Fading Sustainability

Understanding the Declining Influence of Sustainability in Infrastructure and Mobility Decision-Making

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by

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TU Delft

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Preface

This thesis marks the completion of my Master's degree and the conclusion of my time as a student. Over the past seven years, I have studied in Delft with great pleasure. It has been a period of academic development, personal growth, and lasting friendships.

I would like to thank several people who supported me throughout the process of writing this thesis. First, Jan Anne, thank you for your honest guidance, fast feedback, and for making time in your busy schedule. Adam, thank you for your valuable input, for sparring with me on ideas, and for helping to shape this research within the TIL domain. Niek, thank you for assessing this work.

Special thanks go to Bas, thank you for the constructive feedback, your willingness to discuss ideas, and for introducing me to the Italian sandwich place. More importantly, thank you for the warm welcome into the team and into Witteveen+Bos as a whole. I also want to thank the entire mobility team for the past six months, for your interest, the good conversations, and the fun team outings. I felt truly included.

To my friends and family, thank you for your ongoing support. To my parents, thank you for listening to my endless doubts, especially in the early stages. I also want to thank my friends for their patience with all our study talk, especially my housemates, who frequently had to listen to Roos and me reflect on our TIL experiences. A special thanks to my TIL friends: Roos, a housemate but also a fellow student, thank you for the daily structure, shared routines, and all the small moments in between. Romée, a long-time friend, from Den Bosch to TIL. And Lise, since our very first year, we've walked a similar path, worked late into the evenings, and supported each other throughout. I'm grateful for it all and hope it doesn't stop here.

With this thesis, I close a valuable chapter in Delft, a period in which I've grown both professionally and personally. The TIL programme helped me find energy in advising and process improvement, and gave me a deeper awareness of the importance of contributing to a sustainable future. This moment also marks the end of living with my Delft friends in Rotterdam, and the beginning of a new phase in Amsterdam, a fresh start I look forward to.

S.A.T. Pijnenburg
Delft, August 2025

Abstract

In recent years, the importance of integrating sustainability into infrastructure and mobility projects has been increasingly acknowledged. While such ambitions are often clearly formulated during early planning phases, such as during policy alignment, scope definition, or ambition-setting, they frequently lose traction as projects move closer to execution. This thesis investigates this phenomenon, known as sustainability ambition erosion, by examining how and why initial sustainability goals weaken throughout the decision-making process and what success factors may help to counter this.

The study begins with a systematic literature review, which categorises the main barriers to sustained sustainability ambition into six thematic groups: conceptual and motivational, economic and financial, organisational and cultural, knowledge-related, governance and policy, and stakeholder and participation. For each category, corresponding success factors are identified to explore potential counterforces to ambition erosion. These theoretical insights are then empirically tested through a qualitative multiple-case study of three Dutch infrastructure projects, combining ten in-depth interviews with public clients and engineering consultancies. The projects span different scales, phases, and governance arrangements, and are analysed along three dimensions: the project life cycle, the stakeholder structure, and the decision-making levels: strategic, tactical, and operational.

The empirical findings confirm many of the literature-based barriers and success factors, but also reveal that several of the predefined categories were either too narrow or not sufficiently reflective of practical realities. In particular, certain codes, such as time pressure, or project-specific constraints, proved difficult to categorise within the existing thematic structure, while others overlapped across conceptual, organisational, and behavioural domains. As a result, the categorisation of both barriers and success factors was revised to better account for how these dynamics manifest in real-world projects. This led to a more practice-informed classification, which more accurately captures the interdependencies and contextual nuances of ambition erosion and reinforcement mechanisms. Notably, intrinsic motivation, informal leadership, and team culture emerge as more influential than formal role or mandate. Furthermore, stakeholder influence is found to depend more on behavioural agency than on their specified roles. Intermediate users, such as project managers, technical managers, and sustainability advisors, played a decisive role in maintaining or abandoning sustainability goals, especially during transitions between project phases.

Ambitions are most vulnerable to erosion during the elaboration phase, where design choices and technical detailing occur, and during phase transitions, where lack of continuity, timing misalignments, and weak anchoring often lead to fragmentation. Financial constraints, conceptual vagueness, and temporal pressure and misalignment were particularly salient across cases. At the same time, success factors such as intrinsic motivation and leadership, engagement and steering power, and contractual and procedural governance mechanisms were found to support the retention of sustainability ambitions. Additionally, several context-specific barriers and success factors emerged that could not be generalised, underlining the importance of project-specific reflection and flexibility.

The study concludes that maintaining sustainability ambition throughout the project lifecycle requires both systemic and human-centred interventions. Rather than relying solely on frameworks or instruments, projects need an integrated strategy that combines structural anchoring (e.g. KPIs, contracts), behavioural ownership (e.g. motivation, leadership), and procedural attentiveness (e.g. continuity, timing, phase-specific tools). These three conditions, structure, behaviour, and procedure, must be addressed in parallel if sustainability ambitions are to withstand the complex realities of infrastructure development and result in lasting impact.

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Nomenclature

Abbreviations

Abbreviation	Definition
CBA	Cost-Benefit Analysis
DMP	Data Management Plan
EIA	Environmental Impact Assesment (=MER)
ECI	Environmental Cost Inidcator(=MKI)
EMVI	Economische Meest Voordelige Inschrijving (Economically Most Advantageaous Tender)
GWW	Grond-, weg- en waterbouw (Ground-, Road-, and Water Works)
HREC	Human Research Ethics Committee
IPM	Integraap Projectmanagement
LCA	Life cycle analysis
MCDA	Multi-Criteria Decision Analysis
MER	Milieu Eeffecten Rapportage (=EIA)
MIRT	Meerjarenprogramma, Infrastructuur, Ruimte en Transport
MKI	Milieu Kosten Indicator (=ECI)
PI	Power-Interest
SDG	Sustainable Development Goals
TBL	Triple Bottom Line
W+B	Witteveen+Bos

1

Introduction

This chapter introduces the research topic of the diminishing influence of sustainability ambitions in decision-making within Dutch infrastructure and mobility projects. Section 1.1 first outlines the background and motivation for this study, followed by the problem statement in Section 1.2. Section 1.3 identifies the research gap and highlights the academic and societal relevance. Section 1.4 defines the research objective and questions. Section 1.5 presents the scope. Section 1.6 introduces the company Witteveen+Bos as a key context for this research. Finally, Section 1.7 provides an overview of the structure of this thesis.

1.1. Background and motivation

Already in the 1970s, Meadows (2012) warned that the world would reach the limits to growth within the next century, should current trends in population growth, industrialization, and resource depletion continue. Their message was clear: continued economic, social and environmental pressures would eventually exceed the ecological capacity of the planet, posing serious threats to future generations.

Today, over 50 years later, these pressures have not only persisted, but intensified. Climate change, resource scarcity, and social inequality have grown into systemic challenges, with infrastructure playing a dual role. In the context of the Netherlands, public infrastructure and mobility systems, such as roundabouts, bridges and cycling routes, are fundamental for sustainable urban development and economic growth. Typically commissioned by governmental agencies, these projects aim to improve accessibility, safety, and spatial quality, while shaping the built environment for the future. However, the realisation these projects contributes significantly to global environmental problems. As illustrated in Figure 1.1, infrastructure affects all three dimensions of sustainability, economic, ecological, and social factors (Kristensen & Mosgaard, 2020). The sector accounts for approximately 70% of global greenhouse gas emissions, and is a major driver of resource consumption, land use, and pollution (United Nations Environment Programme, 2021).

This paradox, of infrastructure and mobility projects being both a catalyst for development and a source of environmental impact, places Dutch infrastructure and mobility projects at the heart of the sustainability agenda. As depicted in Figure 1.2 realization of these projects directly influences all three sustainability dimensions.

International agreements, such as the Paris Climate Agreement call for a reduction of 90-100% CO_2 emissions by 2050 compared to 1990 levels (van Vuuren et al., 2017). Achieving these goals requires not only innovation but also massive investments. According to OECD et al. (2018), an estimated USD 6.9 trillion per year is needed globally in infrastructure investment to meet the 2030 Sustainable Development Goals.

Despite these high-level commitments, progress remains inadequate (van Vuuren et al., 2017). The 2024 Sustainable Development Report shows that only 17% of the SDG targets are on track globally. In the Netherlands, just 56% of targets are being met, while 30% are even regressing (Sachs et al., 2024).

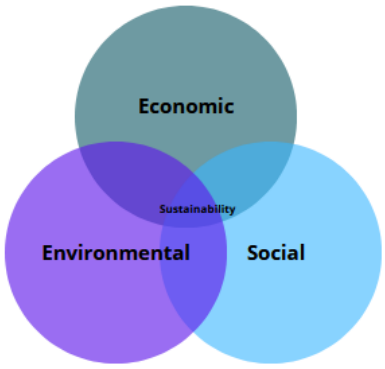

Figure 1.1: Three dimensions of sustainability (TBL), own illustration adapted from Elkington (1997)

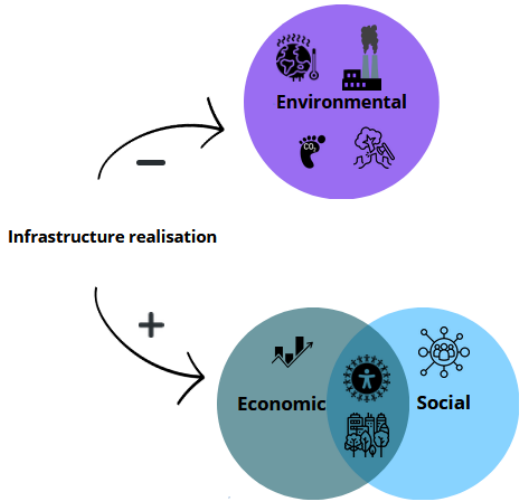

Figure 1.2: Impact of realising infrastructure on dimensions, own illustration

This gap between climate pledges and implementation is further emphasized by recent findings from the Netherlands Environmental Assessment Agency (PBL). Despite widespread net-zero commitments, the global emission gap remains significant. Even if all national policies were implemented, projected emissions in 2030 will still exceed the pathway required to limit global warming to 1.5°C, underlining the persistent mismatch between ambition and action ("Emission gap to net-zero pledges and 1.5 degrees still remains", n.d.). Also, the Dutch Climate Act mandates a reduction in greenhouse gas emissions from 228 million tons in 1990 to 116 million tons by 2030, and a 95% reduction by 2050 (Government, 2020; Klimaatakkoord, n.d.). These ambitions are set against the backdrop of growing infrastructure demand, particularly given that 75% of the infrastructure needed by 2050 still needs to be built (Chatterjee, 2024). This presents both a challenge and a unique opportunity to embed sustainability from the earliest planning stages.

1.2. Problem statement

Despite the availability of various tools and frameworks developed to promote sustainability in infrastructure and mobility projects, such as the Ambitieweb, CO_2-prestatieladder, and Duurzaam GWW principles (See Chapter 5)(CO_2-Prestatieladder, n.d.; Duurzaam GWW, n.d.). There is a recurring pattern of sustainability ambitions losing influence as projects move from planning to realization. While sustainability goals are typically stated in early-stage tenders and strategy documents, they tend to lose influence when practical constraints such as cost, technical feasibility, and risk emerge (Rezaeian et al., 2024).

This phenomenon is widely recognized as the ambition-implementation gap, also known in literature as the policy-practice, or strategy-execution gap. Although this phenomenon is extensively discussed across various domains, very few studies examine this phenomenon within the domain of infrastructure and mobility projects, and even fewer within the Dutch context (see Appendix Table B.1). These findings illustrate that empirical insight into how and why sustainability ambitions fade in Dutch practice remains very limited.

A possible reason for this limited reflection is that acknowledging such a gap can be politically or reputationally sensitive for both public and private actors. Admitting that sustainability ambitions have not been realized can undermine the credibility of governments, consultants, and project teams, making actors reluctant to critically assess or publicly discuss these shortcomings (Hahn & Lülfs, 2014). As a result, the underlying causes of this disconnect, ranging from institutional structures and incentive misalignments to fragmented responsibilities, often remain underexplored.

A core complexity underlying this problem is the layered nature of infrastructure and mobility planning and delivery. While sustainability ambitions are often defined at a high level, such as in policy goals,

tenders, or strategic project documents, their actual implementation is shaped by decisions made in subsequent planning and execution phases. These phases are typically managed by different actors operating under different priorities and constraints. This division between ambition-setting and execution can result in sustainability being diluted or reframed over time, especially when it is not translated into concrete requirements or decision criteria at each phase. For example, Chege et al. (2015) finds that only 30% of formulated strategies are implemented at the operational level, highlighting a broader systemic challenge: translating long-term ambitions into concrete action.

Tactical actors (such as project managers or advisors) may encounter conflicting priorities or constraints, while operational teams are usually evaluated on efficiency, cost, and risk management. If sustainability is not structurally aligned across all three levels, it risks becoming an aspirational idea, visible on paper, but invisible in practice.

This pattern is also reflected in exploratory interviews and conversations with employees at Witteveen+Bos, a leading engineering and consultancy firm in the Netherlands committed to integrating sustainability into their projects (Witteveen+Bos, 2025a). Although clients often set sustainability ambitions, these are rarely decisive during final decision-making. Employees indicate that sustainability is often considered as a non-binding criterion, acknowledged, but easily sidelined once other project criteria become dominant.

The diminishing influence of sustainability throughout the project life cycle is problematic for several reasons. Foundational project decisions such as defining the scope, location, and design alternatives, have a disproportionate impact on the environmental, social, and economic footprint of infrastructure over its entire life cycle. If sustainability is deprioritized during these critical phases, later interventions often become costlier, less effective, or infeasible (Bragança et al., 2014). Moreover, when sustainability goals are not met, the credibility of public authorities and engineering firms suffers, undermining trust and weakening support for broader climate and societal commitments (OECD et al., 2018). This is especially problematic in infrastructure and mobility projects where early decisions have long-term spatial, financial and environmental consequences.

1.3. Research gap and relevance

Although the importance of sustainability in infrastructure and mobility projects is widely acknowledged in academic literature (Chatziioannou et al., 2023; Dahl, 2012; Marsden et al., 2011), and its diminishing influence throughout the project life cycle is well observed in practice, most studies remain largely descriptive. They highlight the persistent gap between strategic sustainability ambitions and their actual implementation at the project level, commonly referred to as the ambition–implementation gap (Engert & Baumgartner, 2016; Fast & Widerberg, 2025; Glass & Newig, 2019; Vergerio & Knotten, 2024). While this gap is well documented, the underlying mechanisms that cause sustainability ambitions to weaken over time remain poorly understood.

Several studies point to critical limitations in how sustainability ambitions are operationalized. Engert and Baumgartner (2016) state in their study of the automotive sector, that while it is agreed that corporate sustainability strategy formulation is relevant for companies, to date only little attention has been paid to the concrete steps needed to translate sustainability strategy into practice.

Similarly, Fast and Widerberg (2025) identify that sustainability-related goals such as the Sustainable Development Goals (SDGs) are often framed in broad and aspirational terms. While such goals may help to align political agendas, their vague and non-specific nature hinders effective implementation. Fast and Widerberg (2025) argue that without context-specific translation and coordination between state and non-state actors, the implementation of such ambitions remains symbolic.

Vergerio and Knotten (2024) add to this body of knowledge by examining how high sustainability ambitions in zero-emission neighbourhood projects often fail to materialize due to fragmented collaboration, insufficient accountability, and weak alignment between stakeholders. Their study reveals that while ambitious environmental goals can stimulate innovation and set a strong initial direction, the absence of supporting organizational, contractual, and cultural mechanisms during project execution leads to a significant ambition–delivery gap. Particularly in complex, multi-actor settings, the lack of integrated planning tools, shared ownership, and effective follow-up structures undermines the translation of goals

into tangible outcomes.

Also, Glass and Newig (2019) further argue that the inherent complexity and interrelatedness of the 17 SDGs demand integrated, holistic, and coherent governance. They identify fragmented governance structures and lack of coordination as major barriers to implementation, and call for more country-specific research to unpack how sustainability ambitions interact with institutional realities and actor dynamics.

Despite these insights, there remains a significant lack of empirical research on how and why sustainability ambitions are deprioritized during the planning phases of infrastructure and mobility projects, when foundational decisions on project scope, location, and design are made. Few studies explore the organizational, procedural, and relational dynamics that drive this erosion of ambition over time.

A keyword-based literature search using Scopus and ScienceDirect (see Appendix B) confirmed this gap. While broad studies exist on sustainability and project management, very few studies explicitly address how sustainability ambitions weaken throughout the planning process, especially within infrastructure and mobility contexts. When focusing on ambition erosion or dilution, the number of relevant publications was minimal or absent. This lack of literature highlights the need for further investigation into the mechanisms, actor interactions, and systemic drivers that allow ambitions to fade throughout the project life cycle.

This research contributes to closing these gaps by:

1. Investigating the phenomenon of ambition erosion in infrastructure and mobility projects, with a focus on how sustainability ambitions weaken throughout the different stages of the project life cycle.
2. Exploring how interactions between public clients and engineering consultancies, such as Witteveen+Bos, shape the prioritization of sustainability in real-world projects.

Scientific relevance
This research advances academic understanding of ambition erosion by focusing not only on what fades, but also on how and why. It extends existing literature on governance, project management, and sustainability implementation by examining the interplay between high-level objectives and concrete project-level decision-making. The Dutch infrastructure and mobility context provides a valuable empirical setting to study this misalignment in a country with strong sustainability ambitions and institutionalised planning frameworks. From an academic perspective, this research also aligns with the interdisciplinary foundation of the MSc programme in Transport, Infrastructure and Logistics. The programme combines technical systems thinking with insights from spatial, governance, and policy insights to tackle complex infrastructure challenges in a dynamic societal context. This thesis contributes to that objective by investigating how high-level sustainability ambitions translate or fail to translate into concrete decisions within infrastructure and mobility projects.

Societal relevance
Infrastructure and mobility projects directly shape how people live, move, and interact. Decisions made during their planning stages affect not only environmental outcomes, but also social equity, public health, and the accessibility of cities and regions. When sustainability ambitions are not realised, it can result in infrastructure that reinforces spatial inequality, excludes vulnerable groups, or locks in unsustainable practices for decades. By uncovering why sustainability ambitions fade during key decision-making phases, this research contributes to more inclusive and future-proof infrastructure development. It helps ensure that long-term public values such as liveability, fairness, and resilience are better safeguarded in the processes that shape the physical environments in which people live and work.

1.4. Research objective and questions

To approach the research problem, the following research objective has been formulated:

To explore the phenomenon of sustainability ambition erosion in infrastructure and mobility projects, by identifying involved actors, key barriers, and validating potential strategies to mitigate this erosion

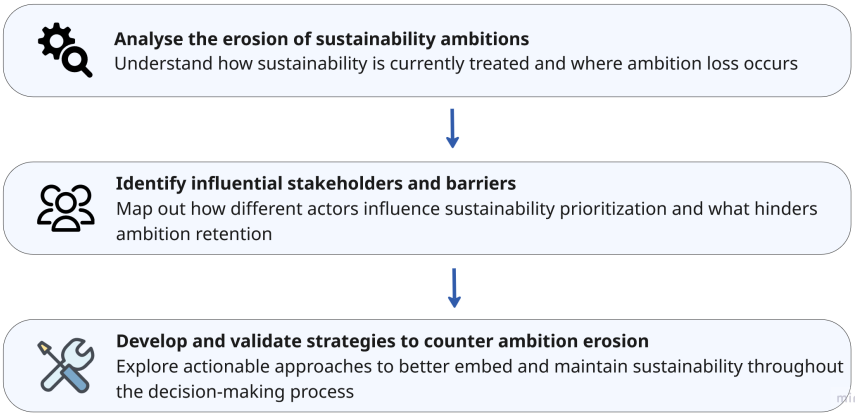

Figure 1.3: Research objectives

By achieving these objectives, as illustrated in Figure 1.3, this research aims to generate insight into the mechanisms behind the erosion of sustainability ambitions and identify leverage points to better maintain those goals throughout the life cycle of the project. These insights can support the development of sustainability into infrastructure and mobility projects, contributing to more future-proof and resilient decision-making processes.

The contribution of achieving this objective is twofold: First, this study contributes to the academic discourse by addressing a gap in current literature concerning the erosion of sustainability ambitions throughout the project life cycle. While prior research has acknowledged the misalignment between strategic sustainability goals and project-level implementation (Engert & Baumgartner, 2016; Fast & Widerberg, 2025; Glass & Newig, 2019), limited attention is paid to the mechanisms and interactions that cause ambitions to fade. Second, it offers practical insights into how sustainability can be more effectively embedded in project development, beyond technical tools, by focusing on actor dynamics and decision-making processes.

This research aims to identify the key barriers that prevent sustainability from maintaining influence throughout the decision-making process. By critically analyzing insights from interviews with stakeholders and experts, this study focuses on identifying opportunities to better embed sustainability throughout the project process and develop strategies that help maintain initial sustainability ambitions.

Based on the problem definition, the main research question is:

How can the initial ambitions for sustainability in infrastructure and mobility projects be maintained throughout the decision-making process?

To answer the main research question, the following sub-questions have been identified:

1. How is sustainability currently considered in the decision-making process of infrastructure and mobility projects across different stages?
2. How do different stakeholders in the case studies influence the prioritization of sustainability in decision-making?
3. What are the key barriers that prevent sustainability from remaining a decisive factor throughout the decision-making process?
4. At what points in the decision-making process do opportunities arise to strengthen sustainability ambitions, and what factors contribute to their successful integration?
5. What success factors can help ensure that sustainability ambitions remain a priority without significantly complicating project decision-making?

1.5. Scope

Defining the scope helps delineate the boundaries of this research by clarifying what is included and excluded. Several considerations were made to ensure the research remains focused and relevant:

- The geographical and sectoral focus lies on public infrastructure and mobility projects in the Netherlands. A key reason for limiting the scope to Dutch projects is that they operate under a shared national planning framework, typically following the same standardized project phases as defined by the Ministry of Infrastructure and Water Management. Additionally, public infrastructure projects in the Netherlands are generally expected to contribute to the same overarching sustainability ambitions, which enhances the comparability between cases and the applicability of research findings.
- Project life cycle scope: The study concentrates on the phases of infrastructure and mobility project development, specifically the initiation, exploration, elaboration, and realisation phases (Ministerie van Infrastructuur en Waterstaat, 2024). These stages are particularly relevant because sustainability ambitions are typically formulated here, but are also most vulnerable to erosion.
- Stakeholder perspective: A broad stakeholder perspective is adopted, focusing on two key organisational actors: the public client and the engineering consultancy. This focus reflects the internal dynamics within typical IPM team structures. By including perspectives from both sides, the study aims to capture the institutional and organizational dynamics that influence the erosion throughout the project. Perspectives from political decision-makers and end-users are deliberately excluded from this study. While these groups play an important role in broader sustainability debates, they fall outside the scope of this research, which concentrates on the actors directly involved in the design and planning process.
- The emphasis is on governance and decision-making dynamics, not on the evaluation of technical assessment tools (e.g., CBA, LCA, MCDA). The study aims to understand why sustainability ambitions fade, rather than how they are measured.

Clarification of terminology

Throughout this thesis, a distinction is made between *infrastructure* and *infrastructure and mobility projects.* The term infrastructure refers to the broader domain, including the systems, networks, and institutional landscape that support transport, energy, water, and communication services. It is used when discussing the sector as a whole, including general developments or governance trends. In contrast, infrastructure and mobility projects refer to specific project-level initiatives related to transport infrastructure, such as roads, railways, bridges, roundabouts or cycling networks. These are the types of projects studied in this research and are central to the empirical analysis.

1.6. The company - Witteveen+Bos

Witteveen+Bos is an independent Dutch engineering consultancy with a strong international presence, specialising in infrastructure, water, environment, and construction projects. As an employee-owned company, it operates under a participatory ownership model that fosters engagement and shared responsibility. The company's mission is to contribute to a better living environment by delivering sustainable and high-quality engineering solutions (Witteveen+Bos, 2024).

Combining technical excellence with social responsibility, Witteveen+Bos places sustainability at the core of both its project delivery and corporate strategy. In line with its commitment to the United Nations Sustainable Development Goals (SDGs), the company has developed a set of seven sustainable design principles. These principles help translate abstract global goals into concrete, actionable guidance at the project level, enabling consistent yet context-specific integration of sustainability while addressing broader societal challenges (Witteveen+Bos, 2025b).

Operating primarily in the public domain, Witteveen+Bos works on projects commissioned by governmental authorities such as Rijkswaterstaat, provinces, and municipalities. These public clients are placing increasing demands on consultancies to not only include sustainability in tender documents, but to demonstrably embed it into measurable project outcomes. Governance frameworks such as the Environment and Planning Act (Omgevingswet), the Dutch Climate Act, and instruments like the

Duurzaam GWW approach and MIRT procedures have reinforced the need for traceable and verifiable sustainability performance (“Climate Act (Klimaatwet) - Climate Change Laws of the World”, n.d.; “De Omgevingswet | Rijksoverheid.nl”, n.d.; PIANOo, 2025; Rijksoverheid, n.d.).

This research is particularly relevant for Witteveen+Bos, given its ambition to remain a leader in sustainable infrastructure development. As a consultancy that actively seeks to embed sustainability across all project phases, a deeper understanding of how and why sustainability ambitions tend to erode over time can offer valuable strategic insights. Such knowledge enables the organisation to anticipate where ambitions are most vulnerable, and to respond more effectively to client expectations, planning procedures, and systemic constraints.

By strengthening its understanding of ambition erosion, Witteveen+Bos can further enhance its capacity to translate sustainability ambitions into concrete and verifiable outcomes. In doing so, the firm not only reinforces its market position and credibility, but also strengthens its ability to deliver integrated, future-proof design solutions that align technical excellence with long-term societal value.

1.7. Thesis structure

This thesis is structured as follows: This chapter provides an introduction to the research. Chapter 2 outlines the methodology, explaining the research design and the methods used to address the research questions. Chapter 3 presents the literature review, forming the academic foundation of the theoretical background. It focuses on the definition of sustainability ambitions, as well as commonly identified barriers and success factors. Chapter 4 outlines the current state of sustainable infrastructure development in the Netherlands. It answers RQ1 and serves as input for the subsequent empirical analysis. The second part of the thesis comprises the empirical research. Chapter 5 introduces the case studies and presents the results based on both interview data and desk research. Together with Chapter 6, which synthesises and validates the findings, this part of the thesis provides answers to RQ2, RQ3, RQ4, and RQ5. The final part of the thesis begins with Chapter 7, which discusses the results from both a theoretical and empirical perspective and reflects on the study’s limitations. Finally, Chapter 8 presents the main conclusions and recommendations, answering the central research question. Figure 1.4 provides a visual overview of the thesis structure, indicating in which chapter each research question is answered.

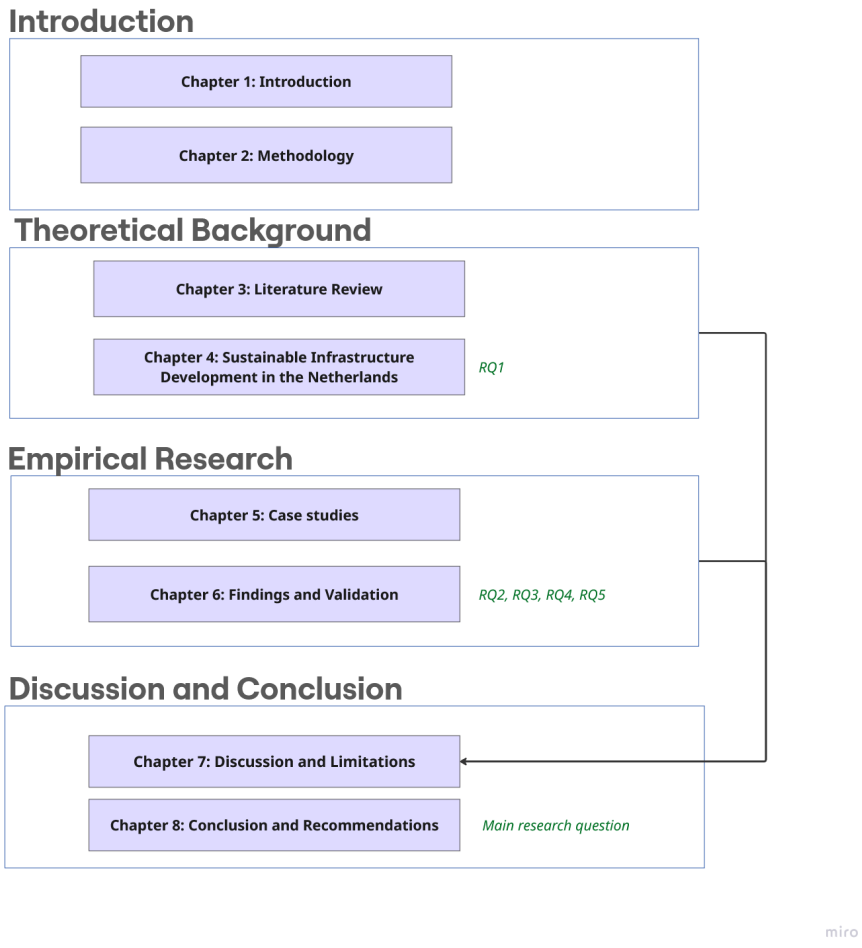

Figure 1.4: Thesis structure and relationship to research questions

2

Methodology

This chapter outlines the research methodology used to answer the research questions. Section 3.1 describes the overall research design and approach. Section 3.2 explains how each research question is linked to its corresponding method, while Subsection 3.3 provides a detailed explanation of the specific research methods. Finally, Subsection 3.4 presents the conceptual framework, illustrating how the research methods contribute to addressing the research problem.

2.1. Research approach

This study adopted a qualitative approach to investigate why sustainability was deprioritized in the early phases of infrastructure and mobility projects. Rather than quantifying sustainability outcomes, the research focused on understanding the underlying decision-making dynamics, subjective judgements, and barriers that lead to erosion of sustainability ambitions. This approach was further justified by the nature of the research questions, which aimed to explore perceptions, experiences, and barriers rather than assess sustainability performance through quantitative indicators. As Liang (2019) states, qualitative research is particularly valuable for investigating complex decision-making processes, as it captures the opinions, suggestions, and experiences of those directly involved. To ensure objectivity and credibility, the research also adhered to best practices for ethical and unbiased qualitative inquiry (Lim, 2024). The study integrated multiple qualitative methods, both theoretical and empirical, to ensure that the findings were grounded in both academic and practical realities.

In line with this qualitative approach, the research followed an abductive reasoning strategy, which moved iteratively between theoretical concepts and empirical observations. Rather than starting from a fixed hypothesis (deductive) or building theory purely from data (inductive), abductive reasoning allowed for the refinement of existing theories through real-world insights, and vice versa. Figure 2.1 provides a visual comparison of these three reasoning strategies, highlighting how abductive analysis combines elements of both inductive and deductive logic. This made it especially suitable for exploring under-theorized and context-dependent issues such as the erosion of sustainability ambitions.

Metric	Inductive	Deductive	Abductive
Approach	Bottom-up	Top-down	Iterative
Data Immersion	Extensive	Moderate	Deep engagement
Theoretical Guidance	Minimal	High	Medium
Flexibility	High	Low	Medium-high
Novel Insights	Likely	Limited	Medium-high
Research Goals	Exploration	Theory Testing	Theory refining
Interpretation Structure	Emergent	Predefined	Evolving and recursive
Time Required	Time-intensive	Moderate	Time-intensive
Suitability	Exploratory Research	Hypothesis Testing	Research seeking depth

Figure 2.1: Key characteristics of inductive, deductive, and abductive analysis. Figure adapted by the author based on "Inductive Thematic Analysis vs. Deductive Thematic Analysis in Qualitative Research" (2024).

2.2. Research design

This research follows an abductive design in which theoretical exploration and empirical investigations inform one another in an iterative and responsive manner. The research process started with the formulation of the research subject, scope and problem statement, followed by defining the research questions. These steps were supported by desk research and literature review, which provided the conceptual foundation for the study.

Empirical data were collected through three case studies, using stakeholder analysis and semi-structured interviews to capture a broad range of perspectives from public clients and Witteveen+Bos. The interview data were thematically analysed to identify mechanisms that influence the erosion or safeguarding of sustainability ambitions in project practice. These insights informed the development of success factors and contributed to answering the sub-questions and the overall research question

Throughout the process, theory-building and empirical inquiry were interwoven. The abductive logic of the study integrated deductive elements, such as the use of theoretical frameworks to structure early thinking and inductive elements, such as the interpretation of observed stakeholder dynamics. This interplay allowed for iterative refinement of both the problem understanding and the analytical focus.

Figure 2.2 visualises this research flow. The central column presents the main research steps, while the left side shows the associated methods. The dotted arrows indicate iterative loops between steps, highlighting how earlier stages were revisited as new insights emerged.

Table 2.1 outlines the five sub-questions, the key deliverables they produced, and the research methods used to answer them.

Table 2.1: Sub-questions, key deliverables, and corresponding methods

Question	Key Deliverables	Method
1.	Overview of stages and considerations of sustainability	Literature review, Desk research
2.	List of stakeholders and their roles, PI grid Overview of stakeholder perceptions on sustainability	Stakeholder analysis Semi-structured interviews
3.	Overview of the main barriers	Semi-structured interviews, Literature review
4.	Timeline with identified opportunities	Semi-structured interviews, Desk research
5.	Identified strategies for maintaining sustainability priorities	Semi-structured interviews, Literature review

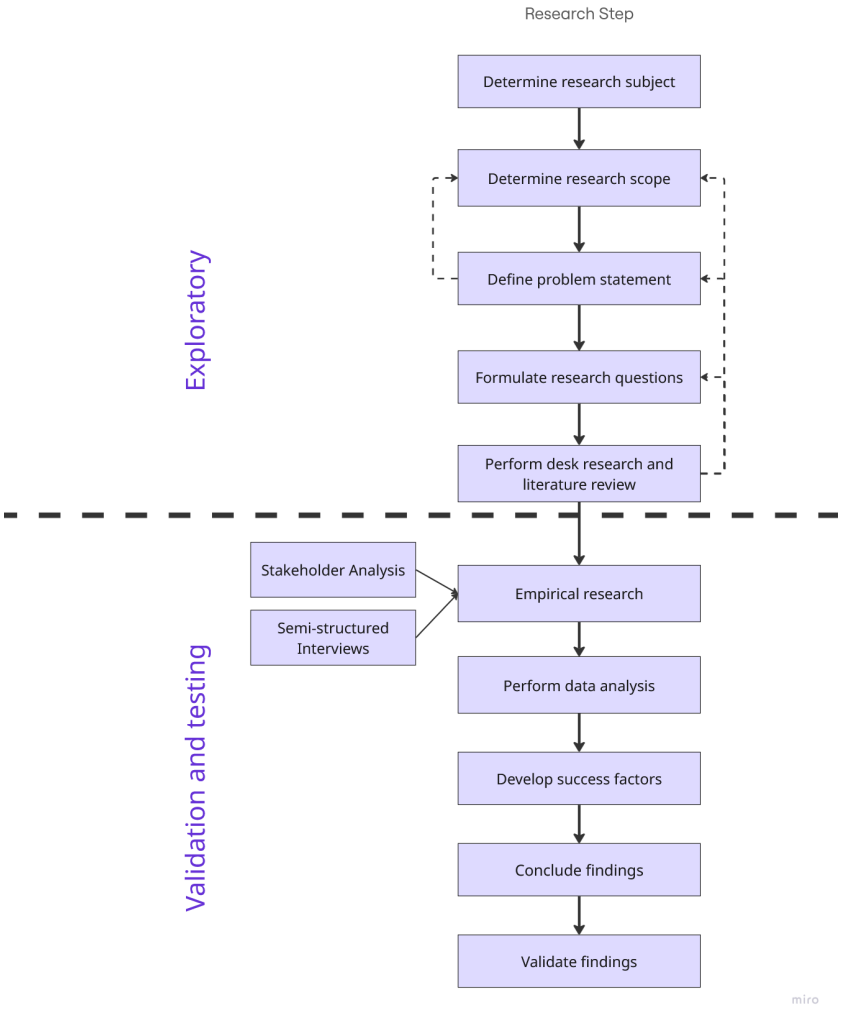

Figure 2.2: Research flow

To ensure transparency and methodological clarity, Table 2.2 provides an overview of each method used in this study, along with its corresponding research questions, data sources, and analysis approach.

Table 2.2: Overview of Research Methods, Data Sources, and Analysis Approaches

Method	RQ	Data Source(s)	Analysis Approach
Literature Review	1, 3, 5	Academic databases	Thematic synthesis
Desk Research	1, 4	Project documents	Document review
Stakeholder Analysis	2	Project org. charts, interview data	PI grid mapping
Semi-structured Interviews	2–5	Expert interviews	Thematic coding (Atlas.ti)
Case Studies	1–5	All combined	Within-case and cross-case Analysis

2.3. Research methods

This section explains the methodologies used to answer the main question.

2.3.1. Literature Review

A literature review was conducted to determine what was already known about the research topic, how it had previously been studied, and where gaps or tensions existed in the current body of knowledge. This review formed the foundation for answering sub-questions 1, 3, and 5 by identifying theoretical perspectives, empirical findings, and practical strategies relevant to the integration of sustainability in early-stage infrastructure projects. As Snyder (2019) argues, literature reviews are essential for establishing a robust understanding of the field and positioning new research effectively within it.

To ensure a comprehensive and systematic approach, the search strategy followed the guidelines described by (Bramer et al., 2018). Several academic databases were consulted, including Scopus, ScienceDirect, the TU Delft repository, Google Scholar, and ResearchGate. Relevant articles were initially identified using predefined keywords (see Table 2.3) combined with Boolean operators such as AND and OR to refine results. However this was used as a starting point; for example, specific searches for 'triple bottom line' and 'economic barriers' were also conducted later on.

Inclusion criteria required that publications were written in either English or Dutch. Initial screening was conducted by reviewing titles, abstracts, and keywords. If a source appeared relevant, key sections of the full text were reviewed to confirm its usefulness for the research context.

To supplement the initial search, snowballing techniques were applied. Both backward snowballing (examining references in selected articles) and forward snowballing (identifying studies that cited the selected articles) were used to expand the literature base.

The selected literature was then analysed and categorised under key thematic areas, including: Defining sustainability, sustainability ambitions, barriers to maintaining sustainability ambitions and success factors to maintain sustainability ambitions.

The review process was iterative, with multiple rounds of searching, filtering, and refining to ensure depth and relevance. This literature base served as the theoretical foundation upon which the empirical components of the research were developed.

Concept groups	**Sustainability defintion; Ambition definition; Sustainability ambitions in decision-making; Barriers to sustainability integration; Success Factors to maintain sustainability**
Keywords	**Sustainability definition**: definition of sustainability, sustainability, triple bottom line **Sustainability ambitions**: definition of ambitions, sustainability ambitions in infrastructure projects, ambition integration in projects, sustainable policy frameworks **Barriers to sustainability integration**: barriers to sustainability, sustainability trade-offs, sustainability challenges in project execution **Success factors to maintain sustainability**: success factors in project management, maintaining ambitions, stakeholder engagement
Boolean Search Query	(”sustainability definition” OR ”sustainable infrastructure projects”) AND (”barriers to sustainability” OR ”sustainability trade-offs”) AND (”sustainability attrition” OR ”decision-making constraints” OR ”sustainability decline in project execution”) AND (”sustainability success factors” OR ”Succes factors project management”)
Databases	Google Scholar, Scopus, TU Delft Library, ScienceDirect, Government & Industry Reports (e.g., Dutch Climate Act, Witteveen+Bos reports)

Table 2.3: Search strategy for constructing the literature review

2.3.2. Desk Research

To complement the literature review and interviews, desk research was conducted to analyse existing project documentation and decision-making guidelines. By examining previous infrastructure and mobility project documentation, desk research provided insight into current practice, ensuring a more comprehensive analysis of sustainability integration. This method was used to answer (parts of) the following research questions:

- Sub-question 1: Identified how sustainability considerations were implemented in real-life projects. While the literature primarily described theoretical approaches, analysing practical cases offered concrete insights into the actual process and the extent to which sustainability was truly incorporated.
- Sub-question 4: Mapped decision-making phases and identified key moments when sustainability ambitions gained or lost influence. By studying past project documentation, it was possible to identify decision phases where there were opportunities to strengthen sustainability. This approach ensured that the research did not rely solely on stakeholder perceptions, but was also supported by empirical project data, thereby increasing the reliability of the findings.

This method strengthened the study by grounding theoretical knowledge in empirical project data.

2.3.3. Stakeholder Analysis

A stakeholder analysis was conducted to identify and classify relevant actors based on their roles, influence, and interests. The goal of this analysis was to identify stakeholder interests and roles to better understand how different actors shape sustainability outcomes in projects.

Wallbridge (2023) proposes to categorise stakeholders based on their interests and influence, using a power-interest grid to visualise this, shown in 2.3. Understanding these relationships was crucial to

developing an effective strategy.

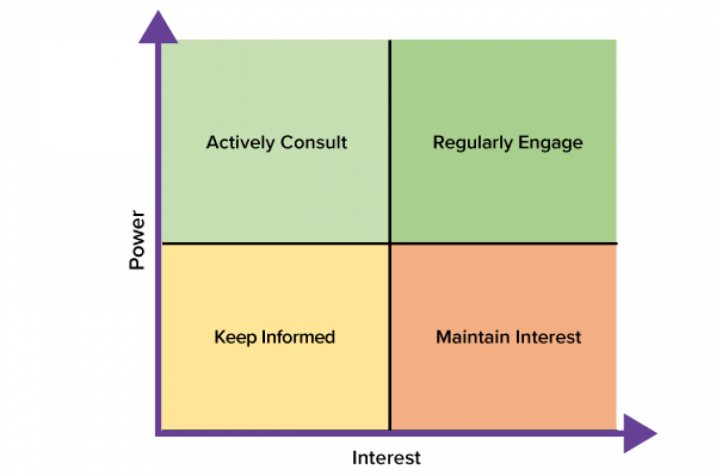

Figure 2.3: PI grid (Improvement Service, n.d.)

2.3.4. Case-study

To investigate how sustainability ambitions were diluted in real-world infrastructure projects, three case studies were selected. These cases were proposed by professionals at Witteveen+Bos, who identified them as illustrative examples of sustainability ambition erosion during decision-making. The selection ensured the presence of recognisable sustainability goals and their observed decline throughout the process.

Each case was discussed with a Witteveen+Bos employee who was directly involved in the project. Following this, relevant project documentation, such as tender requests and ambition web session outputs, was reviewed to establish the contextual background and trace the evolution of sustainability considerations.

A primary source of data in the case studies was semi-structured interviews with stakeholders involved in the decision-making process. Interview participants were asked to describe how they experienced the dilution of sustainability ambitions, whether and how they tried to mitigate it, and what they perceived as promising solutions. Additionally, they reflected on the main barriers and opportunities for strengthening sustainability in similar projects.

Both within-case and cross-case analyses were conducted: the within-case analysis allowed for an in-depth understanding of each individual project in its context, while the cross-case comparison helped identify recurring patterns, barriers, and contextual conditions.

It is important to notice that Case C included only one interviewee, due to limited availability of relevant stakeholders. As a result, Case C is not treated as a fully standalone case in the comparative analysis. However, the insights from this interview were fully incorporated into the thematic coding, where they contributed to triangulating findings and enriching the interpretation of recurring dynamics.

The insights derived from these case studies provided the empirical foundation for answering the main research question. As noted by Crowe et al. (2011), case studies are particularly suitable for research aiming to explore, explain, describe, and understand complex phenomena within real-life contexts, making this method highly appropriate for this research.

Data analysis

The data analysis followed an abductive reasoning strategy, which involved an iterative process between theoretical concepts and empirical findings. This approach allowed the researcher to remain open to unexpected insights from the data, while also being guided by existing literature on sustainability in infrastructure projects.

The analysis began with a descriptive phase in which each case was contextualised using project documentation and background conversations. Then, the interview transcripts were coded using a combination of open and axial coding. Open coding was used to label emerging ideas in participants' own words, while axial coding grouped these ideas into overarching themes (Campbell et al., 2013).

