

What is missing for citizens to engage in building resilient cities? A comparative assessment of Amsterdam and Valencia



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Summary

Cities in Europe and the world are facing increasingly uncertain climate threats. Extreme weather patterns, higher temperatures and rising sea levels are but some of the worrisome climatic trends. Rapid densification and growth in cities have made managing and adapting these areas a more complex undertaking for local governments and stakeholders. This raises questions as to the role citizens and communities have in tackling this complex problem. Increasing complexity requires a complex solution. Urban resilience has become a prominent concept among urban policymakers and practitioners to cope with uncertainty and complexity in cities. However, its conceptualisation has often been dominated by its technical and environmental connotations, limiting the consideration of social aspects and elements in contemporary urban transitions.

This research seeks to address this knowledge gap by enhancing an existing urban resilience framework with social resilience insights. This framework is used to evaluate the urban resilience capacities (capacity to prepare, absorb, recover, adapt, and transform) through a case study of two European cities: Amsterdam and Valencia. This research was complemented by an internship at the Centre for Global Challenges (UGlobe), more specifically in the Transformative Innovation Policy Consortium (TIPC). Amsterdam and Valencia are found to have taken different paths to adapt their urban area, lead to varying resilience emphases. Amsterdam has focused more on water management and adaptive spatial planning and displayed more evidence of bottom-up adaptation. The city has been more focused on preparing, adapting, and transforming to climatic threats. Valencia's emphasis has been on emission reductions and energy efficiency, showing signs of mitigating rather than adapting to climatic threats. This leaves its resilience emphasis less clear.

A variety of hampering factors and mechanisms have been identified for both cities: low awareness and appropriation of measures, an existing implementation gap for local adaptation, gentrification impacting social equity, fragmentation from specialisation, and administrative deficits. The presence of networks and intermediaries was found to positively influence resilience in the cities. While citizen and community engagement are of importance, the appropriation and legitimate adoption of adaptation measures by private entities is vital. This proves to be a key factor when consolidating urban governance strategies to enhance resilience. Factors and mechanisms are discussed within the broader academic literature and societal context, specifically when it concerns citizen-city interactions and urban transformations, and in relation to what the results of this study suggest for urban governance in the wake of growing uncertainty and complexity of threats.

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1. Introduction

1.1 Introduction to the research topic and underlying debate

The 21st century is considered by some as the urban century, with increasingly larger influxes of people migrating to sprawling cities (Lerch, 2014). Rapid urbanisation and urban sprawl have contributed to worsening pressures on cities, which come in the form of overcrowding, social inequality, congestion, atmospheric pollution and the modification of land and surrounding environments (Jarrah et al., 2019). The European Commission (EC) has acknowledged that cities and city inhabitants are facing increasing challenges because of unsustainable urbanisation, climate change and political instability, among other things (European Commission, 2020A). Cities are centres of growth and innovation, providing essential services for their inhabitants and people living beyond their boundaries (Johnson, 2008). However, cities are subject to worsening and more unexpected shocks and stresses that are associated with climate change, global population growth, energy scarcity and economic growth (Sanchez, Van der Heijden & Osmond, 2018).

There is significant evidence regarding emission and resource consumption, land use and biodiversity loss that showcase how cities are responsible for a large proportion of the unsustainable trends which push the planet beyond its ecological boundaries (Alberti, 1999; Rockström et al., 2009). These trends will only worsen when considering that the urban population is expected to increase 25% by 2050, and the global population set to reach 9.3 billion by then (UN DESA, 2018). Efforts towards climate mitigation strategies and schemes in cities across the EU have been noticeable since the start of the century to address heat, water, and human wellbeing related issues (Walsh et al., 2011). However, some authors have noted how the increasing uncertainty of the climate system, socio-economic developments, and shocks (such as a pandemic) means mitigation projects and short-term fixes to address cities' vulnerabilities and risks do not suffice (Lomba-Fernández, Hernantes & Labaka, 2019; Moraci et al., 2020).

In the wake of having to enhance the capacity of cities to adapt to increasing uncertainty and varied risks, the concept of urban resilience has become a more prominent topic of debate in policy and practice (Folke et al., 2002; Rotarangi & Stephenson, 2014). Since the start of the millennium, urban resilience has gained traction as a viable integrated and adaptive strategy to address worsening uncertainties and stresses on cities (ICLEI, 2016). Meerow, Newell and Stults (2016) define urban resilience as:

The ability of an urban system and all its constituent socio-ecological and socio-technical networks to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity.

