce additional layers of coordination and the potential for misunderstandings or misalignment. This complexity can grow further when multiple projects within a portfolio involve the same stakeholders. Recognizing that stakeholder engagement adds complexity can allow strategies to be adapted to these dynamics.

## 6.5. Effects connected to the Implementation of the Portfolio Approach

### 6.5.1. Management Optimization

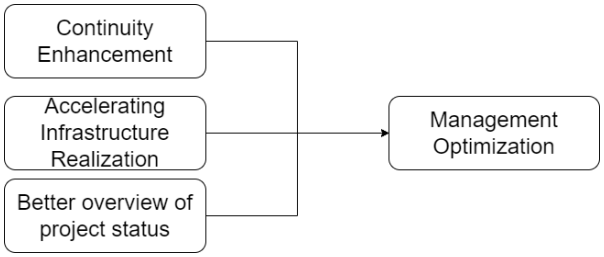


**Figure 6.5:** Data Visual - Management Optimization

**Findings for Client** *Long-term Workforce Planning*: The portfolio approach enables clients to plan manpower allocation in advance, ensuring more efficient use of human resources. It also provides contractors with long-term work security, which can attract new talent to the industry and build stronger project teams over time. However, as the portfolio approach streamlines projects into a series of standardized tasks rather than unique, high-profile projects, some public sector employees may feel less motivated, as they are drawn to complex, standout projects.
*Faster Project Delivery*: The portfolio approach speeds up infrastructure replacement and renovation by minimizing the need for multiple tenders and streamlining project execution. This results in quicker completion times for crucial infrastructure renewal projects, assisting the client in achieving public service and policy goals more efficiently.

**Findings for Contactor** *Long-term Work Security*: The portfolio approach provides contractors with greater stability, reducing project gaps and helping retain skilled workers.

A paradox emerges from the portfolio approach: as projects become part of a more systematic series, they may lose their individual ”uniqueness,” which can impact staff motivation, especially within public sector roles. Both client and contractor employees, particularly those on the client’s side, expressed a preference for working on challenging, high-profile projects.

Schraven et al. (2011) emphasizes management optimization in infrastructure through workforce stability, project visibility, and efficient delivery. Building skills in public infrastructure enhances workforce stability, while asset management practices like regular assessments improve project tracking and decision-making. Aligning objectives and interests reduces inefficiencies, speeding up timelines. Similarly, Flyvbjerg (2007) advocates for reforms in forecasting and incentives for large projects, which the portfolio approach supports by improving monitoring and planning, fostering better incentives and decision-making in infrastructure management.

Experts highlight that enhanced project visibility and status monitoring are indeed applicable. They note that the public parties and contractors should begin planning for subsequent projects earlier, which creates a strong foundation for making faster predictions and decisions. This proactive approach helps streamline project planning and execution, improving overall efficiency.

### 6.5.2. Innovation

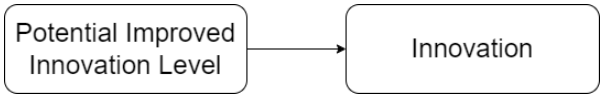


**Figure 6.6:** Data Visual - Innovation

**Findings for Client** *Encouraging Innovation*: The portfolio approach can encourage contractors to implement lessons learned and innovations in subsequent projects. By applying new methods and optimizing processes from earlier assignments, contractors can continuously improve efficiency, leading to more effective and innovative project delivery over time.

**Findings for Contractor** *Catalyst for Innovation*: The portfolio approach can encourage contractors to implement lessons learned and innovations in subsequent projects. By applying new methods and optimizing processes from earlier assignments, contractors can continuously improve efficiency, leading to more effective and innovative project delivery over time.
*Innovation Constraints on Complex Projects*: In large, complex projects, contractors may find that strict contractual frameworks and tight timelines limit their ability to innovate.

Ginger et al. (2014) emphasizes that learning and change are critical factors influencing a company's dynamic capabilities when undertaking projects. These capabilities encompass processes, methods, tools, organizational structures, and human skills. Learning and adapting to change are essential components that can lead to innovation, which in turn contributes to the overall success of the project.

The expert evaluation emphasizes the relevance of the "Project Factory" principle, which refers to the standardization or modularity of similar projects within the portfolio. This approach enhances innovation potential by allowing contractors to invest upfront in new methods, knowing they can apply them across multiple projects to recover costs. This innovation potential is closely tied to key framework actions, including building trust, managing complexity, developing collaborative strategies, and aligning goals. Modular working supports this by creating a stable environment where contractors feel confident their investments will yield returns, promoting innovation through clear alignment and collaborative effort across projects.

This approach also highlights another key consideration: balancing margins and innovation gains. When a contractor invests in an innovation, maintaining a portion of the additional value in subsequent projects is essential to reward their contribution fairly. To truly stimulate innovation, a share of these margins should ideally remain with the innovating party, with clear, upfront agreements to distribute the benefits. This structure preserves the incentive to innovate, aligning both parties' interests and fostering long-term collaboration and continuous improvement across projects.

### 6.5.3. Contractor Dependency

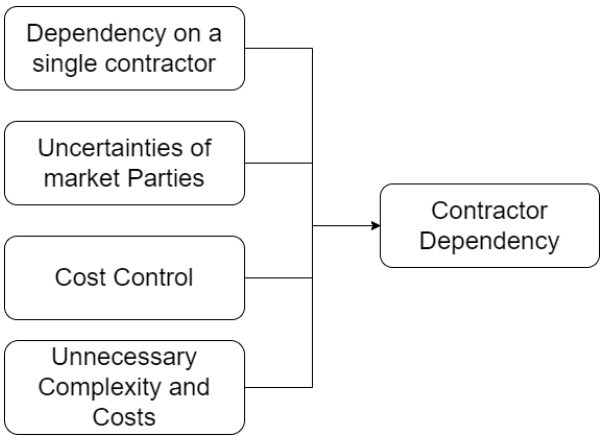


**Figure 6.7:** Data Visual - Contractor Dependency

**Findings for Client** *Limited Negotiation Power*: Heavy reliance on a single contractor or a small pool of contractors may reduce the client's ability to manage costs effectively, as fewer competitors in the market can lead to pricing issues. This dependency can make it difficult for the client to negotiate

favourable terms, potentially increasing overall project costs.
*Unbalanced Knowledge Transfer*: One contractor benefits from the entire portfolio while others do not creating an uneven playing field. This can lead to a situation where certain contractors gain competitive advantages over time, potentially limiting the client's future options for contractor selection.
*Cost Control Risks:* The complexity of pricing within a portfolio approach means that early cost estimates may be less accurate. Although transparency in pricing fosters collaboration, it also increases the risk of cost escalation throughout the project lifecycle, putting pressure on the client to control budgets and manage potential overruns.
*Strategic Pricing Challenges:* Clients must manage the balance between getting accurate early-stage pricing while avoiding commitments that lead to excessive costs as the project develops. Over-reliance on cost estimates without sufficient flexibility can limit the client's ability to adapt to unexpected financial shifts. The contractor may abuse their power to ask for a higher price in the repeat assignment by exaggerating certain risks.
*Managing Project Complexity*: For the client, applying the portfolio approach to highly complex projects may lead to collaboration inefficiencies and increased costs
*Unnecessary Complexity and Costs*: When the portfolio "fails" and the contractor is unable to complete the portfolio, could be due to several reasons. It results in additional costs and complexity, which could have been avoided if the portfolio approach was initially not used.
*Uncertainties of Market Parties*: Ensuring Long-term Collaboration: A stable and predictable collaboration framework reduces uncertainty for contractors, particularly family-owned businesses, ensuring they are more likely to commit to innovative solutions. This enhances market confidence and leads to improved project efficiency over time.

**Findings for Contractor** *Unfair Competition*: When a contractor secures the majority of a portfolio's projects, they gain more knowledge and experience, potentially leading to an unfair advantage over other contractors who miss out on learning opportunities. Contractors working on multiple projects benefit from retaining knowledge, enabling them to apply lessons learned and improve efficiency.

Flyvbjerg (2007) highlights that discrepancies between expected and actual outcomes in large infrastructure projects can erode trust, stressing the importance of accurate, transparent reporting. Limited negotiation power and strategic pricing add to these risks, particularly with a small pool of contractors, where transparency may help but can also lead to inflated costs. Timely reporting is crucial for maintaining trust and controlling costs. Similarly, Kuitert et al. (2020) notes the complexity for public clients in balancing organizational and socio-political interests, especially when reliant on a single contractor. They suggest that public clients benefit from collaboration, though over-reliance can cause inefficiencies and higher costs if the portfolio approach is poorly managed.

Experts do not view contractor dependency as a significant issue. They note that competitive advantages tend to fade as market dynamics evolve and that frequent employee movement between firms spreads expertise across the industry, reducing long-term dependence on single contractors. Additionally, experts relate contractor dependency to principal-agent theory, where the public commissioner relies on the contractor for execution. This relationship may lead to informational imbalances, which can be managed with transparency and robust cost-control measures to prevent the exploitation of informational advantages.

Contractor dependency also brings in the issue of profit margins. Findings from the empirical data indicate the need for a shift towards an open-book collaboration approach. This open-book model enhances transparency by encouraging both parties to engage in discussions about how costs and budgets are structured within the portfolio. Greater openness and clarity about profit margins can help the client and contractor better understand each other's financial constraints and goals. This mutual understanding is essential for effectively managing cost control risks, as it allows for more accurate tracking and adjustment of budget allocations throughout the project lifecycle.

An issue highlighted in the empirical data is related to 'unnecessary complexity and costs.' In the Nether-

lands, infrastructure renewal projects are often viewed as unique, which draws significant manpower; the more complex or unique a project is considered, the more desirable it becomes for managers. However, the focus on uniqueness needs to shift towards standardization and modularity within a portfolio of similar projects.