Initially, codes were assigned to six predefined literature-based barrier categories. However, as analysis progressed, it became clear that several codes overlapped thematically or did not fit well within these domains. In response, an empirically grounded thematic structure was developed, resulting in four revised categories that more accurately reflected the observed patterns. This restructuring allowed for a clearer classification of both barriers and success factors, accounting for project-specific dynamics such as phasing, knowledge loss, and institutional ambiguity. In addition to structural themes, illustrative quotes were retained throughout the coding process to preserve contextual nuance. These narrative fragments were used to support interpretation.

While code frequencies were tracked, they were not treated as decisive. A single respondent repeatedly mentioning a theme could skew interpretation. Instead, meaningful quotes and anecdotes were prioritised to preserve narrative richness and contextual nuance.

Both within-case and cross-case analyses were performed to identify patterns, barriers, and context-specific factors. The within-case analysis was used to identify how sustainability ambitions eroded within each individual project, capturing the unique dynamics between stakeholders, project phases, and decision-making contexts. It provided insight into the specific mechanisms and moments where ambitions faded. The cross-case comparison was used to uncover recurring patterns and shared barriers across the three cases, as well as to identify context-dependent differences (e.g., differences in client priorities, scope definitions, or planning procedures). By combining both analyses, the research identified both project-specific factors and broader, transferable insights on when and why sustainability ambitions tend to weaken and how this process might be mitigated in future projects. This abductive structure enabled the research to develop theoretically informed conclusions that were grounded in the practical realities of decision-makers.

The full coding process is documented in Appendix E. This appendix also includes the final list of codes and their distribution across strategic, tactical, and operational decision-making levels.

2.3.5. Semi-structured Interviews

Interviews were central to answering sub-questions 2, 3, 4, and 5, offering deep, context-rich insights from professionals directly involved in project decisions. They served two purposes: (1) to explore causes of ambition erosion, and (2) to test the feasibility of proposed success factors.

The interviews followed a semi-structured approach. While the interview questions were guided by a predefined protocol, the format allowed for open discussion and the flexibility to explore emerging insights through follow-up questions. This method ensured both consistency and adaptability in the data collection process.

The choice to conduct interviews in this research was based on several key considerations:

- First of all, since the research gap was shaped by real-world experiences, it required insights from professionals directly involved in decision-making. Interviews allowed for a deeper understanding of the underlying motivations and perceptions (Adeoye-Olatunde & Olenik, 2021), as well as institutional pressures that influenced sustainability decisions: factors that could not be fully captured through desk research or literature review. Surveys, by contrast, only revealed generalised trends, whereas interviews enabled the researcher to explore the decision-making dynamics across different phases of the project and explain how and why ambitions faded.
- In addition to technical challenges, institutional, economic, and political factors also shaped sustainability in infrastructure projects. This method provided a nuanced perspective that allowed respondents to elaborate on the trade-offs they faced, ultimately contributing to the identification of feasible strategies.
- Interviews also offered the flexibility to probe deeper into key issues. Follow-up questions ensured that different perspectives and unique experiences were captured, and reasoning could be explored further. Divergent perspectives across stakeholder groups could thus be identified.

- Finally, since sustainability in infrastructure projects could involve sensitive discussions about costs, political pressure, or organisational priorities, one-on-one interviews enabled participants to speak freely and honestly without the constraints of group dynamics or public-facing statements.

Therefore, potential participants were identified through the network of Witteveen+Bos, as they were familiar with the key stakeholders involved in the selected projects. Participants were approached via email or direct communication. Once participation was confirmed, all interviews were scheduled online, as most participants were based in the northern part of the country, which was less easily accessible.

To ensure scientific validity and reliability, several requirements were met:

- Sufficient sample size: As Bryman (2012) notes, qualitative researchers often cannot determine sample size in advance due to theoretical saturation. To balance feasibility with the need for diverse insights, the target was set at 8–12 interviews (Guest et al., 2006; Mason, 2010). In total, 10 interviews were conducted.
- Relevant participants: The quality of interview data depended on the relevance of participants. As Campbell et al. (2013) argued, only those with direct experience could provide actionable insights. Interviewees represented various roles within the case study projects, ensuring a diverse set of perspectives on how sustainability ambitions evolved. A standardised interview protocol (See C was used and tailored slightly depending on stakeholder type. Exploratory conversations with Witteveen+Bos staff followed a separate format focused on background and case selection; formal stakeholder interviews followed the semi-structured approach.
- Data reliability: Interview protocols were refined with academic supervisors to ensure alignment with research objectives. Transcriptions were analysed in Atlas.ti using open and axial coding to identify recurring themes. These insights formed the foundation for both the diagnostic part of the research (understanding where and why sustainability ambitions faded) and the evaluative part (testing which strategies were feasible).

In conclusion, interviews served a dual purpose in this study:

- They were used to identify where and why sustainability ambitions diminished. Discussions with decision-makers revealed which phases of the decision-making process were most vulnerable to attrition and uncovered barriers that prevented sustainability from remaining a decisive factor.
- They were also used to test and validate potential success factors. By gathering stakeholder feedback, the study assessed which interventions were considered realistic and feasible within existing project structures.

Despite this dual purpose, conducting only one interview per stakeholder proved the most feasible and efficient approach given time constraints and stakeholder availability. Multiple interviews would likely have been impractical.

Although the interviews primarily aimed to explore whether participants recognised theoretical insights from the literature, their structure followed an abductive logic. Each interview began inductively with open-ended questions about the participant's own experience. In the second part, relevant academic concepts were introduced to encourage reflection and comparison. This design enabled participants to connect theory and practice and often led to new interpretations or refinements of existing ideas. As such, the interviews actively contributed to iterative knowledge development.

2.4. Data management plan and ethical consideration

As this research required human participation, it was important to create a data management plan and to discuss and be aware of the ethical considerations.

2.4.1. Data management plan

This thesis adhered to the TU Delft Human Research Ethics Policy, which ensured that research involving human participants was conducted in a responsible, respectful, and ethically sound manner ("Human Research Ethics", n.d.). In line with this policy, the research was reviewed through and accepted by the TU Delft Human Research Ethics Review procedure.

An important part of ethically sound research was responsible data management. A Data Management Plan (DMP) played a central role in this process by ensuring that research data was handled in a structured, secure, and transparent manner throughout the project. It outlined how data was collected, processed, stored, and shared, and helped to safeguard research integrity, protect participant privacy, and promote the reproducibility of results.

For this research, a DMP was prepared using the DMPonline tool and approved by the Human Research Ethics Committee (HREC). The full plan, including detailed data handling procedures and storage protocols, is available from the author upon request.

2.4.2. Ethical considerations

To protect participants, each interview was preceded by a clear explanation of the research objectives, the interview procedure, and the way in which data would be handled. This was formalized through an informed consent form, which participants were asked to read and sign before the interview began. The informed consent form outlined the voluntary nature of participation, the right to withdraw at any time, and how confidentiality and data security would be ensured. The full form is available from the author upon request.

2.5. Methods for validation

To ensure the credibility of this qualitative research, several embedded validation techniques were applied throughout the study. These included triangulation of data sources, in-interview member checking, iterative coding, and alignment with existing literature. Rather than relying on a single validation moment, these strategies were integrated across the research process to enhance internal consistency and reduce the risk of bias.

First, in-interview member checking was applied to validate whether the interpretations of the interviews accurately reflected the participants' intended meanings. During each conversation, preliminary interpretations were paraphrased and directly confirmed with the interviewee. Reflective prompts such as "So if I understand you correctly, you mean that...?" helped ensure mutual understanding and prevented misinterpretation.

Second, triangulation was used to cross-verify findings across multiple data sources, including semi-structured interviews, project documents, and academic literature. This multi-method approach improved validity by grounding conclusions in diverse, independent perspectives (Haq et al., 2023; Trullols et al., 2004).

Third, the coding and interpretation process followed an iterative and abductive logic. Rather than applying a rigid, predefined coding scheme, the coding evolved throughout the research, allowing new themes to emerge from the data while remaining connected to theoretical insights.

Lastly, although a structured expert panel was originally planned to assess the feasibility of the identified success factors, it could not be executed due to time constraints. As such, it remains a recommendation for future research. Further elaboration and practical examples of these validation strategies are presented in Chapter 6.

2.6. Limitations of methods

This research design involved several limitations inherent in qualitative studies. In this section, the limitations of each method are described along with the measures taken to mitigate them. Overall, qualitative research often carries a risk of subjectivity and the perceived absence of scientific rigor compared to quantitative research (Malterud, 2001).

2.6.1. Case studies

Hammersley et al. (2000) stated that case studies are context-specific and therefore not easily generalizable to a broader population. They could also be affected by asymmetries in the availability of information across cases (Holznagel et al., 2010). To mitigate these limitations, all cases in this research were carefully selected based on their relevance and the availability of sufficient documentation. Furthermore, triangulation with interviews and desk research ensured that conclusions were not based

on a single source of information. As emphasized by Blaxter et al. (2006), it was equally important to maintain awareness of the broader context when analyzing case studies. This helped prevent insights from being interpreted in a fragmented or overly narrow manner.

2.6.2. Semi-structured Interviews

Although interviews enabled researchers to uncover in-depth information that would likely not be accessible through other techniques such as surveys or observations (Blaxter et al., 2006), they also presented several limitations. One major issue was the potential for bias, both in how questions were phrased and in how participants might have shaped their responses according to social desirability or what they believed the interviewer wanted to hear (Diefenbach, 2009; Malterud, 2001). Moreover, perceptions are inherently subjective and may shift over time, potentially distancing responses from objective reality (Diefenbach, 2009).

Another drawback was the time-intensive nature of interviews, which required substantial effort for conducting, transcribing, and analyzing (Azungah, 2018; Sheppard, 2020; Turner, 2010). This was particularly relevant in qualitative research, where the volume of generated data could be overwhelming and difficult to interpret consistently due to the absence of a standardized analytical framework. The use of Microsoft Teams for interview transcriptions helped to reduce the time burden and contributed to a calm setting by eliminating the need for note-taking during the conversation. Additionally, while the use of recording equipment facilitated transcription, it could also cause discomfort among interviewees. To mitigate this, participants were informed in advance and were offered the opportunity to review the transcripts for accuracy and comfort (Blaxter et al., 2006).

To further address these challenges, interviews were conducted in quiet and private settings. Neutral phrasing and open-ended questions were used to avoid steering responses, while interviewees were encouraged to elaborate and reflect. Interview questions were pre-tested and reviewed with academic supervisors to enhance clarity and reduce interviewer bias.

2.6.3. Qualitative coding of interview data

Qualitative coding of interview data presented several limitations, as discussed by Campbell et al. (2013). One key challenge was the potential fragmentation of data. When transcripts were broken down into coded segments, the broader context of participants' narratives could be lost, which might have led to misinterpretation or a lack of nuance. To minimize this risk, transcripts were reviewed in detail to ensure that coding preserved the intended meaning and connections within the data.

Another critical limitation was the inherent subjectivity of the coding process. Codes were shaped by the researcher's interpretation, which introduced a risk of bias (Campbell et al., 2013). To reduce this subjectivity, Atlas.ti was used to ensure transparency and consistency in the coding process. It was also important to acknowledge that coding should not replace the overarching narrative of the research; it was a tool to support, not define, the analysis. As such, continuous reflection was maintained throughout the process to avoid drawing conclusions solely based on isolated coded segments.

2.6.4. Validation methods

While the validation techniques applied in this study enhanced credibility, each method has inherent limitations.

First, in-interview member checking, although effective in maintaining alignment between researcher and respondent, lacks the deeper reflection that post-interview member validation can provide. Additionally, follow-up validation of transcripts or findings was not conducted due to time constraints, which may have limited the opportunity for participants to revise or expand on their earlier statements (Birt et al., 2016; Harvey, 2015).

Second, triangulation, while valuable, can become complex when sources yield divergent findings. Contradictory evidence between literature, interview data, and project documents can complicate interpretation and does not automatically enhance validity (Haydn, 2019). Throughout this research, the potential for bias was acknowledged, and efforts were made to approach the data from multiple perspectives, ensuring a reflective and objective interpretation of the results.

Third, although the iterative coding process supported theoretical grounding, it remained a subjective

exercise. Despite efforts to reflect critically and revisit earlier interpretations, the coding process was conducted by a single researcher, which may have introduced interpretation bias (Campbell et al., 2013).

Finally, the absence of the planned expert panel session limited external validation. Such a session could have provided valuable feedback on the practical feasibility of the proposed strategies and improved the generalisability of conclusions. The panel was designed to mitigate common pitfalls such as dominant voices and unclear definitions of expertise (Evans, 1997), but due to limited time, it remained unexecuted. Therefore this component remains a recommendation for further research.

Together, these limitations highlight the importance of interpreting the findings within the methodological scope of qualitative research. While embedded validation strategies helped strengthen the internal consistency of the results, further external validation is recommended in future work.

3

Literature Review

This chapter provides the theoretical foundation for this research and forms the basis for the empirical work conducted through interviews. It explores how sustainability is defined and conceptualized, how sustainability ambitions are formulated, and what barriers hinder their consistent implementation. The review also identifies critical success factors that may help bridge the ambition–implementation gap.

This chapter addresses (parts of) the following sub-questions

- **RQ1** *How is sustainability currently considered in the decision-making process of infrastructure and mobility projects?*
- **RQ3** *What are the key barriers that prevent sustainability from remaining a decisive factor throughout the decision-making process?*
- **RQ5** *What strategies can help ensure that sustainability ambitions remain a priority without significantly complicating the process?*

The chapter is structured as follows: Section 3.1 explores the concept of sustainability and outlines its relevance to infrastructure planning and decision-making (SQ1). Section 3.2 delves into the nature and role of sustainability ambitions, highlighting how they are defined, expressed, and operationalized within organizations. Section 3.3 identifies the main barriers that lead to the erosion of sustainability ambitions throughout the project life cycle, thereby addressing SQ3. Section 3.4 considers sustainability as a criterion for project success and reviews key success factors for effective sustainability implementation (SQ4). The final section consolidates the findings in a conceptual framework that informs the empirical phase.

3.1. Defining sustainability

Sustainability is a widely used but loosely defined concept. As Kuhlman and John (2010) notes, there is no single, universally accepted definition. Over time, the term has evolved from a predominantly environmental concern to a multi-dimensional principle that includes ecological, economic, and social dimensions.

This evolution was driven by the growing awareness of the negative effects of unchecked industrialization and resource exploitation. Without a fundamental shift toward sustainable development,it would result into an unlivable world for future generations (Silvius et al., 2012). In response to these concerns the United Nations established the World Commision on Environment and Development, which published the Brundtland Report in 1987. This report introduced the now widely cited definition of sustainable development:

> *Development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (“Brundtland Report”, n.d.).

This definition placed intergenerational equity at the heart of sustainable development and helped move the topic into the mainstream of policy and governance. The Dutch government responded actively, as

van der Mey (1995) explains, the Netherlands integrated sustainable development into national and environmental strategies.

Throughout its historical journey, sustainability has been interpreted in various ways (Silvius et al., 2012). However, the common notion remained consistend: to generate economic and social prosperity without undermining environmental limits (Silvius et al., 2012). This is reflected in the widely used Triple Bottom Line framework developed by Elkington (1997), which conceptualises sustainability across three interdependent pillars: Social (People), Environmental (Planet), and Economic (Profit). As illustrated in 3.1, the framework proposes that sustainability can only be achieved by optimizing all three dimensions simultaneously (Elkington, 1997; Yilmaz & bakış, 2015a; Zietsman & Ramani, 2011).

Figure 3.1: Triple Bottom Line (Dalibozhko & Krakovetskaya, 2018)

Despite its popularity, the TBL model faces criticism for lacking practical applicability, especially when trade-offs between dimensions arise (Visser, 2013). In the infrastructure and construction sector, sustainability tends to focus disproportionately on environmental concerns, such as emissions reduction, resource efficiency, and waste minimization. However, scholars like Meynerts et al. (2017) advocate for an integrated life-cycle perspective that incorporates economic and social considerations alongside environmental performance.
Beyond public and policy domains, sustainability is also gaining traction in the private sector. With increasing societal pressure and regulatory incentives, firms are increasingly embedding sustainability objectives into their corpoate strategies (Peenstra & Silvius, 2017). This development has been further institutionalised through the 2030 Agenda for Sustainable Development and its associated Sustainable Development Goals (SDG).

Given the various interpretations of sustainability across disciplines and industries. Appendix B includes a comparative table (Table B.3) that highlights the presence of environmental, social, and economic dimensions in a range of widely cited definitions. These diverse conceptualizations underscore the importance of clearly specifying what sustainability entails in a given context.

For the purpose of this research, the following definition is adopted:

> *Sustainable infrastructure (sometimes also called green infrastructure) systems are those that are planned, designed, constructed, operated, and decommissioned in a manner that ensures economic and financial, social, environmental (including climate resilience), and institutional sustainability over the entire infrastructure life cycle. Sustainable infrastructure can include built infrastructure, natural infrastructure, or hybrid infrastructure that contains elements of both (United Nations Environment Programme, 2021).*

This definition captures the interrelated nature of the three sustainability pillars and acknowledges the operational realities of infrastructure projects.

3.2. Sustainability ambitions

A key international reference point for articulating sustainability ambitions is the 2030 Agenda for Sustainable Development, which introduced the Sustainable Development Goals (SDGs). These 17 interconnected goals represent a global framework for addressing humanity's most urgent environmental, social, and economic challenges (Sachs et al., 2024). Building on the Triple Bottom Line (TBL) framework of people, planet, and profit, by integrating broader dimensions such as peace, justice, and partnership (see Figure 3.2). Together, they express a global sustainability ambition that calls for integrated and multi-level action.

Figure 3.2: Sustainable Development Goals (Sachs et al., 2024)

In this global context, project-based and corporate organizations are increasingly expected to translate high-level sustainability ambitions into internal strategic and operational objectives (Peenstra & Silvius, 2017). This translation process occurs across three interconnected levels of decision-making (Schmidt & Wilhelm, 2000):

- Strategic level: defines long-term sustainability visions, typically led by top management.
- Tactical level: translates these visions into programs, projects and internal processes
- Operational level: implements ambitions through concrete project actions and day-to-day decisions.

This multilevel structure reflects how sustainability ambitions are embedded and operationalised within organisations. Figure 3.3 visualises this vertical translation of sustainability ambitions from strategic vision to operational implementation. The pyramid illustrates the organisational layering between management and project levels, highlighting the role of the tactical layer in bridging high-level goals and execution.

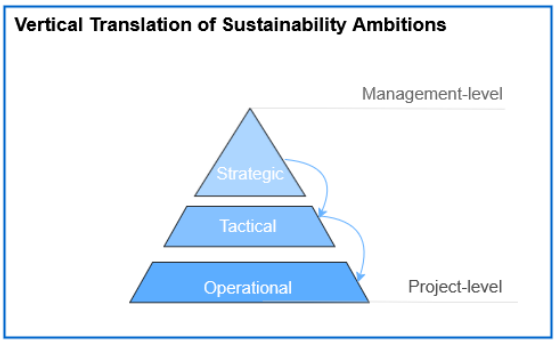

Figure 3.3: Organisational embedding and vertical translation of sustainability ambitions across strategic, tactical, and operational levels, own illustration

However, the way in which organizations define and pursue sustainability ambitions varies widely. A key reason is the conceptual ambiguity of the term “ambition” itself (Juárez, 2021). In both policy and organizational literature, ambition is generally understood as a motivational construct:

> *”The persistent and generalized striving for success, attainment, and accomplishment”(Judge & Kammeyer-Mueller, 2012), or “A yearning desire to rise that is committedly pursued ”(Pettigrove, 2007).*

In sustainability contexts this can be described in terms of the scope of goals. The level of intended impact, and the pace of transition envisioned in a project, policy or programme.

Yet, despite its normative appeal, ambition remains a vague and underdefined concept. As Tørstad and Wiborg (n.d.) note, sustainability ambitions are frequently communicated in ways that are rhetorically strong but operationally weak. This is referred to as *”commitment ambiguity”*: the discrepancy between how bold a pledge sounds and how it is structured for accountability and follow-through.

As Verstraeten (n.d.) describe, ambitions can broadly be understood as future-oriented aspirations or motivations to achieve particular goals. Although no universal definition exists, several recurring characteristics appear in the literature:

- Self-orientation: Ambitions are often formulated from an individual perspective and reflect personal motivations or desires (although this may be less applicable in collective or organizational contexts);
- Future- and goal-directedness: They are focused on achieving goals that lie in the future and have not yet been realized;
- Pursuit of extrinsic rewards: Traditionally, ambition is associated with striving for external rewards such as status, power, influence, or material gain.

Although these characteristics primarily serve to describe ambition as a motivational construct, they also contain underlying tensions relevant to the sustainability domain. While this may not immediately appear problematic, the implications of self-orientation, future directedness, and the focus on extrinsic rewards will be revisited in Section 3.3, where they are shown to contribute to the practical challenges of sustaining ambitious goals in complex project environments.

Gollwitzer and Sheeran (2006) distinguish between goal intentions, what one wants to achieve, and implementation intentions how, where, and when one intends to act. Expressing a sustainability ambition is a form of goal intention. However, without concrete plans for realization, such ambitions often remain symbolic. Implementation intentions, by contrast, anchor ambition in concrete, situation-bound action through “if–then” planning. Similarly, translating ambitions into SMART goals (Specific, Measurable, Acceptable, Realistic, Time-bound) is seen as a critical step toward realization.

A key risk in sustainability transitions is that ambition erodes throughout the project life cycle. This occurs when initial sustainability intentions lose strength during various decision-making phases. Re-

search shows that this erosion often arises from unclear goals, shifting priorities, or insufficient integration into organizational processes (Langendijk et al., 2025; Tørstad & Wiborg, n.d.). Moreover, organizational ambitions are not always aligned with individual motivations. While committed individuals may drive sustainability from within, systemic support mechanisms are needed to ensure ambitions are realized at scale (Hirschi & Spurk, 2021a).

To strengthen the formulation and realization of sustainability ambitions, the literature highlights four critical conditions:

- Clear and context-specific definitions of ambition (Langendijk et al., 2025);
- Internal alignment between strategic goals, operational processes, and project execution (Juárez, 2021);
- Acknowledgment of ambition as a dynamic and socially constructed concept (Hirschi & Spurk, 2021b);
- Implementation of feedback mechanisms and progress monitoring (Langendijk et al., 2025).

In sum, while sustainability ambitions play a central role in guiding transition pathways, their transformative potential depends on how clearly they are defined, how consistently they are embedded across organizational layers, and how actively they are governed. Treating ambition not as rhetoric but as a governable construct is essential for achieving long-term sustainable impact.

3.3. Barriers to maintaining sustainability ambitions

Despite increasing awareness of the importance of sustainable development, infrastructure projects often struggle to maintain sustainability ambitions throughout the decision-making and implementation process. Based on academic literature and industry reports, this section synthesizes key barriers into thematic categories.

While the barriers discussed in this section are widely recognized in the academic and professional literature, most of the sources draw from general construction contexts, corporate sustainability strategies, or public sector project environments. Only a limited number of studies explicitly focus on infrastructure planning and decision-making. Nonetheless, the identified patterns offer valuable insights into the dynamics that can undermine sustainability ambitions across project life cycles.

3.3.1. Conceptual and motivational barriers

As already stated above, a key challenge in maintaining sustainability ambitions lies in the abstract and ambiguous nature of sustainability itself. Sustainability is often described as a multidimensional and normative concept, which lacks a universally accepted operational definition (Epstein, 2018; Goedknegt, 2013; Silvius et al., 2012). This conceptual vagueness creates space for divergent interpretations among stakeholders, leading to misalignment across phases and a lack of clarity on what should actually be achieved (Jakobsen, 2024).

Second, ambitions are inherently future-oriented, which make them difficult to maintain in project environments that are driven by tight deadlines and short-term deliverables, particularly when the benefits are perceived as uncertain or intangible (Jakobsen, 2024). The issue is compounded by weak self-orientation: ambitions are typically framed at the collective level (e.g., municipal or project team level), which diffuses individual ownership and accountability (Verstraeten, n.d.). When no one feels personally responsible for upholding sustainability goals, it becomes easier to shift priorities when obstacles arise.

A lack of concrete strategies, operational roadmaps, or life cycle-specific guidelines further limits implementation. Vergerio and Knotten (2024) highlights how vague planning processes and weak goal formulations result in ambitions being sidelined. Strategic priorities often shift toward initial cost minimization, rather than maximizing life cycle value, especially in early-stage decision-making. This tendency is reinforced by the traditional focus on incremental improvements and system optimization, which characterizes much of infrastructure system research and practice. Rather than embracing disruptive innovation or circular design strategies, projects often default to optimizing existing materials and processes. While such improvements may appear efficient in the short term, they risk sidelining

the transformative changes required for genuine sustainability transitions (Loorbach et al., 2010). This preference for optimization over innovation reflects a deeper conceptual barrier: the dominant mental models in infrastructure planning are still rooted in stability, predictability, and control principles that do not align well with the complexity and radical shifts that sustainability often demands.

Finally, a broader conceptual challenge stems from the inherent tensions between the economic, environmental, and social pillars of sustainability. In practice, these goals often conflict, especially under time and budget constraints. For example, social or ecological improvements may be perceived as threats to short-term financial viability. As a result, sustainability is frequently seen as a long-term investment that lacks immediate returns, which makes it vulnerable to strategic compromises (Visser, 2013).

3.3.2. Economic and financial barriers

Financial constraints and economic reasoning are among the most frequently cited causes for the erosion of sustainability ambitions in infrastructure projects. A widely held perception is that sustainable alternatives are inherently more expensive or financially riskier than conventional solutions (Vergerio & Knotten, 2024). This perception leads stakeholders to deprioritize sustainable options, especially under conditions of tight budgets, strict deadlines, and regimes that reward lowest-price bids rather than long-term value (Cecere et al., 2020; Graham et al., 2005; Haessler, 2020; Wuni, 2022). Several specific financial barriers have been identified.
First, hidden or unforeseen costs of sustainable technologies can discourage adoption, especially when budget contingencies are limited or when uncertainty around performance remains high (Vergerio & Knotten, 2024; Wuni, 2022).

Second, split incentives frequently arise when the actor bearing the investment cost is not the same as the one reaping the long-term benefits making sustainable solutions unattractive from an individual business case perspective. Third, new or unproven technologies are often perceived as risky investments, leading to a preference for familiar but less sustainable alternatives (E.E. & Davies, 2017; Vergerio & Knotten, 2024). These dynamics are reinforced by systemic factors. According to Loorbach et al. (2010), infrastructures are embedded in socio-technical systems characterized by ”lock-in” effects: deep interdependencies between technologies, institutions, and practices that favor incremental change over radical innovation. Sustainable options that challenge these embedded norms or require higher upfront investments may therefore be excluded because they conflict with existing sunk costs, institutional routines, or dominant cost-driven paradigms.

Additionally, Wuni (2022) identify several financial and market-related barriers to sustainability, including competition with cheaper non-sustainable alternatives, and uncertainty around the long-term economic benefits of green investments.

Similarly, E.E. and Davies (2017) emphasize that when evidence on the long-term economic returns of sustainability is lacking, it becomes difficult to justify investments to decision-makers focused on short-term performance.

3.3.3. Organisational and cultural barriers

One of the most cited barriers is institutional inertia: The tendency of organisations to rely on established routines and traditional project delivery methods. These methods often prioritize short-term efficiency, standardization, and risk aversion over innovation and long-term sustainability goals (Loorbach et al., 2010; Vergerio & Knotten, 2024). As a result, even when sustainable alternatives are considered early on, they may be gradually sidelined in favor of more familiar and proven approaches.

Second, a lack of life cycle thinking hampers sustainable decision-making. This short-term perspective means that more sustainable, are frequently rejected upfront, despite offering long-term value (Olfert et al., 2020; Vergerio & Knotten, 2024).

Third, sustainability efforts are undermined by fragmented communication and poor internal coordination. Infrastructure and mobility projects typically go through multiple stages and involve multiple departments, contractors, and governance layers, each with their own priorities. If sustainability objectives are not clearly communicated and consistently followed up across these interfaces, they are easily diluted or lost altogether (Koistinen et al., 2022; Vergerio & Knotten, 2024).

Fourth, unclear or inefficient decision-making processes hinder the translation of sustainability ambitions into concrete action. When responsibilities are not clearly assigned, or decision timelines are misaligned, sustainability is often the first to be compromised in negotiations or time-constrained decisions (Tessitore et al., 2023; Vergerio & Knotten, 2024). Similarly, when decision-makers lack the authority or confidence to prioritize long-term outcomes over short-term wins, ambitions tend to weaken.

Fifth, organizational culture remains a decisive factor. If sustainability is not deeply embedded in values, routines, and incentive structures, it will not survive operational pressures. A culture that rewards speed, cost-efficiency, and project delivery above all else often has no room for ambitions that require experimentation, learning, or upfront investment (Loorbach et al., 2010; Wuni, 2022).

Finally, many organizations struggle with knowledge management and expertise availability. Without consistent access to sustainability experts, best practices, or tools in early planning, project teams may lack the confidence to propose or defend sustainable alternatives (Krancher, 2020). Especially in the absence of formal learning mechanisms, knowledge about sustainability tends to remain tacit and disappears when key individuals leave or when organisational memory is not maintained.

3.3.4. Knowledge-related barriers

A persistent and widely acknowledged barrier to maintaining sustainability ambitions in infrastructure projects is the lack of relevant knowledge and expertise across key stakeholders. Sustainability is a complex and evolving domain that requires not only technical understanding of materials, design methods, and assessment tools, but also strategic insight into life cycle impacts, stakeholder dynamics, and regulatory developments (Durdyev et al., 2018). When this expertise is missing, even well-intentioned sustainability ambitions can falter in practice.

One core issue is the limited absorptive capacity of project teams: their ability to recognize, assimilate, and apply sustainability knowledge effectively (Krancher, 2020). This is especially critical in early project phases, when key decisions about design, procurement, and performance requirements are made. Without the capability to evaluate sustainable alternatives or understand trade-offs, teams often default to standard solutions, regardless of their long-term impact.

Second, tacit knowledge, such as values, routines, and informal best practices, is often not documented or transferred effectively. Sustainability ambitions are frequently embedded in individuals rather than in systems. When those individuals leave or are not involved throughout the project life cycle, knowledge is lost and ambitions erode (Krancher, 2020). This problem is compounded when organizations fail to formalize or institutionalize sustainability know-how into procedures, templates, or decision protocols (E.E. & Davies, 2017; Krancher, 2020).

Third, the fast pace of innovation in sustainable technologies poses a challenge for practitioners to stay up to date. New certifications, tools, and design approaches are continuously emerging, yet many organizations lack the structures or incentives to ensure continuous learning. Sustainability indicators are also often developed top-down, leading to a disconnect between strategic ambition and the practical reality of engineers and contractors (Bell & Morse, 2001; Engert & Baumgartner, 2016).

Fourth, ineffective knowledge management systems contribute to what Yap et al. (2022) describe as ”knowledge leakage”: the gradual erosion of critical insights due to the lack of learning routines, feedback loops, and knowledge-sharing platforms. Without deliberate efforts to capture, reflect upon, and disseminate sustainability lessons, especially across projects or between departments, organizations risk repeating the same mistakes or failing to improve over time.

Finally, a lack of shared understanding between different disciplines and stakeholders creates cognitive distance. Differences in goals or assumptions can obstruct mutual learning, collaboration, and the alignment of ambitions (Krancher, 2020; Wuni, 2022).

3.3.5. Governance and policy-related barriers

Governance and policy structures play a critical role in shaping the extent to which sustainability ambitions can be maintained throughout infrastructure project life cycles. Yet, in many projects, these structures are insufficiently equipped to support the complexity, uncertainty, and long-term nature of sustainability transitions (Hoeft et al., 2021; Loorbach et al., 2010).

There is often no formal mechanism to monitor or enforce sustainability ambitions over time. Even when sustainability is integrated into initial project plans, it may not be accompanied by clear performance indicators, accountability mechanisms, or adaptive evaluation tools (Bocken & Geradts, 2020; Eikelenboom et al., 2022). As a result, ambitions can quietly fade when external pressures arise or priorities shift during implementation.

Organizational structures and internal politics can hinder the consistent application of sustainability ambitions. Resistance to change, lack of alignment between hierarchical levels, and the absence of cross-departmental coordination all contribute to fragmented implementation (Koistinen et al., 2022)

Also, a persistent barrier in safeguarding sustainability throughout projects is the difficulty of translating high-level ambitions into concrete and measurable outcomes. Performance indicators are often missing, poorly defined, or disconnected from the project's operational levels (Bocken & Geradts, 2020; Eikelenboom et al., 2022). This weakens the ability to track progress, learn from experience, and hold actors accountable.

3.3.6. Stakeholder and participation-related barriers

The involvement of diverse stakeholders is widely acknowledged as essential for embedding and maintaining sustainability ambitions in infrastructure projects. Yet, participation often remains superficial, fragmented, or strategically managed in ways that ultimately undermine long-term sustainability outcomes (Jakobsen, 2024; Journeault et al., 2021; Tessitore et al., 2023).

First, a common issue is the lack of early and meaningful stakeholder engagement. Many stakeholders are only involved once key decisions have already been made, limiting their influence and creating a disconnect between strategic goals and local needs or values (Jakobsen, 2024; Journeault et al., 2021; Tessitore et al., 2023). Without co-creation in the early stages, sustainability ambitions may not reflect the concerns of future users or affected communities, weakening their legitimacy and resilience throughout the project life cycle.

Second, conflicting interests and institutional diversity among stakeholders can dilute sustainability goals. Infrastructure and mobility projects often involve actors with divergent business models, temporal priorities, and value orientations, such as developers focused on short-term returns versus municipalities aiming for long-term social benefit. These tensions can lead to compromises that prioritize immediate feasibility over long-term sustainability (Vergerio & Knotten, 2024). Particularly in complex urban environments, densification pressures or economic development goals may override ecological or social considerations (Jakobsen, 2024).

Third, lack of ownership and commitment among key actors undermines accountability. When sustainability is framed as a collective ambition, but no one feels individually responsible for delivering it, it becomes easy to deprioritize under pressure (Sharma et al., 2023). This is particularly relevant during transitions between project phases, where responsibilities shift (Vergerio & Knotten, 2024). Without clear continuity and mandate, ambitions risk getting lost in translation.

Fourth, limited trust and poor communication among stakeholders can erode cooperation and shared purpose. Research has shown that high-performing partnerships require shared understanding, open dialogue, and long-term collaboration (Huang, 2023). In infrastructure projects, however, collaboration is often constrained by rigid contractual relationships, misaligned incentives, and time pressure. This lack of alignment weakens the shared motivation needed to uphold ambitious sustainability goals in complex environments.

Fifth, cognitive distance between disciplines and stakeholders undermines shared understanding and learning. Differing backgrounds, priorities, and assumptions can lead to conflicting interpretations of sustainability, which obstruct collaboration and coordinated action (Krancher, 2020; Wuni, 2022). This is particularly critical in multidisciplinary infrastructure projects, where engineers, contractors, policymakers, and clients must align around shared sustainability objectives.

3.3.7. Conclusion

To provide a structured overview of the wide range of factors that undermine sustainability ambitions, Table 3.1 categorizes the barriers into six thematic groups. These categories reflect recurring patterns

identified. Each type of barrier interacts with others, reinforcing complexity and making it difficult to maintain sustainability goals throughout the infrastructure project life cycle.

Table 3.1: Thematic categorization of barriers to maintaining sustainability ambitions

Barrier category	Description	Key references
Conceptual and motivational	Sustainability is often vaguely defined, future-oriented, and lacks personal ownership. Weak goal formulation, poor operationalization, and conflicting sustainability pillars hinder implementation.	Epstein (2018), Goedknegt (2013), Jakobsen (2024), Loorbach et al. (2010), Silvius et al. (2012), Vergerio and Knotten (2024), Verstraeten (n.d.), and Visser (2013)
Economic and financial	Sustainability is perceived as costly or risky. Barriers include hidden costs, split incentives, lack of long-term return evidence, and lock-in to existing financial models.	Cecere et al. (2020), E.E. and Davies (2017), Graham et al. (2005), Haessler (2020), Loorbach et al. (2010), Vergerio and Knotten (2024), and Wuni (2022)
Organisational and cultural	Institutional inertia, short-term thinking, fragmented decision-making, weak sustainability culture, and poor knowledge embedding undermine ambitions.	Koistinen et al. (2022), Krancher (2020), Loorbach et al. (2010), Olfert et al. (2020), Tessitore et al. (2023), Vergerio and Knotten (2024), and Wuni (2022)
Knowledge-related	Lack of technical expertise, tacit knowledge loss, poor knowledge management, and limited absorptive capacity prevent effective implementation and learning.	Bell and Morse (2001), Durdyev et al. (2018), E.E. and Davies (2017), Engert and Baumgartner (2016), Krancher (2020), Wuni (2022), and Yap et al. (2022)
Governance and policy	Weak institutional structures, lack of monitoring mechanisms, unclear performance indicators, and fragmented governance hinder enforcement.	Bocken and Geradts (2020), Eikelenboom et al. (2022), Hoeft et al. (2021), Koistinen et al. (2022), and Loorbach et al. (2010)
Stakeholder and participation	Late or superficial engagement, conflicting interests, lack of ownership, low trust, and cognitive distance weaken shared sustainability commitment.	Huang (2023), Jakobsen (2024), Journeault et al. (2021), Krancher (2020), Sharma et al. (2023), Tessitore et al. (2023), and Vergerio and Knotten (2024)

3.4. Succes Factors

Despite the many challenges that undermine sustainability ambitions in infrastructure projects, a growing body of literature highlights key success factors that can counteract these barriers. This section presents a thematic synthesis of such success factors, mirroring the categories used in the barriers section.

While the insights discussed in this section are highly relevant, it is important to note that most sources

do not specifically focus on infrastructure planning and implementation. Instead, they stem from broader contexts, such as the construction sector, corporate sustainability management, or general project-based environments. Nonetheless, the identified patterns offer valuable guidance for strengthening sustainability integration across the infrastructure project life cycle.

3.4.1. Conceptual and motivational drivers

Across various studies, ranging from construction management (Banihashemi et al., 2017), corporate sustainability implementation (Engert & Baumgartner, 2016), and neighborhood-scale energy projects (Vergerio & Knotten, 2024), a recurring pattern is that sustainability ambitions are more likely to be maintained when they are supported by concrete, measurable objectives and embedded in an organization's strategic logic.

First, a lack of clarity in sustainability goals has often been cited as a reason for implementation failure (Loorbach et al., 2010). Conversely, well-defined, actionable objectives significantly enhance the likelihood of consistent follow-through. In project contexts, such as those studied by Banihashemi et al. (2017), "clearly defined goals" and a "well-defined scope of work" were identified as critical success factors in the identification phase of construction projects.

Engert and Baumgartner (2016) emphasizes that bridging the ambition–implementation gap in corporate settings requires the ability to translate abstract visions into tangible strategies, supported by performance indicators and implementation roadmaps. This notion is echoed by von Rosing et al. (2025), who argue that sustainability strategies only gain traction when they are structured, measurable, and linked to personal and organizational motivation. Leadership commitment is cited as a decisive influence: "when leaders take sustainability seriously, it stimulates motivation among employees," and a lack of roadmap leads to fragmented implementation (von Rosing et al., 2025).

Furthermore, the concept of life cycle thinking, found in energy-efficient neighborhood projects, supports a more holistic understanding of sustainability from project inception onward. Adopting this mindset is classified as a motivational driver as it redefines how project actors value long-term outcomes (Vergerio & Knotten, 2024).

3.4.2. Economic and financial drivers

Economic and financial considerations are often seen as key barriers to sustainability, but they can also serve as powerful enablers when reframed through a long-term perspective. A recurring theme in the literature is that the perception of sustainability as a cost driver must shift toward understanding its potential as a value-creating investment.

Several studies highlight the importance of acknowledging long-term financial benefits of sustainability, including cost savings from energy efficiency, operational optimization, and brand value improvement (von Rosing et al., 2025). For example, Alabi (2024) emphasizes that energy-efficient infrastructure may initially require higher investment but often leads to lower life cycle costs, supporting a more sustainable business model.

At the project level, the availability and timely allocation of financial resources is a basic condition for successful implementation. Banihashemi et al. (2017) stresses that projects are more likely to succeed when resources, such as funds, machinery, and materials, are planned and available throughout all stages. Furthermore, deploying realistic cost and time estimates helps ensure that sustainability goals remain achievable and credible within broader project constraints.

External factors such as economic and political stability significantly affect the viability of sustainability initiatives. Supportive macroeconomic conditions and consistent policy incentives serve as important enablers (Banihashemi et al., 2017). Equally important is the framing of sustainability, not as a financial burden, but as a strategic opportunity for innovation and growth.

3.4.3. Organisational and cultural drivers

Organisational and cultural conditions within project environments strongly shape whether sustainability ambitions are upheld throughout the infrastructure life cycle. Many authors emphasize that sustainability cannot be successfully implemented through technical tools alone, it requires alignment between routines, team structures, leadership values, and the underlying organizational culture.

A central theme in the literature is the importance of creating a culture of sustainability that goes beyond symbolic commitment. For instance, Engert and Baumgartner (2016) identifies organisational culture as the top implementation issue in corporate sustainability strategies. A sustainability-centered culture reinforces environmental and social values and guides the behavior of both managers and employees. Furthermore, this same study highlights the importance of organizational structures that enable interdisciplinary collaboration, as the complexity of sustainability often spans traditional departmental boundaries.

The role of leadership is consistently described as crucial. According to Engert and Baumgartner (2016), managerial values and intrinsic motivation from top leaders significantly influence the success of sustainability strategies. This is echoed in the empirical work of Banihashemi et al. (2017), who found that trust within the project management team and support among team members are vital in complex construction settings. Similarly, commitment to high-quality workmanship and professional standards was shown to sustain ambition under practical pressures.

In project-oriented settings, having a competent, experienced, and stable project management team can make a substantial difference. Banihashemi et al. (2017) emphasize the need for transparency in team formation and the experience of project managers as critical success factors. The organisational phase should also include clearly defined responsibilities and internal accountability mechanisms to ensure continuity and consistency in sustainability efforts.

Finally, a culture of collaboration and performance must be actively maintained. Vergerio and Knotten (2024) recommend setting clear frameworks, shared goals, and trust-building practices from the start, while also ensuring onboarding of new team members aligns with sustainability norms. This helps prevent cultural drift or dilution of ambitions across project phases.

Moreover, von Rosing et al. (2025) underline that organizational culture plays a pivotal role in determining whether sustainability ambitions are upheld or eroded during implementation. Internal alignment around sustainability values, routines, and incentives is necessary to withstand operational pressures. This alignment must go beyond symbolic gestures: “sustainability should not become lip service,” but must be structurally embedded into every function of the organization to achieve long-term impact.

Similarly, White and Patton (2002) emphasize the need to build a culture of sustainability through shared guidelines, collaborative routines, and structural adaptations such as new roles, processes, and communication channels. These findings suggest that organizations must consciously recalibrate their internal structures and culture to support sustainable delivery.

A further organizational enabler is the consistency of sustainability practices across project phases. Holding on to project management methods that prioritize sustainability, and formalizing them in contracts, can reduce backsliding and ambiguity. von Rosing et al. (2025) stress the importance of strict policy enforcement and clear mandates to maintain ambition over time.

Finally, both Engert and Baumgartner (2016) and von Rosing et al. (2025) and Sabini and Alderman (2021) point to the crucial role of leadership in sustaining ambition. When project managers demonstrate strong commitment to sustainability through action, this signals priority across the organization. Structured approaches, such as clear portfolios, timelines, and measurable roadmaps, make sustainability strategies more actionable and reduce fragmentation. As von Rosing et al. (2025) argue, “without a well-defined strategy with an attached roadmap, implementation can become haphazard.”

3.4.4. Knowledge-related drivers

Knowledge is a critical success factor for sustaining sustainability ambitions throughout the infrastructure project life cycle. At every stage of the process, access to relevant, up-to-date, and shared knowledge is essential to support, evaluate, and adjust sustainable decision-making. Both project teams and external stakeholders must possess sufficient knowledge to translate sustainability principles into concrete actions.

A key insight is that learning and knowledge sharing must be structurally embedded in the organization. Banihashemi et al. (2017) emphasize the importance of knowledge and awareness of sustainable project delivery within project management teams. In addition, effective and open sharing of knowledge among team members supports better decision-making and helps overcome fragmentation. Engert

and Baumgartner (2016) point out that missed opportunities, such as cost reductions or quality improvements. are often due to a lack of knowledge and training. They stress the importance of targeted training programs for managers to bridge this gap.