(P: 45)

Whilst urban resilience has garnered significant attention, its conceptualisation has been noted as being dominated by its environmental and engineering connotations, with social resilience and social aspects not adequately considered in contemporary urban transitions (Ernstson et al., 2010; Widborg, 2017). Moreover, it has been noted that a vital ingredient for building urban resilience in cities is understanding the degree of social resilience and citizen engagement in discourses and initiatives that

aim to propel forward instances of climate adaptation, sustainable growth, and resilience building (Richard & David, 2018; Espoi, 2018). Based on this, as well as other scholars that have written on urban resilience, understanding social elements in urban resilience is of particular interest in this study in order to attempt to connect urban and social resilience in a more conceptualised manner. Social resilience is regarded as the 'ability of social entities and social mechanisms to effectively anticipate, mitigate and cope with threats and contribute to recovery activities that minimize social disruptions and reduce the impact of future threats in an area' (Saja et al., 2019: 2). The EC has stated how understanding social capacities and factors is vital for pursuing actions for resilience that are adapted to local needs, with local communities and citizens playing a larger role in their undertaking (European Commission, 2020B). Furthermore, the social dimension in cities plays an important role in understanding the interactions and attitudes of varying levels of governance (civil society, public institutions and private institutions), when formulating and implementing climate resilient measures (Weichselgartner & Kelman, 2014).

Citizens and community engagement in the decision-making and the implementation process of projects for urban adaptation have been noted as playing an important role in improving the resilience of cities (Bedi et al., 2014; Mees et al., 2019). For meaningful contributions from citizens to take place, local governments need to facilitate greater community and citizen engagement if they look to delegate responsibility to more local entities (Granier & Kudo, 2016). Local inhabitants and neighbourhoods of cities are the primary victims of worsening urban conditions and are increasingly being tasked to contribute towards addressing them (Gaillard & Maceda, 2009). Therefore, the role that local governments play in urban resilience efforts in cities is seen as gradually shifting towards promoting more steering and inclusive practices, rather than non-inclusive and fragmented ones (Mees et al., 2019).

While there have been studies that have started to investigate local governments roles in urban resilience, there is still a lack of thorough understanding related to what citizens and communities, who are involved in urban resilience and adaptation projects, think of the role of local governments and the overarching resilience strategy of the city they live in (Aylett, 2013; Mees et al., 2019). An implementation gap has been noted by Wagenaar and Wilkinson (2015: 1265) 'between resilience as an ambitious objective, and the capacity to govern resilience practice'. This can be partially attributed to a lack of understanding about the changing social dynamics and attributes in cities which should be acknowledged when adapting the urban environment to climatic and socio-economic stresses (Brink & Wamsler, 2019). Additionally, to a large extent studies on urban resilience and social resilience have been handled in isolation, when it has been noted that studies should assume that both concepts overlap and influence each other in urban contexts (Eakin et al., 2017; Meerow, Pajouhesh, & Miller, 2019). Merging attributes of these concepts could contribute to a better understanding of citizen-city interactions, and how to bolster citizen engagement for a more coordinated pursuit of urban resilience in cities by all relevant stakeholders (Mees et al., 2019; Biesbroek et al., 2010).

1.2 Research aim, questions, and research framework

To address the identified knowledge gap, the proposed thesis project aims to contribute with insights into factors that might help enhance the degree of urban resilience, with a particular emphasis on citizen-city interactions, in the wake of uncertain climate-change induced risks and stresses. This is

done by evaluating and scoring the degree of urban resilience of Amsterdam and Valencia, followed by an inductive exploration of factors, mechanisms and approaches that might explain the degree of resilience found and the attitudes towards resilience in each city by different stakeholders. Lessons learnt from each context will help provide recommendations for practitioners and policymakers in both Northern and Southern EU cities facing similar challenges of instilling resilience thinking.