## 6.6. Content Framework

Sub-question four is: *How can insights on actions and effects from the portfolio approach be structured into a framework for Dutch public infrastructure projects?* The framework illustrates this structure and shows how each element is integrated. This touches, for example, on the challenges that both public and private parties experience, where traditional ways of working and rigid internal processes often stand in the way of the necessary flexibility that the portfolio approach requires. The framework presented, Figure 6.8, is based on findings from empirical research, including document analysis and in-depth interviews. This framework has been explored through literature review and expert feedback, as demonstrated in this chapter. By exploring the principles underlying the portfolio approach in practice, the research has highlighted certain effects and actions that could potentially enhance its application. The framework offers an overview of the possible benefits of the portfolio approach, while also identifying key areas that may require attention and the potential risks that could arise. It provides insights that may inform the optimization of the portfolio approach in infrastructure management.It's a tool for guiding decision-making and project execution within the portfolio approach.

The actions and effects are not separated for the client and contractor, as both parties benefit from a shared understanding of the requirements for effective portfolio implementation. The results indicate that transparency and communication play a central role. When both parties discuss actions and effects openly, it can support alignment and collaboration, fostering a unified approach where each party is aware of its roles and responsibilities. Maintaining open dialogue about actions and effects may help ensure that the portfolio approach functions efficiently, with both client and contractor aligned toward common goals.

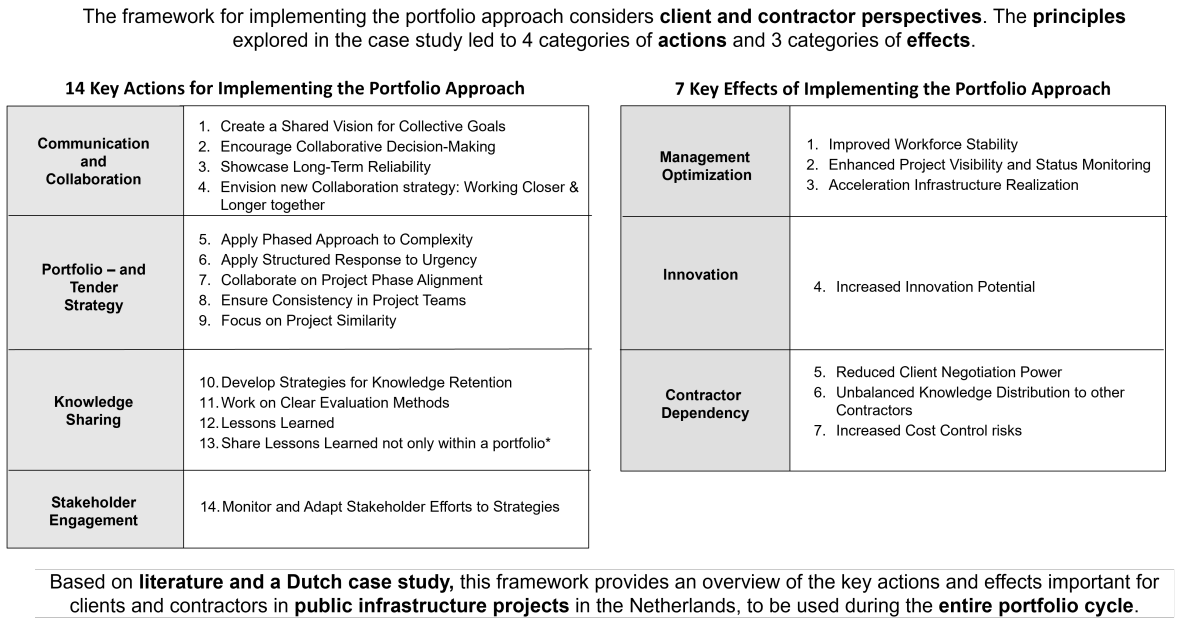


**Figure 6.8:** Framework for Exploration and Implementation of Portfolio Approach

# 7

# Discussion

In the previous chapters, the following work has been undertaken: In chapter 3, a literature review was conducted focusing on the public client, the contractor, the portfolio approach, and specifically the intersection of these themes. This review produced a list of so-called principles, which are further investigated in chapter 4 through a document study of public records related to the portfolio approach and the case study of the portfolio for the two bridges. A shortlist of principles from the literature was then compiled based on the document analysis, selecting those that most closely aligned with the priorities identified in the public documentation. This resulted in five principles being shortlisted. These five principles were subsequently explored in a case study to assess their applicability in practice and to derive new insights. The data analysis from this case study is presented in chapter 5.

## 7.1. Public Infrastructure Management

In practice, both public and private sectors lack adaptability in the required skill sets, mentioned by Schraven et al. (2011), reflecting a hesitation to move beyond traditional roles. This gap highlights the need for a shift in mindsets and readiness to support the portfolio approach effectively. Interestingly, the public commissioner shares this perspective, working on internal reforms to improve adaptability and willingness to embrace necessary organizational changes. This reform aims not only at structural shifts but also at fostering a culture that values and trusts dynamic collaboration. The literature and empirical findings converge on the challenges of managing complex, large-scale infrastructure projects, particularly around flexibility, risk, and evolving processes. Long timelines, multi-party coordination, and complex project structures can diminish benefits and lower the chances of success. Rigidity in internal processes and strict budget timelines in government bodies are identified as primary barriers to successful portfolio implementation. Respondents underscore the importance of collaborative, trust-based management over traditional adversarial methods. The portfolio approach promotes centralized oversight, shared risk management, and continuous feedback to improve alignment, which echoes Flyvbjerg (2007) emphasis on systemic risk management reforms. While Flyvbjerg (2007) advocates for policy-level adjustments, empirical data points to direct changes in collaboration dynamics—particularly open communication and shared goals—as actionable methods to address risks and inefficiencies within infrastructure projects. The public commissioner's reform efforts reflect this understanding, as they aim to create a more dynamic organization willing to embrace these changes.

## 7.2. Need for Interaction

The empirical data reveals how communication and trust impact decision-making and coordination across projects within a portfolio, with respondents particularly emphasizing the necessity of trust for

managing risks and aligning project goals. This aligns closely with Suijkerbuijk et al. (2019) who describe collaboration as being rooted in joint production and mutual learning, with the goal of performance improvement. Respondents' focus on open communication to build a collaborative environment also supports this.

In terms of collective goals, both the literature and empirical data underscore the value of shared objectives in improving collaboration. Kuitert et al. (2020) point out that joint competencies between the client and contractor are needed for adequate service delivery, and the empirical data supports this with references to the importance of establishing measurable, shared goals from the onset. The data points suggest that collaboration under the portfolio approach not only facilitates smoother execution but also helps break down traditional adversarial dynamics. When it comes to collective goals, it's important to remember that the client and contractor may have different viewpoints. Their objectives must be aligned with the overarching goals of the portfolio to ensure successful collaboration and outcomes.

Bai et al. (2022) and Ma et al. (2022) emphasize the importance of aligning project portfolios with strategic objectives to drive long-term organizational success. This focus on shared goals is reflected in the case study, where the portfolio approach helps accelerate infrastructure projects—a priority for the public commissioner. The early integration of the portfolio approach into projects supports acceleration by reducing the need for multiple tender processes and saving time and costs. The approach also provides market certainty, encouraging companies to invest in innovation.

## 7.3. Balancing Objectives in Client-Contractor Relationships

In the portfolio approach, the public commissioner and contractor have differing objectives: the public commissioner, as a taxpayer-funded entity, aims for public value, while contractors focus on profit, creating inherent tensions. Nonetheless, the portfolio approach offers benefits to both. For the public commissioner, the intended outcome is to address the replacement and renewal challenges faced by the Netherlands. The portfolio approach aligns the interests of both parties in practice.

Pricing remains a recurring challenge, especially concerning the repeat assignment, as it won't undergo traditional tendering. Without a competitive benchmark, the public commissioner may be at a disadvantage, relying on the contractor for transparent cost estimates. This creates a principal-agent dynamic where the public commissioner depends on the contractor for accurate pricing. The contractor, with more knowledge of costs and risks, could exploit this by inflating prices, particularly in repeat assignments. This scenario underscores the importance of transparency, cost management, and trust to ensure fair pricing. Some experts argue this risk is mitigated by rapid market changes and employee mobility, which spread expertise and reduce reliance on a single contractor. This highlights the need for a balance between collaboration and accountability in long-term contracts, especially without external competition, to ensure a fair and effective partnership throughout the portfolio's lifecycle.

Contractor dependency raises concerns about profit margins. Findings from the empirical data suggest a need to adopt an open-book collaboration approach. This model enhances transparency by encouraging both parties to openly discuss how costs are structured within individual projects as well as across the project portfolio. By fostering greater openness and clarity regarding both project-specific costs and overall profit margins, the client and contractor can gain a deeper understanding of each other's financial constraints and objectives, ultimately supporting a more equitable and collaborative partnership.

## 7.4. Stakeholders Engagement

The principle of stakeholder engagement, recognized in the literature by Martinsuo (2013) and Hansen and Svejvig (2023), is also highlighted in the empirical data from this research. Respondents frequently emphasize the benefits of having the same stakeholders involved across multiple projects within a portfolio. By grouping these projects into a single portfolio, it becomes possible to manage stakeholders

collectively. This continuity allows stakeholders to become familiar with each other's roles, expectations, and communication styles, which can significantly improve collaboration. Established relationships lead to clearer communication, faster decision-making, and a stronger foundation for working together, all of which contribute to more efficient project execution within the portfolio approach. However, the involvement of more stakeholders can also introduce added complexity, making project management more challenging. This dynamic—balancing the benefits of stakeholder continuity with the complexity introduced by additional parties—should be carefully considered within the portfolio approach.

The findings highlight stakeholder engagement as a key principle in both literature and empirical data, with a focus on the perspectives of the public commissioner and contractor. However, views from other critical stakeholders—like municipalities and provinces—are notably absent. Including these parties would offer a fuller understanding of portfolio impact, especially as municipalities and provinces bring essential insights about local needs and coordination requirements. Their involvement could strengthen collaborative efforts and improve project outcomes by addressing local challenges and aligning with broader community goals.

## 7.5. Implicit Principles Revealed

Some principles were not explored in the case study but were highlighted in the literature as important aspects of the portfolio approach. The fact that they were not explicitly measured does not mean they did not emerge. This paragraph will emphasize these principles.

