Double Trouble: Navigating Sustainability Transitions & Infrastructure Renewal

Value Integration as key to Tactical Transition Governance in the Dutch Infrastructure Sector

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Preface

This report presents my graduation research conducted at the Faculty of Architecture and the Built Environment at Delft University of Technology, within the Master's track in Management in the Built Environment. The study investigates the use of value integration as a tool to safeguard sustainability transitions under challenging circumstances and to drive societal change.

After a year of dedicated effort in literature review, research, and writing, this study addresses the pressing "double trouble" challenges facing society today. It provides actionable insights into the activities associated with these challenges and seeks to foster stronger connections among professionals within the infrastructure sector. The outcomes and insights from this research have sparked my interest and further knowledge that will support me in my future professional career.

As I share this master's thesis, I find myself navigating my own "double trouble." Completing six and a half years at TU Delft brings both a sense of accomplishment and a bittersweet farewell to a familiar, inspiring environment. For much of my academic journey, the Faculty of Architecture has been like a second home, where I have grown into who I am today, shaped by my own values, activities, and a complex network of experiences and connections. Yet, as I turn toward the future, I am ready to take the skills and insights I have gained and apply them to create my own impact to our built environment.

I would to thank both my supervisors, Paul and Aksel, for their unwavering guidance and support throughout this graduation process. Their expertise and enthusiasm provided me with the motivation and curiosity to look beyond my capabilities. I strongly enjoyed our meetings filled with language discussions and continuous motivation.

Additionally, I want to express my gratitude Hazal for her guidance, input and time in this complex journey towards shaping and conducting my research. Her insights and effort in tackling the complex puzzle of infrastructure systems and tactical content has been inspiring, but above else fun.

Finally, I would like to mention my deepest appreciation to my friends and family for their support, (re)assurance and patience in listening to my extensive explanations of my research.

Sincerely,

E. E. (Emma) van Dongen

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Abstract

The Dutch infrastructure sector faces a dual challenge of renewing aging infrastructure and achieving sustainability goals under the constraints of limited resources and high societal demand. This research explores how value integration can facilitate transition governance at the tactical level, bridging the gap between strategic visions and operational realities in infrastructure renewal projects.

Through a qualitative research design, this thesis combines theoretical exploration of transition theory, value methodology and the activity theory with empirical data collected via semi-structured interviews and a further elaboration through a collaborative scenario workshop. Findings highlight drivers to implement sustainability into the organisational fabric as well as barriers, such as fragmented governance, resistance to change, and misaligned priorities between national and regional levels. By analysing opportunities for integrative solutions to these barriers, the study identified four key tactical activities for value integration: collaboration, alignment, co-creation and sharing. The study reveals the critical role of tactical governance in translating strategic goals into operational actions, emphasizing the need for cohesive decision-making, stakeholder engagement, and adaptive governance mechanisms. The proposed Value Integration Model addresses these challenges by identifying activities and conditions essential for embedding integrated values into governance frameworks, fostering alignment across organizational levels and among diverse stakeholders.

This research contributes to the field by operationalizing value integration as a practical tool for managing complex transitions under high-pressure scenarios. It offers actionable insights for policymakers, infrastructure managers, and practitioners, demonstrating how value integration can drive systemic change and support the dual objectives of sustainability and infrastructure renewal.

Key words; Value integration, sustainability transition, transition management, tactical governance, infrastructure renewal, activity theory

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Glossary

Asset	An asset is an item, thing, or entity that has potential or actual value to an organization. An asset may be fixed, mobile, or movable. It may be an individual item, a system, connected equipment, space within a structure, a plot of land, an entire piece of infrastructure, or a building or portfolio of assets. (Author)
Contractor	A contractor is an individual or organization engaged in a formal agreement to perform services or provide goods for another party, typically under a legally binding contract. Contractors operate independently and are often hired for specialized expertise or project-based work. (author)
Governance	Governance refers to the processes, systems, and principles by which an organization or entity is directed, controlled, and held accountable. It encompasses decision-making structures, stakeholder involvement, and the enforcement of policies to ensure transparency, fairness, and efficiency in achieving objectives (OECD, 2015).
Governance mechanism	A governance mechanism refers to the formal and informal structures, processes, and instruments employed to direct, control, and coordinate activities within organizations or between entities. These mechanisms are designed to align interests, manage relationships, and ensure compliance with established policies and objectives. They encompass a range of tools, including contracts, policies, procedures, and relational norms, that collectively facilitate effective governance (Williamson, 1996).
Infrastructure	Infrastructure refers to the fundamental physical and organizational structures and facilities needed for the operation of a society or enterprise. This includes transportation systems, communication networks, energy supplies, and public institutions that support economic activity and quality of life (World Bank, 1994).
Innovation	Innovation refers to the generation and implementation of new ideas that result in the development of new products, processes, or services, contributing to economic growth, increased productivity, and competitive advantage. It involves multiple stages, from idea conception to commercialization, often driven by the identification of new customer needs or production methods (Kogabayev & Maziliauskas, 2017).
Market	A market is a collective term for the actors in the construction industry, including companies, contractors, developers, knowledge institutions, and suppliers who engage in the exchange of goods, innovations, services, or financial transactions, often influenced by supply and demand dynamics. The market is frequently referred to as the private sector, which maintains relations with public institutions such as governmental agencies.

Renewal	Renewal refers to the process of renovating, renewing, or updating an asset or system to maintain or improve its performance, relevance, and sustainability. This can apply to physical assets, business strategies, or even ecosystems (Author).
Socio-Technical System	Socio-technical systems are configurations where technological components, human actors, institutional rules, and cultural meanings interact to fulfil societal functions, such as energy provision or transportation (Geels, 2004).
Sustainability	Sustainability refers to the capacity to maintain or improve the state and availability of desirable materials or conditions over the long term. It involves meeting the needs of the present without compromising the ability of future generations to meet their own needs, integrating environmental, social, and economic dimensions (Moldan et al., 2012).
Transition	Transition denotes a process of change from one state, condition, or system to another. It often describes significant shifts, such as energy transitions from fossil fuels to renewables, involving structural and behavioural changes across multiple levels (Geels, 2002).
Value	Value refers to the perceived worth or benefit derived from a project or its outcomes, encompassing economic, social, environmental, and symbolic dimensions. It is subjective and shaped by the diverse perspectives of stakeholders and their interactions (Laursen & Svejvig, 2019).

1. Introduction

Globally, the sustainability transition is one of the greatest challenges of our time. The construction and buildings sector is a significant contributor, accounting for 37% of global emissions (UN Environment Programme, 2023) and being the largest consumer of resources worldwide, responsible for approximately 60% of global resource use (IPCC, 2014; Tokede et al., 2022). In line with the European Union's ambition to reduce CO₂ emissions to net zero by 2050 and transition towards a circular economy (European Union, 2020), national governments are taking progressive steps to meet these goals. To drive the necessary transformation, various strategies and visions have been developed to promote safer, more accessible, and sustainable construction practices. As the backbone of modern society, infrastructure systems play a crucial role in this transition. The construction and renewal of infrastructure projects commissioned by the Dutch Ministry of Infrastructure and Water Management (IenW) alone generate approximately 800 kilotonnes of CO₂ emissions annually (Ministerie van Infrastructur en Waterstaat, 2023). To address this impact, IenW has developed multiple transition pathways aimed at achieving a climate-neutral and circular construction sector by 2030, contributing to the broader sustainability transition (Rijkswaterstaat, 2023).

However, The Netherlands currently faces a critical point in their infrastructure development, as hundreds of infrastructure structures, such as bridges, roads and tunnels, have reached the end of their life. Most of these structures were constructed during the 1960s, where the calculated load from vehicles was considerably less, both in terms of number of vehicles and their weight (TNO, 2023). The Dutch road network is both the second highest quality networks in the world (Schwab, 2019), it is also one of the most dense once regarding paved roads (TNO, 2023). This shows on the one hand the national value of the network, as well as the many strategic interdependencies that the renewal task of infrastructure assets throughout the Netherlands carry. As these projects depend on governmental expenditure, they are directly related to societal impact and societal value. Not only do these projects carry large financial risks considering their national investment, they are also crucial for the quality of life of users, in terms of safety, accessibility and economic well-fare. With the total cost expectancy of on average 3 billion EURO per year, the impact of this challenge reaches deep into the national focus (TNO, 2022).

The Dutch department of Infrastructure and Waterways (Rijkswaterstaat) now faces the great task navigating the sustainability transition towards a climate neutral and circular infrastructure sector, while being pressured by the increasing demand of the renewal of aging infrastructure structures by the end of the century.

Infrastructure, by definition, represents the fundamental structures and facilities that support the functioning of any organization or system (World Bank, 1994), including the societal system of public works within a country or region. Since transitions inherently require systemic changes within society (Geels, 2002), infrastructure plays a critical role in driving such transitions forward. Beyond their significant contribution to CO_2 emissions, large-scale construction projects are key to enabling structural change. These projects, often involving infrastructure, reflect complex transition dynamics due to their cross-sectoral and multi-scalar nature (Frantzeskaki & Loorbach, 2010). They operate under greatly complexity and uncertainty, thus needing the collaborative support and guidance from separately involved partners (Marrewijk, et al. 2008). They are multi-organisational, allowing actors interplay from both public and private organisations (Papachritos, 2024; Denicol et al, 2021). The actors within these formed project coalitions carry different perspectives, being considered their value systems, by which they base their choices and actions. Large-scale construction projects are characterized by long lead times, largely due to the sector's project-driven nature. While projects often span several years from planning to completion, their results tend to be measured and delivered in the short term, on a project-by-project basis. This short-term focus makes it challenging to adapt swiftly to evolving societal demands and environmental challenges, posing a significant barrier to driving longterm transitions toward a more sustainable and, ultimately, circular construction industry (Coenen et al., 2022; Vosman et al., 2023; Vrijhoef, 2011; Yu et al., 2022).

As these short-term values, service quality, accessibility, hindrance and cost efficiency directly emerge at the feet of the renewal task, the tendency lingers to overlook sustainable value that only presents itself on the long-term (Matrinsuo, et al 2019; Zerjav et al., 2021; Frantzeskaki & Loorbach, 2010).

Therefore, the Dutch infrastructure sector faces a double challenge: navigating the sustainability transition while tackling the urgent renewal of aging infrastructure, while keeping up their conflicting values. Their reach across scales and sectors provides complexity and short-term priorities often overshadow long-term sustainable goals, making it critical to find innovative ways to align these competing demands. This research addresses the urgent need, exploring how value integration can drive systemic change and balance sustainability with infrastructure renewal.

1.2 Problem statement

The Dutch infrastructure sector stands at a critical juncture, facing dual, interconnected challenges: the renewal and renovation of aging infrastructure systems and the transition toward a sustainable built environment. Rijkswaterstaat, the public governmental body overseeing this sector, is tasked with ensuring safety, accessibility, and liveability for the Netherlands, requiring a balance between addressing immediate infrastructure needs and advancing long-term sustainability goals. On one hand, the renewal and renovation task involves replacing thousands of infrastructure systems that are nearing end-of-life. According to research by TNO (2023), this task is pressed through sectorial challenges such as rising costs, labour shortages, and material constraints. On the other hand, the sector must adopt sustainable innovations and practices across all projects to align with broader environmental and social objectives.

Overall, both transitions and large-scale infrastructure systems are understood as complex, due to the multi-dimensional nature of interactions across different scales and sectors (Marrewijk, et al. 2008; Geels, 2002). Hereby transitions involve a broad range of actors, who are often more orientated at short-term results and objectives (Turnheim, et al., 2018). Within the infrastructure sector the focus on short-term technical and commercial values, such as service quality, accessibility, and cost efficiency, often overshadows the need for long-term social and sustainability values (Koppenjan and Enserink, 2009; Coenen et al., 2022; Kuitert et al., 2022). This tendency is heightened by the sector's fragmented nature, leading to differing value definitions, which provide tension and potential fall back to these short-term, traditional project management approaches to value (Frantzeskaki et al., 2016; Zerjav et al., 2021). Both transitions and infrastructure projects are characterized by long lead times, which can cause their development pathways to overlap or conflict, making coordinated progress challenging (Frantzeskaki & Loorbach, 2010). As a result, both processes require deliberate guidance and strategic direction through well-designed policies and strategies to ensure alignment and effective progress (Turnheim et al., 2015; Geels, 2012;). Tactical transition governance, typically operating within a five-to-ten-year timeframe, focuses on steering activities based on specific goals and interests within structured societal systems where patterns, rules, institutions, and networks have already been established (Loorbach, 2009).

However, this underdeveloped level of governance is often characterised by fragmentation, as individual parties operate based on their strategic visions and perceptions, hindering the integration of long-term, integrative policies. This fragmentation at the tactical level needs addressing to ensure that strategic visions for sustainability are effectively translated into operational actions that align with long-term sustainable objectives, both nested in governance and the industry. In high-pressure scenarios like infrastructure renewal projects, the risk of prioritizing immediate gains over sustainable, long-term objectives becomes particularly acute (Steg et al., 2014). Interestingly, tighter time frames have been suggested to potentially serve as a 'pressure cooker' that could stimulate collective action and more integrated decision-making (Neef et al., 2023), and others suggest that sustainability can be used by public institutions to put effective pressure on the private sector towards more sustainable innovation and practices in the infrastructure sector (Frantzeskaki et al, 2016).

To navigate this double tension, there is an increasing demand for integrated approaches to value in infrastructure governance that address the multidimensional and dynamic nature of transitions (Matrinsuo, et al., 2019; Zerjav et al., 2021; Frantzeskaki & Loorbach, 2010; Visser, 2018; Kuitert et al., 2023; Fisher, 2014). Current approaches struggle with the fragmented and dynamic nature of these systems. In order to address the complexity of transitions and the needed transformative system change, integrated governance mechanisms are required to both guide and manage the pluralities of normative considerations, such as values (Visser, 2018; Smith et al, 2005; Wiarda, et al. 2024).

1.2 Research gap

Infrastructure systems play a crucial role in driving societal transition (Frantzeskaki & Loorbach, 2009). Studies have explored the organizational and institutional aspects and barriers of operationalising transition strategies (Coenen et al. 2022), highlighting the potential of integrated value frameworks to support sustainability transitions within this context (Kuitert et al. 2023). A key focus identified the difficulty of prioritizing and safeguarding long-term sustainable value over short-term objectives, especially under the significant pressures often faced by infrastructure projects (Steg et al., 2014), as currently seen in the Dutch infrastructure sector.

Despite these insights, a notable gap remains in understanding how value integration can effectively be achieved and embedded within current transition governance approaches, especially at the underdeveloped tactical level of transition governance of infrastructure (Frantzeskaki et al, 2016).

1.3 Research objective

The Dutch infrastructure sector faces the dual challenge of addressing the extensive renewal of aging infrastructure while ensuring a sustainable, resilient, and reliable network. This balance is further complicated by the risk that immediate demands of the renewal task may overshadow long-term sustainability objectives. To navigate these tensions, a governance approach at the tactical level, where strategic goals are translated into operational actions, is critical.

This research aims to explore how value integration can facilitate alignment between the renewal task and sustainability goals by identifying obstacles that hinder progress and opportunities that add value to both objectives. By examining current activities of value integration, the study provides a comprehensive overview of the scope and nature of the challenge, emphasizing the barriers that constrain transitions and the mechanisms needed to overcome them.

Incorporating value integration as a practical tool offers insights into addressing the complexities of the renewal task without compromising overarching sustainability ambitions. This approach not only mitigates pressures but also leverages transitions themselves as opportunities for systemic innovation and organizational advancement.

The theoretical foundation of this study integrates concepts from sustainability transitions, complex systems theory, and activity theory. These frameworks define the research scope and offer a structured lens for understanding the interplay between value integration, governance, and systemic change. This approach seeks to deliver a comprehensive understanding of how value integration can drive sustainable and resilient infrastructure renewal.

1.4 Research questions

To address and achieve the previously mentioned problem statement and research objective, this thesis research aims to answer the following main research question:

How can value integration facilitate transition governance at the tactical level in infrastructure renewal?

The main research question will be addressed through three sub-questions:

- SQ1: What are the drives, barriers and challenges to further implementing transition strategies in infrastructure renewal?
- SQ2: What opportunities exist for value integration to address barriers and enhance transition governance?
- SQ3: How can value integration be embedded into governance structures in relation to the infrastructure renewal task?

A simplified conceptual framework is presented in Figure 1.



Figure 1. Simplified conceptual framework (author)

1.5 Research relevance

Societal relevance

The Netherlands' economy and society are highly dependent on a reliale and efficient infrastructure network, making the renovation and renewal of aging infrastructure assets critical. This challenge is further compounded by the need to achieve ambitious sustainability goals, such as a circular construction sector by 2030, outlined in sustainability transition pathways. Both objectives, renewal and sustainability, are under significant time pressure, as an increasing number of infrastructure assets near the end of their service life and sustainability deadlines approach.

The Dutch government faces the dual task of making substantial investments and overcoming systemic transition barriers, while baring in mind the large financial cost surrounding the renewal task, of which a further case and context exploration is provided in *Appendix A*. This urgency calls for innovative governance mechanisms that integrate the goals of infrastructure renewal with sustainability transitions while addressing these barriers. A comprehensive governance approach could provide policymakers and market stakeholders with a valuable framework to navigate these dual pressures effectively, fostering both societal resilience and environmental progress.

Scientific relevance

While there has been a lot of research in the past decades on transition governance and complex systems, the role of value tactics in transition governance has barely be touched upon. Hereby the use of the activity theory as lens to understand transition context, barriers and the role of value integration is yet to be explored. This research addresses the knowledge gap between tactical-level transition governance and the role of infrastructure renewal projects in advancing sustainability transitions. It examines the current context and barriers that hinder transition strategies within the infrastructure

sector, particularly under pressing scenarios. Given the applicability of these findings to other sectors undergoing transitions, this research provides a foundation for further academic exploration. By focusing on the interplay between infrastructure renewal and sustainability pathways, this study emphasizes how value integration can serve as a practical tool to overcome barriers and drive systemic change, contributing to both theoretical understanding and real-world applications.

1.6 Dissemination and audiences

This thesis aims for a contribution to a broad range of stakeholders who are directly involved or influenced by the sustainability transition in the Dutch infrastructure sector. The primary audiences for this research include policy-makers at the local and national government levels, particularly governmental bodies such as Rijkswaterstaat and other relevant departments within the Dutch construction sector.

In addition to professionals within the construction and infrastructure sector, including project managers, contractors, consultants and sustainability officers, this research offers insight into the public actors perspective on values and supports the strategic integration of private value in the broader transition management of large public projects. The workshop format developed in this research can be a practical tool for real-world applications. Beyond the academic setting, it can be used in project environments where multiple stakeholders need to collaborate on sustainability goals. The format helps explore complex challenges, uncover tensions, and encourage open conversations about solutions.

Finally, this research aims to contribute to academic literature in the fields of transition governance, construction and infrastructure project management, and value integration, offering both theoretical insights and practical methodologies for advancing sustainability transitions in complex systems.

2. Theory

This chapter provides the theoretical foundation for this thesis through a literature review, outlining the key concepts that shape the research context. It explores three core concepts: value methodology, transition management, and Activity Theory, offering the necessary background to understand the research approach. First an overview of value methodology, focusing on value management, creation, and integration. Various tools for generating value in projects are introduced, which are essential to the research's perspective. Next, the chapter examines transitions more broadly, providing deeper insights into the complexities of systemic change. This section narrows down to sustainability transitions, emphasizing transition governance and the challenges faced in complex systems like infrastructure systems. Finally, the chapter explores how Activity Theory serves as a lens to better understand the dynamic interactions between the other two theoretical concepts. It provides a guiding framework for both data collection and analysis in this research. Together, these theoretical perspectives aim to capture the problem context, background, and foundational concepts that inform this study.

