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MASTER THESIS

What If We Were Ready for Climate Adaptation?

Institutional Prefiguration and the Mainstreaming of Climate
Adaptation in Urban Built Infrastructure

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Marthe Meijer

Abstract

This research examines how institutional prefiguration can contribute to mainstreaming climate adaptation in urban built infrastructure in the Netherlands. Although technical capability and societal urgency have increased over the last decade, a persistent implementation gap remains: climate adaptation is recognised as necessary, but is not yet consistently embedded in infrastructure governance and delivery. This thesis asks how anticipatory, forward-looking forms of institutional action can help close this gap.

Using a multi-method approach centred on the renewal of Amsterdam's quay walls and bridges, and complemented by the Hofplein redevelopment in Rotterdam, the research unfolds in three phases. First, it identifies the factors that have shaped adaptation mainstreaming through interviews with public and private actors. Second, it examines how prefigurative practice unfolds in present-day projects and how this affects implementation. Third, it operationalises institutional prefiguration in an agent-based model to explore its contribution to institutional change.

The findings show, first, that fragmented responsibilities, limited ownership, and an ambiguous problem definition recur across public and private actors. Second, institutional prefiguration unfolds most consequentially above the individual project level, where anticipation of future requirements is supported programmatically and carried into implementation by boundary spanners operating across project phases and institutional boundaries. Third, the modelled what-if scenarios suggest that institutional prefiguration contributes not through coercion, but by changing the rule actors default to: it enacts a future institutional reality before it is formally mandated.

The thesis concludes that institutional prefiguration cannot by itself force a full regime shift, but it can prepare and partially enact one. In this sense, becoming ready for adaptation does not mean waiting for future regulation to arrive; it means governing, procuring, and building as if that future had already become the rule.

Keywords: institutional prefiguration, climate adaptation, mainstreaming, urban built infrastructure, anticipatory governance, institutional modelling

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List of Abbreviations

Abbreviation	Definition
ABM	Agent-Based Model / Agent-Based Modelling
ABDICO	Institutional Grammar components: Attribute, oBject, Deontic, alm, Condition and Or else
AI	Artificial Intelligence
AMS Institute	Amsterdam Institute for Advanced Metropolitan Solutions
ATLAS.ti	Qualitative data analysis software used for coding and thematic analysis
BAM Infra	Infrastructure division of Royal BAM Group
DPRA	Delta Programme for Spatial Adaptation / Deltaprogramma Ruimtelijke Adaptatie
ECI	Environmental Cost Indicator
GRP	Gemeentelijk Rioleringsplan / Municipal Sewerage Plan
IG	Institutional Grammar
IP	Institutional Prefiguration
IPCC	Intergovernmental Panel on Climate Change
IPK	Innovatie Partnerschap Kademuren / Innovation Partnership Quay Walls
MIRT	Meerjarenprogramma Infrastructuur, Ruimte en Transport / Multi-Year Programme for Infrastructure, Spatial Planning and Transport
MLP	Multi-Level Perspective
NAS	National Adaptation Strategy / Nationale klimaat Adaptatie Strategie
NbS	Nature-based Solutions
NUP KA	Nationaal Uitvoeringsprogramma Klimaatadaptatie / National Implementation Programme for Climate Adaptation
ODD	Overview, Design concepts and Details protocol for documenting agent-based models
PBK	Programma Bruggen en Kademuren / Programme Bridges and Quays
PBL	Planbureau voor de Leefomgeving / Netherlands Environmental Assessment Agency
PMC	Product Market Combination
PoR	Programme of Requirements
UNESCO	United Nations Educational, Scientific and Cultural Organization
V&OR	Verkeer & Openbare Ruimte / Traffic and Public Space, treated in the model as the municipal approval actor
WKP	Water- en Klimaatadaptatieprogramma / Water and Climate Adaptation Programme

1. Introduction

1.1 Background and Context

One of the biggest challenges of our time is climate change, which is leading to a wide array of impacts, including extreme weather events, biodiversity loss, and food and water scarcity (Goncalves et al., 2025). Extreme climate events, such as heat waves, torrential rain and floods, highly impact cities and are expected to increase in frequency and severity (IPCC, 2022). This growing risk threatens our society, economy and environment: to guard the vitality and robustness of these three, climate adaptation (hereafter, adaptation) is imperative (Mendes et al., 2020).

At the same time, the urban population is projected to reach 70% globally in 2050, whereas Europe has already reached that level (UN, 2025). In Europe, urban areas are vulnerable to the challenges posed by climate change, particularly due to factors such as construction density and ageing grey infrastructure. Built infrastructure designed to serve for a long time (e.g. quay walls and bridges) is at particularly high risk as it will still be in use in the coming decades and might be affected by increasingly extreme climate change conditions (Giordano, 2012). This is concerning because the failure of built infrastructure profoundly affects daily life, disrupting logistics, emergency services, waste collection, work, and social interactions.

Within Europe, the Netherlands is at high risk. It is one of the most densely populated countries worldwide and a delta country, increasing its climate vulnerability (Claassens et al., 2020). Failing infrastructure in this region can turn climate impacts into disasters. In a system this dense and interconnected, failures rarely remain isolated: they cascade across networks that many people rely on simultaneously. This can turn a local breakdown into a society-wide disruption (Deltares, 2026).

1.2 Problem Definition

A major issue is that although the urgency of adaptation is stressed throughout many studies over the last decade (Alves et al., 2024; Baack et al., 2024; IPCC, 2022), a substantial gap persists between adaptation capability and local implementation (IPCC, 2022). Over 10 years ago, Eisenack et al., (2014) already mentioned this in their influential paper on adaptation barriers, “Implementation of adaptation is not keeping pace with the ever-increasing need: the ‘adaptation deficit’ is getting wider” (p.867). In practice, the implementation gap affects a wide range of actors: residents face a growing flood risk and heat stress, municipalities bear increasing fiscal and legal responsibility, and infrastructure providers face greater uncertainty, asset vulnerability, and liability. This means that adaptation unfolds within a multi-actor system, involving public and private actors.

Due to the local nature of the impacts of climate change, local adaptation responses are essential, underlining the importance of public and private collaboration at a local level (Baack et al., 2024). Over the last few years, the importance of municipalities and local actors in adaptation has significantly increased. This notion has gathered broad consensus today, already stated in 2014 by the 5th IPCC report: “Local government and the private sector are increasingly recognized as critical to progress in adaptation” (IPCC, 2014, p.19).

Paradoxically, in the domain of land-use policy and long-term spatial planning, the role of local governments has shifted from active participant to a more strategic, facilitative and regulatory institution in recent years (Ten Brinke et al., 2022), even as their function becomes increasingly important. This is not to say municipalities have become completely passive, they remain highly active on fronts such as emission-free construction and nature-inclusivity, but their steering role in land development specifically has eroded. In the Netherlands, for instance, the active municipal role in Dutch spatial planning has been traditionally celebrated for its effectiveness, but over the last few decades it has weakened (Buitelaar et al., 2025). Since the mid-1990s, neo-liberal privatisation has led to a more market-driven land policy that prioritised short-term interests, such as crisis management and housing shortage, over long-term interests, such as adaptation (Buitelaar et al., 2025).

This development is problematic because the private business case for adaptation is uneven. In the housing market, for instance, green and adaptive neighbourhoods bring an increasingly competitive benefit. Yet, in other sectors, particularly in urban built infrastructure, the benefits of adaptation are primarily societal, or felt by parties other than the ones bearing the cost, reducing the incentive for private actors to invest in it. This thesis defines urban built infrastructure as the essential engineered physical structures and systems that enable daily urban life, including everything from public transport and utilities to the buildings where people live, work, and gather. Climate-adaptive urban built infrastructure specifically refers to these systems that are designed, retrofitted, or managed to withstand and respond to the increasing frequency and severity of climate-related extremes while remaining functional across its long service life (European Commission, 2021). Whereas mitigation tries to alter the road to climate change by reducing or preventing the emission of Green House Gases (GHG), adaptation anticipates on the adverse effects climate change will bring (European Environment Agency, 2024). This includes either minimising or preventing the expected damage of current and future effects.

Despite growing awareness in the private sector of the essential role of adaptation, its explicit inclusion in large projects lagged behind (Ten Brinke et al., 2022). Although room for adaptation has begun to widen in practice lately, its uptake stays inconsistent and is seldom embedded as a standard requirement (Dorst et al., 2026). Consequently, responsibility for adaptation perpetually falls between two stools, claimed by neither the profit-oriented private sector nor an increasingly facilitative public one. This dynamic, together, intensifies urban vulnerability as market-driven planning persists and leaves long-term risks unaddressed.

An essential part of implementation is “mainstreaming”, a specific strategy for translating adaptation into tangible policies, programmes and processes, and implementing them locally (Ten Brinke et al., 2022). Climate mainstreaming is even seen as pivotal to mobilise private and public actors towards sustainable urban development (Wamsler & Osberg, 2022) and therefore is a significant factor in improving adaptation implementation. In urban contexts, this integration often occurs through spatial planning, where long-term decisions about land use and urban form are made. Accordingly, a substantial body of literature has identified general barriers to incorporating adaptation within spatial and urban planning (Dorst et al., 2022; Eisenack et al., 2014; Reinwald et al., 2024). These studies show that adaptation remains difficult to implement in practice due to a fragmented legal framework, limited enforceability of commitments, and

inconsistent local application, particularly where local authorities face limited powers and resources (García-Blanco et al., 2025).

The core tension of this study is the implementation gap: despite broad recognition of the urgency of adaptation and the technical capability to deliver it, translation into concrete action remains inconsistent and lagging in urban built infrastructure. Closing this gap depends not only on technical and financial capabilities but also on actors' capacity to anticipate institutional change and adjust their practices accordingly. Consider the renovation of a city bridge, on hot days it has to be sprayed with water to stop its steel expanding. Under current practice it is built to today's norms: concrete, asphalt and a specific brick pattern, still dependent on that same spraying ritual, only now intensified by future heat waves. If, instead, the actors involved anticipate future conditions and adaptively renovate, choosing heat-tolerant materials for instance, the bridge withstands the heat by design. Public and private actors may revise their strategies, design choices, and decision-making in anticipation of future (regulatory) conditions: understanding how such anticipatory dynamics emerge is therefore essential to exploring how adaptation could become structurally embedded within urban infrastructure.

1.3 Analytical Perspective

Mainstreaming can be done in multiple ways, but one of the most relevant ideas for this paper is institutionalisation: embedding the mainstream by shaping it (Baack et al., 2024). As such, mainstreaming is a way to incrementally reform the institutional configuration into a new status quo, the mainstream. Institutional change usually happens incrementally, in a setting where actors are allowed to experiment with anticipated changes.

One way of understanding institutionalisation is through prefiguration: “the act of performing in the present what the future society can be” (p.146) (Savini, 2025). This approach to institutionalisation forms a type of prefigurative politics called institutional prefiguration. In this study, the choice of institutional prefiguration is relevant because it enables the analysis of the anticipatory processes essential to mainstreaming climate-adaptive urban infrastructure. Drawing on transition studies and socio-technical theory, institutional prefiguration challenges the traditional 'state-centric' view that change must be initiated by existing institutions. Instead, it suggests that radical change is instantiated through practice by, for instance, innovative engineers who anticipate a future society at a micro level. Through the creation of experimental environments, the desired 'ends' are embodied directly in the 'means' of present-day action (Törnberg, 2021). This study explores how private and public actors, with a focus on infrastructure actors, anticipate a future in which climate adaptation is fully mainstreamed.

To understand anticipation, this study draws on Cooper's (2020) version of 'as-if' prefiguration: the enactment of a preferred set of conditions, norms and possibilities as though they were already in place. Preferred here refers to adaptation mainstreaming. Building on that logic, this thesis introduces the 'what-if' framing: it asks what dynamics would emerge if adaptation were already fully mainstream and what institutional prefiguration could mean for adaptation tomorrow. Accordingly, the thesis explores what would happen if we imagined a future in which adaptation is mainstream, and how this could contribute to preparing urban built infrastructure for the future. The thesis thus shifts from diagnosing the implementation gap to exploring, anticipatorily, how it might be closed.

1.4 Research Relevance

This study contributes to a multidisciplinary metropolitan challenge at the intersection of adaptation, mainstreaming and institutional change. Mainstreaming adaptation into urban built infrastructure is a multi-actor governance challenge, with fragmented responsibilities between public and private actors, leading to complex decision-making and diffuse accountability. Scientifically, while a substantial body of research on adaptation barriers exists (Biesbroek et al., 2013; Eisenack et al., 2014; Runhaar et al., 2018), comparatively little work explores anticipatory institutional change and prefigurative approaches within climate adaptation, and specifically as a strategy to close the implementation gap. In doing so, this research not only addresses the substantive challenge of mainstreaming adaptation in urban built infrastructure but also responds to a methodological gap in the literature, where forward-looking and anticipatory approaches remain underdeveloped.

Moreover, although mainstreaming methodologies, frameworks, and approaches are expanding, there has been little academic research on institutional prefiguration in mainstreaming adaptation governance. This research addresses this conceptual gap by treating institutional prefiguration as an institutional driver for adaptation governance, which could potentially ignite radical institutional change.

Lastly, but perhaps most urgently, this study responds to a pressing societal challenge: the persistent deflection of adaptation responsibilities between private and public actors. In the absence of clear ownership, adaptation is repeatedly postponed, deepening the vulnerability of current and future generations.

1.5 Research Context

The metropolitan context of this study is examined empirically through analysing public-private interactions within the sector of urban built infrastructure in the Netherlands. In particular, the thesis draws largely from the case study of Amsterdam's quay wall and bridge project, which requires large-scale renewal and renovation due to overdue maintenance. This is complemented by a secondary case study on the renovation of Hofplein in Rotterdam, a different context but similar challenge. In these dense realms, climate risk, infrastructure lock-ins, and public-private collaboration intersect. The cases involve multiple disciplines, as they are not merely technical design problems but require coordination among asset management, legal, finance, engineering, ecology, and leadership. Additionally, both cases are characterised by temporal tension arising from their long asset lifetimes (100-200 years), which combine with short-term procurement logic and long-term climate risk. Therefore, the cases are well-suited to exploring how the actors involved collaborate and anticipate climate-adaptive urban infrastructure.

This thesis is also anchored in a collaboration with The Royal BAM Group, specifically BAM Infra. The research emerged from the implementation gap experienced by practitioners at BAM Infra. The Royal BAM Group has committed to integrating climate-adaptive measures into all infrastructure works by 2030 (BAM Royal Group, 2023), making it both a relevant private actor in this case and a host organisation that provides direct access to project documentation, internal practitioners, and tender processes. Building companies such as BAM are challenged to protect their assets against climate change, as the effective life expectancy of infrastructure works

(originally engineered for milder conditions), shortens under intensifying heat waves and water exposure.

1.6 Research Aim and Focus

Ultimately, this research aims to improve the integration of adaptation into spatial planning processes and to help close the implementation gap in adaptation mainstreaming. It asks a simple but powerful question: *what if we were ready for adaptation?* In engaging with this question, the study seeks to understand the role institutional prefiguration can play in transformative institutional change, and to assess its contribution to mainstreaming adaptation. In doing so, it offers insight into an anticipatory, forward-looking approach in which adaptation is addressed in the present rather than postponed to the future.

Scientifically, the study addresses the research question of:

How can institutional prefiguration contribute to the mainstreaming of climate adaptation in urban infrastructure governance? It does so by answering three sub-research questions, each focusing on different temporalities. First, addressing past experiences, the thesis asks:

What factors do public and private actors identify as influencing climate adaptation mainstreaming in Dutch urban infrastructure projects? Addressing the present, it subsequently asks:

How does institutional prefiguration unfold in innovative urban infrastructure projects, and what is the effect on implementing adaptation? Finally, it looks into the future, asking:

How can institutional prefiguration be operationalised within a concrete case and what does this reveal about how institutional prefiguration drives institutional change in urban built infrastructure?

The research is structured in several steps. First, it outlines the policy environment to establish the institutional context. Second, it presents the theories and builds a conceptual framework that will serve as the backbone of the study. Third, it defines the empirical baseline by identifying factors influencing the mainstreaming of adaptation among public and private actors. Fourth, it examines where and how prefigurative institutional behavior is already evident in practice. Fifth, it explores future ‘what-if’ scenarios by operationalising institutional prefiguration to a specific case. Sixth, it discusses the outcomes within the context of existing academic debates. Lastly, it summarizes the key findings and provides answers to the research questions.

2. Policy and Regulatory Context

Before turning to how adaptation is analytically viewed in this thesis, it is necessary to map the policy and regulatory landscape that frames it. As set out in the problem statement, the persistence of the implementation gap is intertwined with the voluntary, non-binding character of adaptation policy. This section traces this character across international, national and local levels of policy and regulation, illustrated in Figure 1.

During the UN Climate Change Conference (COP21) in 2015, the legally binding Paris Agreement was adopted by 195 parties to combat climate change. A central component of this international treaty is the Global Goal on Adaptation, to support adaptation measures. The overarching goal is to limit global warming to 2 degrees Celsius (UNFCCC, 2026). Closely related is the UN 2030 Agenda for Sustainable Development, which grounds adaptation planning in the United Nations Sustainable Development Goals (SDGs), especially SDG 13, Climate Action. These goals have helped set the universal adaptation agenda and have stimulated action over the last few years (United Nations, 2015).

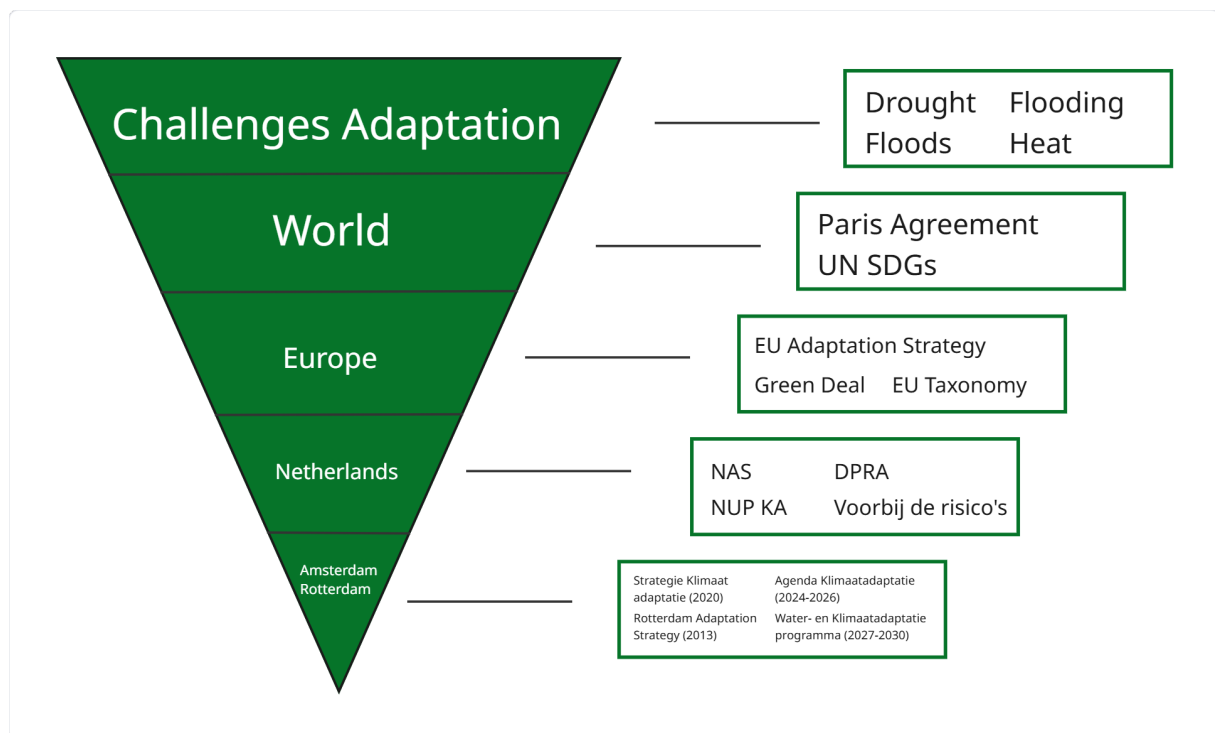


Figure 1: Policies, Regulations and Reports Relevant to Thesis' Scope

In Europe, efforts are further aligned with the Paris Agreement through the adoption of the EU Adaptation Strategy, which aims to make Europe climate-resilient by 2050. This strategy aims to activate member states through smart, fast, and systemic operations, but without being legally binding, thereby influencing only legislation and funding adaptation measures (García-Blanco et al., 2025). Europe's adaptation framework is reinforced by the Green Deal, which has set binding targets in sectors such as the built environment by, for instance, influencing public and private investments. In addition, the EU Taxonomy was established in 2022, a system that classifies and scientifically assesses companies' economic activities in terms of sustainability. Although the EU

Taxonomy is not binding, the publication of economic activities is a big incentive for real estate and building companies to improve their sustainable practices (DGBC, 2025).

In addressing adaptation in the Netherlands, two programmes have been established: Nationale klimaat Adaptatie Strategie (NAS) and the Delta Programma voor Ruimtelijke Adaptatie (DPRA). The first is the overarching Dutch strategy, which outlines the climate risks we face. The latter is developed by national, regional, and local authorities to address the consequences of climate change. This plan emphasises, among other things, that all parties involved should collaborate closely to improve the Netherlands' climate resilience and adaptation (Ten Brinke et al., 2022). The DPRA has set the goal of building a water-robust and climate-resistant spatial planning, through focusing on waterlogging, heat stress, drought and sea-level rise (Mesdaghi et al., 2022). As of 2021, the Dutch government has identified climate adaptation as one of the 5 biggest challenges of this time in the National Environmental and Planning Strategy (Gemeente Amsterdam, 2020b).

The national strategy is further aligned in the Nationale Uitvoering Programma Klimaatadaptatie (NUP KA). This execution program sets the approach and accelerates measures towards sector-specific adaptation in the Netherlands. To safeguard an adaptive and resilient infrastructure, it is vital to understand future scenarios and their implications for design criteria, risk management, and the management and maintenance of infrastructural works (Rijkswaterstaat, 2024).

In request of the ministries involved with the National Climate Adaptation Strategy (NAS), the Netherlands Environmental Assessment Agency (PBL) published *Voorbij de risico's: Keuzes voor een klimaatbestendige leefomgeving* in March 2026 as a revision of the NAS and a reassessment of the Delta Decisions (PBL, 2026). The conclusion of this report is unmistakable: the changing climate will increasingly affect everyone and everything. There are ways the Netherlands can prepare itself, but it requires fundamental choices to be made immediately. The PBL states that the central decision here is to do everything in a climate-adaptive manner: in other words, every investment or adjustment planned for the coming years should reckon with the consequences of climate change (PBL, 2026). The two possible directions we can take are to intensify or to transform. The first direction allows society to perform the same activities in the same locations as it has always done, relying on technical innovations that will keep us cool and dry, such as stronger dikes, better pumps, and air conditioning. Thus, intensifying the current policies and governance with fast but short-term relief. The latter direction will adjust the country to the changing climate and transform it to the natural (old) situation. Here, society will be better prepared for the unknown and uncertain future scenarios through, for instance, more greenery in cities and space for rivers to overflow. This will create a less vulnerable, more robust environment in the long term but will also increase complexity as it will challenge the logic of the existing institutions (PBL, 2026).

It can be concluded that these policies and regulations share high ambitions, green goals, and strong incentives, but also a common absence of legal binding and regulatory force. Only the Paris Agreement constitutes a legally binding international treaty, yet it follows a 'hybrid' approach under international law (Bodansky, 2021), whereby individual countries may determine their emission targets, for instance, voluntarily. The fragility of even this binding instrument was exposed when the United States, the world's second-largest carbon emitter, withdrew from the Agreement on 27 January 2026 (The Guardian, 2026). This withdrawal not only represents a

shifting global political climate, it lays bare the enforcement gap that runs through adaptation policy as a whole. From the Paris Agreement down to local implementation, the governance of adaptation rests on a cascade of voluntary instruments, ambitious in aspiration, but rarely binding. Confirming that adaptation policy is encouraged everywhere but enforced nowhere. For urban built infrastructure, this holds great significance: when no rule enforces the uptake of adaptation in the contract, it is dependent on the voluntary, individual choices of actors, resulting in fragmented responsibilities and lagged implementation. Consequently, this supports the thesis prefigurative direction: if there is no binding regulation yet, closing the implementation gap may depend less on waiting for this regulation to arrive than on actors anticipating and enacting such rules before they are mandated.