The evaluation of the cities is done by assessing their degree of urban resilience, drawing inspiration from Wardekker and other's (2020) framework that specifies certain urban resilience capacities. Using social resilience capacities and principles, derived from other literature (Saja et al., 2019; Sharifi et al., 2017; Wamsler & Raggars, 2018; Mattijssen et al., 2019), said framework is modified and given a more socially oriented focus. Wardekker and others' (2020: 1) framework acts as a 'diagnostic tool that elaborates on resilience capacities, principles and narratives to provide a comprehensive picture of the different pathways that resilience-building could take, and make more explicit, facilitative reflections on the choices embedded in planning for urban resilience'. Urban resilience capacities are regarded as the ways in which individuals, communities, institutions, businesses, and systems within a city survive, adapt, and grow to deal with chronic climatic and socio-economic stresses and acute shocks (Maytas & Pelling, 2015; Fu & Wang, 2018). Social resilience capacities are deemed as the abilities of citizens or a community to cope with, adapt to and engage in tackling climate change, socio-economic and urban issues (Keck & Sakdapolrak, 2013).

By evaluating the cities' capacities with the modified framework, insights can be derived about their strengths and weaknesses (which city demonstrated a greater performance/score, overlap in city-resilient elements and capacities) and whether there are indications that urban resilience and adaptation is being pursued by local governments with the engagement of lower-tier stakeholders (i.e. citizens, communities). Additionally, lessons can be uncovered that are potentially transferable from one context to another (or other contexts and cities). Recommendations for local policymakers and practitioners could contribute towards more transformative urban approaches to help engage citizens and communities in urban resilience efforts.

In order to steer this study, the following research question was formulated:

RQ: *How resilient are Amsterdam and Valencia, and what governance strategies can enhance their resilience, with a greater engagement of communities and citizens?*

Moreover, a set of sub-questions will help address the overarching research questions. These include:

SQ1: How is urban resilience conceptualised in existing literature?

SQ2: What relevant insights on social resilience and citizen engagement can be used to specify an existing urban resilience framework into one coherent assessment framework?

SQ3: By applying the assessment framework to Amsterdam and Valencia, what can be learned about the performance of both cities in terms of their urban resilience?

SQ4: What approaches, mechanism and factors can be inductively derived from the findings for both cities that may help understand the degree of resilience found?

To be able to achieve the aim of the study and answer the RQ and following SQs, the following research framework will steer the research.