2.1 Value Methodology

Value as a concept does not operate under one definition. In their research, Zerjav et al. (2021) looked at the multiplicity of value, and explain that value can be seen as a concept with a multifaced nature, that occurs in different ways, across the time scales and in relation to various stakeholders, and can be observed at various levels of analysis, making project value complex and multidimensional. Defining value in early stages of the project is therefore seen as difficult, but critical in the process towards success. The multiplicity of value can create conflicts and barriers in achieving value outcomes in the long-term, as certain values may only emerge later in the project lifecycle. Therefore looking at value delivery across multiple dimension requires an integrative way of thinking (Fisher 2014). Martinsuo and Killen (2014) suggest more qualitative research into processes and practices of value identification and legitimization, as included in managers' work and how decisions made by managers can be made credible

2.1.1 Value management in construction

Value management in construction projects is multifaceted and extends beyond the traditional iron triangle of cost, time, and quality, which has long been the standard measure of project success (Pollack et al., 2018). Operational factors, such as service quality and accessibility, also play a crucial role in determining the value of infrastructure projects (Koppenjan & Enserink, 2009). Beyond these operational measures, the broader economic contributions of infrastructure as an asset that enables commercial and social activities must also be considered, as these significantly enhance the local economy (Frischmann, 2012).

However, large infrastructure projects often prioritize short-term economic values due to their extensive investments, high risks, and prolonged durations. This focus can overshadow the strategic value that could be derived from considering non-commercial aspects (Martinsuo & Killen, 2014). The challenge is compounded by the complexity of large-scale projects, which involve multi-organizational systems consisting of both public and private entities. This complexity complicates the delivery and capture of value for all stakeholders, including society as a whole (Artto et al., 2016; Vosman et al., 2023; Martinsuo et al., 2019).

As discussed, value in construction spans economic, social, and environmental dimensions and requires embedding through strategic and institutional approaches within these multi-organizational systems (Martinsuo et al., 2019). Strategic measures, including mechanisms to facilitate mutual alignment among parties in inter-organizational networks, are essential for creating long-term value (Martinsuo & Killen, 2014; Matinheikki et al., 2016; Zerjav et al., 2021; Liu et al., 2019). Overcoming uncertainties and avoiding optimism bias are critical to preventing the misalignment of values and incentives, which can result in significant value loss (Järvi et al., 2018).

Moreover, integrating the concept of creating value for future generations into strategic project planning is crucial for ensuring sustainable long-term impacts (Zerjav et al., 2018). Research emphasizes the importance of exploring the co-creation of 'values-in-use' in infrastructure development programs to achieve these objectives (Liu et al., 2019). This approach highlights the necessity of adopting a comprehensive and strategic perspective on value management in construction, emphasizing the integration of diverse values to meet both current and future needs.

2.1.2 Value strategies

Value alignment & value creation

Value alignment and value creation are long visited topics in academic research. Griffith and Gibson (1997) define alignment within construction projects as "the conditions where appropriate participants are working within acceptable tolerance to develop and meet an uniformly defined and understood set of objectives". They state that this alignment of objectives should happen at the same time in multi-dimensional context. Alignment in construction specifically is also understood as the relationship between sustainability objectives and those in construction process itself (Pulaski, 2005). Value creation enables this process. In research the focus lies on enhancing value creation in the project context, trough several value creation activities (Laursen & Killen, 2018), and is almost always looked at from a stakeholder perspective (Pulkka, et al., 2016, Haddadi, et al., 2016; Gaur & Tawalare, 2024).

Value integration

While integration as a concept can also be used for managing conflicts (Candel et al., 2021), it can also be used as an approach to foster or embrace at the start. Visser (2018) describes integrated value as a tool or method for strategic transformation, and emphasizes embedding this into governance systems of organizations in order to keep on track when trying to achieve transformative goals.

Kuitert and van Buuren (2022) examine how value integration can support sustainability transitions in the construction industry, particularly in Blue and Green Infrastructure, by exploring different types of governance innovation. They identify three key approaches: (1) top-down bureaucratic innovation (BI), (2) innovation in public procurement through public-private partnerships, and (3) bottom-up social innovation (SI). Four governance factors shape the success of value integration: professional culture, governance level, geographical level, and time conception. Professional culture sets the stage for value integration by determining how stakeholders are involved, aligned, and guided by shared value systems. Governance level provides the institutional framework needed for integration, and these two factors are interdependent, as effective integration requires top-down institutional support without stifling the bottom-up input of stakeholders. The geographical level expands value creation beyond the immediate project scope, addressing constraints like budget, rigid project structures, and policies. Time conception considers the different timelines of value emergence, recognizing that long-term benefits may not be apparent at the time of creation.

These factors shape governance innovations and influence how value integration is achieved. The authors emphasize the need for an organizational structure that encourages collaboration and exploration, allowing technical, spatial, social, and sustainable values to be integrated effectively. Combining the three governance innovations into a multi-level governance approach is proposed as a strategy to enhance value integration in construction projects.

2.2 Transitions

Transitions are understood as long-term processes of significant and structural changes that occur in societal, technological, economic or ecological systems. Scholars describe transitions as a shift from one stable system to another, which is often driven by a combination of socio-technical interactions, regulation and market dynamics (Geels, 2002). Transitions are experienced as complex in steering and

guiding through policies, due to the multi-dimensional nature of interactions across different scales and sectors (Turnheim et al., 2015; Geels, 2012; Geels et al., 2017).

2.2.1 Multi-level Perspective

The Multi-level perspective (MLP) developed by Geels (2002) is an understanding of how and under what conditions these interactions occur. It recognizes three levels: macro, meso and micro. The macro-level, the transition context, is understood as the sociotechnical landscape. It is the umbrella that houses various societal structures that shape the world around us, such as economic or political landscapes. The meso-level is where socio-technical regimes take their place. Regimes are driven through industry, market dynamics, politics and technology (Geels, 2002).

At the micro-level niches emerge. These can be understood as radical innovations that deviate from the current regime. But when niches find their way through the current regime, they can create systemic change. (Geels, 2012). The multi-level perspective illustrates the dynamic interaction between the niche, regime and landscape level. How socio-technical transitions move through different time and scale dimensions can be illustrated by transition pathways (Geels and Schot, 2007). These allow for a better understanding of the processes that occur and the opportunities for intervention. In sustainability transitions specifically, there is a need for windows of opportunity in order for transition pathways to be followed. Through multi-level and system dynamics, such as pressure from the landscape, innovation can occur, which eventually can establish the new regime. This regime then has the ability to change the current landscape, as can be seen in *Figure 2*(Geels, 2002).

Still, large scale systems, such as sectors, must give room within the socio-technical regime for change to occur. This can be done by allowing for co-evolutionary processes, which can develop by over time through collaboration, and multi-dimensional interactions (Geels 2012; Geels, et al., 2017)



Figure 2. Multi-level perspective (Geels, 2002).

2.2.2 Transition governance

As transitions, and specifically sustainability transitions, are inherently complex societal processes that require fundamental change in systems, proper guidance is needed through transformative policies and governance mechanisms in order to successfully move through transitions (Smith et al., 2005). In order to do so, various scholars have constructed complementary governance mechanisms to guide the institutional support in transitions. For governance of transitions to be effective it requires to acknowledge the complexity, uncertainty and imbalances of power, but there remains a distributed opinion on governing the dynamics of transitions (Turnheim, et al., 2018).

To start, it is generally argued that working towards sustainable transitions is not a matter of achieving an ultimate sustainable goal, but rather looking at the strategic planning processes that can enable sustainable system transformations, which is recognized by Truffer et al. (2010). They emphasize that decision-making processes for strategic planning in sustainability transitions should be participative, incorporating diverse knowledge perspectives and value positions with respect. Additionally, these processes should be reflexive, considering values that prioritize long-term sustainable futures.

2.2.3 Transition management

Transition management is one of the developed governance mechanisms that helps to understand transition patterns and pathways, how they evolve and how they can be steered, to move forward more sustainable directions (Rotmans, et al., 2001; Loorbach, 2009). It argues that transitions are governed on different levels: strategic, tactical and operational (Table 1). The strategic level focuses on shaping culture and long-term visions within societal systems. Activities at the strategic level are directed to a longer term time period, where norms, values and sustainability are debated.

At the tactical level activities happen that are driven by interest and specific goals within a particular context. This is often structures or societal systems, in which patterns, rules, institutions and networks can be established. At this level, value, interests, and objectives guide actions. With a medium term time span, tactical activities are there to translate strategic visions into the regime. And finally, at the operational level, these activities are carried out through experiments and actions. These are typically short-term innovations found in different sectors. These innovations include societal, technological, institutional and behavioural changes, involving different actors (Rotmans, et al., 2001; Loorbach, 2009)

Management Types	Focus	Problem Scope	Time Scale	Level of Activities
Strategic	Culture	Abstract/Societal system	Long term	System
Tactical	Structures	Institutions/regime	Mid term (5-15 years)	Subsystem
Operational	Practices	Concrete/project	Short-term (0-5 years)	Concrete

Table 1. Transition levels and their focus (Loorbach, 2009)

This distinction between the strategic level and tactical level is essential for understanding the multidimensional approach transitions require. In the field of construction management this distinction is also made by Herazo et al. (2012), where strategic management is the process of formulating a strategy, which includes the identification and prioritization of objectives at the organizational level, focussing on long-term goals and how to implement them, but it is at the tactical level that the actual translation towards necessary activities happens. They link these two types of management to the principles sustainable development, through its influence in aligning long- and short-term objectives. Additionally, they emphasize that the influence of sustainable development happens at both strategic and tactical level of decision making, and addresses both internal and external stakeholders (Herazo, et al., 2012).

2.2.4 Transitions in Complex Systems

Infrastructure systems

Considering the MLP framework (Geels, 2002), infrastructure systems are considered as sociotechnical systems, that are influenced by several dimensions -technology, policy, science, industry, market and culture (Schot and Geels, 2007) that need to be aligned to enable change (Gürsan et al., 2023).

From research done by Frantzeskaki and Loorbach (2010) infrastructure systems (infrasystem), take on a dual role. They state, that from taking the transition management approach, both infrasystem change can help accelerate ongoing societal transition, and societal transitions can drive infrasystem change. They aim to set strategies, in light of transition management, regarding fundamental shifts in social demands and use, with which infrasystems change can co-evolve. This can also be understood as the interconnected nature of infrastructure systems, where one change might have effect on others, as explained by Gürsan et al. (2023). These interdependencies involve complex relationships between various infrastructure systems may complement or compete; evolutionary, reflecting how systems adapt over time; spatial, influenced by geographic proximity; life-cycle, considering long-term impacts; policy/procedural, shaped by regulatory frameworks; market, driven by economic interactions; and cultural/norm, affected by social values. Navigating these complex interdependencies by integrating diverse stakeholder perspectives, utilizing interdisciplinary approaches, and ensuring long-term foresight in decision-making is a way to effectively shaping sustainability transitions (Gürsan et al., 2023).

However, infrastructure systems are considered as generally 'slow' in moving forward in transitions, as barriers arise due to system inertia, large costs and a broad range of stakeholders (Loorbach, et al., 2010). In research done by Willems et al. (2017) of the renewal of infrastructure systems, in their scope waterways, barriers are shown in achieving long-term transition objectives. These are supported by general transition research, were long-term objectives are difficult to reach, as actors are oriented on short-term results (Turnheim, et al., 2018). This creates a fundamental barrier for strategic considerations on the organisational level. They call for integrative, in their case, waterway planning approaches, via new inter-organisational structures that move more towards the co-creation of societal value. To achieve these inter-organisational structures, the institutional boundaries need to be overcome through the involvement of a broader range of stakeholders

Transition Management Cycle

To navigate and understand these complex systems in transitions even better, Rotmans & Loorbach (2009), position the framework of transition management against the complex systems theory. As transitions span multiple scales and domains and evolve through the interplay between structure, culture and practice, similarly to complex systems, these two are inherently intertwined.

Transitions Management offers a structured approach towards guiding and understanding the transformation and dynamics of such complex societal systems, as both draw their foundation from the dynamics, adaptive nature and uncertainties embedded in large-scale systemic changes. This involves a cyclical process of steps: stimulating niche development at the micro-level, fostering coevolution through experimentation, and selecting successful initiatives that align with broader systemic goals. By setting a long-term vision for sustainability at the macro-level, transition management integrates diverse actors, aligns perspectives, and creates pathways for scaling up innovations.

These complex systems alternate between periods of equilibrium and non-equilibrium. While periods of equilibrium foster order, they can hinder innovation, necessitating phases of non-equilibrium where instability catalyses transformative change These windows of instability present critical opportunities for guiding systems towards desired outcomes, and therefore are critical in transitions. Here, complex adaptive systems are particularly relevant, as these have the ability to coevolve with, and adapt to their changing environments through the interplay of structure (institutional and physical setting), culture (ruling perspectives) and practices (rules and routines). In transition theory, these are the dominant elements of the configurations of regimes. (Rotmans & Loorbach, 2009). Here the theoretical principles of transition management help steer these configurations. First, there is an emphasize on creating space for niches to emerge, aligned with Geels (2012). In this case, niches can emerge as pockets of innovation, led by frontrunners who have the creative and strategic capabilities to deviate from the incumbent regime and potentially establish a new one. Through guided variation and selection highlights the process of diverse experimenting

and informed decision making. These actions underscore the need for small paced incremental change, which is needed to foster radical change without the resistance of the underlaying structure. One of the foundational requirements for this to happen, is the idea of "empowering niches", through the provision of resources needed to build up a niche regime. This can include financial, release of rules and laws and knowledge (Avelino & Rotmans, 2007). These principles, as earlier states, transitions span multiple domains and scales, which should be approached through with an anticipative and adaptive attitude..

Rotmans and Loorbach (2009) describe this iterative process of the transition management cycle (*Figure 3*) based on the earlier notion of the levels of transition management, namely strategic, tactical, operational and reflexive (Rotmans, et al., 2001). This starts by understanding the system through an integrated system analysis beforehand. Here the complexity of the system is unravelled, including the identification of the most influential actors in that system, which plays a crucial part in the formation of the transition arena, which is included in the first step of the cycle. Rotmans & Loorbach (2009) explain arena's as a collaborative and innovative space where diverse actors come together to share knowledge, engage in dialogue and co-create solutions for these complex challenges. It is here, where the problem can be structured through the sharing of stakeholders on their interests, values, perspectives and strategies related to a specific issue or topic, such as sustainability.

From here, a shared transition image can be created. These images have the aim to create widespread support and initiate action, by translating this into overarching criteria or principles that take into account the different meaning of sustainability to different actors in different contexts. This way, transition objectives and sustainability goals are understandable by all. The transition agenda then encompasses the most engaging and reachable images through the setting of objectives in content, process and learning. Through this agenda, the transition experiments are set up, through a selection based on the contribution to the systems objectives. In this process actors are engaged in executing these projects. The final part of the cycle is reflexive in nature, as it focusses on the monitoring and evaluating of the transition process and its outcomes. On the one hand, actors and their behaviour and responsibilities in relation to their activities are monitored. On the other hand the actions and projects in the agenda needs to be monitored. And, to conclude, barriers and the opportunities for improvement in the transition process itself can be identified in this phase.

Through the combination of complex system characteristics, the principles of transition management and by applying its systemic instruments, managers can identify critical opportunities and the conditions necessary to direct systems toward sustainable transitions effectively (Rotmans & Loorbach, 2009). The way transition management can additionally supports the governance processes with



Figure 3. Transition managagement cycle (Rotmans & Loorbach, 2009)

oriented policy interventions within the complex and adaptive social systems of existing sectors by recognizing the concept of multi-stakeholder arena's is emphasized by other researchers also (Markard et al., 2012, Voß et al., 2009).

The transition literature highlights the interplay between infrastructure systems, transition management, and complex systems theory, offering a framework to guide societal shifts towards sustainability. Infrastructure systems, while key to driving and adapting to change, face challenges from inertia and conflicting objectives. Transition management leverages periods of instability for incremental change, fostering coevolution and enabling innovation through niches. Its cycle integrates system analysis, collaborative arenas, shared visions, and experimentation to align stakeholder perspectives, acknowledging their role in long-term societal change.

2.3 Activity theory

As addressed from the work of Engeström (1987), the Activity Theory (AT) offers a framework for understanding the dynamic interplay between human activities, tools and the social and cultural context in which they occur. It conceptualizes activity as the primary unit of analysis, moving between *subjects* (individuals or groups), *objects* (goals or motives), and mediating *tools* (artifacts, rules, and norms). Activities are built around goal-oriented actions, aiming to achieve specific objectives. However, Engeström (2001) emphasizes that while activities are directed toward predetermined outcomes, these outcomes can evolve over time.

The broader activity system incorporates additional elements, such as the community, representing the collective sharing common goals and social meanings. This community embodies norms, shared values, and cultural practices that shape interactions and collaboration. Rules serve as explicit or implicit guidelines, regulating behaviour and influencing decision-making and collaboration within the activity system. Analysing these rules can reveal systemic barriers or facilitators of change. The division of labour refers to the allocation of roles, responsibilities, and tasks, establishing accountability and decision-making structures. Misalignment in this division can disrupt the activity, highlighting the need for coordination and clarity. Hereby, these systems elements can be linked together in the model for human activity presented in *Figure 4*. (Engeström, 1987; Engeström, 2001).



Figure 4. Model of the structure of human activity (Engeström, 2001)

The systemic perspective of AT underscores the dynamic interplay between actors and their environment, facilitating the exploration of how collective practices evolve over time. This makes AT particularly relevant for understanding transitions in complex organizations and the activities that accompany such transitions. Engeström (1987) further expands the theory by introducing the concept of activity systems, where contradictions act as catalysts for systemic change and innovation. Addressing these contradictions, such as the tension between long-term sustainability goals and immediate operational demands, enables the identification of expansive learning opportunities. These opportunities foster novel practices to resolve tensions and adapt to changing conditions (Engeström, 2001).

Jonassen and Rohrer-Murphy (1999) link the activity theory framework to the analysis and definition of needs, tasks and outcomes in designing 'constructive learning environments.' They emphasize the interaction between consciousness and activity within a specific context. As described from activity

theory literature, consciousness is ideologized as "you are what you do". This related directly to the system an individual is currently in, where the physical, mental or social conditions can create change to the situation and reflect in their activities. This links to actors their own value systems, where value systems are based on the persons their surroundings, affecting the activities they perform and the values they embed in that system. The complexity of this dynamic arises as individuals simultaneously engage in multiple activities, each with distinct elements and relationships. Moreover, each component of an activity system is itself a product of other activity systems, which Engeström (1987) describes as "a system of collaborative human practice." This interconnectedness aligns with the complexity of transition management (Rotmans & Loorbach, 2001), where stakeholders engage in multiple overlapping cycles of management and actions.

In this context, AT offers a lens to analyse how large and complex organizations integrate diverse values and priorities into actionable strategies. It bridges the gap between individual actions and collective change, and helps analyse and direct complex adaptive systems. AT's focus on mediating tools and community dynamics is particularly valuable, as it explains how new practices can be embedded into existing systems, fostering alignment and value integration.

2.4 Theory summary

This literature review integrates insights from transition management, complex systems theory, and activity theory to understand sustainability transitions within infrastructure renewal. Infrastructure systems, as socio-technical entities, play a dual role in societal transitions but face barriers such as system inertia, conflicting priorities, and complex multi-stakeholder environments. Transition management offers a cyclical approach to navigate these challenges, emphasizing niche development, co-evolutionary processes, and iterative experimentation during periods of instability to enable transformative change.

Value integration emerges as a vital element in aligning stakeholder perspectives across economic, social, and environmental dimensions. Effective integration balances top-down institutional support with bottom-up practices and aligns short-term operational goals with long-term ambitions. Collaborative governance structures and exploratory practices are essential for fostering alignment and sustaining transformative objectives.

Activity theory complements these frameworks by highlighting on the interplay of actions, tools, and community dynamics, providing a guiding approach for data collection and analysis. Hereby focussing on how contradictions between long-term goals and immediate needs can drive innovation. By addressing these tensions, new practices can be embedded into existing systems, facilitating organizational alignment and value co-creation.

Together, these theories highlight the need for integrated, adaptive governance approaches that address the interconnectedness of systems, align diverse values, and foster collaboration. This review provides a foundation for analysing the dual challenge of infrastructure renewal and sustainability transitions, emphasizing the critical role of governance, innovation, and value-driven practices in achieving systemic change.

3. Research design

In the research introduction the main research question and research sub-questions were presented. The research aims to find a way to facilitate sustainability transition governance in infrastructure renewal and renovation in the Netherlands, through the integration of values at the tactical management level. In this chapter the research design will be presented.