3. Conceptual Framework

This chapter sets out the conceptual framework through which the thesis examines the central problem in two parts that should be read as lens and object. The first (3.1) is the analytical lens through which institutional change is understood, built from transition theory, socio-technical theory, the Multi-Level Perspective (MLP) and institutional prefiguration. The second (3.2) is the object or concept the lens targets: mainstreaming adaptation, consisting of the definition, identified barriers and strategies to overcome these barriers. The two parts are directly connected: the analytical lens locates the implementation gap at the regime level but does not provide what the resistance towards mainstreaming consists of. The literature on mainstreaming provides this knowledge.

3.1 Analytical Lens: Transition, Socio-Technical Theory, MLP, IP

The focus of this study is the implementation gap and the role institutional prefiguration can play in closing it through mainstreaming. Closing this gap is inherently a matter of institutional change. The implementation gap persists even though adaptation is technically achievable and broadly recognised as urgent: the obstacle is therefore not a missing capability or absent funding, but the rules, routines and divided responsibilities that govern how infrastructure is commissioned and delivered: addressing this gap means reconfiguring institutions. It is thus important to outline which theory this thesis adopts to understand institutional change, how the thesis conceptualises the implementation gap, and by what mechanism this is examined.

3.1.1 Transition Theory and Socio-Technical Transitions Theory

During the 1990s, the literature on transition studies grew: these studies try to understand why innovations were not allowed to enter the market, whilst the societal benefits were undeniably demonstrated (Kemp et al., 1998). Scholars at this time highlighted the importance of ‘niches’, protected spaces where early-phase innovations could grow without being rejected by the incumbent socio-technical regime or subject to market competition (Törnberg, 2021). In response to this, socio-technical change theory has developed to describe the stages through which technical innovations diffuse across society.

The overarching element of transition theories is the understanding of technical innovations as deeply interconnected, complex systems continuously shaped by social and cultural values and practices, making them socio-technical innovations. The interdependence between technologies and society often hinders the spread of novel technologies due to concepts such as path dependence and lock-in (Geels, 2005), a dynamic often seen in infrastructural projects. At the same time, however, this interdependency gives a viable innovation the power to radically challenge or change the incumbent socio-technical regime, by the cascading effect one innovation can have on the system as a whole.

3.1.2 Multi-Level Perspective

As this study treats adaptation as a socio-ecological-technical challenge which sits within one incumbent regime, a brief outline of the MLP by Geels (2005) is warranted. This interpretation of the MLP is inspired by the work of Törnberg (2021) which approaches institutional change by

distinguishing interactions between three analytical levels: landscape (macro), regime (meso), and niches (micro).

The landscape (macro) refers to broader external developments that put pressure on existing systems. In this study, the socio-political context at this level includes, for instance, escalating climate change, geopolitical conflicts, evolving European regulation, and, prospectively, increasing societal expectations of mainstreamed adaptation. These developments challenge current infrastructure practices and may open windows of opportunity for institutional change. This could happen, for instance, due to a severe, prolonged drought in the Netherlands. This will result in high economic impacts when shipping is disturbed, but will also disrupt other areas in society since roads and rail cannot withstand drought for too long due to land subsidence (Deltares, 2026). These landscape changes may open a window of opportunity by revealing shortcomings in current infrastructure practices and thereby pressuring the regime.

The regime (meso) encompasses not only the formal institutions and organisations in the current system but also the broad institutionalised acceptance of rules, norms, values, structures, actor networks, and infrastructures that stabilise it. In urban built infrastructure, this includes established procurement practices, contractual norms, engineering standards, and financial norms that help maintain stability. These regime structures generate path dependency and help explain the persistent implementation gap in adaptation. This is seen for instance through the lowest-price procurement logic often seen in infrastructure projects. Clients use it because it is standard and defensible, contractors organise their bidding around it, and the whole market is structured to reproduce it, but it can lock out collaborative, adaptive contracting even where it would deliver better outcomes.

Niches (micro) are protected, free spaces where alternative practices and innovations can emerge. In the context of adaptation, this includes, for instance, pilot projects, prefigurative behaviour or climate-adaptive experiments in housing cooperatives. Such niches enable learning and experimentation that may, under sufficient landscape pressure, challenge or reconfigure the regime.

Recently, scholars in this field have called for an even broader approach to the social element of socio-technical innovation, including innovations such as the sharing economy and, in this case, adaptation (Törnberg, 2021). A recently published article on mainstreaming Nature-based Solutions in the infrastructure sector concludes with the key insight that NbS should be regarded as part of a broader socio-ecological-technical system rather than isolated interventions to pursue a more integrated form of governance, planning and assessment (Dorst et al., 2026).

In this thesis, the MLP is used to identify the implementation gap at the regime level, with adaptation pilots positioned as niches under landscape pressure. Drawing on this approach, the study treats climate-adaptive infrastructure not merely as a technical challenge but as an innovation towards a future consisting of new rules, social practices, and institutional relations. This approach opens space for an anticipatory form of institutional dynamics, which explains how institutions act “what-if” a new, alternative reality already exists. In this thesis, *what if we were ready for adaptation?*

3.1.3 Institutional Prefiguration

In a broad sense, prefigurative practices represent changes in the way things are done. This can happen in two ways: the *reformatory* way follows the logic of the incumbent regime and thus does not challenge the existing institutions. The *radical* way provokes the current rules, social practices and institutional relations deeply (Törnberg, 2021). This radicality is connected to the transformative direction of adaptation, described in Chapter 2.

This study will explore the role that institutional prefiguration can play in transformative institutional change and assess its contribution to the mainstreaming of adaptation. Therefore, it is useful to further elaborate on the definition of prefiguration and how it is understood in this thesis. The contributions of prefiguration on institutional change will be researched through the following definition:

“to prefigure is to anticipate or enact some feature of an ‘alternative world’ in the present, as though it has already been achieved.” (Yates, 2015, p.4)

This goes beyond the classic definition, coined by Carl Boggs, that prefiguration is a form of political practice in which the means to reach the ultimate goal should always reflect the ends (Boggs, 1977). The study focuses on the adapted ‘as-if’ version of prefiguration in which “a preferred set of conditions, facts, possibilities and norms are enacted (or assumed to be already in place)” (Cooper, 2020, p.895).

This study uses institutional prefiguration as an analytical lens to explore how adaptation could become mainstream within urban built infrastructure and thereby directly address the implementation gap described in the introduction. Further, the thesis seeks to identify prefigurative practice in urban built infrastructure. Therefore, it is valuable to outline how institutional prefiguration unfolds in reality, what shape it takes, and to explore different kinds of ‘what-if’. Drawing on Cooper’s (2020) definition, prefigurative behaviour is where actors demonstrate ‘what could be’ through their actions, whether it be through the measures they introduce or the agenda they advance, they seek to share a desire for institutional change across scales (Cooper, 2020). In other words, actors acting now as if the desired future were already real. To understand what this could look like at the Quays and Hofplein, two examples from the UK will be used to illustrate the guiding elements of this lens.

The first example demonstrates how British local councils passed motions to boycott Israeli goods and fly the Palestinian flag in support of Palestine, acting as if they held the authority to conduct foreign policy. By behaving as though they already possessed this authority, the councils enacted an alternative idea of what a local state is and can do (Cooper, 2020). Not only did they bypass this power, formally held only by national governments, by simply acting as if they could, they also enacted a symbolic (flag) and spatial (town hall) claim of a political matter as if it were their legitimate role. The second example describes a British university project researching “decertification”: the idea that the state could stop assigning a legal gender at birth to everyone. Although this proposal was never considered by any law reform body, by researching and interviewing people as if the law reform were already under official review, the project advanced this progressive idea, giving it serious and detailed consideration in the present. Hereby effectively pulling a non-existent reform to the table simply by treating it as though it were existent. This funnels into three possible forms of prefiguration that institutions could adopt: acting beyond

one's authority or responsibility, enacting a meaning or idea as if already settled, and anticipatory enactment of a future proposal.

Building on Törnberg (2021), Cooper (2020), and Yates (2015), institutional prefiguration is understood here as the experimentation of future institutional conditions in the present, operating through an “what-if” logic. In this thesis, the future condition under consideration is one in which adaptation is mainstream rather than sporadic.

3.2 The Concept: Mainstreaming Adaptation

The chapter now turns to the concept the analytical lens is applied to: what mainstreaming is, what resists it, and how that resistance can be tackled.

3.2.1 Definition

Mainstreaming is a concept that helps accelerate and achieve adaptation in spatial planning by translating adaptation into tangible policies, programmes and processes and implementing them locally (Ten Brinke et al., 2022). Its core purpose is to enhance the long-term sustainability of investments, reduce vulnerability to climate impacts, and strengthen the adaptive capacity of systems, particularly in urban contexts (Uittenbroek et al., 2013). Mainstreaming promotes a holistic, multi-disciplinary approach, rather than a separate policy domain. It thereby improves coordination and the efficient use of financial and human resources. Central is that future climate scenarios are systematically considered in policies and plans, and private actors actively adjust their decisions accordingly (Uittenbroek et al., 2013).

3.2.2 Barriers and Enablers to Mainstreaming Adaptation

There is a substantial body of scientific literature which researched the barriers and enablers to mainstreaming adaptation (Baack et al., 2024; Biesbroek et al., 2013; Dorst et al., 2022; Eisenack et al., 2014; Runhaar et al., 2018; Ten Brinke et al., 2022; Uittenbroek et al., 2013; Wamsler & Osberg, 2022). The work of Runhaar et al., (2018) has integrated these into the following categories:

1. Political factors: concerned with the broader governance context, including political interest for adaptation, the level of commitment from policymakers, public awareness and support, coherence between policies across different levels, flexibility of legal frameworks, and overall political stability
2. Organisational factors: relating to relations within organisations as well as inter-organisational. Including the objective to set adaptation plans, characteristics of a supportive regulatory framework, the collaboration within government departments and cooperation with the private sector. It also involves clarity around responsibilities, institutional fragmentation, and leadership within organisations
3. Cognitive factors: including the degree of uncertainty, urgency and knowledge-sharing
4. Resources: availability of staff and financial means, access to knowledge and expertise, and support from higher departments
5. Characteristics of the adaptation problem: degree of clarity and accuracy of the adaptation objective. Whether adaptation timeframes match existing planning processes

6. Timing: highlights the importance of momentum and the window of opportunity. Adaptation is more likely to succeed when triggering events create a favourable environment

3.2.3 Strategies to Overcome Barriers

The large body of literature on barriers and enablers has been followed by a growing body of scientific papers developing strategies to overcome the identified barriers. The influential paper by Ekstrom & Moser (2014) has identified three strategies to overcome these barriers:

1. Firstly, the most common strategy aims to change policy, planning and management. This could be seen as efforts to change the existing governance structure or, more radically, to build completely new structures.
2. The second most common strategy is aimed at improving communication styles in consciousness and strategic influence.
3. Lastly, and most importantly to this research as institutional prefiguration ties into this, is the set of interrelated strategies which includes institutional dynamics such as networking, partnerships and cooperation. In overcoming the challenges of mainstreaming adaptation, it is important to recognise the value of various formal and informal agreements. Maybe not intuitively surprising, but informal political cooperation, coalitions, and agreements are notably important for overcoming fragmentation and steering adaptation toward normality.

3.3 Conceptual Framework

Taken together, the two parts of this chapter form a single conceptual framework, visualised in Figure 2. The analytical lens consists of three interrelated building blocks that form the thesis' theoretical basis.

The first block combines transition theory and socio-technical theory, serving as the theoretical foundation that sets the outer boundaries. The socio-technical transitions perspective frames adaptation as more than a technical challenge: it is an innovation embedded in rules, practices, and institutional relations.

The MLP locates the implementation gap at the regime level, with adaptation pilots positioned as niches under landscape pressure from e.g. climate hazards. This perspective enables the analysis of institutional change across three analytical levels.

Within this structure, institutional prefiguration provides the analytical mechanism by which future institutional conditions are explored in urban built infrastructure, prefiguring what if the present reality were as desired (e.g. mainstream adaptation), thereby putting pressure on the incumbent regime. This way, institutional prefiguration is a mechanism through which closing the implementation gap is explored.

Mainstreaming is the condition that would close the implementation gap: the barriers literature specifies what resists it at the regime level and the multi-level perspective explains why that resistance is so stable, through the path dependence and interconnection that bind the regime together. Institutional prefiguration is the mechanism this thesis uses to examine a potential solution: rather than asking retrospectively why mainstreaming has failed, it anticipates the

institutional arrangements of a future in which adaptation is already mainstream and imagines what it would take to enact them now. In this sense, institutional prefiguration extends the transformative, institutional-dynamics strategy identified in the literature (Ekstrom & Moser, 2014) into the anticipatory mode that defines this study.

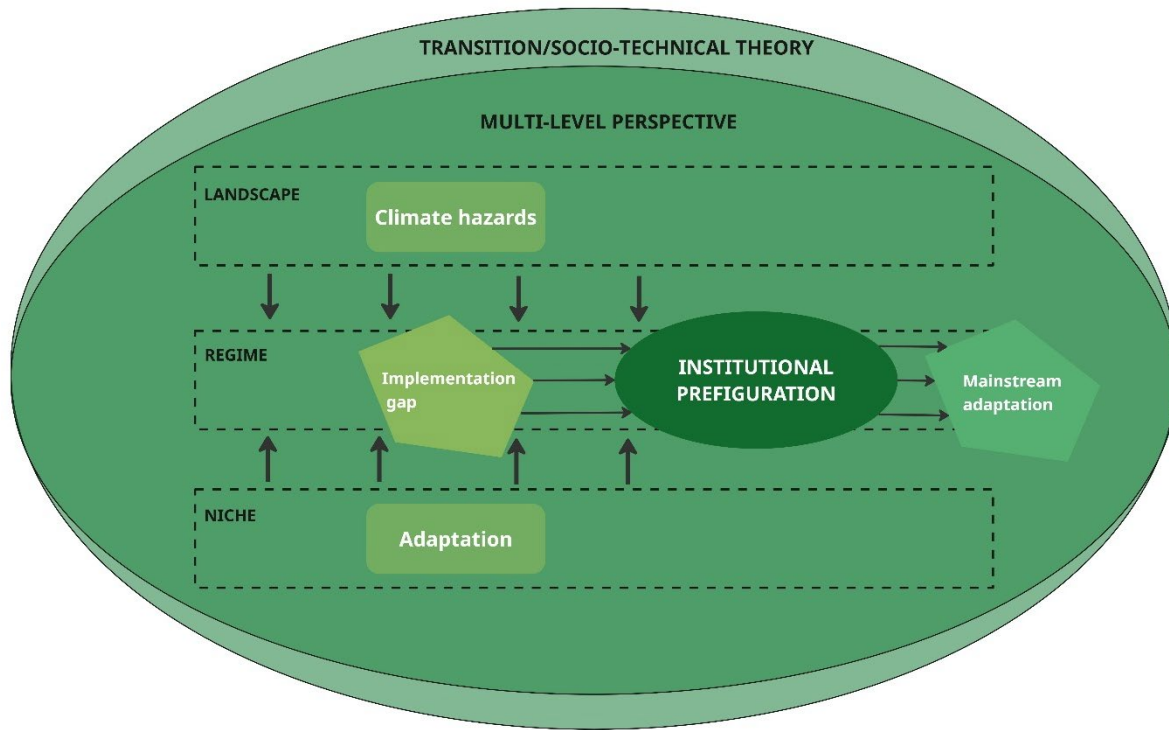


Figure 2: Conceptual Framework

4. Research Design and Methodology

4.1 Research Design

This thesis adopts a mixed-methods approach with three sequential phases. The aim is not to test causal relationships but to understand how institutional dynamics shape the mainstreaming of adaptation in urban infrastructure and to explore the role that institutional prefiguration could play in this transition. The study consists of three overlapping phases:

1. Identifying factors that influence adaptation mainstreaming in urban infrastructure projects, across public and private actors (past)

This phase draws on qualitative research through multi-actor interviews, analysed using a hybrid (deductive/inductive) thematic analysis. The deductive coding is based on the categories defined by Runhaar et al. (2018) (Appendix A), while the inductive coding captures factors that emerged from the data itself. These findings are complemented by results from the primary case study interviews.

2. Understanding how institutional prefiguration unfolds in practice through specific cases of urban infrastructure projects (present)

This phase combines a qualitative analysis of secondary data, such as policy documents and grey literature (see Appendix C), with qualitative research through multi-actor interviews. Together, these inform a qualitative case analysis of two cases: the primary case of the quay wall renovation in Amsterdam, and the secondary case of Hofplein in Rotterdam. This approach enables the identification of prefigurative practice at the two sites today.

3. Modelling institutional prefiguration using an agent-based modelling (ABM) approach (future)

This phase operationalises institutional prefiguration through Institutional Grammar and ABM. Building on the insights from phases one and two, the primary case was conceptualised and simulated using an ABM, enabling the prefigurative exploration of two 'what-if' scenarios. This approach is suited because the challenge of mainstreaming adaptation unfolds within a highly fragmented institutional environment, involving many stakeholders with competing interests whose interactions are difficult to grasp through qualitative analysis alone. ABM is well-suited to such conditions: it simplifies complex multi-actor systems into a set of agents and rules, making their interactions observable and manipulable.

These phases are linked to research questions, data sources and methods. Table 1 gives an overview.

Table 1: Data Source and Methods per Sub-Question

SQ/phase	Data source	Method
SQ1 (Factors)	Multi-actor Interviews + Literature Review	Hybrid Thematic Analysis (ATLAS.ti)
SQ2 (IP in practice)	Case Interviews + Secondary Data Case	Qualitative Case Analysis
SQ3 (IP into ABM)	Case Interviews	Institutional Grammar + ABM

The phases are translated into a research design, illustrated in Figure 3 and elaborated in the following sections.

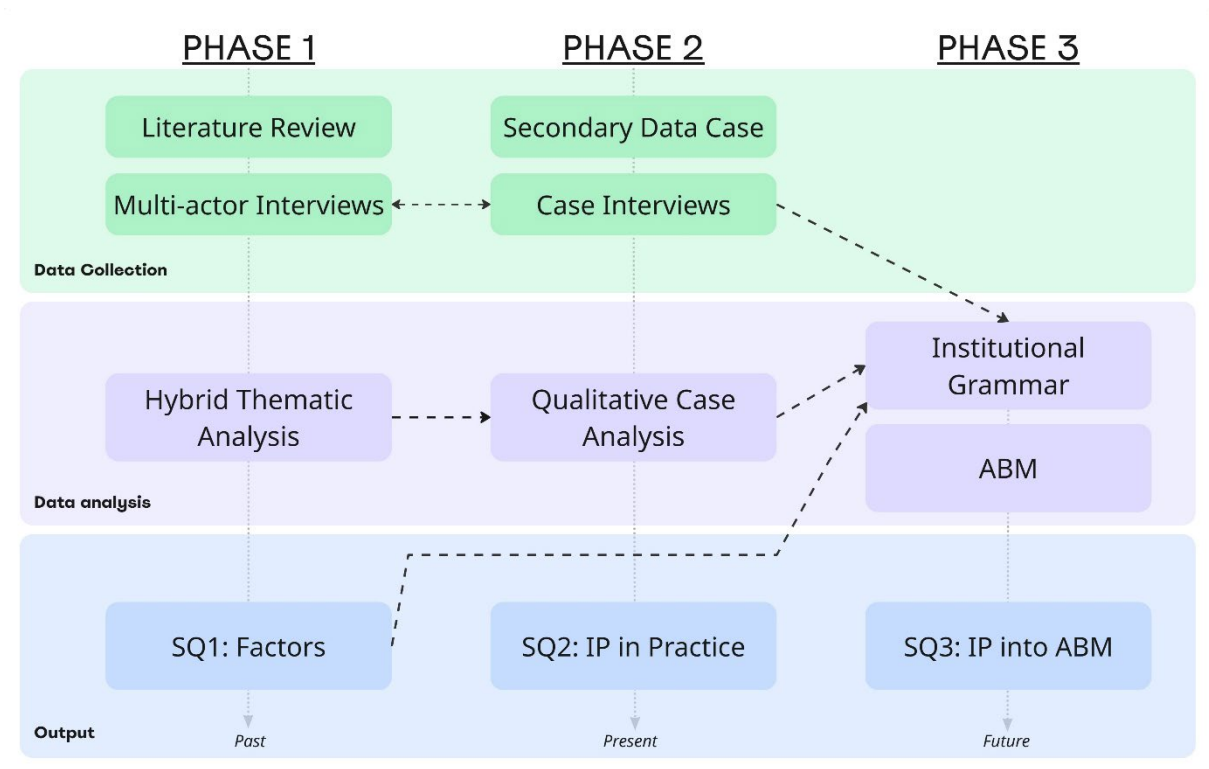


Figure 3: Research Design

4.2 Case Selection

This research employs a multi-case design in which two cases play deliberately unequal roles. The large-scale quay wall renovation programme in Amsterdam serves as the primary case, examined in depth across all three research phases, while the Hofplein redevelopment in Rotterdam serves as a triangulation point, drawn upon solely in phase two. This asymmetry is intentional: the primary case provides the analytical depth required to operationalise institutional prefiguration into an agent-based model, whereas the secondary case provides triangulation, analysing IP dynamics in a different institutional context. Additionally, the cases represent two contrasting approaches to adaptation consideration: the two cases are described next.

Primary case: This research primarily examines two programmes within the Amsterdam quay wall landscape. The first is the Programme Bridges and Quays (PBK), launched in 2020, and the second is the Innovatie Partnerschap Kademuren (IPK), initiated a year earlier but included in the empirical focus later. Due to its narrower scope, this project is better suited to detailed analysis. Both programmes are part of Amsterdam’s large-scale infrastructure redevelopment, chosen as the primary case for three reasons. First, they fall within the Product Market Combination (PMC) of above-ground civil works, a domain characterised by high adaptation complexity: it involves multiple stakeholders, public–private governance, fragmented responsibilities, constraints from existing grey infrastructure, and competing interests within a dense, historically protected city centre. Moreover, the high complexity is due to the fact that adaptation goals were not clearly defined from the outset in these projects. Second, the case presents a temporal tension central to this study: quay walls have asset lifetimes of over a hundred years, whereas procurement logic

is short-term and climate risks are long-term, allowing observable anticipatory behaviour. Third, institutional ties through collaboration with BAM Infra (contractor in IPK) and the AMS-Institute (knowledge partner in IPK and PBK) provide access to project documents, tender processes, and practitioners across the public and private sectors. These factors make this case an ideal site to investigate the complex institutional dynamics through institutional prefiguration.

The primary case is engaged at increasing depth across the three phases. In phase one, it is analysed briefly to surface case-specific factors influencing adaptation mainstreaming that extend beyond those identified by the more general public and private infrastructure actors. In phase two, case-specific multi-actor interviews and secondary data are collected for a qualitative case analysis of prefiguration in practice. In phase three, the factors identified in phase one and the qualitative findings from phase two jointly inform the parameters and the two simulated what-if scenarios of the agent-based model. Here, the scope of the case was narrowed to the Innovatie Partnerschap Kademuren (IPK), a smaller innovation partnership that was more readily conceptualised as an ABM. The primary case therefore runs as a continuous thread through the entire study, each phase building on the last.

Secondary case: The Hofplein redevelopment was selected as a triangulation point for phase two only. Hofplein represents a contrasting condition: a redevelopment in which adaptation was treated as significant from the outset. This difference, compared to the Amsterdam case, is precisely what makes it analytically valuable. By examining how prefigurative dynamics emerge, and how they enable or constrain mainstreaming, in a setting where adaptation was a starting point rather than a later addition. Situated in a different PMC and a different municipal context, Hofplein thus serves as a means of triangulation, strengthening the phase-two findings. To ensure clarity, the primary case will be referred to as 'Quays', and the secondary case as 'Hofplein' throughout this thesis.

4.3 Data Collection

The methods for collecting data in this research are fourfold. Although not always retrieved linearly, the different methods did inform one another, as shown in Figure 3.

4.3.1 Literature Review

A structured literature review served two purposes. First, it established the regulatory context, defined the study's core concepts, and built the theoretical foundation synthesised in the conceptual framework. Second, it generated the deductive codes for the thematic analysis in phase 1, provided in Appendix A. To this end, the review systematically targeted the literature at the intersection of adaptation, mainstreaming, barriers, and infrastructure, extracting factor categories that formed the coding scheme.