### 7.5.1. Competitive Advantages

An interesting insight emerged during the study, even though it wasn't explicitly sought, which can be linked to principle 13: "Competitive Advantage through Strategic Projects" by Martinsuo (2013). This principle suggests that a market player gains a competitive advantage when securing a portfolio of projects. According to the literature, strategic alignment directly impacts a company's market position and contributes to its business success. However, in the empirical study, it became apparent that the public sector views this as a potential risk. The reason is that, unlike other countries, the Netherlands does not have many infrastructure projects. If a public commissioner were to award a portfolio containing more than three projects to a single market player, that company would gain substantial knowledge and experience that other competitors might not, raising concerns about fairness from the public perspective. However, this risk could be mitigated if market parties shared their knowledge and learning experiences gained from these projects. Unfortunately, this level of information-sharing is not yet common practice and is even seen as classified information in competition.

Not only do concerns about fairness arise, but consider this scenario: a portfolio containing five movable bridges is awarded to a single combination of two contractors. This could lead to those contractors dominating the market, potentially sidelining other contractors entirely. Such a situation raises significant concerns about market competition and diversity, as well as the long-term sustainability of the sector.

### 7.5.2. Resource Allocation

It can be noted that the principle of Resource Optimization and Allocation, as highlighted by Martinsuo (2013), may not be fully applicable to portfolio projects in the Netherlands. The empirical study reveals that projects within the portfolio are typically built sequentially rather than simultaneously, which reduces the immediate need for intensive resource allocation across multiple projects. Consequently, the challenges of simultaneous resource demands and conflict resolution, as emphasized in the literature, are less relevant in this context.

However, one advantage of this sequential approach is the ability to allocate manpower in advance. Even though projects are not concurrent, securing the necessary workforce ahead of time offers a significant planning benefit, especially in a market with scarce labour. Yet, this approach also brings

a paradox. While sequential planning enables smoother execution, it often involves standardized or modular work, which some personnel may find less appealing or 'unsexy.' The public commissioner aims to make modular work an integral part of project delivery for efficiency, but it faces resistance from individuals who prefer the unique challenges that custom projects bring. This tension highlights a key cultural shift required to fully leverage the portfolio approach's efficiency benefits.

### 7.5.3. Change and Parodoxes

The principle of Readiness to Change and Handling Paradoxes from Hansen and Svejvig (2023) aligns closely with insights from the empirical data, particularly regarding the challenges faced by public commissioners in adopting the flexibility required by the portfolio approach. Respondents point out the rigidity of existing internal processes and the difficulty in breaking from established routines, underscoring the complexities of adapting to a new model.

The portfolio approach, as discussed by respondents, offers contractors increased stability and continuity, fostering an environment conducive to innovation and continuous improvement. This aligns with Hansen's emphasis on creating adaptable conditions within organizations. By establishing a stable framework and allowing contractor autonomy, the portfolio approach enables contractors to optimize methods and workflows, a reflection of the organizational agility recommended by Hansen. However, the empirical data also reveals a paradox: while the portfolio approach facilitates innovation in smaller, similar projects, it often constrains creativity in larger, more complex projects due to restrictive contractual frameworks and time pressures. This reflects the challenge of balancing stability and efficiency with the adaptability needed for innovation across project types.

### 7.5.4. Coherent System and Organizational Culture

The principle Building a Coherent PPM System and Organizational Culture (Hansen and Svejvig, 2023) highlights that for project portfolio management (PPM) to be truly effective, it is not sufficient to rely solely on structured governance and processes. It also necessitates cultivating an organizational culture that supports and aligns with these processes. This principle stresses that the systematic management of projects—through governance, rules, and procedures—must be in harmony with the broader culture of the organization.

The empirical data reveals that while the initial steps toward this approach have been made, there remains a significant journey ahead and considerable challenges already encountered. The decision to implement a portfolio strategy was made too late, primarily due to the urgent condition of the case study. This delay created friction within the public organization, as there was insufficient time to fully adapt to the new approach. Consequently, this has led to an unstable organizational culture, where the alignment between the newly introduced portfolio management processes and the existing organizational culture has yet to be fully realized.

## 7.6. New Insights Emerging

### 7.6.1. Complex Projects

Respondents noted that while the portfolio approach promotes efficient coordination and smooth execution in less complex projects, it faces challenges in highly complex projects, hindering collaboration and increasing costs. They emphasized refining this approach for complex projects to unlock its potential benefits. Discussions also mentioned creating dedicated "complex portfolios" that focus solely on these intricate projects, allowing for tailored strategies and specialized management to address their unique challenges.

The findings also highlight a connection between project complexity and workforce planning. While the portfolio approach favours less complex projects due to their simpler coordination and execution, it raises questions about the availability and suitability of manpower. Less complex projects may not

attract highly specialized professionals, as these projects can lack the ”challenge” that more complex assignments provide. This presents a paradox: although less complex projects streamline processes, they may struggle to engage top talent who prefer more demanding roles. As such, there's a need for strategic workforce planning to ensure that the portfolio approach is not only feasible but also adequately staffed. Balancing the appeal of complex projects with the efficiency of standardized, simpler tasks requires careful workforce engagement strategies, where staff are motivated by clear, long-term project objectives and the opportunity to contribute to a portfolio that still offers growth and innovation opportunities.

### 7.6.2. Portfolio Formation

Effective portfolio formation relies on selecting projects with shared characteristics to streamline management and improve efficiency. Respondents highlight that portfolios are most successful when projects align in scope, type, and geography, which supports coordinated planning and resource allocation. Factors like geographical proximity and similar infrastructure types (e.g., movable bridges) help create cohesion. Some respondents emphasize the need for financial comparability, warning that overly diverse projects may turn a portfolio into disconnected initiatives.

Respondents expressed concerns about complex internal approval processes in public organizations, which can delay transitions between projects and disrupt team continuity. For example, respondents mention that lengthy approvals and budget requests create gaps between projects, risking knowledge loss as team members are reassigned. Some suggest that simplifying documentation with broader functional descriptions, such as general requirements for a bridge over water rather than detailed technical specifications, could speed up approvals and improve efficiency. Project phasing within portfolios is another area of concern. Respondents point out that regulations requiring the second project to start within a limited timeframe after the first can restrict the number of complex projects in a portfolio, disrupting consistent workflows. Aligning project phases more closely could help mitigate these issues, keeping teams engaged and making the most of resources.

Kuitert et al. (2020) emphasizes that public entities must balance collaborative adaptability with adherence to foundational public administration frameworks. This balance is essential in portfolio management, where collaboration with private entities is critical. Public organizations need flexibility to foster effective collaboration without risking their administrative integrity or creating inefficiencies. The empirical data highlight challenges in portfolio formation related to geographic boundaries, which can be set nationally or regionally. Each approach has unique advantages, and public organizations must carefully consider which structure best suits their specific portfolio needs.

## 7.7. Research Limitations

A key limitation of this study is the imbalance between the perspectives of the client and the contractor. While the aim was to give equal attention to both sides, this was not fully achieved. As a result, important insights from the contractor's perspective may have been overlooked.

Since the portfolio approach in the Dutch public infrastructure sector is still in its early stages, the research I conducted focused on one of the first case study experiments applying this methodology. While this provides valuable insights into the initial implementation, it also presents a limitation in that the study may not account for deeper, long-term challenges that could emerge as the approach matures. The findings are specific to the Dutch context, where public infrastructure projects operate under unique regulatory, cultural, and organizational conditions. Although the principles and results of this study may have broader applicability to other regions or sectors, it is essential to consider that the research is based solely on experiences within the Netherlands. As such, any generalization should be approached with caution, recognizing the specific characteristics and early-stage nature of the portfolio approach explored in this context.

One inherent risk of using interviews as a research method is the possibility that the interviewer might unintentionally influence the interviewees' responses. This can happen through subtle cues, the phrasing of questions, or the interviewer's own biases. To reduce this risk, the research carefully relied only on direct quotes from the interviewees as the primary data source. Additionally, open-ended questions were employed to encourage participants to express their thoughts freely, without being led towards specific answers.

A limitation of this research is its narrow focus on stakeholder perspectives, primarily from the public commissioner, client, and contractor. Missing insights from municipalities and provinces restrict the full understanding of stakeholder engagement's impact on portfolio outcomes. Including these additional perspectives in future research would provide a more comprehensive view of collaborative dynamics in the portfolio approach.

The final limitation is that relying on established theoretical frameworks can restrict a study's ability to uncover unexpected or unique insights. When a study adheres to predefined theories, it tends to organize its analysis around principles that are already familiar and widely accepted. While this approach can help make sense of the data, it may also overly narrow the focus of the analysis. In this case, sticking to these frameworks means that certain context-specific issues or emerging patterns in the Dutch infrastructure sector—those that don't fit neatly into the existing theories—might be overlooked. For example, there could be unique challenges or opportunities in the Dutch portfolio approach that aren't well-covered in general theories, such as specific regulatory pressures or particular types of contractor relationships. Because these themes fall outside the predefined frameworks, they may not receive the attention they deserve in the analysis.

# 8

# Conclusion

## 8.1. Answers Sub-Questions

**Sub-Question 1** *What are the principles of a portfolio approach in public infrastructure projects according to existing literature?*

The literature reveals that public clients experience complexities and challenges in managing infrastructural assets. There are risks and inefficiencies linked to current project management practices, such as complexity, inadequate planning, significant misinformation, trust issues, and the need for policy reform. In the Netherlands, large public infrastructure projects are led by two main parties: the client and the contractor. A balance is needed between relying on external partners and maintaining their responsibility in protecting public values. This involves managing conflicts between traditional internal administrative values and new values that arise from collaborating with external networks. Collaboration plays a key role here; there are many different forms of collaboration, but it is important to understand that each project presents unique requirements.