At the systemic level, knowledge plays a central role as well. Vergerio and Knotten (2024) highlight the need for better simulation models, more empirical data, and wider dissemination of life cycle analysis knowledge. These tools enable project teams to justify sustainable alternatives using both qualitative and quantitative data. Additionally, digital information technologies can enhance communication and coordination between stakeholders, particularly during the design stage.

Knowledge is also essential for innovation. Smits and Moor (2003) underline that effective knowledge management is key to fair and transparent evaluation of project alternatives, especially in data-intensive decision contexts. Similarly, Lahsen and Turnhout (2021) argue that openness to diverse knowledge systems and inclusive dialogue strengthens the legitimacy and effectiveness of sustainability solutions.

Education, capacity-building, and openness to new technologies emerged as core enablers of sustainable practices (von Rosing et al., 2025). Shared learning environments and structured knowledge-sharing mechanisms support continuous improvement (Lahsen & Turnhout, 2021; von Rosing et al., 2025).

3.4.5. Governance and policy-related drivers

Governance structures and policy mechanisms are critical for embedding sustainability into infrastructure projects in a consistent, enforceable, and accountable manner. Literature across different domains emphasizes that sustainability is most effective when translated into formal procedures, frameworks, and strategic alignment across all decision-making levels.

One of the most recurrently mentioned success factors is the early integration of sustainability considerations in project planning. According to Omar et al. (2008) and Olfert et al. (2020), this is the phase where financial and technical flexibility is highest and where critical trade-offs can still be influenced. Integrating sustainability at this point helps prevent lock-in effects, where unsustainable decisions become difficult to reverse later due to entrenched investments and path dependencies (Omar et al., 2008). Tools such as Multi-Criteria Decision Analysis (MCDA) are recommended to broaden the evaluation framework beyond short-term economic feasibility and systematically incorporate environmental and social impacts (Omar et al., 2008).

From a corporate sustainability perspective, Engert and Baumgartner (2016) argue that well-defined implementation plans, performance indicators, and roadmaps are vital to ensure that sustainability ambitions are aligned across strategy and operations. Similarly, the adoption of structured management systems is considered essential to institutionalize sustainability practices within organizations' core decision-making processes.

At the project level, a wide variety of governance-related enablers has been identified. Banihashemi et al. (2017) highlights transparent procurement processes, comprehensive contract documentation, and the implementation of effective change, quality, and risk management procedures as key drivers. These mechanisms ensure that sustainability is not only agreed upon at the strategic level, but also maintained across all operational phases.

Furthermore, recent studies stress the importance of contracts as dynamic management instruments. Rather than being static documents, contracts should facilitate collaboration, define sustainability roles and responsibilities, and embed flexibility to adapt to evolving sustainability priorities (Vergerio & Knotten, 2024). As von Rosing et al. (2025) underline, sustainability should never be seen as a "one-and-done" effort. Instead, continuous policy commitment and enforcement, guided by clear mandates and aligned incentives, are essential to safeguard long-term ambition and prevent backsliding during implementation.

Finally, bridging the vertical gap between strategic, tactical, and operational governance levels is vital. Too and Weaver (2014) and White and Patton (2002) emphasize that lack of coordination between these levels can undermine even well-formulated sustainability strategies. A strategic portfolio approach that links overarching goals to project-level actions is therefore a key enabler for maintaining sustainability throughout the infrastructure life cycle.

3.4.6. Conclusion

Despite persistent challenges, the literature identifies several success factors that help sustain sustainability ambitions in infrastructure projects. Key among these are clear, measurable goals embedded in strategies, performance indicators, and monitoring systems (Engert & Baumgartner, 2016; von Rosing et al., 2025). Early and meaningful stakeholder engagement fosters alignment, trust, and long-term commitment (Banihashemi et al., 2017; Vergerio & Knotten, 2024), while motivated project managers with sufficient support and resources play a pivotal role (Silvius et al., 2012). Effective project teams built on trust, open communication, and knowledge sharing, strengthen implementation, especially when supported by ongoing learning and openness to new tools (Lahsen & Turnhout, 2021; von Rosing et al., 2025). Formalizing sustainability in methods and contracts, combined with early integration in planning and strong governance mechanisms, further enhances consistency (Banihashemi et al., 2017; Omar et al., 2008). Finally, a supportive organizational culture with aligned values and leadership commitment is essential to prevent ambition erosion. Crucially, the literature stresses that sustainability must be embedded across all organizational levels: strategic, tactical, and operational, to ensure coherence and continuity throughout the project life cycle (Engert & Baumgartner, 2016; Too & Weaver, 2014).

Table 3.2: Thematic categorization of success factors supporting sustainability ambitions

Driver category	Description	Key references
Conceptual and motivational	Clearly defined, measurable, and actionable sustainability goals are essential. Strong leadership, vision translation into roadmaps and indicators, and adoption of life cycle thinking ensure that sustainability remains a guiding principle throughout project phases.	Banihashemi et al. (2017), Engert and Baumgartner (2016), Loorbach et al. (2010), Vergerio and Knotten (2024), and von Rosing et al. (2025)
Economic and financial	Acknowledging long-term financial benefits of sustainability and ensuring availability, planning, and allocation of resources (e.g., funds, materials) enables credible and stable implementation. External economic and political stability further reinforces ambition.	Alabi (2024), Banihashemi et al. (2017), and von Rosing et al. (2025)
Organisational and cultural	A culture of sustainability must be structurally embedded in the organization. Key enablers include strong project leadership, shared norms and values, trust, team competence, interdisciplinary collaboration, and contractually secured methods.	Banihashemi et al. (2017), Engert and Baumgartner (2016), Sabini and Alderman (2021), Vergerio and Knotten (2024), von Rosing et al. (2025), and White and Patton (2002)
Knowledge	Sustainability implementation depends on systemic knowledge integration. Training, capacity-building, digital tools, simulation models, shared learning platforms, and openness to diverse knowledge systems enable more informed and adaptive project decisions.	Banihashemi et al. (2017), Bell and Morse (2001), Engert and Baumgartner (2016), Lahsen and Turnhout (2021), Smits and Moor (2003), Vergerio and Knotten (2024), and von Rosing et al. (2025)
Governance and policy	Early integration of sustainability into project planning enables fundamental design decisions before lock-ins occur. Formal frameworks, clear mandates, performance indicators, and vertical alignment across governance levels foster enforceability and consistency.	Banihashemi et al. (2017), Engert and Baumgartner (2016), Olfert et al. (2020), Omar et al. (2008), Too and Weaver (2014), Vergerio and Knotten (2024), von Rosing et al. (2025), and White and Patton (2002)
Stakeholder and participation	Sustainability is strengthened by early involvement of stakeholders, shared goals, long-term collaboration, open communication, and trust. Continuous engagement, co-creation, and clarity on roles promote ownership and alignment.	Banihashemi et al. (2017), Engert and Baumgartner (2016), Hoeft et al. (2021), Vergerio and Knotten (2024), and von Rosing et al. (2025)

3.5. Conclusion

This chapter has explored how sustainability is defined and translated into ambitions across organisational structures. There was a particular focus on the barriers that hinder, and success factors that may support the consistent implementation of sustainability ambitions.

Although sustainability is widely acknowledged as a multidimensional principle that includes environmental, social and economic goals, translating this into operational practice proves challenging. Sus-

tainability ambitions are typically formulated at strategic level but must be translated across multiple layers before reaching project implementation. The literature suggests that during this translation process, from formulating to operationalizing them, ambitons can easily erode due to various obstacles.

These barriers have been synthesised into six thematic categories: motivational and conceptual, economic and financial, organisational and cultural, knowledge-related, governance and policy, and stakeholder and participation. These categories are interlinked and may reinforce one another in practice, making it difficult to preserve long-term sustainability objectives in dynamic project environments.

To counteract these challenges, several success factors are proposed in the literature, including life cycle thinking, strategic alignment, long-term financial planning, strong leadership, embedded knowledge systems, and early stakeholder involvement. However, most of these insights stem from broader construction or corporate settings. Research that explicitly examines sustainability ambition erosion and mitigation within infrastructure projects remains limited.

Despite this gap, the patterns identified in adjacent fields provide a valuable starting point for empirical investigation. This thesis aims to address the identified empirical gap by exploring whether and how the barriers and success factors discussed in the literature manifest in practice within Dutch infrastructure and mobility projects. It will also examine the roles of key stakeholders in shaping and sustaining sustainability ambitions throughout the project life cycle.

4

Sustainable Infrastructure Development in the Netherlands

This chapter provides the conceptual foundation for this research. It introduces the project life cycle structure used in Dutch infrastructure development, identifies key stakeholders and their roles, explains how sustainability is embedded through existing frameworks such as Duurzaam GWW, and describes the organisational dynamics that influence decision-making.

The chapter directly contributes to answering RQ 1 — *"How is sustainability currently considered in the decision-making process of infrastructure and mobility projects across different stages?"* By exploring how sustainability is addressed in each project phase, what tools and frameworks are used, and what challenges arise in maintaining long-term ambitions.

In addition, the chapter also lays the foundation for RQ 2 — RQ5 by describing stakeholder dynamics, highlighting structural and procedural barriers, and clarifying the frameworks that shape the prioritisation and translation of sustainability ambitions throughout the project life cycle.

By establishing these theoretical perspectives, this chapter also supports the analytical framework used in the empirical part of this study and provides a reference point for interpreting the interview data in later chapters.

4.1. Understanding the project life cycle

Infrastructure projects in the Netherlands typically follow five main planning phases: Initiation, Exploration, Elaboration, Realisation, and Maintenance & Demolition (Ministerie van Infrastructuur en Waterstaat, 2024). Each phase plays a distinct role in shaping the final project outcome, particularly regarding the integration of sustainability considerations.

Initiation phase: The public client identifies a problem or opportunity. Strategic ambitions, including sustainability goals, are typically based on high-level policy frameworks or national strategies.

Exploration phase: During this phase, the problem is analysed, possible solutions are explored. If a consultancy-engineering firm is involved, this happens during this phase. The firm helps the client translate ambitions into feasible plans. Key activities here include f ormulating what should be achieved and how ambitions from the initiation phase can be fulfilled and prioritized. Also, concept designs are created and an early feasibility check is performed by estimating material and labor needs. The procurement process also begins here, with preliminary tenders issued and evaluated.
Outcome: Conceptual project plan, initial budget, and potential contractors.

Elaboration phase: Final preparations for construction are made, including refined planning, design finalization, procurement, cost estimations and finalizing the project decision. Also a decision of the consultancy engineering firm is made.
Outcome: A formal project decision containing a fully developed execution plan.

Realisation phase: The contractor executes the physical construction. Planning and monitoring processes ensure quality and adherence to the schedule.
Outcome: Completed infrastructure asset.

Maintenance and Demolition phase: Finally, the Maintenance and Demolition phase addresses the long-term performance of the asset. It includes regular operation and maintenance tasks, and eventually decommissioning, repurposing, or demolition.
Outcome: Long-term functioning infrastructure, maintained or dismantled responsibly.

Although this five-phase model offers a structured overview of infrastructure development in the Netherlands, it simplifies a process that, in practice, is far more complex. Each phase consists of multiple substeps, feedback loops, and decision points that demand active stakeholder involvement and careful evaluation. Numerous national and international frameworks illustrate this complexity through visualizations that break down each phase into more detailed activities and interactions. To underscore the multifaceted nature of infrastructure planning and the need for tailored sustainability integration, an overview of such visualizations is presented in Figure B.1 (see Appendix B). These illustrations offer complementary perspectives and underline the importance of structured yet flexible decision-making throughout the project life cycle.

In particular, international literature such as that by United Nations Environment Programme (2021) highlights a more granular life cycle approach, dividing infrastructure development into ten steps across two broader categories: upstream (planning and design) and downstream (implementation, operation, and decommissioning). This broader classification reflects an emerging consensus: that infrastructure development should move away from a linear perspective toward a more circular and adaptive process.

Rather than seeing planning as a flat, finite trajectory, a closed-loop life cycle approach emphasizes ongoing feedback, adaptability, reuse of resources, and long-term performance. This mindset is essential for embedding sustainability not only in design but across all stages, from execution to operation and eventual transformation or reuse.

As illustrated in Figure 4.1, this shift from linear to circular thinking is visually captured by combining the Dutch five-phase model with internationally recognized life cycle frameworks. The figure highlights how sustainability ambitions should be continuously monitored and adapted throughout the entire project timeline.

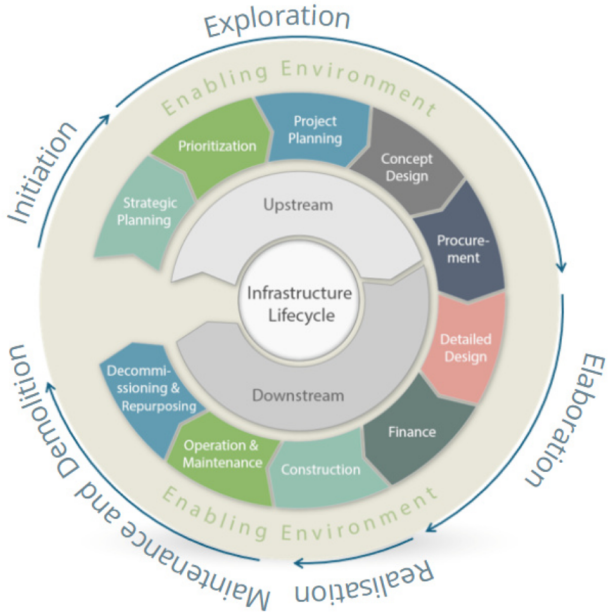

Figure 4.1: Comparison of linear and circular infrastructure planning frameworks, own illustratioon adapted from United Nations Environment Programme (2021) and Ministerie van Infrastructuur en Waterstaat (2024)

In addition to the life cycle model shown above, a structured matrix has been developed to clarify the specific sustainability objectives, decision-making tools, involved stakeholders, and contractual mechanisms across each project phase. This matrix helps bridge the gap between conceptual life cycle thinking and practical implementation by illustrating how sustainability ambitions evolve and are embedded at each stage of the infrastructure planning process. The full matrix is presented in Appendix D.

4.2. Stakeholders

Executing an infrastructure project is inherently complex, partly due to the large number of stakeholders involved. These actors span both public and private domains and operate across multiple governance levels and project phases. Various actors are engaged throughout the project phases.

Although many actors contribute to infrastructure projects, this study focuses specifically on the interaction between the public client and the consultancy engineering firm. These two stakeholders were selected due to their continuous involvement in the early project phases and their strategic influence on the formulation and translation of sustainability ambitions. A full overview of other relevant actors is provided in Appendix D.

The public client, typically a governmental agency, acts as project owner and holds final decision-making authority, granting it the highest level of formal power. Consultancy engineering firms, play an advisory role by offering technical expertise, feasibility assessments, and design services. While they lack formal decision-making authority, they may exert considerable informal influence through professional authority, reputation, and strong sector networks (Mayers, 2005).

Political actors, such as aldermen or provincial deputies, fall outside the direct empirical scope of this study. However, they play a crucial contextual role by shaping the strategic and financial conditions under which public clients operate. Their mandates, aligned or not with sustainability, can strongly influence the level of ambition set at the project's outset. For this reason, they are included in the PI grid. As projects move into later phases, contractors assume a more dominant role during execution. Depending on the contract type, they may also have responsibility for detailed design choices. Their influence on early-stage sustainability ambitions is typically limited, although their role in delivering sustainable outcomes can be significant. End-users, such as local residents or commuters, do not participate in formal decision-making but are directly affected by the outcomes. While their influence is typically limited to participatory processes, their interest in sustainability is high due to its impact on quality of life, mobility, and environmental health.

Figure 4.2 presents a power–interest (PI) analysis, distinguishing between formal and informal power positions of key stakeholders. These actors were selected because of their consistent presence across infrastructure projects and their recurring roles in shaping or implementing sustainability ambitions. Other stakeholders, such as local communities, may also exert influence, but due to their project-specific involvement, they are included in Appendix D rather than in the main grid.

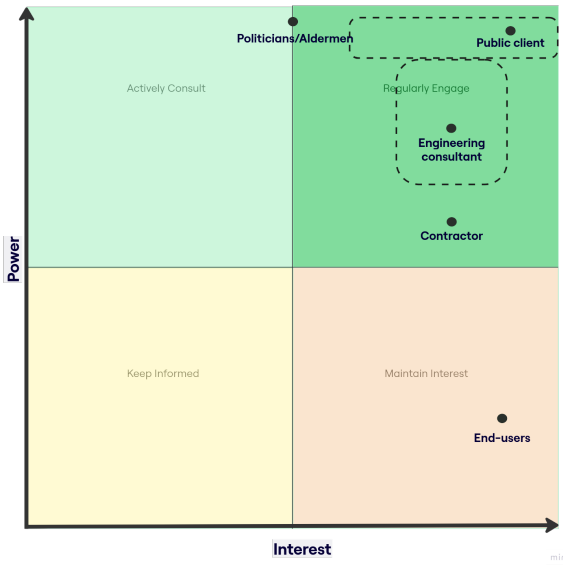

Figure 4.2: Stakeholders' positions in the PI grid. The dashed line represents informal power, while the dots indicate formal power.

To complement the PI analysis, Table 4.1 provides an overview of each key stakeholder's typical level of power, interest, and their general motivation for sustainability within infrastructure projects. These characteristics form a theoretical basis for understanding how different actors influence the prioritisation of sustainability, as will be further explored in Chapter 5.

The positions of stakeholders in the PI-grid are theoretically grounded in their institutional roles, the timing of their involvement, and their perceived responsibility for project outcomes (Maier & Aşchilean, 2020; Osei-Asibey et al., 2021). While each infrastructure project may show slight variations, the relative positions shown reflect common patterns observed across the Dutch infrastructure sector.

The public client holds final decision-making authority and is ultimately accountable for the project's societal, environmental, and financial outcomes. This grants them the highest level of formal power. Their interest in sustainability tends to be high, as they are expected to deliver public value, comply with national climate goals, and act in alignment with long-term societal interests. This central role also implies that the client is in a unique position to integrate sustainability into the project's strategic objectives.

Consultancy engineering firms, although formally in an advisory role, are involved from the earliest project phases and contribute specialised knowledge in areas such as feasibility, design, and technical innovation (Osei-Asibey et al., 2021). While they do not hold formal power to decide, they may exert significant informal influence by steering the client toward sustainable options. This influence stems from their professional authority, accumulated project experience, and established reputational standing within the sector (Mayers, 2005). Moreover, promoting sustainability aligns with their own organisational goals: it enhances their competitive position and contributes to their public image and brand identity.

Contractors generally enter the process during the tender or realisation phase (Maier & Aşchilean, 2020). Depending on the contract form, they may have some control over detailed design decisions. Their power increases in later stages and their influence on early sustainability ambitions is limited. Contractors do have a vested interest in delivering sustainable outcomes. As emphasised by Tan et al. (2015), contractors should be the game changers with new technologies and innovations in compliance with sustainable development to be winners in the market.

Political actors influence the strategic and budgetary frameworks in which projects are initiated, even if they are not involved in operational decisions. Their level of ambition can enable or restrict sustainability.

End-users, have minimal formal or informal power. Their influence is generally limited to participatory meetings. Nevertheless, their interest in sustainability is high, given the long-term impact of infrastructure on their health, mobility, and living environment.

These stakeholder dynamics illustrate that power and interest do not always align symmetrically, those with the most to gain from sustainability may have little influence, while those with decision power must be consciously motivated to act on sustainability goals. This insight is fundamental to understanding how sustainability is prioritised in practice and underlines the importance of strategic stakeholder engagement throughout the project life cycle. It also highlights the influence of actors beyond the project team. Politicians, though not involved in operational decisions, often set the level of ambition expected from public clients. Their support or disinterest in sustainability may therefore create enabling or limiting conditions for the ambitions defined in project plans.

Table 4.1: Overview of key stakeholders' power, interest, and sustainability orientation

Stakeholder	Power	Interest	Sustainability Orientation
Public client	High	High	Accountable for long-term outcomes; responsible for meeting policy goals and ensuring public value
Consultancy engineering firm	Medium	High	Advisory role; committed to innovation and quality; sustainability strengthens reputation and client relations
Contractor	Medium–High	Medium	Responsible for execution; sustainability tied to quality, compliance, and long-term performance
Politicians/Aldermen	High	Medium	Define long-term public goals and budgetary constraints; indirectly influence sustainability expectations through mandates and political agendas
End-users	Low	High	Directly affected by the end result; value environmental quality, accessibility, and health impacts

Given that each organisation has its own ambitions, structures, and incentive frameworks, the prioritisation of sustainability is unlikely to be uniform across stakeholders. For public clients, how strongly sustainability is embedded in project ambitions often depends on political mandates, institutional culture, and policy priorities. While they are expected to meet national targets, they retain discretion in how to translate these into concrete project terms, leading to variation in their positioning within the PI-grid.

The influence of consultancy engineering firms is similarly contingent. Their authority stems from technical expertise and experience, but their ability to steer decisions toward sustainable outcomes relies on the extent to which they can exercise informal power.

These dynamics underline that sustainability prioritisation is shaped not just by formal roles. Crucially, those who have the greatest long-term interest in sustainability, such as end-users, often lack the formal power to ensure its implementation, while decision-makers must actively choose to prioritise it.

This highlights the importance of not only analysing inter-organisational dynamics, but also the intra-organisational layering within key actors. Later in this chapter, therefore examines how public and private organisations are structured across strategic, tactical, and operational levels. Understanding this internal logic is critical for identifying where sustainability ambitions originate, how they are interpreted or redefined at different levels, and how it determines their position in the PI grid.

4.3. Project Teams

Once a public client initiates a project and selects a consultancy engineering firm through a tender procedure, an IPM (Integrated Project Management) team is established. This structure plays a crucial role in shaping how strategic sustainability ambitions are translated into operational project decisions. All three case studies in this research, further detailed in Chapter 5, were executed using the IPM model. The IPM structure ensures that responsibilities are clearly allocated across five core roles, each assigned to a dedicated individual and supported by a team. Together, these roles facilitate coordinated management across technical, contractual, stakeholder, and planning domains (Waterstaat, n.d.):

- **Project Manager:** Responsible for overall coordination, quality assurance, stakeholder alignment, and internal support. The project manager holds final accountability for the project outcome.
- **Project Control Manager:** Focuses on managing project risks, finances, scheduling, and progress. The project control manager is responsible for identifying and mitigating risks and deviations.
- **Stakeholder Manager:** Responsible for maintaining relationships with external stakeholders such as residents, businesses, interest groups, and government bodies. The stakeholder manager ensures continued support for the project and addresses concerns from the surrounding environment.
- **Technical Manager:** Concerned with the technical and content-related realisation of the project. The technical manager oversees the technical design, decision-making, and the control of substantive risks during design and execution.
- **Contract Manager:** Aimed at managing contractual risks between the client and market parties. The contract manager is responsible for procurement, contract negotiations, and maintaining relations with contractors.

Both the public client and the consultancy engineering firm appoint a representative for each role, fostering close collaboration within the IPM team structure on a tactical decision-making level, shown in Figure 4.3.

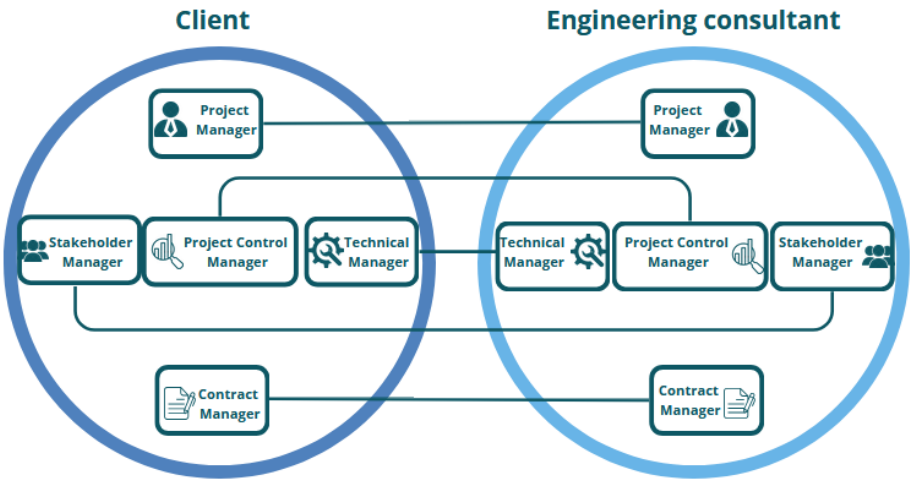

Figure 4.3: IPM team structure

Although the IPM team functions as a single, integrated entity with shared responsibility for delivering the project, its internal roles differ in terms of formal decision-making mandates and sustainability-related expertise. These differences influence how each role contributes to shaping and embedding sustainability within the project.

The Project Manager typically holds the most comprehensive mandate, overseeing the alignment between strategic objectives and project choices. Other roles, such as the technical manager, contract manager, and stakeholder manager, have more domain-specific responsibilities but often bring substantial sustainability-relevant expertise to the table. For example, the technical manager may explore sustainable design options, while the contract manager ensures that sustainability requirements are properly embedded in procurement documents.

Importantly, the team's effectiveness is not solely determined by formal responsibilities. Factors such as intrinsic motivation, domain-specific sustainability expertise, and cross-role collaboration significantly affect how sustainability is prioritised in practice. A motivated technical manager might actively push for greener design alternatives, while a committed stakeholder manager may advocate for inclusive processes that elevate sustainability concerns from the community.

In addition to the five formal IPM roles, the team is supported by specialist advisors, such as sustainability experts. These advisors typically lack formal authority but act as key enablers by bridging the gap between high-level ambitions and domain-specific implementation, e.g., by translating sustainability goals into design briefs or procurement criteria. Their influence lies in their expertise and the extent to which the IPM team values and integrates their advice.

Understanding how sustainability is operationalised within the IPM structure thus requires attention to both decision-making mandates and informal influence mechanisms, such as knowledge sharing and motivation. Ultimately, successful integration depends not only on who decides, but also on how well the team aligns around shared ambitions and complements each other's capacities.

4.4. Duurzaam GWW

In the Netherlands, various frameworks and tools have been developed to support the integration of sustainability into infrastructure projects. One of the most prominent and widely promoted approaches is Duurzaam GWW a structured method designed to guide both public and private actors in embedding sustainability throughout the project life cycle (PIANOo, 2025). Although its application varies in practice, Duurzaam GWW reflects the broader institutional efforts within the Dutch infrastructure sector to systematically address sustainability from the earliest project phases onward.

Duurzaam GWW was developed collaboratively by major public clients such as Rijkswaterstaat, ProRail, various provinces and water boards, and private sector representatives. The Duurzaam GWW approach is widely applied across the Dutch infrastructure sector.

While numerous sustainability tools and frameworks already exist, such as Environmental Impact Assessments (EIA), Life Cycle Assessments (LCA), and Cost-Benefit Analyses (CBA) (all are briefly explained in Appendix D), many of these are applied in isolation and lack alignment with broader planning decisions. Several of these instruments focus primarily on environmental impacts, sometimes neglecting the social or governance dimensions of sustainability. Others are highly compliance-driven, leaving little room for innovation or context-specific solutions. As noted by Bank (2019), most tools also offer limited guidance for incorporating sustainability ambitions during the policy phases of infrastructure development, placing disproportionate responsibility on early-stage design teams and increases the risk that sustainability ambitions fade over time.

To address these challenges, the Duurzaam GWW initiative offers a practical and process-based framework that guides stakeholders in systematically integrating sustainability into all phases of project development. The approach is grounded in five guiding principles:

1. Translate organizational sustainability goals into concrete project ambitions.
2. Integrate sustainability as early as possible when the greatest impact can be achieved.
3. Focus on project-specific themes that offer the highest sustainability potential.
4. Enable innovation by allowing market players to propose their own solutions.
5. Use a consistent and shared set of tools to assess and safeguard sustainability throughout the process .

These principles are operationalized through a recurring six-step process that is applied within each phase of a project:

- Analyze the demand and ambitions, here the omgevingswijzer can be used.
- Identify and explore opportunities, Duurzaam GWW urges the user to base their decisions on Ambitieweb.
- Taking into account all measures and define project-specific sustainability ambitions.
- Translate ambitions into specifications and design, here Dubocalc and the CO_2-prestatieladder can be used as inidcators.
- Assess and balance sustainability performance.
- Justify and document sustainability outcomes.

To support this structured process, the Duurzaam GWW approach recommends the use of several standardized tools:

- Omgevingswijzer: An assessment tool that helps evaluate the environmental and societal impacts of infrastructure plans in the early stages. Providing a structure to discover focus point on twelve sustainability themes. the goal is to create awareness and insight into sustainable ambitions.
- Ambitieweb: A visualization tool used to set and align sustainability ambitions across a wide range of themes (Duurzaam GWW, n.d.). It aims to create insights in the most negative impacts and how to achieve a minimal sustainability goal, show a goal that reduces the negative impact significantly for the specific theme and also discusses the added value of an action.
- DuboCalc: A life cycle-based calculation tool that quantifies the environmental impact of design alternatives based on material use (Ecochain, n.d.). takes all environmental effects into account for each phase of the process. The effects are formulated in monetary terms, also called ECI (in dutch: MKI).
- CO_2-Prestatieladder: A performance ladder that incentivizes carbon reduction efforts through procurement advantages and continuous monitoring (CO_2-Prestatieladder, n.d.). This tool functions as a certification that shows the level of measures a company takes to reduce their co_2 emissions.

Together, these tools offer a consistent and measurable way to embed sustainability goals into the decision-making process. They also facilitate dialogue between clients and contractors and create space for innovative, tailored solutions. Over time, the Duurzaam GWW approach has become more and more important in the Dutch infrastructure planning and procurement practice, helping to ensure sustainability remains a central priority throughout the entire life cycle of a project.

4.5. Strategic–Tactical–Operational Dynamics

Infrastructure projects require close collaboration between multiple organisations, such as public clients, engineering consultancies, and contractors. Each of these actors brings its own sustainability ambitions to the table, often formulated at the strategic level and rooted in broader organisational agendas, such as becoming energy-neutral by 2030, advancing climate adaptation, or promoting biodiversity.

Once these actors join forces in a project, their individual ambitions must be aligned and translated into a shared project approach. While many ambitions may converge in general direction, they often differ in urgency, specificity, or measurability. Active coordination is therefore required to shape a coherent and actionable sustainability strategy at project level.

The process of translating strategic sustainability ambitions into project-level action follows a layered logic, as introduced in the literature (Schmidt and Wilhelm, 2000). In infrastructure projects, this unfolds as follows:

- Strategic level: Public clients and consultancies define long-term ambitions, which may be informed by climate agreements, organisational policies, or corporate sustainability strategies. For example, a municipality may require all infrastructure projects to contribute to circularity or climate resilience by 2030.

- Tactical level: IPM teams and project leaders translate these ambitions into project objectives, procurement conditions (e.g., EMVI-criteria), and design frameworks. Here, ambitions become more specific, shaped by project context, budget, and scope. For example, a climate adaptation goal might be translated into a requirement to include nature-based solutions in the preliminary design, or into a gunning criterion rewarding low life-cycle CO_2 emissions in tenders.
- Operational level: Engineers, designers, and contractors embed ambitions into concrete choices, such as material selection, energy performance standards, or biodiversity measures during execution. This may include selecting low-carbon concrete, integrating wadi systems for rainwater drainage, installing solar lighting, or preserving existing green structures to support biodiversity.

This layered structure creates two types of dynamics. First, vertical translation within organisations, where strategic ambitions are gradually interpreted and adapted through tactical and operational levels. Second, horizontal alignment between organisations, where multiple strategic intentions must converge into one shared vision for the project. Both dynamics shape how sustainability is formulated, interpreted and enacted in practice.

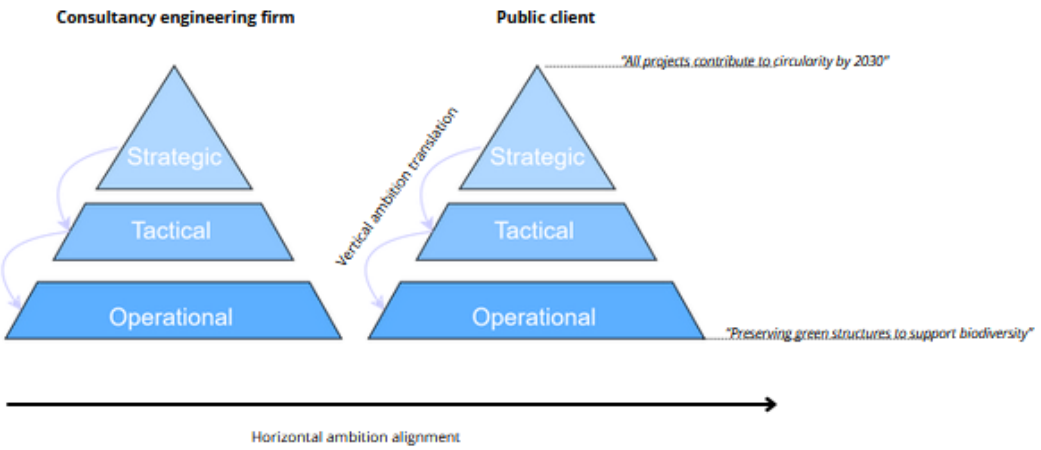

Figure 4.4: Vertical and horizontal dynamics of sustainability ambition translation

Figure 4.4 visualises how both vertical and horizontal processes influence the realisation of sustainability ambitions. Within each organisation, ambitions must be translated across strategic, tactical, and operational levels. Simultaneously, cross-organisational alignment ensures that different actors move in the same direction. A lack of coordination either internally or between parties, may result in fragmented implementation or erosion of sustainability goals.

4.6. Conclusion

This chapter has provided the theoretical foundation to understand how sustainability ambitions are shaped, translated, and implemented within Dutch infrastructure and mobility projects. It has combined literature and sector-specific insights to construct a coherent picture of the multi-layered and multi-actor reality of ambition realisation.

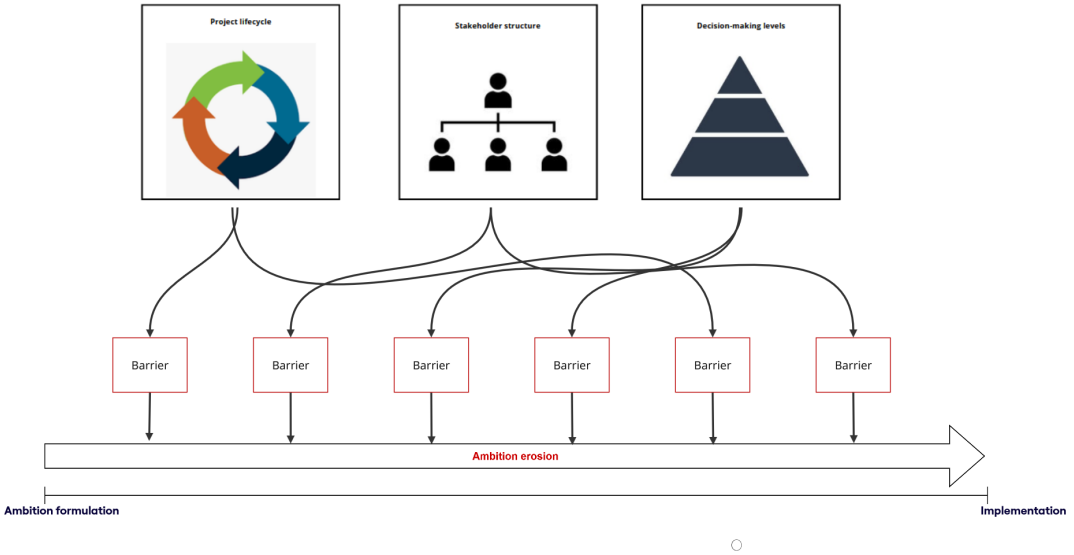

Figure 4.5: Theoretical framework

Figure 4.5 visualises the theoretical framework developed throughout this chapter. It integrates the three dynamics discussed in this chapter that jointly shape the erosion of sustainability ambitions in infrastructure and mobility projects:

- Project life cycle logic: As infrastructure and mobility projects progress from initiation to implementation, decision-making responsibilities shift between actors and disciplines. While ambitions may be strong in the early planning phases, they are often downscaled in later stages.
- Stakeholder and team structure: Infrastructure projects involve multiple collaborating organisations, each with its own sustainability priorities and institutional culture. These organisations work together within a shared IPM team, a structure jointly staffed by both the public client and the consultancy engineering firm. Within this team, five defined roles coordinate elements of the project. While formally structured, the effectiveness of this collaboration depends among others on clear mandate distribution, mutual trust, and the integration of sustainability expertise across roles.
- Organisational layering (decision-making levels): Within each organisation, sustainability ambitions must be translated across strategic, tactical, and operational levels. Simultaneously, alignment is needed between collaborating organisations to ensure ambitions are understood and consistently applied. A lack of vertical coherence or horizontal coordination can lead to conflicting interpretations and implementation gaps.

These dynamics together explain how barriers may arise and cause the erosion of sustainability ambitions. While literature has identified generic types of barriers, such as fragmentation, vagueness, or shifting priorities, the exact mechanisms and moments at which these occur in practice remain underexplored. This framework thus provides the analytical lens for the empirical chapters that follow. It helps to investigate not only where and how ambitions fade, but also which roles and relationships are most critical in safeguarding them throughout the project lifecycle.

Answering Research Question 1

RQ1:How is sustainability currently considered in the decision-making process of infrastructure and mobility projects across different stages?

Sustainability is increasingly recognised as an integral consideration in infrastructure and mobility projects, but its practical integration across project stages is fragmented and often vulnerable to erosion. At the strategic level, public clients and engineering consultancies formulate ambitions inspired by broader societal goals such as the Sustainable Development Goals, national climate agreements,

or organisational goals. These are translated into project objectives during the initiation and exploration phases, where tools such as the Duurzaam GWW framework (Ambitieweb, Omgevingswijzer, Dubocalc) could help structure sustainability discussions and ambition-setting.

In the elaboration phase, tactical actors refine these ambitions into concrete technical requirements, design criteria, and contract documents. Here, decisions on trade-offs (e.g. between cost, time, and sustainability) are critical. During the realisation phase, contractors implement design and material choices, but their influence on sustainability is partly dependent on what is embedded earlier. If not properly safeguarded, sustainability ambitions may erode as projects progress from strategy to execution.

In sum, sustainability is most strongly considered during early stages but risks losing priority during tactical translation and operational execution.

Establishing the Foundation for RQ2–RQ5

This chapter also lays the foundation for the remaining research questions:

- RQ2 – This chapter highlights that different stakeholders are involved at different stages, with varying degrees of formal and informal influence. Understanding how these actors interact, align, and prioritise sustainability is central to explaining variations in sustainability outcomes across projects.
- RQ3 – The framework reveals several critical points where sustainability ambitions may fade, during vertical handovers between strategic, tactical, and operational levels, at moments of actor misalignment or through deprioritisation during project phases. These insights provide a structural lens to identify and categorise barriers in the empirical chapters. Moreover, the theoretical barriers identified from literature will be tested and refined in empirical analysis.
- RQ4 – By embedding the project life cycle into the framework, a foundation has been established for understanding the structure and sequence of project phases, from initiation and exploration to elaboration and realisation. This enables a phase-specific lens to identify where sustainability ambitions are most vulnerable or can be most effectively reinforced. It also clarifies which actors are involved at each phase and how decision-making structures evolve over time.
- RQ5 – The integrated view of vertical (S–T–O) and horizontal (multi-actor) dynamics, combined with life cycle thinking, uncovers practical entry points for reinforcing sustainability. Additionally, success factors derived from literature are positioned within this framework to inform strategic interventions in practice.

Towards the Empirical Phase

To conclude, this theoretical framework clarifies how sustainability ambitions are formulated, negotiated, and translated into practice in infrastructure projects. It provides a structure to analyse when, where, and why ambitions are weakened, or successfully realised. By bridging life cycle logic, organisational layering, and multi-actor collaboration, it offers a coherent analytical lens for the empirical chapters that follow.

5

Case studies

The preceding chapters provided the theoretical and conceptual foundation for this study. This chapter marks the start of the empirical phase, in which those foundations are tested and refined through a multiple case study. The process follows the staged approach depicted in Figure 5.1, moving from tailored case selection and data collection to structured within-case and cross-case analysis. While the planning and desk research phases have been covered earlier, the focus here is on the design and execution of the empirical research and its analytical outcomes.

Figure 5.1 outlines the empirical approach proposed for this study, based on the six-step process described by Yin (2009) and complemented by applications from Adams et al. (n.d.) and Seligman (2013). The process allows for iterations between the preparation, data collection, and analysis phases. For example, small refinements to question phrasing or analytical focus may be made to enhance clarity and maintain consistency across cases, provided that these adjustments stay within the predefined methodological framework.

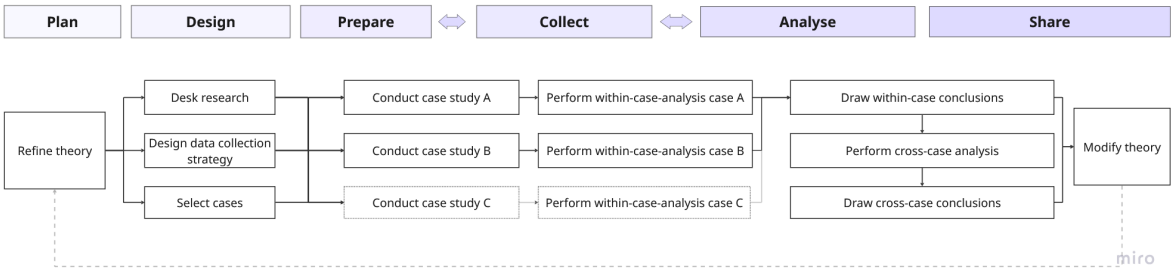

Figure 5.1: Case study approach, based on the studies of Adams et al. (n.d.), Seligman (2013), and Yin (2009)

Once the theoretical foundation is in place and a clear focus has been established regarding what should be tested or refined, the study will proceed into the design phase. This includes conducting desk research, selecting relevant case studies, and developing a tailored data collection strategy to ensure comparability between cases. In the second phase, data will be prepared and collected through the execution of three case studies. Each case will undergo a within-case analysis to extract meaningful, context-specific insights.

The results from these individual case analyses will form the basis for the subsequent cross-case analysis. This comparison is intended to synthesise patterns across cases, which will then be reflected against the theoretical framework. The purpose is twofold: to assess whether the findings reinforce existing theory and to explore whether they provide novel insights that may inform future research or theory development. In particular, this comparison will help determine whether known dynamics also apply to infrastructure projects, or whether distinct mechanisms emerge.

It should be noted that Case C is shown with a dashed outline in the figure. This indicates that, due to

the limited availability of suitable interview participants, the depth of analysis for this case may be more limited compared to Cases A and B. As such, Case C may serve a supporting role, used to illustrate or contrast findings, rather than acting as a fully equivalent unit in the cross-case analysis.

In the remainder of this chapter, each phase of the empirical process is described in more detail, following the structure outlined in Figure 5.1.

5.1. Empirical Approach and Case Selection

This section explains how the case study approach was applied in practice, including case selection, interview design, and the overall analytical strategy.

5.1.1. Data Collection Strategy

A tailored data collection strategy was designed to ensure a consistent and comparable empirical base across the selected cases. This strategy built on the conceptual categories derived from the literature, translated into interview themes, and operationalised through a semi-structured interview format. Key stakeholders from the public client and consultancy side were targeted to provide a multi-perspective view on ambition evolution in infrastructure projects. The interviews were recorded, transcribed and coded using Atlas.ti, ensuring traceability from raw data to insight.

As explained in Chapter 2, the interviews were conducted in a semi-structured manner. This approach was chosen for its flexibility and its ability to allow interviewees to elaborate on their experiences and perspectives (Bryman, 2012). While allowing room for detailed responses, the semi-structured format also ensured that all interviews followed a consistent structure and addressed the same core themes.