4.3.2 Multi-actor and Case Interviews

The objective of the semi-structured interviews was threefold. Firstly, semi-structured interviews were conducted with public and private actors from various building and engineering companies, as well as the municipality, to understand what factors influence the mainstreaming of climate-adaptive infrastructure, such as city squares, sluices, and bridges. Secondly, simultaneously, interviews were conducted with actors working on quay walls in Amsterdam, from both the public

and private domains. These case interviews deepened the qualitative case analysis, allowing for the identification of institutional prefiguration in practice and informed the parameters of the ABM in phase 3. Lastly, interviews with practitioners involved with Hofplein informed the emergence of institutional prefiguration of a different institutional context.

A total of 21 semi-structured interviews involving multiple actors were conducted: 10 broadly addressed climate-adaptive infrastructure, 8 focused specifically on the Quays, and 3 on Hofplein. The sample included 7 public actors from the Amsterdam and Rotterdam Municipalities, 12 private sector representatives from construction and engineering firms, and 2 hybrid actors from knowledge institutes. Table 2 summarises the distribution of these interviews across sample groups. Table 3 provides a more detailed summary of the interviewee per area and topic.

Table 2: Overview Interview Sample

Sample	Topic	Quantity
1	Broad	10
2	Quays	8
3	Hofplein	3

Table 3: Overview Interviewees per Stakeholder Area

Interview	Stakeholder area	Topic
1	Construction company – Tender Manager	Climate-adaptive infrastructure
2	Construction company – Sustainability Manager	Climate-adaptive infrastructure
3	Construction company – Civil Engineer	Climate-adaptive infrastructure
4	Municipality of Amsterdam – Project Leader	Quays
5	Construction company – Sustainability Manager	Climate-adaptive infrastructure
6	Municipality of Amsterdam - Ecologist	Quays
7	Construction company – Commercial Manager	Climate-adaptive infrastructure
8	Construction company – Hydrologist	Climate-adaptive infrastructure
9	Construction company – Sustainability Manager	Climate-adaptive infrastructure
10	Municipality of Amsterdam - Advisor Climate Adaptation	Climate-adaptive policy
11	Construction company – Project Leader	Quays
12	Knowledge Institute – Living Lab Coordinator	Mainstreaming
13	Municipality of Amsterdam - Constructor	Quays
14	Construction company – Tender Manager	Climate-adaptive infrastructure
15	Municipality of Amsterdam – Project Leader	Quays
16	Knowledge Institute - Director	Climate-adaptive governance

17	Engineering company – Project Manager	Quays
18	Engineering company – Technical Design Manager	Quays
19	Construction company – Project Manager	Hofplein
20	Municipality of Rotterdam – Project Manager	Hofplein
21	Municipality of Rotterdam – Project Leader	Hofplein

The three interviewee groups differed slightly in interview procedure. Sample 1 focused on the factors influencing adaptation mainstreaming, whereas samples 2 and 3 centred on case dynamics: actor interactions, objectives, obstacles, and prefigurative activities. The following examples illustrate the questions that structured the interviews, the full set of questions is provided in Appendix B:

Sample 1: Mainstreaming factors:

- In your experience, what most strongly enables or obstructs the integration of climate adaptation into infrastructure projects?
- Where does responsibility for adaptation tend to sit between public and private actors, and how does that affect implementation?
- Have you seen adaptation treated as a core requirement or as an optional addition, and what drives that difference?

Samples 2 & 3: Case dynamics and prefiguration:

- Could you describe your role in the project and which other actors you interact with most closely?
- At what point does climate adaptation enter the process, and who raises it and how?
- Can you give an example of an adaptive measure that was successfully integrated, and one that was not, what made the difference?

4.3.3 Secondary Data

Alongside the interviews, a desk-based analysis of secondary data was conducted for both cases to reconstruct the institutional context in which prefigurative dynamics unfold. The material comprised policy documents, programme strategies, tender and procurement documents, and publicly available reports on the Quays and the Hofplein. Appendix C contains the complete list of these documents.

This analysis served two functions. First, it established the factual and chronological backbone of each case: the sequence of decisions, the actors involved, against which the interview accounts could be triangulated. Second, for the primary case, the documents provided the contextual information from which the agent-based model was later derived, bridging the qualitative analysis of phase two and the operationalisation of phase three.

4.4 Data Analysis

The collected data were analysed through triangulation, combining systemic, descriptive and exploratory approaches.

4.4.1 Hybrid Thematic Analysis

Interview transcript samples 1 and 2 were systematically coded and clustered using a thematic analysis approach, this was done with qualitative coding software ATLAS.ti. The coding scheme was developed according to the established categories of Runhaar et al. (2018) (Appendix A). The coding and clustering proceeded through five sequential stages:

First, code-document tables were generated to provide an overview of code frequency per transcript. This offered an initial bird's-eye view of the data, revealing which thematic categories were densely or sparsely represented and surfacing preliminary differences between document groups, notably between public and private actors, and between case-specific and broadly oriented interviews.

Second, code frequencies were compared across actor groups using a normalised table to account for differences in transcript length and number of interviews per group. Examining divergences and convergences between actor types proved analytically valuable for understanding how public and private actors perceive and experience the challenge of mainstreaming adaptation differently.

Third, a co-occurrence analysis was conducted to identify which codes tend to appear in the same quotations or in close proximity. The resulting clusters reveal how barriers and enablers relate to one another, exposing underlying patterns in interviewees' experiences of the implementation gap.

Fourth, a qualitative in-depth analysis was conducted into the most analytically significant codes. All quotations for key codes were reviewed side by side, and analytical paragraphs were written to summarise the dominant patterns, internal tensions, and unexpected findings within each code. At this stage, the codes that emerged inductively were analysed alongside the deductive analysis, and quotations that did not necessarily fit any of the codes set in advance were used to strengthen it.

Fifth, the case-specific interviews were revisited to parameterise the agent-based model. For each actor type identified in the case study, coded segments were compiled into agent profiles specifying their goals, decision rules, resources, interaction patterns, and behavioural thresholds, forming the basis for the model's agent specifications. More on this step on the next page.

4.4.2 Qualitative Case Analysis

The qualitative case analysis integrated the interview and secondary data into a coherent account of how institutional prefiguration unfolds within each case. Particular attention was paid to moments where actors acted in anticipation of conditions not yet formally in place, as these constitute the prefigurative behaviour at the heart of the research. For the primary case, this

analysis was then carried forward into phase three, where the identified actors, relationships, and decision logics informed the structure and parameters of the agent-based model.

4.4.3 Institutional Grammar and ABM development

Following the theories described in chapter 3, institutions are not only formal political organisations but also the institutionalised rules in society that shape human interaction within certain defined constraints (Ghorbani, 2022; Törnberg, 2021). Through functioning as a social backbone, institutions are challenging to model: this process is called Institutional modelling: a branch within agent-based modelling and simulation (ABMS), which aims to translate institutions into socio-(ecological-)technical systems (Ghorbani, 2022). Simulating certain roles, dynamics, interactions, and objectives of key stakeholders is useful for exploring a future institutional dynamic.

The Institutional Grammar (IG) is an established framework developed by Elinor Ostrom and Sue Crawford to provide researchers with a systematic way to analyse institutions (Crawford & Ostrom, 1995). This entails the rules, norms, and shared strategies that shape how people behave in groups, organisations, and societies. The developed IG framework treats institutions as a set of institutional statements, the core insight being that these statements share a common underlying structure that can be broken down into components (Crawford & Ostrom, 1995). This grammar is thus built of institutional statements and each statement consists of a maximum of 6 components, the ABDICO syntax (Ghorbani, 2022). The IG fits this study, as it enables the coding of institutions, their conceptualisation, and their integration into different parts of an agent-based model. Hence, in this thesis, IG describes the rules through which actors shape, enable, and/or constrain the mainstreaming of adaptation. Therefore, the ABM will simulate how these rules influence actor behaviour and in turn affect the mainstreaming of adaptation over time. The six components of ABDICO grammar of institutions are (Ghorbani, 2022):

1. [A]ttribute: the individual, group of people or organisation to whom the institutional statement applies
2. [D]eontic type: the strength or nature of the statement explaining whether it is a “prohibition”, “obligation” or “permission”
3. A[i]m: the action or goal of the statement
4. O[b]ject: the element of the statement that is the receiver of the action/aim
5. [C]ondition: the situation in which the institution holds, this can be temporal or physical
6. [O]r else: the explicit consequence of not following the statement or institution.

There are three different types a statement can belong to: these types help model the diversity of institutions in a tangible and systemic way (Ghorbani, 2022). Not every statement contains all 6 components of ABDICO. Depending on which components belong to a statement, a differentiation is made between the type of statement:

1. Rules (A-D-I-C-O): Rules are a type of institutional statement that have explicit and unique sanctions.
2. Norms (A-D-I-C): Norms do not have an “or else” component. However, this still means disobedience may have consequences. Yet, there is no explicit sanction (i.e. formally written) attached to a norm.

3. Shared Strategies (A-I-C): This type of institutional statement is a common routine with no explicit sanction when not complying. It differs from rules since there is no deontic connection to it.

To capture the dynamics of institutions in future scenarios, this study further incorporates the institutional model into an ABM. The development of an ABM occurred in roughly five steps, as illustrated in Figure 4. Whereas the first step focuses on IG, the last four concentrate on developing the ABM. These methodological steps thus built on the previous work of Crawford and Ostrom (1995) and Ghorbani (2022):

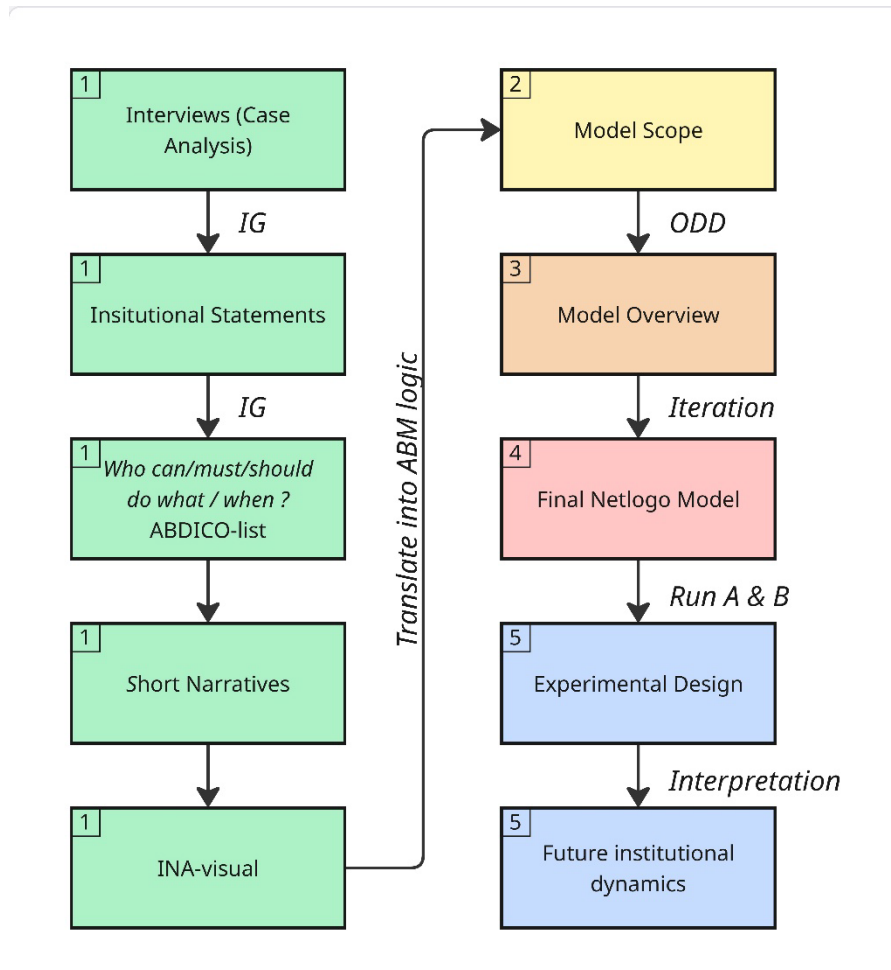


Figure 4: Flowline Development ABM in 5 Steps

Step 1: From interviews to institutional statements

The first step translated the qualitative findings into institutional statements. Four interviews were transcribed and analysed through coding, after which the codes were translated into ABDICO elements, distinguishing between norms, rules and shared strategies, and between their components: Attributes, Deontic, alm, oBject, Condition and Or-else. This produced the ABDICO statement overview in Appendix E, comprising 47 statements initially, of which 17 were selected. This selection was based on each statement's relevance to the main factors identified in phase 1 and its feasibility for translation into code: statements focused on technical design constraints, for instance, were not selected. From these final statements, short narratives were written to informally describe how and when agents and their environments act and communicate. Finally,

the statements were visualised in an Institutional Network Analysis to bridge the qualitative analysis and the model (see Appendix D).

Together, these seventeen statements form the institutional backbone of the model: a structured, coded representation of the rules, norms, and shared strategies that show how actors behave within the project. Whereas the qualitative analysis of the previous phases described prefigurative behaviour in narrative terms, the IG translation operationalises it in computational form. The following section sets out how these statements were carried forward into the agent-based model.

Step 2: Defining Model Scope

The link between the two is direct: each ABDICO statement specifies who acts, under what conditions, with what degree of obligation, and to what end, which is precisely the information an agent needs to behave within a simulation. In translating institutional statements into agent logic, the deontic type becomes especially important, as it distinguishes between what actions agents are obliged to take and what actions they are merely permitted to take. This is the difference that lets the model explore what happens when a permission becomes an obligation, which is the core "what-if" of this study.

Because most case-specific interviews had been held before the ABM work began, considerable knowledge about the case was already available, which enabled some preliminary scoping before modelling. It was clear, for instance, that the model would simulate the IPK project within the PBK project, and that it should include no more than three actors given the time constraints of this thesis. A major part of the process, the coding of the interviews, had also been partly completed during the interview analysis. The model is exploratory: its purpose is to operationalise the institutional factors identified during the interviews and to investigate their system-level patterns, rather than to predict or calibrate the project. The scope was therefore limited to the elements necessary to describe it: a static, exploratory model in which scenario parameters are altered and the resulting changes observed, with two agent types (municipality and consortium, to which sub-breeds were later added for complexity) and a maximum of roughly fifteen statements.

Step 3: Model Description (ODD)

In order to appropriately report on the model, it is described following the logic of the 7 stages of the conventional Overview, Design concepts and Details (ODD) protocol by (Grimm et al., 2020), adapted for the exploratory scope of this model.

1. Purpose and Patterns (Overview)

The purpose of this model is to explore how institutional prefiguration, through rule-based and advocacy-based anticipation of change, affects the mainstreaming of climate-adaptive practices in Amsterdam. The key pattern of interest is whether and when adaptive innovations cross from pilot status to standard practice, and thus mainstream. The ABM terminology is illustrated in Table 4 to clarify the meanings of essential terms.

Table 4: ABM Terminology

Term	Definition
Tick	One simulation step. In this model, one tick equals one quay wall renewal project. Each run consists of 50 ticks.
Counter	A variable that matches cumulative outcomes across a run. Counters reset to 0 at the start of every run.
PoR	Programme of Requirements. The brief the municipality issues to the consortium at the start of each project.
Bidder	The consortium agent. Reads the PoR and submits either an "adaptive" or "default" bid.
Lever	A parameter the modeller can switch to test interventions. This model has two: por-binding (rule-based) and frontrunner-active? (advocacy-based).
Precedent	The number of approved adaptive projects accumulated so far. V&OR's institutional memory of past pilots.
Mainstreaming	One-time institutional shift: climate-adaptive becomes standard practice. Fires once precedent $\geq$ accept-threshold, stays true for the rest of the run.

2. Entities, state variables and scales (Overview)

The model contains three agent types. The municipality is characterised by its risk aversion: the consortia by a climate focus and a profit motive and the frontrunners by their motivation, motivation step, and lobbying threshold (further elaborated in Table 5). The model has no spatial dimension, and its temporal scale is one project per tick, with fifty ticks per run. Alongside the agents, a set of global variables holds the shared state of the system:

- Project-id: counter
- Total-adaptive-built: outcome metric, how many pilots delivered "adaptive"
- Precedent-count: the V&OR memory, grows only when adoption fires
- Accept-threshold: how many adoptions V&OR needs before the next one fires
- Total-mainstreamed: total adaptive built projects actually accepted to mainstream
- Mainstreamed?: institutional state, has the innovation crossed into standard practice?
- Total-stalled: adaptive bids rejected by V&OR
- Approval-prob-adaptive: the probability V&OR approves an adaptive project.

Table 5: ABM Agent Overview

Agent	Role	ABM rules	Default states
Municipality	Drafts the PoR: vague or binding (lever).	draft-PoR : returns "binding" if lever ON, else "vague"	Risk-aversion: 0.7 Default bid framing: "vague".
V&OR (part of municipality, not own agent)	Sub-department (maintenance body of the municipality): decides whether to approve consortium's bid & innovation mainstreams after threshold.	Approval gate: approves default bids unconditionally: approves adaptive bids with probability $1 - \text{risk-aversion}$ Mainstreaming check: if precedent $\geq$ accept-threshold, set mainstreamed? true.	Approval probability: 0.3 Accept-threshold: 3
Consortia	Submits bid to PoR. Under binding PoR: must	Submit-bid: returns "adaptive" if PoR = binding:	Climate focus: 0.2 (chance of

	bid adaptive. Under vague PoR: bids adaptive only with probability climate-focus.	else returns "adaptive" with probability climate-focus, otherwise "default"	voluntary adaptive bid, change with slider)
Frontrunner	Internal or external advocate for adaptive practice. Builds motivation from approved adaptive outcomes: periodically lobbies V&OR to relax its risk-aversion. Operationalises advocacy-based prefiguration to change.	Update-motivation (every tick): +0.1 if approved adaptive, -0.1 if stalled adaptive, no change otherwise Lobby-vor (every 5 ticks): if motivation $\geq$ lobbying-threshold, raise V&OR approval probability by +0.05 (capped at 0.9)	Motivation: 0.5 Motivation-step: 0.1 (reactiveness to outcomes) Lobbying threshold: 0.7 (needs strong motivation to act)

3. Process overview and scheduling (Overview)

Each tick proceeds through four steps: (1) the municipality drafts the PoR, (2) the consortium submits a bid, (3) V&OR approves or rejects the bid (executing it if approved), and (4) a mainstreaming check is performed. Two periodic processes run alongside these: the frontrunner's motivation updates every tick, while frontrunner lobbying and precedent decay occur every five ticks.

4. Design Concepts

Emergence occurs through mainstreaming as a system-level state arising from individual project decisions and regime-dependent behaviour across thresholds. Stochasticity enters through the consortium's climate-focus draw and V&OR's approval gate. The model is observed through the percentage mainstreamed, total-adaptive-built, total-stalled, and precedent-count.

5. Initialisation (Design Concepts)

All counters are set to 0, the bookkeeping counters (total-adaptive-built, total-mainstreamed, total-stalled, project-id) count outcomes during the run and must start empty by definition. The state variable precedent-count is also initialised at zero, representing a starting condition in which V&OR has no accumulated institutional memory of prior adaptive pilots. This is a conservative choice, as a positive starting value would represent a partially positive institutional attitude and shift mainstreaming toward earlier ticks.

6. Input data (Design Concepts)

The model is parameterised at initialisation: no external data is read during simulation

7. Submodels (Details)

The four submodels correspond to the ABDICO statements and the full NetLogo code, provided in Appendices E and F. The overview of model flowchart is illustrated in Figure 5.

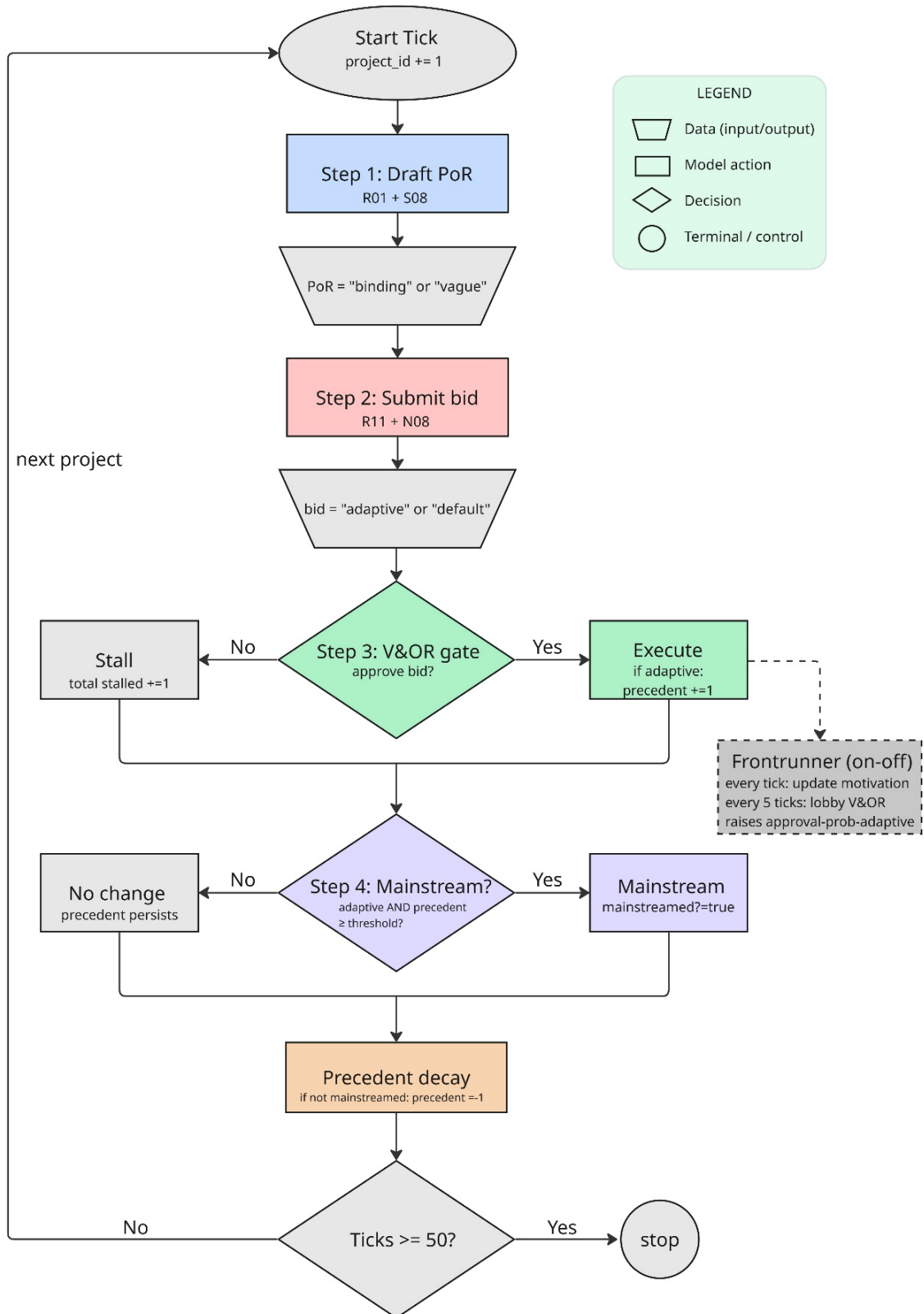


Figure 5: Model Flowchart

Submodel 1: Draft PoR (Municipality). If the por-binding lever is active, the PoR mandates adaptive design: otherwise it remains vague (*R01, S08*).

Submodel 2: Submit bid (Consortium). Under a binding PoR, the bid is adaptive (*R02, N05*). Under a vague PoR, the bid is adaptive with probability climate-focus, otherwise default (*R11, N08, S02*).

Submodel 3: V&OR approval and execution (Municipality). Default bids are approved unconditionally. Adaptive bids are approved with probability 1 – risk-aversion (*R13*). Approved adaptive bids increment precedent-count: rejected bids increment total-stalled.

Submodel 4: Mainstreaming check (Municipality). If precedent $\geq$ accept-threshold and an adaptive bid was approved, mainstreamed? flips to true: a one-time event (*N06, N07, S10*). Periodic processes. Every five ticks, precedent-count decays by one unless mainstreaming has occurred. The frontrunner (when active) updates motivation each tick based on outcomes and lobbies V&OR every five ticks if motivation is sufficient

Step 4: Iteration as Method

This model was developed iteratively: each iteration was grounded in the ABDICO statements.

Step 5: Experimental Design

Two experiments were run. Run A are the scenario results from a 2×2 factorial design (lever × frontrunner) with 20 seeds, totalling 80 runs, with the percentage of seeds achieving mainstreaming as the outcome. Run B repeats the same factorial across four levels of the accept-threshold, totalling 320 runs, as a sensitivity analysis: 20 seeds is sufficient to estimate variance. In both runs, mainstreaming is treated as a binary, per-run outcome (achieved or not achieved), yielding a percentage metric per cell.