The portfolio approach is a method of tendering in the Netherlands, where the public commissioner places a 'bundle' of projects on the market, which are carried out sequentially by the same contractor, provided they perform well. The literature identifies various characteristics, actions, and associated elements. These have been grouped under the term principle: *A principle is a set of related thoughts, intentions, and actions that differ from rule-based guidelines.*

In conclusion, 15 principles have been identified in the literature that describe the portfolio approach, its effects, and the associated elements. These principles can be categorized into six topics:

1. **Strategic Management**: emphasizes the importance of aligning project outcomes with organizational goals to create synergy, maintaining a balanced and diversified portfolio to optimize performance and manage risks, and ensuring efficient resource management to support projects and reduce conflicts. Together, these principles contribute to the effective management and success of a project portfolio.
2. **Decision-Making and Evaluation**: highlights the importance of systematic decision-making with benefit evaluation, improving decisions through feedback, and continuously controlling and evaluating projects to align with strategic goals and adapt as needed.
3. **Risk and Change Management**: stresses adaptability, strategic risk management, and readiness for change to effectively navigate complex and dynamic portfolio environments.
4. **Communication and Collaboration**: emphasizes the importance of communication and knowledge sharing for fostering innovation and efficiency, and highlights the role of stakeholder involvement in improving the effectiveness of strategic decision-making and project outcomes.

5. **Strategy with Adaptability**: stresses the importance of building a structured PPM system aligned with a supportive organizational culture for effective portfolio management, and highlights how aligning strategic projects can directly enhance competitive advantage and business success.
6. **Performance and Benefit Management**: emphasizes the strategic management of collective benefits for organizational alignment and value creation, while also highlighting the use of dynamic, data-driven approaches to continuously improve portfolio performance and decision-making.

These principles can be seen as the basis of exploring a portfolio approach in public infrastructure management.

**Sub-Question 2** *What actions support the adoption of a portfolio approach, and what effects arise from it from the client's perspective?*

In the case study, the client aims to speed up progress using the portfolio approach: the renewal and renovation task, while simultaneously fulfilling their role as the contracting authority. They aim to secure the best possible price based on criteria such as quality, time, and sustainability. The portfolio approach could help the client accelerate renewal and renovation tasks while fulfilling their role as the contracting authority. Key strategic actions for successful adoption include fostering a shared vision with contractors, promoting collaborative decision-making, establishing clear communication and feedback loops, and developing knowledge retention strategies. Clients should set predefined KPIs for consistent performance measurement, group similar projects to streamline management and coordinate project phases to avoid gaps. Ensuring consistent teams and adapting internal processes for flexibility and quicker approvals are important points to consider from the client's point of view.

However, the portfolio approach presents both challenges and benefits for the client. Limited negotiation power and dependency on a few contractors can lead to strategic pricing and cost control risks. Unbalanced knowledge transfer may also give some contractors a competitive advantage. On the positive side, the approach could foster innovation as contractors apply lessons learned across projects, improve long-term workforce planning, and accelerate project delivery by reducing tender processes. While managing complexity and costs can be difficult, the portfolio approach offers significant opportunities for improving project efficiency and meeting public service goals.

**Sub-Question 3** *What actions support the adoption of a portfolio approach, and what effects arise from it from the contractor's perspective?*

The contractor's objectives differ from the client's objectives, as the emphasis is on managing and optimizing their project portfolio rather than considering broader national interests. The contractor's objectives are more centered on delivering successful projects that enhance their business outcomes, rather than the holistic view of national infrastructure needs that the client maintains. This divergence in focus means that the contractor may prioritize their project timelines and resources, sometimes conflicting with the client's broader goals of public service, long-term planning, and policy alignment. Contractors can enhance project outcomes by focusing on several key actions aimed at improving collaboration and efficiency. Building strong, trust-based relationships with both clients and other contractors can help reduce traditional adversarial dynamics. Open communication, transparency in pricing, and a shared focus on long-term project success could maintain positive working relationships. Additionally, establishing effective knowledge retention strategies, such as documenting lessons learned and maintaining consistent project teams across different phases, can help ensure continuity and prevent the loss of valuable insights. Contractors can also play a role in optimizing project sequencing and phase alignment, working with clients to minimize gaps between phases and reduce inefficiencies. By focusing on these practical actions, contractors can contribute to smoother project execution and more reliable outcomes over time.

The portfolio approach presents both benefits and challenges for contractors. One key effect is the potential for unfair competition, as contractors who secure multiple projects within a portfolio gain valu-

able experience and knowledge, giving them an advantage over others. However, this approach can also catalyze innovation, allowing contractors to implement lessons learned and new methods across projects, driving efficiency and continuous improvement. On the other hand, complex projects may limit innovation due to rigid contractual requirements and tight timelines. Lastly, the portfolio approach provides contractors with long-term work security, helping reduce gaps between projects and aiding in the retention of skilled workers.

**Sub-Question 4** *How can insights on actions and effects from the portfolio approach be structured into a framework for Dutch public infrastructure projects?*

The findings from this study offer insights into the implementation of the portfolio approach in Dutch public infrastructure projects, with a particular focus on the challenges and opportunities observed in the case-study. The portfolio approach, while promising in terms of improving resource efficiency and fostering collaboration, reveals both complexities and advantages that need careful consideration. Insights on actions and effects from the portfolio approach can be structured into a framework for Dutch public infrastructure projects by categorizing them into actions (e.g., collaboration, knowledge sharing, and strategic planning) and effects (e.g., reduced contractor dependency, management optimization, and innovation). The framework structures insights on actions and effects by creating an overview that highlights what is important for both public and private stakeholders when implementing the portfolio approach. It focuses on providing clear, practical guidance for exploring or adopting the approach without delving into overly specific project details. By addressing key principles like collaboration, knowledge sharing, adaptability, and market dynamics, the framework ensures relevance across various projects within a portfolio while fostering alignment and mutual understanding between stakeholders. The structure is added to this thesis in Appendix G.

## 8.2. Answer Research Question

*How can the portfolio approach for infrastructure renewal be implemented, considering both client and contractor perspectives?*

Within the scope of this research, actions and effects of the portfolio approach were examined through a case study in an infrastructure renovation project in the Netherlands. Various principles were explored within this context. A range of actions and effects have emerged as significant, and these must be taken into account when implementing the portfolio approach in the Netherlands, both by the contractor and the client. By addressing these key actions and effects, the portfolio approach could contribute to more successful project management in Dutch infrastructure projects.

The portfolio approach is supported by key actions that span communication, collaboration, strategic tendering, and knowledge sharing. Creating a shared vision for collective goals is essential, alongside encouraging collaborative decision-making between the client and contractors. Demonstrating long-term reliability helps build trust and maintain solid working relationships over time. From a portfolio and tender strategy perspective, it's important to avoid including overly complex projects and prevent urgency, which can lead to rushed and ineffective decisions. Aligning the phases of various projects ensures smooth transitions, while maintaining consistency in project teams helps preserve quality and continuity. Additionally, focusing on similar types of projects within the portfolio minimizes the risk of scope changes and tender process complications. In terms of knowledge sharing, it is critical to develop strategies that ensure knowledge retention across projects. Implementing clear evaluation methods allows for consistent assessment of project performance, while documenting and applying lessons learned helps improve future project execution. Altogether, these actions aim to foster better collaboration, effective planning, and continuous improvement in portfolio management.

The recommendation is to avoid highly complex projects and to explore the possibilities of modular construction. Focusing on similar and repeatable projects within the portfolio also reduces the risk of scope changes and delays, ensuring smoother project execution. By steering clear of overly complex

projects, contractors and clients can achieve better alignment, leading to improved collaboration and more successful project outcomes. This strategy of repetition and modularity is essential for optimizing the portfolio approach in Dutch infrastructure projects. By selecting projects that share similar characteristics, such as scope, infrastructure type, or geographical proximity, it becomes easier to implement best practices and streamline management across the portfolio. Repetition allows for the refinement of methods and processes, leading to more predictable timelines and outcomes.

The effects of the portfolio approach focus on three main areas: management optimization, innovation, and contractor dependency. In terms of management optimization, the portfolio approach improves workforce stability by allowing better long-term planning and resource allocation. It also enhances project visibility and status monitoring, giving the client a clearer overview of ongoing projects. Additionally, it accelerates the realization of infrastructure projects by streamlining processes and minimizing delays. From an innovation perspective, the portfolio approach fosters increased innovation potential. Contractors can apply lessons learned and new methods from earlier projects to subsequent ones, leading to more efficient and innovative project delivery. However, contractor dependency presents challenges. The client may experience reduced negotiation power, particularly if reliant on a single or small pool of contractors. This can limit the client's ability to manage costs effectively. There is also a risk of unbalanced knowledge distribution, where some contractors benefit from repeated work while others do not, creating an uneven competitive landscape. Finally, cost control risks arise as the complexity of pricing within a portfolio approach can lead to inaccuracies in early cost estimates and potential budget overruns.

## 8.3. Theoretical and Practical Contributions of Research

This section will elaborate on the theoretical contributions and practical contributions of the research. In the practical contributions, the section will discuss what key insights to gain from this research. In the theoretical contributions, the focus will be on how this study extends the existing literature on portfolio management.

### 8.3.1. Practical Contributions

At the start of this project, PwC aimed to gain valuable insights into the portfolio approach through a thorough analysis. This focused on two main goals: dedicating time for in-depth exploration and using a scientific method to gather, analyze, and objectively present interview data within an academic framework. This approach provides PwC with a more objective foundation than previously available. With the final document, PwC now has a practical tool to improve its chances of securing new projects by demonstrating an evidence-based understanding of the portfolio approach. PwC can also apply this knowledge directly to ongoing projects, ensuring that its advisory services are both well-informed and strategically focused. Additionally, this research can support PwC's advisory work beyond infrastructure—such as in technology and data projects within government—where similar large-scale initiatives can benefit from these insights.

Both the literature and empirical data highlight a strong need for change in the public sector, with public entities eager to find strategies to accelerate infrastructure development and, more broadly, to boost execution power. The traditional procurement model is falling short, facing numerous challenges. The portfolio approach offers a collaborative alternative, moving away from an "us versus them" mindset. This shift aligns with PwC's extensive experience in supporting two-phase projects, specifically aimed at addressing the renewal and renovation challenges in the Netherlands. These projects are also designed to overcome the 'us versus them' mentality, fostering a more integrated and cooperative approach to project execution. This research contributes to that shift in three ways. First, it explores the principles behind the portfolio approach, including key actions, intentions, and thought processes, helping contractors and clients understand the essential elements for successful implementation. Second, a document analysis of the Dutch public infrastructure sector provides a concise summary of portfo-

lio approach goals, giving stakeholders a strong foundation. Finally, a simplified framework based on actionable steps, explored by experts, guides clients and contractors. Reviewing and referencing this framework throughout the portfolio lifecycle could ensure a clear focus on what matters most for effective collaboration and project success.