3.1 Conceptual framework

The conceptual framework is designed around the context and concepts on which this research is build and is presented in *Figure 5*. The framework shows the overall context of "infrastructure renewal", which is the outer layer in which the governmental infrastructure agency takes its place. Both sustainable strategies and the renewal demand, which is shared with other sector partners form the transition drivers and barriers in the transition governance. Within transition governance integration opportunities between organisational actors and sector partners can be detected. Finally, the inner layer shows the "tactical level", which is considered a level of transition governance where strategies are translated to operational action. Here tactical activities will emerge from the transition drivers and barriers in combination with the integration opportunities. Together these form the Value Integration Model that can be embedded in the governance structure in transition governance and the governmental infrastructure agency.



Figure 5. Conceptual framework (author).

3.2 Methodology

The methodology of this research describes what type of research are done in this thesis to answer the main research question and complementary sub-questions. The overall approach represents a qualitative nature. The theoretical research offers insight and information on the main concepts and theories on which this research is build and provides tools by which the data from the empirical research can be analysed. The empirical research allows to dive deeper into the problem context and explore the possibilities for solutions. In *Figure 6* the research methodology is shown.



Figure 6. Research Methodology (author).

3.3 Theoretical research

To create the theoretical background for this study, a theoretical research was first performed, which is presented in Chapter 2. Here the main concepts were explored that were fundamental for the understanding of the research frame. The theoretical research helped to dive deeper into the interrelations between the concepts and how they fit within the infrastructure renewal context. This created a better understanding of what systems are at play within transitions and where the opportunities lie for elaboration and improvement. The theory encompasses literature on transitions, value methodology and the activity theory.

The objective of the theoretical research is to understand the complexities of transition literature and research frameworks before conducting the expert interviews.

3.4 Empirical research

The empirical research firstly consisted of in-dept interviews with institutional experts surrounding the transitional pathway and renewal and renovation task at different levels of the organisation. From here expert interviews were conducted to get deeper insight into the drivers of the sustainability transition, its application in practice and the barriers that accompany them. To test the the outcome of this research against different contexts and gather more insights, a workshop has been organised

3.4.1 In-dept interviews

The primary data collection method in this research was semi-structured interviews. This approach enabled an in-depth exploration of the research topics by utilizing open-ended questions and allowing the interviewer to engage with emerging themes and interesting insights (Harrell and Bradley, 2009). The interviews provided valuable data for identifying barriers, drivers, and challenges within current transition trajectories and the renewal and renovation of aging infrastructure. Additionally, they shed light on stakeholder interdependencies and revealed opportunities for improvement.

Objective

The objective of conducting these interviews was to gain comprehensive insights into the intersection of the sustainability transition and the renewal task of aging infrastructure. Specifically, the aim was to explore the current organizational and operational context, uncover challenges and systemic barriers, and identify existing practices and opportunities for value integration. By involving participants with diverse roles and expertise, the interviews sought to provide a holistic understanding of how governance mechanisms, stakeholder interdependencies, and tactical-level activities shape these processes. The findings would inform the development of the Value Integration Model, offering actionable strategies for embedding sustainability objectives within complex infrastructure systems. Participants for the exploratory interviews were initially approached through the Next Generation Infrastructure (NGInfra) research program. Subsequently, a snowball sampling method was employed, where existing participants referred others whose expertise was relevant to the research topic and whose insights could contribute meaningfully to the study.

Before conducting the interviews, preparation involved structuring the topics and questions around the general framework of context, content, process, and outcome. The interviews were designed to capture knowledge about the current state of the sustainability transition and the renewal task, focusing on what this context entails in terms of change and barriers. Questions followed a structured "what, why, who, when, where, and how" approach to provide a systematic exploration of the subject. These steps are detailed in the interview protocol (*Appendix B*). Participants received an informed consent form (*Appendix C*) in advance, ensuring ethical compliance and transparency. ring the interviews, the semi-structured format allowed for adaptability, enabling the interviewer to steer the conversation towards the participant's specific expertise. This flexibility ensured that emerging insights and new lines of inquiry could be incorporated into the discussion, enhancing the richness of the data collected.

Workshop

Following the in-depth interviews and the subsequent analysis of the data, the workshop was introduced as an essential component to extend the research findings. While the interviews formed the foundation of the Value Integration Model by identifying the current activity system, barriers, and opportunities, the workshop served as an exploratory and reflective exercise rather than a strict validation. Its purpose was to test the applicability of the findings in dynamic and complex scenarios, allowing participants to engage with the insights in a collaborative setting and adapt them to potential future challenges. This iterative process aimed to deepen the understanding of how value integration could address systemic barriers and unlock opportunities in varied contexts.

The workshop was organized in collaboration with the NGInfra project ADEPT, involving both interviewees and additional actors from Rijkswaterstaat. Participants represented diverse organizational scales and departments, all sharing a focus on the sustainability transition, the renewal task, and innovation. The workshop invitation can be found in *Appendix D*.

Objective

The workshop embedded two objectives. To start, the workshop aimed to provoke collaborative action and problem-solving among actors when faced with pressing scenarios that required immediate attention. By fostering dialogue and encouraging innovative approaches, the workshop sought to identify opportunities for value integration and strategies for overcoming systemic barriers. Additionally, it aimed to provide actionable insights into how diverse actors could collectively navigate complex and urgent challenges within the sustainability transition and infrastructure renewal. Secondly, it served as the foundation for a second, multi-organization workshop, involving other infrastructure partners connected to ADEPT, aimed at exploring interdependencies more closely.

To achieve its objectives, the workshop introduced three "extreme" scenarios, inspired by evidencebased challenges or plausible future threats. These scenarios encompassed organizational, economic, and environmental dimensions, each designed to challenge participants' perspectives and provoke strategic thinking. The use of these scenarios was guided by Activity Theory, ensuring a structured yet flexible framework for participants to navigate and address systemic challenges collaboratively.

3.4 Data collection and analysis

This section discusses data analysis following the collection for information from literature and semistructured interviews. In this research there is both data collected from primary and secondary sources. Firstly, Chapter 3 on the theoretical background uses secondary data from the analysis of existing academic publications, obtained mainly through academic search engines, such as Google Scholar. The primary data is collected by the researcher through the exploratory interviews and the workshop. The interviews were conducted in Dutch and the workshop in English.

Literature review

To conduct the theoretical research, a literature review was done. In order to conduct an extensive theoretical study, the Google Scholar database was used. Here relevant and reliable sources were gathered that provide the secondary data, which is examined through an extensive analysis.

Explorative interviews

The in-dept semi-structured interviews served two functions concerning this research. Firstly, they played a role in exploring the current situation and perception around infrastructure renewal and renovation in the Dutch context. This is, as these interviews allowed for a deeper understanding and further framing and defining of the problem in the current context and the underlying project governance processes, which otherwise wouldn't have been found. Secondly, they provided a first insight in the value priorities of the participant.

These interviews served an additional underlying function in relation to a broader PhD research, in which this research was conducted. The contribution of these interviews was twofold. One, to figure out who operates at the tactical level in governmental infrastructure agencies. And second, to get an insight understanding of the inter-organisational dependencies between both public and private infrastructure partners in sharing knowledge and information, and possibilities for innovation.

Interviews were analysed through the use of ATLAS-ti, a grogram to thematically analyse interview transcripts through the used of coding. It allows for cross transcript analysation, which is useful when conducting several interviews. The coding applied what-why-who-where-when-how as themes in which concepts where framed. An additional layer to the analysis of the interviews comes from the application of the Activity Theory (Engeström, 2001) system and its complementary elements: object, subject, rules, tools, community and division of labour. Codes are presented in *Table 2*.

Theme	1st Order Construct	Description	
What	Sustainability Transition	The incentive and strategy towards a sustainable infrastructure sector, both in organisational process and operations activities,	
(Object)		reflecting long-term sustainable visions	
	Project Approach	The shift in methodologies, frameworks, and strategies in project execution to address both the renewal task and sustainability objectives effectively.	
	Innovation	The objective and integration of new technologies, methods, and ideas within the infrastructure sector to enhance efficiency, sustainability, and adaptability.	
Why (Community)	Ambition & Demand	The collective goals and objectives driving the sustainability transition and renewal task, shaped by societal, political, and organizational pressures.	
	Capacity	Availability and allocation of resources, such as labour, funding, and materials, impacting the ability to meet both the sustainability and renewal objectives	
	Culture	Shared norms, values, attitudes, and behaviours within the organization that influence its openness to change, adaptability, and alignment with sustainability goals.	
	Project Principles	The foundational values, standards, and practices that guide how projects are planned, executed, and assessed within the organization.	
Who (Subject)	Stakeholder engagement	Refers to the role and involvement of internal and external stakeholders, fostering collaboration to achieve shared sustainability and renewal goals. This includes individuals, teams, and broader organizational units.	
When (Rules)	Policy & Regulations	Formal rules, policies, and regulatory frameworks that govern the operational and strategic activities of the organization, influencing its ability to implement objectives.	
	Responsibility	Regarding assignment and ownership of accountability among actors, ensuring clarity in roles and fostering commitment to sustainability and renewal goals.	
	Dependency	The interdependencies among organizational units, stakeholders, or external actors that affects the capacity to achieve objectives.	
Where	Implementation &	Areas within the organization where sustainability and renewal	
(Division of Labour)	Process	objectives are implemented, focusing on workflows, processes, and projects.	
	Decision-Making	The hierarchical and collaborative structures where decisions are made, relating to prioritization and alignment of sustainability and renewal objectives.	
How (Tools)	Guidelines & Requirements	Criteria, frameworks, and benchmarks that standardize the integration of sustainability and renewal objectives into projects and processes, enabling progress monitoring and evaluation.	
	Support	Relating to tools, training, resources, and systems required to facilitate the adoption of new practices and to foster a culture of innovation and sustainability across the organization.	

Table 2. Transcript codes

Workshop

After the thorough analysis of the interview findings, which results into the design a value integration model, the workshop provided an additional layer to the research. Here, extra insights were gathered that confirmed and expanded the current research. By creating pressure through immediate scenario's based on future predictions, it can provide insight for the organisation in what areas activities and actions are needed and how they can apply the value integration model to achieve that. In addition, the workshop brought contradictions, interdependencies to other actors and misperceptions to light that might serve as a base for future engagement. Due to constraints, the workshop was held online and a Miro board was used to gather the actions and input of participants. This limited the active discussions and the use of the prepared resources.

3.5 Data Management Plan

A management plan adhering to Wilkinson et al.'s (2016) FAIR Data Principles was implemented to enhance the utility and impact of research data. The FAIR principles emphasize that data should be Findable, Accessible, Interoperable, and Reusable, guiding researchers in the creation of a plan that maximizes data efficiency and efficacy throughout the research lifecycle. A data management plan was developed to outline procedures for data collection, analysis, secure storage, and sharing.

Particular attention was given to safeguarding the data collected through interviews. Data was securely stored and backed up on protected devices. As participants discussed their professional roles, maintaining their privacy was prioritized. Interviewees were anonymized (e.g., Interviewee I, VII), and no personal information was shared. The collected data was carefully documented and archived for potential future use. The data collected in this research falls under the ADEPT project and its complementary Data Management Plan.

Upon completion of the research, the results were made accessible via the TU Delft Repository (<u>www.repository.tudelft.nl</u>), contributing to the broader research field and supporting further studies in this domain.

3.6 Research ethics

In this research, data is collected and used from participants, ethical considerations are of great importance. These four principles of ethical considerations, by Diener and Crandall (1978) are: *informed consent, voluntary participation, anonymity, avoiding exaggeration of objects.*

Before interviews with participants are conducted, informed consent is obtained. Participants are informed in a clear and complete matter what their participation entails, what the research purpose is, the time line and their rights concerning their involvement. Their participation is voluntary and they have the freedom to withdraw at any moment. Privacy and confidentiality is of the upmost importance and therefore personal information will be secured and anonymized during the research.

It is of additional importance that the participants are not harmed in any way during their participation. This complies with the principles of ethical considerations. The informed consent form can be found in *Appendix C*.

4. Expert Interviews

This chapter presents and explains the findings from the conducted exploratory interviews, in-depth interviews and workshop output. The results are explained as follows: to start, the findings from the exploratory interviews with strategy and tactical actors from Rijkswaterstaat are explained. These created the understanding of the infrastructure renewal and renovation task in the context of the sustainability transition. To continue, the in-depth interviews provide even deeper understanding in the practices that drive this challenge. And finally, the workshop output and validation of previous findings is explained.

4.1 Participant information

The explorative interviews consisted of both interviews conducted within this research, and two interviews conducted previously by, of which the transcript data has been used and analysed. Through a snowball approach, several people were approached that are active within Rijkswaterstaat on either strategic or tactical level, and focus on transition management, the renewal and renovation task, and/or sustainability.

Interviewee	Role	Level
I	Portfolio Manager	Portfolio
II	Innovation Manager	Organisation
III	Senior Advisor	Portfolio
IV	Innovation Advisor	Portfolio
V	Strategic Advisor	Organisation
VI	Strategic & Innovation Advisor	Programme
VII	Depertment Director	Department

Table 3. Interview participant information

4.2 Findings

The Activity Theory framework was used as a guiding approach to conduct the interviews and structure and understand the current context of the case. Hereby identifying the '*What is changing*' as well as the other elements in the system. Hereby aiming to find emerging contradictions and tensions in the system, leading to identification of transition dynamics, barriers and opportunities. The fully interlinked Activity System is presented in *Appendix E*.

4.2.1 Sustainability transition

Rijkswaterstaat is actively transitioning towards becoming a sustainable infrastructure organization, driven both by national sustainability policies and European strategies aimed at addressing long-term risks such as climate change and resource scarcity. As a public infrastructure authority, it operates within a complex governance framework shaped by the Dutch national ministries, the government, and the European Union. This structured decision-making framework closely ties sustainability goals to governmental planning cycles, regulatory policies, and budget allocations. These sustainability efforts are not isolated but embedded into broader organizational strategies, reflecting a shift towards long-term resilience while adapting to the evolving challenges of climate change and infrastructure demands.



Figure 7. Sustainability transition activity system (author).

Tension

While the centralized governance structure ensures alignment with national sustainability priorities, it also limits flexibility. Dependencies on budget allocations and policy frameworks can delay proactive sustainability measures and restrict innovation at the project level. Furthermore, hierarchical complexity can create delays in translating sustainability strategies into operational decision-making.

"We zijn ook wel afhankelijk van beleid en het ministerie, omdat wij een uitvoeringsorganisatie zijn en wij krijgen ons opdracht uiteindelijk van het departement plus daarbij de behorende budgetten en richtlijnen als dat nodig is." – Interviewee II

4.2.2 Climate neutral & Circular in 2030

Rijkswaterstaat's commitment to sustainability is not only driven by regulatory requirements but also by its ambition to position itself as a frontrunner in sustainable infrastructure management. The organization has set an ambitious target to become fully climate-neutral and circular by 2030, aligning its efforts with broader national and European sustainability objectives. This vision prioritizes reducing CO₂ emissions, promoting circular building practices, and emphasizing the reuse of materials to minimize environmental impact.

"Dus voor verduurzaming hebben we gewoon die goals op het gebied van circulariteit. En op het gebied van dus, dat is hergebruik van materialen, maar ook de CO2 reductie en het reduceren van ozon en weet ik veel wat hè? Dus de, nou de klimaat verandering tegen te gaan?" – Interviewee I

By positioning itself as a sustainability frontrunner, Rijkswaterstaat seeks to lead by example in the sector, showcasing best practices while encouraging wider industry adoption. This proactive stance reflects its ambition to remain adaptive to evolving sustainability standards and climate challenges, while maintaining its core mission of managing national infrastructure.

"En wij zijn ook koploper van heel veel. In ieder geval op het gebied van duurzaamheid proberen we dus heel veel van dat soort dingen als eerste doen." – Interviewee I



To operationalize this ambition, Rijkswaterstaat integrates sustainability into its strategic agendas, using tools like impact analysis and shared agreements across departments. These approaches aim to balance long-term objectives with the day-to-day realities of managing infrastructure projects.

As a public client, Rijkswaterstaat must balance national sustainability goals with operational realities. Decision-making processes are deeply connected to governmental plans, making financial and policy constraints key factors in determining how sustainability measures are prioritized. Budget allocations, legal mandates, and national performance criteria shape project expectations, while also influencing how sustainability objectives are applied in practice. This structured governance ensures accountability, yet the emphasis on short term values, can sometimes limit long-term sustainability considerations.

"En een impact moet je breder zien dan alleen een financiële of een capaciteitsimpact, hè? Dus eigenlijk een maatschappelijke kosten en baten analyse. Dus de hele natuur kant moet meegenomen worden, de kostenkant en CO twee besparing of extra uitstoot, dat soort dingen moet je allemaal meet mee meenemen." – Interviewee II

Several experts highlight the critical role of other government entities, such as municipalities or provinces, that also concern large parts of the renewal task as public client. On the one hand, there is a need for shared agreements to establish a clear direction for the sector. On the other hand, experts note that municipalities and provinces benefit from Rijkswaterstaat's developments, which aim to provide these local governments with tools and guidelines they can adopt.

"De coalitie duurzame bruggen en viaducten. Dan zeggen eigenlijk verschillende provincies: wij gaan met zijn allen bepaalde standaarden in ons inkoop instrumentaria doen, waardoor we meer gaan duurzame circulair gaan inkoop." – Interviewee IV

Tension

A recurring theme in the data is the tension between long-term sustainability goals and the pressing demands of short-term operational realities. While Rijkswaterstaat's sustainability objectives emphasize long-term benefits such as circularity, emissions reduction, and climate resilience,

immediate challenges like traffic congestion, accessibility, and economic efficiency often take priority. Limited budgets and capacity further intensify these tensions, requiring difficult trade-offs between present operational needs and future sustainability ambitions.

"Of je zegt: nee, we denken nog wat langer, zijn wat meer op lange termijn bezig. Met als consequentie dat we meer overlast meer belemmeringen, files, opstoppingen of scheepvaart barrières hebben. Maar dan doen we het wel meteen goed voor 50 of 100 jaar en dat mag ook dan wat meer kosten." – Interviewee II

4.2.3 Sustainable Organisation

To become a sustainable organisation, and eventually a desired circular asset manager, Rijkswaterstaat is working on continuing transitions through the organisational fabric. Different levels within the organization have varying needs. For some themes within the transition, strategies and requirements have already been developed to guide projects toward sustainable procurement, and efforts are underway to establish a minimum quality framework for monitoring progress. A significant organisational focus also lies in embedding changes within the workflow and culture, by recognizing the various actor values. To this end, a program called *'Programma Klimaatneutraal en Circulair Werken'* (Programme Climate Neutral and Circular Working) has been launched. Through a crossdepartmental approach, this program aims to fully implement the new working methods within two years. Employees are supported in this transition with training and practical tools to facilitate the change.

"Dat heet dan programma duurzame infra en het hele idee is dat mensen twee jaar lang in dat programma zitten en dat het daarna wordt opgeheven, want dan is het een no-brainer in de hele organisatie dat we duurzaam werken." – Interviewee IV



Figure 9. Sustainable Organisation activity system (author).

4.2.4 National Programming

A change in project approach is the shift to a national focus regarding the division of forces to handle the renewal task. As the renewal tasks ask the entire capacity, in terms of budget, people and time, it requires a centralized approach to prioritize projects based on the most pressing national needs. Rather than having regional and national departments working independently on their own agendas, the focus has shifted towards a coordinated national perspective where resource allocation is based on the most urgent infrastructure challenges.

"Een transitie richting opgave gericht werken noemen we dat dan en wat we voorheen hadden we voornamelijk teams die regionaal georiënteerd zijn en dus die doen het werk wat in een regio in Nederland gedaan moet worden en wat we nu aan het doen zijn, is veel meer vanuit een soort landelijk perspectief kijken." – Interviewee V

This shift reflects the need for a collective national effort to maintain infrastructure safety, accessibility, and reliability under rising challenges such as aging assets, climate adaptation, and material scarcity. The transition towards national programming also emphasizes financial dependency on national policies and budgeting, while ensuring sustainability objectives remain at the forefront of infrastructure planning.





Figure 10. National Programming activity system (author).

Tension

However, the pressure to meet both operational and sustainability objectives has also increased the demand for innovation and flexible project execution. This balance requires a proactive working approach, emphasizing learning while executing projects, as rigid planning structures struggle to accommodate dynamic sustainability challenges.