4.5 Ethical Considerations

All interviews were conducted in accordance with ethical guidelines. All interview data is anonymised. Before the interviews started, all participants were explicitly asked whether the interview could be recorded and if their contributions could be used in this thesis. Every participant has signed a consent statement in line with the TU Delft Explicit Consent points.

4.6 Use of AI Statement

Generative AI, Anthropic's Claude specifically, has been used during this research project mostly as a sparring partner. The AI was used to help create weekly to-dos, revise vocabulary and grammar, and build code. The NetLogo implementation was supported by Claude, which was used iteratively in the model structure, explain unfamiliar NetLogo data types, and debug syntax errors during development. All conceptual decisions, however, from agent specification and experimental design to the conceptual framework, were made by the author and grounded in the qualitative analysis. The information produced by AI was always factually reviewed and edited as needed; the author thus takes full responsibility for the content of this thesis.

5. Results

The results of this study are presented in three parts, mirroring the three sequential phases of the research design. Phase 1 reports the factors that public and private actors identify as influencing the mainstreaming of adaptation, based on the thematic analysis of the multi-actor interviews. Phase 2 presents a qualitative case analysis of how institutional prefiguration unfolds in practice, drawing on the primary case of the Amsterdam quay walls and the secondary case of Hofplein in Rotterdam. Phase 3 reports the ABM, operationalising institutional prefiguration with the findings of the first two phases to simulate two 'what-if' scenarios. Together, the three phases follow a past–present–future logic, moving from the factors that have shaped mainstreaming to date, through prefigurative practice as it currently unfolds, to a simulation of how mainstream adaptation might develop.

5.1 Phase 1: Factors Influencing Mainstreaming Adaptation

The factors influencing the mainstreaming of adaptation are presented in the order in which they passed the thematic analysis, moving from a broad overview to a focused, in-depth reading. The analysis first identifies the most prominent factor categories through a brief code frequency analysis, then compares how public and private actors differ in their emphases through an actor-level comparison, and subsequently examines how factors relate to one another through a co-occurrence analysis. Building on these patterns, the most significant factors are then unpacked in a qualitative in-depth analysis, organised around the six categories of Runhaar et al. (2018): political, organisational, cognitive, resources, characteristics of the adaptation problem, and timing. Finally, the factors that emerged inductively from the data, beyond the predefined coding scheme, are synthesised under emergent codes.

5.1.1 Code Frequency Analysis

The first stage of the analysis produced an overview matrix displaying the six main code categories against the four document groups. The results in Figure 6 reveal considerable variation in thematic prevalence across categories. Organisational Factors emerged as the most densely coded category, with 78 coded segments in total, followed by Characteristics of the Adaptation Problem with 63 segments. By contrast, Resources (24) and timing and windows of opportunity (13) were notably less represented. This distribution suggests that interviewees perceive the challenge of mainstreaming adaptation primarily as an organisational and definitional problem, rather than one of resource scarcity or timing alone.

Regarding the quay case specifically, it is worth noting that Political Factors is coded rather frequently for both public and private actors. This is likely because the quays are a politically charged domain in Amsterdam, where policymakers, energy suppliers, maintenance keepers, engineers, ecologists, citizens, and UNESCO all advocate for different interests. To illustrate these dynamics, this quote of a municipal ecologist on citizen resistance is key:

“In West [of Amsterdam], we have had a lot of political stress about trees that were technically in need of replacement (such as old poplars), but which have been preserved after political pressure.”

Similarly, a project leader from one of the construction companies underlined another conflict of interest as follows:

“You can't have it all. If you don't want to let go of the UNESCO status, it will continue to look the way it is today. If we as experts can't figure it out, what can you expect from the municipality? If you don't want to change the look and the way of working, there is little room for innovation.”

	Private - Broad	Private - Quays	Public - Broad	Public - Quays	Totals
A. Political Factors	4	9	7	15	35
B. Organisational Factors	26	25	13	14	78
C. Cognitive Factors	19	5	9	11	44
D. Resources	9	2	8	5	24
E. Characteristics of the Ada...	16	16	16	15	63
F. Timing & Windows of Op...	8	3	2		13
I. Emergent / Inductive Codes	15	12	4	9	40
Totals	97	72	59	69	297

Figure 6: Code frequencies, derived from ATLAS.ti by author. Factors: A. Political, B. Organisational, C. Cognitive, D. Resources, E. Characteristics of the Adaptation Problem, F. Timing & Windows of opportunity, I. Emergent / Inductive

5.1.2 Actor-level Comparison

The second stage compared code frequencies across actor groups using a normalised matrix to account for differences in group size and transcript length, see Figure 7. This comparison reveals several analytically significant divergences and convergences between public and private actors.

Regarding divergences, private actors reported markedly more on organisational collaboration and fragmentation than their public counterparts: the two codes were coded approximately 30 and 32 times respectively among private actors, compared to 16 and 18 times among public actors. This disparity suggests that private actors experience the fragmented institutional landscape more acutely, likely because they must navigate multiple public-sector interfaces simultaneously. One interviewee noted this difficulty within the quay wall landscape:

"At the IPK, the coordination with all those stakeholders was up to the contractor, which cost an awful lot of time and money. In short: keeping the municipal and administrative stakeholders and interests together is the most difficult part, apart from the financial aspect."

Conversely, political awareness was substantially more prevalent among public actors than private actors, indicating that public actors are more attuned to (or more directly exposed to) the public awareness and societal acceptance of adaptation. A further notable divergence concerns the momentum code: this code appeared 7 times in private-actor interviews but was entirely absent from the public-actor transcripts. This asymmetry may reflect a greater sensitivity among private actors to market signals and shifting commercial interest in climate-adaptive infrastructure. Such momentum can create opportunities to scale up adaptation: however, it can also pose significant challenges. One interviewee exemplified this with a project at Schiphol, where a shift in political and organisational priorities led the airport to sharply scale back its

sustainability ambitions. Because contractors largely follow the client's demands, this kind of reprioritisation by a major client directly reduces the traction adaptation has in the projects:

“I think the ambition was there, because Schiphol's ambition was ‘most sustainable airport in the world’. But that has also changed to ‘best passenger experience’ [...] They [the board] simply said that things have to change. We just need to become one of the most popular airports again, so we're going to focus on passenger experience, and with that, the focus has shifted away from sustainability”.

	Private - Broad	Private - Quays	Public - Broad	Public - Quays	Totals
◇ A. POL_awareness	3	4.76	3.47	15.86	27.08
◇ A. POL_coherence		4.76	5.2	6.34	16.3
◇ A. POL_commitment	4	3.17	3.47	1.59	12.23
◇ A. POL_legal		1.59		1.59	3.17
◇ A. POL_voluntary			1.73		1.73
◇ B. ORG_collaboration	14	15.86	6.94	9.51	46.31
◇ B. ORG_fragmentation	13	19.03	6.94	11.1	50.07
◇ B. ORG_leadership	4	7.93	5.2		17.13
◇ B. ORG_procurement	8	9.51	1.73	3.17	22.42
◇ B. ORG_routines		3.17	5.2	6.34	14.72
◇ C. COG_framing	1	1.59		9.51	12.1
◇ C. COG_knowledge	7	1.59	5.2	3.17	16.96
◇ C. COG_uncertainty	4	1.59	8.67	4.76	19.01
◇ C. COG_urgency	12	3.17	1.73	3.17	20.08
◇ D. RES_capacity	4		3.47	3.17	10.64
◇ D. RES_expertise	3		3.47		6.47
◇ D. RES_financial	5	3.17	10.41	4.76	23.33
◇ E. CHAR_ambiguity	8	6.34	13.88	9.51	37.73
◇ E. CHAR_co_benefits	3	14.27	8.67	9.51	35.46
◇ E. CHAR_measurability	2	1.59	3.47	7.93	14.98
◇ E. CHAR_temporal	8	3.17	8.67		19.84
◇ F. TIM_momentum	4	3.17			7.17
◇ F. TIM_trigger	4	1.59	3.47		9.05
◇ F. TIM_window					0
Totals	111	111	111	111	444

Figure 7: Actor-level Comparison, POL= Political, ORG = Organisational, COG = Cognitive, RES = Resources, CHAR = Characteristics of the Adaptation Problem and TIM = Timing

Despite these divergences, the analysis also reveals important convergences. Both actor groups identified organisational collaboration and fragmentation as dominant themes across the full

sample. These were followed by the ambiguity of the adaptation problem and references to co-benefits or trade-offs of adaptation measures, especially the latter. This suggests that regardless of the institutional position, actors share a common experience of adaptation as an ambiguously defined challenge whose integration is complicated by unclear boundaries between adaptation benefits and broader urban trade-offs with for instance, heritage, liveability and decarbonisation.

One further observation is as follows: both codes regarding legal frameworks and the non-binding character of current adaptation policy passed by notably infrequent. The limited presence of legal and regulatory frameworks in the interview data is itself a significant finding: rather than actively constraining adaptation, the regulatory environment appears largely absent from practitioners' day-to-day experience. This absence may function as a hidden barrier: the regulatory framework is not perceived as a concrete obstacle precisely because there is so little regulation to encounter. A quote from a municipal employee working on the city's adaptation policy relates to this stating implementation frequently depends on project-specific choices and individual priorities rather than formal requirements:

"The [adaptation] quick scan is mandatory to be able to make any assessment. What you do with the outcome then differs per project and person. That is one of the things we run into: we try to standardise work, but in projects it often still depends on what considerations individuals make. This also depends on the type of project: the decision may lie for instance with an official client."

This suggests that adaptation is present procedurally but lacks the institutional mechanisms necessary to consistently translate assessments into implementation. This interpretation aligns with the problem statement of this thesis, which identifies the voluntary and non-binding character of the current adaptation policy as a structural obstacle to mainstreaming.

5.1.3 Co-occurrence Analysis

The third step in this analysis entailed a code co-occurrence analysis, see Figure 8. Multiple clusters are identified by this figure: however, only the clusters showing 7 or more ticks are discussed, thus the original figure was reduced to illustrate only the notable clusters.

The first cluster shows a strong connection (17 ticks) between organisational fragmentation and collaboration, the two most frequent codes. Logically, poor collaboration between private and public actors, or even within departments, will lead to unclear and dispersed responsibilities, and vice versa.

What is more notable, however, is that the quotations in this cluster repeatedly point to the same circular logic. Private actors express ambitions to increase the use of climate-adaptive measures in future projects, but also emphasise that these measures will only be implemented if the client explicitly demands them during procurement. Responsibility is therefore shifted back to the client, the market may have ambitions, but does not feel able to act on them independently when adaptation is not part of the formal assignment. A private-sector project manager explains this tension as follows:

"But in the end, the one who pays, decides. If I don't get the job because I push through my own ambitions against the client's wishes, then it stops."

Due to current procurement logics, contractors will not win the tender when not specifically following the stated requirements, thus preventing them from proposing extra climate-adaptive measures, which is a risk underlined by a respondent of one of the construction companies. One interviewee describe this process:

“The focus on climate-adaptive construction in the tender is only there if the customer asks for it or if we can offer added value with it. If it is not required, we are not judged on it and we cannot win the tender on it.”

	◆ A. POL_aware...	◆ A. POL_coh...	◆ A. POL_co...	◆ A. POL_legal	◆ A. POL_volu...	◆ B. ORG_coll...	◆ B. ORG_frag...	◆ B. ORG_lead...	◆ B. ORG_pro...	◆ B. ORG_rout...
◆ A. POL_awareness		1	3			2	1	1		2
◆ A. POL_coherence	1				1		3			1
◆ A. POL_commitment	3					1			1	
◆ A. POL_legal										
◆ A. POL_voluntary		1								
◆ B. ORG_collaboration	2		1				17	1	7	
◆ B. ORG_fragmentation	1	3				17		4	2	1
◆ B. ORG_leadership	1					1	4			1
◆ B. ORG_procurement			1			7	2			1
◆ B. ORG_routines	2	1					1	1	1	
◆ C. COG_framing	1						1			
◆ C. COG_knowledge						3	1	1		1
◆ C. COG_uncertainty							2			2
◆ C. COG_urgency	2		1			2	1			
◆ D. RES_capacity										
◆ D. RES_expertise										
◆ D. RES_financial									1	
◆ E. CHAR_ambiguity	1	1	1			1	2			
◆ E. CHAR_co_benefits	1			1						
◆ E. CHAR_measurability			2				3			2
◆ E. CHAR_temporal	2		2				1	1		1
◆ F. TIM_momentum	2		3			1		1		
◆ F. TIM_trigger	1									

Figure 8: Co-occurrence Analysis

In infrastructure, the client is typically a public commissioning actor, such as Rijkswaterstaat or a municipal project or asset owner. In the quays, this role is not held by “the municipality” as a single actor, but is distributed across project teams, asset managers, policy departments, and political decision-makers. This matters because climate adaptation often requires decisions that cut across these organisational boundaries.

The current procurement logic limits the ability of private actors to take responsibility for adaptation independently: without a formal assignment, adaptation measures are difficult to include without risking higher costs or losing the contract. At the same time, the public client operates in a complex context of overdue maintenance, limited budgets, political shifts, and competing policy demands such as emission-free construction, circularity, safety, and heritage protection. As a result, adaptation is not simply forgotten, but becomes difficult to translate into concrete contractual requirements.

This difficulty is not only financial. The client may lack technical certainty about which climate-adaptive measures are suitable, organisational capacity to coordinate across departments, and a clear budgetary mandate to pay for measures whose benefits fall elsewhere. This creates a

responsibility loop: private actors wait for the client to demand adaptation, while the client struggles to formulate and finance that demand within a fragmented institutional setting. A respondent working in construction design summarises this need for clearer commissioning:

“The perspective must be very clear here, the client must be very clear about this: what needs to be done? Which measures? Should we do a good risk analysis and then find the right climate-adaptive measures?”

The same dynamic appears in the question of who benefits and who pays. A municipal interviewee described why an innovative and adaptive cable duct was not accepted by an Amsterdam utilities company:

“The benefits are for someone else, so with such a duct you can reach cables and pipes much more easily [meaning less nuisance to residents]. But who benefits from it? And who within Amsterdam is responsible for that? There is also no department for that within Amsterdam, which says no, we are going to pay for this.”

This illustrates that the barrier is not only the cost of adaptation itself, but the absence of an institutional arrangement that assigns responsibility for long-term, collective benefits.

The second cluster is closely related to the first one, and builds further on the relationship between current procurement practices and public-private collaboration: organisational collaboration and organisational procurement (7 occurrences). In the Netherlands, procurement commonly follows either traditional contracts, in which the client completes the design before tendering the project, or integrated contracts, in which the contractor is responsible for design, execution, and sometimes maintenance. The main argument that emerges in this cluster, however, is that the real opportunity for mainstreaming adaptation lies in contract forms that allow earlier collaboration between client and contractor, such as construction teams, two-phase contracts, or Early Contractor Involvement.

This point was made by three private-sector interviewees from two construction companies and one engineering firm. One interviewee stated that *“you only really have influence in a construction team or a collaborative contract”* because once a project has already been fully developed and put on the market, private actors *“no longer have any influence.”* Another interviewee similarly emphasised that contractors need to be involved early, as only then can the necessary tools be used to visualise climate risks and potential measures. A third interviewee made the same point more explicitly, arguing that collaborative contracts are *“the only chance to design climate-adaptively,”* since involving market parties only after the design has been fixed represents *“a missed opportunity.”*

Taken together, these quotations suggest that adaptation is not only constrained by whether it is demanded, but also by when private expertise enters the project. If adaptation is considered only after the design phase, it becomes an add-on. If it is addressed through early collaboration, it can become part of the design logic itself.

5.1.4 Qualitative In-depth Analysis

This qualitative deep dive elaborates on all significant factors, identified by their frequency and interconnectedness in the coded data. Per factor (political, organisational, cognitive, resources,

characteristics of the adaptation problem, timing & windows of opportunity) patterns will be discussed and described below.

Political factors

Political factors profoundly shape the mainstreaming of adaptation in urban infrastructure. The previous Dutch government, which took office in 2024, represents a notably more right-wing political climate than its predecessors, with direct consequences for adaptation policy. One interviewed tender manager from a construction firm, who also holds a seat in a local municipality, describes how a major national infrastructure programme was halted on this basis:

"The MIRT (Meerjarenprogramma Infrastructuur, Ruimte en Transport) was removed 2 years ago, which was 100% for political reasons. The MIRT is about everything on function expansion (biodiversity, climate adaptation, but also road expansion): what is happening now is very little future-oriented. Now the wind is just quite sober and efficient, we are not going to expand on functionalities, and therefore not on climate adaptation."

This shift is reinforced by a changing public mood, in which sustainability has become a less prominent priority, as noted by the same tender manager:

"There was a good wind for a long time: we thought it [sustainability] was very important. The sound of 'we should act a bit more normal, be kind to the earth' was very prevalent. I feel that we have taken many steps back. There is also a huge dissent from society, people do not believe in the importance, the urgency, the costs."

In the quays, political factors were mentioned by all interviewees. Political and public resistance exert a substantial influence on adaptation in Amsterdam's quay walls, much of it concentrated around the implementation of trees. The societal value attached to trees in the quays is considerable, so much so that construction activities are frequently cancelled or postponed due to permit procedures, sometimes up to court. On the one hand, this benefits adaptation, as trees are among the most valuable assets for climate adaptation in the inner city. Paradoxically, however, the opposite often holds: many of the protected trees fail to mature due to low-quality rooting space and never reach their full potential, as noted by the municipal ecologist.

As a result, while innovation and attention focus on climate-adaptive trees, citizen resistance can preserve precisely the trees least able to deliver adaptive value. One interviewee from the IPK consortium describes this tension:

"There is a lot of public resistance. That has quite a lot of influence on the project, and that's why the message is often: leave that tree alone, please. Otherwise, you run the risk of much longer permit procedures and angry residents."

A civil constructor from the municipality echoes this point:

"We are protecting a certain tree, but that is super unwise. It is much better to build a new rake in a smart way, create a good growing place there and put new trees on it."

Organisational factors

Coded most frequently across the sample, organisational factors emerged as the central bottleneck to mainstreaming adaptation, particularly where collaboration is required between governments, organisations and departments. The responsibility loop that emerges around organisational collaboration resembles a hot-potato dynamic: adaptation is acknowledged as important, yet no actor is willing to claim responsibility for it, thereby pushing action into the long term.

Although many companies have developed their own adaptation strategies, the prevailing tendency is to defer to the client. BAM Infra, for instance, commits in its sustainability strategy to integrate climate-adaptive measures into all projects, a commitment that stands in direct tension with the widely held view that contractors cannot integrate adaptation as long as it remains voluntary. As one sustainability manager from a construction company put it:

"The big difference is truly made on the client's side. Since infrastructure is very project-driven, it includes the objectives and conditions in the contract formation. If it is not requested, we will not suddenly make big leaps, because that will not score in a tender."

Clients, whether private or public, could address this issue by requiring adaptation in the contract. However, this rarely occurs, which further reinforces the fragmented responsibility on this matter. One hydrologist at Schiphol mentioned:

"As a contractor, you receive a package of requirements that you must meet and tender for. Why there are no climate resilience requirements is just a bit crazy and unnecessary. It is not very difficult for them to absorb that. And then everyone will register for it that way. Then you create a level playing field and think ahead."

Beyond the lack of clarity around responsibility and collaboration, political leadership emerged as a second organisational concern. The former director of the PBK programme stressed how "someone has to think it's important". Even so, personal commitment to adaptation is decisive for mainstreaming, thus "if a climate adaptation official sees that it is not happening, he or she must talk to the alderman."

Finally, as noted earlier, tender and contract procedures strongly shape the mainstreaming process. Contract and tender design affect whether adaptation can be integrated systematically, a constraint felt most acutely by private actors:

"The contract form is crucial. With traditional RAW contracts, there is often not much more possible: you just have to deliver. That is why we are trying to win over more Early Contractor Involvement contracts, because they offer the opportunity to have that [adaptation] conversation at an early stage."

At the quays, these broader organisational tensions manifest acutely. Most strikingly, the sheer scale of the municipality of Amsterdam complicates internal communication and the location of decision-making authority. As one IPK consortium member describes, the 'client' at the municipality of Amsterdam is not one person: rather, it "is a wasp's nest: a fragmented group with conflicting interests."

This fragmentation translates directly into delays and missed opportunities for embedding adaptive measures. Within this fragmented ecosystem, several consortium members pointed specifically to the municipal maintenance department as a conservative bottleneck: a regime actor, in the MLP's terms, whose path-dependent routines effectively determine which innovations survive the transition from design to delivery. One IPK consortium member made the point explicitly, framing the maintenance department as a gatekeeper:

"You have to make sure that the maintenance clubs go along with this, otherwise you will get a nice idea, but if maintenance does not put a stamp on it, it will not happen."

Another consortium member described the resignation in this context, emphasising that their responsibility ends after presenting an innovative adaptation measure: *"I offered it to you, we explored it, we looked at it, but there is a deadline, so here it ends for us."*

What emerges from these accounts is not simply a coordination problem, but a structural one: adaptation requires an institutional owner within the municipality, and at present, no such owner exists. As one consortium member stated, one of the most important reasons for lagging adaptation measures in Amsterdam is *"there must be an owner of such an opportunity."*

The absence of ownership is also acknowledged from within the municipality itself. A municipal employee described the internal communicative struggle to define a coherent adaptive strategy across the city's many sites:

"What do we want [with adaptation] and what do we prioritise at which location, so that we don't have to make the decision per location every time? What are we going to do here? When you layer all elements, you can see: okay, what is the needed here?"

In the language of MLP, these citations reveal a regime in which the institutions governing adaptation are reluctant or struggling to adopt adaptation. There is no clear responsibility, and adaptation is not mandatory. Mainstreaming stalls precisely because the institutional conditions required to enforce it are not established.

Yet the case also demonstrates that this institutional vacuum can, at times, be filled productively. One construction company representative described an instance in which the municipality issued a tender with an explicit nature-inclusive focus, effectively allowing nature-inclusive innovation to enter into the procurement process, and the prefigurative space this opened:

"The municipality of Amsterdam had issued a tender focusing on nature inclusiveness. Then you offer the possibilities and create the conditions for contracting authorities to go 'wild' in their design."

The contrast with the broader pattern of fragmentation and ownership voids is valuable for phase three of this research: it suggests that the leverage point for mainstreaming may lie precisely at the level of tender and procurement design, where prefigurative institutional design can be altered to explore transformational change.

Cognitive factors

Cognitive factors emerged as a substantial driver of the implementation gap, operating through three connected mechanisms: gaps in knowledge, uncertainty about the future, and a general lack of perceived urgency.

Uncertainty about climate scenarios and their technical implications delays action, as actors hesitate to commit while the evidence base remains incomplete. A municipal employee reflected on this internal hesitation:

"We sometimes let ourselves be held back too much by the fact that we don't know everything yet. Sometimes you just have to do it."

This hesitation is backed by the absence of legal requirements to act against: as the same employee noted, *"for heat, drought, and flooding, such hard obligations are still lacking,"* leaving decisions to rest on individual judgement under uncertainty rather than on a clear standard.

Most strikingly, a lack of urgency runs through the sample, urgency was coded 17 times, with respondents repeatedly noting that adaptation is not yet experienced as pressing. A tender manager framed this as a national-level problem, observing that while adaptation *"is simply necessary to keep our country liveable, urgency is not yet felt everywhere."* A sustainability manager at a construction company located the same dynamic in the cost-benefit framing that dominates decision-making, describing a recurring mentality: *"there is a once-in-fifty-years chance of a major flood, should we incur so many costs and set up an entire system for that?"* In both accounts, the obstacle is not technical capacity but a perception that the threat is too distant or too unlikely to warrant action now.

At the quays, these cognitive factors narrow into a sharper, more specific framing, in which trees come to dominate the cognitive landscape of climate-adaptive quays, often at the expense of other measures. One municipal employee confirms this concentration of attention: *"trees are, of course, the big winners for climate adaptation, against heat stress and for the cooling capacity of the city."* This reflects a wider tendency to understand adaptation through its most visible asset. Yet, as established earlier, many of the protected trees never mature enough to deliver that cooling value, so the cognitive focus settles on the symbol of adaptation rather than on its most effective forms.

Resources

Resource factors, which span both financial means and capacity, emerged as the second-least frequent code in the sample. Capacity constraints are treated in the previous section, where they sit more naturally as a knowledge- and staffing-related issue. This section therefore focuses on the financial dimension. Although budget is often assumed to be the decisive bottleneck for adaptation, a closer reading of the data suggests it is rarely the underlying cause. A municipal employee captures this directly:

"Budget ultimately also plays a role, but substantial investments are being made. There is, in principle, enough money to make the quay walls more climate-adaptive."