The interviews were partly designed to validate the findings from the literature in the specific context of Dutch infrastructure and mobility projects. They aimed to explore to what extent the theoretical barriers and success factors identified in Chapter 3 are recognized in practice and to uncover any additional context-specific factors. In doing so, the interviews contributed to answering Research Questions 3 and 5. In addition, interviewees were asked about their prioritization of sustainability and the project phases in which they believe there are opportunities to strengthen sustainability ambitions, thereby addressing Research Questions 2 and 4.

Due to time constraints, each interview was scheduled for 45 to 60 minutes, it was not possible to explore every topic in unlimited depth. Therefore, a clear distinction was made between core questions and optional follow-up questions. These optional questions were included on the final slide of the interview protocol and could be addressed if time permitted. In addition, indicative time allocations were set per theme to ensure that all key topics could be covered within the available time.

To guide the interviews, a topic guide with predefined questions was used and can be found in Appendix C. This ensured that all key themes were covered consistently across interviews and helped prevent the discussion from drifting into irrelevant areas. In designing the questions, several qualitative interviewing principles were taken into account (DeJonckheere & Vaughn, 2019), including:

- Ensuring a neutral approach in order to prevent the researcher's personal perspectives from shaping the analysis
- Not posing the research questions directly
- Use open-ended questions
- Limiting questions that merely elicit opinions
- Avoiding academic jargon
- Starting with so-called "tour questions or context-setting" (e.g., "What is your role in the project?")

The interview followed a logical sequence of themes. First, general questions were asked about the interviewee's role, responsibilities, and work context. This was followed by questions on the influence of their role on sustainability in decision-making and their interaction with relevant stakeholders. The next section focused on barriers to maintaining sustainability ambitions throughout infrastructure projects. Interviewees were first asked to name three barriers based on their experience, after which they were

presented with a selection of barriers identified in the literature review and asked whether they recognized them in practice. A similar approach was followed for success factors. After discussing both barriers and enablers, interviewees were asked to reflect on how these factors manifested across different project phases. The interviews concluded with a discussion on opportunities for strengthening sustainability in future projects.

The interview structure therefore contained both exploratory and confirmatory elements. For Research Questions 2 and 4, no predefined themes were used, these parts relied on open thematic exploration based on the interviewee's own views. In contrast, for Research Questions 3 and 5, a set of themes was predefined based on the literature, making this part of the interview more suitable for content validation. In Appendix E a more detailed explanation of the data processing is given.

5.1.2. Participant selection

When approaching interviewees, an introductory email with general information about the study was sent in advance. In most cases, initial contact was made through a Witteveen+Bos colleague, with whom I first discussed the suitability of the case study. Based on this conversation, they suggested relevant participants and typically reached out to them prior to my approach. As a result, most potential interviewees had already received some basic information about the research before I contacted them directly.

Participants were selected based on their involvement in the project and their ability to reflect on the evolution of sustainability ambitions over time. Ideally, each case included both a client and a consultant perspective, representing roles from the IPM team such as project manager, project control manager, contract manager, stakeholder manager, or technical manager. These criteria, further outlined and processed in the case selection criteria section, were applied consistently to ensure depth of knowledge and a variety of perspectives across different project contexts.

5.1.3. Case Study Selection

This research was conducted under the supervision of Witteveen+Bos. Consequently, the selection of case studies was necessarily limited to projects within the Witteveen+Bos portfolio. All selected cases therefore concern infrastructure projects executed in the Netherlands, commissioned by public clients.

In qualitative research, case selection is a crucial step that involves assessing the relevance and suitability of potential cases to answer the research question (Yin, 2009). For this study, three infrastructure projects were selected using a diverse case selection strategy, as defined by Seawright and Gerring (2008). This strategy allows for analytical comparisons by selecting cases that show a certain degree of variation on key dimensions while maintaining sufficient overlap to enable meaningful cross-case analysis.

To ensure comparability, all selected projects are road infrastructure projects of similar scope and size, managed through the IPM model, as explained in Chapter 4. They were all required to have started after the Dutch Climate Agreement, to ensure alignment with contemporary sustainability policies and expectations. Importantly, all cases had reached at least the elaboration phase, meaning that key project decisions had already been completed. This allowed for retrospective reflection across decision-making moments.

However, due to the long duration of infrastructure projects, it proved challenging to identify cases that were both sufficiently advanced and still had stakeholders available who had been involved since the early phases. Many projects had either not progressed far enough to enable reflection on key sustainability decisions, or involved individuals who were no longer engaged with the project, or no longer employed at the organization. As a result, the inclusion criterion was pragmatically set to projects that had reached at least the elaboration phase, with the additional condition that key stakeholders with relevant knowledge were still available for interviews.

The cases were suggested by Witteveen+Bos employees, based on their familiarity with projects in which sustainability had been visibly addressed. A key requirement was that sufficient data would be available, either through documentation or through the knowledge and willingness of involved stakeholders to participate in interviews.

To ensure analytical consistency, comparable roles were interviewed across all cases. This enabled a multi-perspective understanding of how sustainability was framed, operationalised, and evolved throughout the project life cycle.

Although the projects differed in their context and in the emphasis placed on sustainability, they were not chosen at random. Rather, they represent a deliberately selected subset of infrastructure projects in which sustainability played a meaningful role.

Table 5.1 summarizes the full set of selection criteria across four categories: institutional context, project characteristics, data availability, and analytical requirements.

Table 5.1: Case selection criteria

Category	Criterion	Explanation
Institutional context	Affiliated with Witteveen+Bos	Project access facilitated through internal supervision
	Public client	Focus on publicly commissioned infrastructure
	Dutch road infrastructure project	Ensures consistency in type, governance, and policy context
Project characteristics	Similar size and scope	Projects are comparable in terms of budget and complexity
	IPM governance structure	Common management approach enabling role comparability
	Sustainability ambition present	Sustainability is explicitly or implicitly addressed
	Started after 2019	Aligns with the Dutch Climate Agreement
Data availability	Reached elaboration phase	Key decisions are already formalised
	Availability of informed participants	Stakeholders from early phases are still available
	Willingness to participate	Interviewees are open to reflecting on project dynamics
Analytical requirements	Comparable roles across cases	Ensures multi-perspective, role-based analysis

While all three cases initially met the selection criteria outlined in Table 5.1, Table 5.2 shows how each case fulfilled these criteria in practice.

During the data collection phase, however practical limitations emerged in relation to Case C. Although the case was selected based on the expected availability of informed participants, it later became evident that key stakeholders were no longer reachable due to job transitions, retirement, or, in one case, passing away. An attempt was made to contact the contractor involved in the project to obtain additional perspectives, but this outreach did not result in a response. As a result, it was not possible to gather multiple viewpoints through interviews.

Additionally, Case C was already smaller in scale compared to the other two projects. Combined with the limited data availability, the differences in project scope and structure were deemed too substantial to allow for meaningful comparison. Therefore, it was decided to include Case C only as a supplementary source of information to support the cross-case analysis, but not to treat it as a full case contributing separate within-case findings or conclusions.

While all cases addressed sustainability to some degree, they did so with varying levels of ambition, consistency, and integration. This variation was important for cross-case learning, even though all cases initially met the same inclusion criteria regarding sustainability relevance.

Table 5.2: Fulfilment of selection criteria across all three cases

Criterion	Case A – Westerwoldse AA	Case B – Cruquius	Case C – Marssum Roundabout
Affiliated with Witteveen+Bos	✓	✓	✓
Public client	✓ Rijkswaterstaat	✓ Province of North Holland	✓ Province of Friesland
Dutch road infrastructure project	✓ Replacement and renovation of a movable bridge	✓ Renovation of provincial bridge	✓ Turbo roundabout and underpass
Similar size and scope	✓	✓	~ Smaller in scale
IPM governance structure	✓	✓	✓
Sustainability ambition present	✓ Ambition web updated mid-project	✓ High-profile project	✓ EMVI award criterion and design optimisations
Reached elaboration phase	✓ Elaboration phase	✓ Realisation phase	✓ Finished
Documentation access	✓	✓	✓
Availability of informed participants	✓	✓	✗ Key actors unavailable
Willingness to participate	✓	✓	✗ Attempted – no contractor response
Variation in sustainability integration	Moderate	High	Moderate
Comparable roles across cases	✓	✓	~ Fewer interviews conducted

5.2. Case Descriptions and Within-case Analysis

To determine whether potential projects met the case selection criteria, each candidate case was first discussed in a meeting with an internal stakeholder familiar with the project. During these conversations, the project's context, scope, and development were reviewed, including whether it would be suitable for further analysis. Where available, relevant documentation was subsequently shared. The case descriptions in the following section are based on these internal conversations and the review of the provided project materials.

For each selected case, a reconstructed project timeline was created to visualise key milestones across the project life cycle. These timelines illustrate the evolution of sustainability ambitions across project phases, highlighting key developments, shifts, or turning points. They are not intended as objective records, but rather as interpretive visualisations based on internal perspectives. As such, they serve an illustrative purpose and are integrated within the respective case descriptions. They are based on the interpretation of interviewed Witteveen+Bos staff and should therefore be read as perspective-based reconstructions rather than objective accounts.

5.2.1. Case A: Cruquius bridge

his case concerns the replacement and renovation of the Cruquius Bridge on the N201, a key provincial route connecting Hoofddorp and Heemstede. In addition to the replacement and widening of the east-

ern span, the project includes major maintenance of the western span, the construction of a pedestrian and cyclist underpass, and the extension of an adjacent footpath. Due to its high visibility and strategic location near Schiphol Airport, the project involves several public stakeholders, including the Province of North Holland, the municipalities of Heemstede and Haarlemmermeer, Vervoerregio Amsterdam, and Hoogheemraadschap Rijnland.

The project was initiated in 2018 and has since undergone several development phases. A competitive dialogue procedure was followed for procurement, placing strong emphasis on sustainability ambitions, specifically circularity, energy neutrality, and low-maintenance design. This sustainable procurement approach earned the project the KoopWijsPrijs in 2021 for exemplary integration of sustainability in tendering processes ("Project Cruquiusbrug in Noord-Holland wint KoopWijsPrijs 2021", 2022). The design incorporates industrial, flexible, and demountable (IFD) construction methods and includes materials passports to support future reuse. The project entered the realisation phase at the end of 2023 and is scheduled for completion in 2026 ("Over het project", 2024).

Despite this promising start, the realisation of sustainability ambitions proved challenging in practice. Several ambitions were only vaguely defined at first, and the responsibility for interpreting and operationalising them was delegated to Witteveen+Bos after the contract award. This post hoc interpretation introduced subjectivity and ambiguity. Although an ambition web was developed to structure these goals, certain ambitions, such as biodiversity or circularity, proved difficult to quantify or directly translate into deliverables.

As the project progressed through different phases, particularly into realisation, various sustainability ambitions were diluted or dropped. This was often due to constrained budgets, trade-offs between cost and risk, and the changing composition of project teams. For example, the idea to reuse structural steel elements was abandoned due to market limitations and timing concerns. In other instances, less ambitious but more feasible sustainability measures, such as nature-inclusive design features, were implemented as substitutes to maintain a positive public image.

The erosion of ambitions was closely tied to changes in project governance and financing. The lack of continuous involvement of key sustainability advocates across phases led to knowledge loss and differing interpretations of earlier goals. Political backing was seen as essential in maintaining the sustainability agenda, but technical and financial constraints ultimately led to compromise.

Nonetheless, some sustainability measures have been retained. The application of IFD principles and materials passports are expected to contribute to long-term adaptability and reduce future environmental impact. The Cruquius Bridge project thus serves as a nuanced example, demonstrating both the persistence and erosion of sustainability goals across an infrastructure project's life cycle.

The timeline in Figure 5.2 presents a reconstruction of how the project's sustainability ambitions were embedded, reinterpreted, and at times diminished across different phase. The timeline is based on internal perspectives, and should be interpreted as an illustrative reconstruction rather than an objective chronological account.

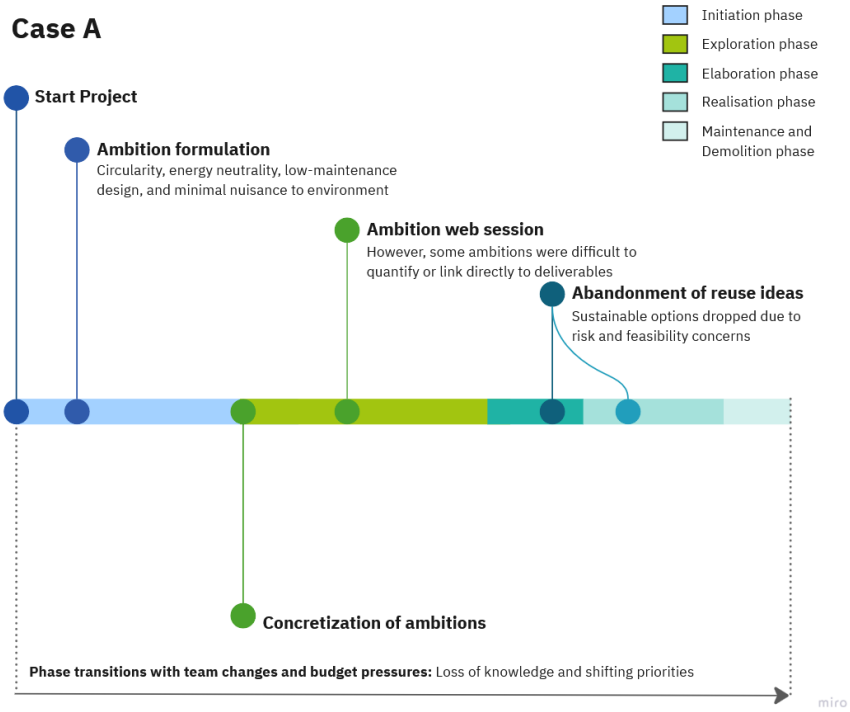

Figure 5.2: Timeline of case A

5.2.2. Case B: Westerwoldse AA bridge

This case concerns the replacement of a movable bridge led by Rijkswaterstaat and forms part of the national renovation and replacement programme for infrastructure in the Netherlands. The project is currently at the end of the elaboration phase and aims to improve safety and reduce noise disturbance caused by vibrations from heavy traffic. A fixed bridge has been selected as the preferred alternative.

From the early stages, sustainability played a clear role in the project. An ambition web session was hThis case concerns a bridge replacement project led by Rijkswaterstaat, as part of the broader national programme for renovating and replacing movable bridges. Sustainability ambitions were defined early in the project through an internal ambition web and subsequently formalised in contract clauses, including the aim to explore additional ecological compensation measures.

However, internal reflections during the elaboration phase suggest that these ambitions were not consistently anchored throughout the project lifecycle. For instance, a nature-based solutions (NBS) scan was proposed as a systemic and knowledge-driven alternative to the standard ecological quick scan. Despite its potential added value, the proposal was declined with the argument that the existing contractual requirement had already been met. Even when the ambitions were updated mid-project to reflect higher sustainability targets, this did not lead to adjustments in the project scope or deliverables.

A brainstorm session was held to identify opportunities for additional ecological measures, yet its outcomes were accepted without follow-up. No concrete actions were implemented. This pattern suggests a dilution of the original sustainability intent. Although ambitions were articulated, they remained relatively vague and were not backed by sufficient monitoring or enforcement mechanisms.

These developments point to a dilution of the originally stated ambitions. Sustainability objectives remained relatively vague and were not supported by mechanisms for monitoring or enforcement. This case demonstrates how policy-level aspirations can weaken over time when not clearly embedded in project structures and decision-making processes.

The timeline in Figure 5.3 visualises the evolution of these dynamics throughout the project. This case illustrates:

- The gap between stated ambitions and actual project outcomes.
- The importance of formulating clear and actionable sustainability goals.
- The challenge of aligning long-term policy ambitions with the realities of project execution.
- The need for tools and governance structures to safeguard sustainability commitments over time.

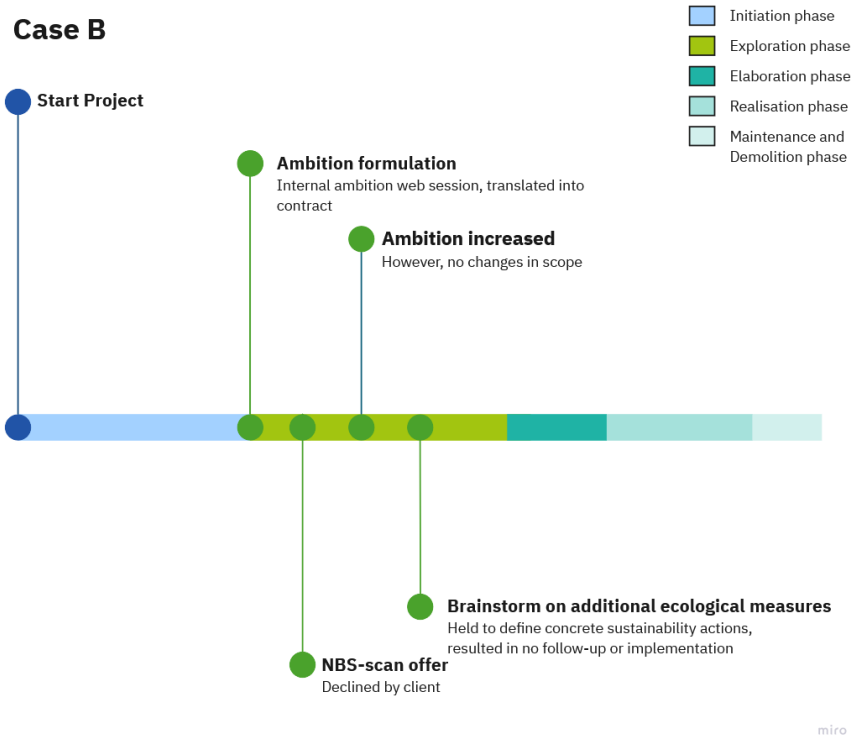

Figure 5.3: Timeline of case B

5.2.3. Case C: Roundabout Marssum

This case involves the upgrade of an existing single-lane roundabout into a turboroundabout, combined with the construction of a bicycle and pedestrian underpass. The project was commissioned by the Province of Friesland and executed by KWS Infra. It aimed to improve road safety, particularly for vulnerable users, and enhance traffic flow at a key junction near the village of Marssum.

The project forms part of a broader regional vision to improve accessibility and safety, following the earlier De Haak om Leeuwarden infrastructure programme (2010–2014). While that programme focused on major new infrastructure and area redevelopment, the Marssum project represents a later, more localized intervention addressing remaining bottlenecks in the network. The project was executed in December 2021. Construction was completed in May 2022. A key challenge was maintaining traffic flow during implementation, which influenced design and construction choices.

Sustainability was given explicit attention during the preparatory phase. A project-specific sustainability intake session was held using the Ambitieweb method, and a MilieuKostenIndicator (MKI) baseline was calculated to support environmental optimisation. Contractors were encouraged to incorporate sustainability measures in their proposals, aided by a sustainability opportunity dossier that outlined possible design improvements. Sustainability was included as an award criterion (EMVI) during procurement, and fictive budgets were introduced to incentivise innovative, environmentally friendly solutions.

While these measures reflect a relatively advanced procurement strategy for that time, deeper sustainability ambitions encountered resistance during implementation. According to the internal discussion, operational departments expressed concerns about the long-term costs and maintenance implications

of certain proposals. As a result, only a selection of the intended measures such as bamboo signage and wooden guardrails, was ultimately realised, while more systemic or circular innovations were not pursued.

The same internal conversation highlighted that project leaders and contractors were not always sufficiently equipped or intrinsically motivated to prioritise sustainability beyond fulfilling basic contractual obligations. Although the ambition web was updated mid-project to reflect heightened sustainability aspirations, these updates did not result in any significant changes to the project scope or deliverables.

Notably, the application of sustainability tools such as the Ambitieweb occurred relatively late in the process. This limited their potential impact, as key design decisions had already been made by the time these frameworks were introduced. This case thus demonstrates how sustainability ambitions despite being present can remain fragile and vulnerable to erosion if they are not structurally embedded in project governance, design workflows, and operational planning.

Figure 5.4 provides an illustrative timeline of the projects development and the evolving role of sustainability. It visualises the phases and decision points where sustainability ambitions were introduced, adjusted or deprioritised, based on internal interpretation and retrospective reconstruction.

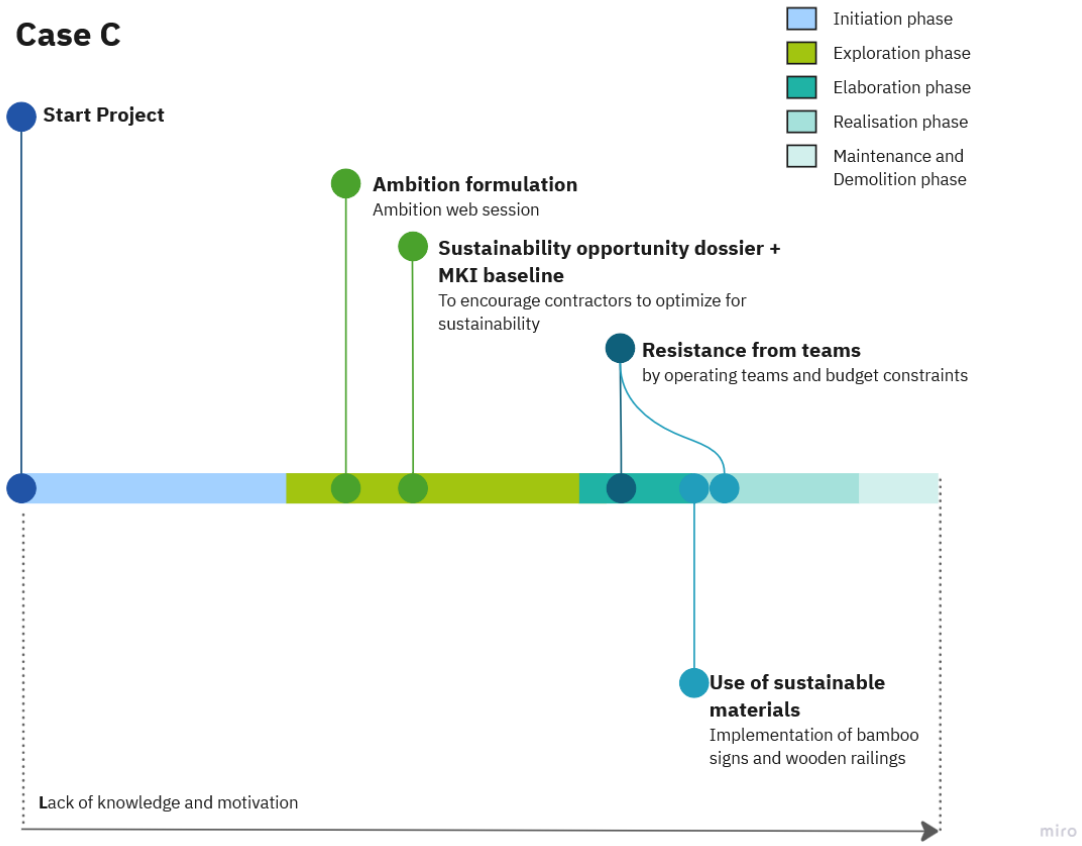

Figure 5.4: Timeline of case C

5.3. Data Analysis

Before analysis, all interview transcripts were carefully read and cleaned. This cleaning process involved removing filler words, redundant phrasing, and off-topic digressions. The cleaned transcripts were then uploaded into Atlas.ti and grouped into three document groups: Case A, Case B, and Case C.

The coding strategy was based on the research questions rather than the specific interview questions.

For each research question, a primary code was created. Interview segments were coded accordingly when they contributed to answering a research question. For Research Questions 2 and 4, which explored perception and opportunities, an open coding method was applied. For Research Questions 3 and 5, this process resulted in a total of 135 coded references for barriers and 150 for success factors.

Initially, all codes were classified into six thematic domains derived from the literature: *Knowledge*, *Motivational + Conceptual*, *Participation + Stakeholder*, *Economic + Financial*, *Governance + Policy*, and *Organisational + Cultural*. These were implemented as code groups in Atlas.ti. In addition, particularly illustrative or nuanced passages were in-vivo coded and stored under a separate category labelled *"Quotes"* for easy retrieval during analysis and reporting.

Code Consolidation and Theme Revision

After the full set of transcripts was coded, codes related to barriers and success factors were reviewed and organised thematically. Duplicate or highly similar codes were merged into second-order categories to reduce redundancy and enhance clarity. Examples of this consolidation process are included in Appendix E.

Initially, all codes were grouped under the six predefined literature themes. However, during coding, it became clear that several emerging barriers either overlapped multiple domains or did not fit any of the predefined themes. Examples include codes such as:*"Long project duration"*, *"Phase transitions"* and *"Execution-oriented project structure"*.

These codes pointed to structural and temporal challenges specific to infrastructure projects, which were not adequately captured by the existing domains. As a result, the thematic structure was revised, leading to four final categories:

- Project Structure and Temporal Dynamics
- Personal and Cultural Resistance
- Institutional and Governance
- Conceptual Ambiguity and Knowledge Gaps

Figure 5.5 visualises the transition from the original six thematic domains to the revised structure.

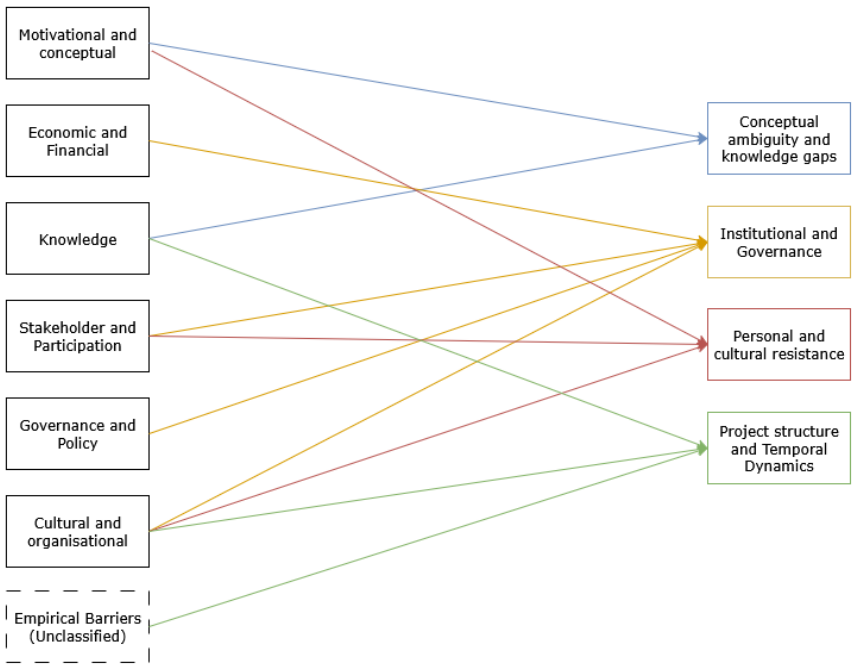

Figure 5.5: Transition from literature-based to data-driven thematic structure

Where possible, related codes were merged into second-order categories to improve clarity and reduce fragmentation. Illustrative examples of this consolidation process are included in Appendix E. Each final barrier was then assessed according to the decision-making level at which it primarily manifests: strategic (S), tactical (T), or operational (O). This classification was based on the scope of influence and typical responsibilities. Table E.1 in Appendix E presents a detailed overview of these findings, including an overview of all identified barriers, clustered by theme and level, and including a concise description of each.

Similar to the thematic revision performed for barriers, a more integrated structure was developed to improve analytical clarity and better reflect the specific dynamics of infrastructure project contexts. Clarifying and Sharing Knowledge encompasses success factors related to concrete ambition formulation, measurability, and continuous knowledge transfer. Embedding through Governance and Systems includes factors that support the formal and institutional integration of sustainability, such as contractual anchoring, monitoring mechanisms, and policy alignment. Structuring for Continuity and Timing covers enablers that ensure consistency across project phases, including phase-to-phase coordination, early agreements, and temporal awareness. Finally, Motivating and Aligning People brings together cultural and interpersonal drivers such as team engagement, trust, intrinsic motivation, and leadership commitment.

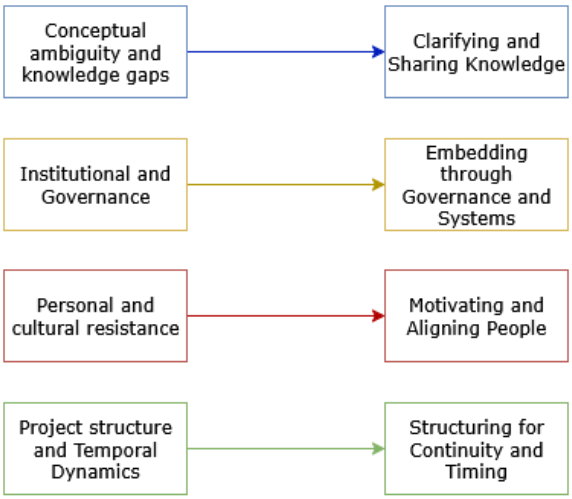

Figure 5.6: Revised Succes Factor themes

This thematic revision enables a more streamlined presentation of success factors and facilitates direct comparison with the barrier themes. As with the barriers, each success factor is linked to a dominant decision-making level (strategic, tactical, or operational), which supports a more nuanced understanding of where specific actions are most effectively deployed. An overview of all empirically identified success factors, categorised according to this structure, is included in Table E.2 in Appendix E.

5.3.1. Within-case-analysis case A

This case was marked by a high level of enthusiasm and participation. In total five participants were interviewed for this case: The project manager of W+B, the technical manager of W+B, the technical manager of the Province, the sustainability advisor of the province and the sustainability advisor of W+B. Sustainability was consistently present in discussions, yet its prioritisation varied. Figure E.1 in Appendix E provides a visual overview of the interviewees involvement across phases and moment they marked critical.

A key insight is that influence was less a function of formal role, and more dependent on intrinsic motivation, technical knowledge, and the ability to embed sustainability in formal processes (e.g., tender documents, design tools, KPIs).

While the Province provided clear ambitions, supported by a 3.5% cost margin for sustainability and the project's status as an icon project, the realisation of those ambitions faced common barriers. Inter-

viewees mentioned risk aversion, competing interests (e.g., biodiversity vs. solar panels), and budget constraints as factors that diluted initial goals. For example, innovative concrete was only used in non-critical components due to perceived risks. The design was eventually approved because responsibility lay contractually with W+B, reducing the client's perceived exposure.

Stakeholder perception

Across the five interviews conducted in Case A, sustainability was consistently recognised as a meaningful and desirable goal. However, the perception of what sustainability entails, who owns it, and how it should be embedded in the project differed significantly between stakeholders. A key insight is that stakeholder influence on sustainability largely depended on personal motivation, technical knowledge, and the ability to embed sustainability in formal processes, such as contracts, designs, or team rituals. Risk considerations, conflicting stakeholder interests (e.g., biodiversity and maintenance), and cost pressures frequently influenced the extent to which ambitions were realised.

These conflicting interests often arose both within and beyond the IPM team. Internal actors, such as the ecology department and asset managers, had diverging priorities: where ecologists advocated for biodiversity, asset managers tended to prefer conventional, low-risk, and easy-to-maintain solutions. External stakeholders, such as municipalities, introduced additional spatial and political considerations. Higher management within the client organisation played a crucial role in maintaining ambition post-procurement, while public visibility, due to the project's status as an 'icon project', further increased the pressure to deliver demonstrable sustainability outcomes.

The technical manager from the Province of North Holland described sustainability as a continuous thread throughout all phases. He actively contributed to shaping ambitions in the early stages and emphasised the value of embedding long-term thinking into project objectives and contractual documents. At the same time, he recognised the complexity of navigating competing interests. As he noted,

> *"Some sustainable ideas, like Corten steel, didn't go through due to practical or aesthetic objections."*

For him, successful integration depended on both individual initiative and organisational support:

> *"You need people who think innovatively, who are willing to take risks. But it's not just about individuals; the organisation must support them."*

The provincial sustainability advisor reinforced this emphasis on personal commitment and institutional backing. He argued that sustainability ambitions are often vague at the start and tend to lose momentum after the tender phase unless higher management continues to advocate for them.

> *"If higher management doesn't continue to label the project or allocate extra resources, sustainability quickly fades after procurement."*

He pointed out that sustainability advisors typically lack formal decision-making power, which limits their influence:

> *"Sustainability advisors lack the power to push sustainability independently."*

According to him, contract anchoring ('the stick') must be complemented by leadership, communication, and visibility ('the carrot').

On the side of Witteveen+Bos, the project manager shared that although ambitions were provided by the client, his personal motivation and curiosity played an important role in their translation into practice:

> *" I could stimulate or limit sustainability depending on my attitude."*

He maintained involvement across project phases to ensure continuity and advocated for quantifying sustainable options to increase their tangibility. Nevertheless, he acknowledged that as technical and financial pressures increased, sustainability ambitions often faded:

> *"As technical elaboration and financial constraints increase, parts of the ambition disappear"*

The technical manager at Witteveen+Bos echoed the view that sustainability was often one of many competing concerns in a consensus-driven IPM team setting.He stressed that without explicit require-

ments from the client or clear contractual anchoring, sustainability ambitions tend to fade over time—particularly under financial or technical pressures. To navigate this, he relied on structured tools such as trade-off matrices, multi-criteria analyses, and design logs to support balanced decision-making. However, he emphasised that these tools should be used to guide dialogue rather than hinder it:

> *"It is important that these tools facilitate the conversation, not paralyse it."*

To embed sustainability in projects where it might not be prioritised, he described a strategic reframing of ecological ambitions through risk management. For instance, if biodiversity was not gaining traction, he would elevate nature permit risks in the project's risk register. This made room for introducing biodiversity-enhancing measures as legitimate risk mitigation:

> *"I turn it around, if there's no attention to biodiversity, I raise the nature permit risks significantly. Then biodiversity enters as a mitigation measure for top risks. [...] Eventually you still do what you wanted to do, but it's a detour."*

The sustainability advisor from Witteveen+Bos contributed primarily through technical expertise, focusing on the quantification and communication of sustainability ambitions. He supported the team by making ambitions measurable, for example through Key Performance Indicators (KPIs) and environmental impact calculations (MKI), and by bringing in substantive sustainability knowledge. This content-driven approach helped convince others of the added value of sustainability:

> *"My influence was mainly content-based: quantifying ambitions, bringing in knowledge and expertise, and making them measurable through KPIs."*

However, his influence was largely limited to the content side; he had little influence on governance structures or decision-making processes. He noted that even well-supported arguments sometimes failed to translate into action due to time or capacity constraints:

> *"Through technical argumentation, for example via MKI reductions. Sometimes it worked, but in other cases sustainability was not further elaborated due to time or capacity pressure."*

He also highlighted that implementation often depended on individual engagement, especially among project leaders, rather than on formal mandates:

> *"It largely depended on individual engagement."*

Furthermore, he observed that sustainability was not structurally secured in governance, and that advisors like himself often lacked the formal authority to enforce sustainability decisions. As a result, he emphasised the need for standardisation, visibility, and repetition to keep sustainability ambitions alive throughout the project life cycle:

> *"Unless sustainability is explicitly named and revisited, it risks fading."*

Despite a shared belief in the importance of sustainability and the presence of structured instruments, all interviewees acknowledged that implementation was hindered by practical barriers. These included the rejection of solar panels due to biodiversity concerns and the deferral of sensor installations because of cost constraints. Ultimately, the interviews revealed that stakeholder influence was shaped more by intrinsic motivation and the ability to embed sustainability into concrete processes than by formal role or mandate.

Table 5.3: Key takeaways on stakeholder perception per role – Case A

Role	Key takeaways
Technical manager (Province)	Framed sustainability as a life cycle-wide concern; balanced ambitions with feasibility; acknowledged influence of ecology, maintenance, and municipalities; emphasised individual drive and organisational support.
Sustainability advisor (Province)	Highlighted risk of ambition fade post-procurement; called for stronger leadership and visibility; pointed to limited governance role of sustainability experts.
Project manager (W+B)	Maintained phase continuity; promoted sustainability through curiosity and quantification; observed ambition fade under budget constraints.
Technical manager (W+B)	Operated in consensus-based structure; saw sustainability as one of many concerns; used decision tools; warned against passive client attitudes.
Sustainability advisor (W+B)	Focused on content-level influence (KPI, MKI); highlighted dependency on individual champions; called for standardisation and programmatic reinforcement.

Barriers

All five interviewees acknowledged the presence of significant barriers to embedding sustainability, though they varied in how and when these emerged across the project phases.

The sustainability advisor from the Province of North Holland recognised that conceptual and motivational barriers primarily occurred in the early stages, while financial and economic challenges became especially pressing during the transition from exploration to elaboration. Knowledge-related and organisational barriers were also mentioned, but he indicated these were more relevant in smaller municipalities. He did not perceive governance and policy issues at the project level, although he acknowledged their relevance at intergovernmental levels.

The technical manager from the Province of North Holland identified all barrier categories as relevant. He observed that sustainability ambitions were challenged by a wide range of factors, including time pressure, shifting stakeholders, and competing values from different internal departments.

The project manager at Witteveen+Bos also recognised all barrier types and noted their presence throughout all project phases. According to him, consistent involvement and personal motivation were key to navigating these barriers, but time and capacity constraints often limited the ability to respond adequately.

The technical manager from Witteveen+Bos described sustainability as just one of many considerations within a consensus-driven IPM structure. He did not recognise governance and policy as relevant barriers within his role, but acknowledged that: Conceptual and motivational barriers mostly appear in the early phases. Financial barriers depend on strategic choices and credit requests. Organisational and cultural issues span multiple phases. Knowledge is always relevant. Stakeholder participation plays a smaller role in our context. He also noted that when tenders were still upcoming, contractors tended to withhold information, further complicating knowledge exchange and collaboration.

The sustainability advisor at Witteveen+Bos recognised all barrier types and observed that most occurred in every phase. He highlighted a tendency toward standardisation and time pressure, noting that engineering teams often defaulted to tried-and-tested solutions rather than investing time in defining and embedding sustainability ambitions:

> *"We often have to jump on a moving train. By the time governance structures and ambitions are sorted out, the preliminary design is already done. That's maybe the summary of all barriers: we have little time to break patterns."*

He stressed that vague definitions, changing personnel, and tight schedules made it difficult to implement sustainability in a structured way:

> *"Even if you solve vague definitions early, new people keep joining. It remains a continuous concern."*

Taken together, the interviews suggest that while certain barriers intensify during specific phases, many are persistent and embedded in the structure and rhythm of infrastructure projects.

Budget constraints were consistently highlighted as a major limiting factor, often surfacing when ambitions clashed with what was financially deemed feasible. Especially during phase transitions, such as from exploration to elaboration, sustainable options were frequently abandoned in favour of cheaper or faster alternatives.

However, temporal pressure emerged as the most dominant and cross-cutting barrier. Multiple interviewees referred to the urgency and duration of projects as key challenges. Infrastructure initiatives often span multiple years. As one stakeholder stated:

> *"you're always jumping on a moving train."*

This sense of urgency not only restricted the time available to explore more sustainable alternatives but also discouraged deviation from tried-and-tested routines. Sustainability options that required additional research, coordination, or definition were easily discarded, not because of cost alone, but because there was simply no time to figure it out.

Examples included postponing decisions until more clarity could be obtained, rushing design before ambitions were finalised, or choosing new construction over reuse due to the complexity of second-hand integration. The longer the project ran, the more fragmented the attention became, with decisions being shaped by immediate constraints rather than long-term goals. As such, time was not just a constraint, it actively shaped the boundaries of what was considered realistic.

Interestingly, formal anchoring, such as contractual obligations or governance-based mandates, was rarely mentioned as a decisive factor. Although such instruments may help institutionalise sustainability, interviewees mentioned dynamic and relational aspects such as timing, involvement, and momentum more often. The implication is that even with formal frameworks in place, sustainability ambitions may falter if not actively upheld in the face of daily operational pressures.

Opportunities

All interviewees identified clear opportunities to embed sustainability, with a dominant consensus around the importance of early phases, particularly the initiation and exploration stages. It is in these stages that ambitions can be most openly formulated, aligned, and embedded before technical and procedural constraints begin to narrow the scope for change.

The sustainability advisor from the Province of North Holland emphasised that "most influence lies at the front" where ambitions can be articulated and given priority. According to him, the client's role is decisive in setting the tone for the rest of the process. However, he also noted that the elaboration phase is particularly vulnerable, as many key decisions have already been made by then, and sustainability tends to fade as projects become more technically detailed. He further pointed to phase transitions as critical moments in which continuity and momentum can be lost.

Similarly, the technical manager from the Province of North Holland stressed the value of early involvement, especially in defending more difficult or less conventional sustainability choices. Yet he added that opportunities were not strictly phase-bound, but instead depended on the willingness to make and sustain trade-offs over time.

The project manager at Witteveen+Bos reinforced the importance of early anchoring. He reflected that the ambitions which remained intact throughout the project were those "defined clearly at the start," providing a stable framework and reference point during later phases. This suggests that early decisions do not just shape direction, they provide lasting structure.

The technical manager at Witteveen+Bos offered a more balanced view, suggesting that opportunities existed in all phases, albeit in different forms. While the beginning allows for ambition-setting, later

stages also offer chances to make design or implementation choices that influence sustainability outcomes.

Finally, the sustainability advisor at Witteveen+Bos echoed the importance of early influence: “the earlier you intervene, the bigger the impact.” However, he pointed out a critical tension, ambitions erode over time, meaning that while the front-end offers the biggest leverage, later phases might require more deliberate effort to uphold those ambitions. In his view, initial momentum must be actively maintained, especially as projects move from ambition to execution.

Success Factors

In Case A, a broad range of success factors were identified across the four thematic categories. Interviewees consistently emphasised the importance of effective governance and intrinsic motivation. Celebrating achievements and making sustainability efforts visible, through media exposure and public milestones, were also seen as important drivers for maintaining momentum and internal commitment.

A notable difference emerged in how success factors were distributed among actors. Provincial stakeholders referred more frequently to factors associated with embedding through governance systems, such as formal anchoring in policies and procedures, and strong political support. Also, both technical managers emphasised structuring for continuity and timing, including knowledge transfer between phases, team continuity, and timing awareness. This reflects their later-stage involvement, where integration and project cohesion become more pressing.

The W+B project manager specifically advocated for embedding a sustainability advisor throughout the project, a practice that supports both motivating and aligning people and clarifying and sharing knowledge. The same interviewee was also the only one to mention financial flexibility as a key enabler, suggesting it allowed more room for sustainable options during trade-offs.

Finally, building trust with political and market stakeholders was repeatedly mentioned by provincial interviewees. The presence of co-financing public authorities, such as the Amsterdam Transport Authority, was seen to enhance shared ownership and reinforce sustainability through joint accountability and visibility.

5.3.2. Within-case-analysis case B

Case B centres on the replacement of a bridge crossing the Westerwoldse AA. A key decision was whether the bridge should be fixed or movable, considering its location on a waterway with limited shipping activity. The bridge was ultimately designed as a fixed structure. Although the project was not labelled as a “green pearl or icon project,” sustainability ambitions played a role in early discussions about design options and material reuse. The interviews include representatives from both the client organisation (Rijkswaterstaat) and the engineering consultancy (Witteveen+Bos), covering the roles of project manager, technical manager, and project control manager. Figure E.2 in Appendix E provides a visual overview of the interviewees involvement across phases and moment they marked critical.

Stakeholder perception

The stakeholder interviews in Case B, reveal differing perceptions of how sustainability was prioritised, defended, and operationalised throughout the project life cycle.

The project manager from Rijkswaterstaat considered sustainability an integral part of his quality responsibilities. However, he admitted that it was often treated implicitly and rarely formalised:

> *Sustainability was mainly implicitly taken into account; it was not mentioned as a theme apart, more as part of integral trade-offs.*

Although ambition-setting tools such as the Ambitieweb were deployed, these did not lead to concrete follow-up actions. He stressed the importance of early agreements:

> *Make clear agreements at the start if you want more than the basic effort.*

The technical manager from Rijkswaterstaat acknowledged that ambitions existed but depended heavily on individual initiative. He identified the elaboration phase as critical for anchoring sustainability but recognised that institutional risk aversion and practical constraints often limited innovation:

> *We even proposed a composite pile, but because it's a national road, you don't want to do pilot or pioneer projects.*

As the project progressed, he observed a shift from ambition to risk management and cost efficiency.