"We hebben aan de ene kant geen tijd meer om helemaal te bedenken hoe je het zou precies zou willen doen. Dus het is wel een beetje learning by doing." – Interviewee I

4.2.5 Portfolio approach

This strategic shift towards national programming naturally led to the adoption of a portfolio approach, emphasizing both standardization and innovation. Rather than tendering projects individually, sets of similar infrastructure assets are now offered together as portfolios. This allows for standardization of project elements, making maintenance and future renewals more efficient. Through long term market engagement, the portfolio strategy stimulates the market to innovate, as

they can learn gradually after each project, providing the market with more security on their investments.

"...portfolio aanpak. Dat is voor de markt wel interessant. Wat heb je een veel grotere opdracht. Heb je veel meer zekerheid. Ga je misschien eerder innovaties toepassen, want dan kan je ook bij de eerste opdracht iets testen." – Interviewee IV

The portfolio approach also promotes cross-regional collaboration, ensuring consistency in sustainability practices across different parts of the Netherlands. Since projects within a portfolio may span multiple regions, a key focus has been ensuring early stakeholder involvement. This requires a coordinated dialogue between public agencies, contractors, and regional authorities to ensure sustainability expectations and technical requirements are clearly aligned before projects enter the tendering phase.



Figure 11. Portfolio approach and Innovation activity system (author)

4.2.6 Innovation

The national programming and portfolio approaches have amplified the need for innovation capacity within Rijkswaterstaat. The organization has shifted from rigid, prescriptive planning to a more flexible, dynamic approach where learning occurs alongside project execution. This translates into a fundamental change in how Rijkswaterstaat has traditionally operated and these changes have led to significant transformations.

"We kijken naar het proces of we een handig en slim georganiseerd innovatieprocessen hebben. We kijken naar de inhoud, is welke innovaties hebben we nodig voor onze opgave en bekijken hebben we de juiste mensen om dat voor ons voor elkaar te krijgen, dus op de mensen, op de inhoud en op het proces." – Interviewee II

Beyond internal efforts, innovation is also driven by collaborative partnerships with external knowledge institutions, universities, and private-sector innovators. Recognizing that no single
organization holds all the expertise required for sustainable infrastructure renewal, Rijkswaterstaat has actively engaged in partnerships with universities and research institutions to fill knowledge gaps and drive collaborative innovation.

"We hebben lang niet alle kennis in huis, dus wij willen goede relaties nodig met universiteiten met kennisinstellingen, maar ook met bedrijven. Heel veel innovaties ontstaan helemaal niet bij Rijkswaterstaat zelf." – Interviewee II

4.2.7 "Market Unless" to "With the market"

Rijkswaterstaat has made significant changes to its project procurement approach, particularly in the context of infrastructure renewal. These projects often involve high complexity, significant risks, and long-term investments, which can create market hesitations due to the long-term financial and legal liabilities involved, leaving an unfeasible case.

To address this, Rijkswaterstaat shifted from a "market unless" procurement strategy to a "with the market" approach. This means the organization now shares responsibility for project risks and collaborates more closely with market actors rather than outsourcing complete risk burdens to contractors.

"De markt, tenzij" dat noemen wij nu "samen met de markt". Dat betekent dat we eigenlijk weer professioneel technische opdracht gegeven worden en niet een professionele inkooporganisatie zijn." – Interviewee I

By assuming a more proactive role, Rijkswaterstaat now retains partial responsibility for the project process, including taking ownership of design elements. This strategic change not only helps mitigate financial risks but also encourages early collaboration between Rijkswaterstaat and its market partners, aligning expectations from the start and supporting a more sustainable project delivery process.



"Wij gaan nu ook het referentie ontwerp wat wij zelf hebben gemaakt voorschrijven. En dat betekent dus dat wij dan het risico van het ontwerp nemen." – Interviewee I

Figure 12. "With the Market" activity system (author).

4.2.8 Barriers

This chapter presents the key barriers identified from the interview data and contextual analysis, emphasizing the contradictions and tensions that arise within Rijkswaterstaat's activity systems. These barriers reveal the complexity of implementing sustainability objectives alongside innovation processes and infrastructure project renewals. By exploring these systemic challenges, the chapter aims to shed light on the dynamic and interconnected nature of sustainability transitions, where conflicting priorities, structural limitations, and cultural resistance often impede progress.

To provide structure and clarity, the data has been categorized into five key dimensions: organisational culture, governance structure, market & financial, operational & technical, and temporary & external factors. In *Appendix F* provides an overview on the relation of interview data with the identified barrier dimensions.

Organisational Culture

The first dimension describes the barriers related to the organisational culture. These encompass norms, attitudes, and internal behaviours that impact openness to change, risk-taking, sustainability and adaptability within Rijkswaterstaat.

- **Resistance to innovative approaches:** Traditional mindset and long-standing practices create resistance and inflexibility toward adopting sustainable, experimental working methods. (C1)
- **Misalignment between national and regional:** Discrepancies between national directives and regional priorities create tension and hinder unified action. (C2)
- **Intrinsic Motivation as a Driver**: Adoption of sustainable practices often depend on personal commitment rather than organizational support, leading to inconsistent outcomes. (C3)
- **Focus on Short-Term values**: Evaluation based on short-term objectives (time and cost) overshadows long-term sustainability goals, discouraging sustainable decision-making. (C4)

"Als je heel duurzaam wil werken, kan het best kan best, want je hebt heel veel dingen. Beleidshaakjes project opstart formulieren. Dat kan best, maar dan moet je net even een tandje extra net even een dingetje verder willen gaan. En als jij niet heel intrinsiek bent gemotiveerd en in je P [persoonlijke] gesprekken en in je projecten wordt je afgerekend of wordt gestuurd op budget en tijd." – Interviewee IV

Governance structure

A partial cause for the is the lack of governance structure to guide the organisation into the desired direction. This is partly caused by external influences, such as politics. As Rijkswaterstaat is a governmental infrastructure agency, they depend on the policies of the current national government and the allocation of budgets associated with them, particularly regarding investments in innovation and sustainability. The governance structure refers to the decision-making processes, hierarchical clarity, and policy alignment challenges between various organizational levels and departments.

- **Large organisational system:** fragmentation on activities and understandings on certain topics between the different layers and scales of the organisation makes it difficult to create collective understanding and coherence in objectives. (G1)
- Lack of Organisational Directive: while the tools and frameworks are there to work sustainably, the organisation lacks in steering mechanisms, such as evaluation, to embed it into the entire organisation. (G2)
- **Complex decision-making**: Decision-making integrates numerous perspectives, making it difficult for any one person or team to have a organisation wide view. (G3)
- **Need for sectorial alignment**: hinders driving the market towards innovation as different governmental agencies apply different regulations and requirements. (G4)

""De besluiten zijn zo complex. Dat komt allemaal samen bij een directeur of iets dergelijks, maar die krijgt dan zoveel facetten waar hij over moet gaan besluiten, terwijl die de achtergrondinformatie daar misschien helemaal niet over heeft." – Interviewee II

"Voor een deel is het volgens mij ook de aansturing, dus de aansturing is ook wel regionaal versnipperd." – Interviewee V

Market & Budget

Challenges related to budget limitations, market demands, profit-driven motivations, and financial risks that affect investment in sustainable practices and innovation.

- **Scarcity in capacity**: all infrastructure organisations struggle with the scarcity of labour, materials in addition to the financial capacities of governmental institutions. (M1)
- Lack of sustainable financial Incentives: Budget restrains and small margins in infrastructure projects limit investment in innovative materials and techniques, and withhold innovation in all sustainability objectives. (M2)
- **Uncertainty in Financial Responsibility**: Lack of clarity over who should bear the costs of implementing new, sustainable techniques hinders commitment from stakeholders. (M3)
- **Conservative mindset**: Risk aversion and profit-centric views make the construction sector hesitant adopt innovations in existing practices and makes companies and partners to prioritize commercialisation of innovations. (M4)

"We hebben echt heel weinig capaciteit en weinig geld om al die projecten uit te voeren en het moet ook allemaal duurzaam en snel." – Interviewee V

Operational & Technical

Refers to technical, procedural, and logistical challenges directly impacting the implementation and scaling of sustainable projects.

- Challenges in Upscaling Innovations: issues with for example storage of reused parts, Eurocode compliance, and integration with other materials, as well as the financial barriers and restricting frameworks pose logistical challenges to upscale innovations. (O1)
- Undefined sustainability project expectancies: the translation of organisational sustainability goals to concrete and clear project objectives and performance indicators is missing, as well as evaluation criteria and accompanied steering to achieve that. (O2)
- Lack of implementation support: actors in the organisation lack tools, guidelines and support to implement sustainable practices into their day to day operations, including the need for adjusted frameworks and requirements. (O3)
- Renewal project characteristics: as renewal projects deal with an existing situation, limitations arise regarding the environment in which the projects are executed, including physical space and impact on society, such as traffic hindrance. (O4)

"We hebben gezegd, we doen het duurzaam of we doen het niet. Alleen, hoe duurzaam wil je dat doen?" – Interviewee III

Barrier framework

The barrier dimensions have been mapped across different organisational scales, portfolio, organisational, and sectorial, as visualized in *Figure 13*. The fifth dimension, temporary and external barriers, has been excluded from this figure. These include political policies, which depend on the current sitting national government, and external regulations, that exceed the direct influence of the individual organisation, such as laws and agreements stated by the European Union.



Figure 13. Barrier framework (author).

This figure demonstrates how certain individual barriers emerge at the intersection of multiple barrier dimensions, embedding both direct and indirect interdependencies. These connections reveal how challenges in one area can amplify or reinforce issues in others, forming a complex web of systemic obstacles. For instance, the large organisational system (G1) contributes to the complexity of decision-making processes (G2), which can lead to misaligned priorities (C2). This misalignment, in turn, reduces implementation support (O3), ultimately hindering the upscaling of innovations (O1). This chain of interdependencies is illustrated in *Figure 14*.

A more extensive example is shown in *Figure 15*, where the barrier *lack of organisational directive* (G2) exhibits three direct and three indirect interdependencies across multiple dimensions. This broader pattern highlights how a single barrier can extend its influence across the entire framework, underscoring the interconnected nature of these challenges and the need for holistic approaches to address them.



Figure 15. Barrier Interdependency G2 (author).



Figure 14. Barrier Interdependency G1 (author).

Conclusion

The findings reveal that barriers to sustainability integration in infrastructure renewal projects are deeply embedded within both the structural and cultural fabric of Rijkswaterstaat. The identified challenges span organisational culture, governance structures, financial constraints, technical limitations, and external influences, emphasizing the systemic nature of these barriers. Key issues include resistance to change, fragmented decision-making, insufficient policy clarity, and misaligned priorities across different layers of the organisation.

The analysis also underscores the interconnectedness of these barriers, with several challenges overlapping multiple dimensions, such as the lack of clear performance indicators, limited collaboration across organisational layers, and unclear financial responsibilities. These patterns reflect both direct and indirect dependencies that hinder progress toward sustainability objectives.

Overall, the barriers reflect cultural, structural, and practical challenges that hinder the progression of sustainable objectives in infrastructure renewal. Overcoming these barriers requires structural adjustments alongside a cultural shift where sustainability objectives are consistently embedded in

4.2.9 Opportunities for value integration

The dual challenge of infrastructure renewal and sustainability transitions presents Rijkswaterstaat with significant systemic and organizational barriers. While these barriers, ranging from governance fragmentation to operational resistance, complicate progress, the interviewees also highlight opportunities that can serve as action points for transformation.

Clarity

A recurring need identified by participants is the translation of sustainability objectives into clear, operational requirements. This lack of clarity often leads to fragmented efforts and hinders accountability, while also undermining the organisations fundamental goals. Hereby *collaboration* plays a role in bridging the knowledge gap between strategic understanding and operational reality, from where clear rules, responsibilities, and performance indicators can be *defined* for actors, both internal and external, to better integrate sustainability into daily operations, ensuring coherence across the organization.

To enable successful implementation and continuation through changes that might occur, a level of *steering* is desired in combination through monitoring and evaluation mechanisms, through which actors can be held accountable and responsible for their part.

"Eigenlijk is het zinniger om te zeggen, om het te vertalen naar allerlei activiteiten die je verwacht van de organisatie, want daar kun je ook veel beter op sturen." – Interviewee VI

Join

Misalignment between national and regional priorities and a lack of communication channels between layers in the organization create inefficiencies and value disintegration. By fostering a shared understanding and collective action through *alignment*, an efficient approach to tackling the current and future challenges can be ensured. Hereby, information *sharing* and communication are key. This relates not only to procurement and prioritisation of projects in the current renewal context, but also comes back to the allocation of budget.

"Ik denk dat het heel erg zou helpen als er dus veel duidelijkere communicatie duidelijkere besluiten worden genomen, zodat die waarde ook overeind blijven." – Interviewee V

Sharing ensures that stakeholders understand the rationale behind decisions, enabling them to align their actions with overarching sustainability goals. Through collaborative workshops and dialogues, different departments and scales of the organization can align their priorities, fostering cohesion and allow *strategizing* for future scenario's. This aligns with the barrier of fragmented governance structures by creating shared frameworks for decision-making.

"Op enig moment zul je echt naar andere samenwerking systemen moeten komen of netwerken moet om het probleem dat we hebben in Nederland op te lossen."

– Interviewee VII

Assist

Given that the entire sector faces scarcity in financial and practical capacities, participants emphasize the importance of jointly discussing what progress on sustainability can be achieved through investing in and developing innovations, and how clients and the government can create the conditions that enable this process.

Through *co-creation* solutions can emerge, by focusing on developing joint strategies with market parties and other governmental agencies. By co-creating, stakeholders can agree on feasible solutions,

balancing market constraints with sustainability goals, while also *facilitating* them with tailored and *standardized* frameworks.

This approach addresses barriers such as a lack of sustainable financial incentives and market hesitation by providing clear guidance and shared responsibility for innovation investments.

"Wij moeten gaan bespreken, ook op het gebied van duurzaamheid: wat is haalbaar, wat is niet haalbaar voor jullie, wat zijn de condities waaronder je kunt gaan innoveren, et cetera." – Interviewee VII

Lead

When asked who should be responsible for guiding processes toward the desired direction and how this should be achieved, no definitive answer emerged. The findings revealed that the current governance structure, characterized by fragmentation and complex decision-making lines, lacks a clear embodiment of responsibility and accountability. While transition paths and roadmaps provide strategic direction, they lack the authority and mandate needed to enforce and prioritize progress. Leadership emerged as a critical need to bring coherence to the organization and ensure that sustainability objectives are not only defined but also effectively integrated into everyday practices. Leadership plays a pivotal role in addressing the cultural dimensions of the organization, influencing how actions are adopted in the daily work of actors.

"Ik denk dat je nodig hebt, is leiderschap. Je moet een aantal mensen hebben die tijd en ruimte en de denk power hebben en de inspiratie kunnen overbrengen om dit waar te gaan maken én de politieke steun." – Interviewee VII

Strong leadership also tackles the cultural barrier of resistance to innovation by fostering openness and trust. This is achieved through the dissemination of successful practices and lessons learned, encouraging a shift toward a more adaptive and proactive organizational culture. In this sense, leadership is not only about direction but also about cultivating a change-oriented culture that aligns with the organization's sustainability goals.

4.3 Results

In the interviews, the questions asked to participants aimed at gathering an understanding of the current context of the sustainability transition and renewal task that are guiding the operations of Rijkswaterstaat. While interviewees mentioned several occasions, contexts and initiatives at which value integration occurs, the activity in itself, does not ensure that value integration is transferred to all the organisational layers and departments. Therefore, value integration happens through three identified key activities; *plotting, pulling* and *positioning*.

4.3.1 Plotting

Rijkswaterstaat's current operations are characterized by fragmentation at various organizational levels, misaligned priorities between national and regional departments, and a lack of clear accountability. These contradictions create significant tensions, such as balancing short-term project pressures with long-term sustainability goals and addressing uncertainty over financial responsibilities. To navigate these challenges, plotting activities serve as a tactical tool for assessing current processes and identifying transitional or context-related changes, contradictions, and pressures, both internal and external.

"Dat is het grotere plaatje, dat is meer het strategische plaatje en daaronder moet je doorgaan naar de naar de, naar de operatie hè. Dus je hebt strategisch, tactisch, operationeel. En daar moet je in gaan kijken van wat is er waar nodig, op welke termijn?" – Interviewee VII

Through plotting, specific points where value integration can be achieved are identified by pinpointing the elements that influence the system. The interviews revealed four main tactics within this activity: identifying key problems and areas for improvement, mapping actors and processes within the system to uncover interdependencies, organizing teams and workflows to address challenges, and researching internal and external best practices and innovations. These steps provide a structured approach to understanding and improving the system's functionality.'

Transitions, however, are dynamic by nature, with processes, people, and contexts continuously evolving. Systematically plotting these changing contexts allows for the identification of potential areas for improvement and growth throughout the transition trajectory. This approach forms the foundation for effective collaborative action, ensuring adaptability and alignment as circumstances shift.

"Ik ben bezig om te kijken van als we kijken naar de opgave die op ons af komt de komende jaren, hoe moeten wij dan eigenlijk onze eigen teams vormen? Ook in samenwerking met marktpartijen, om zo efficiënt mogelijk zoveel mogelijk te kunnen doen?" – Interviewee V

Plotting provides the tactical assessment of current processes regarding the transitional or context related changes. From here the points on which value integration can be achieved are highlighted, through the identification of the specific elements that influence that system, respectively *why, what, who, when, where and how.*

4.3.2 Pulling

The second main activity, *Pulling*, involves operationalizing value integration through activities that address identified barriers and leverage opportunities. Through the iterative and thorough analysis of the interview data four key tactics were identified as central to this process. These activities are dynamic and interconnected, enabling stakeholders to collectively tackle challenges and align their values and perceptions with sustainability and renewal objectives.

Collaboration, while seemingly straightforward, is deeply ingrained in the organization, evident through events and gatherings. Participants highlight that tackling the organization's significant challenges requires joint efforts—internally and externally—since these challenges cannot be addressed in isolation. Collaboration enables the integration of diverse values and interests, rooted in individuals' expertise or work environments, into a unified approach.

"Die markt transitie, daar hebben we ook gewoon een transitiepad voor, en dat doen we dan met bijeenkomsten. Maar dat doen we met opdrachtgevers. En dat doen we dus ook met de aannemers en met de ingenieursbureau en soms ook adviesbureaus, maar ook soms leveranciers. En niet alleen in Nederland, soms ook in het buitenland." – Interviewee I

Aligning involves discussing and reconciling the differing values and priorities of various stakeholders within the constraints and conditions of the situation. Scarcity plays a central role here, as resources and capacities must be allocated to where they are most needed. This often involves making difficult decisions, prioritizing certain regions, assets, or values over others, while ensuring all important aspects are carefully weighed.

"Er zijn nu nog allerlei groepjes die wel de taak hebben om prioriteiten te stellen. Op regionaal niveau maar dan zijn er dus weer andere groepjes die dat op landelijk niveau doen. Die die komen dan Natuurlijk weer net tot een ander lijstje." – Interviewee II

The process of *Co-Creating* involves collaboratively developing solutions that reflect the needs and capabilities of all stakeholders. Participants mentioned various examples where strategies and requirements were co-developed with other parties. By working together to address challenges through discussing what is feasible and achievable from both perspectives, these co-created strategies are more likely to be effective and widely adopted. What makes this integration activity particularly powerful is the way it combines actors needs and desires to create solutions that enable them to perform their work effectively in the new circumstances.

"En dat zijn die eisen, dat zijn eigenlijk veelal sector brede eisen die we eerder In de afgelopen jaren hebben ontwikkeld met mede overheden met de sector." – Interviewee VI

Sharing ensures transparency and fosters trust through the exchange of knowledge, insights, and challenges. Effective sharing accelerates innovation and ensures that decisions are understood and accepted, even when they involve difficult trade-offs. By addressing contradictions, misperceptions, or conflicting opinions, Sharing plays a crucial role in maintaining alignment within a complex system.