### 8.3.2. Theoretical Contribution

In addition to the practical contribution, this research also offers a theoretical contribution. Firstly, five principles from the literature are evaluated, thereby enhancing their significance. These include 'Improved Decision Making' by Aritua et al. (2009), 'Communication and Knowledge Sharing' by Martinsuo (2013), 'Stakeholder Involvement and Strategy Effectiveness' by Hansen and Svejvig (2023) and Martinsuo (2013), 'Adaptability to Dynamic Environments and Change' by Aritua et al. (2009), Ginger et al. (2014), and Hansen and Svejvig (2023), and finally 'Portfolio-Level Benefit Management and Optimization' by Bai et al. (2022). This research shows that these principles are indeed applicable to some extent within the portfolio approach. A new contribution of this study is that these principles are specifically relevant to the portfolio approach for infrastructure renovation projects in the Netherlands. This adds a unique perspective, applying established theoretical principles to a specific sector and context, thereby expanding these theoretical insights' practical applicability.

Additionally, this research highlights new principles that are of importance to the implementation of the portfolio approach. The last contribution of this research can be seen as a start for future studies. The research establishes a connection between the existing academic discourse and the practical goals of a public commissioner, as highlighted in chapter 4. By bridging the gap between theory and practice, this study provides a foundation for future research to build upon. Scholars can use this connection as a starting point to further explore and refine how theoretical principles align with the needs and strategies of public infrastructure agencies, allowing for more targeted and applicable future studies.

## 8.4. Recommendations for Future Research

In this section, potential recommendations for future research will be explored. Building on the findings and contributions of this study.

### 8.4.1. Measurement of Complexity

A recommendation for future research is to further explore the concept of project complexity within a portfolio context. As previously mentioned, the complexity of individual projects within the portfolio presents a significant challenge. A recommendation for future research is to delve deeper into the application of project complexity within a portfolio approach, acknowledging the robust body of research that already exists on defining and measuring complexity in projects. While much is known about general project complexity, the question arises of how this concept adapts or shifts when applied to interconnected projects within a portfolio.

### 8.4.2. Procurement Law Issues

An issue that emerged during this research is related to legislation, specifically the Dutch Public Procurement Act, Article 2.36 of 2012, which stipulates that the contract for a second project must be awarded within three years of the first. This presents significant challenges for large-scale projects, as it effectively prevents the tendering of a portfolio consisting of, for example, five major bridges. The regulation's time constraint complicates the management of multiple large projects within a cohesive portfolio, limiting opportunities for streamlined planning and execution across complex infrastructure endeavours. However, this is not necessarily a major obstacle, as the portfolio approach can still be applied in alternative ways, such as through framework agreements or other flexible contracting models. Exploring these alternative methods could provide valuable insights into how the portfolio approach might be effectively adapted to work within existing regulatory constraints.

A limitation of this research is that time constraints did not allow for a deeper exploration of this issue. As a result, further investigation is recommended to determine the full implications of this legislation. It could potentially mean that the portfolio approach, as currently regulated, may only be feasible for less complex portfolios with a limited number of objects, due to the strict time limitations imposed by the legislation.

### 8.4.3. After completion Portfolio

For future research, it would be highly beneficial to evaluate once the portfolio approach has been fully implemented and completed. This follow-up study should focus on reassessing the actions taken during the portfolio's lifecycle and examining the actual effects and outcomes compared to the expectations set in this thesis. Specifically, it would be valuable to investigate which principles and strategies proved effective in practice, and whether the anticipated benefits, such as improved collaboration, were realized. An evaluation would provide insight into whether the portfolio approach delivered on its promises. Additionally, this research could help identify unforeseen challenges or benefits that emerged throughout the process, offering lessons that can be applied to future portfolios.

### 8.4.4. Relationships Principles, Actions and Effects

It is recommended that future studies explore these connections in greater detail. Understanding how specific actions, informed by certain principles, lead to particular effects—and how these effects may influence one another—could offer valuable insights for optimizing the portfolio approach. This investigation would enable both public and private sector entities to refine their strategies for more effective project outcomes. Further empirical research into these relationships would not only validate the theoretical pathways suggested in this study but also provide a clearer framework for implementing portfolio strategies in infrastructure projects.

### 8.4.5. Generalizability and Modular Way of Working

An aspect of the portfolio approach is modular working and standardizing parts of projects. This could involve, for example, segmenting part of a project in advance and applying modular methods to these segments. While this approach offers numerous possibilities, it also faces significant resistance. Investigating how modular working could be practically implemented within a portfolio approach is an interesting area of study. For instance, contracts could include predefined prices for various segments of a bridge within a portfolio, adjusted with index factors. This would provide clear pricing and greater predictability, helping to align expectations and facilitate modular implementation.

# Reflection

Reflecting on my thesis journey, I see how much my approach and mindset have evolved. At the start, I threw myself fully into exploring the portfolio approach within the context of public commissioning, focusing intensely on my case study. I believed that anchoring my research in this specific context was essential. However, I also realize that I placed too much focus on the specific documents within my case study, letting them drive my analysis rather than treating them as one part of a larger whole. This narrowed my scope unnecessarily. By stepping back earlier and considering how my findings could connect to broader contexts and be more widely applicable, I could have made my work more impactful and generalizable.

I also came to understand a lot about my own working style. I tend to start projects slowly, making steady progress but often feeling frustrated that it's not happening fast enough, even when putting in long hours. As deadlines drew closer, I surprised myself by how quickly I could shift gears and focus on what was needed most. By my third progress meeting, this ability to work decisively became clear. If I had recognized and trusted that capacity earlier—and paired it with moments to step back and assess the bigger picture before diving in again—I think I could have elevated my project much sooner.

Finally, I started this process with a strong sense of independence, determined to manage all aspects of the research on my own. While that independence kept me committed and driven, I came to realize how invaluable external input can be. Feedback from my committee provided fresh perspectives and much-needed factual clarity, grounding my work in ways I could not achieve alone. For example, Ad's sharp observation that the portfolio approach is not entirely new but rather new within the context of public infrastructure in the Netherlands helped me recognize how my narrow focus on the case study limited the broader scope of my findings. This insight encouraged me to reassess my approach and connect my work to the larger picture.

This journey has taught me not only about research but also about the importance of balance—between independence and collaboration, between focusing on the details and stepping back to see the bigger picture. It is through this balance that I've learned to refine my work and create something truly meaningful.

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# A

# Principles Identified in the Literature

**Table A.1:** Overview of Principles from Multiple Studies on Project Portfolio Management

| No. | Principle | Source |
|---|---|---|
| 1 | Inter-relationships: Actions in one project can affect outcomes in others, emphasizing the need for coordinated management. | Aritua et al. (2009) |
| 2 | Adaptability: Portfolio management should dynamically respond to changes in the business environment. | Aritua et al. (2009) |
| 3 | Self-organisation: Encourages projects to operate independently within set guidelines. | Aritua et al. (2009) |
| 4 | Emergence: Collective outcomes can be greater than the sum of individual project outputs. | Aritua et al. (2009) |
| 5 | Feedback: Importance of continual feedback to adapt and stabilize project delivery. | Aritua et al. (2009) |
| 6 | Non-linearity: Small changes can lead to significant, unpredictable outcomes. | Aritua et al. (2009) |
| 7 | Dynamic Environment: Portfolio management should be an ongoing process that adjusts as projects evolve. | Ginger Levin et al. (2014) |
| 8 | Managing Risks at the Portfolio Level: Address risks collectively across the portfolio. | Ginger Levin et al. (2014) |
| 9 | Portfolio Balance: Maintain a diverse and balanced portfolio. | Ginger Levin et al. (2014) |
| 10 | Goal Alignment: Ensure all projects are aligned with the strategic objectives of the organization. | Ginger Levin et al. (2014) |
| 11 | Balance the portfolio: Use strategic criteria to select and prioritize projects. | Hansen and Svejvig (2023) |
| 12 | Coherent system: Need for a structured approach to portfolio management. | Hansen and Svejvig (2023) |
| 13 | Strategy Effectiveness and Stakeholder Involvement: Align projects with strategic goals and enhance decision-making. | Hansen and Svejvig (2023) |
| 14 | Readiness to Change: Be agile and adaptable to manage uncertainties. | Hansen and Svejvig (2023) |
| 15 | Strategic Alignment: Ensure all projects contribute towards the strategic goals. | Martinsuo (2013) |

*Continued on next page*

| No. | Principle | Source |
|---|---|---|
| 16 | Rational Decision Making: Systematic approach to evaluate and select projects. | Martinsuo (2013) |
| 17 | Project Control and Evaluation: Regular monitoring and evaluation of projects. | Martinsuo (2013) |
| 18 | Resource Optimization: Optimal allocation of resources across the portfolio. | Martinsuo (2013) |
| 19 | Communication and Knowledge Sharing: Share insights and information between projects. | Martinsuo (2013) |
| 20 | Improved Decision Making: Utilize a rational, data-driven approach. | Martinsuo (2013) |
| 21 | Adaptability to Change: Portfolios should be flexible to respond to external changes. | Martinsuo (2013) |
| 22 | Competitive Advantage: Align projects with strategic objectives to enhance market position. | Martinsuo (2013) |
| 23 | Project Portfolio Performance: Use dynamic assessment modelling to optimize portfolio performance. | Bai et al. (2022) |
| 24 | Benefit Evaluation: Evaluate project benefits from multiple perspectives. | Bai et al. (2022) |
| 25 | Benefit Optimization: Maximize project benefits by managing risks and exploring opportunities. | Bai et al. (2022) |
| 26 | Portfolio-Level Benefit Management: Manage the collective benefits of a project portfolio strategically. | Bai et al. (2022) |

# B

# Interview Protocol

## B.1. English

**Introduction**

1. Name of the researcher – Merel van ’t Hoen
2. Field of study – MSc. Construction Management & Engineering
3. Research objective – Analysis of actions and associated benefits of the portfolio approach
4. Provide informed consent

**Opening questions**

1. Briefly describe your role and experience at the company.
2. What is your experience with the portfolio approach?

**Decision-making through Feedback**

3. Are there processes to evaluate the Bridge project? If so, what kind of processes are these?
4. How has feedback influenced or contributed to the decision-making process?
5. Can you give an example of how project monitoring and feedback took place in the project?
6. Did feedback always lead to consensus or clear decision-making?