From the consultancy side, the technical manager at Witteveen+Bos emphasised his advocacy for the reuse of the existing bridge. He stated that sustainability was not structurally embedded and was only addressed when intrinsically motivated individuals raised the issue. He expressed concern over the person-dependency of such efforts:

> *Can you call it erosion if the ambition wasn't strong to begin with?*

The project control manager at Witteveen+Bos confirmed this perspective. While tools like the Ambitieweb and quickscans were used, they were rarely linked to scope or budget, and ambitions often faded without monitoring or follow-up. He highlighted phase transitions as especially risky:

> *Ambitions were raised halfway, but nothing was done with them.*

He advocated for shared responsibility and warned against rigid project structures that suppress flexibility:

> *Project-based work is like a block on my leg... you enter a straitjacket that forces you to let go of flexibility.*

Collectively, the interviews reveal a shared awareness of sustainability's importance but a lack of structural reinforcement. Intrinsic motivation served as both a driver and a vulnerability. A tension emerged between the top-down expectations of the client and the bottom-up, fragmented reality experienced by the consultancy.

Table 5.4: Key takeaways on stakeholder perception per role – Case B

Stakeholder role	Key observations
Project manager (Rijkswaterstaat)	Viewed sustainability as part of overall quality responsibility, but noted it remained implicit. Emphasised that no additional sustainability actions would be taken unless labelled as *koppelkansen*. Identified a shift in focus from ambition to risk and delivery.
Technical manager (Rijkswaterstaat)	Recognised that ambitions depended on individuals. Noted policy teams were more ambitious than delivery teams. Stressed that innovative ideas were limited by institutional frameworks.
Technical manager (Witteveen+Bos)	Advocated reuse as a sustainable option. Highlighted lack of structural embedding; sustainability was rarely addressed unless raised by motivated individuals.
Project control manager (Witteveen+Bos)	Highlighted loss of ambition during phase transitions and absence of monitoring. Emphasised cultural resistance and limited support for sustainability.

Barriers

The participants identified a wide array of barriers that challenged the prioritisation and implementation of sustainability throughout the project life cycle. While tools such as the Ambitieweb and MKI calculations were used, their impact was often undermined by weak institutional embedding, conceptual ambiguity, and phase discontinuities.

On the client side, both the project manager and technical manager from Rijkswaterstaat referred to sustainability as an integral component of quality. However, they noted that ambitions faded once projects moved towards execution, as financial and temporal constraints started to dominate. The technical manager observed that without strong top-down pressure, sustainable alternatives were difficult to defend:

"Now, sustainability is still passed around like a hot potato."

Moreover, although the elaboration phase was seen as critical, ambiguity in ownership and responsibility often resulted in inertia.

In contrast, Witteveen+Bos staff reflected on the cultural and interpersonal barriers within the team. The technical manager confirmed that all barrier types from the literature were present, except governance, which he did not experience as a limiting factor. He pointed to conceptual ambiguity and a lack of follow-up as the main challenges. The project control manager went further, identifying cultural resistance as the most pressing issue. In his view, sustainable efforts were largely dependent on individual initiative rather than collective responsibility, and he experienced little support when advocating for sustainability: *"The further you get into the process, the harder it becomes due to fixed products, rigid documentation, and a lack of flexibility."* The transition from exploration to elaboration was particularly highlighted as a vulnerable phase.

Interestingly, while all actors acknowledged the importance of sustainability, their framing differed. Client-side stakeholders emphasised institutional and governance-related constraints, while Witteveen+Bos respondents underlined the lack of team culture and structural follow-up. All interviewees agreed that conceptual ambiguity and missing anchoring mechanisms were central weaknesses. Case B revealed several barriers undermining sustainability throughout the project. These included:

- Governance and policy: Weak contractual reinforcement and unclear follow-up procedures.
- Conceptual ambiguity: Sustainability was not managed as a distinct objective but embedded in broad notions of quality.
- Economic and financial constraints: Budget limitations and risk aversion discouraged sustainable innovation.
- Organisational discontinuity: Long timelines and personnel changes weakened ambition tracking.
- Cultural resistance: Sustainability was often seen as an individual responsibility rather than a collective goal.

Opportunities

Despite the barriers, stakeholders identified multiple windows of opportunity to enhance sustainability, also visualised in FigureE.2 in Appendix E. Following the technical manager of Rijkswaterstaat, the initiation phase is crucial for embedding ambitions and aligning expectations with among others, the budget. The technical manager of Witteveen+Bos emphasised the importance of the exploration phase as this phase offers room for developing and deepening ambitions he also viewed elaboration phase as a critical moment to formalise ambitions into system requirements and contractual terms.

However, stakeholders stressed that early-phase alignment, sustained engagement and team continuity were key to realising sustainability throughout the projct.

> *Let it recur in your reporting and decision-making process, that's what you focus your elaboration on. that's also how you measure it, so let plan do check act recur in this, let the sustainability cart ride that you must support, and as a project team you must always be able to tap into that*

> *Make sure it's defined at the front end so you can plot the project that way. To make it concrete I would steer towards that more than triggering on intrinsic motivation, there you don't have the translation yet that it has been applied*

Success Factors

Interviewees in Case B identified a diverse set of success factors that contributed to the advancement of sustainability throughout the project. Several respondents emphasised the importance of clear agreements and standardised procedures at the outset to ensure that sustainability would be pursued beyond minimum requirements. Additionally, monitoring mechanisms and structured moments of reflection were considered necessary to maintain ambition across project phases and avoid dilution over time.

Although examples of intrinsic motivation and proactive leadership were only observed in a few individuals, these were widely acknowledged as crucial enablers. A shared sense of purpose and collective engagement within teams was seen as essential to avoid reliance on isolated champions. One interviewee stated that success relied on *"individuals willing to bear risks and stick out their necks, supported by the organisation."*

While a variety of structural tools were in place, such as the Ambitieweb and trade-off matrices, interviewees noted that the effectiveness of these tools depended largely on how consistently sustainability was kept on the agenda. Success, was less about the presence of tools than about their active use, supported by institutional reinforcement and dedicated individuals.

Notably, Witteveen+Bos stakeholders placed relatively greater emphasis on embedding through governance systems, whereas Rijkswaterstaat interviewees mentioned this theme only once. Among W+B representatives, the project control manager in particular highlighted the importance of motivating and aligning people, underscoring the need for collective commitment and empowered teams. Meanwhile, the provincial interviewees placed stronger emphasis on clarifying and sharing knowledge, particularly the need for clear ambition formulation and knowledge transfer across phases.

5.3.3. Within-case-analysis case C

Case C represents a unique case within this research, as only one stakeholder was interviewed: the contract manager from Witteveen+Bos. This person was responsible for drafting the contract and specifying the system requirements. Although his role was primarily situated in the elaboration phase, the interview also provided insights into earlier phases of the project. Figure E.3 in Appendix E provides a visual overview of the participation of the interviewee in the phases and the moment they marked critical.

Stakeholder perception

The contract manager influenced the prioritization of sustainability in multiple ways. On the one hand, he promoted sustainable outcomes through design choices, such as reusing foundations, selecting sustainable materials, and proposing shorter tunnel lengths. On the other hand, sustainability ambitions were explicitly embedded in the contract through EMVI criteria and minimum MKI requirements. These specifications were based on the client's policy objectives and translated into concrete and verifiable criteria by the advisor, who also consulted external sustainability experts to support this process.

In terms of stakeholder perceptions of sustainability, the interview revealed a range of attitudes. The client's internal sustainability advisor was perceived as having a positive influence on ambition formulation. The client's project manager, in contrast, was described as neutral: not intrinsically motivated but willing to approve proposals as long as they aligned with policy and budget constraints. The contract manager himself acted proactively, using both the design and the contract to promote sustainability. His influence was reinforced by the client's openness to adopting concrete suggestions, provided they were realistic and cost-feasible.

Barriers

Regarding barriers, nearly all literature-based barriers were recognized. However, some played a less prominent role in this case, such as stakeholder participation and inconsistent policy alignment. The most significant barriers included:

- Budget constraints, where sustainable solutions were only considered if budget was explicitly allocated
- Lack of intrinsic motivation of the project manager, leading to a reactive rather than proactive stance
- Knowledge discontinuity between project phases, which complicated the embedding of sustainability ambitions in later stages
- An additional barrier that emerged inductively from the interview was the insufficient early involvement of key advisors. The respondent reflected that Witteveen+Bos joined the process after major design directions had already been determined, which significantly reduced the capacity to embed sustainability in foundational decisions. This timing misalignment was seen as a structural

limitation:

> "*The impact would have been greater if we had started earlier.*"

Opportunities
In terms of opportunities for strengthening sustainability, the respondent emphasized the initiation and exploration phases as critical moments for impactful intervention. These stages allow for more fundamental decisions to be influenced, including whether or not to build at all, or how to shape key design choices. The underlying message was clear: the earlier sustainability is considered, the greater the potential impact.

Success Factors
A wide range of success factors emerged from this case, many of which align with the literature. These included explicitly placing sustainability on the agenda, translating vague ambitions via quick scans, and using tools such as the Ambition Web or trade-off matrices. Consistent policy, political support, and structured knowledge transfer between phases were also highlighted. Additional success factors mentioned were team culture, use of external expertise, mandatory reflection points, and transparency in decision-making rationales. Standardisation, such as through a sustainability handover document, was seen as helpful, though it was noted that creative flexibility should also be preserved.

In summary, Case C shows that a proactive advisor with sufficient technical and procedural space can effectively embed sustainability, even when the client lacks intrinsic motivation. Crucial success factors in this case were the translation of policy into contractual requirements, the facilitation of decision-making through clear proposals, and early involvement in the decision-making process.

5.3.4. Cross-Case Analysis
This section compares the three cases to identify key differences and similarities in stakeholder perception, barriers, opportunities, and success factors. The comparison highlights the complex interplay between individual agency and institutional embedding in sustaining sustainability ambitions in infrastructure projects.

It is important to note that due to the limited number of interviews conducted for case C, its findings are not treated with the same evidentiary weight as those of Case A and B. While relevant insights from Case C are included to enrich the comparison, no firm conclusions are drawn from this case alone.

Stakeholder Perception
All three cases formally recognised sustainability, yet the level of prioritisation and interpretation varied significantly. In Case A, sustainability was explicitly put on the agenda by the client, who labelled the project an “icon project”. Clear sustainability ambitions were communicated early on, and mechanisms such as document handovers and team continuity supported long-term visibility.

In Case B, sustainability was perceived as a necessary component of integrated quality but rarely discussed actively within the team unless initiated by a highly motivated individual. While tools like the Ambition Web were available, they were underused, and sustainability remained a background concern. The project team showed limited openness to innovation, and intrinsic motivation was rarely rewarded.

Case C presented a somewhat hybrid picture. Although the client demonstrated limited intrinsic motivation, early technical anchoring and a proactive contract advisor ensured that sustainability did not massively fade. Measures were taken not out of sustainability ambition per se, but due to their financial advantages, illustrating a pragmatic approach to sustainable choices.

Across all cases, it became evident that the intrinsic motivation of individuals, rather than formal project roles or tools, was the most decisive factor in keeping sustainability visible throughout the project life cycle.

Barriers
Thematic coding revealed that tactical-level barriers were most dominant, followed by operational (13) and strategic (9). While personal and cultural barriers were least frequently mentioned across all cases,

other categories showed clear differences between projects.

In Case A, barriers related to budget constraints, temporal pressure, and perceived feasibility were most prominent. These were particularly emphasised by stakeholders from the client organisation, who had to balance sustainability with risk and cost considerations.

Case B showed stronger emphasis on lack of formal anchoring, limited intrinsic motivation, and participation-related barriers. Several respondents pointed to governance gaps and unclear responsibilities, especially in the later phases, contributing to the erosion of sustainability ambitions.

In Case C, nearly all barrier types were mentioned despite only one interviewee, suggesting a broad awareness of challenges. Notably, knowledge gaps and the absence of client-side motivation were seen as critical issues.

This analysis underlines that while operational-level barriers are the most visible, strategic and institutional barriers, especially in terms of governance, clarity, and continuity, ultimately determine the degree to which sustainability can be safeguarded.

Opportunities

The cases revealed distinct entry points for strengthening sustainability: In Case A, opportunities were dispersed across all phases, highlighting the importance of team continuity and well-managed phase transitions. Case B presented most opportunities in the initiation and exploration phases, where ambitions could still be concretised. Respondents noted that later phases offered less flexibility, which underlines the importance of early anchoring. In Case C, opportunities were most clearly realised during the early design and contracting stages, where ambitions were concretely embedded and using tools like trade-off matrices facilitated impact despite low client engagement

These findings confirm that the window of opportunity is largest in early phases, but that phase transitions and strategic timing remain crucial to prevent ambition fading.

Success Factors

From a total of 157 success factor mentions, the most frequently coded theme was “Motivating and aligning people” (51 times), followed by “Embedding through governance systems” (47) and “Clarifying and sharing knowledge” (38).

Case A showed strong emphasis on structuring for continuity and timing, with 24 of the 37 codes in this category originating from this case. Team continuity, celebration of successes, and proactive knowledge transfer were seen as instrumental. Case B placed greater emphasis on motivating and aligning people, particularly from the perspective of project control and team culture. Although tools were available, their success depended on proactive leadership and engagement. In Case C, despite fewer interviewees, a focus on embedding through governance systems emerged. The use of EMVI criteria, early contract formulation, and standardised handovers enabled tangible progress.

These patterns suggest that while intrinsic motivation and collaborative team dynamics are key enablers, governance structures and procedural clarity are equally important to maintain ambitions across phases and stakeholder transitions.

This cross-case analysis highlights the complementarity of structural and people-centred approaches. While individual agency and intrinsic motivation remain crucial in maintaining momentum, long-term sustainability integration requires strategic alignment, formal governance, and institutional support.

Sustainability tends to erode not because of bad intentions, but due to institutional inertia, knowledge discontinuities, and budgetary or procedural rigidity. Therefore, efforts must move beyond operational tweaks to address the systemic and structural factors underpinning ambition loss.

6

Findings and Validation

This chapter presents the key empirical findings from the multiple case study. The results are structured along four analytical dimensions that correspond with the research questions: stakeholder perception, barriers to sustainability, opportunities for influence, and success factors. The purpose of this chapter is to offer a systematic and descriptive overview of how sustainability ambitions were perceived, constrained, and enabled across different roles, phases, and organisational contexts. These findings form the empirical basis for interpretation and synthesis in Chapter 7. The chapter presents the most important findings from the empirical research and provides sufficient insight to address RQ2, 3, 4 and 5.

While three cases were included in the research, it is important to note that Case C is treated as an illustrative case only. Due to limited data availability, only one interview could be conducted, this case does not provide sufficient empirical depth to support standalone conclusions. However, the insights from Case C are still considered valuable. They are used to nuance or contextualise patterns that were primarily derived from the two full cases. In other words, Case C serves to illustrate and enrich existing findings, but is never used as an independent basis for generalisations or core claims.

6.1. Findings

6.1.1. Stakeholder Perception of Sustainability

Across all three cases, stakeholders acknowledged the importance of sustainability, though its prioritisation varied significantly. A key observation was that sustainability was not perceived as the responsibility of a single role, but rather as a shared concern shaped by intrinsic motivation and organisational culture. Although organisations had formal sustainability goals at the strategic level, implementation at the project level strongly depended on individuals operating at tactical and operational levels.

The sustainability advisor was often the only role with an explicit sustainability mandate, yet lacked formal decision-making power. In contrast, sustainability-related responsibilities were diffused across various IPM roles. Technical managers focused on feasibility and cost implications, contract managers ensured sustainability was included in EMVI or MKI criteria, project control managers monitored planning constraints, and project managers held ultimate authority, resulting in fragmented ownership. As one interviewee noted:

> *"They are sort of the ingredients of a big soup, at some point it is no longer traceable, but part of the whole."*

Intrinsic motivation often proved more decisive than formal mandates. Individuals who personally valued sustainability frequently acted as informal drivers, even in the absence of formal authority. However, the organisational culture in which they operated influenced the extent to which this motivation could be expressed and sustained.

The role of the client was consistently described as pivotal. As budget holder and final decision-maker,

the client's ambition and level of engagement shaped the overall trajectory of sustainability integration. In projects where the client was proactive and articulated ambitions early, sustainability remained more visible and actionable throughout the process.

Tools such as the Ambitieweb were available in all cases, yet only had impact when actively used and embedded in team routines. Their effectiveness depended less on technical content and more on whether project teams felt ownership and motivation to apply them. This illustrated the interplay between the operational and tactical levels: while intrinsic motivation originated at the individual level, it was shaped and constrained by the priorities and culture at the organisational level.

6.1.2. Barriers to Sustainability Ambition Maintenance

The case studies confirmed several known barriers from the literature while also highlighting context-specific constraints. These barriers were often interrelated and spread across all decision-making levels, with the tactical level emerging as the primary locus of constraint.

All cases revealed barriers consistent with previous studies, including financial limitations, lack of mandate, and insufficient knowledge sharing. At the strategic level, outdated contractual frameworks and weak governance mechanisms were common. In several cases, contracts lacked the flexibility to incorporate evolving sustainability ambitions, limiting the scope for innovation or long-term value optimisation. Policy ambitions were often not effectively translated into actionable criteria, resulting in misalignment between strategic goals and project-level implementation.

At the tactical level, ambitions were frequently reduced to symbolic language without measurable indicators. This conceptual ambiguity limited accountability and made sustainability vulnerable to deprioritisation under time or budget pressure. Organisational discontinuity caused by long project durations, staff turnover, and fragmented teams further disrupted the continuity of sustainability efforts. As one respondent explained:

> *"We tried to keep the same people involved and explain clearly what was done and why."*

At the operational level, intrinsically motivated individuals often experienced limited room to manoeuvre. Their efforts were constrained by rigid procedures, risk-averse cultures, and unclear mandates. Clients were often reluctant to approve innovative or sustainable options when these entailed uncertainty, even when long-term benefits were likely. This tendency was especially evident in Case A and Case B, where proposals involving novel materials or designs were ultimately rejected due to perceived risk.

A recurring cross-level barrier was the project-centric mindset. Lessons, tools, and sustainability knowledge were seldom transferred between projects or embedded in programme-level practices. Despite the availability of instruments such as the Ambitieweb, their impact remained minimal unless embedded in routines and actively supported by leadership. In the absence of structured mechanisms for knowledge retention and ownership, teams frequently had to 'reinvent the wheel', undermining institutional learning.

These findings suggest that barriers to sustainability do not originate from any single factor or level but rather from the interplay between fragmented responsibilities, risk-averse procedures, and the absence of long-term learning systems. Without active alignment across strategic, tactical, and operational layers, ambitions lose momentum over time.

6.1.3. Opportunities to Reinforce Sustainability

Despite these challenges, several key opportunities emerged to reinforce sustainability ambitions throughout the project life cycle. These occurred across multiple phases and governance levels. The initiation phase was particularly important, allowing ambitions to be formulated while resources and scope were still flexible. In the exploration phase, ambitions could be aligned with stakeholder input and project framing. The elaboration phase still permitted sustainable design decisions, especially when team continuity was preserved. Finally, phase transitions stood out as critical points. Depending on leadership and communication, such transitions could function as either moments of risk or as windows of opportunity.

Seizing these opportunities required coordination across layers, particularly between strategic ambition-setters and operational implementers. A shared view among interviewees was that earlier anchoring of

sustainability increased its long-term influence, yet anchoring alone was insufficient. Ambitions needed to be continuously maintained through visibility, ownership, and reinforcement mechanisms.

6.1.4. Success Factors

Successful integration of sustainability could rarely be attributed to a single driver. Instead, it emerged from the interplay of tools, timing, individual agency, and institutional support. Across all three cases, interviewees highlighted the importance of people, leadership, shared ownership, and a culture of openness were often the most decisive factors. Celebrating progress and making achievements visible were also mentioned as important motivational levers.

Structural elements were equally important. Clear mandates, governance frameworks, and procedural consistency enabled actors to operate with continuity and legitimacy. In Case A, for instance, political visibility, budgetary flexibility, and a stable project team contributed to successful implementation. In Case B, the lack of such structures placed greater pressure on individual initiative. The interviewee in Case C described how contractual clarity may support sustainable implementation, even in the absence of strong client engagement. While this is based on a single perspective, it offers an illustrative example that aligns with broader observations from Cases A and B.

Success also depended on the effective use of tools, not merely their presence. Instruments such as KPIs, trade-off matrices, and the Ambitieweb only gained traction when embedded in practice and supported by leadership. Without team ownership and belief in their relevance, tools remained symbolic or underutilised.

6.1.5. Conclusion

Across the three cases, the integration of sustainability into infrastructure and mobility projects was shaped by both institutional structures and interpersonal dynamics. While sustainability was broadly valued, it was rarely structurally secured. Intrinsic motivation was a powerful success factor, but its effectiveness was constrained by ambiguity, rigidity, and a lack of consistent anchoring.

Opportunities were most abundant in the early phases: during initiation and exploration, when ambitions could still be shaped and strategic alignment was feasible. Yet successful implementation required more than early enthusiasm. In Case A, phase transitions were actively managed to maintain momentum. In Case B, persistent individuals carried ambitions forward despite weak structures. In Case C, contractual safeguards compensated for limited client engagement.

These findings indicate that timing alone is insufficient. Persistence is equally vital. Where ambitions were clearly defined and backed by monitoring, reporting, and visibility, sustainability remained a priority. In their absence, even committed individuals could not prevent ambitions from fading.

Sustained integration of sustainability requires both committed people and enabling systems. This study identifies four interrelated themes as critical success conditions:

- **Clarifying and sharing knowledge:** Including ambition formulation, measurability, and knowledge transfer.
- **Embedding through governance and systems:** Through contractual mechanisms, monitoring, and procedural alignment.
- **Structuring for continuity and timing:** Supporting team cohesion and momentum across project phases.
- **Motivating and aligning people:** Fostering leadership, ownership, and a culture of intrinsic commitment.

Across all three cases, alignment among these dimensions was essential. Tools functioned only when embedded in supportive structures and cultures. Sustained visibility, shared commitment, and reinforcement of individual motivation were needed to turn ambition into practice.

6.1.6. Comparing Stated and Emergent Themes

During each interview, respondents were asked to name the three most important barriers and success factors for maintaining sustainability ambitions within their project context. This question was posed

before any discussion of academic literature, allowing for open, unprompted reflection. A comparison between these top three answers and the themes that emerged throughout the interviews reveals a notable asymmetry, particularly with regard to success factors.

For barriers, there was a relatively high degree of alignment between what respondents named explicitly and what they elaborated on during the interview. The three most frequently coded themes were temporal pressure (21 coded mentions), budget and costs (20), and conceptual ambiguity (13). These largely match the barriers most often listed in the top three answers: budget and costs (5/10), temporal pressure (4/10), and intrinsic motivation (5/10) (see Figure 6.1). This suggests that respondents were generally aware of and able to articulate the barriers they encountered in both spontaneous reflection and in-depth conversation. Although some structural barriers, such as knowledge gaps or governance fragmentation, were less frequently named explicitly, they did appear consistently in the broader thematic analysis, indicating their implicit influence.

In contrast, the alignment between coded themes and named success factors was weaker. The three most frequently coded success factors were motivating and aligning people (51 of 157 total success factor mentions), embedding through governance systems (47), and clarifying and sharing knowledge (32). However, when respondents were asked to name their top three success factors, they most frequently mentioned policy and institutional anchoring (6/10) and contractual or procedural governance (4/10), while team leadership and intrinsic motivation were cited by only 3 of 10 respondents (see Figure 6.2). This indicates that although interpersonal dynamics played a major role throughout the conversations, respondents tended to highlight more formal or system-oriented success factors when prompted.

A further nuance is that the most frequently named success factors do not always correspond to, or resolve, the most frequently named barriers. For instance, while financial constraints and procedural rigidity were commonly cited obstacles, financial or contractual flexibility were seldom named as key success factors. Instead, respondents more often pointed to leadership, motivation, and team ownership as crucial success factors. However, the thematic coding also shows that structural anchoring remains an important success factor in practice, embedding through governance systems was the second most coded theme overall, indicating that both relational and institutional success factors are considered relevant.

Taken together, these findings suggest that barriers and success factors operate across different system levels and are not always framed symmetrically in stakeholder reflections. While institutional and contractual constraints are widely acknowledged as barriers, the success of sustainability ambitions is often attributed to a combination of human-centred effort and formal anchoring. This highlights the need for at least dual-level strategies: reducing systemic and procedural barriers, while simultaneously strengthening the soft power of leadership, motivation, and shared ownership.

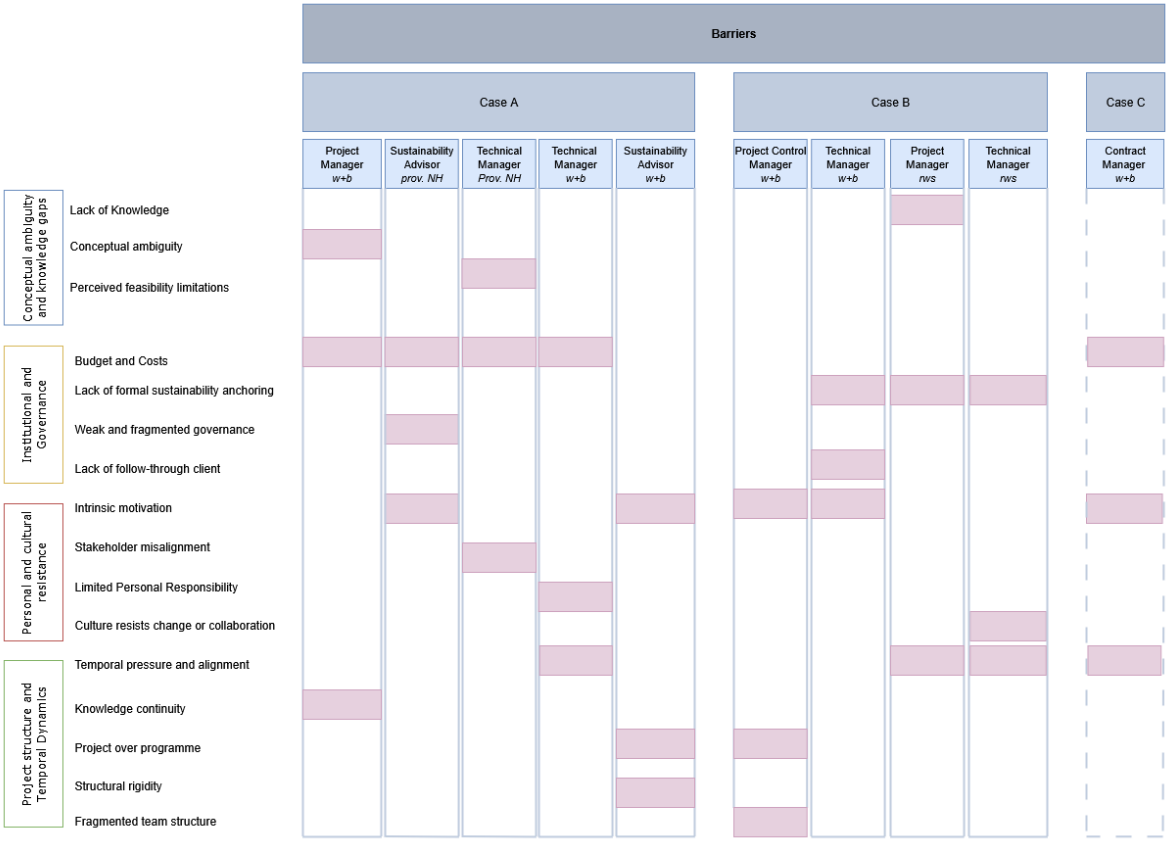

Figure 6.1: Three most important barriers to sustainability ambition, as named by interviewees

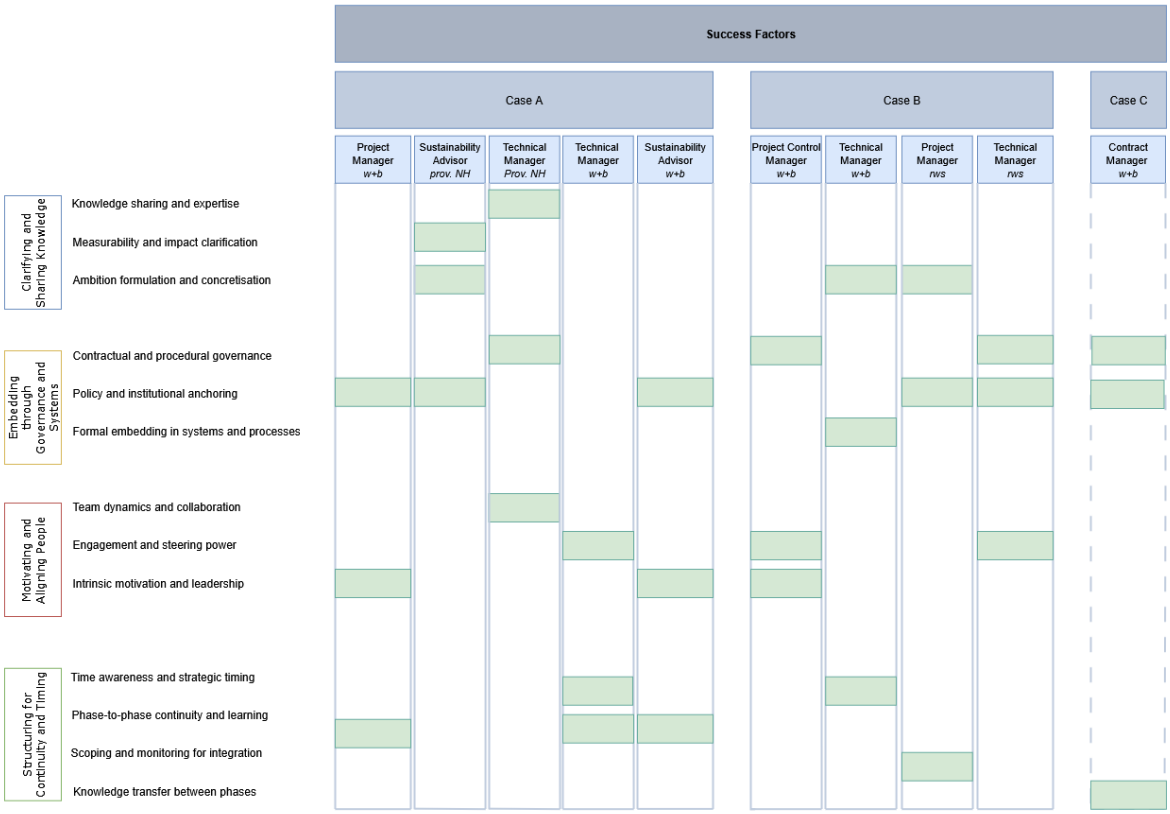

Figure 6.2: Three most important success factors for sustainability ambition, as named by interviewees

6.2. Concluding Reflection

As one interviewee aptly remarked:

> *"We say it has to be wine and it has to be red, but we never ask about the alcohol percentage."*

This metaphor captured a recurring challenge across the cases: while sustainability was often present in strategic ambitions, it lacked specificity and enforceability in practice. Intrinsic motivation was valuable, but insufficient in isolation. Without clear alignment, ownership, and accountability across decision-making levels, sustainability ambitions risked erosion.

Taken together, the findings presented in this chapter offer a robust empirical foundation to address the core analytical dimensions of this study. They provide concrete insights into how sustainability ambitions are influenced by stakeholder roles (RQ2), constrained by barriers (RQ3), reinforced through timely opportunities (RQ4), and supported by a combination of success factors (RQ5). These insights form the basis for the synthesis and design implications explored in the next chapter.

6.3. Validation

The credibility of the findings was enhanced through a range of embedded validation strategies that strengthened the internal consistency and robustness of the research.

First, the findings were derived through triangulation of multiple data sources: ten semi-structured interviews, document analysis (where available and shared), and cross-case comparison. This multi-method approach allowed for consistency checks across different forms of evidence and ensured that observed patterns were not reliant on a single perspective.

Second, member checking in context was applied throughout the interviews. Preliminary interpretations were regularly paraphrased and verified with the interviewees in real time to ensure that the researcher's

understanding remained aligned with the respondent's intent. This helped prevent misinterpretation of key statements and enabled immediate refinement. For example:

> "So, what you just said, do you mean that the goal is really to quantify it, so that it becomes easier for people to understand, and gives them a clearer picture?" "Yes."

Third, the coding and interpretation process was iterative and reflective. Rather than relying solely on a fixed set of pre-defined codes, the researcher repeatedly returned to the data to reassess, adapt, and refine emerging themes. This involved coding the same interview segments multiple times across different stages of the analysis, allowing for a continuous comparison between new empirical patterns and existing theoretical concepts. This process strengthened the internal validity by ensuring that the findings were not the result of one-time interpretations, but were grounded in repeated and deliberate examination.

Fourth, the findings were validated against existing literature. A key element of the research design was to examine whether well-documented barriers and success factors from literature were also observable in the empirical context. Several expected patterns (e.g. financial constraints, governance fragmentation) were confirmed, while additional themes (e.g. the strategic impact of phasing and lack of knowledge handover) emerged inductively.

Fifth, preliminary conversations with key stakeholders were conducted before case selection. These preparatory dialogues provided early insights into the project context, helped assess whether sustainability ambitions had evolved or faded across phases, and informed the development of timeline reconstructions. While not formally recorded, these conversations strengthened the internal validity of case selection and thematic focus.

Together, these strategies offer a robust foundation for the empirical claims presented in this study, compensating for the absence of external expert validation and supporting the credibility of the findings.

7

Discussion and Limitations

7.1. Discussion

This chapter reflects on the empirical findings in light of the academic literature discussed in Chapter 2. Following the six barrier categories introduced earlier: *conceptual and motivational, financial and economic, organisational and cultural, knowledge-related, governance and policy, and stakeholder and participation-related* this section compares theoretical expectations with observed dynamics in the three infrastructure case studies. this discussion evaluates to what extent existing scholarship reflects the practical realities of sustaining sustainability ambitions throughout early project phases. Furthermore, it identifies inductively derived insights that suggest directions for theoretical advancement and practical intervention.

Each of the barriers and succes factors identified from literature are linked and analysed to the findings from the emprical research.

Conceptual and Motivational

The literature highlights that sustainability in infrastructure projects is often vaguely defined, future-oriented, and lacks clear ownership. Weak goal formulation, poor operationalisation, and tensions between the different pillars of sustainability are frequently cited as key impediments to effective implementation (Epstein, 2018; Goedknegt, 2013; Jakobsen, 2024; Loorbach et al., 2010; Silvius et al., 2012; Vergerio & Knotten, 2024; Verstraeten, n.d.; Visser, 2013). These findings are clearly echoed in the interviews. All respondents indicated that they find it difficult to concretise or interpret sustainability goals within the project context, which often results in inertia or conservative ambition levels.

However, the empirical data also revealed several important nuances that go beyond what is covered in the existing literature. One key insight is that the future-oriented character of sustainability is not just a conceptual issue but is reinforced by the absence of concrete translation into project definitions. This disconnect contributes to sustainability being sidelined in later phases. In addition, several stakeholders referred to perceived feasibility limitations as a major reason for deprioritising sustainability in design choices. Although this aspect is not explicitly addressed in existing research, it is closely linked to knowledge and motivation: stakeholders refrain from sustainable alternatives not necessarily due to unwillingness, but because of uncertainty about their feasibility or perceived risks. In this sense, risk aversion and feasibility doubts can be interpreted as expressions of limited knowledge or experience with sustainable alternatives, rather than purely motivational barriers.

Moreover, while the literature does refer to a lack of ownership, it does not explicitly address the role of intrinsic motivation. In contrast, the empirical findings identified intrinsic motivation as a critical factor: in projects where stakeholders were personally engaged or felt a sense of responsibility for sustainability, ambitions were more likely to be maintained. This suggests that fostering intrinsic motivation at the individual level may be just as crucial as formal anchoring at the organisational level, an insight that is underrepresented in existing theoretical work.

Economic and Financial

The literature consistently identifies budget constraints, cost-risk trade-offs, and short-term financial logics as key barriers to sustainable decision-making (Cecere et al., 2020; Vergerio & Knotten, 2024; Wuni, 2022). These themes were strongly confirmed in the empirical research. Stakeholders across roles and cases noted that financial feasibility often became the dominant criterion during later project phases, particularly in the elaboration phase. Sustainability ambitions were regularly scaled back or shelved entirely when confronted with perceived budgetary pressures. Interestingly, the empirical findings further revealed that financial rigidity was not only linked to overall budget limitations but also to procedural timing, sustainability assessments were often conducted too late to affect financial frameworks.

Organisational and Cultural

Literature on organisational culture highlights the importance of shared sustainability norms and leadership commitment (Silvius et al., 2012). Empirically, this was confirmed, yet with a notable nuance: intrinsic motivation at the individual level often outweighed the influence of broader organisational culture. Projects benefited when key team members personally valued sustainability, even in contexts with weak institutional anchoring. Another literature theme: short-term thinking, was confirmed as a critical issue, but with expanded meaning. In practice, short-termism was linked to project-based logic and the lack of programme-level coordination. Furthermore, team fragmentation and lack of continuity emerged as central barriers. Although governance fragmentation is widely discussed in literature (Wuni, 2022), the specific operational effects of changing team compositions were not.

Knowledge-related

Academic sources frequently point to deficits in sustainability knowledge, particularly at strategic and early tactical levels (Krancher, 2020; Silvius et al., 2012). This was corroborated in the case studies. However, interviewees stressed not only a general lack of knowledge but also an absence of structured knowledge transfer. Project-based governance structures, high staff turnover, and poor documentation resulted in repeated mistakes and missed opportunities for learning. Tools like the Ambition Web were considered helpful, but only when used as part of a reflective team culture. Their standalone effect was limited, highlighting that knowledge tools must be embedded in organisational learning mechanisms to be effective, an aspect underexplored in existing literature.

Governance and policy

The literature highlights regulatory fragmentation, vague mandates, and weak institutional frameworks as key governance barriers (Vergerio & Knotten, 2024; Wuni, 2022). These were echoed in the empirical findings, but new details emerged. Misalignment between project timelines and sustainability procedures was particularly problematic: environmental assessments or stakeholder dialogues were often introduced too late to meaningfully shape project trajectories. Furthermore, interviewees stressed the lack of follow-up mechanisms across phases, ambitions formulated in the initiation or exploration phase were rarely fully translated into later stages. This points to the need for governance models that better accommodate phase transitions and continuity of sustainability objectives.

Stakeholder and participation

Stakeholder engagement is widely promoted in literature as a means to enhance legitimacy and improve sustainability outcomes (Silvius et al., 2012). However, the empirical findings suggest that such engagement, when poorly timed or undefined in scope, can dilute rather than enhance sustainability ambitions. In particular, early involvement without clear mandates or expectations led to confusion and slowed decision-making. Moreover, the strategic role of internal champions, such as sustainability advisors, was underutilised. Although literature values participation, it often overlooks the relational and power dynamics that determine whether participatory processes effectively shape project outcomes.

Inductively Derived Insights

Several barriers emerged from the interviews that were not strongly represented in the literature. First, the issue of timing, particularly the long duration of infrastructure projects, led to mismatches between initial sustainability goals and final contract execution. One project control manager described con-

tracts as "*snapshots from five years ago,"* highlighting the need for adaptable frameworks. Second, organisational risk culture proved decisive. Sustainability innovations were often only approved when consultants explicitly took on the associated risks, suggesting that client risk aversion remains a hidden but potent barrier.

Success Factors and Levels of Decision-making

The literature identifies a variety of success factors, which were largely confirmed in the empirical cases. These include: strong mandates, early integration in procurement processes, empowered internal advocates, and embedded reflection points. However, the empirical work also revealed that many of these success factors are concentrated at the strategic or tactical level. At the operational level where actual design choices are made, success is more dependent on individual motivation, team culture, and continuity. This discrepancy suggests that while high-level frameworks are necessary, sustainable outcomes depend on consistent translation and ownership at lower levels.

In sum, the literature provides a solid foundation for understanding sustainability barriers in infrastructure projects, but it insufficiently addresses phase continuity, team dynamics, and the operational-level factors that drive or block sustainable decisions. The empirical cases highlight that success hinges not only on strategic ambition but on sustained commitment across phases and roles.

7.1.1. Concluding Reflection

Overall, the literature provides a useful starting point for understanding sustainability erosion in infrastructure and mobility projects. Yet it does not fully capture the procedural, cultural, and temporal dynamics revealed in practice. The empirical findings illustrate that sustainability success hinges on more than strategic intent: it requires sustained commitment, reflective processes, and individual agency throughout the project lifecycle.

Despite certain limitations that are discussed in the next subsection, the research presents several important strengths. The inclusion of diverse perspectives across three IPM teams allowed for multi-actor, real-world insights. The abductive design facilitated theoretical grounding while remaining open to emerging themes. Rather than focusing on frequency, the analysis foregrounded illustrative quotes and anecdotes, offering a rich, nuanced view of practice.

7.2. Limitations

During this research several limitations were encountered.

At first, **the sample size and stakeholder coverage**. While qualitative research typically reaches data saturation with 8 to 12 interviewees (Guest et al., 2006; Mason, 2010), this study included a total of 10 interviewees. Although this falls within the acceptable range, the aim was to ensure representation from different organisations and functions involved in each case to capture diverse interests and perspectives. In practice, this proved difficult. Infrastructure projects often span multiple years, and some individuals involved in earlier phases were no longer reachable due to staff turnover, retirement, or in one case, death. As a result, not all cases had equal representation. For example, in the Marssum project, it was not possible to interview the client, and follow-up attempts to include the contractor were unsuccessful. Consequently, this case was informed by interviews from only one organisation, which limits the ability to compare across organisational perspectives and reduces the depth of triangulation. These limitations affect the overall transferability and robustness of the findings.

Secondly, **the ambiguity in the interpretation of 'fading sustainability ambitions'** posed a methodological challenge. Although the concept served as a guiding lens throughout the analysis, its practical application proved complex. In the Cruquius case, for instance, it was evident that certain sustainability measures were removed over time, which clearly illustrated a decline in ambition. In contrast, in cases such as Westerwoldse AA, it was less straightforward to determine whether a similar pattern had occurred. Diverging interpretations among respondents regarding what constitutes a loss or dilution of sustainability ambition may have influenced the consistency and comparability of the findings across cases.

Another limitation is the **limited theoretical foundation**. The concept of fading sustainability ambitions in the early phases of infrastructure projects is relatively underexplored in academic literature. As a

result, this research had to rely on insights from related domains such as transition governance, project management, and sustainability decision-making. While this allowed for an interdisciplinary approach, the limited availability of prior empirical work on this specific topic may affect the conceptual clarity and comparability of findings with other studies.

Another limitation is the **limited number of case studies**. The study examined a small number of cases, which inherently limits the available data and restricts the ability to generalize findings. With a limited sample, it becomes more difficult to distinguish between common patterns and outlier outcomes. Although the multiple case study approach strengthens internal comparison and structure, external validity remains limited. The validation of findings was conducted with an expert panel; however, all consulted experts were from Witteveen+Bos, which may limit the objectivity and breadth of the validation process.

Also, a limitation is the **potential bias and subjectivity**. As with many qualitative studies, this research is subject to potential bias. Both from the researcher and from participants. Interview data relies on self-reporting and may be affected by memory limitations or social desirability bias, as respondents might have framed their organisation's role more positively. Additionally, the researcher's interpretation plays a role in the analysis. While efforts were made to minimise bias, such as using standardised interview guides, triangulation, transcript reviews and transparent documentation, subjectivity cannot be entirely excluded. In several cases, the absence of multiple perspectives within a single case further limits the ability to cross-validate statements.

This research is also limited to a certain **contextual and geographic scope**. This research is rooted in the Dutch policy and governance context, particularly in the framework used by the Ministry of Infrastructure and Water Management. This national context limits the generalizability of findings to projects in other countries or regions, where planning processes, institutional structures, or cultural norms may differ significantly. However, within the Dutch context, attention was paid to ensuring geographic and contextual diversity. The selected cases are spread across both densely populated areas, such as North Holland, and more sparsely populated regions in the north of the country. This spread allows for insights into different regional dynamics and planning challenges, thereby enhancing the relevance of findings across varied Dutch contexts. In addition, all selected cases involved public or semi-public clients with mandates related to long-term societal value creation. As such, the findings and recommendations are primarily applicable to governance institutions. In contrast, infrastructure projects in the private sector, where profitability and financial performance are more dominant drivers, operate under different incentives and constraints. Therefore, the applicability of the findings to privately commissioned projects is limited.