"Ik denk dat er veel beter moet worden uitgelegd waar dat specifieke geld dan wel heen gaat en waarom dat dan in het grotere plaatje toch de goede keuze is." – Interviewee V

4.3.3 Positioning

While there is a clear organizational incentive to work sustainably, interviewees highlighted the lack of structural mechanisms to embed sustainability practices within Rijkswaterstaat. This gap often leads to the loss of integrated value over time or under pressure, emphasizing the need for institutionalizing value integration. Positioning focuses on embedding the results of value integration into the organizational structure and processes to ensure their long-term effectiveness. This involves several key tactics:

Defining clear expectations through the translation of sustainable objectives into concrete, actionable requirements, ensures that sustainability goals are not abstract ideals but integrated into the day-today operations of projects. These can be embedded in key performance indicators (KPI's) for both sustainability and innovation. "Dus eigenlijk vraagt het projecten niet om klimaatneutraal circulair te werken, maar om XYZ te doen wat veel tastbaarder en concreter is." – Interviewee VI

By revising existing policies and frameworks, Rijkswaterstaat can create room for innovation while maintaining consistency. *Standardization* ensures that sustainability objectives are integrated into daily operations and that all projects adhere to common guidelines.

"Maar bij die 95% willen we dan ook echt al deze eisen. Dat zijn dingen waarvan wij weten: die kan de uitvoerder, die kan onze eigen organisatie aan, die hebben zoveel mogelijk ook al in standaarden gehangen. En daar hebben we onze kaders op geprobeerd aan te passen, dat die goed werkbaar zijn." – Interviewee VI

Providing actors with the necessary tools, such as sustainable procurement training or expert support, empowers them to adopt new practices effectively. This *facilitation* ensures that sustainability becomes part of the organizational fabric.

Finally, by *strategizing* the sustainability goals by setting clear targets in specific timeframes for each layer of the organisation, the organisation can create a shared focus and ambition, as well as the required directive. Specific targets make the transition objectives more tangible in comparison to single long-term goal strategies.

"Wij zetten wel de innovatieagenda neer en de prioriteiten doen we in overleg met heel veel collega's, maar Wij hebben een innovatieagenda. Daarin staat hier langs innoveren we en daarbuiten in principe niet . Gebeurt wel eens, maar liever niet." – Interviewee II

By institutionalizing these tactics, *positioning* ensures that sustainability practices are not isolated initiatives but integral to the organization's operational and cultural identity.

4.3.4 Pushing

While various activities and tactics for value integration have been identified, a recurring theme among interviewees was the absence of strategic direction and coordinated efforts to effectively translate sustainability strategies into tangible, actionable practices. This gap underscores the need for what can be summarized as *Pushing*, a key activity that combines decisive leadership with mechanisms to overcome organizational inertia and cultivate collective action.

Pushing is not merely a top-down directive tool; it serves as a multifaceted mechanism to inspire and motivate stakeholders across the organization. It entails providing clear priorities, decisive leadership, and an emphasis on accountability and recognition to drive sustainable practices. Participants highlighted that leaders should be assigned clear responsibility for aligning resources and efforts with overarching sustainability goals, ensuring that innovations and sustainable practices are scaled effectively. Leadership in this context acts as a unifying force that motivates stakeholders while addressing systemic fragmentation.

Ik denk dat je nodig hebt, is leiderschap. Je moet een aantal mensen hebben die tijd en ruimte en de denkpower hebben en die inspiratie kunnen overbrengen om dit waar te gaan maken. En de politieke steun." – Interviewee VII

Key activities accompanying this leadership include monitoring progress in the transition and evaluating the performance of various actors, supported by appropriate evaluation mechanisms. Participants noted that an effective way to drive sustainable practices is to hold people accountable for underperformance, while actively recognizing and rewarding those who perform well. It is hereby

essential that feedback on sustainable changes and implementations is gathered and evaluated by the assigned responsible entity. This approach fosters a culture of continuous improvement, where successes are celebrated and organizational inertia is systematically disarmed. In doing so, Pushing transcends hierarchical boundaries, engaging actors at all levels to take ownership of sustainability objectives and encouraging mutual support.

"Een probleem in bredere zin is dat echt sturen. Echt harde afspraken maken en echt afrekenen, hè? Dus zeggen van dit resultaat is niet naar behoren. En iemand op het matje roepen, daar zijn we nog niet zo heel sterk in en dat geldt voor duurzaamheid. Maar eigenlijk geldt dat wel voor meer dingen in onze organisatie." – Interviewee VI

While value integration is evident in various positive engagements with actors both within and beyond the central organization, participants emphasized the absence of broader, cohesive steering mechanisms. *Pushing* addresses this gap by combining accountability with inspiration, targeting not only structural challenges but also the cultural dimensions of organizational change. By embedding sustainability as a central, integrated priority rather than a optional concern, Pushing generates the momentum needed to overcome resistance, align fragmented efforts, and drive a unified approach toward achieving long-term sustainability goals.

"Wat je zou moeten willen denk ik, maar dan weer breder als Rijkswaterstaat, dat duurzaamheid een vanzelfsprekendheid is." - Interviewee V

The interview data identified a dynamic and iterative process for operationalising the opportunities of value integration, which consists of three interconnected key activities: Plotting, Pulling, and Positioning, supported by a Pushing mechanism. These four key integration activities can together ensure effective tactical transition governance, that provide the base for the Value Integration Model (*Figure 16*).

4.4 Value Integration Model

The Value Integration Model is presented in *Figure 16*. This shows the four identified key activities through which value integration occurs, *plotting*, *pulling*, *positioning*, *pushing*. Each relates to the organisational fabric in terms of *context*, *integration*, *practice*, *culture*, together embedded in the *structure* of tactical transition governance.

In the context, a certain issue, gap or barrier can be found though plotting activities. This can provide an opportunity for value integration, which is then approached in the pulling phase. Here the identified aspects in the plotting phase can be integrated through pulling activities, *collaboration, co-creation, alignment, or sharing.* The result of the pulling activities is the value integration. To embed this outcome into the organisational structure, positioning activities should be executed in order to secure it in strategic and operational practices. Finally, when the positioning activities have successfully been completed, these can move into the culture of the organisation. This is accompanied by pushing conditions that ensure that the established integration in the organisation is fostered. These conditions could include *leadership, responsibility, accountability and monitoring and evaluating*.



4.4.1 Value Integration Cycle

An example of how value could be integrated is highlighted in the data. The participant highlights a current issue that staggers the sustainable progress in the organisation as caused by lack of steering, evaluation and appropriate consequences.

"Een probleem in bredere zin is dat echt sturen. Echt harde afspraken maken en echt afrekenen, hè? Dus zeggen van dit resultaat is niet naar behoren en iemand op het matje roepen, daar zijn we nog niet zo heel sterk in en dat geldt voor duurzaamheid. Maar eigenlijk geldt dat wel voor meer dingen in onze organisatie." – Interviewee VI

Plot

Here, the interviewee identifies the gap (*what-object*) and uses it as a starting point for conducting research (*how-tool*), within the framework of the sustainable working programme. The focus of this research is employees (who-subject) and their attitude and opinion (*why-community*) regarding sustainability in the organisation and to dive further into the cultural fabric of the organisational.

"Toevallig werk ik nu ook aan een onderzoek over de duurzaamheid cultuur en hoe die wordt ervaren binnen de organisatie." - Interviewee VI

This activity of researching helps uncover gaps in the cultural embeddedness of sustainability within the organization. Employees express a clear need for more structured steering toward sustainability and innovation.

"Eigenlijk met zijn allen aangeven dat we heel erg gebaat zouden zijn met meer sturing op duurzaamheid, maar ook op innovatie. Onze werknemers denken zelf, dat zou ons helpen." – Interviewee VI

Pull

Building on this opportunity, the interviewee highlights the next step: engaging directors to collaboratively develop solutions. By integrating employees' values and perspectives, as revealed through the research, with the strategic and organizational goals of senior leadership, the organization can drive positive change.

"Dat is weer een hele mooie aanleiding om dat gesprek te voeren." – Interviewee VI

Position and Push

To embed these values into actionable governance, the interviewee proposes assigning clear directives and responsibilities to the organizational director (where-division of labour). This leadership would establish organizational expectations and implement an evaluation process to monitor progress (when-rules).

"Dus je wil eigenlijk dat onze opperbaas dat die zegt: 'Ik verwacht van jou dit en van jou dit van jou dit.' En dan vervolgens na een half jaar eens bespreekt van hoe sta je ervoor en misschien tot aan het niveau van de werknemer." – Interviewee VI

5 Workshop

The workshop was designed to examine how Rijkswaterstaat can effectively navigate the dual pressures of sustainability transitions and the demands posed by future scenarios. It aimed to test the applicability of theoretical insights and gather additional perspectives to strengthen practical recommendations.

5.1. Participant information

The workshop included participants from diverse roles within Rijkswaterstaat, such as project and program directors, innovation advisors, and community managers. Their expertise spanned critical areas such as renewal, circularity, and civil structures, offering a multifaceted understanding of the dual challenges. The participant overview is shown in *Table 3*.

Participant	Role	Focus
А	Project & Programme Director	Renewal
В	Innovation & Community Manager	Civil structures ('Kunstwerken')
С	Innovation Advisor	Circularity & Biobased

Table 4. Workshop participant information.

5.2 Findings

The workshop began by engaging participants in defining sustainability within the context of Rijkswaterstaat's operations. This exercise revealed a shared commitment to sustainability but also highlighted differences in how it is perceived and prioritized, depending on participants' roles and interests. These diverse interpretations underscored the need for a unified yet adaptable understanding of sustainability to ensure alignment across the organization. Building on this foundation, three future scenarios were presented, each framed within the timeline of 2035, to explore the compounded pressures on the ongoing transition trajectory. Participants collaboratively worked on a poster (*Figure 17*), first developing a shared definition of the task at hand and then identifying what they considered the optimal solution. Through group discussions, they mapped out the necessary steps, activities, and requirements across three guiding questions: *How do you get there? What do you need? and What is the desired outcome?* These insights were further linked to the stakeholder groups responsible or most relevant for action, categorized as the *Ministry, Rijkswaterstaat, Provinces & Municipalities, and Market Parties.*



Figure 17. Workshop template (author).

A key objective of the workshop was to provoke participants' immediate reactions to these scenarios by encouraging them to identify the core problems, articulate their implications, and pinpoint where opportunities for the greatest impact lie. The insights gathered from these discussions were categorized into moments of disintegration and integration. Disintegration refers to instances where sustainable efforts are undermined, resulting in underperformance or non-sustainable outcomes. These moments often arise from misalignment, misperceptions, or a lack of coordination within the system. Conversely, integration refers to the proactive actions and strategies that can transform disintegration into integration, driving progress and alignment toward sustainable goals.

5.2.1 Scenario 1 Electrified Use and Construction of Infra Network

The first scenario envisioned a fully electrified Netherlands, with all construction sites operating on zero-emission equipment and widespread adoption of heavier electric vehicles (EVs). This dual shift posed significant challenges: higher energy demands, accelerated wear and tear on roads and bridges due to the increased weight of EVs, and logistical bottlenecks in coordinating construction projects under these new conditions.

Disintegration

Participants highlighted that the transition to EVs, while seemingly positive, introduces practical challenges. Participant C noted that contractors struggle with EV limitations such as range and load capacity, which hinder operations.

Participant A pointed out that increasing societal demands often depend more on policy-driven solutions than on technical innovations, leaving limited room for practical responses within the organization's existing process boundaries. This underscores the unintended consequence of sustainable solutions in one system creating negative ripple effects in another.

"But everything starts with what are the demands that you put on your infrastructure. If you strive for higher demands, then it will be very difficult to make the solution sustainable." – Participant A

Integration

To address these issues, participants suggested advocating for comprehensive policy adjustments at the ministerial level to align overarching frameworks with practical realities. Enhanced collaboration with market stakeholders was also identified as crucial for co-developing practical solutions to overcome barriers.

Second, fostering closer dialogue with the market was identified as a critical step. Engaging contractors and industry stakeholders in collaborative discussions could uncover practical needs and co-develop solutions to overcome barriers. This two-way communication could ensure that these transition benefits all parties involved, strengthening resilience and adaptability across the sector.

"I've also heard when I talk to contractors, they complain about the electrical cars. [...] And I think we need to be honest about those problems." – Participant C

5.2.2 Scenario 2 Strict Nitrogen Rules

The second scenario introduced stringent nitrogen emission regulations imposed by the European Union, requiring a 75% reduction. Non-compliance would result in severe penalties, including reduced EU funding and construction restrictions. These limitations directly conflicted with the renewal task, which inherently involves high-emission construction processes, placing significant strain on Rijkswaterstaat's operations.

Disintegration

In scenario 2, a general lack of clear perspective by the Dutch Government is given as a constraint in moving forward. Participants state that it is a matter of priorities, where sustainable objectives are not prioritised over other organisational goals. Here, the capacity is directed to general production, instead of the focus on sustainable innovation. They also noted the failure to meet 'frontrunner' measures due to project teams' limited knowledge and tools for implementation.

"It is not prioritized as much as the other goals we have. So we have multiple goals and this one just get gets overruled by priority of just getting the production up. So most of our capacity is going there." – Participant B

Integration

Participants emphasized the need for an integrated approach where collaboration bridges innovation and practical project implementation. Combining diverse perspectives and roles was seen as crucial for aligning efforts effectively.

"How do we combine the innovation power of the people that are thinking about solutions, with the power of the people that are able to do your projects? If you can combine these two forces and align them, that's really powerful." – Participant A

Beyond technical implementation, participants pointed to the need for mutual motivation and inspiration within the organization. They also highlighted that scaling sustainable practices requires shared leadership, balancing traditional priorities like safety with sustainability goals. Leadership was framed as a collective responsibility, extending beyond senior management to all levels of the organization.

"We need this cooperation from people that have a drive, anywhere in the organization. If they are the Director General or people like us, it doesn't matter. That's what we need. So it's not only the leadership from the top, but also from ourselves." – Participant A

5.2.3 Scenario 3 Extreme Crisis: Multi-Infra Failure

The final scenario depicted a catastrophic climate event: 30 days of extreme heat followed by severe flooding in the Randstad region, including the Port of Rotterdam. This dual crisis caused widespread infrastructure failures, disrupted economic activities, and jeopardized public safety. Participants examined how such a crisis could additional prompt more sustainable and proactive responses under resource constraints, hereby creating opportunities for change.

Disintegration

The workshop revealed that the organisation embeds points op misconceptions and misunderstandings in the reasoning behind choices or misplaced expectations. A key challenge identified was the lack of urgency within the organization to proactively address potential crises. Participant A shared an anecdote about resistance from the ministry to implement necessary dike reinforcements, which persisted until the situation became critical and action was unavoidable. This example illustrates how delayed responses due to institutional inertia or lack of foresight can exacerbate the impacts of crises.

Integration

Participants agreed that a crisis of this magnitude could serve as a wake-up call, fostering urgency to act proactively against future threats. This requires a shift from reactive adaptation to proactive mitigation, with debates emerging about whether to "build with nature" or "build against it" as part of a broader strategy.

"Civilians and politics, realising that we do have some urgency on this topic and should take some more measurements than we already do." – Participant B

To avoid reaching a breaking point, participants emphasized initiating early conversations and actions. Optimizing knowledge-sharing across all levels of the organization was seen as critical to ensuring coordinated responses and uniform implementation of sustainable measures. To ensure that their implementation does not depend on people their willingness, there is again an emphasis on the power of steering and rewarding, to push people in the right direction. Clear priorities and actionable measures that align with Rijkswaterstaat's values are essential to drive change. Steering, combining top-down directives with inspiration, was highlighted as a powerful tool to set priorities, motivate stakeholders, and foster a collective sense of responsibility.

"Steering is also making a choice: what is more important?" – Participant A

This scenario underscored the importance of proactive planning, improved alignment between strategy and operations, and robust governance. By fostering a sense of urgency and prioritizing climate mitigation, Rijkswaterstaat can better prepare for extreme crises while advancing its sustainability objectives.

5.2.4 Conclusion and Continuation

The workshop outcomes underscored both the challenges and opportunities in advancing sustainability transitions under pressing scenario's within Rijkswaterstaat's governance structures. Throughout the workshop, participants identified moments of disintegration, where structural misalignment, limited clarity, and organizational inertia undermined sustainability efforts. On the other hand, moments of integration were pinpointed, where proactive strategies such as policy adjustments, cross-sector collaboration, and shared leadership could create pathways for progress.

A key takeaway was the importance of fostering both structural alignment and cultural shifts within the organization. The discussions highlighted that while technical innovations and sustainability goals were present, their effective implementation was often hindered by a lack of clarity on roles, responsibilities, and measurable outcomes. Importantly, the workshop also demonstrated that integrating sustainability objectives requires not just technical adjustments but deeper collaboration, shared leadership, and proactive governance mechanisms.

Participants responded positively to both the workshop design and the presented scenarios, noting how the structured discussions sparked fresh insights into how sustainability could be better integrated into Rijkswaterstaat's governance practices. Many felt the workshop helped break down complex challenges, encouraging open dialogue and collaboration across roles. The scenarios, while thought-provoking, also felt realistic and pushed participants to explore solutions from multiple angles. The success of the workshop has sparked further action within the Rijkswaterstaat organization. Building on the momentum generated, additional steps are being taken to continue the dialogue, with plans for expanded collaborative sessions and pilot projects focused on embedding the workshop insights into ongoing sustainability initiatives. This continued focus aims to turn the conversations into tangible actions, embedding sustainability more deeply into day-to-day practices while reinforcing the importance of proactive, system-wide approaches for addressing complex governance challenges. The workshop's positive response and continued engagement has shown the workshops impact as a meaningful tool toward open conversation and shared accountability, strengthening sustainability transitions within Rijkswaterstaat.

6. Discussion

The discussion section of this research report will reflect on the research topic and findings in relation to the chosen method and final outcome. These components will be linked back to the literature discussed in *Chapter 2 Theory* and how the results can be positioned into the currently applied frameworks and structures. This research builds upon established frameworks of transition governance, complex systems theory, and activity theory, and aims to position value integration as a tactical tool to navigate double demands and future challenges. While the primary focus is on how value integration supports transitions, this study also explores the complementary dynamic: transitions themselves create the necessary space and opportunities for embedding value integration within existing systems.

Transitions in Complex Systems

The interview data provided valuable insights into tactical governance, highlighting the barriers and opportunities associated with aligning sustainability objectives with the operational realities of large-scale infrastructure renewal. Tactical governance emerges as the critical interface where strategic goals meet day-to-day project management, often under intense pressure. Infrastructure organizations adapt through iterative processes such as experimentation, feedback loops, and scaling successful innovations. For instance, the ambition to position as frontrunners in sustainable practices demonstrates an organizational willingness to embrace change.

However, these adaptations occur within the dynamic context of complex systems, characterized by alternating periods of stability and instability. Infrastructure renewal exemplifies this duality inline with existing literature: immediate demands and significant societal impacts simultaneously constrain and catalyse transitions (Frantzeskaki & Loorbach, 2009). While moments of instability challenge existing systems, they also present opportunities for innovation and systemic change toward a sustainable infrastructure sector (Rotmans & Loorbach, 2010).

The workshop scenarios further illustrated these dynamics, emphasizing how contradictions and tensions within socio-technical transitions often result in misalignment, misperceptions, and value disintegration. Participants were prompted to reconsider societal demands and infrastructure use rather than merely mitigating damage or maintaining the status quo, which is in line with Frantzeskaki & Loorbach (2009). A particularly striking insight was the emerging interdependencies between transitions in one system and their broader impacts on interconnected systems. For example, sustainable decisions aligned with transitional goals in one domain could unintentionally create non-sustainable consequences in another, highlighting the complexity of achieving holistic and resilient systemic change.

Governance Barriers and Opportunities

Despite the opportunities identified, the research findings underscore that adapting to these dynamics remains constrained by the incumbent structures of the current system. Regulatory limitations, organizational inertia, and a lack of clarity hinder progress. While innovative and sustainable activities are introduced, they often conflict with existing system elements, creating contradictions and tensions that lead to misalignment and barriers to implementation (Gürsan, 2023). This fragmentation in tactical governance observed within Rijkswaterstaat supports the theoretical claim that insufficient coherence at this level can stall sustainability transitions, as mentioned by Turnheim et al. (2018).