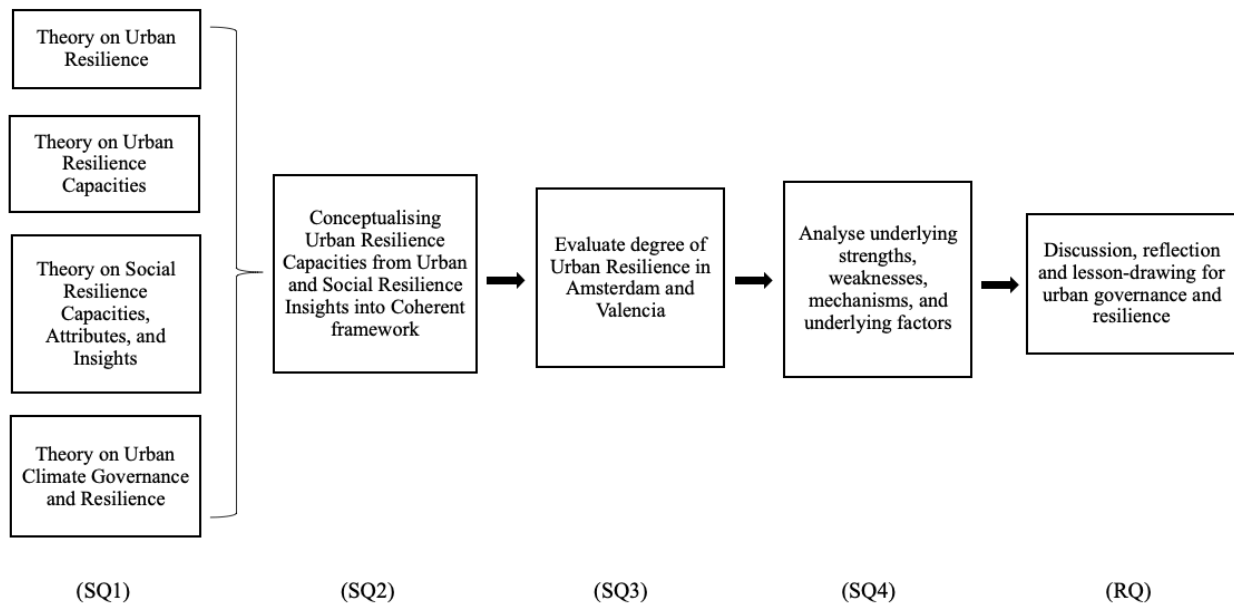


Figure 1: Research Framework

1.3 Societal and Scientific Relevance

The societal relevance of this study ties in with the urgency of resilience in cities. Action towards adaptation and resilience has never been as urgent as it currently is, with average temperatures already having risen to approximately 1.2°C above pre-industrial times (European Commission, 2020B). This is resulting in more frequent and sporadic extreme weather conditions and shocks (extreme rainfall, urban heatwaves, flooding and drought), and exacerbating the risks and vulnerabilities of EU cities and their inhabitants (European Commission, 2020B). Uncertain climate conditions and patterns will continue putting urban populations at risk if adaptation and resilience efforts do not take place in a more strategic and comprehensive manner. A resilience approach to tackle the complex challenges of climate change is underway in many cities, but its conceptualisation and application with a greater consideration of social resilience and citizens aspects is still limited and needs further investigation to uncover more about citizen-city interactions and collaboration.

Therefore, the scientific relevance of this thesis is twofold. First, it seeks to enhance Wardekker and colleagues' (2020) urban resilience framework. Second, it aims to contribute to the broader scientific effort to assess and identify ways of improving urban resilience for the benefit of citizens and to help them engage more effectively. Evaluating and extrapolating the mechanisms, strengths, and underlying factors that determine the extent of Amsterdam and Valencia's resilience capacities to combat climatic threats, could allow for the formulation of prescriptive lessons for urban governance, local resilience policies and bolstering adaptation projects. This will aid in addressing the previously mentioned 'implementation gap between resilience as an ambitious objective, and the capacity to govern resilience in practice' (Wagenaar & Wilkinson, 2015: 1265).

1.4 Outline of the report

The paper proceeds in the following manner. Chapter 2 outlines the conceptual research design and analytical framework utilised in this study. Next, details on the methods utilised are elaborated on in Chapter 3. A description and outline of the cases (Amsterdam & Valencia) take place in Chapter 4. Subsequently, both cases are scored and assessed in Chapters 5 (Amsterdam) and 6 (Valencia). Discussion and reflection on findings and analytical approach take place in Chapter 7. Lastly, Chapter 8 outlines concluding remarks and recommendations.

2. Conceptual Design

2.1 Relevant Theories and Approaches

2.1.1 Urban Resilience, Capacities and Principles

To address SQ1 - *How is urban resilience conceptualised in existing literature?* – the following section explores resilience literature, reports and conceptualisations by different scholars and academics. Over the last couple of decades, planning and preparing in urban areas for the consequences of climate change has paid close attention to mitigation and adaptation in the wake of worsening climatic threats and risk. Policymakers and scholars have noted adaptation as being vital to reduce vulnerabilities, particularly in sectors like critical infrastructure, urban planning, public health, and agriculture (Wamsler 2014; Wamsler & Pauleit 2016). To address this, mainstreaming mitigation and adaptation objectives has gained prominence and been noted as an important development to either integrate these objectives into existing policies (integration), or develop dedicated adaptation policy (separate policy) (Runhaar et al., 2018). Attempts at mainstreaming have often taken place at different scales (e.g. international, national, regional, and local), sectors (e.g. mobility, infrastructure, agriculture), and among varying stakeholders (e.g. public institutions, private companies, and civil society) (Runhaar et al., 2018). Runhaar and colleagues (2018), who studied the mainstreaming of adaptation, expressed how this mainly takes place at a national level, followed by the local government level. There are indications that more attention is paid to the national level, despite cities and urban areas being increasingly seen as important stakeholders in adaptation planning (Bulkeley & Betsill, 2013; Wamsler, 2017).

Worsening climate uncertainties are also influencing the division of tasks between stakeholders when managing and adapting to such events (Adger et al., 2013; Wamsler, 2016). While in cities, local administrations play a key role in governing climate action and associated impacts, their effectiveness has been noted as being significantly dependent on citizen behaviour and levels of engagement (Agrawala, 2011; Tompkins & Eakin, 2012; Wamsler & Riggers, 2018). This has prompted debates about the interactions between citizens and cities, as society's climate resilience has been noted as being dependent on the interplay between public policy and actions undertaken by a variety of private stakeholders, including households and private individuals (Agrawala, 2011). The emergence of resilience thinking in urban areas stems in part from worsening and more uncertain climatic and socio-economic conditions that can no longer be contained or addressed with mitigation and adaptation measures to safeguard the prosperity of these areas (Sharifi, 2020). Blossoming urban centres and cities are closely associated with human society's development and growth, with climate change considered as a disturbance that potentially jeopardises such advancements and in need of more holistic resilience thinking (Leichenko, 2011; Kim & Lim, 2016).