Yet another limitation is the **stakeholder and disciplinary representation**. Most respondents, had a technical background. Although many had transitioned into managerial or coordinating roles, their technical orientation may have influenced their responses. This could result in a bias toward technical or procedural explanations for challenges, potentially underrepresenting organisational, behavioural, or cultural factors that also contribute to sustainability ambition fading.–> Aanvullen met witteveen+bos enkel

Finally, a limitation is that in this research the focus was on **breadth over depth**. The study prioritised a broad understanding of how sustainability ambitions evolve during early infrastructure project phases, with a focus on client and consultant perspectives. As a result, other perspectives, such as those of contractors, community stakeholders, or political decision-makers, were not included in the analysis. While this choice aligns with the research objective, it limits the overall scope and depth of the findings.

8

Conclusion and Recommendations

This chapter synthesises the main findings of this research by providing clear answers to the five sub-questions, reflecting on the overarching research objective, and offering targeted recommendations for future research and professional practice. The study explored how sustainability ambitions are formulated, maintained, and potentially eroded across decision-making processes in Dutch infrastructure and mobility projects.

8.1. Conclusion

Research objective reflection

The central objective of this study was:

> *To explore the phenomenon of sustainability ambition erosion in infrastructure and mobility projects, by identifying involved actors, key barriers, and validating potential strategies to mitigate this erosion.*

This objective was addressed through literature review and three empirical case studies, each tracing how sustainability ambitions evolved over time and across decision-making levels. The study found that ambition erosion is rarely caused by a single failure but results from a misalignment between strategic intentions, tactical translation, and operational execution. The research confirmed that sustainability ambition erosion is not the result of a single factor but emerges from a systemic misalignment across three interdependent layers: structural embedding, procedural reinforcement, and behavioural commitment. Even when one or two of these elements are present, the absence of the third often leads to ambitions fading in practice. This insight aligns more closely with the three-legged stool model: just as a stool cannot stand if one leg is missing, sustainability cannot persist unless all three supporting dimensions are upheld. The research identified actionable success factors, ranging from early ambition anchoring to individual advocacy and phase-specific interventions. The sub-objectives were addressed as follows: sustainability ambition erosion was analysed through multi-level thematic barriers, influential stakeholders were identified with particular attention to their behavioural roles and success factors were validated through the case-study, amongst others via cross-case comparison.

RQ1 - How is sustainability currently considered in the decision-making process of infrastructure and mobility projects across different stages?

Sustainability is most actively considered in the early strategic and tactical phases of infrastructure projects. Ambitions are typically aligned with societal objectives and translated into frameworks or tools during initiation and exploration. However, this conceptual attention does not guarantee continuity. In the elaboration phase, where decisions are formalised, sustainability is often displaced by cost constraints and technical feasibility. In the realisation phase, the influence of prior ambitions largely depends on their earlier formalisation. Thus, while ambition-setting is structurally embedded upstream, follow-through is inconsistent downstream, especially when ambitions lack measurable definitions or are not contractually safeguarded.

RQ 2- How do different stakeholders in the case studies influence the prioritization of sustainability in decision-making?

Different stakeholders influence the prioritisation of sustainability primarily through their individual motivation and behaviour, rather than through their formal role or hierarchical position. While actors can impact sustainability, the empirical cases show that intrinsically motivated individuals are most decisive in keeping sustainability ambitions alive. This influence is not confined to specific roles; project managers, technical experts, and advisors alike played pivotal roles when personally committed.

The findings therefore indicate that the ability of stakeholders to influence sustainability is not determined by their formal team role, but by the extent to which they are intrinsically motivated to prioritise it. Formal mandates and authority remain relevant, but they are not sufficient in themselves to sustain ambition across phases. Motivation enables action, regardless of position.

This insight is visualised in Figure 8.1, which illustrates that the impact of an actor on the prioritisation of sustainability depends more on personal motivation than on their assigned IPM role.

Figure 8.1: Intrinsic motivation outweighs formal role

RQ3 - What are the key barriers that prevent sustainability from remaining a decisive factor throughout the decision-making process?

The erosion of sustainability ambitions is rarely caused by a single factor. Rather, it results from a web of interrelated barriers that emerge across different project contexts, decision-making levels, and phases of the infrastructure life cycle. While each case exhibited a unique configuration of constraints, several overarching patterns and shared challenges could be identified.

The case studies confirmed six barrier categories that are well-documented in the literature: conceptual ambiguity, financial constraints, organisational resistance, knowledge gaps, weak governance, and shallow participation. However, the empirical findings also revealed context-specific dynamics that shaped how, where, and when sustainability lost priority.

Across all cases, three barrier types stood out as particularly prominent, either because they were literally named by interviewees or because they appeared consistently in the thematic analysis:

- Temporal pressure and misalignment
- Budget and cost concerns
- Conceptual ambiguity

These barriers were often closely interwoven. When sustainability ambitions were vaguely defined or lacked measurable criteria, they became especially vulnerable to deprioritisation under time pressure or financial constraints.

While some barriers, such as time pressure or feasibility concerns, were openly recognised and verbalised by participants, others, such as fragmented governance or the absence of institutional learning, emerged more subtly. These inductively derived insights point to structural conditions that, although less visible, significantly undermine sustainability ambitions.

In sum, the barriers that prevent sustainability from remaining a decisive factor are both systemic and situational. Addressing them requires deliberate alignment across strategic ambition-setting, tactical

translation, and operational implementation. Without such coherence, even well-intended sustainability goals are unlikely to withstand the practical pressures of project delivery.

RQ4 - At what points in the decision-making process do opportunities arise to strengthen sustainability ambitions, and what factors contribute to their succesful integration?

Opportunities to strengthen sustainability arise primarily during transitions between project phases. The shift from exploration to elaboration proved especially critical. If ambitions were revisited and redefined at this moment, projects maintained greater consistency. Early phases offer flexibility to define ambitions, but without strategic tools (e.g. Ambitieweb) and clear alignment mechanisms, this potential was underused. Later phases, although more constrained, still allowed for reinforcement if supported by team continuity, structured reflection (e.g. kick-offs), or committed individuals. Phase transitions thus act as inflection points: without deliberate interventions, they risk becoming erosion points.

RQ5 - What succes factors can help ensure that sustainability ambitions remain a priority without significantly complicating project decision-making?

The empirical research revealed that sustainability ambitions are most likely to be maintained when they are embedded across three complementary dimensions: *structurally, procedurally, and behaviourally*. Rather than complicating decision-making, these success factors can provide clarity, direction, and momentum, if they are applied strategically.

Across all cases, the most commonly mentioned success factors were:

- Intrinsic motivation and leadership
- Engagement and steering power
- Contractual and procedural governance

However, the findings revealed that success factors were not uniformly distibuted. while aforementioned themes were present in all cases, certain factors emerged more strongly in one context than another, illustrating the importance of case-specific dynamics. For example, phase-to-phase continuity and strategic timing were especially prominent in one case, whereas institutional anchoring stood out in another.

Across all cases procedural instruments such as KPI, trade-off matrices and the ambitieweb gained effectiveness only when supported by leadership and embedded in practice. Tools were not decisive in themselves, their value depended on whether teams believed in their relevance and had the capacity to act on them. Success therefore relied on the interplay of structure process and behaviour, not on isolated interventions.

Ultimately, success depended not just on the presence of individual measures, but on their timely and combined deployment. As one project manager stated:

> *"Sustainability only survives if you anchor it early, revisit it often, and allow people to own it along the way."*

This underlines the importance of a deliberate strategy that embeds sustainability at multiple levels, without overloading the process. When implemented in this way, sustainability integration can become a reinforcing rather than complicating element in project decision-making.

In summary, success factors are both systemic and context-sensitive. Some factors, such as leadership, engagement and govenance clarity are essential across all projects. Others, such as timing, continuity, or institutional anchoring, may prove decisive in a particular casses. What unites the successful examples is not a specific formula, but a deliberate strategy to reinforce sustainability through multiple, aligned, dimensions. When structural, procedural and behavioural supports converge, sustainability becomes a reinforcing, rather than complicating element of infrastructure and mobility projects.

MQ - How can the initial ambitions for sustainability in infrastructure and mobility projects be maintained throughout the decision-making process?

Sustainability ambitions in infrastructure and mobility projects can only be maintained when actors remain aware of the systemic complexity in which these ambitions evolve. The research shows that ambition erosion does not occur at a single moment or phase, but unfolds gradually through the interaction of structural, behavioural, and procedural dynamics.

The figure below provides an integrated visualisation of this process. It starts with the normative definition of sustainability and the systemic project conditions: the **project life cycle**, **stakeholder structure**, and **decision-making levels**. Each of these dimensions gives rise to potential barriers, ranging from budget pressures and conceptual ambiguity to weak governance and fragmented responsibility, which can undermine sustainability ambitions between formulation and implementation.

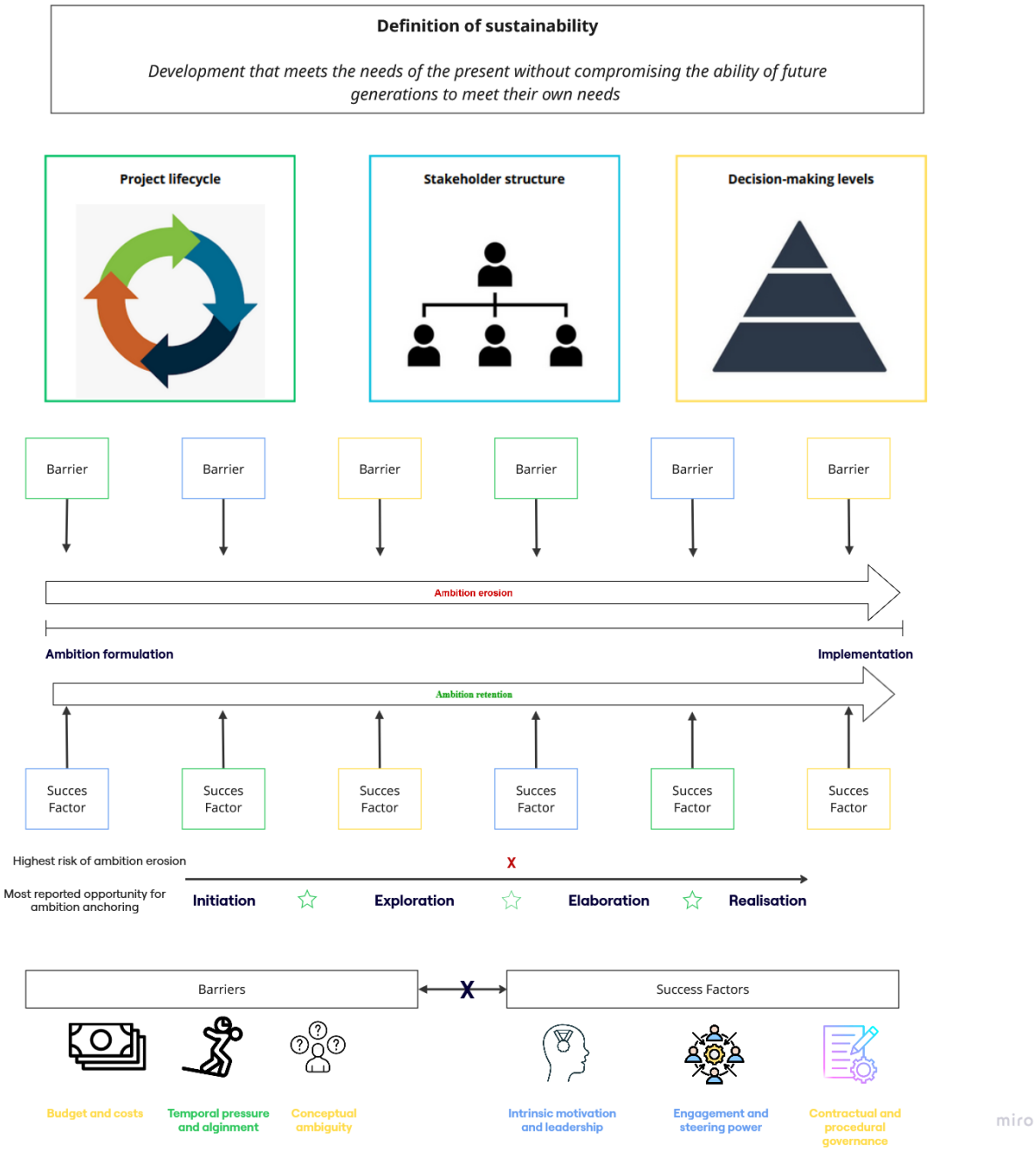

Figure 8.2: Visualisation of the sustainability ambition process: systemic context, barriers, and success factors across the project lifecycle. Colour-coded elements reflect their dominant source.

At the same time, the research identified a range of success factors that can help counteract this erosion. However, these did not correspond one-to-one with the barriers raised by respondents. Interviewees often cited different elements as success factors than they did as barriers. For instance, while budget constraints were frequently mentioned as a major barrier, the solution “more budget” was rarely cited as a key success factor. Instead, respondents pointed to elements such as team leadership, contractual clarity, or intrinsic motivation. This mismatch suggests that actors perceive barriers and success factors through different lenses. As a result, overcoming a barrier does not automatically lead to success. Ambition retention requires more than the removal of obstacles, it requires deliberate activation of supportive conditions.

The empirical analysis further revealed that sustainability ambitions are not tied to a single phase. While

the initiation and early exploration phases offer important opportunities to embed ambition, especially when teams are reflective and ambitions are translated early into concrete guidelines, every phase contains risks and opportunities. In particular, the transition from exploration to elaboration was identified as the most vulnerable moment for ambition erosion, due to changes in team composition, shifting priorities, or lack of procedural reinforcement. These findings emphasise the importance of actively managing phase transitions, rather than viewing them as neutral handovers.

Although some barriers and success factors were identified across all three cases, their relative weight varied significantly. In Case A, strong emphasis was placed on continuity and timing, while in Case B, intrinsic motivation and cultural alignment were decisive. This variation underscores that each project may require different types of support. In some contexts, intrinsic motivation is high but structural frameworks are weak, in others, formal instruments are present but intrinsic motivation is lacking. Identifying which of these three dimensions: structure, procedure, or behaviour, requires reinforcement is therefore a project-specific task.

These insights point to the need for a more holistic perspective on sustainability management. Rather than relying on technical tools or individual champions alone, the question should be: how do we reinforce sustainability at every level of the process? This leads to the core conclusion of the study, visualised through the metaphor of the three-legged stool. As illustrated below, sustainability can only persist when supported by three equally essential dimensions:

- Structural anchoring: through policies, contracts, procurement criteria, and measurable KPIs (top-down formalisation)
- Procedural reinforcement: via ambition revisits, onboarding, design rituals, and phase transitions (tactical translation)
- Behavioural commitment: including intrinsic motivation, ownership, leadership, and trust (bottum-up commitment)

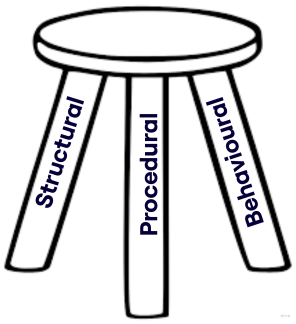

Figure 8.3: The three essential legs

Even when two of these pillars are well-established, the absence of the third often leads to ambition erosion. For instance, a well-written contract and motivated individuals cannot compensate for weak procedural structures during phase transitions. Conversely, clear procedures and governance frameworks cannot ensure sustainable outcomes if behavioural ownership is lacking.

In conclusion, when structure, procedure, and behaviour are aligned and when their vulnerabilities are prevented from reinforcing one another, sustainability can become a durable and enabling force in infrastructure and mobility projects.

8.2. Recommendations

This research does not provide a ready-made roadmap or fully developed operational framework to prevent the erosion of sustainability ambitions in infrastructure and mobility projects. Instead, it offers a conceptual structure that explains how and why ambition loss occurs, and what types of reinforcement are needed to counter it. This study forms the substantive starting point for the development of a structured ambition support guide. Such a guide would help project teams recognise where sustainability

ambitions are at risk and identify appropriate reinforcement strategies across structural, procedural, and behavioural domains. While the findings may eventually be translated into practical tools, such as reflection formats, onboarding methods, or decision support templates, the current research already offers the core principles and structure upon which such instruments can be built.

The core contribution of this study lies in its redefinition of ambition erosion as a problem of systemic misalignment between three interdependent pillars: structural anchoring, procedural reinforcement, and behavioural commitment. The research reveals that sustainability ambitions are unlikely to endure unless these three dimensions are simultaneously supported. This interdependence, rather than any single barrier or solution, should guide future interventions.

To advance this agenda, the following research directions and practical actions are proposed.

First, future research should **expand the empirical base**. The current study is based on two full case studies and one supporting case, offering thematic depth but not empirical generalisability. **Broader inclusion of project actors**, such as contractors, politicians, stakeholder managers, and delivery teams, could enrich the understanding of cultural and procedural dynamics that affect sustainability. Retrospective **case studies of completed projects** may also help surface long-term effects and institutional learning, particularly regarding ambition retention across the full project life cycle.

Second, greater **conceptual clarity is needed around the term "sustainability ambition."** The study revealed that stakeholders interpreted the term differently, often without shared definitions or explicit documentation. Misalignment in interpretation risks ambiguity in implementation. Exploring how these differences in interpretation influence implementation could help reduce misalignment in later stages.

Similarly, **greater attention should be paid to phase transitions**, particularly the shift from exploration to elaboration, which emerged in all cases as a moment of heightened vulnerability. What makes these transitions fragile, and how might procedural tools or onboarding rituals strengthen ambition continuity?

Fourth, **the behavioural dimension deserves focused attention**. The research found that intrinsic motivation and informal leadership were often decisive in maintaining sustainability ambitions, but also fragile and poorly supported. Future studies could examine how to foster such motivation structurally, through leadership practices, role design, or team culture. Mechanisms to support knowledge retention and team continuity (e.g. minimum contract durations, long-term team composition, or sustainability champions) also warrant investigation.

Finally, research is needed into **adaptive forms of ambition integration in contracts**. While formal ambition anchoring was seen as a success factor, overly rigid formulations can lead to erosion when contexts shift. Further work is needed on flexible, context-sensitive ambition frameworks that combine clarity with innovation space.

In parallel, this study also identifies key areas for practical improvement, particularly for consultancies like Witteveen+Bos. One such recommendation is to **formalise the structural role of sustainability experts within project teams.** Examples such as the Province of North Holland, where each procurement is reviewed by a sustainability advisor, demonstrate how such roles can help ensure consistent ambition translation across projects.

Recommendations for practice

This research also provides direction for practice, particularly for consultancies such as Witteveen+Bos and their public clients. A first recommendation is to **formalise the role of sustainability experts within project teams**, ensuring that ambition translation and continuity are structurally embedded from procurement to elaboration. The example of the Province of North Holland, where sustainability advisors review all tenders, demonstrates how this can be implemented effectively.

Second, Witteveen+Bos can strengthen its position as a **partner in ambition realisation** by facilitating the translation of strategic sustainability goals into concrete project-level decisions. This could be supported through co-creation sessions, ambition-setting workshops, or structured reflection tools. Furthermore, consultants can improve client engagement by framing sustainability not only as a normative goal, but also as a form of risk management, addressing long-term regulatory, reputational, and resource-related risks.

Third, the firm is encouraged to explore and promote **collaborative risk-sharing mechanisms**. By co-investing in innovative solutions, such as low-carbon materials or nature-based designs, clients and contractors can jointly reduce the perceived risks of sustainability-driven innovation. The Cruquiusbrug case illustrates how this type of shared commitment can open the door to new practices.

Fourth, **the internal and external communication of good practices** should be reinforced. Lessons learned from projects where sustainability ambitions were successfully retained can be shared through internal platforms, sector publications, and contributions to professional dialogues, creating a culture of shared learning and inspiration.

At a systemic level, the **procurement and evaluation culture** should shift from short-term price–quality ratios to long-term public value. Sustainability ambitions should be established early, translated into measurable criteria, anchored contractually, and clearly communicated across project layers: Advance, translate, anchor, clarify *(vervroeg, vertaal, veranker, verduidelijk)*. This approach offers a practical method for embedding sustainability throughout the decision-making process. As one interviewee noted:

> "Circularity doesn't cost money, it saves money. But only if you make the right choices upfront. It often becomes expensive when you try to implement it afterwards."

This quote captures the core message of this study: sustainability must be embedded early, reinforced consistently, and supported collectively. Without such a layered approach, even the most well-intentioned ambitions risk being undermined by shifting priorities, procedural pressure, or behavioural disengagement.

8.2.1. Final reflection

The recommendations presented here do not constitute a prescriptive checklist or static framework. Rather, they provide the building blocks for a practical ambition support guide, one that enables project teams to assess where sustainability is most at risk and determine the appropriate type of reinforcement, depending on context. Whether this takes the form of a self-assessment tool, onboarding ritual, reflection worksheet, or strategic dialogue format remains open to future development.

What this thesis already provides is a conceptual foundation to guide such efforts. It reframes sustainability ambition as a dynamic, collective responsibility, that requires deliberate attention to organisational structure, procedural design, and human behaviour. The task ahead is to continue this development: Design targeted instruments, test their applicability, and ultimately empower project teams to transform ambition into lasting outcomes.

References

Adams, C. R., Minton, C. A. B., Hightower, J., & Blount, A. J. (n.d.). A Systematic Approach to Multiple Case Study Design in Professional Counseling and Counselor Education.

Adeoye-Olatunde, O., & Olenik, N. (2021). Research and scholarly methods: Semi□structured interviews. *Journal of the American College of Clinical Pharmacy*, *4*. https://doi.org/10.1002/jac5.1441

Alabi, M. (2024). Sustainable infrastructure and climate change resilience.

Azungah, T. (2018). Qualitative research: Deductive and inductive approaches to data analysis. *Qualitative Research Journal*, *18*(4), 383–400. https://doi.org/10.1108/QRJ-D-18-00035

Banihashemi, S., Hosseini, M. R., Golizadeh, H., & Sankaran, S. (2017). Critical success factors (CSFs) for integration of sustainability into construction project management practices in developing countries. *International Journal of Project Management*, *35*(6), 1103–1119. https://doi.org/10.1016/j.ijproman.2017.01.014

Bank, I. A. D. (2019). *Inter-american development bank sustainability report 2018* (tech. rep.). https://doi.org/https://doi.org/10.18235/0001639

Bell, S., & Morse, S. (2001). Breaking through the glass ceiling: Who really cares about sustainability indicators? *Local Environment*, *6*(3), 291–309. https://doi.org/10.1080/13549830120073284

Birt, L., Scott, S., Cavers, D., Campbell, C., & Walter, F. (2016). Member checking: A tool to enhance trustworthiness or merely a nod to validation? *Qualitative Health Research*, *26*(13), 1802–1811. https://doi.org/10.1177/1049732316654870

Bisbey, J., Hosseini Nourzad, S. H., Chu, C.-Y., & Ouhadi, M. (2020). Enhancing the efficiency of infrastructure projects to improve access to finance. *Journal of Infrastructure, Policy and Development*, *4*, 27. https://doi.org/10.24294/jipd.v4i1.1175

Blaxter, L., Hughes, C., & Tight, M. (2006). *How to research* (3rd). Open University Press. https://abcreorg.weebly.com/uploads/9/9/8/2/9982776/how_to_research.pdf

Bocken, N. M., & Geradts, T. H. (2020). Barriers and drivers to sustainable business model innovation: Organization design and dynamic capabilities. *Long Range Planning*, *53*(4), 101950. https://doi.org/https://doi.org/10.1016/j.lrp.2019.101950

Bragança, L., Vieira, S. M., & Andrade, J. B. (2014). Early stage design decisions: The way to achieve sustainable buildings at lower costs. *The Scientific World Journal*, *2014*(1), 365364. https://doi.org/https://doi.org/10.1155/2014/365364

Bramer, W. M., de Jonge, G. B., Rethlefsen, M. L., Mast, F., & Kleijnen, J. (2018). A systematic approach to searching: An efficient and complete method to develop literature searches. *Journal of the Medical Library Association : JMLA*, *106(4)*, 531–541. https://doi.org/10.5195/jmla.2018.283

Brundtland report. (n.d.). Retrieved April 16, 2025, from https://www.sciencedirect.com/topics/social-sciences/brundtland-report#definition

Bryman, A. (2012). *Social research methods* (4th). Oxford University Press Inc.

Campbell, J. L., Quincy, C., Osserman, J., & Pedersen, O. K. (2013). Coding In-depth Semistructured Interviews: Problems of Unitization and Intercoder Reliability and Agreement. *Sociological Methods & Research*, *42*(3), 294–320. https://doi.org/10.1177/0049124113500475

Cecere, G., Corrocher, N., & Mancusi, M. L. (2020). Financial constraints and public funding of eco-innovation: Empirical evidence from european smes. *Small Business Economics*, *54*(1), 285–302.

Chatterjee, S. (2024). *Synergy solutions for climate and sdg action: Bridging the ambition gap for the future we want*. United Nations Publications.

Chatziioannou, I., Nikitas, A., Tzouras, P. G., Bakogiannis, E., Alvarez-Icaza, L., Chias-Becerril, L., Karolemeas, C., Tsigdinos, S., Wallgren, P., & Rexfelt, O. (2023). Ranking sustainable urban mobility indicators and their matching transport policies to support liveable city futures: A micmac approach. *Transportation Research Interdisciplinary Perspectives*, *18*, 100788. https://doi.org/https://doi.org/10.1016/j.trip.2023.100788

Chege, J. N., Wachira, J. W., & Mwenda, L. (2015). Effects of leadership styles on implementation of organization strategic plans in small and medium enterprises in nairobi. *International Journal of Economics, Commerce and Management*, *3*(6), 1–16. https://www.semanticscholar.org/paper/Effects-of-Leadership-Styles-on-Implementation-of-Chege-Wachira/9c6266d4176d054daa2a1ce8895c0b94eb6f86e3

Climate Act (Klimaatwet) - Climate Change Laws of the World. (n.d.). Retrieved August 5, 2025, from https://climate-laws.org/document/climate-act_4bc4

Cost-Benefit Analysis - an overview | ScienceDirect Topics. (n.d.). Retrieved June 23, 2025, from https://www.sciencedirect.com/topics/engineering/cost-benefit-analysis

CO_2-Prestatieladder. (n.d.). Co_2-prestatieladder - het instrument voor co_2-reductie [Accessed: 3 March 2025]. https://www.co2-prestatieladder.nl/

Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011). The case study approach. *BMC Medical Research Methodology*, *11*(1), 100. https://doi.org/10.1186/1471-2288-11-100

Dahl, A. L. (2012). Achievements and gaps in indicators for sustainability [Indicators of environmental sustainability: From concept to applications]. *Ecological Indicators*, *17*, 14–19. https://doi.org/https://doi.org/10.1016/j.ecolind.2011.04.032

Dalibozhko, A., & Krakovetskaya, I. (2018). Youth entrepreneurial projects for the sustainable development of global community: Evidence from Enactus program (O. Dębicka, W. Rogula-Kozłowska, & P. Rogula-Kopiec, Eds.). *SHS Web of Conferences*, *57*, 01009. https://doi.org/10.1051/shsconf/20185701009

De Omgevingswet | Rijksoverheid.nl. (n.d.). Retrieved August 5, 2025, from https://www.rijksoverheid.nl/onderwerpen/omgevingswet

DeJonckheere, M., & Vaughn, L. M. (2019). Semistructured interviewing in primary care research: A balance of relationship and rigour. *Family Medicine and Community Health*, *7*(2), e000057. https://doi.org/10.1136/fmch-2018-000057

Diefenbach, T. (2009). Are case studies more than sophisticated storytelling?: Methodological problems of qualitative empirical research mainly based on semi-structured interviews. *Quality & Quantity*, *43*(6), 875–894. https://doi.org/10.1007/s11135-008-9164-0

Durdyev, S., Zavadskas, E. K., Thurnell, D., Banaitis, A., & Ihtiyar, A. (2018). Sustainable construction industry in cambodia: Awareness, drivers and barriers. *Sustainability*, *10*(2), 392. https://doi.org/10.3390/su10020392

Duurzaam GWW. (n.d.). Ambitieweb - duurzaam gww [Accessed: 3 March 2025]. https://www.duurzaamgww.nl/documenten/58-ambitieweb

Ecochain. (n.d.). Wat is de milieukostenindicator (mki)? [Accessed: 3 March 2025]. https://ecochain.com/nl/blog/milieukosten-indicator-mki/

E.E., D., & Davies, O. (2017). Barriers to implementation of sustainable construction techniques. *Journal of Environmental Science*, *2*.

Eikelenboom, M., Stella, C., & Decadri, S. (2022, July). Overcoming the challenges to sustainability. Retrieved April 16, 2025, from https://www.adlittle.com/en/insights/report/overcoming-challenges-sustainability

Ek, K., Mathern, A., Rempling, R., Rosén, L., Claeson-Jonsson, C., Brinkhoff, P., & Norin, M. (2019). Multi-criteria decision analysis methods to support sustainable infrastructure construction. https://doi.org/10.2749/guimaraes.2019.1084

Elkington, J. (1997). *Cannibals with forks: The triple bottom line of 21st century business*. Capstone Publishing.

Emission gap to net-zero pledges and 1.5 degrees still remains. (n.d.). Retrieved May 13, 2025, from https://www.pbl.nl/en/image/news/emission-gap-to-net-zero-pledges-and-15-degrees-still-remains

Engert, S., & Baumgartner, R. J. (2016). Corporate sustainability strategy – bridging the gap between formulation and implementation. *Journal of Cleaner Production*, *113*, 822–834. https://doi.org/10.1016/j.jclepro.2015.11.094

Epstein, M. J. (2018). *Making sustainability work: Best practices in managing and measuring corporate social, environmental and economic impacts*. Routledge.

Evans, C. (1997). The Use of Consensus Methods and Expert Panels in Pharmacoeconomic Studies. *PharmacoEconomics*, *12*(2), 121–129. https://doi.org/10.2165/00019053-199712020-00003

Fast, C., & Widerberg, O. (2025). Governance through goals in action: How multi-stakeholder partnerships translate and connect the SDGs. *Earth System Governance*, *23*, 100238. https://doi.org/10.1016/j.esg.2025.100238

Glass, L.-M., & Newig, J. (2019). Governance for achieving the Sustainable Development Goals: How important are participation, policy coherence, reflexivity, adaptation and democratic institutions? *Earth System Governance*, *2*, 100031. https://doi.org/10.1016/j.esg.2019.100031

Goedknegt, D. (2013). Responsibility for adhering to sustainability in project management. *Proceedings of the 7th Nordic Conference on Construction Economics and Organization*.

Gollwitzer, P. M., & Sheeran, P. (2006). Implementation Intentions and Goal Achievement: A Meta□analysis of Effects and Processes. In *Advances in Experimental Social Psychology* (pp. 69–119, Vol. 38). Elsevier. https://doi.org/10.1016/S0065-2601(06)38002-1

Government, D. (2020). Klimaatwet [Retrieved February 24, 2025, from https://wetten.overheid.nl/BWBR0042394/2020-01-01].

Graham, J. R., Harvey, C. R., & Rajgopal, S. (2005). The economic implications of corporate financial reporting. *Journal of accounting and economics*, *40*(1-3), 3–73.

Guest, G., Bunce, A., & Johnson, L. (2006). How Many Interviews Are Enough?: An Experiment with Data Saturation and Variability [Publisher: SAGE Publications Inc]. *Field Methods*, *18*(1), 59–82. https://doi.org/10.1177/1525822X05279903

Haessler, P. (2020). Strategic decisions between short-term profit and sustainability. *Administrative Sciences*, *10*(3). https://www.mdpi.com/2076-3387/10/3/63

Hahn, R., & Lülfs, R. (2014). Legitimizing Negative Aspects in GRI-Oriented Sustainability Reporting: A Qualitative Analysis of Corporate Disclosure Strategies. *Journal of Business Ethics*, *123*(3), 401–420. https://doi.org/10.1007/s10551-013-1801-4

Hammersley, M., Foster, P., & Gomm, R. (2000). Case study and generalisation. *Case Study Method*.

Haq, Z. U., Rasheed, R., Rashid, A., & Akhter, S. (2023). CRITERIA FOR ASSESSING AND ENSURING THE TRUSTWORTHINESS IN QUALITATIVE RESEARCH. *International Journal of Business Reflections*, *4*(2). https://doi.org/10.56249/1.04.2.7358

Harvey, L. (2015). Beyond member-checking: A dialogic approach to the research interview. *International Journal of Research & Method in Education*, *38*(1), 23–38. https://doi.org/10.1080/1743727X.2014.914487

Haydn, T. (2019). Triangulation in history education research, and its limitations: A view from the UK. *History Education Research Journal*, *16*(1). https://doi.org/10.18546/HERJ.16.1.04

Hirschi, A., & Spurk, D. (2021a). Ambitious employees: Why and when ambition relates to performance and organizational commitment. https://doi.org/https://doi.org/10.1016/j.jvb.2021.103576

Hirschi, A., & Spurk, D. (2021b). Striving for success: Towards a refined understanding and measurement of ambition. https://doi.org/https://doi.org/10.1016/j.jvb.2021.103577

Hoe werkt de projectfasering? (n.d.). Retrieved June 23, 2025, from https://vervoerregio.nl/pagina/20160609-hoe-werkt-de-projectfasering

Hoeft, M., Pieper, M., Eriksson, K., & Bargstädt, H.-J. (2021). Toward Life Cycle Sustainability in Infrastructure: The Role of Automation and Robotics in PPP Projects [Number: 7 Publisher: Multidisciplinary Digital Publishing Institute]. *Sustainability*, *13*(7), 3779. https://doi.org/10.3390/su13073779

Holznagel, B., Picot, A., Deckers, S., Grove, N., & Schramm, M. (2010). The shortcomings of the case studies. In B. Holznagel, A. Picot, S. Deckers, N. Grove, & M. Schramm (Eds.), *Strategies for Rural Broadband: An economic and legal feasibility analysis* (pp. 77–91). Gabler. https://doi.org/10.1007/978-3-8349-8692-4_8

Huang, X. (2023). The roles of competition on innovation efficiency and firm performance: Evidence from the Chinese manufacturing industry. *European Research on Management and Business Economics*, *29*(1), 100201. https://doi.org/10.1016/j.iedeen.2022.100201

Human Research Ethics. (n.d.). Retrieved April 14, 2025, from https://www.tudelft.nl/over-tu-delft/strategie/integriteitsbeleid/human-research-ethics

Improvement Service. (n.d.). Power-interest grid [Accessed: 3 March 2025]. https://www.improvementservice.org.uk/business-analysis-framework/consider-perspectives/powerinterest-grid

Inductive Thematic Analysis vs. Deductive Thematic Analysis in Qualitative Research. (2024, December). Retrieved April 21, 2025, from https://delvetool.com/blog/inductive-deductive-thematic-analysis

Infrastructure in development: Navigating infrastructure investments towards sustainability goals - GRESB. (n.d.). Retrieved June 25, 2025, from https://www.gresb.com/nl-en/infrastructure-in-development-navigating-infrastructure-investments-towards-sustainability-goals/

IPLO. (n.d.). Milieueffectrapportage (mer) [Accessed: 3 March 2025]. https://iplo.nl/regelgeving/instrumenten/milieueffectrapportage/

Jakobsen, B. (2024). *Working towards unclear goals: Exploring the concept of social sustainability in a city development project in Oslo, Norway* [Master's thesis] [Accepted: 2024-08-21T23:33:19Z]. Retrieved April 17, 2025, from https://www.duo.uio.no/handle/10852/112264

Journeault, M., Perron, A., & Vallières, L. (2021). The collaborative roles of stakeholders in supporting the adoption of sustainability in smes. *Journal of environmental management*, *287*, 112349.

Juárez, A. N. (2021). A theoretical approach to ambition in fiction.

Judge, T. A., & Kammeyer-Mueller, J. D. (2012). On the value of aiming high: The causes and consequences of ambition [Place: US Publisher: American Psychological Association]. *Journal of Applied Psychology*, *97*(4), 758–775. https://doi.org/10.1037/a0028084

Klimaatakkoord. (n.d.). *Wat is het doel van het klimaatakkoord?* [Retrieved February 24, 2025]. Retrieved February 24, 2025, from https://www.klimaatakkoord.nl/klimaatakkoord/vraag-en-antwoord/wat-is-het-doel-van-het-klimaatakkoord

Koistinen, K., Onkila, T., Teerikangas, S., Mäkelä, M., Sarja, M., & Valkjärvi, M. (2022). Bold ambition, blunted agency? examining top management perspectives on a circular economy transition in finland. *Energy Research & Social Science*, *86*, 102451. https://doi.org/https://doi.org/10.1016/j.erss.2021.102451

Korea (South), United Nations, & Seoul Initiative Policy Forum on Sustainable Infrastructureg(2006, Seoul, Republic of Korea) (Eds.). (2007). *Sustainable infrastructure in Asia: Overview and proceedings: Seoul Initiative Policy Forum on Sustainable Infrastructure, Seoul, Republic of Korea, 6-8 September 2006* [Meeting Name: Seoul Initiative Policy Forum on Sustainable Infrastructure]. United Nations, ESCAP.

Krancher, O. (2020, July). Knowledge transfer in the transition phase. In E. Beulen & P. M. Ribbers (Eds.), *The Routledge Companion to Managing Digital Outsourcing* (1st ed., pp. 177–202). Routledge. https://doi.org/10.4324/9781351037785-13

Kristensen, H. S., & Mosgaard, M. A. (2020). A review of micro level indicators for a circular economy – moving away from the three dimensions of sustainability? *Journal of Cleaner Production*, *243*, 118531. https://doi.org/10.1016/j.jclepro.2019.118531

Kuhlman, T., & John, F. (2010). What is sustainability? *Sustainability*, *2*. https://doi.org/10.3390/su2113436

Lahsen, M., & Turnhout, E. (2021). How norms, needs, and power in science obstruct transformations towards sustainability [Publisher: IOP Publishing]. *Environmental Research Letters*, *16*(2), 025008. https://doi.org/10.1088/1748-9326/abdcf0

Langendijk, G. S., Boon, E., Goosen, H., Jeuken, A., Castresana, S. Z., Cerezo, N. P., Mysiak, J., & Kapetas, L. (2025). Ambition setting through climate services to drive climate resilient development. https://doi.org/https://doi.org/10.1016/j.cliser.2025.100556

Liang, J. (2019). Qualitative research methods: Collecting evidence, crafting analysis, communicating impact. *Communication Research and Practice*, 1–2. https://doi.org/10.1080/22041451.2019.1688620

Lim, W. M. (2024). What Is Qualitative Research? *Australasian Marketing Journal*. https://doi.org/10.1177/14413582241264619

Loorbach, D., Frantzeskaki, N., & Thissen, W. (2010). Introduction to the special section: Infrastructures and transitions. *Technological Forecasting and Social Change*, *77*(8), 1195–1202. https://doi.org/10.1016/j.techfore.2010.06.001

Maier, A., & Aşchilean, I. (2020, November). *Importance of stakeholder management for sustainable construction industry*.

Malterud, K. (2001). Qualitative research: Standards, challenges, and guidelines. *The Lancet*, *358*(9280), 483–488. https://doi.org/10.1016/S0140-6736(01)05627-6

Marsden, G., Ramani, T. L., Zietsman, J., Gudmundsson, H., & Hall, R. P. (2011). Framework for sustainability assessment by transportation agencies. *Transportation Research Record: Journal of the Transportation Research Board*, *2242*(2242), 9–18. https://doi.org/10.3141/2242-02

Marshall, J. D., & Toffel, M. W. (2005). Framing the Elusive Concept of Sustainability: A Sustainability Hierarchy [Publisher: American Chemical Society]. *Environmental Science & Technology*, *39*(3), 673–682. https://doi.org/10.1021/es040394k

Mason, M. (2010). Sample Size and Saturation in PhD Studies Using Qualitative Interviews. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *11*.

Mayers, J. (2005, March). *Stakeholder power analysis*. https://doi.org/10.13140/RG.2.2.22745.57446

Meadows, D. (2012). Limiting growth to save the world [Accessed April 7, 2025].

Meng, J., Xue, B., Liu, B., & Fang, N. (2015). Relationships between top managers' leadership and infrastructure sustainability. *Engineering, Construction and Architectural Management*, *22*, 692–714. https://doi.org/10.1108/ECAM-01-2014-0013

Meynerts, L., Götze, U., Claus, S., Peças, P., & Ribeiro, I. (2017). Concept of Integrated Life Cycle Assessment and Costing – Application to the Case of Designing a Hybrid Train. *Procedia CIRP*, *61*, 744–749. https://doi.org/10.1016/j.procir.2016.11.241

Milieu, M. v. I. e. (2016, October). Startbeslissing A67 Leenderheide – Zaarderheiken, Ministerie van Infrastructuur en Milieu [Publisher: Ministerie van Binnenlandse Zaken en Koninkrijksrelaties]. Retrieved June 23, 2025, from https://zoek.officielebekendmakingen.nl/stcrt-2016-54567.html

Ministerie van Infrastructuur en Waterstaat. (2024, July). Projectverloop. https://www.rijkswaterstaat.nl/zakelijk/zakendoen-met-rijkswaterstaat/werkwijzen/werkwijze-in-gww/werken-in-projecten/projectverloop

MIRT-traject-scaled.jpg (JPEG-afbeelding, 2560 × 670 pixels) - Geschaald (50%). (n.d.). Retrieved June 23, 2025, from https://oeververbindingen.nl/app/uploads/MIRT-traject-scaled.jpg

Newman, P. W. (2015). Transport infrastructure and sustainability: A new planning and assessment framework [Publisher: Emerald Group Publishing Limited]. *Smart and Sustainable Built Environment*, *4*(2), 140–153. https://doi.org/10.1108/SASBE-05-2015-0009

OECD, The World Bank, & UN Environment. (2018). *Financing climate futures: Rethinking infrastructure*. https://doi.org/10.1787/9789264308114-en

Olfert, A., Hirschnitz-Garbers, M., Walther, J., Hölscher, K., Brunnow, B., & Schiller, G. (2020, January). *Strengthening early stage decision-making by process-integrated sustainability assessment in local infrastructure transitions*.

Omar, M. F., Trigunarsyah, B., & Johnny, W. (2008). Decision making tools for infrastructure project planning.