Notably, almost all interview participants emphasized the need for stronger leadership to drive change. However, this leadership was often externalized, with participants hesitating to assume such a role themselves. This reluctance could stem from uncertainty about how to take ownership or a perception that the scale of the challenge is too vast for individual action. From an Activity Theory perspective (Engeström, 2001), this leadership gap can be seen as a misalignment between the division of labour and the collective object of sustainability transitions. Leadership, in this context, becomes not just a role but a distributed responsibility across the system, requiring clearer frameworks for accountability and shared ownership. Activity Theory (Engeström, 2001) proved a useful analytical lens in this research, highlighting how transitions function as continuous learning environments. By identifying further dynamics and gaps linking to steering mechanisms (rules) and fragmented decision-making (division of labor), the theory underscores the systemic and interdependent nature of organizational activities and their alignment with sustainability objectives. It resonates with the notion that flexible and collaborative governance approaches, such as multi-stakeholder collaborations and cross-sectoral partnerships, are essential in overcoming these challenges. These approaches foster coevolution, by revisiting established practices and underlying values, and enable value integration across fragmented organizational structures (Willems et al., 2017).

Tactical Perceptions

The overall output of the research also revealed that uncertainty surrounding the trajectory of transitions and societal needs significantly hinders the ability to make convincing and precise innovation choices. This hesitation extends beyond external market parties to infrastructure agency actors themselves, who often perceive sustainability and innovation as optional rather than normative. Innovation, while generally regarded as necessary, relies heavily on actors' perceptions and their recognition of its overall value. This resistance to change is closely tied to actors' limited capacity for knowledge and adaptability. It extends beyond a narrow understanding of future challenges, but delves more into the constrained scope of individual actor's knowledge, which affects their ability to navigate uncertainty. This is further influenced by differences in actors' roles and values, and their physical, mental and social environments. Strategic-level actors, for instance, naturally adopt a longer-term perspective when formulating plans, whereas project-oriented actors tend to focus on 'in the moment' variables and might generally take asset lifespans as defined scope. Hereby a reflection can be made to the notion of "you are what you do", regarding the consciousness and activity of an actor, related to their own system (Jonassen and Rohrer-Murphy, 1999). These divergent scopes of focus highlights misalignment and limit the broader adoption of sustainable practices.

Moreover, while transitions are inherently dynamic and continuously evolving processes, the overall research data reveals a lack of insight into how these processes unfold beyond specific time-stamped goals. Milestones, such as achieving climate-neutral and circular infrastructure by 2030, create the illusion of a definitive endpoint. In addition, the workshop data underscored that unforeseen environmental changes can cause immediate change and affect the outcome of planned transition processes. Aligning with the AT, the outcomes of activities can change over time (Engeström, 2001). Therefore, this time-bound perspective can hinder the ability to anticipate and adapt to ongoing and

future changes, which are essential for maintaining momentum in transitions, requiring a more agile attitude.

By framing tactical activities as dynamic and inclusive processes, the study demonstrates how contradictions can be resolved through iterative engagement and collective action. Participants emphasized the need to move beyond the "work-as-usual" approach and embrace transformative and tactical actions that address both cultural and structural challenges. Flexible governance approaches, such as multi-stakeholder collaboration and co-creation, emerged as a critical means to overcome the limitations of hierarchical structures.

Value Integration as a Tool

A key contribution of this study lies in the operationalization of value integration. By identifying specific activities and mechanisms for embedding integrated values into tactical governance frameworks, the research bridges the gap between theoretical concepts and practical application. Value integration serves as a mechanism for aligning diverse stakeholder perspectives and priorities, creating a cohesive vision that guides both strategic and operational actions. The findings underscore a persistent challenge in transferring organizational fundamentals into project execution. Often hindered by a lack of concrete goals and directives, this misalignment leads to value loss (Jarvi et al., 2018) and emphasizes the need for a structured and systematic approach to value integration.

The Value Integration Model facilitates this tactical effort by working through the transition context, integration, practices and culture, hereby being embedded in the governance structure. The four governance factors that shape the success of value integration, as presented by Kuitert and van Buuren (2022), can be linked back to the Value Integration Model. For example, *time conception* aligns with the *plotting* activity, addressing the emergence of different values and changes over varying timelines. *Professional culture* is reflected in the *pulling* activity, where stakeholders actively engage in collaborative efforts. *Geographical levels* are linked to *positioning*, focusing on practical aspects such as projects and policies. Finally, *governance levels* are tied to *pushing*, emphasizing institutional frameworks and leadership.

The workshop findings illustrated how urgent demands in future scenarios can provoke collective action and foster value integration to address pressing and potential threats, by highlighting contradictions and misperceptions. This underscores the dual role of transitions—not only as challenges to be navigated but also as opportunities to align values, priorities, and actions across organizational structures and processes.

Ultimately, the research identified the potential and content of the tactical governance activities_aimed at integrating value to facilitate positive transitions towards sustainable practices while addressing strategic barriers (Fisher, 2014; Artto et al., 2016; Vosman et al., 2023; Martinsuo et al., 2019), which dynamic process moves across all dimensions.

Therefore, this research argues that tactical-level activities and value integration must address not only structural dimensions but also cultural and practice-oriented aspects of transition governance, as these moments of integration reflect critical values and ambitions that directly influence actors' actions. This perspective diverges from the transition-level focus described by Loorbach and Rotmans (2009) and aligns more closely with Kuitert and van Buuren (2022), who advocate for a combination of top-down institutional support, innovation in public procurement, and bottom-up social innovation embedded in cultural structures.

By extending beyond internal organizational governance, value integration facilitates collaboration across sectoral agencies, positioning itself as a pivotal tool for systemic transformation. Through the alignment of fragmented efforts and the resolution of contradictions, tactical governance becomes a driver of long-term sustainability transitions.

6.1 Limitations & Future Research

This research contributes to the understanding of tactical transition governance by demonstrating how value integration can address barriers in sustainability transitions. It bridges theoretical constructs with practical applications in the infrastructure sector, providing both context-specific and broadly relevant insights. However, as with any study, certain limitations must be acknowledged, which also suggest promising directions for future research.

The concept of "transition" and its accompanying literature is complex and continuously evolving. While this study engaged with key frameworks and understandings, it represents only part of the broader transition research landscape. Future studies could build on this foundation by incorporating additional frameworks, such as the Mission-Oriented Innovation System (Hekkert et al., 2020), which emphasizes the alignment of public and private innovation efforts with societal goals. This broader theoretical lens could enrich the understanding of how value integration operates in different governance contexts.

The application of Activity Theory (AT) provided a comprehensive analytical lens, focusing on systemic components such as tools, rules, and the division of labour (Engeström, 2001). However, AT offers limited insights into the role of power dynamics and conflicts, which are particularly significant in large-scale infrastructure projects. Future research could benefit from integrating perspectives from

behavioural economics and political science to examine how power structures, stakeholder conflicts, and negotiation processes influence value integration and the achievement of sustainability outcomes. Additionally, organizational culture emerged as a critical factor in transition efforts. Combining the Value Integration Model with power or organisational culture frameworks like the Denison Model (Denison, 2011), which links culture to performance, could provide deeper insights into embedding cultural shifts in governance.

Furthermore, the qualitative approach generated valuable insights but was limited to participants interested in the research topic, potentially introducing bias. Conducting interviews within a single organization also restricts generalizability. Future studies involving municipalities, provinces, and private-sector partners could provide a more comprehensive perspective on how value integration operates across diverse governance settings. In addition, research in different sectors, such as energy transitions or climate adaptation, can contribute to a more overall resilient approach. Comparative studies across regions or industries could highlight the Value Integration Model's adaptability in different situations.

Finally, further exploration co could also focus on more experimental governance approaches. Pilot studies testing alternative models, such as rotating leadership structures or distributed decision-making mechanisms, could offer practical insights into how fragmented governance can be better managed. Hereby emphasizing the possibility to further explore how value integration strategies account for diverse stakeholder groups, including marginalized communities, ensuring inclusive governance in sustainability transitions.

In conclusion, while this study advances the understanding of tactical governance and value integration in sustainability transitions, addressing these limitations in future research will enhance its theoretical, practical, and methodological contributions, supporting more effective governance in dynamic systems.

7. Conclusion

This research examined how value integration can address the dual challenge faced by governmental infrastructure agencies: transitioning towards sustainability while managing the immediate demands of renewing aging infrastructure. By exploring the intersection of sustainability objectives and the urgent pressures of the renewal task, the study highlights how these infrastructure agencies can navigate this and future "double troubles." While strategies for sustainability have been established, the tendency to prioritize immediate demands often leads to the sidelining of long-term sustainability objectives. This reality calls for integrated and innovative approaches that embed transition objectives into organizational structures. The research aimed to deepen the understanding of the complex dynamics of transition governance, particularly within the context of infrastructure renewal. By analysing current practices and barriers, this study provides actionable insights into strengthening governance through value integration. Therefore, the research rounds off by answering the following research question:

How can value integration facilitate transition governance at the tactical level in infrastructure renewal?

Drivers, Challenges and Barriers

The results from the interviews reveal key drivers for advancing transition strategies, such as existing collaborations with the private sector and the growing importance of sustainability within societal objectives, both of which provide momentum for change. However, significant barriers continue to restrain the full embedding of transition strategies into infrastructure renewal processes. The study highlights that fragmented and complex decision-making processes hinder alignment across strategic organizational levels, creating disconnects between long-term ambitions and day-to-day practices. Additionally, the absence of clear, quantitative criteria for monitoring and evaluating sustainability outcomes results in inconsistencies in implementation at the operational level.

These challenges are further compounded by cultural, structural, and practical barriers. Culturally, organizational inertia and resistance to change often stem from deeply embedded routines and a preference for familiar practices, making it difficult to adopt new approaches. Structurally, the complexity of multi-level governance and the division of responsibilities across different organizational layers lead to a lack of coherence, delaying progress in sustainability integration. On a practical level, the limited availability of tools, resources, and guidance for operational staff constrains the ability to translate strategic ambitions into concrete actions. Addressing these intertwined barriers requires a systemic approach that fosters both top-down alignment and bottom-up engagement to create the conditions for sustained organizational change.

Opportunities for Value Integration

Through an in-depth analysis of the interview data, several opportunities for integration were identified. These include clarifying tasks and goals, joining forces to address current and future challenges, equipping actors with the necessary tools for change, and bridging the gap in responsibility and accountability, highlighting the need for leadership. These have led to the four key activities that leverage opportunities inro overcoming these barriers and facilitating value integration within the organizational framework: *collaborating, aligning, co-creating,* and *sharing*. Together, these activities illustrate how large governance agencies like Rijkswaterstaat can balance long-term sustainability goals with immediate infrastructure demands and future threads, by focussing on collective action.

Firstly, *collaboration* emerged as a fundamental practice within the organization, enabling stakeholders to integrate diverse values, interests and perspectives into a cohesive approach. By fostering internally and externally relations through gatherings and workshops, collaboration creates a foundation for joint decision-making and coordinated action.

Aligning complements this by focusing on the harmonization of differing priorities among stakeholders. In the context marked by resource scarcity, aligning helps allocate capacities effectively while weighing critical decisions to address both regional and national priorities. By engaging in these conversations early and systematically, stakeholders ensure that all relevant aspects are considered, creating a shared understanding of the direction and focus of their efforts.

Co-Creating was identified as a powerful tool for developing solutions collaboratively, as supported by interview findings. This approach allows stakeholders to jointly define strategies and requirements, ensuring that their needs and goals are incorporated into actionable outcomes.

Finally, *Sharing* plays a pivotal role in advancing progress through the exchange of knowledge, both internally and externally. By fostering transparency and communication, sharing ensures that innovation is transferred from one area to another, and that stakeholders understand the rationale behind decisions, even when they conflict with individual priorities or values.

Embedding Value Integration

The potential of value integration lies in strengthening governance structures by transforming opportunities into concrete activities. To effectively integrate value integration activities (*pulling*) into governance structures requires both *plotting* and *positioning* efforts.

By first systematically *plotting* current processes and practices across the different scales, the gaps and opportunities in tactical governance can be identified, allowing for targeted interventions. Plotting can be done through analysing tactics: *identifying* the issues, tensions or opportunities for value integration in the system, by *organising* the current processes, through *mapping* out the actors and teams relevant for the task and through conducting *research* into content related topics. Here, an emphasize lies on the dynamic nature of systems, where changes in the system occur over time.

Positioning focuses on the tactics to embed the integrated value outcomes into the organisational structure. Through nesting these outcomes in agenda's and roadmaps, the value integrated trajectory is then *strategized*. This includes the *defining* sustainability strategies into clear expectancies regarding operational practices and the further *standardizing* which provides the necessary guidelines, criteria and adjusted standard as well as *monitoring* frameworks to ensure consistent practice across the different levels of the organisation. By *facilitating* support through trainings and cross-departmental programmes, employees are put in the position to slowly adapt in culture and structure, towards the new sustainable organisational fabric.

Leadership, or what this research terms "Pushing," plays a pivotal role in driving these efforts forward. Pushing combines decisive leadership with mechanisms to overcome organizational inertia and inspire collective action. By setting clear priorities, holding stakeholders accountable, and fostering a culture of recognition and motivation, leadership acts as a unifying force that aligns fragmented efforts and accelerates progress. This emphasis on leadership is particularly crucial in addressing systemic fragmentation and resistance to change, as it ensures that sustainability objectives are actively pursued and not sidelined by immediate operational demands.

Overall, the Value Integration Model provides a tactical governance mechanism for addressing these challenges by navigating transition contexts, fostering integration, shaping practices, and embedding cultural shifts within governance structures. It emphasizes viewing barriers as dynamic interactions rather than static obstacles, promoting an adaptive governance structure capable of responding to both current pressures and future uncertainties. The workshop findings underscore the importance proactive preparation for complex challenges, highlighting how collaborative action through integration activities can help stakeholder confront difficult scenarios early. By encouraging participants to anticipate potential risks and engage in joint problem-solving, the model demonstrated its ability to turn complex challenges into opportunities, transforming a "double trouble" situation into an approach that effectively "kills two birds with one stone". This not only validated the dynamic applicability of the Value Integration Model but also underscored the importance of foresight and collaborative action in addressing complex transitions.

This study demonstrates that embedding value integration into the organizational fabric transforms "double trouble" into an opportunity for cohesive action. By addressing the structural, cultural, and operational barriers to sustainability, value integration offers a means to align immediate demands with long-term goals. As sustainability transitions unfold, the likelihood of encountering additional "double trouble" moments increases, characterized by overlapping challenges and heightened pressures. This research offers a robust framework to prepare for and navigate these complexities, ensuring that future transitions are met with resilience, adaptability, and strategic foresight. The integration of plotting, pulling, positioning, and pushing equips governmental infrastructure agencies with the tools to meet present challenges while proactively preparing for future scenarios. This ensures that infrastructure renewal not only addresses immediate needs but also contributes to a sustainable, resilient, and future-proof infrastructure network.

8. Recommendations

This chapter presents key recommendations derived from the findings of this research, offering actionable strategies to embed value integration into governance structures. These recommendations aim to address the dual challenge of sustainability transitions and infrastructure renewal, particularly for governmental infrastructure agencies such as Rijkswaterstaat. The recommendations are organized around the research dimensions, "what, why, who, where, when, and how", and are designed to guide both immediate and long-term organizational practices.

8.1 Advice

What: Defining Objectives and Direction

The findings reveal that sustainability objectives within organizations like Rijkswaterstaat are wellestablished but often misaligned across governance levels. To address this, it is crucial to develop a unified vision for sustainability transitions that bridges national and regional priorities. This requires collaborative efforts among municipalities, provinces, and Rijkswaterstaat to establish shared goals and minimize competition among public entities. Rijkswaterstaat can leverage its role as a frontrunner to lead by example, showcasing best practices in sustainable innovation and aligning operational activities with strategic ambitions.

Establishing an "Innovation Board" at the tactical level could provide necessary oversight and direction for activities, such as bringing together the now separate innovation spaces that are scattered across the organisation.

Why: Addressing the need for Integration

A clear and cohesive governance approach is essential for navigating the dual challenge of sustainability transitions and infrastructure renewal. Effective communication and knowledge-sharing mechanisms are critical to reducing fragmentation within large national organizations like Rijkswaterstaat. By fostering systematic information flows across departments, organizations can enhance decision-making and align regional and national goals more effectively. This is essential for not only navigating current challenges, but also being prepared for future scenario's that might affect the entire infrastructure system.

Engaging the private sector and other stakeholders early in decision-making processes strengthens shared ownership of sustainability objectives and ensures coordinated efforts. Establishing a level playing field among public organizations is particularly important to facilitate cooperation rather than competition.

Who: Assigning roles and Responsibilities

The research underscores the importance of clearly defining roles and responsibilities to facilitate accountability within governance structures. Integrated decision-making mechanisms, such as cross-departmental task forces, can help embed sustainability objectives into operations and ensure that accountability is maintained across all levels of governance.

Additionally, engaging external stakeholders, including municipalities, provinces, and private sector actors, in co-developing strategies ensures a shared commitment to sustainability objectives. This collaborative approach enables the alignment of diverse perspectives and interests, fostering a unified effort toward achieving sustainability goals.

Where: Embedding Sustainability into the Organisational Structure

Sustainability must be embedded into the organizational fabric through structural and procedural adjustments. Updating project frameworks and guidelines to integrate sustainability criteria is a critical

first step. These adaptations should enable the implementation of innovative practices and technologies, making sustainability an integral part of daily operations.

Facilitation mechanisms, such as providing resources, training programs, and toolkits, are also essential. These tools empower employees at all levels to adopt sustainable practices effectively, fostering a culture focused on motivation and innovation that supports the organization's long-term sustainability goals.

When: Establishing Rules and Timelines

Timely implementation and evaluation play a crucial role in embedding sustainability into governance structures. Introducing monitoring frameworks can help track progress and identify areas for improvement, ensuring that sustainability initiatives remain aligned with organizational objectives. Additionally, clarifying policy mandates is essential to ensure consistency across all levels of governance. Establishing clear timelines for achieving targets helps maintain focus and accountability, providing a cohesive framework for long-term success.

How: Providing Tools and Support

Effective implementation of value integration requires practical tools and supportive mechanisms. Cross-departmental training programs can foster collaboration and build capacity for sustainable practices. Financial incentives, rewarding systems and comprehensive guidelines further encourage innovation and inspiration, while providing clear criteria helps standardize practices. These tools and resources create an enabling environment for sustainable innovation, ensuring that value integration becomes a shared organizational priority.

By embedding value integration into governance structures, organizations like Rijkswaterstaat can address the challenges posed by sustainability transitions and infrastructure renewal. These recommendations provide a pathway for aligning immediate demands with long-term objectives, fostering a unified approach to building sustainable and resilient infrastructure systems.

8.2 'InnovatieRijk'

To help Rijkswaterstaat implement these recommendations and embed them into its organizational structure, this research introduces an integrated innovation board named "InnovatieRijk". InnovatieRijk is envisioned as the central innovation board, tactically positioned to integrate sustainability, innovation, and renewal efforts across the organization. Situated directly under the central board, InnovatieRijk operates above all departmental levels, serving as a unifying platform that collects, synthesizes, and disseminates critical insights from operational, tactical, and strategic levels. Its role is to ensure alignment between Rijkswaterstaat's overarching vision and the practical realities of its programs, projects, and partnerships.

The board's key responsibilities encompass strategic alignment, advocacy and guidance, monitoring and evaluation, as well as facilitation and support. InnovatieRijk provides a cohesive structure for addressing fragmentation and fostering collaboration across all organizational levels. By centralizing innovation efforts, it ensures that sustainability and renewal objectives are not only embedded in the organization's strategy but also effectively translated into practice. Through periodic evaluations, the board can monitor the progress and effectiveness of these efforts across the entire organization, ensuring continuous improvement and alignment with long-term goals.

To highlight how InnovatieRijk integrates perspectives and priorities from various domains, its functions are framed using a "Rijkswaterstaat as..." approach, with each role emphasizing a specific contribution the organization makes to the broader innovation landscape. This framework showcases InnovatieRijk's capacity to act as a strategic driver for innovation, ensuring that Rijkswaterstaat remains at the forefront of sustainability transitions while maintaining its core responsibilities.



Figure 18. InnovatieRijk organisational structure (author).

Rijkswaterstaat as Operational Vanguard

The board recognizes operational-level needs and ensures they are effectively integrated into overarching program and portfolio strategies. It acts as a navigator, translating ground-level insights into actionable strategies.