The concept of resilience has been applied to a variety of scientific fields including ecology, adaptive systems research, and socio-ecological systems over the course of time (Folke, 2006; Pelling, O'Brein & Matyas, 2015). Resilience has gained interest particularly in urban studies, such as urban planning, adaptation initiatives, and risk management, due to its potential applicability to a wide range of urban risks and stresses (Meerow, Newell, & Stults, 2016). There are inconsistencies when defining urban resilience and certain conceptual tensions exist such as conceptualising 'urban', pathways to

resilience, understanding of adaptation and timescale of actions (Brown et al., 2012; Chelleri, 2012; Wardekker et al., 2010). However, the previously acknowledged definition by Meerow, Newell and Stults (2016) incorporates these conceptual tensions and remains flexible in allowing for different perspectives to remain and flourish. Furthermore, it was chosen for the purpose of this study as instead of conceptualising resilience in terms of 'bouncing back' and an inherently conservative goal, the definition provided by Meerow, Newell and Stults (2016) adopts a more evolutionary conception of resilience that may encompass more radical transformations (Davoudi et al., 2012; Chelleri et al., 2015). This is echoed by other scholars that note how the ability to be resilient in an area or city includes absorbing and coping with shocks, but also evolving and adapting or even transforming technical and behavioural patterns (Walker et al., 2004; Folke et al., 2010).

Whilst there are several frameworks that have attempted to conceptualise and measure urban resilience (Cote & Nightingale, 2012; Tyler & Moench, 2012; Marschütz et al., 2020; Runhaar et al., 2016), the one recently developed by Wardekker and others (2020) is the most encompassing and holistic to date. The *Resilience Diagnostic Tool* developed by these authors provides an assessment tool that combines aspects of previous socio-ecological, urban and governance assessment tools related to resilience (Wardekker et al., 2020). As the current study is focused on exploring urban resilience in the cities of Amsterdam and Valencia, it is fitting to use one of the most recent synthesised resilience assessment frameworks developed. Additionally, it is a valid tool as 'it can be applied at a general, holistic level (all-round resilience, city scale), or specified per topic and/or neighbourhood' (Wardekker et al., 2020: 12). Wardekker and others (2020) split urban resilience into four capacities that require attention in urban settings: I. capacity to prepare, II. capacity to absorb, III. capacity to recover and IV. capacity to adapt. These capacities can be seen as varying paths or emphases for cities to take in improving and building up their resilience to shocks and stresses. Cities can either take a proactive (prepare), reactive (absorb), recuperative (recover) or an adaptive (adapt) approach to deal with urban resilience (Wardekker et al, 2020).

The fact that resilience is conceptualised in terms of capacities stems from Maytas and Pelling (2015) paper which sought to present resilience as a term grounded in reflective decision-making, learning and self-organisation. Their insights left an open scope for developing clear criteria of resilience as a capacity, which was tackled by Wardekker and others (2020). They developed a set of principles corresponding to the capacities in order to render the concepts measurable compared to the studies that previously looked at modelling resilience and its complexity or mainly criticize resilience (such as Davoudi et al., 2012; Maytas & Pelling, 2015).

The set of principles for the capacities are regarded as 'mechanisms and behaviours that make a city resilient or help policies and practices improve resilience' (Wardekker, 2018: 1). Wardekker and others (2020) operationalised the resilience capacities and principles into an analytical framework (incorporating supplementary literature) which is presented in Table 1.

Table 1: Wardekker and others (2020) Analytical Framework for Resilience Capacities and Principles