Financial capacity, in other words, is generally present but is directed elsewhere or made subject to prior institutional decisions. Resource scarcity is thus not the binding constraint on adaptation

in this case. Rather, it is a downstream symptom of the political, organisational, and contractual choices examined above.

Characteristics of the Adaptation Problem

This factor cluster emerged frequently in the coded data, with adaptation's conceptual ambiguity and the discussion of co-benefits (and trade-offs) cited particularly often. The ambiguity is tightly connected to the underlying (temporal) uncertainty of the problem itself, it has both a definitional and a temporal dimension: what does climate-adaptive infrastructure actually mean, which climate scenario should be designed for, and which target year are we preparing for? These questions remain largely unresolved across the sample.

Tellingly, 8 of the 21 interviewees at some point asked, unprompted, for the working definition of climate adaptation in infrastructure work, showing that there is no shared definition or guideline for adaptation. A climate adaptation adviser at the municipality acknowledged this: *"one of the big questions we have is: what is a good standard for climate adaptation across all the different domains?"*

Resolving this ambiguity is not only a matter of definition: it requires confronting the different layers of adaptation (including building norms, risks, responsibilities and trade-offs) that currently remain loosely articulated and undiscussed. A design leader from one of the construction companies framed this directly:

"The question is: what is currently secured in the norms, is that still realistic? Have all the risks been properly inventoried? In my view, that is the key. My sense is that this conversation isn't being had properly."

A more historical dimension of climate knowledge also emerges in the data. The Netherlands has centuries of expertise in adapting to rising water. Rising temperatures, by contrast, are a relatively new challenge, and one that the sector still seems reluctant to engage with directly: *"heat is really quite new for the Netherlands."* The novelty of heat is regarded as part of the problem's definitional ambiguity. It requires additional time to standardise the risk of a sector that has historically not been an issue.

In the quay case, conceptual ambiguity materialises into a concrete set of trade-offs, with UNESCO heritage protection consistently named as the most constraining. Amsterdam's institutional landscape comprises many stakeholders with competing objectives, several of whom can effectively block change, thereby squeezing adaptive innovations out of projects before they reach maturity. A project leader from the IPK consortium put it bluntly:

"You could put the municipality in a deadlock: do you want to preserve UNESCO heritage, or do you want to reduce heat stress? That's how you force the trade-off."

What the interviews leave open is whether heritage and adaptation are treated as equally legitimate goals, or whether heritage is prioritised and in whose interest that prioritisation runs. The argument running through several interviews is that mainstreaming adaptation requires honest engagement with acceptable trade-offs and a clearer view of the co-benefits it actually delivers (trees being the most frequently cited example). Without this, the case becomes locked into preserving existing practice rather than redesigning it. As the same project leader concluded,

“you cannot hold on to the current configuration of the quay and at the same time expect it to be maximally climate-adaptive.” An alternative is to shift adaptation spatially, away from the quay structure itself and into the surrounding public space. This targeting idea will be developed further in the following section on emergent codes.

Timing & Window of Opportunity

Coded least frequently across the sample, timing factors feature only marginally in the present analysis and are illustrated here through a representative quote. The most prominent argument under this code concerns disruptive events as triggers for adaptation: extreme incidents can briefly elevate adaptation to the public and political agenda, but only when their disruption reaches a critical threshold. The former director of the PBK programme illustrated this with the quay wall collapses that initiated the programme itself:

“You have to realise: there were problems with the quay walls [for a long time already]. Several collapsed, but three had to break down before it really became a topic.”

At the same time, it should not be forgotten that political momentum plays a significant role in mainstreaming adaptation, as explained in analyses of political factors. The point of this category is that peaks in attention to the topic, due to a specific event such as a crisis, will only briefly change behaviour, but since no alternatives are yet present to change the regime, the system will typically reconfigure to its old state. Timing, then, is a necessary but insufficient condition for mainstreaming: triggering events can create the opening, but only an available alternative can convert it into durable change.

5.1.5 Emergent Codes

Comparing the inductively derived codes, those that emerged from the data but did not fit the predefined coding scheme, revealed a recurring pattern. Across more than 20 practitioners working on adaptation implementation in urban infrastructure, a small set of intervention ideas recurred. These are synthesised below into three directions.

- Adaptation as an integral, co-benefit-driven task

Practitioners consistently framed adaptation as an integral challenge rather than a standalone objective, closely tied to the co-benefits code. Measures taken for greenery, biodiversity or social cohesion were seen as serving climate adaptation at the same time, making the two difficult to separate in practice. A private actor captured this coupling:

“What helps is that it is an integral task. The need for more greenery, biodiversity and nature-inclusivity serves society in many ways, and that often goes hand in hand with a climate-adaptive environment. That coupling helps us enormously. We need to pursue a different way of designing space in which these themes come together.”

This resonates with the wider literature. Dorst et al. (2026) similarly observe that practitioners frequently mention co-benefits, climate resilience, ecosystem services, spatial quality and long-term lifecycle value, even where these are not yet embedded in formal regulation and decision-making frameworks. The implication is that adaptation gains traction when it is presented not as an additional requirement but as part of an integrated approach to (re)designing space.

- Risk-based targeting: from point projects to area-wide "floor plans"

Respondents cautioned against a one-size-fits-all approach. Adaptation cannot, and need not, be implemented uniformly: effort should be concentrated where climate risk is highest, as these are also where the greatest opportunities lie, most notably the dense inner city. As one private actor put it:

"Our conclusion from the Civil side is that the greatest opportunities for climate-adaptive construction lie in the places where you see the greatest risks, so above all in the inner city. And secondly, wherever we are going to design public space."

This argument extends into a reframing of project scope: from point projects towards area-wide "floor plans." A single object, such as a bridge, offers limited room for optimisation, whereas treating it as part of a larger surrounding area opens up far more adaptive potential through the design of water and greenery in the public space around it:

"Essentially, you should try to make the floor plan as large as possible and, from that perspective, consider which measures we can take. With the object itself there is surely something to optimise, but before you have fully thought it through and calculated it, you have to weigh up variants in terms of structural feasibility, costs and standards. Whereas if you look at the design of the surrounding area, with water and greenery, that is where the quickest steps are, and the ones that will have the most effect."

Taken together, these arguments point towards precise, risk-based targeting. Rather than mandating that every project be climate-adaptive, the more effective strategy is to identify the projects and areas where opportunities are greatest and concentrate on those first.

- Opening an explicit conversation on risk and responsibility

Both public and private actors expressed a desire to open an explicit conversation about risk and responsibility. Under the current procurement regime, contractors are reluctant to offer ambitious adaptation measures for fear of either losing the tender or being held liable later for adaptation commitments they cannot guarantee. The idea of forthcoming regulation appeared to paralyse rather than mobilise the sector, even though such questions could be addressed proactively, before any proposal is formally accepted. Several respondents therefore proposed dedicated working groups focused specifically on the risks and responsibilities of adaptation. A private actor reframed the issue as a cost-of-inaction question:

"What is the consequential damage if we don't make the city heat-resistant now? Then you have a different conversation with the client about the extra costs now versus the damage in thirty years' time. That is where an opportunity lies."

Opening the space for this explicit conversation, together with risk-based targeting, will better inform decision-making and thereby answer the call for more standardisation of demands and performance indicators for adaptation interventions. A public actor extended this to the underlying question of accountability and the prevention paradox:

"Ultimately the question is: who bears the responsibility if we don't adapt? Where does the bill end up? You already see this with insurance becoming more expensive because of climate disasters"

elsewhere in the world. The prevention paradox is that it is more logical to act, but that it often only really happens once someone dies or a city council has to step down."

What unites these reflections is a call to make risk and liability an explicit, shared subject of negotiation rather than a silent shadow, shifting the conversation from who might later be blamed to who bears responsibility for the cost of inaction.

5.2 Phase 2: Institutional Prefiguration in Practice

Phase 1 established that mainstreaming stalls at the regime level, where organisational fragmentation and the ambiguous character of the adaptation problem dominate. This phase turns from *why* adaptation stalls to *how* actors occasionally move it forward anyway, by acting in anticipation of conditions not yet formally in place. Drawing on Cooper's (2020) account of "as-if" enactment, prefigurative behaviour is read here through three forms: acting beyond one's formal authority, enacting an idea as if it were already settled, and anticipating a future proposal before it is officially accepted. These three forms structure the analysis of both cases.

5.2.1 Primary Case: The Quays, Amsterdam

On paper, the quay wall programme is a promising site for prefiguration and the analysis surfaces three dynamics relevant to institutional prefiguration. First, the *Factor 20* framing imagined a "*what-if we actually solved this*" scenario which, though later judged too pessimistic, mobilised an innovation programme and scientific research into the structures' true condition (Gemeente Amsterdam, n.d.). Second, Amsterdam's adaptation strategy enacts a future condition as if it were already settled, committing to make adaptation "the new normal" (Gemeente Amsterdam, 2022). Third, the interview material reveals how prefiguration actually unfolds at the project level, and what this means for mainstreaming. To understand why these dynamics matter, however, it is first necessary to set out the conditions that gave rise to the programme.

On 1 September 2020, part of the Grimborgwal collapsed in Amsterdam's historic city centre. This was not an isolated incident: multiple quay walls had failed in recent years. Many of Amsterdam's quay walls, some dating back over 300 years, are ageing while being subjected to levels of use far beyond their original design capacity. Increased traffic loads, particularly from heavier vehicles, combined with decades of deferred maintenance and budget cuts, have resulted in a significantly deteriorated structural condition. Prior to the collapse, concerns had already been raised, but no adequate action was undertaken (Korff et al., 2022).

The first dynamic concerns how the published *Factor 20* report functioned as an early act of prefiguration. In 2019, the report *Factor 20* warned that the condition of Amsterdam's quay walls required urgent and large-scale intervention. The title refers to the rate at which renovation efforts would need to accelerate to address the maintenance backlog. By dramatizing a "*what-if we actually solved this*" scenario, the report enacted an ambitious future as if it were already within reach and, in doing so, set the quay wall programme in motion. This provocative statement explored the idea of 'what if' we actually solve this problem, set against the logistical challenges it would involve.

In response, the municipality of Amsterdam indeed took action and established the *Programma Bruggen en Kademuren* (PBK), aimed at addressing the extensive challenge of renewal and

renovation. It aims to renovate 200 km of quay walls in the coming decades: roughly 5 kilometres of quay walls should be replaced every year (Gemeente Amsterdam, 2020a). This challenge was deemed impossible: besides the costs, the city would become unliveable, market parties would not be able to deliver the people, nor the machines and the demanded use of resources would take its toll on the environmental and sustainable objectives (Ingenieursbureau, 2025).

Nonetheless, the framing of *Factor 20* caused such a shockwave that direct action followed, such as special quay intervention teams, multiple research consortia and the public-private partnership IPK were established (Parool, 2019). The city has since adopted a broad approach, including establishing an innovation programme and conducting scientific research into existing structures. As a direct result, the bridges' wooden pile foundations and bridge decks were found to be in a far better state than previously calculated, resulting in a huge decrease of quay walls at immediate collapse risk (Ingenieursbureau, 2025). Revealing that even though the factor 20 framing is now regarded as too pessimistic, acting as if the idea were settled led to direct action in the form of an innovation programme and scientific research. Although this prefigurative instance strongly aided the renovation challenges of the quays, adaptation objectives were not included in these developments, noted by a municipal interviewee, explaining how some projects established then do not fit the current strategy on sustainability, let alone adaptation:

"You have to realise: 'Sustainable, unless' was not yet in force at the time. The sustainability expert in my team is super disappointed with the ECI values (Environmental Cost Indicator) of these three [consortium] parties. An awful lot of steel goes into the ground and they say that you can reuse those steel pipes in 100 years... Those projects are simply from a time before the current strategies were in place. "

The second dynamic concerns how Amsterdam's adaptation strategy enacts a future condition as if it were already settled. The city commits to becoming fully circular, halving resource use, and being fully prepared for climate change by 2050 (Gemeente Amsterdam, 2021). This last goal in particular remains vague, which makes it worth setting out the concrete adaptation objectives the municipality has defined across its three central documents: the *Strategie Klimaatadaptatie 2020*, the *Voortgangsrapportage Klimaatadaptatie 2022*, and the *Agenda Klimaatadaptatie 2024-2026*.

The clearest prefigurative move is the ambition to steer adaptation towards the "new normal": the systematic integration of adaptation into all urban development, through principles of structural integration, a pivotal role in every project, clear requirements, support for promising pilots, and the identification of areas in which to scale them (Gemeente Amsterdam, 2020). In enacting these principles, the municipality treats the systemic integration of adaptation as if it were already adopted. The 2022 progress report makes the as-if logic explicit, insisting that *"the discussion about the appropriate climate-adaptive solution should ultimately become just as normal as the discussion about the type of asphalt"* (Gemeente Amsterdam, 2022, p.21).

Yet this enactment is not sustained through to implementation. The most recent agenda acknowledges that, even under the most optimistic climate scenario and if all planned activities are carried out, Amsterdam will not be adequately prepared by 2050 (Gemeente Amsterdam, 2024). The PBK's own execution plan echoes this, stating that the technical water system has *"reached its limits"* while still framing structural integration of adaptation as a necessity yet to be realised (Gemeente Amsterdam, 2022a). The Amsterdam financing gap reinforces the pattern: the

costs of weather-hazard consequences (e.g. heavy rainfall) fall outside the allocated adaptation budget (Gemeente Amsterdam, 2024), leaving open the question of who pays, and pushing the challenge into the long term, throwing the hot potato just a little further.

As with Factor 20, then, a prefigurative act produced real institutional movement, the strategy genuinely sets adaptation as the intended default, but again the adaptation content fails to travel with it from ambition into delivery.

The third dynamic emerges from the eight quay-related interviews, where prefigurative behaviour surfaces at the project level, though either in weak, isolated, or reactive forms. The impact of contractual details in combination with prefiguration appears through the experiences of a sustainability manager from a contracting party:

"The municipality of Amsterdam had issued a tender focusing on nature inclusiveness in the quay. Then you offer the possibilities and create the conditions for contracting authorities to go 'wild' in their design."

In prefigurative terms, this is a small but telling instance of as-if enactment: by writing nature-inclusivity into the tender as though it were standard practice, the municipality momentarily prefigured an institutional condition that has not yet been formalised at the regime level. The result is not a system-wide shift but a single project in which adaptive innovation was made possible.

However, upon closer examination, institutional prefiguration stays sporadic and reactive rather than systemic. The ambition of weaving the new normal into every project remains limited, even so, implementing adaptation remains a project-to-project negotiation. The instances where prefiguration does appear are either small or rather reactive than anticipatory. One project manager working within one of the IPK consortia wishes this what-if thinking to be more structurally part of the public-private dialogue, stating:

"What is the consequential damage if we do not make the city heat-resilient now? Then you have a different conversation with the client about the extra costs now versus the damage in thirty years."

This reframing is itself a small prefigurative move: reasoning *what if* long-term consequences were already the dominant decision criterion, in advance of any institutional rule requiring it. The quote of the former PBK director on the prolonged action to several collapsing quays is reflective here again, echoing the reactive logic identified under timing factors in the previous chapter.

The pattern reflects a responsive rather than anticipatory institutional logic: adaptation enters the agenda through crisis rather than foresight, and only when the costs are so big they become inevitable. The implications for mainstreaming are clear: relying on external shocks is neither a reliable nor a desirable pathway to structural change.

5.2.2 Secondary Case: Hofplein, Rotterdam

Whereas prefigurative practice at the quays surfaced mainly in policy documents and only faintly in the interviews, Hofplein presents the opposite: the reviewed documents reveal little institutional prefiguration, while the interviews contain rich data on how prefigurative dynamics unfolded. The section, therefore, begins with Rotterdam's adaptation policy (2013) and its water

and climate-adaptation programme (2025), establishing the different institutional context against which the interview accounts can be read. It then turns to the interviews, where prefiguration emerges through *De 7 Stadsprojecten*, a progressive alderman, and ambitious project managers.

The foundation of Rotterdam's adaptation policy is primarily the 2013 Rotterdam Adaptation Strategy. Notably, the strategy predominantly addresses water-related challenges, making up 67% of climate-related keywords, while heat adaptation is less prioritised at 33%, substantiating the earlier findings of phase 1 (calculated directly from Gemeente Rotterdam, 2013). The objective of this document was explicit: a 100% climate-proof city by 2025 (Gemeente Rotterdam, 2013).

The second reviewed document is the *Water- en Klimaatadaptatieprogramma* (WKP), which provides an integrated vision for a climate-adaptive Rotterdam for 2027–2030, organised around five strategic pillars (Gemeente Rotterdam, 2025). These span a (1) healthy city focused on sewers and public health, (2) a shift "from pipe to public space" through green-blue transformation and water-permeable paving, (3) co-design that takes the natural soil and water system as the starting point for new development, (4) a climate-robust city interpreting national adaptation standards for the Rotterdam context: and (5) an explicit social-equity framing that ties adaptation to vulnerable neighbourhoods.

Significant for this analysis is that the WKP merges the *Rotterdams Weerwoord*, which defines the city's climate-adaptive measures, with the *Gemeentelijk Rioleringsplan* (GRP), the sewage programme. This constitutes a notable institutional shift as Rotterdam now funds adaptation through the sewer tax (*rioolheffing*), so that adaptation is no longer a separately contested budget but is structurally embedded in mandatory infrastructure financing and anchored as an *omgevingsprogramma* under the *Omgevingswet*. Compared to Amsterdam, this move shows a more direct effect on institutional change, putting words into action by enacting the structural integration of adaptation.

In Rotterdam, the Hofplein square was rebuilt after the WWII bombing, in the 1950s as part of the modernist *Wederopbouw* (post-war reconstruction). The design of that time left plenty of space for cars, including up to five lanes at the Hofplein roundabout, thereby blocking pedestrian access to the fountain (Gemeente Rotterdam, 2020). The Hofplein transformation is part of *De 7 Stadsprojecten*, founded in 2020. After the COVID-19 pandemic, a number of progressive aldermen in the municipality developed a plan that aims to give Rotterdam seven green "lungs" by transforming Hofbogenpark, Hofplein, Westblaak, Schouwburgplein, Alexanderplein, Rijnhavenpark, Park Maashaven, and Tidal Park Feyenoord (Gemeente Rotterdam, 2020). During the pandemic, it became painfully clear how much the city needed outdoor space, which was either lacking or, at best, in the form of concrete with limited accessibility. The *7 Stadsprojecten* is funded by the City of Rotterdam with a budget of 233 million euros, transforming these seven iconic places into green, healthy, productive, inclusive, and compact public spaces (Gemeente Rotterdam, 2020).

Three interviews were conducted to analyse if and how institutional prefiguration is performed at Hofplein. The first was with the project manager of the contractor at Hofplein, who was candid about the internal drive of the municipality stating "*that has been the city of Rotterdam completely. They have been very ambitious with this project.*"

Notably, this project is being executed under a traditional RAW contract, which is at odds with the findings of phase 1, in which contractors repeatedly argued that collaborative contracts (e.g. *bouwteam*) are essential for climate-adaptive building to succeed. The same project manager echoes this argument, *"in any case, I would choose a different contract form, not RAW. As a contractor, you are far freer under any other contract form."*

This contradiction, where a more traditional contract has opened the space for a progressive proactive attitude towards adaptation, is not explained by the project manager. The possible manifestation of anticipatory what-if thinking is therefore extra relevant in this project. Additionally, the project manager describes a tension with the local transport authority in the ongoing execution of the Hofplein. One of the complaints of this local authority is, for instance, that the increase of trees at Hofplein will block the tram driver's view and thereby ultimately obstruct the square's overall accessibility, the contractor's project manager describes this:

"You have an ambitious club that wants a sustainable system. You have another club [the local transportation authority] that wants the city to remain accessible. And they [the latter] usually win. If we start arm-wrestling, they win."

This dynamic mirrors that of the IPK case, where UNESCO heritage and municipal maintenance stakeholders form a strong lobby that frequently overrides sustainability-oriented boundary spanners. Boundary spanners are the individuals or organisations that act as a bridge between different departments, organisations, or sectors. Their efforts include creating and simulating (informal) networks and interaction, and thereby building trust (Edelenbos & Van Meerkerk, 2015). At Hofplein, the transportation actor is the one who most strongly resists the transformation due to the aforementioned concerns about the square's car and tram accessibility.

The second and third interview, with the project manager and project leader of Gemeente Rotterdam, provided additional insight from the municipal side. As the contractor suggested, any anticipatory practice would most likely be found here, since the municipality was responsible for the project's vision and design framework. Whereas the contractor's role has mostly been to pivot execution, following traditional contract logic.

The municipal project manager emphasised how thoroughly climate goals had been embedded in the wider *Stadsprojecten* programme, noting they were *"rock solid in the programme of requirements [...] and alderman [name] really worked hard for that."* On its own, embedding climate goals into a legally binding programme of requirements is not prefigurative, it is an institutionalised rule. This is institutional prefiguration in its accomplished form. What makes Hofplein analytically prefigurative is the anticipation ahead of it, often entailing acting beyond one's authority. Thereby enacting those goals as settled before they were officially institutionalised.

This indicates that prefigurative behaviour at Hofplein did not operate at the project level, as is regularly the case in many researched examples of, for instance, grassroots activism igniting prefigurative practice (Lawford & Sareen, 2025; Törnberg, 2021; Yates, 2015). Instead, anticipatory what-if thinking, within the civil service, enabled Hofplein to follow the logic of the programme of requirements. Thus, embedding the mandatory climate goals into the overarching *7 Stadsprojecten*, before they were the norm.

When asked what enabled the institutional embedding of climate goals in the wider 7 *Stadsprojecten* programme, the municipal project manager gave an explicit conditional frame:

"You have to have a financial injection. There must be a number of progressive people in your civil service. You have to have someone in your council who really has guts, and that also has to stick for a while in the periods that follow. So a few things have to fall together."

Although not the complete equivalent, these conditions do strongly align with the categories Yates (2021) describes the fundamentals of prefiguration in social movement strategy: reproduction, mobilisation and coordination. Reproduction here is the maintenance of the resources, skills, relationships, and infrastructure that a movement needs to act at all. Then, mobilisation is the deployment of those resources, putting the movement's capacity to work toward a goal, including the establishment of new institutions to support these anticipatory practices. And lastly, coordination is the imagining, planning, and directing of activity toward goals (Yates, 2021). Some context but also given by the project manager: in 2017, the municipality of Rotterdam sold its shares in the energy company Eneco, generating almost 1 billion euros for the city. In terms of reproduction, this enabled the initiation and maintenance of the resources and infrastructure needed for the 7 *Stadsprojecten*. Later, a civil servant reproduced the programme's green goals through strategic work, as described in the citation below. And finally, the solid coordination of the overarching *Stadsprojecten* vision. By imagining Hofplein as one of the 'green lungs', before it was officially adopted, and repeatedly directing the square renovation towards the greener, better-adapted and cooler place it should become. The citations below further elaborate on the work of these boundary-spanners.

Admittedly, these fundamentals described by Yates (2021) are not the analytical lens for identifying institutional prefiguration in practice and do focus on social movements rather than institutions. Nevertheless, they do share an important perception: prefiguration is rarely a complete strategy on its own, meaning prefigurative behaviour in practice should be understood as an element operating alongside conventional procurement, regulation, and planning, not completely replacing it (Yates, 2021). This connects to the conditional frame described in the aforementioned quote, which described Hofplein's anticipatory behaviour as built from multiple elements: a group of progressive civil servants enacting an idea as if settled, whilst having the guts to act beyond their official authority.

The strategic, anticipatory work of one of these civil servants is described directly in the interview:

"He had a story, knowing full well that 'oh yes, at this council we can get this through.' But of course there is also a bit of political sensitivity in a civil servant. You also have to have a feeling for what you can say against whom, and where, to achieve those goals. That is purely strategic thinking."

This description fits a textbook example of a boundary-spanning proactive actor engaged in prefigurative work: anticipating and shaping a narrative suited to the specific moment, and understanding the necessities after exploring desired what-if scenarios. Before the idea is actually settled, help establish it. Subsequently, this created a vivid vision of a desired future before its actual realisation.

The clearest example of prefigurative enactment, however, occurred when the final design of Hofplein was made public (Liukku, 2020). The following combination of elements emerged: actors

acting beyond their authority, passing an idea as if settled and anticipating a future proposal not yet decreed:

"COR Geluk actually came up with a kind of crushing idea... Then the alderman immediately published a piece about it in the AD newspaper. That was extraordinary, without any money having been determined in the Council. There was nothing yet."