Rijkswaterstaat as Match Maker

Acting as a mediator, the board ensures that national-level directives are aligned with the priorities and realities of regional departments. By fostering open communication and collaboration, it prevents conflicts and inconsistencies between these levels.

Rijkswaterstaat as Big Brother

The organisation serves as a role model for other governmental bodies, showcasing successful sustainability and innovation initiatives. It shares best practices, sets benchmarks, and creates a ripple effect of progress throughout the public sector.

Rijkswaterstaat as Market Advocate

The board positions itself as a facilitator for innovation within the private sector. By providing clarity on regulations, offering pilot opportunities, and supporting partnerships, it encourages market players to invest in and adopt sustainable practices.

Rijkswaterstaat as Innovation Navigator

InnovatieRijk ensures that the central board is well-informed about operational realities and emerging trends. It advocates for innovation as a strategic priority, pushing the organisation towards progressive change. This provides a direct line of influence towards the central board and the national government

9. Reflection

Research topic and design

Method

This thesis research was conducted in a qualitative manner, in the form of expert interviews and a workshop. The research was supported by a literature reviews, that was conducted in an iterative way with the process, as topics emerged later. The decision for interviews resulted in interesting insights into the actual interaction, perceptions and perspectives of the interviewees and allowed for both a analytical view on the organisational governance and transition processes, as well as a reflection on the current situation. This qualitative approach is somewhat subjective, as data is collected through a small group of participants within a large organisation. Therefore, the research remains of an exploratory character and to effectively integrate the collected data in this study required thorough analysis. Interviews were planned and held in collaboration with a PhD candidate, Hazal Kaya. As the research was conducted within the scope of Rijkswaterstaat, but not internal at Rijkswaterstaat through e.g. an internship, this resulted in both a barrier for deeper understanding, as well as a objective look at the organisation.

After the P2 phase, the methodology was adjusted from using a Delphi-Method approach to a workshop, due to both time constraints and the more suitable role a workshop would have. In collaboration, Hazal and I worked together in designing the workshop so it would both be suited to provide data for my research as for the PhD research. The workshop had to be postponed various times, due to a lack of responses from participants, which led to a lot of uncertainty and stress on my part. The workshop will now take place one week after the P4 deadline, but will provide a significant insight into the collective processes and action taking under pressure, which will provide an additional layer to my research.

Context

Before the start of the research, I had yet to discover the level of complexity regarding this research topic. Transitions in itself demand a strong understanding connection between different scales and sectors, as well as their interdependencies. Also, the current context of the Dutch infrastructure sector with the renewal and renovation task, seems to share these characteristics. These two domains will constantly engage on their shared integral and active development path. It therefore will take their place in the relevant challenges of today and tomorrow. The complexity of their interrelation has sparked a great interest to delve deeper into the challenge in moving towards a sustainable built environment. However, because of both their own complexities, it created a web of endless concepts and approaches, and therefore many researches and articles that could contribute to the entire story. This asked a great deal of boundary setting, which I found difficult to do.

The research relevance is closely linked to the moment in time, where the worldwide construction sector is facing several challenges, which will only increase over the upcoming decades. In the case of the Netherlands, the envisioned sustainability goals are not being achieved within the set time frame, and therefore call for a new and innovative approach. This is emphasized in the conducted interviews. With the renewal task at the door, the potential embedding of sustainable processes and the integration of values is essential for bringing this task to a long-term objective. With an eye on the future, the design and implementation of such an approach in organisations, can support the challenges ahead, such as climate adaptation.

Personal reflection

Process towards P2: Graduation Laboratory

During the first part of our thesis, the graduation laboratory course, I was still actively searching for an engaging topic thesis, that combined both my interest in construction management, specifically on stakeholder management and larger societal contributions. The course was guided through a structure that provided new insights and perspectives to define our topic and research approach.

The four theme's, from which we could choose, gave some kind of guidance. Theme 5, *Gamechangers* – *Sustainability Transitions and Changing the Regime*, directly sparked my interest and the suggested topics provided definitely showed the importance of this field in the current context. For me, the societal relevance was of great importance, as this motivated me to work hard and thorough. However, this first phase of my thesis research is still cost me quite some time to figure out exactly what my research was going to be. This took a lot of rephrasing, reshaping and rescoping through intensive literature research and lots of conversations.

Finally, I found my interest in the renewal of infrastructure. As I have been always been rather interested in things that are already there (heritage), instead of things that are 'new', this was a suiting topic. In addition, the large-scale of infrastructure interested me greatly, as it crosses both geographical, sectorial, and scale levels. Therefore its relation to sustainability and transitions is quite complex, which posed an interesting challenge.

The road o fining my main research question and sub-questions was not the smoothest. It was a lot of going back and forth, and still, at my P2, I was not yet completely satisfied. The support I got from my mentors through our thesis meeting and the intensive input they gave, had me thinking in new ways. Also, in the possibility to connect my research to a PhD project allowed me to both give my research more reason and actuality, and provided me with interesting insights and incentives from a broader research perspective.

The final weeks before my P2 moment, were filled with intensive work. I put a lot of pressure on myself to deliver something good and ambitious, which was pared with some stress and a long days. The summer break afterwards created a period in which I was able to workout my research more on a very slow pace and draft a plan for the interviews.

Process towards P4

In September, I found myself navigating a challenging restart to my graduation year. Despite having done some work over the summer, the shift into the new academic period felt disorienting, as I felt a strong doubt of what the research would bring.

My research, now linked to a PhD project and the broader research program it belonged to, introduced an added layer of dependency on others for continuity. This reliance became particularly evident during the search for interview participants—a process that proved far more difficult than anticipated. While the month of September passed with minimal opportunities for data collection, this creating a lingering sense of pressure and uncertainty, I used this time to delve further into the theory and understanding of the context, before starting the interviews. As I delved deeper, it became clear that the topic held far more intricacies than I initially anticipated. While this complexity has also been sparking my curiosity and excitements for the topic, it has also brought its own set of challenges.

While the number of interviews increased very slowly over time, with the most being conducted after the P3 moment, the interviews did gave me a great insight in to the complexity of the organisation and all the different processes that accompany them. Many participants emphasized the relevance of my research topic to be the motivation for participation, and genuine interest in the research outcome. This gave me an additional boost of motivation and confirmation.

Effectively analysing the interviews deemed to be a challenge for my, as the interviews gave a wide range of interesting output and revealed the complexity of the organisation itself, as well as the dynamics outside of the organisation. This process of processing the data without the a clear direction was really difficult and left me very uncertain about the output.

While the interviews already gave a very extensive layer of input, my will to also design a workshop as an additional layer to my research, revealed to be challenging and time demanding. With the realisation just before P3, that organising a workshop together with Hazal before my P4 was not possible, I opted for a different approach. However, short after, the workshop was back on the table, with now a short time frame in which the workshop had to be planned. An additional struggle was with the lack of responses when reaching out to participants, due to which the workshop the date had to be adjusted three times, now being scheduled the week after P4. Though this is unfortunate, I believe it holds great potential to bring valuable insights and add a collaborative dimension to the research. The workshop offers an opportunity to explore the collective integration of values under pressure, which is a central theme of my study, and I am eager to see how this will unfold. Working with Hazal on the design and preparation of the workshop has been aside from, incredibly inspiring and helpful, also really fun. With every meeting, my motivation increased and the certainty on an impactful contribution grew. I want to thank her greatly!

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Appendix A: Case description of the Dutch Infrastructure sector

To provide more clearance and insight into the context and case of the Dutch Infrastructure sector, an additional introduction is given.

In the Netherlands, the management and maintenance of infrastructure are collaborative efforts involving multiple governmental entities: municipalities, provinces, waterboards and Rijkswaterstaat. Each plays a distinct role in ensuring the country's infrastructure remains functional and resilient. Municipalities manage local infrastructure, such as roads, public transport, and utilities, within their jurisdictions. Provinces oversee regional infrastructure projects, ensuring alignment with national policies while fostering collaboration between municipalities. At the national level, Rijkswaterstaat, as the executive agency of the Ministry of Infrastructure and Water Management (IenW), is responsible for designing, constructing, managing, and maintaining the Netherlands' primary infrastructure facilities. These include major road networks, bridges, tunnels, waterways, and water systems such as locks, which are critical to the country's safety, accessibility, and liveability.

Rijkswaterstaat's strategic framework, "Kompas RWS," prioritizes sustainability, innovation, and resilience, focussing among other on asset management, climate adaptation (Rijkswaterstaat, 2021). Hereby including the goal towards Climate Neutral and Circular in 2030.

This ambition is guided by the principle: *"Het werk dat we doen, doen we duurzaam"* ("The work we do, we do sustainable"). This vision is embedded in the emphasizes on the 3 megatons CO₂ emission the governmental agencies collectively produce. Consequently, the Ministry of IenW emphasizes promoting resource efficiency and integrating sustainable practices across its operations, from project planning to execution. The organization focuses on areas with the highest environmental impact, including road pavements, civil structures, coastal maintenance, and fairway dredging, using sector-wide roadmaps to guide these transition pathways (Duurzame Infra).

n addition, Rijkswaterstaat faces the significant task of replacing and renovating thousands of aging infrastructure assets nearing the end of their operational life, known as the *Vervanging en Renovatie* (Replacement and Renovation) program. his challenge is substantial, as research institute TNO has provided a forecast for the required investments to maintain infrastructure reliability and functionality through the end of the century (Rasker et al., 2023):

- The total estimated value of Dutch civil infrastructure: 347 billion EUR
- Annual infrastructure renewal costs expected to rise to 2-4 billion EUR a year
- Total infrastructure renewal costs estimated at 260 billion EUR by 2100

These cost projections account for significant uncertainty, ranging between + \pounds 2.5 billion and - \pounds 1.7 billion per year, highlighting the financial risks and complexity associated with the renovation task. The scale and impact of this financial burden underscore the profound influence the renewal and renovation program has on the Dutch infrastructure sector as a whole (*Figure 19*).



Figure 19. Renewal cost estimation (Rasker et al., 2023)

Appendix B: Interview Protocol

Datum:

Deelnemer:

Allereerst wil ik u bedanken voor uw tijd om deel te nemen aan dit interview. Ik zal me kort voorstellen. Mijn naam is Emma van Dongen, ik ben momenteel bezig met mijn afstudeeronderzoek over hoe duurzaamheidsdoelstellingen worden gewaarborgd onder de druk van de vervangingsopgave. Hierbij kijk ik specifiek naar de hoe de verschillende waarden van stakeholders in het systeem kunnen worden erkend en geïntegreerd.

Dit interview is onderdeel van een reeks interviews, met mensen van uit verschillende lagen van Rijkswaterstaat. Zo streef ik er naar om zo'n breed mogelijk beeld te creëren over de opgave waar Rijkswaterstaat voor stat en om zo veel mogelijk perspectieven te kunnen integreren.

Introductie

- Wat is je/uw naam?
- Wat is je/uw functie?
- Hoelang doe(t) je/u dit werk al?
- Waarmee houd u zich mee bezig binnen Rijkswaterstaat?
 - Wat zijn de grote toonaangevende projecten op dit moment waar je aan mee werkt?
 - Kunt u voorbeelden noemen

Transitie & Vernieuwing context

We bevinden in ons in een transitie. Hierbij beweegt de bouw en constructie sector zich richting een duurzame sector binnen alle fase in het process.

- Wat verandert er in binnen Rijkswaterstaat?
 - Welke organisatorische veranderingen hebben er plaats gevonden in de afgelopen jaren binnen RWS?
 - Welke processen veranderen?
 - Waarom is het aan het veranderen?
 - Wat heb jij ervaren dat er verandert gedurende de tijd in de duurzaamheidsafspraken, ambities
 - En wat voor druk staat er op die veranderingen?
 - Ontstaan er hier conflicten in?
 - Op welk vlak/aspect
 - Wat is er nog nodig in jouw ogen om afspraken, ambities, tijdsdruk en conflicten aan te pakken? Wat mist er nog?
 - Wie zijn hier verantwoordelijk voor?

Als Rijkswaterstaat hebben jullie het doel om **klimaat neutraal en circulair te zijn in 2030**. Ik heb de strategie documenten gelezen en ook het transitie pad kunstwerken en de vernieuwing opgave bijvoorbeeld. Hoe denk je dat deze twee met elkaar kruisen of juist met elkaar conflicteren?

- Welke processen worden hier bij het meest essentieel?
- En wie spelen dan de belangrijkste rol hierin?

We kunnen niet 25 jaar in de toekomst kijken, dus om te werken aan transities, kijken we vaak naar wat er al gedaan is in het verleden, back-casting, wat we daarvan kunnen leren en hoe we dat kunnen toepassen of vandaag en morgen. Alleen hebben we in Nederland nu zo te maken met klimaat verandering, politieke veranderingen en onverwachte toename in vraag.

- Denk je dat het nog steeds mogelijk is om te leren van het verleden?
- Waar en hoe moeten we onze blik veranderen?
- Wat voor controle hebben jullie daar zelf op die veranderingen?

Vertaling strategie \rightarrow operationeel

0

- Wie zou in jouw/uw ogen de vertaal slag moeten maken tussen de duurzaamheid/transitie strategieën en de uitvoering van de vernieuwing?
 - Waar binnen Rijkswaterstaat zou dit met name plaats moeten vinden
 - Waar zouden de keuzes en prioriteiten op moeten worden gebaseerd?
 - En waar liggen vanuit jouw/uw perspectief de prioriteiten?
 - Missen er nog dingen om de juiste keuzes te kunnen maken of de juiste prioriteiten te kunnen stellen?
 - Informatie binnen Rijkswaterstaat / Verantwoordelijkheid / Actie nemen
- En als die vertaal stap is gedaan, wie is er dan verantwoordelijk voor het waarborgen?
 - Hoe houd je zowel lange termijn transitie/duurzaamheid doelen als korte termijn vernieuwingsopgave doelen (snel realiseren van renovaties of vervangingen)
- Ook binnen Rijkswaterstaat is er van alles aan het veranderen, o.a. hoe projecten worden benaderd. Er is een grote vraag voor mee innovatie:
 - Hoe zou je/u de project management vs. De asset management benadering voor transities en de vernieuwingsopgave beschrijven?
 - Wat is er nodig voor het mogelijk maken van meer innovatie in projecten?
 - Standaardiseren / opschalen
 - Wat is nu de grootste barrière hiervoor?
 - Vanuit jouw/uw rol, zijn er activiteiten die je zou willen uitvoeren om dit mogelijk te maken?

<u>Resultaat</u>

Oké, als je je nu de toekomst van Rijkswaterstaat voorstelt en we 10 jaar vooruit gaan in de toekomst.

- Hoe zouden de operationele activiteiten van Rijkswaterstaat er nu uit zien?
- Wat is jouw/uw ideale toekomst?
- En wat denk(t) je/u dat realistisch is?

Wanneer is er succes behaald?

Het ADEPT project is vanuit NGInfra opgezet, waarbinnen verschillende infra partners meewerken zoals, Alliander – Vitens - ProRail – Rijkswaterstaat. Al deze bedrijven werken met vergelijkbare uitdagingen en ook op de renovatie van hun infrastructuur maakt hier deel van uit.

- Denk(t) je/u dat er samenwerkingen kunnen plaats vinden onderling?
- Zijn er vergelijkingen die je/u kunt trekken? Vergelijkbare problemen waar julie tegenaanlopen? Zoals energie congestie, meer vraag vanuit de samenleving, arbeidstekorten?
- Zijn jullie afhankelijk van een van deze bedrijven voor jullie eigen duurzaamheidstransitie?
- Denkt je/u dat er misschien leer mogelijkheden zijn, dat deze andere bedrijven van jullie kunnen leren en waar dan in? En heeft u dingen van hun geleerd?

Appendix C: Informed Consent Form

ADEPT: Adaptable DEsign Pathway Transitions

Participant Information Form for an interview with Hazal Deniz Kaya

You are being invited to participate in an interview conducted by Hazal Deniz Kaya and Emma van Dongen that is part of the research study titled ADEPT: Adaptable DESign Pathway Transitions. ADEPT is a 4-year research program led by Paul W. Chan (TU Delft), in collaboration with multiple university and industry partners, and with funding from the joint research programme of Next Generation Infrastructures (NGInfra) and Netherlands Organisation for Scientific Research (NWO). The project rewarded funding within the call "Responsive Futures: Modelling and Governance for Infrastructures in Transition" from October 15, 2022 to October 15, 2026. The purpose of this research is to investigate the connections and misconnections between the strategy and operations of infrastructure agencies as they navigate through sustainability transitions.

Your participation will consist of a one-on-one interview with a researcher. Your participation will depend upon your interest, willingness to contribute, and expertise, as well as the stage of this multiyear research program. Data will be captured during these research interactions. By participating in this interview, you can make a vital contribution to the project as a subject matter expert representing a key stakeholder perspective.

Written notes will be taken by researchers, and, in particular, we also ask your permission to audio record interactions. Audio recordings will be for internal purposes only and will be transcribed and processed using machine learning techniques to help the research team analyse themes and trends in the research process and facilitate future stakeholder interactions. More information about what information we collect and how we use it can be provided to you by the researcher upon request. This data will be used to define research questions, conduct analysis, validate research findings, and inform policy and practice. Data will inform academic publications, teaching, and other public materials. During interactions, we are likely to ask you to reflect on topics generally related to infrastructure planning for sustainability transitions, including:

- Strategies and approaches of your company to respond the sustainability challenges such as increasing societal demand, resource depletion, and changing conditions of the climate.
- Translation of these strategies to operational realities of infrastructure planning and management and challenges behind that.
- The actors (e.g., infrastructure providers, ministries, institutions) that are involved in infrastructure planning for transitions.
- The economic, political and societal aspects of these strategies and operational challenges.

As with any research activity, the risk of a breach of confidence and/or security is always possible. As a research team, we take your privacy and confidentiality seriously. We are aware that, given the societal sensitivity of this perspective, some opinions may cause personal or industrial harm if not treated with care. We have taken several steps to safeguard your privacy and to give you the right to participate in the project on your own terms.

To the best of our ability your participation in this study will remain confidential unless you explicitly give permission for your contribution to be public. The data you provide is managed according to a

data management plan and protocol which follows best practices and legal standards in the university research sector. The personally identifiable information (e.g. contact details, affiliations) and personally identifiable research data (e.g. interview transcripts) you share with us will be stored at one or more of the participating research institutions using secure password-protected systems. Secure sharing systems will be used in instances where data must be moved between research institutions. Personally identifiable research data will be treated with care by the immediate research team and will anonymized to the extent possible. After the project concludes, select data may be stored in open-access archives to facilitate open science activities and support future research on this topic. This will not include sensitive personally identifiable research data, which will be destroyed. We are happy to share more information about the data we collect, how we process it, and how we store it.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to decline any questions or invitations to contribute to the research process. You can also have your data retroactively excluded from the research project at any time during the four-year research program.

Thank you for your thoughtful contribution to this timely research agenda. If you have any questions, comments, or requests related to your participation, please do not hesitate to contact Professor Paul W. Chan, Principal Investigator of ADEPT.