Capacities	Definition	Principles	Operationalisation Criteria
Preparedness	Identifying issues, assessing consequences, and planning ahead	Anticipation & Foresight	<ul style="list-style-type: none"> Climate-related/Adaptation-related knowledge and information is published and accessible to wide range of city stakeholders Active learning taking places Patterns and trends contributing to enhanced vulnerability are monitored
		Preparedness & Planning	<ul style="list-style-type: none"> Vulnerabilities and risks are communicated to businesses and general public, who are aware of their responsibility Emergency response and management plans are in place
		Homeostasis	<ul style="list-style-type: none"> Responsibilities of stakeholders and actors integrated into law Integrative policy processes ensuring inclusive and equitable benefits (city as a whole) Climate adaptation integrated into other policy domains Communication channels in place and functioning between different levels (community, business, and local government) Regulating ecosystem services are well maintained
Absorption	Dynamically coping with threats and stresses when they occur, whilst maintaining desired functioning	Robustness & Buffering	<ul style="list-style-type: none"> Policy, infrastructural and spatial measures focus on impact and risk reduction which can reduce or lessen climate impacts
		Diversity	<ul style="list-style-type: none"> Multiple ways to fulfil a need or objective (i.e., functional diversity) Diversification of governing authorities, management strategies, resources, institutions, means and stakeholder (diversified response) High biodiversity
		Redundancy	<ul style="list-style-type: none"> Governance roles overlap Back up and alternative sources for essential city functions and resources Functions of public services and resource overlap
Recovery	Rapidly recovering from threats and stresses when they occur, whilst maintaining desired functionality	Flatness	<ul style="list-style-type: none"> Decentralised, non-hierarchical governance allowing competent, autonomous, and authoritative local action Inclusive, active, and broad participation in decision-making (vulnerable communities, citizens, businesses, institutions)
		High Flux	<ul style="list-style-type: none"> Resource-full and flexible decision-makers in responses and strategies Quick funnelling of resources through a system, allowing quick mobilisation in response to threat Widespread access to financial and human resources, information, and connectivity between sectors
Adaptability	Quickly modify and transform, coevolving with threats and stresses	Learning	<ul style="list-style-type: none"> Room for experimentation, innovation and learning-by-doing Reflective, participatory learning from mistakes and experiences Active application and implementation of new knowledge
		Flexibility	<ul style="list-style-type: none"> Flexibility in spatial planning (for future modification, adaptations, and recalibrations of urban landscape) Flexibility in measures (present adaptation measures can be scaled up or built on in future) Institutional flexibility (decision making and cooperation arrangements)

The framework will be used as the starting point for the conceptual and analytical approach, due to its all-encompassing nature and synthesis of existing urban resilience frameworks, capacities, and principles. Some are other frameworks that study resilience like Da Silva and colleagues' (2010) urban resilience framework which provides a lens through which the complexity of cities and contributing factors to resilience can be understood. There is also Tyler and Moench's (2012) framework for urban climate resilience that focuses on extrapolating factors contributing to resilience and translating these concepts into practice. Wardekker and other's (2020) framework allows for the identification of local actions and priorities to enable greater resilience in a strategic manner, as well as stimulate discussion, dialogue and learning on how resilience capacities and planning relate to generic urban goals (Wardekker et al., 2020). However, a noticeable drawback is that the framework may not provide clear answers as to whether the results are good or bad for the local communities and a lack of emphasis on whether urban resilience interventions are rooted in citizen and community attitudes, priorities,

and engagement (Wardekker et al, 2020; Marshütz et al., 2020). Acknowledging social and local narratives are important for connecting climate risk management and urban resilience-building with people's daily lives in the city (Marshütz et al., 2020). Furthermore, empirical studies have increasingly suggested that stopping at adaptation can be considered as a detrimental strategy if the existing system displays persisting vulnerabilities and characteristics of lock-ins which lead to ineffective implementation of adaptation and climate-proofing projects (Wolfram, Borgström & Farrelly, 2019). Therefore, it can be said that some more social elements and principles are not explicitly and clearly conceptualised which leaves room for improvement. These improvements will be done by specifying and altering the operationalisation of the above-mentioned resilience principles to better incorporate more of the social and community side of resilience in cities.

2.1.2 Social Resilience, Capacities and Principles

To address SQ2 - *What relevant insights on social resilience and citizen engagement can be used to specify an existing urban resilience framework into one coherent assessment framework?* – the following section looks at social resilience literature to help specify Wardekker and colleagues' (2020) urban resilience framework (in Section 2.2). As previously mentioned, the ability for an area or city to work towards resilience requires an evolutionary and transformative approach to combat uncertain climate change (Walker et al., 2004; Folke et al., 2010). While cities are increasingly focused on resilience, it is unclear who is truly benefitting from these efforts and what stakeholders are included in the process of enhancing adaptation and resilience in urban areas (Meerow et al., 2016). Additionally, resilience-focused policies are often associated with normalising crisis and forestalling debates and discussion about how to transform the underlying systems that enhance such crises (Davoudi et al., 2012; MacKinnon & Derickson, 2013; Cretney, 2014). Other critiques of resilience argue that the predominant conceptualizations of resilience (those rooted in engineering and ecological theories) inadequately address citizen inclusion and social justice (Meerow & Newell 2019; Ziervogel et al., 2017). As noted in 2.1.1, these social elements and factors are absent in the urban resilience framework of Wardekker and colleagues (2020), leaving room for improvement.