Institutional prefiguration in optima forma, by publishing the design as if it were already approved, the alderman generated a public expectation that effectively closed the political space for rejection, as supported by the project leader of Rotterdam:

"We received so much support, and because of that, politics could not go back. It was in the newspaper and everyone shouted 'hiep hoi, we have to do this, rather start tomorrow than the day after tomorrow.' The win was actually already in."

At the same time, regime tensions are also confirmed from the municipal side. The regulatory framework governing local rail safety (*wet lokaal spoor*) has acted as a persistent blockade against the green ambitions of Hofplein, requiring the project manager and project leader to continuously advocate for their green ambitions:

"Everything we stimulate, more pedestrian routes, more pedestrians, more cyclists, more public transport passengers, more green, is against the assessment framework of the wet lokaal spoor. We still do not have the final permit."

This introduces the final prefigurative element identified at Hofplein: the role of the project manager and the project leader of the municipality, and their teamwork throughout the project. During the interviews, it became clear that the project manager and project leader have had a very important role in the ceaseless negotiations with passive permit issuers, opposing transport actors and frustrated entrepreneurs fighting the traffic-calmed plans for Hofplein. Yet rather than waiting for formal authorisation, the team pushed through regardless:

"We think it's exciting. We also see all those pictures in the newspaper, and we see that everyone thinks it's so inspiring. Just try it, see if you can get that funding, and when the process was running, it turned out that the permit would not be issued at all, because we got a lot of opposition. But yes, we actually just went on like an elephant and tried to keep as much as possible afloat with multiple and very complicated negotiations."

This analysis has shown how institutional prefiguration unfolds in practice, surfacing the actors, relationships, and decision logics through which adaptation is anticipated rather than postponed. Yet observing prefiguration in two cases reveals only how it operates under present conditions. The final phase, therefore, turns from the present to the future, operationalising institutional prefiguration and the quay findings into an ABM to simulate what mainstreaming might look like, in line with the central question: what if we were ready for adaptation?

5.2.3 Effect on Implementation: Programme-Level Default

The second part of the sub-question asks what effect institutional prefiguration has on implementation. The comparison between the Quays and Hofplein shows that this effect is not automatic. Prefiguration contributes to implementation only when anticipatory ideas become connected to the institutional conditions through which projects are designed, commissioned

and executed. Acting “as if” adaptation were already mainstream has limited effect when it remains a project-level ambition, but becomes more consequential when embedded above the individual project.

In the Quays, the effect of prefiguration on adaptation implementation remains weak. Anticipatory ideas such as “the new normal” or the Factor 20 logic either stay too distant from implementation or support quay-wall renovation rather than adaptation specifically. As a result, adaptation does not become a stable requirement, but continues to enter the process through negotiation, crisis response or individual initiative. Its effect is therefore mostly agenda-setting: it helps imagine a different future, but does not improve implementation in present practice.

Hofplein shows a stronger effect. Here, adaptation-related ambitions are supported by the wider Stadsprojecten programme and embedded in the project’s institutional setting. The anticipatory work of aldermen, project managers and other boundary spanners makes the adaptive future appear already settled, so adaptation becomes part of the project logic from the start rather than something to be reintroduced or defended. Boundary spanners are central because they carry the adaptive ambition across phases and institutional boundaries: from political vision to programme requirements, from design to execution, and from municipal ambition to contractor practice.

The effect of institutional prefiguration can therefore be understood as a movement from optional ambition to institutional default. It contributes most strongly when it reduces the need to renegotiate adaptation in every individual project, making it appear normal, expected and legitimate before formal regulation requires it.

5.3 Phase 3: Modelling Institutional Prefiguration: The Quays

This final phase unfolds in two parts. The first sets out how institutional prefiguration was operationalised, translating the qualitative findings into institutional statements through Institutional Grammar and then into an ABM. The second turns to what the model reveals: how prefigurative mechanisms, enacted from a rule-based route or an advocacy based route, shape whether adaptation crosses from exception to standard practice.

5.3.1 From Statements to Model

The qualitative case analysis of the quays set the context, after which it was decided to focus specifically on the IPK (Innovatie Partnerschap Kademuren) project within the broader Amsterdam quay wall landscape. The rationale being that it is a finished project with clear scope boundaries, and that there have been long-term, multi-actor dynamics between the municipality and three consortia. The input for this model has thus been a combination of the case analysis and 4 interviews with actors working in or directly with the IPK project. Following the Institutional Grammar method, four interviews have been analysed for institutional statements. The previously coded citations in ATLAS.ti helped to obtain a solid overview of all relevant statements by these actors, whose backgrounds are:

- Respondent 1: project leader of construction company in consortium
- Respondent 2: project manager of engineering company in consortium
- Respondent 3: project leader of municipality

- Respondent 4: design leader of engineering company connected to consortium

Ultimately, identifying institutional citations and then dissecting these statements into the ABDICO elements made the translation into code comprehensible. The final 17 statements were directly used to inform the model, yet not every individual statement could be translated into a code mechanism. The full list of 47 statements indirectly shaped the logic of the model, for instance, by informing the narrative behind it, but details were left outside the scope of the model. The sheet behind this overview enabled the first trial of agents and model parameters, the full Excel is provided in Appendix E. Throughout this section, the codes such as R01, N3 and S19 refer to the ABDICO statements illustrated in Figure 9 or Appendix E.

ID	[A] Attribute	[D] Deontic	[I] aim	[B] object	[C] Condition	[O] Or else	Type
R01	Municipality of Amsterdam	must	draws up programme of requirements	programme of requirements (PoR)	at the start of a quay wall project	project cannot start	rule
R02	Engineering firm	must	design within the boundaries of the PoR	design	when design assignment has been issued	design is rejected	rule
R05	Municipality	must	apply for permit when altering appearance	permit	when modification affects UNESCO heritage	no permit, project blocked	rule
R11	Contractor	must	take into account cooperation, sustainability, nuisance limitation and innovation as award criteria	bid dossier	when tendering for IPK	bid is rejected	rule
R13	V&OR	must	approves construction on maintainability and uniformity	innovation	before innovation is adopted city-wide	innovation is not included in regular management	rule
N02	Municipality	should	accommodates environmental resistance surrounding trees	project scope	when public resistance is high	longer permit procedures, angry residents	norm
N05	Engineering firm	should not	raises climate adaptation without reason	design proposal	for a standard quay wall project	extra work, unclear added value	norm
N06	Frontrunner within municipality	should	champions opportunities for inclusion in management	innovation	when innovation has been demonstrated in a pilot	opportunity dies a quiet death	norm
N07	V&OR	should	commits as owner	innovation	prior to inclusion in regular management	innovation is not scaled up	norm
N08	Consortium	should	frames innovation as climate-adaptive	bid	as justification for time-driven choices	(geen sanctie)	norm
N13	Contractor	should	advises proactively but primarily follows client request	execution / design choice	when client expresses a specific preference	loss of assignment / reputational damage	norm
S02	Engineering firm	-	restores quay wall to existing state	design	when no explicit deviation has been instructed	-	shared strategy
S08	Municipality	-	issues vague tender with 'opportunities' instead of	tender	in innovation tenders	-	shared strategy
S10	Silent majority within municipality	-	waits for precedent or direction from above	adoption decision	for a new/non-standard solution	-	shared strategy
S14	Contractor	-	receives no compensation for extra costs when using the most sustainable method (lowest MKI)	innovation proposal	during contract negotiations	-	shared strategy
S18	Contractor	-	independently coordinates with all stakeholders in project	project coordination	for IPK projects with multiple municipal departments	-	shared strategy
S19	Consortium	-	follows client request, even against own professional advice	project choice	when there is conflict between own advice and client wish	-	shared strategy

Figure 9: Final ABDICO Statements Overview

An example of how this operationalisation was executed is illustrated in Table 6, which shows how statements R01, R02 and S19 determined the core model mechanism.

The combination of these statements led to the core model mechanism of the binding-PoR lever, which operationalises institutional prefiguration as follows: with the lever off, the PoR stays vague and the consortium falls back to its default: with the lever on, the PoR mandates adaptive, and R02 + N05 force the bid to follow. The lever thus operationalises institutional prefiguration as an act of writing the future institutional rule into the present project. This binding mechanism is not prefigurative because it is mandatory, but because there is no higher authority requiring it. The

project thus imposes this mandate on itself in anticipation of a regime-level rule that does not yet exist, acting as if the future obligation is already in force to help bring it about.

Table 6: Operationalisation of ABDICO Statements into Model Mechanism

Statement	Rule	Mechanism
R01	Municipality draws up programme of requirements (PoR)	PoR is global variable in project
R02	Consortium must design within PoR, otherwise, design is rejected	Agent procedure 'make-design' using PoR as constraint/enabler
N05	Consortium should not raise adaptation without reason	Default: does not propose adaptation unless trigger is true

In parallel with drafting the model mechanism and building pseudocode, a minimalist narrative was created to understand how the actors relate to one another. By setting up such a story, relevant concepts, agents, their decisions and their interactions were contextualised and made vivid. The qualitative case analysis combined with the interviews allowed for a grounded narrative of the IPK project, characterising its two central agents:

The municipality owns and is responsible for the renovation and renewal of the quay walls, and holds high ambitions to become a climate-adaptive city by 2050. To deliver the renovation faster, more cheaply, and with less nuisance, it issues a range of tenders and cooperation agreements to the market. After concerns were raised about deteriorating quays, the municipality set up a specific innovation and research team to ensure future-proof renovation through innovation. Frontrunners are individuals within these departments, while it strives for adaptation, it struggles with the contract logic and financing required to embed it. Within the landscape, trees illustrate this tension well: they are a straightforward and effective way to make quay walls more climate-adaptive, and retaining existing trees carries the added benefit of reducing both residential resistance and project time, since felling permits are slow to obtain (N02). Yet trees with poor soil space never fully mature, diminishing their cooling effect and thus their value for heat-stress reduction. The municipality's room to manoeuvre is further constrained by the UNESCO canal-belt status, which it must take into account whenever the appearance of the quay is altered, and by its own internal fragmentation: a silent majority of departments, some with a strong veto. Notably, even where innovations have been successfully tested, the V&OR maintenance department can block adaptation when it anticipates high maintenance demands. The municipality's goal in this project is to get the quay walls renovated quickly, cheaply, with minimal disruption, and ideally with sustainability objectives integrated.

The consortium enters as bidder and executor. It is driven by a profit motive, possesses professional expertise it is partially invited to use. It operates under a risk-aversion norm of following the client even when it disagrees. In the bid narrative, it innovates as climate-adaptive (N08), often as a post-hoc justification for choices actually driven by time or cost. It absorbs the cost of using the most sustainable method (lowest ECI) without compensation (S14), as the municipality does not reward this separately. Once the contract is won, it coordinates with multiple municipal departments at its own expense, the "hornet's nest" (S18). When the consortium's professional advice diverges from the client's wishes, the client prevails (N13, S19). Within consortia, frontrunners are potentially present too, doing anticipatory work. Its goal is to

win and execute contracts while making a profit. The ABDICO statements and narrative, together, formed the code in NetLogo, found in Appendix F.

Ultimately, the model operationalises institutional prefiguration through two central mechanisms. First, a rule based route, in which a binding programme of requirements route mandates adaptation from a position of formal authority. A anticipatory rule within the project, acting as if the formal obligation already exists. And second, a frontrunner as an advocacy-based route to institutional change, lacking the authority to compel anything, campaigns for adaptation before the existence of any rule requiring it. Both are forms of institutional prefiguration, enacting a future condition as if already in place, but they differ in whether that future is written into a rule or carried by an actor. These two mechanisms allowed for the exploration of two what-if scenarios stated as follows: (1) What if the programme of requirements were binding in terms of adaptation? And (2) What if a frontrunner was active to support adaptive innovations as if they were settled?

5.3.2 Model Outcomes

To understand what this model reveals about institutional change, two experiments were conducted to test the abovementioned scenarios in run A (main findings) and run B (sensitivity analysis). However, since modelling institutions is highly complex, it is not claimed that this model's outcomes predict the future, nor does it portray reality. Rather, the development of the model itself and the institutional dynamics are the subject of interest.

Run A

The main findings from run A are illustrated in Figure 10, which shows the effects of the binding-PoR lever and the frontrunner lever on mainstreaming across the four possible conditions (n = 20 seeds each). What these numbers ultimately represent is not abstract lines of code, but they reproduce the narrative described earlier. In simplified form, these results reveal the dynamic described by the interviewees. Two outcomes are notable: first, the large effect the binding-PoR lever produces on the headline metric: mainstreaming occurred in 5% of runs with the lever OFF and 95–100% of runs with the lever ON (Figure 10, Table 7).

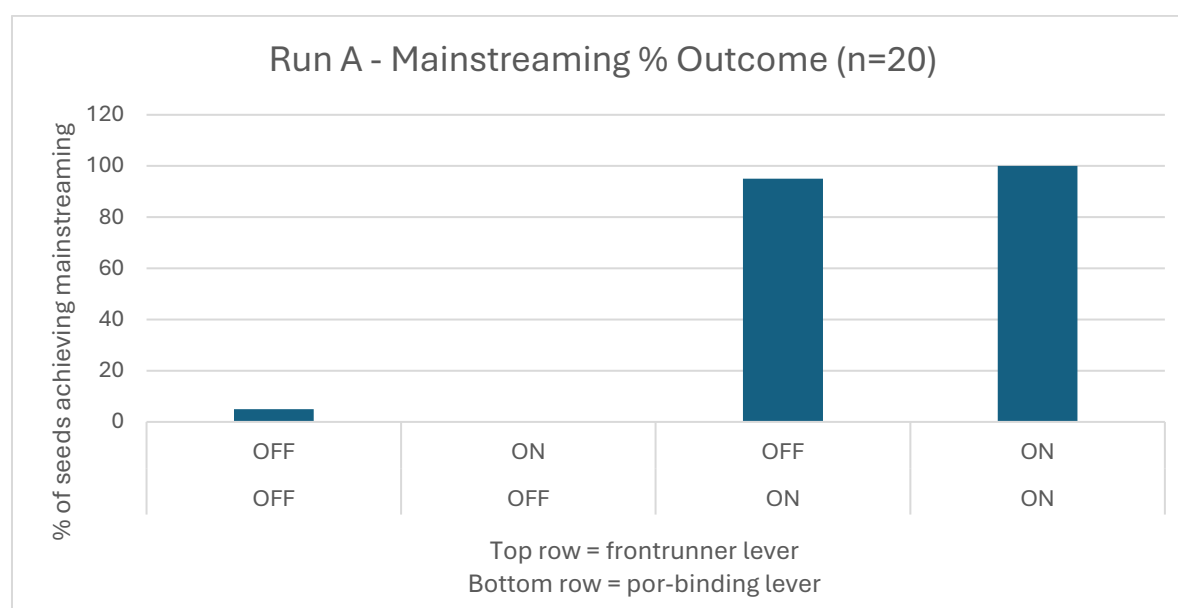


Figure 10: Run A – Mainstreaming % Outcome

When mirrored in the narrative, this could be regarded as the consortia following the client's wishes, even when they disagree (S19). Thereby, the consortia's voluntary climate focus is not altered, rather, its discretion is overridden. In terms of the hot potato analogy, the binding-PoR lever resolves this issue, by deciding who throws the potato first. Once the client demands adaptation, the consortia will follow this lead and act accordingly.

The second headline is that the frontrunner lever reveals no comparable effect to mainstreaming. The effect the frontrunner brings to this run can be disregarded: with the binding-PoR lever OFF, switching the frontrunner ON moves mainstreaming from 5% to 0%: with the binding-PoR lever ON, from 95% to 100%. The mean number of adaptive-projects-built also shifts substantially, from ~3 with the lever OFF to ~15 with the lever ON, with a standard deviation of 1.6–3.6 across seeds, confirming that the model produces run-to-run variation rather than a single deterministic trajectory.

When held up against the narrative, this frontrunner struggles to make an impact on mainstreaming because it encounters a bootstrapping problem. This means it is trying to create the very conditions it needs to grow. The frontrunner cannot build momentum because the approved adaptive projects it needs to act, barely exist yet: it needs the very uptake it is trying to create. This echoes the phase 1 finding that without an institutional owner, promising ideas are explored and then quietly abandoned.

Table 7: Run A - 2x2 Findings

Lever	Frontrunner	n	%mainstreamed	Mean built	Std built
OFF	OFF	20	5	3.1	1.744163199
OFF	ON	20	0	2.95	1.571958216
ON	OFF	20	95	15.1	3.462581939
ON	ON	20	100	15.55	3.546310165

Together, these results demonstrate that the institutional dynamics can be operationalised into agent rules that produce systematically different system-level outcomes. The next subsection tests whether these patterns hold across alternative values of the accept-threshold.

Run B

The sensitivity analysis of run B reports the same 2×2 of levers across four values of the accept-threshold, the parameter governing how much accumulated precedent (successful adaptive pilots) V&OR requires before mainstreaming can occur. The aim is not only to assess whether the run A findings are robust to this parameter or specific to the calibrated value of 3, but an additional scenario can be tested, exploring what if the municipality were less or more risk-averse. The mainstreaming rates across all 16 conditions are shown in Table 8. The pattern is regime-dependent: the binding-PoR lever effect strengthens then degrades as the threshold rises.

At threshold 1, mainstreaming occurs in 80–100% of runs across all four conditions. The institution is effectively permissive, and the lever provides only a modest additional push (80% to 100%). This can be understood as a tolerant V&OR which adopts a climate-adaptive innovation after just one successful pilot. This outcome confirms that the threshold is a binding constraint in the model rather than the bidding behaviour of the consortium, which is not a realistic

representation of V&OR's caution, as described in the interviews, but serves as a boundary case for interpretation. At threshold 3, the pattern logically matches run A: the lever moves mainstreaming from ~5% to 100%, while the frontrunner has no detectable effect. At threshold 5, the lever still produces 80% mainstreaming but the previous 100% rate is lost: the frontrunner remains absent. Held against the IPK narrative, this situation shows a conservative V&OR that demands a large body of evidence before adopting. In other words, before changing standard practice, there needs to be a sustained track record of successful pilots.

Table 8: Run B: Mainstreaming % per Threshold Value

Threshold	F-OFF LEVER OFF	F-ON LEVER OFF	F-OFF LEVER ON	F-ON LEVER ON
Threshold 1	80%	90%	100%	100%
Threshold 3	5%	0%	100%	100%
Threshold 5	0%	0%	80%	80%
Threshold 7	0%	0%	50%	70%

The most insightful result here is at threshold 7, the lever alone produces 50% mainstreaming, and adding the frontrunner increases this to 70%, the only condition in either experiment where the frontrunner shows a meaningful effect. Echoing the narrative, this outcome shows that for the frontrunner to have any effect, it needs two things at once: enough approved adaptive bids to build motivation (binding lever ON), and a system where mainstreaming has not already occurred, leaving room to act. At low thresholds, mainstreaming fires early, before the frontrunner accumulates influence, so no room is left. Only at threshold 7, where the institution is most conservative and mainstreaming is hardest to reach, do both conditions hold long enough for the frontrunner to tip the outcome, raising mainstreaming by 20 points (50% → 70%). This is the single condition in either experiment where advocacy-based prefiguration has a measurable effect.

5.3.3 Implication Institutional Change

This model is exploratory and does not predict the IPK programme's trajectory: its value lies in explaining what these outcomes might reveal on institutional change. Institutional change in this context is understood as an institutional landscape in which adaptation is fully mainstreamed.

The operationalisation of institutional prefiguration into an ABM and the dynamics this model generates reveals three things:

1. Change comes from changing what is most logical, not persuasion

In run A, the binding programme of requirements lever does not force the consortium to value adaptation, it takes away its discretion to leave it aside. Hereby, mainstreaming grows when the rule actors default to is adaptive, rather than a negotiable option project-to-project.

2. Rule-based prefiguration moves the regime more reliably than advocacy-based

At both runs, the binding lever has a stronger effect on mainstreaming than the advocacy-based frontrunner, which barely transforms outcomes. The two forms of prefiguration are not equally effective.

3. The effect is regime-dependent: change requires institutional room

As V&OR grows more conservative, the lever's power decreases, and the frontrunner becomes visible only in the most resistant setting, where the anticipated rule alone cannot carry adaptation through. Institutional change is thus regime-dependent: it is affected by how much precedent the institution requires before a practice becomes standard.

Across both runs, then, the model's outcomes of mainstream adaptation are driven by institutional configuration rather than technical power or the consortium's goodwill: a binding rule overrides discretion, while frontrunner advocacy stays inactive unless the institutional setting leaves room for it. What these mechanisms mean for institutional change more broadly, and how they sit against the prefiguration literature, is taken up in the Discussion.

6. Discussion

This discussion starts with interpreting the research findings and synthesizing the key takeaway of the thesis. Then, the thesis findings are discussed in light of existing theory and literature. After, the thesis' interpretations will be elaborated on in the implication section, which suggests key contributions for science and practice. The chapter then reflects on the robustness, transferability and limitations. This then flows in the outline of future research.

6.1 Interpretation

This thesis sets out to understand what role institutional prefiguration can play in mainstreaming adaptation by examining how public and private actors perceive the challenge (past), how anticipatory practice already unfolds in two cases (present), and how it behaves once operationalised in an agent-based model (future). To do so, the multi-level perspective was used to localise the implementation gap in the incumbent socio-technical infrastructure regime where adaptation pilots are positioned as niches under landscape pressure such as climate hazards.

Overall, the thesis' findings follow a past-present-future chronology, all converging on the same key takeaway: the implementation gap is not primarily a technical or financial problem: rather, it is rooted in institutional challenges, such as fragmented responsibilities and persistent procurement logics that hamper mainstreaming. The results suggest that the regime change for mainstreaming may lie at the level of tender and procurement design, where prefigurative institutional enactment can ignite change.

Institutional prefiguration cannot force this transformational change: it can merely create the conditions of possibility. The regime of urban built infrastructure will thus not be persuaded into a new configuration, instead, by altering the rules institutional actors default to, institutional prefiguration will create the prerequisites under which such change becomes more likely.

6.2 Confrontation with Existing Literature and Theory

Concerning phase 1, the study affirms the established categories of Runhaar et al. (2018) explaining what factors influence mainstreaming adaptation through interviews across the private and public sectors. The study goes further in refining the categories to the urban built infrastructure domain, specifically by underlining the importance of organisational factors, such as fragmented responsibilities, and the ambiguous, temporal characteristics of the adaptation problem. The study challenges the role of financial resources in adaptation mainstreaming, attributing this to other underlying factors, such as trade-offs, stakeholder misalignment and an ambiguous shared definition of adaptation. Together, this means that the thesis moves the barriers literature from a list of obstructing factors toward an explanation of how those factors become institutional defaults

Compared to the recently published work of Dorst et al. (2026), the thesis affirms the holistic multi-level approach to understanding adaptation as part of a broader socio-ecological-technical system in urban infrastructure governance. The analytical lens this thesis adopted has strongly aided this perception by enabling research of abstract concepts, such as mainstreaming, adaptation pilots, procurement practice, and the implementation gap, by considering their

respective positions across the system.

Yet the thesis's findings reveal some contradictions regarding the contract outcomes. Whilst the findings of phase 1 strongly point towards traditional contract details being a significant obstacle to mainstreaming adaptation, the phase 2 findings at Hofplein qualify this, succeeding under a traditional RAW contract, where adaptation did not seem to suffer. Precisely in its uniqueness, the Hofplein illustrates its success. Institutional prefiguration is allowed to flourish at the programme level, instead of project-to-project variation. In this case, a solid foundation for prefigurative practice serves as a substitute for a collaborative contract. Ultimately, this contradiction thus connects to the overarching theory throughout the phases of this thesis, implying that institutional prefiguration contributes not by persuading actors but by changing the rules of the game. The rule actors default to only sticks when it's enacted above the project level, and that is stronger than the details of the building contract.

Phase 3 helps to explain this: by operationalising the institutional dynamics from the earlier phases, it makes visible how prefigurative practice does and does not move the regime. Most significantly, it gives insight into how institutional prefiguration works. The binding lever does not persuade the consortium to value adaptation, it removes its discretion to leave adaptation out, which is not the same. This aligns with Cooper's (2020) argument that prefiguration operates by enacting conditions "as if" they were already real: the effective prefigurative act is not convincing individual actors but changing the rule they default to. Where adaptation is the default rather than the exception, it no longer has to be re-argued in every project. Prefiguration, through this reading, creates conditions of possibility rather than compelling behaviour.