Professor Paul W. Chan

Delft University of Technology

Informed Consent Information Sheet 1.A

Funder: Netherlands Organisation for Scientific Research (NWO)

Research Participant Consent Checklist	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated [], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.		
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.		
3. I understand that taking part in the study involves participation in interviews, focus groups, group meetings, and similar forums over one or more interaction, depending on my interest and expertise. I understand that written notes will be taken during these interactions, and in some instances I may be additionally asked to consent to audio recording. I understand that this data will be stored securely during the lifetime of the project, and every effort will be made to ensure it is anonymous beyond the immediate research team. I understand that sensitive personal information will be destroyed at the end of the project, and that select fully anonymized data (e.g. summary notes based on interviews) may be archived in open data platforms for future use.		
4. I understand that additional consent will be requested before any quotes or other research findings are attributed to me or my company.		
5. I understand that the study will end on October 15, 2026, corresponding with the conclusion of the NWO, Dutch Research Council.		
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. I understand that taking part in the study also involves collecting specific personally identifiable information (PII) [my name, contact details, and affiliation] and associated personally identifiable research data (PIRD) [data on my responses to interview questions and related to other research activities], with the potential risk of my identity being revealed through due to an unforeseen data breach or the actions of other research participants. I understand that taking part in the study involves the risks of personal and/or institutional reputational harm related to the subject matter of the research project. I understand that I can discuss any additional potential safeguards with the research team.		
8. I understand that the research team has developed a data management plan to minimize the threat of a data breach, and protect my identity in the event of such a breach. This includes storing my data securely, instituting protocols to anonymise and separate personally identifiable information and research data from datasets to the extent feasible, and destroying confidential data at the end of the research process (August 31, 2027 or earlier, upon my written request).		
9. I understand that personal information collected about me that can identify me, such as my name, professional contact details, and institutional affiliation, will not be shared beyond the study team.		
10. I understand that after the research study the de-identified information I provide will be used for multiple research outputs, including but not limited to Masters and PhD theses, journal publications, conference presentations, policy reports and white papers, blog posts, podcasts, exhibitions, media interviews, and other formats for wider public dissemination. No		

Research Participant Consent Checklist	Yes	No
recognisable images, quotes, or other personally identifiable research data will be used in these activities without my additional and explicit consent.		
11. No recognisable images, quotes, or other personally identifiable research data will be used in these activities without my additional and explicit consent. I understand and agree that my responses, views or other input can be quoted anonymously in research outputs, however.		
C: RESEARCH PUBLICATION, DISSEMINATION AND APPLICATION		
12. I understand that after the research study the de-identified information I provide can be used for publications, reports, or thesis.		
13. I agree that my responses, views or other input can be quoted anonymously in research outputs.		
D: (LONGTERM) DATA STORAGE, ACCESS AND REUSE		
16. I give permission for the de-identified data created through my contributions [e.g. anonymised summaries of focus group meetings written by researchers and similar data] that I provide to be indefinitely archived in the 4TU.ResearchData and/or Dataverse NL repository so it can be used for future research and learning. I understand that access to this repository is open to any future user under as Creative Commons license and according to FAIR standards.		

Signatures

Name of participant [printed]

Signature

Date

[Add legal representative, and/or amend text for assent where participants cannot give consent as applicable]

I, as legal representative, have witnessed the accurate reading of the consent form with the potential participant and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

Name of witness	[printed]	Signature	Date
I, as researcher, hav and, to the best of r freely consenting.	e accurately rea my ability, ensu	ad out the information she red that the participant un	et to the potential participant derstands to what they are
Hazal Deniz Kaya			20/03/2024
Researcher name [p	rinted]	Signature	Date

Appendix D: Workshop Document (Dutch)





Beste,

Ik hoop dat deze mail je goed bereikt.

We zijn verheugd u uit te nodigen om deel te nemen aan onze komende workshop over het gezamenlijk aanpakken van de dubbele uitdaging van de duurzaamheidstransitie in combinatie met vernieuwingsopgave van infrastructuur te realiseren. De workshop is georganiseerd voor een master thesis project aan de Faculteit Bouwkunde aan de TU Delft en als onderdeel van het ADEPT-onderzoeksproject, ondersteund door Next Generation Infrastructure (NGInfra). De workshop zal actoren binnen Rijkswaterstaat samen brengen die werken binnen vernieuwingsopgave / project-portfolio management (bruggen-sluizen-etc.)/ transities / innovatie / duurzaamheid – circulariteit – klimaat neutraal.

Workshop focus:

De dubbele druk van zowel de verduurzamingstransitie als de vernieuwingsopgave vraagt veel van huidige management systemen binnen, en buiten Rijkswaterstaat. Er zijn twee grote opgave waar Rijkswaterstaat voor staat, die onlosmakelijk met elkaar zijn verbonden:

- Vervangen en renoveren van verjaarde infrastructuur voor het behoud van een veilig, bereikbaar en leefbaar Nederland.
- Volledig klimaat neutrale en circulaire Rijksinfrastructuurprojecten in 2030

In combinatie kunnen deze worden gezien als één grote uitdaging, maar juist ook als een mogelijkheid tot vernieuwing, verduurzaming en innovatie

Tijdens de workshop zullen deelnemers meedoen aan een interactieve sessie. Hierbij worden verschillende <u>"extreme" scenario's</u> worden gepresenteerd, waarop de deelnemers reageren en handelen binnen hun eigen rol, belangen en waarden. Scenario's kunnen verschillende aarden hebben, zoals een duurzaamheidsoogpunt, markt benadering of financiële factoren, en zijn gebaseerd om toekomstige uitdagingen.

Een voorbeeld van zo'n scenario is: "Rijkswaterstaat moet (binnen 3 jaar) een circulaire asset management organisatie zijn."

We willen focussen op het begrijpen vanuit welke perspectieven en waarden men handelt onder de druk van zo'n scenario en hoe dit scenario het beste kan worden aangevlogen. Hierbij zijn we geïnteresseerd in zien hoe deze acties en prioriteiten vanuit een persoonlijk en professioneel oogpunt veranderen op het moment wanneer er integraal wordt samengewerkt onder druk. Door gezamenlijk na te gaan wat er moet gebeuren, waarom dat moet gebeuren en wie of wat daar voor nodig is, kan er een beeld geschetst worden van de nodige verandering richting dit nieuwe scenario.

Workshop structuur:

De workshop zal bestaan uit 3 delen per scenario:

1. Persoonlijk Perspectief

Hierbij zullen de deelnemers vanuit het eigen professioneel perspectief voorleggen wat zij nodig hebben – innovatie, wetgeving, criteria, etc. - om nu actie te nemen om het scenario te benaderen. Hierbij brengen formuleren zij het beste 'idee'.

2. Synergie

De 'beste ideeën' van de deelnemers worden verzameld. Deelnemers beargumenteren vanuit de verschillende perspectieven en prioriteiten hun eigen 'beste idee'. Door middel van een collectieve discussie wordt er één gezamenlijke aanpak gekozen.

3. Actie!

In het laatste deel zullen deelnemers binnen het 'beste idee' gezamenlijke oplossingen en actie punten identificeren om de uitdagingen van de scenario's en andere barrières aan te pakken. Ieder zal vanuit zijn eigen rol kunnen aangeven wat zij daarvoor nodig hebben.

Workshop details:

- Datum: Woensdag 11 December 2024
- **Tijd:** 13:30 17:00
- Locatie: TU Delft, Faculteit Bouwkunde, Julianalaan 134
- Er zal gezorgd worden voor eten en drinken tijdens de workshop

De workshop biedt een kans om vanuit verschillende perspectieven binnen Rijkswaterstaat te bekijken wat er nodig is om de strategieën voor zowel de transitie als de vernieuwingstaak in de realiteit om te zetten. Door het gebruik van scenario's streven we ernaar om onder druk de mogelijkheden uit te lokken en het potentieel voor collectieve actie en procesinnovatie te verkennen.

We horen graag of u er op 11 December 2024 bij kan zijn, en neem vooral contact op mocht u vragen hebben of verdere informatie zou willen krijgen.

We kijken uit naar uw deelname en wat een interessante en leerzame workshop zal worden!

Met hartelijke groet,

Hazal Kaya, PhD Kandidaat, Faculty of Architecture and the Built Environment, Design & Construction Management &

Emma van Dongen, Master Thesis Student, Faculty of Architecture and the Built Environment, MSc Management in the Built Environment



Appendix E: Context Activity System

Appendix F: Interview Data and Barriers

THEME	1st Order Construct	Sub Item	Illustrative quotes Barriers & Challenges	Organisational Culture	Governance Structure	Market & Financial	Operational & Technical	Temporary or External
WHAT (Object)	Sustainability Transition		"We hebben natuurlijk in 2030 moeten we klimaatneutraal en circulair werken en in 2030 is de vervangingsopgave, zeg maar. Dus je krijgt een heel groot spanningsveld de komende jaren." - (IV)		х	х		
			"Moet je daarmee dan je duurzaamheidsdoelen overboord gaan gooien, Omdat het dan nu toevallig even wat langer duurt." - (V)	x				
	Project Approach		"De verleiding is heel groot om er een op een te vervangen, want we weten dat hebben we al een keer gedaan. We weten hoe het moet, Het gaat waarschijnlijk sneller. Tegelijkertijd weten we ook dat dat niet de de, meestal niet de duurzaamste oplossing is om te doen en ook niet altijd de meest klimaatadaptieve" - (II)	x			x	
			"Die strategie van dat objectgericht bundelen per werksoort ja, daarmee daarmee accepteer je dus wel meer hinder." - (V)				x	
	Innovation		"Het is voor mensen in de productie heel lastig om ze kunnen wel vertellen wat er allemaal niet goed loopt, maar om dan de innovatie zodanig te formuleren dat daar een innovatief vraagstuk uit naar voren komt. Daar zit ook nog wel een soort vertaalslag in een. Wie doet dat dan?"		x			
zWHY	Ambition &		"We hebben het nog geen neer strak innovatieproces. (ii) "We hebben wel doelen, maar er wordt alleen per focuspunt of per thema wordt erop gestuurd,		x			
(Comm unity)	Demand		maar niet organisatiebreed." - (II) "We proberen heel erg in hoe we altijd hebben gewerkt. Een hele nieuwe wereld te maken." - (IV)	x	x			
			"Ja, alles moet nu snel snel, snel klopt, maar aan de andere kant, We hebben er ook al eeuwig lang over gedaan om überhaupt he. We schuiven het al zo lang voor ons uit. Hoezo moet het dan nu ineens zo super snel?" - (V)		x		x	
			In the unit wat the touch nog to wark eet in usualse is - (v) "Inkopers of contractmanagers zeggen dan: Ik wil best duurzame innovatief inkopen, maar dan wil Ik graag gewoon lets wat gewoon helemaal Kaar is. Dat ik weet wat ik kan verwachten en maar dat wingt hele ery met het hele idee van innoveren en je moet kunnen experimenteren ¹ - (IV)	x			x	
			"Je komt op een gegeven moment op moment dat je innovaties vanuit klimaatadaptatie moet afwegen ten opzichte van de andere Thema's en welke vind je dan belangrijker op welke zijn de innovaties met de meeste impact?"- (II)		х	x		
			"Als je heel duurzaam wil werken, kan het best kan best, wan ije hebt heel veel dingen. Beleidshaakjes project opstart formulieren dat kan best, maar dan moet je net even een tandje extra net even een dingetje verder willen gaan. En als jij niet heel intrinsiek bent gemotiveerd." - (IV)	x			x	
	Capacity		"Want in de infra sector heb je maar hele kleine marges, en als je daar ook nog van moet innoveren, dat is best wel lastig." (IV)			х		
			"We hebben de waterschappen, de provincie en Rijkswaterstaat natuurlijk. We zitten allemaal in dezelfde vijver te vissen." - (VII)				x	
			"Hoe gaan we dat doen? Allemaal schaars, mensen worden schaars, personeel wordt schaars." - (VII)			х	x	
			"We hebben echt heel weinig capaciteit om al die projecten uit te voeren. We hebben weinig geld om al die projecten uit te voeren en het moet ook allemaal duurzaam en snel." - (V)			х	x	
			"Maar met name gemeentes waar natuurlijk ook een heel groot deel van die van die opgave ligt. We hebben ook gewoonweg het geld niet om het te doen." - (II)		x	х		
	Cultuur		"Je ziet bij ons dat in ieder geval in in onze organisatie die die tactische laag niet goed geregeld is. Wij hebben geen kpi's. We proberen een lerende organisatie te zijn, Maar dat is heel lastig als we iets geleerd hebben in een project, dan blijft het heel lastig om dat in alle andere volgende projecten erin te krijgen." (II)	x	x			
			"Als je in je P gesprekken en in projecten word je afgerekend of word je gestuurd op budget en tijd en als er dan een project: kom, je kan liggers hergebruiken, maar het is wel twee keer zo duur en het kost ook wat meer tijd. Ja, als jij dan niet heel intrinsiek gemotiveerd bent dan en jij wordt daar niet heel hard op gestuurd?- (IV)	x				
			"Wij worden als overheid niet aangestuurd op budgetten, Maar de markt weer wel heel erg en uiteindelijk zit daar waarschijnlijk ook een directie die gewoon winst wil maken." - (IV)			х		
	Practice Principles		"Want de cultuur zit gewoon niet heel erg KPIS." - (IV) "Er zit toch een soort een spanningsveld tussen hoe we altijd hebben gewerkt en die	x				
WHO	Stakeholder	Organisational	experimenteren en duurzaamheid. Dat past gewoon niet in hoe we zijn getraind hier." - (IV) "We zijn georganiseerd in aantal landelijke onderdelen 7 regio, is heel belangrijk hoe jij integraal	×				
(Subject)	Engagement	level	naar alle die thema kijkt, omdat soms kijken ze alleen vanuit het belang van hun interne organisatie onderdeel." (III) "Dat is het verschit tussen de asset manager. die echt in de productie zit en de innovatiemanagers		x		x x	
			die bezig zijn met de projecten die samenwerking, die is niet goed." - (II) "Ik denk dat die verbinding met een afdeling als een WVL zo belangrijk is, want zij krijgen vanuit het ministerie een bepaald budget en mogen ze allerlei onderzoeken vooruitzetten. Maar ja, wij moeten		x			
			wel weten wat daar gebeurt." - (IV) Wat bij ons grote uitdaging is om lange termijn in de korte termijn bij elkaar te brengen (II)		x			
		0	"Wat ik heel belangrijk vind is dat degene die het innovatieproces doen. Niet per definitie ook de beste personen zijn om het opschalingsplang gedetet voor rekening te nemen. Daar heb je andere drijfveren voor nodig dan andere waarden als persoonlijke drijfveer." - (II)		x			
		Agencies	Zeker mensen die bijvoorbeeu in meisaan o in Limourg on in Zeevand werken, die zijn gewoon die regio. Dus die die hebben een binding met de kunstwerken daar en niet zozeer met de rest van het land." (V) "Marzue hebben die more on dool en die matte stie die heber in oeit matteratien teise one	x	x			
			read we neuber usion make een kan use marks. En uarmong eou markspangen tegen use zeggen: 1a, dat is allemaal leuk dat julie dons woorschrijven. Maar ja, bij hoeven dan niet van de gemeente of van het waterschap of van de provincie". (VII) "Er dreist concurrent nou. die is er woor een deel al. concurrentie te onstaan tussen de		x	x		
			opdrachtgevers en als gevolg van schaarste." - (VII)		X	х		
		Markat	moet om het probleem dat we hebben in Nederland op te lossen." (VII)		x			
		FILING	bepaalde investeringen." (V) "Wat we worramelik altiket terugkristen is dat marktanation juist consideration dat to bet const			x		
Marchi	Daliau A		wat we voornamen hat hat de rugkrijgen is dat mark parigen just aangegeven dat ze net seper irritant vinden dat het elke keer weer verandert en dat we geen duidelijke lijn hebben." - (V)		x	х		
(Rules)	Regulations		*Kjk ook nu met net nuidige kabinet kunnen we denk ik wel stellen dat dat die verschuiving van focus weer helemaal terug bij af is." (V)					x
			wy килиен ujna niet met een party aan oe stag om samen te innoveren. Omdat dan al heel snel de de aanbestedings en de medelingingswetgeving zegt: 'Ja je bevooroordeeld hier een partij boven andere." (II)				x	x
			"IK wat IK zett echt lastig vind in zo een politiek gestuurde organisatie is dat je gewoon heel erg afhankelijk bent van de grillen van het kabinet." - (V)					x
			"We zijn best wel een een organisatie van eisen en processen en werkwijze werkwijzeers en die staan ons denk ik best wel vaak In de weg." - (VI)			x	x	
			"Dus de kaders botsen nog met de wensen die we hebben of de verwachtingen die we hebben als het gaat over duurzaam werken." - (VI)	х			x	

Table F.I. Interview data and barrier relation.

Decision- making	"Je ziet gewoon dat in de projecten komt alles samen en dan is het gewoon heel fijn om te kunnen zeggen van. hé dit, dit heeft prioriteit voor." - (VI)		х			
0	"Maar op het moment dat je verder gaat met opschalen heb je een ander financieel potje nodig en is er		х	х		
	"Maar dat de manier hoe je kijkt verschilt. Dus somnige mensen hebben het hele land in inzicht en andere mensen hebben gewonn hun project waar zij on dat moment aan werken in zicht en andere		x			
	mensen hebben een bepaalde regio in in zicht." - (V)		~			
	"Waar we intern tegenaanlopen is dat besluitvorming niet altijd duidelijk is." - (II)		Х			
	"Voor een deelis het volgens mij ook de aansturing, dus de aansturing is ook wel regionaal versnipperd." -		~			
	(V)		^			
	"Ik denk wat er nu gebeurt, is dat er niet hele duidelijke nieuwe lijn hebben gekozen." - (V)		х			
Implementatio n & Process	"Wij hebben op het strategische niveau geen innovatie board of innovatie beraad of iets dergelijks die als het vastloopt of op doelen stuurt." - (II)	x	x			
	"Dat is voor hè om voor verschillende values ook heel belangrijk dat mensen, gebruiker, kunnen					
	herkennen van waarom doen we dit en waarom zitten die vertragingen? Waarom sta ik langer In de file of				х	
	Waarom kan ik de tunnel niet onderdoor?"(V)					
	voldoen als je kiikt naar duurzaamheid?" (VII)		х		х	
	Bij aanleg is standaardiseren niet zo'n probleem, maar bij vervanging en renovatie is dat nog niet zo					
	makkelijk."(VII)			х	х	
	"Mijn persoonlijke mening is, is dat dingen teveel spreid zijn he? Dus, en dan doen we een onderwerp en	v				
	er zit op 10 plekken binnen Rijkswaterstaat." - (VII)	x				
	"Omdat een keertje uitproberen. Dat kan allemaal hè? Pilot dingen, Dat is allemaal niet zo'n probleem,		x		x	
	maar die opschaling is wel vaak een probleem." - (IV)		~		~	
	"We hebben 9000 Mensen zijn. Ze werken niet alle 9000 op projecten, Maar het wel heel erg veel. En hoe		v			
	ja, noe zoig je ei dan voor dat de informatie goed van de ene naar de andere plek gaat? Ja, dat volgens mij		^			
	"Als ie kijkt naar de programmering van projecten, dus wanneer gaan we welk project aanpakken, dat we					
	daarin nog eigenlijk heel weinig samenwerken." - (VI)	x				
	"Maar dan vervolgens moet je al die kaders gaan aanpassen om te zorgen dat dat je het kan opschalen en	v	~			
	dat is vak vaak wat wij, en volgens mij heel veel organisaties, vergeten te doen." - (VI)	^	^			
Responsibility	"Een probleem in bredere zin is dat echt sturen. Echt harde afspraken maken en echt afrekenen, hê? Dus zeggen van dit resultaat is niet naar behoren. En iemand op het matje roepen, daar zijn we nog niet zo heel sterk in en dat geldt voor duurzaamheid. Maar eigenlijk geldt dat wel voor meer dingen in onze organisatie". (VI)		x			
	"Er zijn nu nog allerlei groepjes die wel de taak hebben om prioriteiten te stellen. Op regionaal niveau maar dan zijn er dus weer andere groepjes die dat op landelijk niveau doen. Die die komen dan Natuurlijk weer net tot een ander lijstje." - (II)		x			
	"De besluiten zijn zo complex. Dat komt allemaal samen bij bij een directeur of iets dergelijks, maar die krijgt dan zoveel facetten waar hij over moet gaan besluiten, terwijl die de achtergrondinformatie daar misschien helemaal niet over heeft"- (II)		x			
	"Dat zijn echt mega projecten dat je ja, dat kan je niet aan de portfolio manager overlaten. Die moet dan niet eens willen." - (VII)		х		х	
	"Alleen, hoe ga je het verbinden? Hoe ga je het verbinden met anderen?" - (VII)		X			
	"We zijn denk ik bij de overheid en bij het rijk nog meer dan bij gemeente het wel gewend om gewoon de regie in handen te houden. En we vinden het nog wel heel erg spannend als andere entiteiten of organisaties of belangengroepen. Ons gaan helpen met met oplossingen, terwijl we daar dan niet meer helemaal de regie over hebben." - (V)	x				
Dependency	"We hebben ook een hele hoop kader beheerders en die moeten gewoon eigenlijk tijd maken om zo nu en dan met ons het gesprek te voeren over waarom een kader iets moet worden aangepast en hoe we dat kunnen doen. En hetzelfde geldt voor een aantal technisch specialisten." - (VI)	x			x	