As a result of the lack of conceptualisation regarding social elements in urban resilience in Wardekker and others (2020) framework, exploring social resilience literature can help tackle this shortfall. As acknowledged previously, social resilience is the 'ability of social entities and social mechanisms to effectively anticipate, mitigate and cope with threats and contribute to recovery activities that minimize social disruptions and reduce the impact of future threats' (Saja et al., 2019: 2). Understanding the social dimensions involved in urban resilience is important in order to work more closely with citizens for inclusive and transformative approaches to address climate change and socio-economic stresses (Sharifi et al., 2017; Wamsler & Riggers, 2018; Mattijssen et al., 2019). Cities play an important role in fostering greater social resilience through improvements in social connectivity and in coordinating local climate change plans and initiatives (Cash et al., 2003; UN-Habitat, 2019). To do so, unpacking social resilience into a set of dimensions and principles needs to take place.

Varying authors have written on social resilience dimensions (Cox & Hamlen, 2015; Sharifi, 2016; Säumel, Reddy & Wachtel, 2019). However, as of late Saja and others (2019) synthesised previous research into an adaptive and inclusive framework for assessing social resilience to stresses and disasters. Five dimensions are specified within their framework, which include I. social structure, II.

social capital, III. social mechanisms, competences, and values, IV. social equity and diversity, and V. social beliefs, culture, and faith (Saja et al., 2019). Of these five, understanding social capital (II) and mechanisms and values (III) in urban areas and cities have been noted by several authors as being important for urban and community resilience assessments and improved city life for citizens (Aldrich & Meyer, 2015; Marshütz et al., 2020). Additionally, several factors relating to the other three dimensions overlap with those of social capital and social mechanism. Therefore, for the purpose of this study those two will be utilised and are presented in Table 2 along with their principles and operationalisation (Saja et al., 2019).

Table 2: Social Resilience Dimensions adopted from Saja and colleagues (2019)

Dimensions	Principles	Operationalisation
Social Capital	Social Cohesion (Community Bond)	<ul style="list-style-type: none"> ▪ Sense of trust between communities ▪ Instances of community led leadership ▪ Connectivity between communities and local governing bodies
	Social Support (Norms of reciprocity)	<ul style="list-style-type: none"> ▪ Social support system mechanisms present ▪ Sense of shared collective responsibility and experiences ▪ External support systems present
	Social Network (Social Associations)	<ul style="list-style-type: none"> ▪ Evidence of civic engagement in social network ▪ Presence of civic organizations ▪ Culture of volunteerism present
Social Mechanisms, Competences and Values	Community Engagement	<ul style="list-style-type: none"> ▪ Evidence of political participation efforts ▪ Community engagement strategy present ▪ Involvement in public affairs ▪ Perception of communities regarding resilience
	Community Goals	<ul style="list-style-type: none"> ▪ Evident goals, priorities, and roles of citizens
	Community Shared Values and Attitudes	<ul style="list-style-type: none"> ▪ Sense of community/pride and attachment to area ▪ Shared beliefs relating to resilience and adaptation in area ▪ Examples of previous/traditional coping mechanisms
	Community Processes	<ul style="list-style-type: none"> ▪ Collaborative frameworks present addressing instances of adaptation and resilience ▪ Evidence of collaborative problem solving and decision making between community/citizens and local government
	Community Competence	<ul style="list-style-type: none"> ▪ Knowledge of local risks and relevant information made known to citizens ▪ Evidence of learning from past experiences and recovery processes ▪ Communication avenues and services between communities and institutions present
	Local cultural beliefs/norms	<ul style="list-style-type: none"> ▪ Existing cultural and behavioural norms and roles ▪ Sense of cultural and historical preservation/conservation

Social capital involves network connectivity of citizens and communities with one another and their interactions with local governing entities (Säumel, Reddy & Wachtel, 2019). Social mechanisms and values involve the development of community goals and priorities with the engagement of the community in the adaptation and resilience-building process (Saja et al., 2019). Drawing from these insights and building on existing social resilience principles, some will be integrated in the urban resilience framework of Wardekker and others (2020) to give it a more social scope and contribute to more socially oriented urban resilience principles.