Osei-Asibey, D., Ayarkwa, J., Adinyira, E., Acheampong, A., & Amoah, P. (2021). Roles and Responsibilities of Stakeholders towards Ensuring Health and Safety at Construction Site [Number: 1 Publisher: Scientific Research Publishing]. *Journal of Building Construction and Planning Research*, *9*(1), 90–114. https://doi.org/10.4236/jbcpr.2021.91008

Over het project [Last Modified: 2025-06-27]. (2024, August). Retrieved June 29, 2025, from https://www.noord-holland.nl/Onderwerpen/Verkeer_vervoer/Projecten_Verkeer_en_Vervoer/Cruquiusbrug/Over_het_project

Peenstra, R., & Silvius, G. (2017). Enablers for considering sustainability in projects; the perspective of the supplier. *Procedia Computer Science*, *121*, 55–62. https://doi.org/10.1016/j.procs.2017.11.009

Pettigrove, G. (2007). Ambitions. *Ethical Theory and Moral Practice*, *10*(1), 53–68. https://doi.org/10.1007/s10677-006-9044-4

PIANOo. (2025). Duurzaam gww / maatschappelijk verantwoord inkopen (mvi) [Geraadpleegd op 16 april 2025]. https://www.pianoo.nl/nl/sectoren/gww/duurzaam-gww-mvi

Project Cruquiusbrug in Noord-Holland wint KoopWijsPrijs 2021. (2022, September). Retrieved June 29, 2025, from https://www.platformbruggen.nl/nieuws/88-project-cruquiusbrug-in-noord-holland-wint-koopwijsprijs-2021

Radermacher, W. (1999). Indicators, Green Accounting and Environment Statistics— Information Requirements for Sustainable Development [_eprint: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1751-5823.1999.tb00453.x]. *International Statistical Review*, *67*(3), 339–354. https://doi.org/10.1111/j.1751-5823.1999.tb00453.x

Rezaeian, M., Pinkse, J., & Rigby, J. (2024). Transforming titans: The role of policy mixes in business model adaptation strategies for sustainability transitions. *Energy Research & Social Science*, *112*, 103499. https://doi.org/https://doi.org/10.1016/j.erss.2024.103499

Rijksoverheid. (n.d.). Meerjarenprogramma infrastructuur, ruimte en transport (mirt) [Accessed: 3 March 2025]. https://www.rijksoverheid.nl/onderwerpen/ruimtelijke-ordening-en-gebiedsontwikkeling/meerjarenprogramma-infrastructuur-ruimte-en-transport-mirt

Sabini, L., & Alderman, N. (2021). The Paradoxical Profession: Project Management and the Contradictory Nature of Sustainable Project Objectives [Publisher: SAGE Publications Inc]. *Project Management Journal*, *52*(4), 379–393. https://doi.org/10.1177/87569728211007660

Sachs, J. D., Lafortune, G., & Fuller, G. (2024). *The sdgs and the un summit of the future. sustainable development report 2024*. SDSN, Dublin University Press. https://doi.org/10.25546/108572

Schmidt, G., & Wilhelm, W. (2000). Strategic, Tactical and Operational Decisions in Multi-national Logistics Networks: A Review and Discussion of Modeling Issues. *International Journal of Production Research - INT J PROD RES*, *38*, 1501–1523. https://doi.org/10.1080/002075400188690

Seawright, J., & Gerring, J. (2008). Case Selection Techniques in Case Study Research: A Menu of Qualitative and Quantitative Options. *Political Research Quarterly*, *61*(2), 294–308. http://www.jstor.org/stable/20299733

Seligman, J. (2013). Dialectical Inquiry–Does It Deliver? A User Based Research Experience. *Qualitative Report*, *18*. https://doi.org/10.46743/2160-3715/2013.1462

Sharma, P., Kumar Jain, J., & Kalla, P. (2023). A multi-criteria decision analysis (mcda) approach for evaluating the performance of indian cities' sustainable infrastructure. *Materials Today: Proceedings*. https://doi.org/https://doi.org/10.1016/j.matpr.2023.06.355

Sheppard, V. (2020). 10.7 Strengths and Weaknesses of Qualitative Interviews. Retrieved April 15, 2025, from https://pressbooks.bccampus.ca/jibcresearchmethods/chapter/10-7-strengths-and-weaknesses-of-qualitative-interviews/

Silvius, G., Schipper, R., & Planko, J. (2012). *Sustainability in project management*. Gower Publishing, Ltd.

Smits, M., & Moor, A. (2003, January). *Effective Knowledge Management in Project-Based Organisations*.

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research*, *104*, 333–339. https://doi.org/https://doi.org/10.1016/j.jbusres.2019.07.039

Tan, Y., Ochoa, J. J., Langston, C., & Shen, L. (2015). An empirical study on the relationship between sustainability performance and business competitiveness of international construction contractors. *Journal of Cleaner Production*, *93*, 273–278. https://doi.org/10.1016/j.jclepro.2015.01.034

Tessitore, S., Corsini, F., & Iraldo, F. (2023). Exploring the alignment and misalignment in the transition to a circular economy within private companies and public organizations. *Journal of Cleaner Production*, *430*, 139528. https://doi.org/https://doi.org/10.1016/j.jclepro.2023.139528

Too, E., & Weaver, P. (2014). The management of project management: A conceptual framework for project governance. *International Journal of Project Management*, *32*, 1382–1394. https://doi.org/10.1016/j.ijproman.2013.07.006

Tørstad, V., & Wiborg, V. (n.d.). Commitment ambiguity and ambition in climate pledges. Retrieved April 16, 2025, from https://link.springer.com/article/10.1007/s11558-024-09575-y

Trullols, E., Ruisánchez, I., & Rius, F. X. (2004). Validation of qualitative analytical methods. *TrAC Trends in Analytical Chemistry*, *23*(2), 137–145. https://doi.org/10.1016/S0165-9936(04)00201-8

Turner, D. W. I. (2010). Qualitative interview design: A practical guide for novice investigators [Licensed under a Creative Commons Attribution-Noncommercial-Share Alike 4.0 International License]. *The Qualitative Report*, *15*(3), 754–760. https://doi.org/10.46743/2160-3715/2010.1178

United Nations Environment Programme. (2021). *Integrated approaches to sustainable infrastructure* (tech. rep. No. DTI/2238/GE) (Accessed: 2024-03-19). United Nations Environment Programme. https://www.unep.org/resources/report/integrated-approaches-sustainable-infrastructure

van Vuuren, D. P., Boot, P. A., Ros, J., Hof, A. F., & den Elzen, M. G. (2017). *The implications of the paris climate agreement for the dutch climate policy objectives* (tech. rep.) (Translation: October 2017). PBL Netherlands Environmental Assessment Agency.

van der Mey, L. M. (1995). Sustainable Development in Dutch Policy: A National Response to an International Appeal [Publisher: Sage Publications, Inc.]. *The Journal of Environment & Development*, *4*(2), 205–219. Retrieved July 2, 2025, from https://www.jstor.org/stable/44319137

Vergerio, G., & Knotten, V. (2024). *Ensuring ambitious goals: Barrier and good practices in the planning and building process*. SINTEF akademisk forlag.

Verstraeten, R. C. E. (n.d.). Two Types of Ambition in order to get a better Picture of Gender Differences in.

Visser, W. (2013). The three fundamental criticisms of the triple bottom line approach: An empirical study to link sustainability reports in companies based in the asia-pacific region and tbl shortcomings. *Asian Journal of Business Ethics*, *2*(1), 91–111. https://doi.org/10.1007/s13520-012-0019-3

von Rosing, M., Shepperson, L., Foldager, U., Laurier, W., Czichos, H., Arnold, H., Yousaf, M., Fisseau, A., Pinto, J., Spiegel, H. W., Kemp, N., Urquhart, B. S., Muhita, D. H., Abele, V., Shyam, A., Razek, A. R. A., Svendsen, A. D., Solomon, A., Khan, A., … Chungyalpa, W. (2025). Chapter 1 - why is sustainability so important? In M. von Rosing (Ed.), *The sustainability handbook, volume 1* (pp. 3–7). Elsevier. https://doi.org/https://doi.org/10.1016/B978-0-323-90110-9.00044-1

Wallbridge, A. (2023). How to conduct a bullet-proof stakeholder analysis matrix in 4 useful steps. *TSW Training*.

Waterstaat, M. v. I. e. (n.d.). Integraal projectmanagement [Last Modified: 2025-01-02T09:14:27]. Retrieved May 13, 2025, from https://www.rijkswaterstaat.nl/zakelijk/zakendoen-met-rijkswaterstaat/werkwijzen/werkwijze-in-gww/werken-in-projecten/integraal-projectmanagement

White, D., & Patton, J. (2002). Closing the strategic vision and implementation gap. Retrieved June 24, 2025, from https://www.pmi.org/learning/library/closing-strategic-vision-implementation-gap-109

Wiersum, K. F. (1995). 200 years of sustainability in forestry: Lessons from history. *Environmental Management*, *19*(3), 321–329. https://doi.org/10.1007/BF02471975

Witteveen+Bos. (2024). Annual report 2023 [Accessed: 2025-04-11]. https://www.witteveenbos.com/about-us/what-we-do/annual-reports/annual-report-2023

Witteveen+Bos. (2025a). *Duurzame ontwerpprincipes*. Retrieved March 3, 2025, from https://www.witteveenbos.com/nl/over-ons/hoe-wij-werken/duurzame-ontwerpprincipes

Witteveen+Bos. (2025b). Sustainable design principles [Accessed: 2025-04-11]. https://www.witteveenbos.com/about-us/how-we-work/sustainable-design-principles

Wuni, I. Y. (2022). Mapping the barriers to circular economy adoption in the construction industry: A systematic review, Pareto analysis, and mitigation strategy map. *Building and Environment*, *223*, 109453. https://doi.org/10.1016/j.buildenv.2022.109453

Yap, J. B. H., Lim, B. L., & Skitmore, M. (2022). Capitalising knowledge management (KM) for improving project delivery in construction. *Ain Shams Engineering Journal*, *13*(6), 101790. https://doi.org/10.1016/j.asej.2022.101790

Yilmaz, M., & bakış, A. (2015a). Sustainability in construction sector. *Procedia - Social and Behavioral Sciences*, *195*, 2253–2262. https://doi.org/10.1016/j.sbspro.2015.06.312

Yilmaz, M., & bakış, A. (2015b). Sustainability in Construction Sector. *Procedia - Social and Behavioral Sciences*, *195*, 2253–2262. https://doi.org/10.1016/j.sbspro.2015.06.312

Yin, R. K. (2009). *Case Study Research: Design and Methods* [Google-Books-ID: FzawIAdilHkC]. SAGE.

Zietsman, J., & Ramani, T. (2011). *Guidebook for sustainability performance measurement for transportation agencies*. Transportation Research Board.

A

Scientific Paper

Exploring the Erosion of Sustainability Ambitions in Dutch Infrastructure and Mobility Decision-Making

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Sustainability ambitions are increasingly embedded in infrastructure and mobility projects, yet their influence often diminishes as projects progress from strategy to implementation. This paper investigates how and why such ambition erosion occurs within Dutch infrastructure and mobility decision-making processes. Using a qualitative, abductive research design, the study analyses three case studies through literature review, document analysis, stakeholder mapping, and semi-structured interviews. Findings reveal that sustainability ambitions erode due to misalignment across structural, procedural, and behavioural dimensions, particularly during tactical transitions and under time or budget pressures. Conceptual ambiguity, discontinuity, and short-term logic further undermine continuity. However, success factors such as intrinsic motivation, leadership, contractual anchoring, and procedural reflection can counteract erosion when applied in a coherent, multi-level manner. The study concludes with practical and theoretical recommendations to support the design of future ambition support strategies and reinforce sustainability integration throughout infrastructure project lifecycles.

0 Introduction

A. Context

Infrastructure and mobility projects play a critical role in enabling sustainable development. In the Netherlands, demand for future-proof infrastructure and mobility projects is rising, driven by urbanisation, climate ambitions, and societal needs. These projects, ranging from bridges and roundabouts to cycling routes, are essential for economic growth and accessibility. However, their realisation also contributes significantly to global environmental degradation, accounting for approximately 70% of worldwide greenhouse gas emissions [1].

This paradox places the infrastructure sector at the heart of the sustainability challenge. On the one hand, infrastructure is vital for achieving the United Nations Sustainable Development Goals (SDGs); on the other, it accelerates environmental pressures through land use, emissions, and resource depletion. In response, international frameworks such as the Paris Climate Agreement and national legislation including the Dutch Climate Act have set ambitious targets up to 95% CO_2 reduction by 2050 [2]. Yet, progress remains insufficient. The 2024 Sustainable Development Report shows that only 17% of SDG targets are on track globally, with just 56% met in the Netherlands [3].

The urgency is intensified by the anticipated infrastructure needs:75% of the infrastructure required by 2050 still needs to be built [4]. This creates a narrow and critical window for integrating sustainability into early-stage decisions. Despite widespread ambitions and the availability of tools to guide sustainable infrastructure development, a growing mismatch exists between stated ambitions and realised outcomes. Understanding how and why these ambitions erode during planning and implementation is essential to closing this ambition-realisation gap.

B. Problem Definition

Despite the availability of established frameworks to support sustainable decision-making sustainability ambitions in Dutch infrastructure and mobility projects often fade as projects progress from planning to realisation [5, 6]. While ambitions are frequently formulated in policy strategies and tenders, they tend to lose influence when cost, feasibility, or risk become dominant decision criteria [7].

This erosion of ambition, referred to as the ambition-implementation gap, has been widely discussed in sustainability literature, yet it remains underexplored in the context of Dutch infrastructure and mobility projects. The phenomenon is particularly difficult to address because of political and reputational sensitivities. Acknowledging failed sustainability goals may undermine the perceived credibility of public authorities, or engineering firms [8], discouraging critical evaluation and public learning.

The complexity is further compounded by the fragmented structure of infrastructure and mobility project planning. While ambitions are often set at a strategic level, implementation is shaped by tactical and operational actors working under distinct priorities, responsibilities, and constraints. Without mechanisms that embed sustainability across all levels of decision-making, initial ambitions risk becoming symbolic rather than actionable. As previous studies show, only a fraction of formulated strategies are implemented effectively at project level [9].

Exploratory interviews with professionals at a leading Dutch engineering firm confirm this pattern: although clients regularly set sustainability goals, these are rarely decisive during final design and execution. Sustainability tends to function as a secondary, non-binding criterion, acknowledged in theory, but sidelined in practice once other project demands emerge [10].

This erosion is problematic because early project decisions, such as scope definition, spatial planning, and design choices have a disproportionately large impact on long-term environmental, economic, and social outcomes [11]. When sustainability is not structurally embedded in early phases, the opportunity to steer towards more sustainable infrastructure is lost.

C. Research Gap and Relevance

Academic literature widely recognises the ambition-implementation gap [12, 13, 14, 15]. Yet most studies are descriptive and lack empirical insights into how this gap manifests in infrastructure and mobility projects. Few studies examine the actor dynamics, governance misalignments, or procedural structures that drive ambition erosion over time.

This research addresses that gap by focusing on how sustainability ambitions weaken throughout the decision-making process. It contributes new knowledge on the institutional, organisational, and behavioural factors that shape ambition erosion. Empirically, it focuses on the Dutch context, which is characterised by strong formal sustainability ambitions and institutionalised planning frameworks.

D. Research Objective and Questions

The aim of this study is to explore the erosion of sustainability ambition in infrastructure and mobility projects by identifying involved actors, key barriers, and validating success factors to mitigate this erosion. The main research question for this research is:

How can the initial ambitions for sustainability in infrastructure and mobility projects be maintained throughout the decision-making process?

To answer this question, the following sub-questions have been formulated:

1. How is sustainability currently considered in the decision-making process across different project phases?
2. How do different stakeholders influence the prioritisation of sustainability?
3. What are the key barriers preventing sustainability from remaining a decisive factor?
4. When do opportunities arise to reinforce sustainability, and what enables success?
5. What success factors help ensure sustainability remains a priority without complicating decisions?

E. Scope and Case Context

This study focuses on infrastructure and mobility projects in the Netherlands, specifically during the Initiation, Exploration, and Elaboration phases. The research adopts a dual-actor perspective, focusing on the interaction between public clients and engineering consultancies. The study does not assess technical tools such as LCA or MCDA, nor does it include political decision-makers or end-users. Instead, it focuses on decision-making dynamics within the IPM project team context.

F. Paper Outline

This paper is structured as follows: Section II presents the methodology, including the case study design and data collection. Section III provides the empirical results based on three infrastructure projects. Section IV discusses the implications of the findings in relation to theory and practice. Section V concludes with recommendations for research and policy.

1 Methodology

A. Research Approach

This study adopts a qualitative, abductive research approach to explore the erosion of sustainability ambitions in infrastructure and mobility projects. Instead of quantitatively evaluating sustainability performance, the study investigates how decision-making dynamics and actor interactions influence sustainability prioritisation throughout different project phases. Abductive reasoning was chosen to iteratively move between empirical findings and theoretical concepts, which is particularly suitable for context-specific and under-theorised problems [16, 17]. Figure 1 illustrates this research logic. The methods used, including literature review, desk research, stakeholder analysis, and interviews are integrated within a case study design.

B. Case Study

Case Selection and Data Collection

Three Dutch infrastructure and mobility projects were selected through purposive sampling to reflect variation in project types, phases, and stakeholder composition. Primary data were collected through ten semi-structured interviews with public clients and engineering consultancy Witteveen+Bos. Respondents represented various roles in Integrated Project Management (IPM) teams and were directly involved in project decision-making. Supplementary data sources included project documents, tender specifications, ambition web outputs, and internal reports. Table 1 summarises the applied methods per research question.

Table 1. Overview of research methods, data sources, and analysis approaches

Method	RQ(s)	Data Sources	Analysis Approach
Literature Review	1, 3, 5	Academic databases	Thematic synthesis
Desk Research	1, 4	Project documentation	Document analysis
Stakeholder Analysis	2	Org. charts, interviews	Power-interest mapping
Semi-structured Interviews	2-5	Expert interviews	Thematic coding (Atlas.ti)
Case Studies	All	Combined sources	Within-case and cross-case analysis

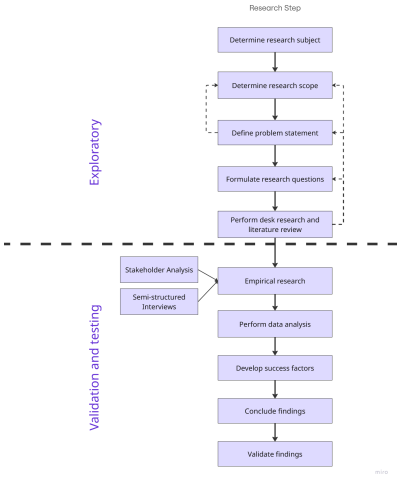


Fig. 1. Research approach

C. Data Analysis

Interview transcripts were analysed in Atlas.ti using a hybrid thematic coding approach [17]. Codes were initially derived from six literature-based barrier and success factor domains but refined inductively as patterns emerged. Coding focused on four key themes: stakeholder perceptions, barriers, opportunities, and success factors, and linked these to project phases and decision levels (strategic, tactical, operational). The analysis consisted of two steps:

1. **Within-case analysis** to identify context-specific mechanisms.
2. **Cross-case comparison** to detect recurring patterns and contrasting dynamics.

Triangulation across data sources, member checking during interviews, and iterative validation with the literature were applied to ensure reliability and transparency. Several strategies were used to enhance the credibility of findings: triangulation across data sources, in-interview member checking, and an iterative coding process [18]. Interview protocols were refined with supervisors, and interpretations were tested against existing literature.

2 Literature Review

Sustainability in infrastructure and mobility projects is often framed through the Triple Bottom Line (TBL), balancing environmental, economic, and social dimensions [19, 20]. However, this multidimensionality introduces ambiguity: sustainability lacks a universally operational definition, leading to divergent interpretations among stakeholders [21, 22]. For this study, sustainable infrastructure is defined as infrastructure that ensures long-term environmental, social, financial, and institutional viability across its full life cycle [1].

Sustainability ambitions are increasingly embedded in infrastructure discourse, shaped by frameworks such as the SDGs [3]. However, these ambitions often remain rhetorical unless translated into concrete implementation intentions with clear accountability structures [23, 24]. Particularly in complex project environments, sustainability ambitions tend to erode over time, weakening between strategic vision and operational realisation.

The literature identifies six thematic categories of *barriers* that explain why sustainability ambitions often fade throughout the infrastructure life cycle:

- **Conceptual and motivational barriers:** Sustainability is often vaguely defined, future-oriented, and lacks personal ownership. Weak goal formulation, poor operationalization, and conflicting sustainability pillars hinder implementation. [25, 20, 26, 22, 27, 15, 28, 29].
- **Economic and financial barriers:** Sustainability is perceived as costly or risky. Barriers include hidden costs, split incentives, lack of long-term return evidence, and lock-in to existing financial models. [15, 30, 31, 32, 33, 29, 34].
- **Organisational and cultural barriers:** Institutional inertia, short-term thinking, fragmented decision-making, weak sustainability culture, and poor knowledge embedding undermine ambitions. [15, 29, 35, 36, 37, 32, 38].
- **Knowledge-related barriers:** Lack of technical expertise, tacit knowledge loss, poor knowledge management, and limited absorptive capacity prevent effective implementation and learning [39, 38, 34, 40, 12, 41, 32].
- **Governance and policy barriers:** Weak institutional structures, lack of monitoring mechanisms, unclear performance indicators, and fragmented governance hinder enforcement. [29, 42, 43, 44, 36].
- **Stakeholder and participation barriers:** Late or superficial engagement, conflicting interests, lack of ownership, low trust, and cognitive distance weaken shared sustainability commitment. [22, 37, 45, 15, 46, 47, 38].

In response, the literature identifies six thematic *success factors* that support the preservation of sustainability ambitions:

- **Conceptual Motivational:**Clearly defined, measurable, and actionable sustainability goals are essential. Strong leadership, vision translation into roadmaps and indicators, and adoption of life cycle thinking ensure that sustainability remains a guiding principle throughout project phases. [12, 48, 15, 49, 29].
- **Economic and Financial:** Acknowledging long-term financial benefits of sustainability and ensuring availability, planning, and allocation of resources (e.g., funds, materials) enables credible and stable implementation. External economic and political stability further reinforces ambition. [49, 50, 48].
- **Organisational and Cultural:** A culture of sustainability must be structurally embedded in the organization. Key enablers include strong project leadership, shared norms and values, trust, team competence, interdisciplinary collaboration, and contractually secured methods. [49, 12, 15, 51, 52, 48].
- **Knowledge:** Sustainability implementation depends on systemic knowledge integration. Training, capacity-building, digital tools, simulation models, shared learning platforms, and openness to diverse knowledge systems enable more informed and adaptive project decisions [49, 15, 53, 40, 12, 48, 54].
- **Governance and Policy:** Early integration of sustainability into project planning enables fundamental design decisions before lock-ins occur. Formal frameworks, clear mandates, performance indicators, and vertical alignment across governance levels foster enforceability and consistency [49, 12, 15, 35, 55, 56, 51, 48].
- **Stakeholder and Participation:** Sustainability is strengthened by early involvement of stakeholders, shared goals, long-term collaboration, open communication, and trust. Continuous engagement, co-creation, and clarity on roles promote ownership and alignment. [49, 15, 12, 42, 48].

Together, these insights provide a comprehensive view of the conditions under which sustainability ambitions either fade or endure in infrastructure project environments.

3 Application

A. Decision-Making Structure in Ductch Infrastructure and Mobility Projects

Infrastructure and mobility projects in the Netherlands operate within a structured project delivery environment, guided by public commissioning and executed through Integrated Project Management (IPM) teams. These teams typically consist of five roles: project manager, contract manager, technical manager, environmental manager, and project control manager. Each role is designed to manage a distinct domain of responsibility while maintaining coordination across the project life cycle phases: intitiation, exploration, elaboration, realisation and maintenance and demolition.

Decision-making unfolds across three interdependent levels [57]:

- **Strategic level**: High-level ambitions and policy goals are formulated.
- **Tactical level**: These ambitions are translated into programs, project plans, and contract frameworks.
- **Operational level**: Day-to-day decisions and project implementation occur.

Sustainability ambitions must be translated both vertically from strategic intent to operational practice and horizontally across different organizations within the same projects. As illustrated in Figure 2, erosion often occurs when vertical alignment between levels is lacking or when horizontal coordination within project teams fails to embed shared understanding. As illustrated in Figure 2, erosion often occurs when vertical alignment between levels is lacking or when horizontal coordination within project teams fails to embed shared understanding. Without clear ownership and continuity, ambitions risk being reframed, deprioritised, or lost during phase transitions.

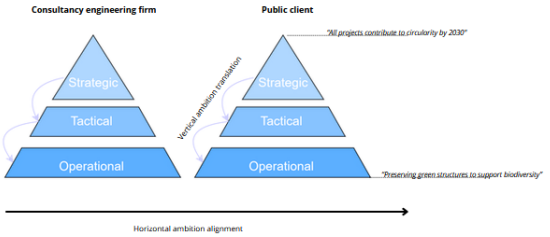


Fig. 2. Vertical and horizontal translation of ambitions

This multi-level governance structure affects how sustainability ambitions are defined, interpreted, and prioritised throughout the project lifecycle. The lifecycle itself typically follows five key phases: initiation, exploration, elaboration, realisation, and operation, as shown in 3. The project life cycle includes multiple moments where ambitions can be strengthened, or diluted. As sustainability ambitions are often formulated in early phases, their successful integration depends on how well they are embedded across subsequent decision points and organisational layers.

Together, the decision-making levels, lifecycle phases, and organisational structure shape how sustainability is operationalised in practice. Each dimension brings its own barriers and success factors, as synthesised in the theoretical framework in Figure 4. This framework illustrates how ambition erosion can result from misalignments.

With this decision-making context in place, the next section presents the empirical execution of the case studies.

Case Study Execution and Data Analysis

To understand how sustainability ambitions evolve in practice, three infrastructure and mobility projects were analysed using the methodology outlined in Section II. The se-

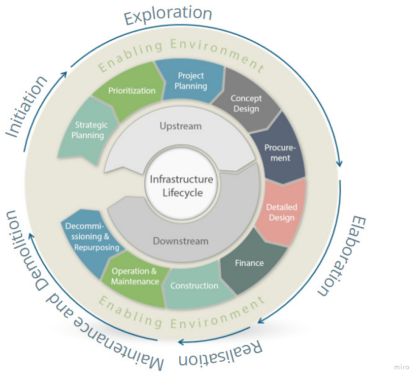


Fig. 3. Life cycle of infrastructure planning

lected cases reflected diversity in scale, client-consultant relations, and planning stage. Semi-structured interviews targeted professionals active at different decision levels. Additional data sources, including ambition web outputs, and internal reports, supported contextual understanding and triangulation.

Interview data were coded thematically in Atlas.ti using both literature-derived categories (barriers and success factors) and inductively emerging themes. Codes were (where possible) linked to project phases and decision-making levels. Each case was analysed individually to capture local dynamics, followed by a cross-case comparison to identify common mechanisms, differences in ambition erosion, and recurring opportunity points.

B. Observed Application Patterns

The empirical analysis confirmed and nuanced several theoretical insights:

- **Ambition erosion occurred across all decision levels**, though tactical transitions were particularly vulnerable due to lack of translation and ownership.
- **Institutional structures and team composition** influenced how sustainability was operationalised. Frequent handovers, unclear mandates, or inconsistent tool usage hindered continuity.
- While all cases experienced ambition erosion, **some cases showed partial success**, enabled by motivated individuals, trust-based collaboration, and repeated reflection moments.
- **Informal mechanisms**, such as personal leadership and team culture, played a significant role in preserving sustainability when formal structures fell short.

These patterns underscore that sustaining sustainability is not only a technical or procedural task but deeply dependent on human dynamics and institutional alignment.

4 Results

This section presents the empirical findings derived from the case studies. The results are structured around four key themes: stakeholder perception, identified barriers, critical opportunities, and success factors. Each theme was derived through within-case and cross-case thematic coding, capturing how sustainability ambitions evolved throughout the project life cycle and across decision-making levels.

A. Stakeholder Perception and Prioritisation of Sustainability

Across all cases, stakeholders consistently recognised sustainability as an important project objective. However, their interpretations and priorities varied markedly by role and decision-making level.

The perceived priority of sustainability was highest during the initiation and early exploration phases but declined as technical feasibility and budgeting constraints gained prominence. This was especially evident during project handovers, where vague ambitions and shifting team compositions weakened continuity.

Interestingly, the analysis shows that individual commitment often outweighed formal role definitions. Motivated team members, regardless of their role, could act as informal sustainability stewards, pushing ambitions forward even in the absence of structural support (Figure 5).

B. Barriers Undermining Sustainability Ambitions

The empirical findings confirm the presence of all six literature-derived barrier domains across the studied infrastructure projects. Among these, two categories stood out as particularly influential in practice: **budgetary constraints** and **conceptual ambiguity**. Sustainability ambitions were often vaguely formulated, lacked concrete operationalisation, and suffered from unclear ownership. As a result, they were highly susceptible to being deprioritised once financial constraints emerged, especially near critical decision points.

In addition to these well-documented challenges, the study identified project-specific dynamics that have received limited attention in prior literature. A notable example is *temporal pressure*: tight deadlines, driven by external events or political milestones, often left little room for reflective decision-making or deliberation on sustainability trade-offs.

These barriers were not isolated phenomena but mutually reinforcing. Conceptual ambiguity weakened the case for sustainability under tight budgetary or time constraints, while fragmented responsibilities and a lack of continuity exacerbated the challenge. Together, they contributed to a systemic erosion of ambition across project phases.

To synthesise both literature-based and empirically grounded barriers, the identified mechanisms were clustered into four overarching themes: *Conceptual ambiguity and knowledge gaps*, *Institutional and governance barriers*, *Personal and cultural resistance*, and *Project structure and temporal dynamics*. Figure 6 visualises how the six literature-derived domains map onto these clustered mechanisms, integrating both academic and practice-based insights.

C. Opportunities for Strengthening Sustainability

Each case revealed specific decision points where sus-

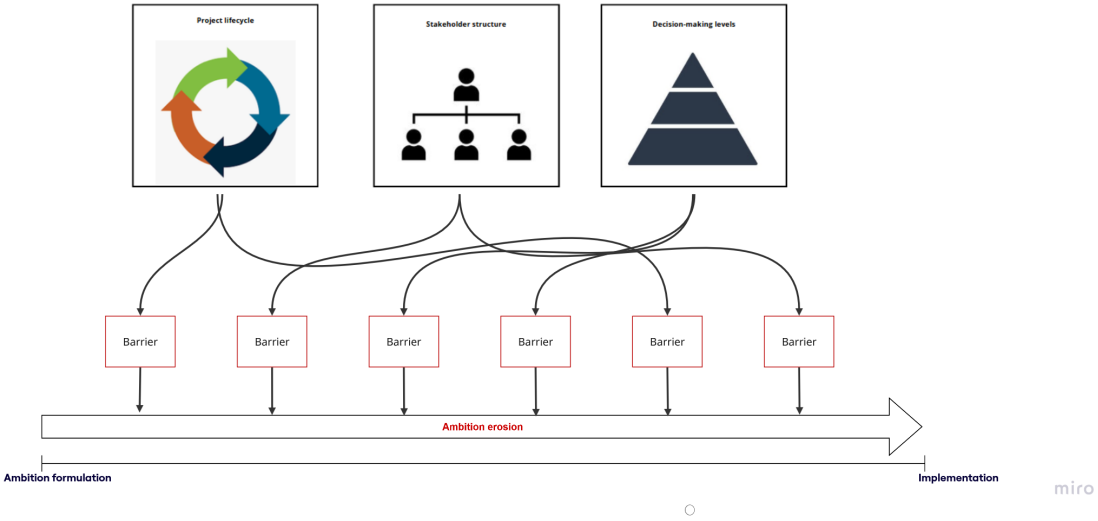


Fig. 4. Theoretical framework

tainability ambitions could be reinforced. These moments typically occurred:

- At the **early phases**, when ambitions were still negotiable and tools like the Ambitieweb were deployed.
- During **team onboarding or reflection moments**, especially when motivated individuals took initiative.
- At **phase transitions**, when strategic/tactical alignment was proactively maintained.

However, these opportunities were often informal and dependent on individual actions. Their impact was amplified when embedded in structured project rituals such as kick-offs, internal reviews, or design logbooks..

D. Success Factors Enabling Continuity

During the empirical research, several success factors emerged that helped maintain sustainability through the project life cycle:

- **Intrinsic motivation and leadership**:
- **engagement and steering power**:
- **Contractual and procedural governance**:

These success factors highlight that sustainability continuity is not only a matter of policy or tools but also of culture, leadership, and process design.

A visual framework (Figure 7) illustrating the observed erosion mechanisms, intervention points, and actor roles

Fig. 5. Intrinsic motivation outweighs formal role

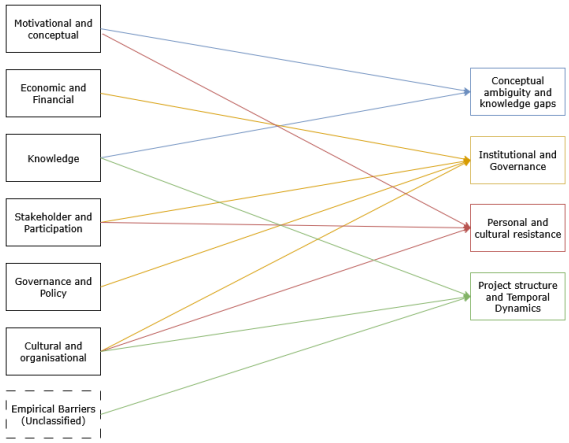


Fig. 6. Revised Barriers

was developed and included in the Appendix. This model synthesises the case findings and may serve as a discussion tool for future projects.

5 Discussion

A. Reflection on Findings

This study confirms that sustainability ambitions in infrastructure and mobility projects often erode over time, particularly during tactical and operational phases. The results align with six key barrier domains derived from the literature: conceptual ambiguity, financial constraints, organisational fragmentation, knowledge gaps, weak governance structures, and limited stakeholder alignment. These theoretical expectations were confirmed across all cases. However, several important refinements and extensions emerged from the empirical data.

Conceptual ambiguity was consistently cited as a primary cause for erosion, especially during phase handovers. Stakeholders struggled to concretise ambitions into action-

able goals. While this barrier is well-established in literature, the findings further revealed that ambiguity is reinforced by feasibility concerns and risk aversion, factors often tied to limited experience with sustainable alternatives.

Financial and economic barriers were particularly dominant during the elaboration phase. Sustainability measures were deprioritised when confronted with tight budgets or cost uncertainties. Importantly, this was not solely due to limited resources, but also due to procedural rigidity and late-stage assessment of sustainable alternatives. These findings extend the literature by revealing that financial constraints are often process-induced rather than purely resource-driven.

Organisational fragmentation and lack of team continuity emerged as core barriers. Changes in personnel, unclear mandates, and phase transitions consistently disrupted the implementation of sustainability ambitions. While literature acknowledges governance fragmentation, this study adds specificity by highlighting how unstable team compositions can disrupt continuity and ownership.

Knowledge-related challenges were not only about lack of expertise, but also about poor knowledge transfer and inconsistent tool use. Instruments such as the Ambitieweb were only effective when embedded in reflective team practices. This suggests that sustainability tools require supportive organisational cultures and continuous learning processes, an underdeveloped theme in current scholarship.

Governance and policy barriers were found to stem from a lack of performance criteria, poor alignment between project phases, and limited follow-up mechanisms. The study highlights a need for more robust translation of strategic ambitions into enforceable project-level requirements.

Stakeholder-related barriers included declining engagement post-tender. While the literature promotes participatory processes, this study shows that participation without mandate or clarity can diminish effectiveness. Sustainability ownership often weakened after the contract phase, undermining shared responsibility.

B. Novel Insights and Domain-Specific Barriers

The study also uncovered barriers not extensively addressed in existing literature. Notably:

- **Temporal pressure:** Long project durations led to disconnects between initial ambition and later implementation, with outdated contracts becoming a structural barrier.
- **Project-focused logic:** The dominance of project-based thinking over programme-level coordination hindered long-term vision and knowledge continuity.
- **Risk culture:** Risk-averse client behaviour restricted sustainable innovation, especially when responsibility for failure was not clearly allocated.
- **Alignment challenges:** Misaligned timing between procedures (e.g., stakeholder dialogues, environmental assessments) and project decision points weakened ambition realisation.

These findings suggest that infrastructure and mobility projects, due to their scale, duration, and actor complexity, face unique erosion dynamics not fully captured in existing frameworks.

C. Theoretical and Practical Implications

Theoretically, this study contributes to a more granular understanding of how sustainability ambitions degrade over time. It bridges strategic and operational levels, and stresses the importance of temporal dynamics, actor continuity, and informal mechanisms such as intrinsic motivation.

Practically, the findings point to the need for:

- Phase-spanning sustainability ownership roles.
- Formal embedding of sustainability criteria in contracts and decision gates.
- Reflective team practices and structured onboarding to maintain ambition continuity.
- Early and consistent use of tools like the Ambitieweb in combination with leadership support.

Limitations

This study is subject to several limitations. First, the sample size, limits generalisability. Also, not all roles or organisations were equally represented, particularly in Case C. Second, the concept of ”fading ambitions” proved difficult to define uniformly across cases, potentially affecting analytical consistency.

Third, while rooted in literature, the study had to synthesise literature from adjacent domains, due to limited prior work on this specific topic. Fourth, the exclusive focus on the Dutch context and involvement of a single consultancy in the validation process may limit transferability.

Fifth, participant bias is possible. Most interviewees had technical backgrounds and may have underemphasised organisational or cultural factors. Social desirability and retrospective rationalisation may also have coloured responses.

Lastly, by focusing on breadth over depth, the study excluded perspectives from contractors, community stakeholders, and political actors. Future research should broaden the stakeholder base and explore the impact of formal instruments and informal dynamics through longitudinal and comparative designs.

6 Conclusion and Recommendations

This paper investigated how sustainability ambitions in Dutch infrastructure and mobility projects erode over time, and what factors enable their continuity. Drawing on literature and empirical case studies, the research shows that ambition erosion stems not from a single cause but from misalignment across structural, procedural, and behavioural dimensions. The study answered five sub-questions to address the main research question: *How can the initial ambitions for sustainability in infrastructure and mobility projects be maintained throughout the decision-making process?*

- **RQ1** showed that sustainability is typically embedded during early strategic and tactical phases but often fades during elaboration due to shifting priorities.
- **RQ2** revealed that individual motivation and informal leadership influence sustainability prioritisation more than formal roles within project teams.
- **RQ3** explored the key barriers that prevent sustainability from remaining a decisive factor. The six literature-based barrier categories were confirmed, but empirical findings revealed a refined typology of four overarching themes. Among these, budget concerns, time pressure, and vague ambitions were consistently mentioned across all cases. However, several case-specific barriers, such as fragmented team structures, limited procedural follow-up, or risk aversion, emerged contextually. These insights show that while certain barriers are systemic, others depend on project-specific dynamics.
- **RQ4** highlighted that phase transitions, especially between exploration and elaboration, are both vulnerable moments and key opportunities for reinforcement.
- **RQ5** confirmed that continuity relies on success factors such as intrinsic motivation, procedural tools, and contractual anchoring, most effective when aligned across decision-making levels.

To maintain sustainability ambitions throughout the decision-making process, three pillars must be addressed:

- **Structural anchoring:** measurable ambitions embedded in contracts, KPIs, and frameworks;
- **Procedural reinforcement:** tools, reflection points, and onboarding moments across project phases;
- **Behavioural commitment:** intrinsic motivation, ownership, and informal leadership.

These pillars must be addressed in parallel; omitting one weakens the entire structure. The proposed visual framework (Appendix, Figure 7) illustrates how barriers and success factors interact across project phases, highlighting vulnerable moments and entry points for reinforcement.

Recommendations

1. For research:

- *Expand the empirical base*: Include completed projects and more diverse actors (e.g., contractors, politicians) to assess ambition continuity over time.
- *Refine conceptual clarity*: Investigate how varying definitions of 'sustainability ambition' affect interpretation and implementation.
- *Focus on phase transitions*: Develop and test procedural tools (e.g., onboarding, ambition revisits) for critical handovers.
- *Strengthen behavioural understanding*: Explore how intrinsic motivation and leadership can be supported through team culture, roles, or incentives.
- *Explore adaptive contracting*: Investigate flexible ambition anchoring that allows for innovation without eroding intent.

2. For practice:

- *Formalise sustainability roles*: Embed sustainability experts from procurement through elaboration to maintain ambition translation.
- *Translate ambition into design*: Use ambition workshops, co-creation sessions, and design reviews to integrate goals into concrete decisions.
- *Share risk and innovation*: Promote collaborative investment in sustainable practices to reduce perceived innovation risks.
- *Foster reflective culture*: Create time and space for dialogue, learning, and cross-project knowledge exchange.
- *Reframe procurement culture*: Shift focus from cost-performance to long-term public value, using the principle of advance, translate, anchor, clarify.

As one interviewee remarked: *"Circularity doesn't cost money, it saves money. But only if you make the right choices upfront."* This quote captures the core insight: sustainability must be embedded early, revisited often, and collectively supported.

3. Final Reflection:

This research offers the conceptual foundation for a future ambition support guide. While not a checklist, it identifies where sustainability is most at risk and what dimensions require reinforcement, structure, procedure, or behaviour. Future work should translate these principles into tangible instruments to empower teams in bridging ambition and implementation.

7 REFERENCES

[1] United Nations Environment Programme, "Integrated Approaches to Sustainable Infrastructure," Tech. Rep. DTI/2238/GE, United Nations Environment Programme (2021), URL https://www.unep.org/resources/report/integrated-approaches-sustainable- accessed: 2024-03-19.

[2] Klimaatakkoord, "Wat is het doel van het klimaatakkoord?" URL https://www.klimaatakkoord.nl/klimaatakkoord/vraag-en-antwoord/wat-is-het-doel-van-het-klimaatakkoord, retrieved February 24, 2025.

[3] J. D. Sachs, G. Lafortune, G. Fuller, *The SDGs and the UN Summit of the Future. Sustainable Development Report 2024* (SDSN, Dublin University Press, Paris, Dublin) (2024), doi:10.25546/108572.

[4] S. Chatterjee, *Synergy Solutions for Climate and SDG Action: Bridging the Ambition Gap for the Future We Want* (United Nations Publications) (2024).

[5] Duurzaam GWW, "Ambitieweb - Duurzaam GWW," URL https://www.duurzaamgww.nl/documenten/58-ambitieweb, accessed: 3 March 2025.

[6] CO_2-Prestatieladder, "CO_2-Prestatieladder - Het instrument voor CO_2-reductie," URL https://www.

co2-prestatieladder.nl/, accessed: 3 March 2025.

[7] M. Rezaeian, J. Pinkse, J. Rigby, "Transforming titans: The role of policy mixes in business model adaptation strategies for sustainability transitions," *Energy Research & Social Science*, vol. 112, p. 103499 (2024), doi:https://doi.org/10.1016/j.erss.2024.103499, URL https://www.sciencedirect.com/science/article/pii/S2214629624000902.

[8] R. Hahn, R. Lülfs, "Legitimizing Negative Aspects in GRI-Oriented Sustainability Reporting: A Qualitative Analysis of Corporate Disclosure Strategies," *Journal of Business Ethics*, vol. 123, no. 3, pp. 401–420 (2014 Sep.), doi:10.1007/s10551-013-1801-4, URL https://doi.org/10.1007/s10551-013-1801-4.

[9] J. N. Chege, J. W. Wachira, L. Mwenda, "Effects of Leadership Styles on Implementation of Organization Strategic Plans in Small and Medium Enterprises in Nairobi," *International Journal of Economics, Commerce and Management*, vol. 3, no. 6, pp. 1–16 (2015), URL https://www.semanticscholar.org/paper/Effects-of-Leadership-Styles-on-Implementation-Chege-Wachira/9c6266d4176d054daa2a1ce8895c0b94eb6f86e3.

[10] Witteveen+Bos, "Duurzame ontwerpprincipes," (2025), URL https://www.witteveenbos.com/nl/over-ons/hoe-wij-werken/duurzame-ontwerpprincipes.

[11] L. Bragança, S. M. Vieira, J. B. Andrade, "Early Stage Design Decisions: The Way to Achieve Sustainable Buildings at Lower Costs," *The Scientific World Journal*, vol. 2014, no. 1, p. 365364 (2014), doi:https://doi.org/10.1155/2014/365364, URL https://onlinelibrary.wiley.com/doi/abs/10.1155/2014/365364.

[12] S. Engert, R. J. Baumgartner, "Corporate sustainability strategy textbf– bridging the gap between formulation and implementation," *Journal of Cleaner Production*, vol. 113, pp. 822–834 (2016 Feb.), doi:10.1016/j.jclepro.2015.11.094, URL https://www.sciencedirect.com/science/article/pii/S0959652615018259.

[13] L.-M. Glass, J. Newig, "Governance for achieving the Sustainable Development Goals: How important are participation, policy coherence, reflexivity, adaptation and democratic institutions?" *Earth System Governance*, vol. 2, p. 100031 (2019 Apr.), doi:10.1016/j.esg.2019.100031, URL https://www.sciencedirect.com/science/article/pii/S2589811619300308.

[14] C. Fast, O. Widerberg, "Governance through goals in action: How multi-stakeholder partnerships translate and connect the SDGs," *Earth System Governance*, vol. 23, p. 100238 (2025 Jan.), doi:10.1016/j.esg.2025.100238, URL https://www.sciencedirect.com/science/article/pii/S2589811625000047.

[15] G. Vergerio, V. Knotten, *Ensuring ambitious goals: barrier and good practices in the planning and building process*, no. no. 54 in ZEN report (SINTEF akademisk forlag, Trondheim) (2024).

[16] J. Liang, "Qualitative research methods: Collecting evidence, crafting analysis, communicating impact," *Communication Research and Practice*, pp. 1–2 (2019), doi:10.1080/22041451.2019.1688620, URL https://doi.org/10.1080/22041451.2019.1688620.