Whereas the previous work of Törnberg and Cooper has laid the first steps in connecting prefigurative politics to institutional change (Cooper, 2020; Törnberg, 2021), this study takes this further and integrates the role of institutional prefiguration in mainstreaming adaptation in the domain of urban built infrastructure. Whilst literature on prefiguration often describes it as an informally organised activity mostly concerned with bottom-up actors (Törnberg, 2021; Yates, 2021), the thesis challenges this through the identification of project-transcending prefigurative elements which are established through top-down programmatic decision-making. This extends prefiguration theory by showing that "acting as if" can be institutionalised through programme-level rule-making, rather than only through informal or bottom-up experimentation.

Here, the model in phase 3 exposes a structural weakness in advocacy-based prefiguration, as the frontrunner gains influence only once adaptive projects exist. Yet, those projects are precisely what it is trying to bring about, the bootstrapping problem described earlier. This is more than a model distortion, it mirrors a recognisable real-world phenomenon in which pioneers need the very conditions they are working to establish. This dynamic is recognisable in infrastructure innovation more broadly. For instance, Nature-based Solutions (NbS) must be standardised before they can be adopted, but they will not be adopted because there is no standard, as concluded by the published work of Dorst et al. (2026) too. The thesis affirms the importance of experimental environments in urban built infrastructure, where niches, such as NbS and adaptation innovations, can mature and standards can be tested.

A critical addition to this is the one situation in which the frontrunner did matter, which brings an

interpretation of institutional change. It became visible only in the most conservative setting, where mainstreaming was hard to reach and room therefore remained for the frontrunner to make a difference. Read cautiously as the model is exploratory and bottom-up actors were not interviewed, this suggests individual efforts may matter most where the institution is least permissive, and least where change is already underway. Rather than a flaw, this points to a complementarity: the strongest case for transformation is not top-down rule or bottom-up advocacy alone, but the two coinciding.

6.3 Implications

This section now turns to what the thesis findings mean and why they matter, distinguishing among practical, theoretical, and methodological implications.

Practically, the thesis suggests that mainstreaming adaptation requires shifting attention from individual project ambition to the institutional conditions under which projects are commissioned and delivered. For municipal clients and public asset owners, this means programme requirements, tender criteria, risk assessments and contract language. As long as adaptation remains loosely articulated, building firms will have little incentive to include it, since it might reduce their chances of winning a tender. The main practical implication is therefore that public clients should make adaptation part of the default project logic rather than an add-on that has to be negotiated over again.

A second practical implication concerns the importance of an institutional owner. The findings suggest that adaptation innovations rarely scale when there is no actor responsible for nurturing beyond the individual project. An institutional owner is therefore needed to define what adaptation means in a given context, coordinate across departments and projects, and decide how to handle trade-offs among heritage, cost, ecological value, heat stress, and long-term climate risk. This is especially important in urban built infrastructure, where adaptation does not fit neatly within one sector.

For programme managers and boundary spanners, the findings point to the programme level as the key site of intervention. Their role is to prevent adaptation from being reopened as a negotiable project-level ambition each time, and instead to stabilise it across projects through shared requirements, decision moments and institutional ownership.

For building and engineering firms, the implication is that adaptation should not be approached as a purely technical challenge or intervention. Adaptive measures reshape spatial urban quality, risk allocation, public value and political decision-making, and should thus be treated accordingly. These actors can contribute by translating their adaptation knowledge into relevant procurement language, such as risks, avoided damage and co-benefits. Although the thesis suggests that voluntary private-sector ambition remains structurally fragile, these actions help strengthen the presence of adaptation in the default mode.

Theoretically, the thesis contributes to adaptation mainstreaming literature by reframing the implementation gap as one of institutional configuration. Existing barriers such as fragmented responsibilities, ambiguous definitions, limited ownership and procurement constraints do not operate separately: they become powerful through what is considered normal and legitimate by actors in the field. The thesis contributes to institutional prefiguration literature by showing that

prefiguration can happen through programme and procurement-level rulemaking, not only through informal, bottom-up experimentation. Acting “as-if” adaptation were already required becomes institutionally influential when it is translated into the rules, requirements and decision structures through which actors already work.

A key insight at the intersection of theory and practice is that adaptation should not be regarded as an isolated intervention. Instead, it sits within a larger socio-technical system, and successful implementation requires consideration of the interplay between levels of that system. This understanding implies that adaptation should be recognised for its co-beneficial values, such as economic, social and ecological improvement.

Methodologically, the thesis contributes by building a bridge between qualitative case analysis, Institutional Grammar and agent-based modelling. The value of this approach does not lie in predicting real-world outcomes, but in making institutional assumptions explicit. By translating qualitative findings into actors, rules, and scenarios, the ABM enables exploration of how different forms of institutional prefiguration may behave under simplified conditions. This is particularly useful for anticipatory governance research, where the object of study is not only what has happened, but what kinds of institutional futures could be enacted in the present.

6.4 Robustness, Transferability and Limitations

Having outlined the practical, theoretical and methodological implications of the thesis, it is necessary to reflect on the strength and scope of these claims. This section therefore discusses the robustness of the findings, their transferability beyond the studied cases, and the limitations.

The robustness of the findings lies primarily in the convergence between the different phases. The interview findings, case comparison and agent-based model all point toward the same central mechanism: adaptation is more likely to mainstream when it is embedded in the institutional rules and procurement conditions through which actors already operate. The contrast between the Quays and Hofplein further strengthens this interpretation, because the two cases show different degrees of project-level and programme-level prefiguration. Finally, the ABM adds conceptual robustness by making the proposed mechanism explicit, even though it should be read as exploratory rather than predictive.

The findings are analytically transferable rather than statistically generalisable. They are most transferable to Dutch urban infrastructure projects, especially public-private projects with long asset lifetimes, fragmented responsibilities and procurement-based delivery. They may also be relevant to other infrastructure domains in which adaptation is recognised as important but not yet legally or contractually mandatory. The findings are less directly transferable to contexts with different procurement or contract dynamics, fully private projects, or sectors where adaptation requirements are already mandatory.

Despite this robustness, the study also has several limitations. The first set of limitations relates to the empirical material. Only practitioners were interviewed, which means the study captures the perspectives of actors directly involved in project delivery but excludes other relevant voices, such as start-ups, activists, residents or other bottom-up actors engaged in adaptation mainstreaming. This particularly qualifies the conclusion that advocacy-based prefiguration is structurally weak. Since actors who often embody bottom-up advocacy were not directly included

in the empirical sample, this conclusion rests mainly on the model and only partly on case evidence.

A second limitation concerns the scope of the research. One of the main conclusions is that public clients should make adaptation part of the default project logic. However, doing so may require substantial public investment, new funding arrangements and political choices about who pays for long-term climate resilience. This thesis does not examine how these costs should be distributed or financed. The financial and governance arrangements needed to make adaptation requirements feasible therefore remain outside the scope of this study.

A third set of limitations concerns the agent-based model. The model is exploratory rather than predictive: it was designed to operationalise institutional prefiguration and the factors identified in the qualitative phases. Hereby examining the system-level patterns they produce, not to forecast the IPK programme's trajectory. Its scope is bounded, and several sources of institutional friction present in the real case were excluded, most notably the UNESCO canal-belt constraint, residents, and the greater part of the inter-departmental fragmentation within the municipality. Because the excluded actors function largely as veto, the model states minimal institutional friction, the strong effect of the binding-PoR lever should therefore be read as a possible mechanism rather than a real-world outcome. The model was also only lightly validated: its parameters were grounded in the case material but not empirically estimated, one sensitivity analysis was conducted, and face validity rests on one practitioner interview. The model should therefore be understood as a tool for exploring institutional mechanisms, not for predicting real-world outcomes.

6.5 Future Research

These limitations point towards several directions for future research. First, the relationship between institutional prefiguration and the mainstreaming of adaptation would benefit from stronger longitudinal empirical grounding. The thesis has identified prefiguration in practice and how this does or does not support mainstreaming, but it cannot show whether these conditions actually become institutionalised over time. Future research could therefore follow urban built infrastructure projects over a longer period to examine whether anticipatory behaviour, such as programme-level requirements, remain in place, become formalised, or disappear under regime pressures. This would help clarify when institutional prefiguration becomes durable institutional change.

Second, future research is suggested to extend the analysis to other cases and sustainability domains. A broader comparative research design across Dutch urban built infrastructure would enable examination of whether the distinction between project-level and programme-level prefiguration holds beyond the Quays and Hofplein. Similar dynamics could also be studied in other domains, such as nature-based solutions, circular infrastructure, or emission-free construction, where innovation similarly depends on the movement from pilot to standard practice. Such comparative work would strengthen understanding of how mainstreaming, institutional prefiguration and institutional change interrelate across different governance contexts.

Third, more research is needed into the political, financial and governance arrangements through which public clients can make adaptation part of the default project logic. This thesis argues that adaptation becomes more likely to mainstream when it is embedded in programme requirements, procurement conditions and contract structures. However, it does not resolve how public clients should finance these requirements, distribute who carries which costs and risks, or justify long-term climate value within short-term budget cycles. Future research could therefore examine concrete governance and financing models that allow adaptation to become mandatory without simply transferring unmanageable costs to public clients or building firms.

Fourth, future research should examine rule-based and advocacy-based prefiguration more directly across different types of actors. This thesis suggests that rule-based prefiguration is more powerful when enacted above the individual project level, while advocacy-based prefiguration remains structurally fragile without institutional backing. However, bottom-up actors such as activists, residents, start-ups and civil society organisations were not central in the empirical sample. Including these actors would allow future research to compare how top-down and bottom-up forms of prefiguration converge, conflict or reinforce one another. Citizen participation may be especially important here, as residents can function both as veto actors and as carriers of alternative adaptation futures.

Finally, the methodological step toward institutional modelling deserves further development. The ABM in this thesis was exploratory and served mainly to make the institutional mechanism explicit. Future modelling research could develop more empirically calibrated models by including additional (veto) actors, financing structures, political dynamics and interdepartmental fragmentation. This would be especially relevant for urban spatial planning, where climate adaptation increasingly intersects with stakeholder management, conflicting public values and long-term uncertainty. In this context, ABM offers a promising way to explore not what will happen, but how different institutional arrangements may make adaptation more or less likely to mainstream.

7. Conclusion

This chapter concludes by answering the sub-research questions one by one, after which the main research question will be answered. Finally, the thesis concludes with one recommendation that links to the research main findings.

7.1 Answers to the Sub-Questions

Starting with the question of what factors public and private actors identify as influencing climate adaptation mainstreaming in Dutch urban built infrastructure. Drawing from 21 semi-structured interviews with various relevant actors, this study corroborates previous studies that show that adaptation mainstreaming depends less on technical capacity than on institutional configuration. Specifically, it points to a clear bottleneck of institutional dynamics: fragmented responsibilities, procurement dynamics and the absence of a clear institutional owner.

To explain how this connection obstructs the mainstreaming of adaptation, the hot-potato analogy is used once more. The topic of adaptation is currently postponed rather than advanced, with responsibility avoided by passing the hot potato from the public to the private sector, and vice versa. The contractor will wait for the client to incorporate adaptation into the contract, as they will not risk losing the tender under current procurement logic. The client currently has no mandate to require adaptation, whilst not being able to afford the necessary interventions for this sustainable societal transition today. Clarity on what the hot potato (characteristics of adaptation) actually entails is largely absent for both actor groups due to ambiguity about the challenge's true definition and ill-defined temporal characteristics, both of which complicate the dialogue. Additionally, adaptive innovations that do enter projects rarely scale into the mainstream: without a clear institutional owner to nurture them, the transition stalls before it can mature. Interviewees suggest that a key potential is to realign governance, decision-making and procurement dynamics, creating space to properly address risks, responsibilities, and roles. The current infrastructure approach is a fragmented, siloed sector, a division of, for instance, roads, bridges, and rails, which overlooks the wider impacts of adaptation within the socio-technical system. This is despite the boundary-spanning nature of adaptation interventions, which requires strong coordination across sectors and departments to align stakeholders. This way, the siloed strategy leads to delays and reduces efficiency.

Moving to the question of how institutional prefiguration unfolds in innovative urban built infrastructure, and what is the effect on implementing adaptation, this study shows that institutional prefiguration unfolds more strongly in the Hofplein case than it does at the quays. This is because anticipatory practice at the quays remains a project-by-project negotiation, leaving the implementation of adaptation weak and reactive rather than anticipatory. The instances of programmatic prefiguration that were identified, such as “*the new normal*” or *Factor 20* report, proved either too distant from actual implementation to take hold or, where they did drive action, advanced renovation practice rather than adaptation. Contrary to Hofplein, where actors enact ideas as if settled through every phase of the project: from aldermen acting beyond their authority by publishing Hofplein’s final design before it is officially confirmed, to project managers continuously enacting the adaptive innovations as if they were long settled. The key difference in this is that institutional prefiguration successfully manifests itself above the project

level in Hofplein, at a higher programmatic level where multiple boundary spanners operate between levels of research to governance, design to implementation and project management to execution. Hereby, advancing the implementation of adaptation.

Subsequently, the study asks how institutional prefiguration can be operationalised into a concrete case and what this reveals about institutional change in urban built infrastructure. Here, the operationalisation of institutional prefiguration through Institutional Grammar and ABM enabled the direct exploration of future institutional dynamics. Through two what-if scenarios, the anticipatory enactment of a rule-based binding proposal and an advocacy-based frontrunner, the implications for institutional change could be explored. This exploratory analysis suggests, in line with previous findings, that the leverage point for mainstreaming may lie in procurement dynamics: the prefigurative enactment of a binding requirement can begin to shift the urban built infrastructure regime. The mechanism behind this is not coercion but redirection. Private actors already operate under the norm of following the client's demands, thus structurally writing adaptation into the contract will simply change the default that actors fall back to, making it the path of least resistance rather than an imposed obligation. Moreover, the model suggests that anticipatory frontrunner actors alone will not accelerate mainstreaming adaptation easily. Yet, under the right circumstances, such as in Hofplein, having enough mandate and motivation, a project manager could deliver boundary-spanning work. Although the model does not claim to reflect reality, operationalising institutional dynamics in this way offers insight in itself, particularly into the implications to transformational change.

7.2 Answer to the Main Research Question

Taken together, these findings answer the main research question: institutional prefiguration contributes to the mainstreaming of climate adaptation in urban built infrastructure governance by changing the institutional default through which actors make decisions. Its value does not lie primarily in convincing individual actors that adaptation matters, since many already recognise its importance. Rather, its contribution lies in enacting future adaptation requirements in the present, before they are formally mandated. When adaptation is embedded above the level of the individual project, in programme requirements, procurement conditions or contractual rules, it no longer depends on repeated negotiation or individual initiative. Instead, it becomes part of the structure within which public and private actors already operate.

This is why institutional prefiguration is most powerful when it moves beyond isolated project-level experimentation. At the project level, adaptation can remain reactive, voluntary and vulnerable to budget, timing and procurement pressures. At the programme level, however, prefiguration can shift adaptation from an exceptional ambition to a normal condition of infrastructure delivery. It writes tomorrow's institutional rule into today's projects, thereby creating the conditions under which adaptation becomes the path of least resistance. Institutional prefiguration cannot by itself force a full regime shift, but it can prepare and partially enact one. In this sense, becoming ready for adaptation does not mean waiting for future regulation to arrive, it means governing, procuring and building as if that future had already become the rule.

7.3 Recommendation

This thesis concludes with one final recommendation: open a mandated multi-actor collaborative space in which public clients, building companies, contractors, engineering firms, knowledge institutes, and relevant civic actors jointly translate adaptation from an ambiguous ambition into shared institutional rules. Such a space should not be limited to general networking, partnerships, or cooperation. Its purpose should be to define what adaptation means in a specific infrastructure context, which climate risks and time horizons actors are preparing for, which trade-offs and co-benefits are accepted, which floor-plan projects in which locations are targeted and who is responsible for carrying adaptation beyond the individual project. In doing so, the space can connect advocacy-based and rule-based forms of institutional prefiguration: frontrunner actors can bring urgency, knowledge, and alternative futures into the process, while public clients and programme-level actors can stabilise these ambitions into requirements, procurement criteria, and ownership structures.

This recommendation follows directly from the central conclusion of the study and it returns the thesis to the question it began with. We could keep innovating around technical defences, hold on to a reactive strategy that responds only once problems surface, and go on absorbing scarcity and damage as they come. But what if we adapted our system to the adaptation it demands? What if we built our country to anticipate the risks that climate adaptation requires? What if we chose a society that looks ahead and creates the conditions for a healthy socio-ecological-technical environment? In other words: what if we were ready for adaptation?

8. References

- Alves, A., van Opstal, C., Keijzer, N., Sutton, N., & Chen, W.-S. (2024). Planning the multifunctionality of nature-based solutions in urban spaces. *Cities*, 146, 104751. <https://doi.org/10.1016/j.cities.2023.104751>
- Baack, F., Özerol, G., Vinke-de Kruijf, J., Halman, J., & Kuks, S. (2024). Implementing climate change adaptation through mainstreaming at the local level—A comparative case study of two municipalities in the Netherlands. *Regional Environmental Change*, 24(2), 49. <https://doi.org/10.1007/s10113-024-02214-7>
- BAM Royal Group. (2023). *Duurzaamheids-strategie BAM 2023-2030*. <https://www.bam.com/nl/duurzaam/klimaat-adaptief-bouwen>
- Biesbroek, G. R., Klostermann, J. E. M., Termeer, C. J. A. M., & Kabat, P. (2013). On the nature of barriers to climate change adaptation. *Regional Environmental Change*, 13(5), 1119–1129. <https://doi.org/10.1007/s10113-013-0421-y>
- Bodansky, D. (2021). *Paris Agreement*. Legal.Un. <https://legal.un.org/avl/ha/pa/pa.html>
- Boggs, C. (1977). Marxism, prefigurative communism, and the problem of workers' control. *Radical America*, 11(6), 99–122.
- Buitelaar, E., Van Den Hurk, M., Lebbing, J., Pelzer, P., & Van Karnenbeek, L. (2025). Land Policy in the Netherlands: An Ambiguous Utopia on the Move. In T. Hartmann, A. Hengstermann, M. Jehling, A. Schindelegger, & F. Wenner (Eds), *Land Policies in Europe* (pp. 203–217). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-83725-8_13
- Claassens, J., Koomen, E., & Rouwendal, J. (2020). Urban density and spatial planning: The unforeseen impacts of Dutch devolution. *PLOS ONE*, 15(10), e0240738. <https://doi.org/10.1371/journal.pone.0240738>
- Cooper, D. (2020). Towards an adventurous institutional politics: The prefigurative 'as if' and the reposing of what's real. *The Sociological Review*, 68(5), 893–916. <https://doi.org/10.1177/0038026120915148>
- Crawford, S. E. S., & Ostrom, E. (1995). A Grammar of Institutions. *American Political Science Review*, 89(3), 582–600. <https://doi.org/10.2307/2082975>
- Deltares. (2026). *Klimaatrisico's infrastructuur* (Nos 11212760-010-ZWS-0001). <https://www.deltares.nl/expertise/publicaties/klimaatrisico-infrastructuur-mogelijkheden-klimaatadaptatie>
- DGBC. (2025). EU Taxonomie raakt bouw- en vastgoedsector. *DGBC*. <https://www.dgbc.nl/interviews/eu-taxonomie-raakt-bouw-en-vastgoedsector/>

- Dorst, H., Van Der Jagt, A., Toxopeus, H., Tozer, L., Raven, R., & Runhaar, H. (2022). What's behind the barriers? Uncovering structural conditions working against urban nature-based solutions. *Landscape and Urban Planning*, 220, 104335.
<https://doi.org/10.1016/j.landurbplan.2021.104335>
- Dorst, H., Van Kempen, S., & Bigaj-van Vliet, A. (2026). Infrastructure Transitions Through Nature-Based Solutions: Aligning Perceptions. *Infrastructures*, 11(3), 102.
<https://doi.org/10.3390/infrastructures11030102>
- Edelenbos, J., & Van Meerkerk, I. (2015). Connective capacity in water governance practices: The meaning of trust and boundary spanning for integrated performance. *Current Opinion in Environmental Sustainability*, 12, 25–29. <https://doi.org/10.1016/j.cosust.2014.08.009>
- Eisenack, K., Moser, S. C., Hoffmann, E., Klein, R. J. T., Oberlack, C., Pechan, A., Rotter, M., & Termeer, C. J. A. M. (2014). Explaining and overcoming barriers to climate change adaptation. *Nature Climate Change*, 4(10), 867–872.
<https://doi.org/10.1038/nclimate2350>
- Ekstrom, J. A., & Moser, S. C. (2014). Identifying and overcoming barriers in urban climate adaptation: Case study findings from the San Francisco Bay Area, California, USA. *Urban Climate*, 9, 54–74. <https://doi.org/10.1016/j.uclim.2014.06.002>
- European Commission. (2019). *Communication from the Commission to the European Parliament, the European Council, the Council, the European economic and social committee and the committee of the Regions—The European Green Deal*. <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52019DC0640>
- European Commission. (2021). *Technical guidance on the climate proofing of infrastructure in the period 2021-2027* (Official Journal of the European Union C 373, p. 92) [Commission Notice]. European Union. chrome-extension://efaidnbmnnnibpcajpcgclefindmkaj/https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOC_2021_373_R_0001&from=EN
- European Environment Agency. (2024, August 20). *What is the difference between adaptation and mitigation?* <https://www.eea.europa.eu/en/about/contact-us/faqs/what-is-the-difference-between-adaptation-and-mitigation>
- García-Blanco, G., Zorita, S., Wirth, M., Biernacka, M., & Lozano, P. J. (2025). Dilemmas in Statutory Urban Planning When Addressing the Climate Adaptation Implementation Gap: Insights from Six European Cities. *Land*, 14(12), 2304.
<https://doi.org/10.3390/land14122304>
- Geels, F. W. (2005). The dynamics of transitions in socio-technical systems: A multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860–

- 1930). *Technology Analysis & Strategic Management*, 17(4), 445–476.
<https://doi.org/10.1080/09537320500357319>
- Gemeente Amsterdam. (n.d.). *Dit hadden we nooit durven dromen* [Webpagina]. Gemeente Amsterdam. Ingenieursbureau Amsterdam. Retrieved 29 June 2026, from
<https://www.amsterdam.nl/iba/nieuws/nieuwsberichten/nieuws/2025-jan-jun/hadden-we-nooit-durven-dromen/>
- Gemeente Amsterdam. (2020a). *Programma Bruggen en Kademuren*. Gemeente Amsterdam.
<https://openresearch.amsterdam/en/page/56187/programmaplan-bruggen-en-kademuren>
- Gemeente Amsterdam. (2020b). *Strategie Klimaatadaptatie Amsterdam*. Gemeente Amsterdam.
https://openresearch.amsterdam/image/2020/3/4/strategie_klimaat_adaptie.pdf
- Gemeente Amsterdam. (2021). *Amsterdam Omgevingsvisie 2050: Een menselijke metropool*. Gemeente Amsterdam.
<https://openresearch.amsterdam/nl/page/72134/omgevingsvisie-amsterdam-2050>
- Gemeente Amsterdam. (2022). *Voortgangsrapportage Klimaatadaptatie 2022*. Gemeente Amsterdam. <https://openresearch.amsterdam/nl/page/90629/voortgangsrapportage-klimaatadaptatie-2022>
- Gemeente Amsterdam. (2024). *Agenda Klimaatadaptatie 2024-2026*. Gemeente Amsterdam.
<https://openresearch.amsterdam/en/page/109972/agenda-klimaatadaptie-2024-2026>
- Ghorbani, A. (2022). Institutional modelling: Adding social backbone to agent-based models. *MethodsX*, 9, 101801. <https://doi.org/10.1016/j.mex.2022.101801>
- Giordano, T. (2012). Adaptive planning for climate resilient long-lived infrastructures. *Utilities Policy*, 23, 80–89. <https://doi.org/10.1016/j.jup.2012.07.001>
- Goncalves, J. E., Narendra, N., & Verma, T. (2025). Everything about climate change is disproportionate: Principles for spatial justice in urban climate action. *Geo: Geography and Environment*, 12(2), e70024. <https://doi.org/10.1002/geo2.70024>
- Grimm, V., Railsback, S. F., Vincenot, C. E., Berger, U., Gallagher, C., DeAngelis, D. L., Edmonds, B., Ge, J., Giske, J., Groeneveld, J., Johnston, A. S. A., Milles, A., Nabe-Nielsen, J., Polhill, J. G., Radchuk, V., Rohwäder, M.-S., Stillman, R. A., Thiele, J. C., & Ayllón, D. (2020). The ODD Protocol for Describing Agent-Based and Other Simulation Models: A Second Update to Improve Clarity, Replication, and Structural Realism. *Journal of Artificial Societies and Social Simulation*, 23(2), 7. <https://doi.org/10.18564/jasss.4259>