**Questions about Communication and Knowledge Sharing**

7. How does communication and knowledge sharing take place?
8. What tools or platforms are used to facilitate knowledge sharing within the project?
9. What insights has the team gained during this project that can be valuable for future projects?

**Stakeholder Involvement and Strategic Effectiveness**

10. Which stakeholders were actively involved in the project and what role did they play?
11. How do you ensure the active involvement of stakeholders in the planning and decision-making of the project?
12. How do you ensure that the interests of stakeholders do not directly conflict with the goals of the project?

13. What actions can be taken to further improve collaboration with and involvement of stakeholders in future projects?

**Adaptability to Dynamic Environments and Change**

14. How does the project team deal with unexpected changes or dynamic factors during the project?
15. Is there an example of a situation where the project team had to quickly respond to a change?
16. What mechanisms are in place to promote flexibility and responsiveness within the project?

**Portfolio Management and Optimization of Benefits at Portfolio Level**

17. How is attention paid to the collective goals of the organization within project management, and how are these goals discussed?
18. Is there a reassessment of the collective goals during the course of the project, and if so, how is this process approached?
19. How is the realization of project results managed within the portfolio, and how are these results integrated into the specific objectives of individual projects?
20. Can you explain the process of collaboration between the client and the contractor, particularly how they work together to achieve the common project goals?

**Conclusion**

21. Is there anything else you would like to add regarding this topic?

## B.2. Dutch

**Openingsvragen**

1. Beschrijf kort uw rol en ervaring bij het bedrijf.
2. Wat is uw ervaring met de portfolio-aanpak?

**Besluitvorming door Feedback**

3. Zijn er processen om het brugproject te evalueren? Zo ja, wat voor soort processen zijn dit?
4. Hoe heeft de feedback een rol gehad/ bijgedragen aan besluitvorming?
5. Heeft u voorbeelden van waar expliciete feedback wel/ geen impact had op besluitvorming?
6. Leidde feedback altijd tot consensus/ eenduidige besluitvorming?

**Vragen over Communicatie en Kennisdeling**

7. Op welke manier vindt communicatie en kennisdeling plaats?
8. Welke tools of platforms worden gebruikt om kennisdeling binnen het project te faciliteren?
9. Welke inzichten heeft het team opgedaan tijdens dit project die waardevol kunnen zijn voor toekomstige projecten?

**Betrokkenheid van Belanghebbenden en Strategische Effectiviteit**

10. Welke stakeholders waren actief bij het project betrokken en welke rol hadden zij?
11. Hoe zorgt u voor actieve betrokkenheid van belanghebbenden bij de planning en besluitvorming van het project?

12. Hoe zorgt u ervoor dat belangen van stakeholders niet lijnrecht op de doelen van het project staan?
13. Welke acties kunnen worden ondernomen om de samenwerking met en de betrokkenheid van stakeholders in toekomstige projecten verder te verbeteren?

**Aanpassingsvermogen aan Dynamische Omgevingen en Verandering**

14. Hoe gaat het projectteam om met onverwachte veranderingen of dynamische factoren tijdens het project?
15. Is er een voorbeeld van een situatie waarin het projectteam snel moest inspelen op een verandering?
16. Welke mechanismen zijn er om flexibiliteit en responsiviteit binnen het project te bevorderen?

**Portfoliobeheer en Optimalisatie van Voordelen op Portfolioniveau**

17. Hoe wordt binnen het projectmanagement aandacht besteed aan de collectieve doelen van de organisatie, en op welke wijze worden deze doelen besproken?
18. Vindt er een herbeoordeling van de collectieve doelen plaats gedurende de looptijd van het project, en zo ja, hoe wordt dit proces aangepakt?
19. Op welke manier wordt de realisatie van projectresultaten binnen het portfolio beheerd, en hoe worden deze resultaten geïntegreerd in de specifieke doelstellingen van individuele projecten?
20. Kunt u het proces van samenwerking tussen de opdrachtgever en de aannemer toelichten, met name hoe zij samenwerken om de gemeenschappelijke projectdoelen te verwezenlijken?

**Afronding**

21. Is er verder nog iets dat u zou willen toevoegen met betrekking tot dit onderwerp?

C

# Informed Consent Form

Interviewee: _____
Organisation: _____

Please tick the appropriate boxes

| **Participation in study** | **Yes** | **No** |
|---|---|---|
| 1. I have read and understood the study information, or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction. | ☐ | ☐ |
| 2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason. | ☐ | ☐ |
| 3. I understand that taking part in the study involves audio-record of the interview for data analysis purposes, after which the recording will be deleted. | ☐ | ☐ |
| **Use of data for research** | **Yes** | **No** |
| 4. I understand that personal information collected about me that can identify me, such as my name and/or email address, will not be shared beyond the study team. | ☐ | ☐ |
| 5. I understand that the (identifiable) personal data I provide will be destroyed. | ☐ | ☐ |
| 6. I understand that after the research study the de-identified information I provide will be used for the graduation thesis report and presentation at the Technical University of Delft, unless indicated that information is confidential. | ☐ | ☐ |
| 7. I agree that my responses, views or other input can be quoted anonymously in research outputs. Names or personal details will not be used unless agreed otherwise. | ☐ | ☐ |
| **Data storage** | **Yes** | **No** |
| 8. I acknowledge the publication of the graduation thesis to be archived in the TU Delft educational repository so it can be used for future research and learning. | ☐ | ☐ |

**Signatures**

Name of participant: _____
Signature: _____
Date: _____

I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

Researcher: Merel van 't Hoen

Merel van 't Hoen

Signature:
Date: _____

# Invitation to Participate in Graduation Research

Dear [Name],

FORMULIER VOOR GEINTERVIEWDE TOESTEMMIMG

Beste heer/mevrouw [Achternaam], Graag nodig ik u uit om deel te nemen aan mijn onderzoek genaamd “Enhancing Dutch Infrastructure”. Dit onderzoek voer ik, Merel van ‘t Hoen, uit als afstudeerder van de masteropleiding Construction Management and Engineering aan de Technische Universiteit Delft tijdens mijn stage bij PwC Public Sector.

Het doel van dit onderzoek is om te onderzoeken hoe innovatieve methoden kunnen worden toegepast om de Nederlandse infrastructuur te verbeteren en te verduurzamen. Het onderzoek zal zich richten op het verzamelen van gegevens over bestaande infrastructuurprojecten en het evalueren van nieuwe benaderingen voor het bouwproces.

Dit interview zal ongeveer 1 uur duren. De verzamelde gegevens zullen worden gebruikt om aanbevelingen te formuleren voor toekomstige infrastructurele projecten. U wordt gevraagd om tijdens het interview meerdere open vragen te beantwoorden, en ik moedig u aan om hierbij zoveel mogelijk voorbeelden en ervaringen te delen.

De focus van mijn afstudeeronderzoek ligt op de voordelen die de portfolio-aanpak in publieke infrastructuur projecten met zich meebrengen mijn onderzoek wordt de portfolio-aanpak beschouwd als een strategie om een verzameling van onderling gerelateerde projecten te beheren op een wijze die de waarde maximaliseert en aansluit bij de doelstellingen van zowel de opdrachtgever als de opdrachtnemer. Zoals bij elke onderzoeksactiviteit, bestaat er een risico op datalekken. Ik neem alle noodzakelijke maatregelen om uw gegevens vertrouwelijk te behandelen en de risico’s te minimaliseren. Persoonlijke data wordt zo snel mogelijk verwijderd. De interviewopname wordt na afloop van de transcriptie verwijderd en de data geanonimiseerd. De niet-anonieme gegevens worden opgeslagen in beveiligde mappen in mijn OneDrive en zullen zo snel mogelijk worden verwijderd.

De geanonimiseerde transcripten zullen worden opgeslagen als een bijlage bij mijn thesis, die bij de TU Delft bewaard wordt voor visitatiedoeleinden. Deze zullen niet openbaar toegankelijk zijn. Deelname aan dit onderzoek is volledig vrijwillig. U kunt zich op elk moment terugtrekken uit het onderzoek zonder opgaaf van reden en u bent vrij om bepaalde vragen niet te beantwoorden.

Bijgevoegd vindt u een formulier met enkele basisvragen. Ik vraag u dit formulier ingevuld en ondertekend naar mij terug te sturen om uw toestemming te bevestigen. Uw gegevens zullen veilig bewaard worden gedurende het onderzoek.