[17] J. L. Campbell, C. Quincy, J. Osserman, O. K. Pedersen, "Coding In-depth Semistructured Interviews: Problems of Unitization and Intercoder Reliability and Agreement," *Sociological Methods & Research*, vol. 42, no. 3, pp. 294–320 (2013 Aug.), doi:10.1177/0049124113500475, URL https://journals.sagepub.com/doi/10.1177/0049124113500475.

[18] E. Trullols, I. Ruisánchez, F. X. Rius, "Validation of qualitative analytical methods," *TrAC Trends in Analytical Chemistry*, vol. 23, no. 2, pp. 137–145 (2004 Feb.), doi:10.1016/S0165-9936(04)00201-8, URL https://www.sciencedirect.com/science/article/pii/S0165993604002018.

[19] J. Elkington, *Cannibals with Forks: The Triple Bottom Line of 21st Century Business* (Capstone Publishing, Oxford, UK) (1997).

[20] G. Silvius, R. Schipper, J. Planko, *Sustainability in Project Management* (Gower Publishing, Ltd., Farnham, UK) (2012).

[21] T. Kuhlman, F. John, "What is Sustainability?" *Sustainability*, vol. 2 (2010 11), doi:10.3390/su2113436.

[22] B. Jakobsen, *Working towards unclear goals: Exploring the concept of social sustainability in a city development project in Oslo, Norway*, Master's thesis (2024), URL https://www.duo.uio.no/handle/10852/112264, accepted: 2024-08-21T23:33:19Z.

[23] P. M. Gollwitzer, P. Sheeran, "Implementation Intentions and Goal Achievement: A Meta-analysis of Effects and Processes," in *Advances in Experimental Social Psychology*, vol. 38, pp. 69–119 (Elsevier) (2006), doi:10.1016/S0065-2601(06)38002-1, URL https://linkinghub.elsevier.com/retrieve/pii/S0065260106380021.

[24] V. Tørstad, V. Wiborg, "Commitment ambiguity and ambition in climate pledges," URL https://link.springer.com/article/10.1007/s11558-024-09575-y.

[25] D. Goedknegt, "Responsibility for Adhering to Sustainability in Project Management," presented at the *Proceedings of the 7th Nordic Conference on Construction Economics and Organization* (2013).

[26] M. J. Epstein, *Making Sustainability Work: Best Practices in Managing and Measuring Corporate Social, Environmental and Economic Impacts* (Routledge, New York, NY) (2018).

[27] R. C. E. Verstraeten, "Two Types of Ambition in order to get a better Picture of Gender Differences in," .

[28] W. Visser, "The three fundamental criticisms of the Triple Bottom Line approach: An empirical study to link sustainability reports in companies based in the Asia-Pacific region and TBL shortcomings," *Asian Journal of Business Ethics*, vol. 2, no. 1, pp. 91–111 (2013), doi:10.1007/s13520-012-0019-3, URL https://link.springer.com/article/10.1007/s13520-012-0019-3.

[29] D. Loorbach, N. Frantzeskaki, W. Thissen, "Introduction to the special section: Infrastructures and transitions," *Technological Forecasting and Social Change*, vol. 77, no. 8, pp. 1195–1202 (2010 Oct.), doi: 10.1016/j.techfore.2010.06.001, URL https://www.sciencedirect.com/science/article/pii/S0040162510001228.

[30] G. Cecere, N. Corrocher, M. L. Mancusi, "Financial constraints and public funding of eco-innovation: Empirical evidence from European SMEs," *Small Business Economics*, vol. 54, no. 1, pp. 285–302 (2020).

[31] J. R. Graham, C. R. Harvey, S. Rajgopal, "The economic implications of corporate financial reporting," *Journal of accounting and economics*, vol. 40, no. 1-3, pp. 3–73 (2005).

[32] I. Y. Wuni, "Mapping the barriers to circular economy adoption in the construction industry: A systematic review, Pareto analysis, and mitigation strategy map," *Building and Environment*, vol. 223, p. 109453 (2022 Sep.), doi:10.1016/j.buildenv.2022.109453, URL https://www.sciencedirect.com/science/article/pii/S0360132322006849.

[33] P. Haessler, "Strategic Decisions between Short-Term Profit and Sustainability," *Administrative Sciences*, vol. 10, no. 3 (2020), URL https://www.mdpi.com/2076-3387/10/3/63.

[34] D. E.E., O. Davies, "Barriers to implementation of sustainable construction techniques," *Journal of Environmental Science*, vol. 2 (2017 Jul.).

[35] A. Olfert, M. Hirschnitz-Garbers, J. Walther, K. Hölscher, B. Brunnow, G. Schiller, *Strengthening early stage decision-making by process-integrated sustainability assessment in local infrastructure transitions* (2020 Jan.).

[36] K. Koistinen, T. Onkila, S. Teerikangas, M. Mäkelä, M. Sarja, M. Valkjärvi, "Bold ambition, blunted agency? Examining top management perspectives on a circular economy transition in Finland," *Energy Research & Social Science*, vol. 86, p. 102451 (2022), doi:https://doi.org/10.1016/j.erss.2021.102451, URL https://www.sciencedirect.com/science/article/pii/S2214629621005387.

[37] S. Tessitore, F. Corsini, F. Iraldo, "Exploring the alignment and misalignment in the transition to a circular economy within private companies and public organizations," *Journal of Cleaner Production*, vol. 430, p. 139528 (2023), doi:https://doi.org/10.1016/j.jclepro.2023.139528, URL https://www.sciencedirect.com/science/article/pii/S0959652623036867.

[38] O. Krancher, "Knowledge transfer in the transition phase," in E. Beulen, P. M. Ribbers (Eds.), *The Routledge Companion to Managing Digital Outsourcing*, pp. 177–202 (Routledge), 1st ed. (2020 Jul.), doi: 10.4324/9781351037785-13, URL https://www.taylorfrancis.com/books/9781351037778/chapters/10.4324/9781351037785-13.

[39] S. Durdyev, E. K. Zavadskas, D. Thurnell, A. Banaitis, A. Ihtiyar, "Sustainable Construction Industry in Cambodia: Awareness, Drivers and Barriers," *Sustainability*, vol. 10, no. 2, p. 392 (2018), doi:10.3390/su10020392, URL https://doi.org/10.3390/su10020392.

[40] S. Bell, S. Morse, "Breaking through the Glass Ceiling: Who really cares about sustainability indicators?" *Local Environment*, vol. 6, no. 3, pp. 291–309 (2001), doi: 10.1080/13549830120073284.

[41] J. B. H. Yap, B. L. Lim, M. Skitmore, "Capitalising knowledge management (KM) for improving project delivery in construction," *Ain Shams Engineering Journal*, vol. 13, no. 6, p. 101790 (2022 Nov.), doi:10.1016/j.asej.2022.101790, URL https://www.sciencedirect.com/science/article/pii/S2090447922001010.

[42] M. Hoeft, M. Pieper, K. Eriksson, H.-J. Bargstädt, "Toward Life Cycle Sustainability in Infrastructure: The Role of Automation and Robotics in PPP Projects," *Sustainability*, vol. 13, no. 7, p. 3779 (2021 Jan.), doi: 10.3390/su13073779, URL https://www.mdpi.com/2071-1050/13/7/3779, number: 7 Publisher: Multidisciplinary Digital Publishing Institute.

[43] M. Eikelenboom, C. Stella, S. Decadri, "Overcoming the challenges to sustainability," (2022 Jul.), URL https://www.adlittle.com/en/insights/report/overcoming-challenges-sustainability.

[44] N. M. Bocken, T. H. Geradts, "Barriers and drivers to sustainable business model innovation: Organization design and dynamic capabilities," *Long Range Planning*, vol. 53, no. 4, p. 101950 (2020), doi:https://doi.org/10.1016/j.lrp.2019.101950, URL https://www.sciencedirect.com/science/article/pii/S0024630119301062.

[45] M. Journeault, A. Perron, L. Vallières, "The collaborative roles of stakeholders in supporting the adoption of sustainability in SMEs," *Journal of environmental management*, vol. 287, p. 112349 (2021).

[46] P. Sharma, J. Kumar Jain, P. Kalla, "A multi-criteria decision analysis (MCDA) approach for evaluating the performance of Indian cities' sustainable infrastructure," *Materials Today: Proceedings* (2023), doi:https://doi.org/10.1016/j.matpr.2023.06.355, URL https://www.sciencedirect.com/science/article/pii/S2214785323037537.

[47] X. Huang, "The roles of competition on innovation efficiency and firm performance: Evidence from the Chinese manufacturing industry," *European Research on Management and Business Economics*, vol. 29, no. 1, p. 100201 (2023 Jan.), doi:10.1016/j.iedeen.2022.100201, URL https://www.sciencedirect.com/science/article/pii/S2444883422000079.

[48] M. von Rosing, L. Shepperson, U. Foldager, W. Laurier, H. Czichos, H. Arnold, M. Yousaf, A. Fisseau, J. Pinto, H. W. Spiegel, N. Kemp, B. S. Urquhart, D. H. Muhita, V. Abele, A. Shyam, A. R. A. Razek, A. D. Svendsen, A. Solomon, A. Khan, A. S. Alshebami, A. Wijayanayake, A. Dicks, C. Hellmich, C. van Husen, D. Fehrenbach, D. C. Guerrero, D. H. H. Niwunhella, F. A. Schmidt, H. A. I. Udakanjalee, J. Cilliers, J. Schmider, J. Warm, J. M. González-Páramo, H. K. Baker, K. S. Yogi, K. Yeboua, M. J. Álvarez Gil, M. M. Khan, N. I. B. Za-

karia, P. Solomon, R. Zwingenberg, S. Mubarik, S. Kwasi, S. Atapattu, S. Seibert, T. Kaur, U. Schade, W. Ali, W. Chungyalpa, "Chapter 1 - Why is sustainability so important?" in M. von Rosing (Ed.), *The Sustainability Handbook, Volume 1*, pp. 3–7 (Elsevier) (2025), doi:https://doi.org/10.1016/B978-0-323-90110-9.00044-1, URL https://www.sciencedirect.com/science/article/pii/B9780323901109000441.

[49] S. Banihashemi, M. R. Hosseini, H. Golizadeh, S. Sankaran, "Critical success factors (CSFs) for integration of sustainability into construction project management practices in developing countries," *International Journal of Project Management*, vol. 35, no. 6, pp. 1103–1119 (2017 Aug.), doi:10.1016/j.ijproman.2017.01.014, URL https://www.sciencedirect.com/science/article/pii/S0263786317300856.

[50] M. Alabi, "Sustainable Infrastructure and Climate Change Resilience," (2024 10).

[51] D. White, J. Patton, "Closing the strategic vision and implementation gap," (2002), URL https://www.pmi.org/learning/library/closing-strategic-vision-implementation-gap-1097.

[52] L. Sabini, N. Alderman, "The Paradoxical Profession: Project Management and the Contradictory Nature of Sustainable Project Objectives," *Project Management Journal*, vol. 52, no. 4, pp. 379–393 (2021 Aug.), doi:10.1177/87569728211007660, URL https://doi.org/10.1177/87569728211007660, publisher: SAGE Publications Inc.

[53] M. Lahsen, E. Turnhout, "How norms, needs, and power in science obstruct transformations towards sustainability," *Environmental Research Letters*, vol. 16, no. 2, p. 025008 (2021 Feb.), doi:10.1088/1748-9326/abdcf0, URL https://dx.doi.org/10.1088/1748-9326/abdcf0, publisher: IOP Publishing.

[54] M. Smits, A. Moor, *Effective Knowledge Management in Project-Based Organisations* (2003 Jan.).

[55] M. F. Omar, B. Trigunarsyah, W. Johnny, "Decision making tools for infrastructure project planning," (2008 12).

[56] E. Too, P. Weaver, "The management of project management: A conceptual framework for project governance," *International Journal of Project Management*, vol. 32, pp. 1382–1394 (2014 Nov.), doi:10.1016/j.ijproman.2013.07.006.

[57] G. Schmidt, W. Wilhelm, "Strategic, Tactical and Operational Decisions in Multi-national Logistics Networks: A Review and Discussion of Modeling Issues," *International Journal of Production Research - INT J PROD RES*, vol. 38, pp. 1501–1523 (2000 May), doi:10.1080/002075400188690.

Appendix

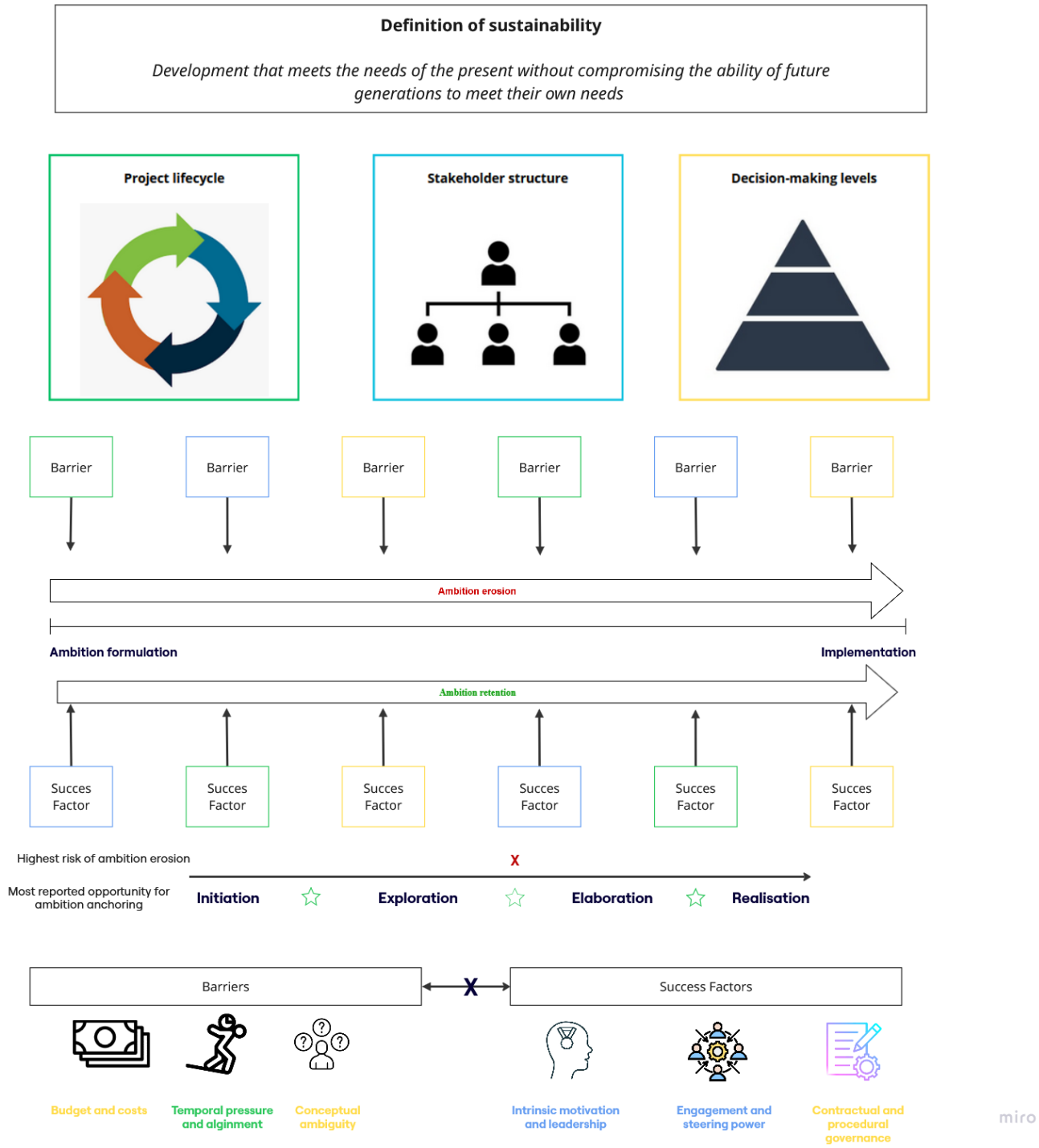


Fig. 7. visualisation of the sustainability ambition process

B

Literature Study

B.1. Problem definition search strategy

Table B.1: Literature search to support the identification of the problem

Search string (keywords)	Scopus	ScienceDirect
ambition AND implementation AND gap	200	71
ambition AND implementation AND gap AND infrastructure	12	5
ambition AND implementation AND gap AND infrastructure AND (Dutch OR Netherlands)	4	1
ambition AND implementation AND gap AND sustainability AND (Dutch OR Netherlands)	1	1
policy AND Practice AND gap	23,821	2,975
policy AND practice AND gap AND (Dutch OR Netherlands)	251	27
policy AND practice AND gap AND infrastructure AND (Dutch OR Netherlands)	16	3
policy AND practice AND gap AND sustainability AND infrastructure AND (Dutch OR Netherlands)	1	1
strategy AND execution AND gap	1,004	161
strategy AND execution AND gap AND (Dutch OR Netherlands)	3	0
strategy AND execution AND gap AND infrastructure AND (Dutch OR Netherlands)	0	0

Table B.2: Literature search to support the identification of the research gap

Search string (keywords)	Scopus	ScienceDirect
sustainability AND project management	18,335	6,376
sustainability AND project management AND infrastructure	2,126	743
sustainability ambitions AND project management	63	24
sustainability ambitions AND project management AND infrastructure	8	7
ambition dilution AND project management	3	0
ambition dilution AND infrastructure	4	1
ambition erosion AND infrastructure	0	0

Note. A keyword-based literature search was conducted using Scopus and ScienceDirect to evaluate the availability of studies relevant to the research problem. The initial search terms were intentionally broad (e.g. *sustainability AND project management*) to map the general field. Subsequent, more refined queries focusing on *sustainability ambitions*, *ambition dilution*, and *ambition erosion* resulted in significantly fewer hits, particularly when combined with the infrastructure domain. These findings highlight the scarcity of studies that explicitly address the weakening of sustainability ambitions in the early stages of infrastructure project planning and decision-making. This supports the need for further research into the mechanisms and actor interactions that drive this erosion. Also, when reviewing the abstract and contents of the papers found, they turned out not to be useful for the problem in this research.

B.2. Sustainability definitions

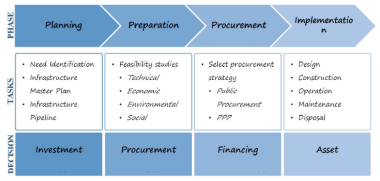
Table B.3 provides an overview of various definitions of sustainability and sustainable infrastructure as found in academic and institutional sources. Each definition is assessed based on whether it explicitly addresses economic, social, and/or environmental dimensions, the three pillars commonly used to conceptualize sustainability as explained in Chapter 1. The table shows that while some definitions emphasize a single dimension (often environmental), others aim for a more integrated, triple-bottom-line perspective. This comparison highlights the diversity in how sustainability is framed and underscores the importance of selecting a definition that aligns with the context and objectives of a given project or analysis.

Source	Definition	Econ.	Soc.	Env.
Wiersum (1995)	Never harvesting more than what the forest yields in new growth			×
Kuhlman and John (2010)	Maintaining well-being over a long, perhaps indefinite period		×	
Yilmaz and bakış (2015b)	Use natural resources in equilibrium to avoid depletion and pass them on			×
Meng et al. (2015)	Effective urban system functionality across economic, social, and ecological domains over life cycle	×	×	×
Elkington (1997)	Ensure current actions do not restrict future economic, social, and environmental options	×	×	×
“Brundtland Report” (n.d.)	Meeting present needs without compromising future generations’ ability to meet theirs	×	×	×
Radermacher (1999)	Sustainability should include globalization, time, externalities, environmental policy, cradle-to-grave			×
Marshall and Toffel (2005)	Development that meets the needs of the present without harming the future			×
Newman (2015)	Reduce urban development footprint while improving liveability		×	×
Korea (South) et al. (2007)	Infrastructure aligned with economic and environmental sustainability, focused on resource conservation	×	×	×
“Infrastructure in development: Navigating infrastructure investments towards sustainability goals - GRESB” (n.d.)	infrastructure that is planned, designed, constructed, operated, and decommissioned in a manner that ensures economic and financial, social, environmental, and institutional sustainability over the entire lifecycle.	×	×	×

Table B.3: Overview of Sustainability Definitions and Dimensions Covered

B.3. Planning phases

Figure B.1 presents a collection of lifecycle visualizations from various national and international sources. While all models aim to describe the phases of infrastructure project development, they differ in terminology, level of detail, and structuring. For example, some emphasize policy and enabling environments (b), while others focus on procurement and implementation (a, e). This variation illustrates that although the general sequence of phases is similar, each organization or institution applies its own interpretation based on context, priorities, and objectives.



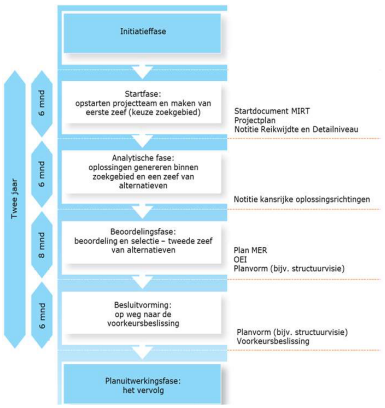
(a) Planning phases overview, (Bisbey et al., 2020)

(b) Circular infrastructure lifecycle, (United Nations Environment Programme, 2021)

(c) ("Infrastructure in development: Navigating infrastructure investments towards sustainability goals - GRESB", n.d.)

(d) ("Hoe werkt de projectfasering?", n.d.)

(e) From initiative to realisation, ("MIRT-traject-scaled.jpg (JPEG-afbeelding, 2560 × 670 pixels) - Geschaald (50%)", n.d.)



(f) Steps in MIRT exploration phase, (Milieu, 2016)

Figure B.1: Collection of lifecycle visualizations from national and international sources. These illustrations emphasize that each project phase consists of multiple sub-steps, decision-making moments, and iterations. They support the argument for a more detailed and flexible approach to sustainability integration across the infrastructure lifecycle.

C

Interview Questions

Research:MSc thesis on the erosion of sustainability ambitions in infrastructure and mobility projects
Institution: Delft University of Technology
Researcher: Sophie Pijnenburg

Introduction
Thank you for participating in this research on the erosion of sustainability ambitions in infrastructure and mobility projects, focusing specifically on discovering the phenomenon in the corresponding stages of the project lifecycle. This research is part of my graduation thesis for the MSc Transport, Infrastructure and Logistics at the Delft University of Technology. The aim of this research is to give insight and gain knowledge on how the diminishing of sustainability ambitions arises and provide an advice on how to effectively mitigate this erosion to improve project outcomes.

Your role within the selected project in particular and your experience in comparable projects in general are of great value for this research. I am particularly interested in the following aspects:

1. You professional background, function within the project and role in the project team;
2. Your view on the causes of the erosion experienced in the project, the methods used to resolve the erosion and what your role was;
3. Your view on the possibilities and barriers of the implementation of potential strategies to mitigate the dilution.

Please note that there are no wrong answers, your personal honest view is what counts. The data you provide will not be used for any other purposes beyond this research. You are not obliged to answer all questions and you may whitdraw at any time. This interview will take approximately X minutes.

General

- What was your role and the scope of your work within this project?
- In what stage of the project were you active?

Stakeholders

- In which ways did your role give you influence on sustainability decisions during the project?
- Can you briefly describe how sustainability came up in the decision-making process within this project?
- Which parties do you think play a key role in (de)prioritizing sustainability?

Barriers

- In your opinion, has there been any dilution of sustainability ambitions in this project? If so:
- How did you experience the occurrence of sustainability ambition dilution in this project?

- In your opinion, what were the 3 main causes of this phenomenon in this project?
- In the literature, several barriers are described, do you recognize these barriers?
- How did your role influence how you dealt with this challenge?
- In which project phase(s) was it particularly difficult to defend sustainable choices?

Opportunities and success factors

- At what stage(s) of the decision-making process do you see opportunities to strengthen sustainability?
- How would you describe the 3 most important factors to maintain sustainability ambitions throughout the project?
- In the literature, several success factors are described, do you recognize these factors?

Strategies

- What has been done in this project to effectively counteract the dilution of sustainability ambitions?
- What actions do you think have the most potential to counteract dilution of sustainability ambitions without adding complexity to the decision-making process?
- Are there tools, formats or processes that you think contribute to practical sustainable decision-making?

Optional

- How would you define 'effective ambition erosion mitigation?'
- What has to change for that to be reached?
- To which degree would you wish to increase the maintenance of sustainability ambitions?

C.1. List of interviewees

Table C.1 provides an overview of the professionals interviewed for this research, categorized by the project they were involved in, their function, the organization they represent, and their years of relevant experience. The interviewees represent both public and private sector stakeholders, including provincial authorities, national infrastructure agencies, and engineering consultancies. Their diverse roles, ranging from project and contract management to sustainability advisory, ensure a comprehensive understanding of how sustainability ambitions are addressed across different phases and responsibilities within infrastructure projects. The variation in experience, with several professionals having over a decade of involvement in the sector, adds depth and credibility to the qualitative insights gathered through the interviews.

Project	Function	Company Name	Years of Experience
Cruquius	Sustainability Advisor	Province of North Holland	16 years
	Technical Manager	Province of North Holland	Unknown (350+ projects)
	Project Manager	Witteveen+Bos	38 years
	Technical Manager	Witteveen+Bos	19 years
	Sustainability Advisor	Witteveen+Bos	19 years
Westerwoldse AA	Assistant Tender Manager + Project Control Manager	Witteveen+Bos	9 years
	Technical Manager	Rijkswaterstaat	20 years
	Project Manager	Rijkswaterstaat	5 years
	Technical Manager	Witteveen+Bos	13 years
Marssum	Contract Manager	Witteveen+Bos	13 years

Table C.1: Overview of interviewees by project, function, company, and experience

D

Theoretical Background

D.1. Overview of Sustainability Considerations per Infrastructure Planning Phase

This section provides an explanation of the matrix presented below, which visualizes how sustainability is systematically integrated into the five main phases of infrastructure development in the Netherlands: Initiation, Exploration, Elaboration, Realisation, and Maintenance & Demolition. The matrix is based on existing policy frameworks and desk research within the context of Dutch infrastructure planning and delivery.

For each phase, the matrix outlines the following elements:

- **General aim and core activities:** These describe the main purpose and actions within each phase, as also detailed in the main report.
- **Key sustainability objectives:** Each phase brings its own sustainability focus, from formulating ambitions in the early stages to embedding concrete performance goals in later stages.
- **Analytical and supporting tools:** The tools listed in the matrix include both assessment methods and implementation instruments that support the integration of sustainability into infrastructure projects. Among the analytical tools, Life Cycle Assessment (LCA) evaluates the environmental impacts of materials and processes throughout the entire life cycle of an infrastructure asset (Meynerts et al., 2017). Cost-Benefit Analysis (CBA) is used to compare the societal costs and benefits of a project, often in monetary terms ("Cost-Benefit Analysis - an overview | ScienceDirect Topics", n.d.). An Environmental Impact Assessment (EIA) (in Dutch: MER) examines the expected environmental effects of a proposed intervention, usually as part of the permitting process (IPLO, n.d.). Multi-Criteria Decision Analysis (MCDA) helps decision-makers weigh various criteria, such as environmental impact, cost, and social value, when comparing alternatives (Ek et al., 2019). Feasibility studies help determine whether a proposed project or alternative is viable from technical, financial, and legal perspectives.

  These tools are often used within the context of the MIRT (Meerjarenprogramma Infrastructuur, Ruimte en Transport), the Dutch national program that structures decision-making for long-term infrastructure investments (Rijksoverheid, n.d.). MIRT provides guidance on when and how to apply such tools across project phases.

  Some tools also support sustainability implementation in practice. For example, the Environmental Cost Indicator (MKI) translates the total environmental impact of a product or design into a single monetary value, based on life cycle data, and is commonly used in procurement (Ecochain, n.d.). Instruments from the Duurzaam GWW framework. such as the Ambitieweb, Sustainability Compass, and Systems Integration Tool are discussed separately in the main report (CO_2-Prestatieladder, n.d.; Duurzaam GWW, n.d.; PIANOo, 2025).

- **Stakeholders involved:** Different actors play a key role in shaping sustainability ambitions across phases. These generally include public clients (e.g. Rijkswaterstaat, municipalities), consultancy and engineering firms, contractors, asset managers, and in some cases local communities or interest groups. The roles, interests, and influence of these stakeholders are discussed in more detail in the main report.
- **Contractual sustainability measures:** This refers to how sustainability is translated into legal commitments. In early phases, sustainability is often captured in ambitions or soft selection criteria. In later phases, enforceability increases through award criteria, technical requirements, and performance-based contracts.

This matrix illustrates that sustainability in early phases is primarily policy-driven and strategic. As projects progress, sustainability becomes more technically defined, monitored, and legally enforced. It underscores the importance of viewing sustainability not as a one-time consideration but as a continuous concern that evolves in form and function throughout the project lifecycle.

Phase	General	Key Sustainability Objectives	Analytical Tools	Corresponding Tools	Stakeholders	Contractual Sustainability measures
Initation	**Objective:** Determine necessity and feasibility of the project **Key Activities**: Problem analysis, stakeholder consultation, feasibility study, regulatory Review	Set initial strategic sustainability ambition	EIA (preliminary assessment), Feasibility study	MIRT, Ambitieweb	Public client, Policy maker	No direct legal binding
Exploration	**Objective**: Explore potential solutions and select preferred approach **Key activities**: Technical assessment, policy alignment, stakeholder engagement	Compare alternatives based on environmental and social impact, conduct feasibiltiy studies	EIA (Scoping and Assesment phase), CBA (detailed Analysis), MCDA, LCA (preliminary)	MKI, Ambitieweb, CO_2-prestatieladder	Public client, consultancy engineering firm	Partially binding - can be included as evaluation criteria, but often not mandatory
Elaboration	**Objective**: Develop detailed designs and prepare for implementation **Key activities:** Detailed engineering design, cost estimation procurement planning, sustainabiltiy integration	Optimize material choices, ensure circular economy principles, asses long-term environmental costs	LCA (Full analysis for materials and design choices), CBA	MKI, CO_2-prestatieladder, DuboCalc	Consultancy-engineering firm, Contractors, Material Suppliers	Binding contract clauses can specify sustainability requirements
Realisation	**Objective**: Construct and execute project **Key Activities**: Official approvals, contractor selection, implementation of sustainable construction methods	Ensure emissions reduction, monitor sustainable practices, minimize waste	LCA (material monitoring)	CO_2-prestatieladder, MKI (Monitoring)	Contractors	Enforced contract clauses, monitoring obligations
Operation and Demolition	**Objective:** Ensure long-term performance **Key Activities**: Maintenance planning, performance monitoring, energy efficiency, durability assessments	Energy-efficient operations, sustainable maintenance practices, material reuse	LCA (Operational and sustainability analysis), CBA	Ambitieweb (monitoring), MKI (Lifecycle analysis)	Operators, municipalities, maintenance teams	Few mandatory sustainability requirements; largely dependent on asset management policies

Figure D.1: Matrix overview of sustainability considerations across infrastructure project phases

D.2. Stakeholder Dynamics in Sustaining Sustainability Ambitions

This section presents an analysis of key stakeholder groups in relation to their ability and willingness to uphold sustainability ambitions throughout the lifecycle of infrastructure projects. The power-interest grid in Figure D.2 visualizes the relative influence and engagement of each stakeholder, offering a strategic lens on who to involve, consult, or inform to safeguard long-term sustainability objectives.

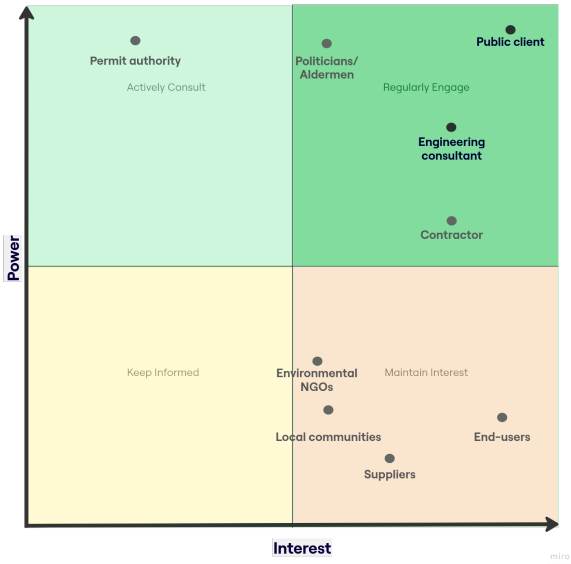


Figure D.2: Stakeholder power-interest grid for maintaining sustainability ambitions in infrastructure projects

To complement this visual representation, Table D.1 provides a structured overview of the most relevant stakeholders, categorizing them based on their level of power, interest, and primary motivation. This synthesis highlights the diverse roles and perspectives that shape the trajectory of sustainability considerations in practice.

Table D.1: Overview of stakeholders based on power, interest, and motivation

Stakeholder	Power	Interest	Motivation
Politicians/Aldermen	High	Medium	Political visibility, public support, electoral incentives
Public client	High	High	Accountable for ambitions
Permit authority	High	Low	Legal compliance and control
Consultant	Medium	High	Design quality, reputation gain
Contractor	Medium	High	Execution focus; cost/time driven
Environmental NGOs	Medium	Medium	Advocacy via media and objections
Local communities	Medium	Medium	Service access and integration
Suppliers	Low	Medium	Provide sustainable materials
End-users	Low	High	Seek sustainable outcomes

E

Case Study

E.1. Thematic Coding Approach and Barrier Structuring

This section provides an overview of how thematic coding was applied and how individual codes were consolidated into a revised barrier structure. The process was grounded in abductive reasoning, combining predefined literature categories with empirically observed patterns to arrive at a more context-specific framework.

During the coding process, multiple quotes emerged that expressed similar ideas using different wording. These were merged into unified second-order codes to improve clarity and consistency. For example:

> *"Such as the missing of intrinsic motivation of some project managers"*
> *"The missing of intrinsic motivation, to go that far to explore all"*
> *"Limited intrinsic motivation of some roles"*
> *"If he doesn't have an intrinsic motivation of himself"*

These quotes were all consolidated under the unified code *Lack of intrinsic motivation*. At first under the predefined theme Conceptual and Motivational, later on under the theme Conceptual Ambiguity and Knowledge Gaps.

In a similar way:

- The quote *"The sustainability ambition was not strongly formulated at the beginning"* was assigned to the barrier *Conceptual ambiguity*, placed under the theme *Conceptual Ambiguity and Knowledge Gaps*.
- Multiple time-related quotes (e.g., *"If you are further in the process, adapting is difficult,"* and *"The earlier you begin, the greater the impact"*) were grouped under the code *Temporal pressure and alignment*, reflecting how timing affects the ability to embed sustainability in a project.
- The quote *"The organisation is a project organisation... everything is organised at project level"* contributed to the code *Project over programme focus*.
- Similarly, *"Typical for infrastructure projects is time; they are long trajectories... sometimes even longer"* and *"Before we start the realisation phase, it takes 1.5 years. There is a chance you completely drop below the baseline, and then you cannot start over"* were key in identifying long project timelines and inflexible transitions.

However, not all empirically identified barriers fit neatly within the six literature-based categories. A number of barriers emerged that were infrastructure-specific and not explicitly discussed in the sustainability or project management literature. These include: *Long project duration*, *Phase transitions*, *Execution-oriented project structure*, *Project over programme focus*, and *Temporal pressure and alignment*. These barriers reflect the complexity, duration, and phasing characteristics inherent to infrastructure projects, and justified the addition of a separate thematic category: *Project Structure and Temporal Dynamics*.

In addition, several barriers originally drawn from literature showed significant overlap across multiple thematic domains, making them difficult to assign to one distinct category. For example: *Stakeholder misalignment and resistance* relates to stakeholder engagement, cultural resistance, and governance challenges. *Limited personal responsibility* reflects motivational, cultural, and governance-related dynamics.*Knowledge continuity* and *Fragmented and unstable team structure* affect both knowledge transfer and organisational stability. *Lack of intrinsic motivation* spans motivational and cultural dimensions. *Lack of follow-through from the client* touches on both governance structures and internal commitment. *Risk perception and avoidance* and *Perceived feasibility limitations* connect knowledge gaps with motivational reluctance. Even conceptually central codes such as *Conceptual ambiguity* reflect both motivational and governance-related causes. *Budget and cost*, although often classified under economic barriers, also directly reflects governance priorities and institutional decision rules.

This observed overlap further reinforced the need to move beyond the literature-derived categories and adopt a more empirically grounded thematic structure. The resulting four themes allowed for a clearer and more coherent clustering of barriers as they appeared across the three cases. The table below presents the final set of 17 identified barriers, categorised into four empirically derived themes. Each barrier is assigned to the level of decision-making at which it primarily manifests strategic (S), tactical (T), or operational (O) based on the scope of influence and typical actor responsibility

Table E.1: Overview of identified barriers by theme and decision-making level

Barrier	Level	Description
Conceptual Ambiguity and Knowledge Gaps		
Conceptual ambiguity	S/T/O	Sustainability goals are vaguely defined or inconsistently interpreted.
Lack of knowledge	S/T/O	Limited expertise or experience with sustainability (tools) in infrastructure contexts.
Perceived feasibility limitations	T/O	Doubts about the practical or technical feasibility of sustainable alternatives.
Risk perception and avoidance	T/O	A tendency to avoid perceived risks associated with sustainable innovation.
Institutional and Governance		
Budget and cost	S/T/O	High costs or limited budgets hinder the inclusion of sustainable options, especially when economic efficiency dominates decision-making.
Lack of follow-through and ownership from client side	T/O	The client does not consistently prioritise or pursue sustainability goals.
Lack of formal sustainability anchoring	S/T	Sustainability is not embedded structurally in policy or procedures.
Weak and fragmented governance	S/T	Lack of coherent policy direction or alignment across governance layers.
Personal and Cultural Resistance		
Culture resists change or collaboration	S/T/O	Organisational culture is conservative or siloed, hindering innovation.
Lack of intrinsic motivation	T/O	Project actors are not personally driven to pursue sustainability goals.
Limited personal responsibility	S/T/O	Individuals do not feel accountable for sustainability outcomes.

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Barrier	Level	Description
Stakeholder misalignment and resistance	S/T/O	Conflicting interests or opposition from key stakeholders.
Project Structure and Temporal Dynamics		
Fragmented and unstable team structure	T/O	Lack of continuity and cohesion within teams due to staff turnover, weak collaboration, or unclear roles.
Knowledge continuity	T/O	Knowledge is not effectively transferred across phases or between projects.
Project over programme focus	S/T	Organisations are structured around short-term projects rather than long-term programmes, limiting learning, innovation, and sustainability scaling.
Structural rigidity	T	Fixed roles, procedures, or project scopes limit the flexibility to include or prioritise sustainability.
Temporal pressure and alignment	T/O	Sustainability ambitions often fade due to time pressure, long lead times, and misalignment across project phases.

The final distribution of barriers across decision-making levels is as follows: strategic (9), tactical (17) and operational (13), highlighting the strong presence of tactical-level barriers, suggesting that mid-level decision-making is a critical point where sustainability ambitions are either translated into practice or lost.

Table E.2: Overview of identified success factors by theme and decision-making level

Success Factor	Level	Description
Clarifying and sharing knowledge		
Ambition formulation and concretisation	S/T/O	Clearly define and concretise sustainability goals early in the process.
Measurability and impact clarification	T/O	Translate ambitions into measurable outcomes to track progress.
Knowledge sharing and expertise	S/T/O	Ensure continuous learning and exchange of sustainability knowledge.
Knowledge transfer between phases	O	Guard knowledge continuity between project phases.
Embedding through governance systems		
Contractual and procedural governance	T/O	Secure sustainability through contracts, requirements, and procedures.
Formal embedding in systems and processes	S/T	Institutionalise sustainability in standards and workflows.
Policy and institutional anchoring	S/T	Align project goals with long-term public policies and political backing.
Resources and structural commitment	S/T/O	Allocate sufficient budget and long-term capacity.
Motivating and aligning people		
Engagement and steering power	T/O	Ensure strong leadership and empowered teams.

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Success Factor	Level	Description
Intrinsic motivation and leadership	T/O	Leverage personal commitment and ownership for sustainability.
Communicate to stimulate	S/T/O	Actively communicate to raise awareness and sustain momentum.
Team dynamics and collaboration	T/O	Build cohesive, collaborative teams with shared sustainability values.
Structuring for continuity and timing		
Phase-to-phase continuity and learning	O	Design for smooth transitions and learning loops across phases.
Time awareness and strategic timing	T/O	Align sustainability efforts with key decision moments in the timeline.
Project anchoring and governance tactics	T/O	Strategically position sustainability within project management.
Scoping and monitoring for integration	T/O	Use scope choices and monitoring tools to embed sustainability.

The final distribution of success factors across decision-making levels is as follows: strategic (6), tactical (14), and operational (14). This highlights the prominent role of both tactical and operational levels in enabling sustainability, suggesting that success is largely driven by mid-level translation of ambition into action, and by practical execution on the ground.

E.2. Visualising Stakeholder Roles Over Time

The following visual timelines illustrate the perceived influence of key stakeholders on sustainability throughout the project lifecycle. The timelines are constructed using input from the interviews. Each coloured bar represents the project phases during which a stakeholder was actively involved. A green star marks the phase identified by the stakeholder as most decisive for maximising sustainable impact. Dotted lines indicate an advisory or peripheral role rather than a formal position within the decision-making structure. A red cross marks a phase where the stakeholder perceived sustainability to be hardest to defend.

These timelines are intended to provide a comparative overview of stakeholder involvement and to highlight perceived windows of opportunity for sustainable influence across the cases. In cases where no green star or red cross is shown, the respective interviewee either referred to multiple phases or indicated that all phases were equally relevant, in such cases, no single phase could be marked as most decisive or most difficult. For example, the technical manager from Witteveen+Bos in case A stated that *“sustainability is relevant in every phase”*, and the sustainability advisor described barriers as *“a recurring point of attention in every phase”*. These cross-phase insights are discussed in the main report.

As the interviewee noted: *“The further you are in the process, the more difficult and costly it becomes to implement changes, reducing the room for sustainable adjustments in later phases.”* - contract manager w+b Case C

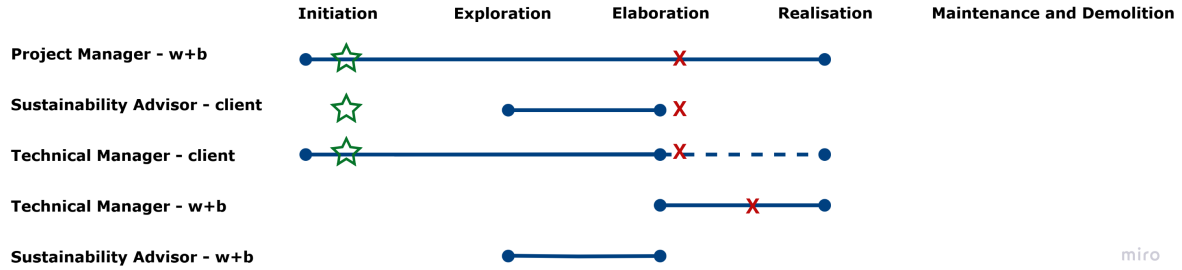

Figure E.1: Perceived involvement and influence on sustainability per project phase — Case A.

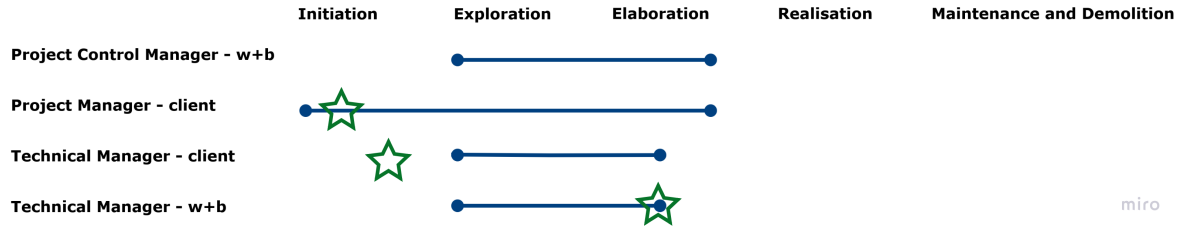

Figure E.2: Perceived involvement and influence on sustainability per project phase — Case B.

Figure E.3: Perceived involvement and influence on sustainability according to the contract manager from Witteveen+Bos — Case C.