- Ingenieursbureau. (2025, January 21). *Hadden we nooit durven dromen*. Gemeente Amsterdam.
<https://www.amsterdam.nl/ingenieursbureau/nieuws/nieuwsberichten/nieuws/2025-jan-jun/hadden-we-nooit-durven-dromen/>
- IPCC. (2014). Summary for Policymakers. In V. R. Barros, D. J. Dokken, K. J. Mach, & M. D. Mastrandrea (Eds), *Climate Change 2014 Impacts, Adaptation, and Vulnerability* (pp. 1–32). Cambridge University Press. <https://doi.org/10.1017/CBO9781107415379.003>
- IPCC. (2022). *IPCC, 2023: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland*. (P. Arias, M. Bustamante, I. Elgizouli, G. Flato, M. Howden, R. Pichs-Madruga, Y. Saheb, R. Sánchez Rodríguez, D. Ürgen-Vorsatz, C. Xiao, N. Yassaa, J. Kim, E. F. Haites, Y. Jung, R. Stavins, A. Birt, M. Ha, D. J. A. Orendain, L. Ignon, ... C. Péan, Eds; First). Intergovernmental Panel on Climate Change (IPCC).
<https://doi.org/10.59327/IPCC/AR6-9789291691647>
- Kemp, R., Schot, J., & Hoogma, R. (1998). Regime shifts to sustainability through processes of niche formation: The approach of strategic niche management. *Technology Analysis & Strategic Management*, 10(2), 175–198. <https://doi.org/10.1080/09537329808524310>
- Lawford, H. L., & Sareen, S. (2025). Institutional prefiguration: Community energy development through spaces of orchestration. *Sustainability Science*, 20(4), 1379–1392.
<https://doi.org/10.1007/s11625-025-01652-4>
- Liukku, A. (2020, June 21). *De ontwerper legt uit waarom het nieuwe, groene Hofplein een voetgangerswalhalla moet worden*. AD.nl. <https://www.ad.nl/rotterdam/de-ontwerper-legt-uit-waarom-het-nieuwe-groene-hofplein-een-voetgangerswalhalla-moet-worden~afad1257/>
- Mendes, R., Fidélis, T., Roebeling, P., & Teles, F. (2020). The Institutionalization of Nature-Based Solutions—A Discourse Analysis of Emergent Literature. *Resources*, 9(1), 6.
<https://doi.org/10.3390/resources9010006>
- Mesdaghi, B., Ghorbani, A., & de Bruijne, M. (2022). Institutional dependencies in climate adaptation of transport infrastructures: An Institutional Network Analysis approach. *Environmental Science & Policy*, 127, 120–136.
<https://doi.org/10.1016/j.envsci.2021.10.010>
- Parool. (2019, December 19). *Jarenlange verkeerschaos dreigt voor Amsterdam door herstel bruggen en kades*. <https://www.parool.nl/amsterdam/jarenlange-verkeerschaos-dreigt-voor-amsterdam-door-herstel-bruggen-en-kades~b1514df0/>

- PBL. (2026). *Voorbij de risico's: Keuzes voor een klimaatbestendige leefomgeving* (No. 5973b). Planbureau voor de Leefomgeving. <https://www.pbl.nl/publicaties/voorbij-de-risicos-keuzes-voor-een-klimaatbestendige-leefomgeving>
- Reinwald, F., Weichselbaumer, R., Schindelegger, A., & Damyanovic, D. (2024). From strategy to implementation: Mainstreaming urban green infrastructure in Austria's spatial planning instruments for climate change adaptation. *Urban Forestry & Urban Greening*, 94, 128232. <https://doi.org/10.1016/j.ufug.2024.128232>
- Rijkswaterstaat. (2024). *Nationale klimaatadaptatiestrategie (NAS)* [Overzichtspagina]. Rijkswaterstaat. Kennisportaal Klimaatadaptatie. <https://klimaatadaptatienederland.nl/beleid/nationale-aanpak/nas/>
- Runhaar, H., Wilk, B., Persson, Å., Uittenbroek, C., & Wamsler, C. (2018). Mainstreaming climate adaptation: Taking stock about “what works” from empirical research worldwide. *Regional Environmental Change*, 18(4), 1201–1210. <https://doi.org/10.1007/s10113-017-1259-5>
- Savini, F. (2025). Strategic planning for degrowth: What, who, how. *Planning Theory*, 24(2), 141–162. <https://doi.org/10.1177/14730952241258693>
- Ten Brinke, N., Kruijf, J. V., Volker, L., & Prins, N. (2022). Mainstreaming climate adaptation into urban development projects in the Netherlands: Private sector drivers and municipal policy instruments. *Climate Policy*, 22(9–10), 1155–1168. <https://doi.org/10.1080/14693062.2022.2111293>
- The Guardian. (2026, January 27). ‘Abdication’: Trump takes US out of Paris climate agreement for a second time. <https://www.theguardian.com/us-news/2026/jan/27/trump-withdraws-paris-climate-agreement>
- Törnberg, A. (2021). Prefigurative politics and social change: A typology drawing on transition studies. *Distinktion: Journal of Social Theory*, 22(1), 83–107. <https://doi.org/10.1080/1600910X.2020.1856161>
- Uittenbroek, C. J., Janssen-Jansen, L. B., & Runhaar, H. A. C. (2013). Mainstreaming climate adaptation into urban planning: Overcoming barriers, seizing opportunities and evaluating the results in two Dutch case studies. *Regional Environmental Change*, 13(2), 399–411. <https://doi.org/10.1007/s10113-012-0348-8>
- UN. (2025). *World Urbanization Prospects 2025: Summary of Results*. United Nations. <https://www.un.org/development/desa/pd/content/world-urbanization-prospects-2025-summary-results>
- UNFCCC. (2026, January). *The Paris Agreement*. UNFCCC. <https://unfccc.int/process-and-meetings/the-paris-agreement>

- United Nations. (2015). *Transforming our world: The 2030 Agenda for Sustainable Development*. United Nations Department of Economic and Social Affairs, Sustainable Development. <https://sdgs.un.org/2030agenda>
- Wamsler, C., & Osberg, G. (2022). Transformative climate policy mainstreaming – engaging the political and the personal. *Global Sustainability*, 5, e13. <https://doi.org/10.1017/sus.2022.11>
- Yates, L. (2015). Rethinking Prefiguration: Alternatives, Micropolitics and Goals in Social Movements. *Social Movement Studies*, 14(1), 1–21. <https://doi.org/10.1080/14742837.2013.870883>
- Yates, L. (2021). Prefigurative Politics and Social Movement Strategy: The Roles of Prefiguration in the Reproduction, Mobilisation and Coordination of Movements. *Political Studies*, 69(4), 1033–1052. <https://doi.org/10.1177/0032321720936046>

9. Appendix

A. Interview Coding Scheme

1. Political Factors

Code	Definition
POL_commitment	Level of political commitment or priority given to adaptation by elected officials or political bodies
POL_awareness	Public awareness and societal support for adaptation measures
POL_coherence	Alignment or misalignment between policies at different governance levels (EU, national, municipal)
POL_legal	Flexibility or rigidity of legal and regulatory frameworks for enabling adaptation
POL_voluntary	The non-binding, voluntary character of current adaptation policy and its consequences

2. Organisational Factors

ORG_collaboration	Quality of collaboration between public and private actors, or across departments
ORG_fragmentation	Institutional fragmentation: unclear or dispersed responsibilities hindering adaptation integration
ORG_leadership	Presence or absence of champions, leaders, or internal advocates driving adaptation
ORG_procurement	How procurement processes and contract design enable or constrain adaptation integration
ORG_routines	Established organisational routines, standard practices, or path dependencies that resist change

3. Cognitive Factors

COG_uncertainty	Perceived uncertainty about climate scenarios, technical solutions, or long-term impacts
COG_urgency	How actors perceive the urgency (or lack thereof) of adaptation action
COG_knowledge	Availability, exchange, and gaps in knowledge about adaptation measures and their effectiveness
COG_framing	How adaptation is framed or understood by the actor as risk, opportunity, obligation, cost, co-benefit

4. Resources

RES_financial	Financial constraints or incentives affecting adaptation decisions
RES_capacity	Staff availability, workforce or organisational constraints for adaptation
RES_expertise	Access to technical expertise, knowledge, or tools for implementing adaptation

5. Characteristics of the Adaptation Problem

CHAR_ambiguity	Lack of clarity in what "climate-adaptive" concretely means for infrastructure design
CHAR_temporal	Mismatch between long asset lifetimes and short-term planning, procurement, or political cycles
CHAR_measurability	Difficulty in measuring, quantifying, or demonstrating the value of adaptation measures
CHAR_co_benefits	References to co-benefits or trade-offs of adaptation measures (biodiversity, liveability, heritage)

6. Timing & Windows of Opportunity

TIM_trigger	Specific events that opened or closed windows for adaptation (crises, policy changes)
TIM_momentum	Sense of momentum or stagnation around adaptation in the current period
TIM_window	Explicit reference to a window of opportunity, the PBK programme as a unique chance to embed adaptation

7. Agent-Based Model (used later)

ABM_goal	What the actor is optimising for: their primary objective or success criterion in the infrastructure process
ABM_rule	Decision rules: under what conditions the actor acts, what triggers a decision, what logic they follow when choosing between options
ABM_resource	Specific resources the actor controls or lacks that constrain their behaviour: budget authority, legal powers, technical capacity
ABM_interaction	How the actor communicates with, influences, or is influenced by other actors: formal and informal, power dynamics, information flows
ABM_threshold	The actor's current position on climate adaptation: from uninterested to proactive

8. Emergent codes

EMRG_label	No description: intentionally left open to allow for emergent, inductive codes, which did not fit the predefined codes
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B. Interview Questions

General questions

- To what extent do you encounter climate adaptation in your work?
- When climate adaptation is requested, in what way is it introduced?
- Which factors do you think influence the mainstreaming of climate adaptation?
- Where in the process does it usually go wrong? Or particularly well?
- How are long-term (climate) risks currently captured in contracts?
- Suppose climate adaptation became mandatory rather than optional, is [company] prepared? What would have to change first? (Tendering, contracts, budgeting, ...)
- Where do you see the biggest opportunities for implementing climate adaptation in infrastructure projects?

Case-specific questions

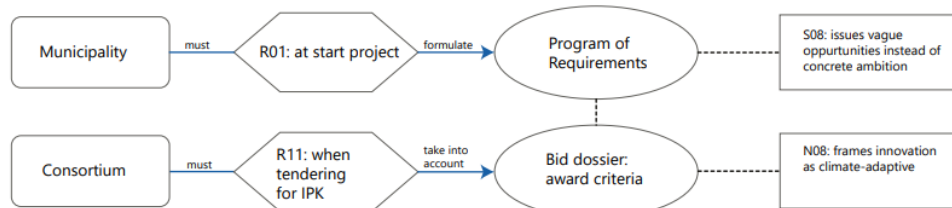
- How does the collaboration between consortium and the Municipality unfold?
- Within this quays/Hofplein collaboration, how is climate adaptation raised? By whom?
- When there is tension between project timing or budget and climate adaptation, how is it resolved? What are the trade-offs?
- How much influence do you have as [company]? Or do you have to execute what is asked of you?
- What would need to change (in the market, in legislation, or in tendering) for adaptation to become a more standard part of quay wall design?
- Is there anything important about how climate adaptation decisions are made in quays/Hofplein that I haven't asked about?

C. Documents Secondary Data

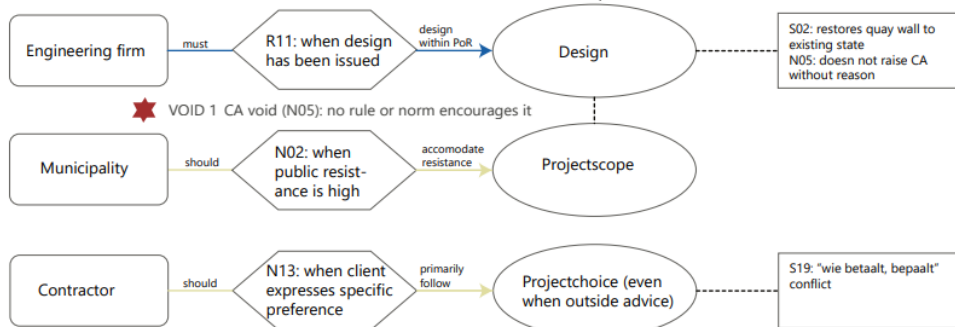
Document	Issuer	Year	Type	Case
Strategie Klimaatadaptatie	Gemeente Amsterdam	2020	Policy strategy	Quays
Voortgangsrapportage Klimaatadaptatie	Gemeente Amsterdam	2022	Progress report	Quays
Agenda Klimaatadaptatie 2024–2026	Gemeente Amsterdam	2024	Implementation agenda	Quays
PBK Uitvoeringsplan 2023–2026	Gemeente Amsterdam	2023	Programme execution plan	Quays
Rotterdam Climate Change Adaption Strategy	Gemeente Rotterdam	2013	Policy strategy	Hofplein
Water- en Klimaatadaptatieprogramma Planperiode 2027-2030	Gemeente Rotterdam	2025	Programme execution plan	Hofplein
De 7 Stadsprojecten	Gemeente Rotterdam	2020	Formal programme document	Hofplein
De ontwerper legt uit waarom het nieuwe, groene Hofplein een voetgangerswalhalla moet worden	Algemeen Dagblad	2020	Newspaper	Hofplein

D. Institutional Network Analysis

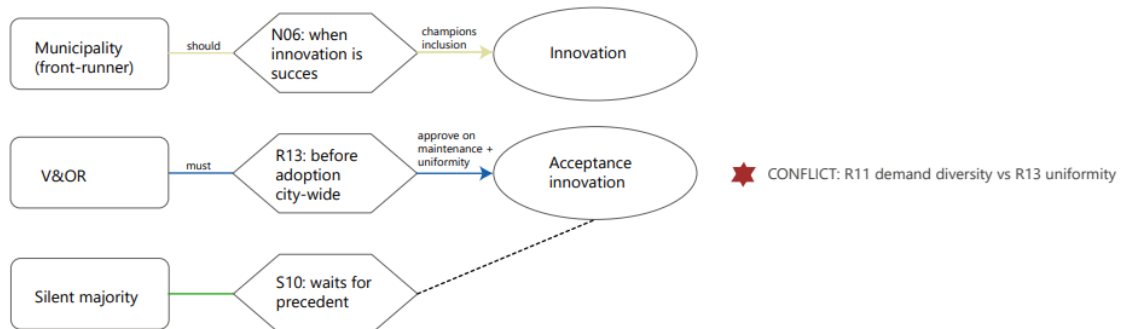
Phase 1: Tender



Fase 2: Design



Fase 3: Upscaling and maintenance



Legenda

□ Attribute (agent) ⬡ Condition (institutie) ○ Object (uitkomst) - - - - - Dependence

★ Point of concern (void or conflict)

E. ABDICO Statement Sheet



ABDICO_IPK_v4.xlsx

F. Netlogo Code

```
breed [municipalities municipality]
breed [consortia consortium]
breed [frontrunners frontrunner]

: -----
: GLOBAL VARIABLES
: shared state, anything that isn't owned by a specific agent.
: They persist across ticks

globals [
  project-id           : counter: which project are we on (1, 2, 3, ...)
  total-adaptive-built : outcome metric: how many tenders delivered
  "adaptive"
  precedent-count      : the V&OR memory: increments only when adoption
fires
  accept-threshold     : how many adoptions V&OR needs before the next one
fires
  total-mainstreamed   : total adaptive built projects actually accepted to
mainstream
  mainstreamed?       : institutional state: has the innovation crossed
into standard practice?
  total-stalled        : new: adaptive bids rejected by V&OR
  approval-prob-adaptive : the probability V&OR approves an adaptive project.

]

: -----
: AGENT-OWN VARIABLES
: <breed>-own [...] declares variables that each agent of that breed
: carries individually.

municipalities-own [
  risk-aversion
]

consortia-own [
  climate-focus           : probability the consortium bids "adaptive" under
                           : a vague PoR.
  profit-motive           : placeholder for v2 (e.g. cost penalty for adaptive)
]

frontrunners-own [
  motivation              : 0-1, current advocacy energy
  motivation-step         : how much each outcome shifts motivation
  lobbying-threshold      : motivation level above which frontrunner
lobbies
]

: -----
: SETUP PROCEDURE
: defines the procedure.

to setup
  clear-all              : wipe everything: agents, globals,
plots, ticks
```

```

clicks accumulate state                                     : without this, repeated SETUP

    set project-id 0                                       : will be incremented to 1 on first
tick                                                        :
    set total-adaptive-built 0                             : no projects executed yet
    set precedent-count 0                                  : V&OR has no precedent at start
    set accept-threshold accept-threshold-init : ad-hoc starting value: refined
later into slider
    set total-stalled 0
    set mainstreamed? false
    set total-mainstreamed 0                               : fix 2: explicit reset

    create-municipalities 1 [                               : create 1 agent of breed
municipalities                                           : the [ ... ] block runs for each
new agent
    set risk-aversion risk-aversion-init : high = V&OR averse to adaptive
    setxy -5 0                                           : put it on the left half of the
world
    set color blue                                       : visual orientation
    set shape "house"
    set size 2
]

    set approval-prob-adaptive 1 - [risk-aversion] of one-of municipalities
: derives V&OR's approval probability from the

: municipality's risk-aversion. Currently  $1 - 0.7 = 0.3$ 

    create-consortia 1 [                                   : create 1 agent of breed consortia
    set climate-focus climate-focus-init : default: 20% chance of voluntary
adaptive bid, change with slider                               : this is the "without binding PoR"
tendency
    set profit-motive 1.0
    setxy 5 0                                           : right half of the world
    set color red
    set shape "circle"                               : shape looking most to a
contractor/engineering firm
    set size 2
]

    if frontrunner-active? [                               : only create if switch
is on
    create-frontrunners 1 [
        set motivation 0.5                               : neutral starting point
        set motivation-step 0.1                           : how reactive to
outcomes
        set lobbying-threshold 0.7                       : needs strong motivation
to act
        setxy 0 3                                         : sits between
municipality and consortium
        set color green
        set shape "person"
        set size 2
    ]

```

```

]

reset-ticks                                : resets the tick counter to 0
                                           : MUST come at the end of setup,
after agents exist                          : otherwise plots and tick-dependent
code break
end

: -----
: GO PROCEDURE – the main loop
: runs once per tick.

to go
  if ticks >= 50 [ stop ]                  : stop condition: 50 projects is
  enough

  set project-id project-id + 1            : increment the project counter
  : -- Step 1: municipality drafts PoR --
  let current-por [draft-PoR] of one-of municipalities

  : -- Step 2: consortium submits bid --
  let current-bid [submit-bid current-por] of one-of consortia

  : -- Step 3 + 4 combined: V&OR project approval, then execution --
  let adopted? false                      : mainstreaming
  flag for the print line
  let approved? false                    : project
  approval flag

  ifelse current-bid = "default" [        : default bids:
  V&OR almost always approves
    set approved? true                    : risk-averse
  V&OR likes default
  ] [                                     : adaptive bids:
  probabilistic approval
    if random-float 1.0 < approval-prob-adaptive [ : V&OR's risk-
  aversion gate
      set approved? true                  : got past V&OR
    ]
  ]

  ifelse approved? [                     : project goes
  ahead
    if current-bid = "adaptive" [         : adaptive built
    → counts + precedent
      set total-adaptive-built total-adaptive-built + 1
      set precedent-count precedent-count + 1 : only adaptive
    builds add precedent
    ]

    : default built:
  no counter, no precedent
  ] [                                     : not approved
  : logged as a
    set total-stalled total-stalled + 1
  stall
  ]

```

```

: -- Mainstreaming: one-time institutional shift --
if not mainstreamed? and approved? and current-bid = "adaptive" and
precedent-count >= accept-threshold [
  set mainstreamed? true : institutional
state changes
  set total-mainstreamed total-mainstreamed + 1 : one-time event,
fires at most once
  set adopted? true
]

: -- Frontrunner reacts to outcome and lobbies periodically --
if any? frontrunners [ : only if frontrunner
exists
  ask frontrunners [
    update-motivation current-bid approved? : react to this tick's
outcome
    if ticks mod 5 = 0 [ lobby-vor ] : lobby every 5 ticks
  ]
]

: -- Precedent decay --
if not mainstreamed? and ticks mod 5 = 0 and precedent-count > 0 [
  set precedent-count precedent-count - 1
]

print (word "Project " project-id
" | PoR: " current-por
" | Bid: " current-bid
" | Approved: " approved?
" | Mainstreamed: " adopted?
" | Precedent: " precedent-count
" | Motivation: " (ifelse-value any? frontrunners [precision
[motivation] of one-of frontrunners 2] ["none"]))
" | V&OR-prob: " precision approval-prob-adaptive 2)

tick
end

: -----
: STEP 1 – Municipality drafts the PoR
:
: ABDICO: R01 (must draft PoR), S08 (default = vague opportunities)

to-report draft-PoR
  ifelse por-binding
    [ report "binding" ] : lever ON → PoR requires climate-adaptive
    [ report "vague" ] : lever OFF → S08 default, no real requirement
end

: -----
: STEP 2 – Consortium submits a bid

: Takes the PoR as an argument (the "por" in square brackets after the
: procedure name). Returns either "adaptive" or "default".

```

```

:
: ABDICO: R11 (4 award criteria), N08 (post-hoc climate framing),
: S02 (default = restore as-is)

to-report submit-bid [por]
  ifelse por = "binding"
    [ report "adaptive" ] : R11 forces adaptive bid
    [ ifelse random-float 1.0 < climate-focus : vague PoR: roll the dice
      [ report "adaptive" ] : voluntary climate framing
    (N08)
      [ report "default" ] : S02 fallback: restore as-
is
  ]
end

: -----
: FRONTRUNNER: update motivation based on last project outcome
: called every tick, takes the bid and approval status as inputs

to update-motivation [bid approved-flag]
  if bid = "adaptive" and approved-flag [ : adaptive project went
through
    set motivation min list 1.0 (motivation + motivation-step)
: bounded at 1.0 (max
enthusiasm)
  ]
  if bid = "adaptive" and not approved-flag [ : adaptive project
stalled
    set motivation max list 0.0 (motivation - motivation-step)
: bounded at 0.0
(burnout)
  ]
: default projects: no
change
end

: -----
: FRONTRUNNER: lobby V&OR if motivation is high enough
: called periodically (every 5 ticks)

to lobby-vor
  if motivation >= lobbying-threshold [ : only lobby if energised
    set approval-prob-adaptive
min list 0.9 (approval-prob-adaptive + 0.05)
: nudge V&OR toward
acceptance
: bounded at 0.9 (V&OR
never fully drops aversion)
  ]
end

```

G. Netlogo Interface

File Edit Tools Zoom Tabs Help

Interface Info Code

Add Widget ▾ Align Widgets ▾    

Model Speed
 ticks: 50
 -  +

☒ View Updates
 Continuous ▾ Settings

precision [motivati...
0.4

precision approval-p...
0.35

climate-focus-init
0.20

setup go

por-bindi...

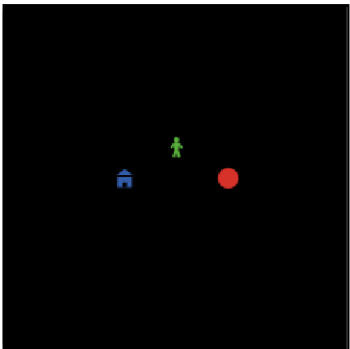
frontrunner-acti...

total-adaptive...
18

precedent-cou...
18

risk-aversion-init
0.7

accept-threshold-init
3



Command Center  Clear

Project 46	PoR: binding	Bid: adaptive	Approved: false	Mainstreamed: false	Precedent: 14	Motivation: 0
Project 47	PoR: binding	Bid: adaptive	Approved: true	Mainstreamed: false	Precedent: 15	Motivation: 0
Project 48	PoR: binding	Bid: adaptive	Approved: true	Mainstreamed: false	Precedent: 16	Motivation: 0
Project 49	PoR: binding	Bid: adaptive	Approved: true	Mainstreamed: false	Precedent: 17	Motivation: 0
Project 50	PoR: binding	Bid: adaptive	Approved: true	Mainstreamed: false	Precedent: 18	Motivation: 0

observer>