Met vriendelijke groet,
Merel van ‘t Hoen

# D

# Data Codes attributed to Principles

**Table D.1:** Principles, Codes, and Argumentation

| Principle | Code | Argumentation |
|---|---|---|
| **1. Improved Decision-making through Feedback** | 16 - Importance of Feedback | Feedback loops allow for real-time adjustments in decision-making, leading to more effective project management. |
| | 3 - Importance of Communication and Trust | Communication and trust foster collaboration, supporting timely and informed decision-making. |
| | 23 - Importance of Knowledge Retention | Ensuring that knowledge is retained allows feedback from previous projects to guide current decision-making. |
| | 25 - Lessons Learned | Applying lessons from previous projects supports continuous improvement in decision-making processes. |
| **2. Communication and Knowledge Sharing** | 3 - Importance of Communication and Trust | Clear communication supports knowledge sharing, strengthening collaboration across project teams. |
| | 9 - Importance of Knowledge Retention | Consistent knowledge sharing helps prevent the loss of important project information and enhances efficiency. |
| | 5 - Definition | A shared understanding of the portfolio approach enables more effective communication and collaboration across teams. |
| | 21 - Changed Way of Collaboration | Knowledge sharing often shifts collaboration strategies, optimizing project management across the portfolio. |
| **3. Stakeholder Involvement and Strategy Effectiveness** | 15 - Importance of Involving Stakeholders | Active stakeholder involvement aligns project goals with the priorities of all parties, improving strategic effectiveness. |
| | 28 - Collaboration in Decision-making | Stakeholder collaboration enhances decision-making, ensuring alignment with strategic objectives. |

*Continued on next page*

| Principle | Code | Argumentation |
|---|---|---|
| | 24 - Buffer for Managers' Risks | Engaging stakeholders can mitigate risks for managers, distributing responsibility and improving strategic outcomes. |
| | 32 - Uncertainty of Market Party | Involving market parties reduces uncertainties, aligning strategies with current market capabilities. |
| **4. Adaptability to Dynamic Environments and Change** | 7 - Urgency | The urgency of the first case-study project required an adaptable approach to respond to the demands of the public commissioner. |
| | 6 - Dependency on Contractor | Flexibility in dealing with contractors ensured that project goals could be met despite tight deadlines. |
| | 21 - Changed Way of Collaboration | Dynamic changes in the project necessitated new forms of collaboration to keep up with evolving demands. |
| | 18 - Innovation | Innovation allowed for flexible responses to changing project conditions, promoting adaptability. |
| **5. Portfolio-Level Benefit Management and Optimization** | 11 - Portfolio Formation | Strategic formation of portfolios optimizes the collective benefits across all projects. |
| | 20 - Unnecessary Portfolio | Evaluating whether the portfolio approach is necessary helps prevent inefficiencies. |
| | 12 - Collective Goals | Aligning goals at the portfolio level ensures maximized benefits across all projects. |
| | 5 - Definition | Clearly defining success ensures all stakeholders understand the objectives and work towards common benefits. |

# E

# Explenation of Code Structure

## Explanations of structure - Actions & Effects

Actions accompanying the Portfolio Approach:

**Collaboration and Communication**

*Importance of Communication and Trust*:

- Strong communication and mutual trust between all parties are essential for successful collaboration and risk management in the portfolio approach.

*Changing Collaboration Method*:

- The portfolio approach can improve project outcomes by fostering a more collaborative and trust-based environment, moving away from traditional adversarial relationships. However, both parties have to be open to such a change.

*Collaboration in Decision Making*:

- The portfolio approach requires significant flexibility and changes to rigid internal processes, posing challenges for government bodies to adapt both structurally and in mindset.

*Collective Goals*:

- Aligning collective goals within a portfolio approach is necessary for maximizing project benefits. Clear communication, mutual understanding, and shared objectives between all parties enhance collaboration and efficiency. This cooperative environment not only mitigates adversarial relationships but also leads to more effective and harmonious project delivery.

**Knowledge Sharing**

*Importance of Knowledge Retention* :

- Knowledge retention is important for continuous improvement, as systematic learning from past projects enhances efficiency, prevents repeated mistakes, and ensures safer, more effective execution of future projects.
- Inconsistent knowledge sharing can lead to inefficiencies and favour contractors' financial gains over project improvement.

*Lessons Learned*:

- Effective knowledge sharing is critical for improving future project efficiency and effectiveness within the portfolio approach.
- Inconsistent implementation of knowledge sharing can lead to inefficiencies, increased costs, and exploitation by contractors.

*Feedback*:

- Pay more attention to feedback to capitalize gains, this creates a beneficial cyclical process.

**Stakeholder Engagement**

*Importance of Involving Stakeholders*:

- For future projects like the repeat project (second bridge), realistic and adequate measures should be implemented to accommodate all stakeholders, rather than relying on minimal solutions.

**Portfolio and Tender Strategy**

*Portfolio Formation*:

- The portfolio composition of the case-study bridges is seen as a mistake by several respondents, due to the complexity and uniqueness of the projects.
- Regional limitations within the public commissioner hinder the potential benefits of the portfolio approach by restricting project composition to single regions.
- Unique projects may not fit well within the portfolio approach, the suggestion is to focus more on similar projects to avoid frequent scope changes. Why is scope changing a problem? Because when the limit of scope changes too much, the repeat project has to go through the tender procedure again.

*Procedures and Phasing within the Public Commissioner*:

- Internal procedures for approvals and budget requests are time-consuming and complex, leading to delays and disrupted team continuity.
- Simplifying approval processes and focusing on functional project descriptions could enhance efficiency.

*Issues too Much Time Between Projects*:

- Issues with long gaps between projects, as highlighted in the data, pose a significant risk to knowledge retention and team cohesion. If too much time passes between the execution phase of one project and the design phase of the next, important insights may be lost.
- The bridges in the case study projects exemplify this challenge, where discontinuity has caused misalignment and this might impact project efficiency.

*Urgency of the case-study Project*:

- The first bridge project was an unusual and complex case within the portfolio approach, with an accelerated timeline and late decision-making impacting its execution. Ensure that this is avoided when creating additional portfolios.
- Initially, the planning phase for the first bridge was already in progress when the portfolio approach was introduced, which forced the planning for the second bridge to be rushed. If the portfolio approach had been decided on earlier, the same team could have managed both planning phases, leading to better knowledge sharing and efficiency in execution.
- This situation highlights the importance of timely decision-making in portfolio management, where early planning could have led to shared gains across projects.

*Challenges with Project Teams*:

- Maintaining consistent project teams across projects ensures continuity, quality, and knowledge retention, which are crucial for successful project execution.

- The alignment of project phases is vital to prevent gaps in work and to maintain team cohesion.

Effects of the Portfolio Approach:

**Contractor dependency**

*Contractor Dependency*:

- Heavy reliance on a single contractor or a small pool of contractors can lead to pricing issues and increased project risks.
- Dependency can limit a client's ability to manage costs and make effective decisions.
- The Portfolio approach can create unfair dynamics between contractors: one contractor may gain valuable insights from the entire portfolio while others may not.

*Pricing*:

- Pricing within the portfolio approach is complex and involves strategic considerations throughout the project lifecycle.
- Early cost estimates and transparent pricing can foster collaboration but also pose risks of price escalation.

*Unnecessary Complexity and Costs*:

- The portfolio approach is more effective when applied to less complex projects, as high complexity can complicate collaboration and efficiency.
- Challenges in the portfolio approach include avoiding unnecessary complexity and costs while balancing the risks of both overestimating and underestimating complexity to prevent errors and additional expenses.

*Uncertainties of market parties*:

- Market parties face uncertainties when committing to new collaboration approaches, especially for family-owned businesses where the risks are higher.
- There is uncertainty about whether the collaboration approach will be sustained in the future, which creates hesitation for market parties to invest fully in new projects. This pertains to the change in collaboration methods. A market party has to invest, but they want assurance that the method will be sustainable for future projects.

**Innovation and Optimization**

*Innovation*

- The portfolio approach provides contractors with greater freedom in how they execute their work, which acts as a catalyst for innovation. When contractors are not constrained by overly rigid guidelines, they can experiment with new methods, optimize processes, and implement creative solutions that enhance project efficiency and outcomes.
- For innovation to thrive, it is crucial for clients to create a stable and predictable environment. When contractors have confidence in the continuity of their work and know that their learning experiences can be translated into optimization, they are more likely to invest in innovative approaches.
- While the portfolio approach offers structure and efficiency—particularly beneficial for smaller, similar projects—it may limit innovation in larger, more complex projects. This is due to the restrictive nature of contract frameworks and the pressure to adhere to tight timelines. Therefore, for complex projects, there needs to be a balance between maintaining structure and allowing room for innovative practices.

*Continuity Enhancement*:

- The portfolio approach enhances continuity by allowing the public party to allocate manpower in advance and giving contractors long-term work security, while also attracting younger generations to infrastructure projects.

*Better Overview of Object Status*:

- The documentation process is enhanced by the portfolio approach and enables the proactive planning of future projects by capturing and transferringinsights on asset conditions.

*Accelerating Infrastructure Realization*:

- The portfolio approach helps accelerate the replacement and renovation.

# F

# Expert Exploration

**Expert 1**

1. Be mindful of language and ambiguity: for example, ”urgency” is quite unclear, as it can also imply something positive, like motivating people to get to work.
2. Add 2 slides with additional explanations so that if a party needs more information, it is easy to find. Make sure the explanations are simple.
3. Explain to which project phase this framework applies to in the framework.

**Expert 2**

1. When assembling a portfolio, consideration must be given to the division within the Dutch organization. A decision needs to be made on whether to apply portfolios regionally or nationally. Currently, this discussion lies with the public commissioner, and it is important to note that the two approaches cannot be merged, as each has its distinct application. For example, in a regional approach, environmental management can be implemented simultaneously.
2. The portfolio approach revolves around a logical combination of projects. In this context, the national or regional application must be considered, and a clear perspective on the composition of projects is essential.
3. Urgency is a key action point. The portfolio approach requires extensive preparation both within and outside of project teams; it should not be implemented hastily. The formation and preparation of the portfolio play a crucial role here.
4. Avoiding complexity is easier said than done, but in the Netherlands, we still need to manage complex projects. Complexity requires a different approach. One way to address this is to create a separate portfolio for complex projects. In practical terms, this means not mixing complex projects with other projects in a portfolio. Instead, create a dedicated portfolio for complex projects and assign the right people with experience managing complexity.
5. Lessons learned are essential. There must be a focus on how these lessons are documented and facilitated.
6. Mutual evaluation is crucial, not only at the end but throughout the entire project cycle. A recommendation is to introduce a third, independent entity to facilitate this.
7. Lessons learned should be shared outside the portfolio as well. Build incentives for contractors to share this information, for example, by using a point system or similar rewards. Take England as an example, where there is an incentive system in place.
8. Enhanced project visibility and status monitoring are highly relevant. The client and contractors can think earlier about the setup of the next project and the one after that. This approach lays a foundation that allows for faster predictions and decisions.

9. Contractor dependency is fundamentally related to principal-agent theory, which can be leveraged in this context: The principal-agent problem arises when the client (the principal) relies on the contractor (the agent) for project execution, but the contractor has more information about the costs and risks. This imbalance can lead to the contractor inflating prices for repeat assignments, as there's no traditional tendering process for comparison. To address this, transparency and strong cost management are essential to ensure trust and prevent exploitation, aligning the interests of both parties.

**Expert 3**

1. The definition of the portfolio approach in the Dutch public infrastructure sector differs from the literature. The definition provided in this research reflects this distinction. It's important to note that this is a unique type of definition. It is not specifically about the portfolio itself, but rather about the organization, making it more of a temporary organizational structure. It's crucial to emphasize that the projects are always executed in sequence.
2. The framework is highly recognizable and consistent with other studies conducted in the same field.
3. Regarding collective goals: keep in mind that the client and contractor may have differing perspectives. Their individual goals must align with the overall objectives of the portfolio.
4. The dynamics between this method of procurement and procurement regulations are significant and could potentially cause complications.
5. The concept of the ”Project Factory” applies to the terminology used in the research, referring to similar projects, such as those involving standardization or modularity.
6. For evaluation, carefully consider KPIs and how they can be coordinated with the contractor. This needs to be flexible, as it should be possible to adjust them further along the portfolio. It's also a form of two-way collaboration and evaluation.

**Expert 4**

1. Contractors are often hesitant to share information that could potentially harm their competitive position. By openly sharing information, contractors may inadvertently provide competitors with the tools to undercut them in future bidding processes. Competitors could use the shared knowledge to offer similar services at a lower cost or improve their bids, thereby reducing the original contractor's chances of securing new contracts. Therefore, an incentive is needed for the contractor to share information. This could indeed include rewards like future contracts or mutual benefits, such as improved project outcomes, making it worthwhile for both parties to collaborate openly. However, when discussing the sharing of lessons learned, it is important to distinguish between generic knowledge and specific knowledge. Contractors are generally reluctant to share specific knowledge, even if offered incentives. However, the sharing of generic knowledge can be encouraged and facilitated more effectively.
2. A common concern with the portfolio approach is the potential for over-reliance on a single contractor, leading to reduced competition. However, this is not necessarily the case due to two key factors: first, any competitive advantage a contractor gains tends to fade quickly as market dynamics shift. Second, employees frequently move between contracting firms, ensuring that expertise and experience are not concentrated within one company for long. As a result, over-dependence on a single contractor is less of a problem.
3. Avoiding complexity is not something we can entirely do, though it may be possible in this research with example projects. However, in the V&R (Replacement and Renovation) program, we deal with complex assets. The recommendation is either to create a separate portfolio for complex assets or to place these complex projects later within a 'normal' portfolio.
4. The same applies to avoiding urgency. I agree that urgency is not ideal for the first project, particularly because the team needs time to prepare and become proficient. However, in the later stages of a portfolio, you can introduce an urgent project. For example, projects 1 and 2 can

be fixed as part of the portfolio, but project 3 could be left as an 'open' project, where an urgent project can be added later. This way, the portfolio is already structured, and you can avoid the negative impacts of urgency.

5. The concept of Monitoring and Adapting Stakeholder Efforts is particularly interesting. While it is often discussed at both regional and national levels, internal conversations within the public commissioner highlight the need for a more unified approach. Ideally, the strategy should be implemented at the national level, allowing regional entities to benefit from the resulting efficiencies. This creates a win-win situation for provinces and municipalities, as they can take advantage of the broader national framework while addressing their specific needs.
6. Increased innovation potential is driven by the need for contractors to make upfront investments, as true innovation can only occur when they commit resources early in the process. However, for contractors to be willing to invest, they need to see a clear opportunity to recover these costs. This is closely tied to several key action points in the framework, such as building trust between parties, managing project complexity, developing a collaborative strategy, and aligning collective goals. Without these foundational elements in place, contractors may hesitate to innovate due to uncertainty about the return on their investments.

# G

# Framework Actions and Effects Portfolio Approach Dutch Public Infrastructure

The framework for implementing the portfolio approach considers **client and contractor perspectives**. The **principles** explored in the case study led to 4 categories of **actions** and 3 categories of **effects**.

**14 Key Actions for Implementing the Portfolio Approach**

| | |
|---|---|
| **Communication and Collaboration** | 1. Create a Shared Vision for Collective Goals<br>2. Encourage Collaborative Decision-Making<br>3. Showcase Long-Term Reliability<br>4. Envision new Collaboration strategy: Working Closer & Longer together |
| **Portfolio – and Tender Strategy** | 5. Apply Phased Approach to Complexity<br>6. Apply Structured Response to Urgency<br>7. Collaborate on Project Phase Alignment<br>8. Ensure Consistency in Project Teams<br>9. Focus on Project Similarity |
| **Knowledge Sharing** | 10. Develop Strategies for Knowledge Retention<br>11. Work on Clear Evaluation Methods<br>12. Lessons Learned<br>13. Share Lessons Learned not only within a portfolio* |
| **Stakeholder Engagement** | 14. Monitor and Adapt Stakeholder Efforts to Strategies |

**7 Key Effects of Implementing the Portfolio Approach**

| | |
|---|---|
| **Management Optimization** | 1. Improved Workforce Stability<br>2. Enhanced Project Visibility and Status Monitoring<br>3. Acceleration Infrastructure Realization |
| **Innovation** | 4. Increased Innovation Potential |
| **Contractor Dependency** | 5. Reduced Client Negotiation Power<br>6. Unbalanced Knowledge Distribution to other Contractors<br>7. Increased Cost Control risks |

Based on **literature and a Dutch case study,** this framework provides an overview of the key actions and effects important for clients and contractors in **public infrastructure projects** in the Netherlands, to be used during the **entire portfolio cycle**.

Portfolio Approach **Actions** through **Collaborative Communication, Strategic Tendering, and Effective Knowledge Sharing**

## Communication and Collaboration

1. **Create a Shared Vision for Collective Goals:** Collaboration between the client and contractors to develop shared goals and performance indicators. Ensure these objectives are clearly defined, measurable, and consistently communicated.
2. **Encourage Collaborative Decision-Making** Ensure both the client and contractors are actively involved early in the decision-making process, particularly during planning and design phases.
3. **Showcase Long-Term Reliability** Both the client and contractors should commit to a long-term partnership focused on continuous improvement. Long-term relationship building is a part of this. To show each other you can trust each other.
4. **Envision new Collaboration Strategies:** Both the client and contractor need to shift away from the traditional "us versus them" mindset and embrace a more collaborative, strategic approach to working together. This involves creating a culture of openness.

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## Portfolio – and Tender Strategy

5. **Apply Phased Approach to Complexity:** Using the portfolio approach on complex projects can lead to inefficiencies and higher costs. The client must ensure that projects within the portfolio are similar enough to benefit from the efficiencies of portfolio management. A solution to complexity could be manage complexity in a single portfolio.
6. **Apply Structured Response to Urgency:** Avoid making a late decision to implement the portfolio approach. Take the necessary time upfront to organize it properly and invest sufficient effort in the planning phase. Be aware that this process takes time and requires careful preparation.
7. **Collaborate on Project Phase Alignment** Coordinate the planning and execution phases of projects closely to prevent long gaps that can result in knowledge loss, misalignment, or a fragmented project team
8. **Ensure Consistency in Project Teams** Where possible, assign the same teams to multiple projects within a portfolio to ensure continuity, quality, and knowledge retention. Consider introducing incentives for team members to remain on the same project series.
9. **Focus on Project Similarity** Ensure future portfolios are composed of similar projects to minimize scope changes that could trigger additional tender processes.

## Knowledge Sharing

10. **Develop Strategies for Knowledge Retention:** Establish a shared knowledge management system where both clients and contractors capture and document all learnings and insights from each project through mandatory debriefings and centralized storage, ensuring continuity and knowledge retention for future projects.
11. **Work on Clear Evaluation Methods:** To evaluate the contractor's performance, the client must set clear guidelines and Key Performance Indicators before the project begins. These criteria should be well-defined and measurable, ensuring that both parties understand the expectations.
12. **Develop Lessons Learned:** Create a structured process for documenting lessons learned from each project and ensure they are consistently shared with the market to improve efficiency and prevent recurring issues in future projects, both within and outside the portfolio.
13. **Share Lessons Learned outside portfolio:** Share knowledge not only within the portfolio or with the parties involved in the project, but also beyond. For the client: creating incentives for the contractor to encourage knowledge sharing. For the contractor: not being afraid to share information and actively utilizing the expertise of other contractors.

## Stakeholder Engagement

14. **Monitor and Adapt Stakeholder Efforts:** Regularly evaluate stakeholder engagement strategies, incorporate lessons learned, and adapt approaches to align with stakeholder needs. Tailor strategies to suit national or regional portfolio contexts, ensuring continuous improvement and reducing future issues.

Portfolio Approach **Effects** of the Portfolio Approach**: Enhancing Management, Driving Innovation, and Addressing Contractor Dependency**

## Management Optimization

1. **Improved Workforce Stability:** The portfolio approach enables clients to plan manpower allocation in advance, ensuring more efficient use of human resources. It also provides contractors with long-term work security.
2. **Enhanced Project Visibility and Status Monitoring:** More effort is put into assessing the condition of assets and determining which projects will be included in future portfolios. This ensures a better understanding of the current state of assets and improved planning for upcoming projects.
3. **Accelerating Infrastructure Realization:** The portfolio approach speeds up infrastructure replacement and renovation by minimizing the need for multiple tenders and streamlining project execution.

## Innovation

4. **Increased Innovation Potential:** The portfolio approach could encourage contractors to apply lessons learned and innovations from previous projects to repeat assignments. This continuous improvement process allows contractors to work more efficiently over time, enhancing overall project delivery. This includes both process and product innovation.

## Contractor Dependency

5. **Reduced Client Negotiation Power:** In repeat assignments, the client cannot easily compare the contractor's price with what other contractors might offer, giving the contractor leverage. If the client rejects the price, they will have to restart the entire tendering process, which is costly. This creates an incentive for the client to accept a higher price.
6. **Unbalanced Knowledge Distribution for other Contractors:** When a contractor secures the majority of a portfolio's projects, they gain more knowledge and experience, potentially leading to an unfair advantage over other contractors who miss out on learning opportunities.
7. **Cost Control risks:** Contractors are expected to provide transparent pricing from the start, which helps build trust with the client. This requires contractors to have strong cost management practices in place to avoid future disputes over costs. The contractor may abuse their power to ask for a higher price in the repeat assignment by exaggerating certain risks.