While the recovery and adaptive capacities are present in the previously noted framework by Wardekker and others (2020), the transformative ability and capacity of urban areas to climate and socioeconomic stresses was missing and is something noted as being important to acknowledge the building of more resilient cities (Wolfram, Borgström, & Farrelly, 2019; Broto et al., 2019). Furthermore, whilst exploring studies and literature on social resilience it was noticeable that certain studies had derived a set of social resilience capacities that should be acknowledged when assessing social resilience. The UN-Habitat published a set of synthesised definitions for each capacity that were compiled from varying scholars (including Keck & Sakdapolrak, 2013; Lorenz, 2013; Béné et al., 2012):

- I. *Coping Capacities:* To maintain continuity, people and societies need coping capacities understood as reactive and absorptive measures to cope with and overcome immediate threats
- II. *Adaptive Capacities:* To positively adapt, people and societies need those adaptive capacities allowing them to be proactive and act in a preventive manner, learning from past experiences, anticipating future risks, and adjusting their livelihoods accordingly
- III. *Transformative Capacities:* To transform, people and societies need transformative capacities that make effective use of assets and support from economic, political and social arenas, that allow them to be active participants in decision-making and decision-implementation processes, and that support them in consolidating an institutional landscape that both improves their individual welfare and fosters societal robustness towards future challenges and crises.'

(UN-Habitat, 2019: 13)

Transformative capacity is defined as 'the ability to recalibrate and create a fundamentally new system when social (including institutional), ecological and economic conditions make the existing system untenable' (Walker et al, 2004: 4). Empirical insights have increasingly suggested that stopping at adaptation can be considered as a detrimental strategy if the existing system displays vulnerabilities and characteristics of lock-ins which lead to ineffective implementation of resilience projects (Wolfram, Borgström & Farrelly, 2019). Additionally, some scholars have identified a gap in the transformative potential of resilience-building in cities, as a result of many continuing to reproduce the status quo (Anguelovski, Connolly, & Brand, 2018; Hermans, Roep & Klerkx, 2016).

For resilience and adaptation to be maximised or recalibrated, understanding the transformative capacities of cities to implement initiatives and 'mainstreaming a resilience approach in all the city-level decision making' must be acknowledged (Coaffee et al., 2018: 404). This means fundamental shifts in urban governance towards more transformative approaches to help 'create conditions for mobilising and navigating the driving forces and dynamics of urban transformations in alignment with long-term sustainability and resilience goals' (Hölscher et al., 2019: 187). Key findings from various bodies of literature outline a variety of conditions that dictate the transformative potential of a city and avenues for improvement. These include:

- *Inclusion and Empowerment of citizens and communities* (Wolfram, Borgström & Farrelly, 2019; Frantzeskaki & Rok, 2018)
- *Acknowledgement and strengthening of intermediaries' and local academia* (Romero-Lankao et al., 2018)
- *Challenging and reinventing planning and projects in cities* (Wolfram, Borgström & Farrelly, 2019)
- *Reflexivity, collective learning, and self-assessment* (Frantzeskaki & Rok, 2018; Borgström, 2019)

- *Proactive leadership at local level* (Beer & Clower, 2014)

Elements from the abovementioned transformative conditions embedded in social resilience and the previously mentioned social resilience principles (as well as elements for their operationalisation) will be used to modify the urban resilience framework of Wardekker and others (2020) in the following section.

2.2 Conceptual and Analytical Framework

The following analytical framework (Table 3) is based on the capacities and principles proposed by Wardekker and others (2020) with the incorporation of social resilience capacities, principles, and criteria for a more socially oriented urban resilience capacities framework. Additionally, within social resilience, insights from transformative capacity-building in cities are also funnelled into the analytical framework. The recalibrated framework will be used to evaluate the degree of resilience in Amsterdam and Valencia according to their capacities, with a better representation of citizen and community involvement in urban resilience. The black bodies of text are from the original urban resilience framework and the blue lines of text have been added from the discussed social resilience and transformative literature.

Table 3: Analytical Framework merging Wardekker and others (2020) and social resilience insights.

Capacities	Principles	Operationalisation	Sources
Preparedness	Anticipation & Foresight	<ul style="list-style-type: none"> Climate-related knowledge and information is published and accessible to wide range of city stakeholders (e.g. through information campaigns and consistent adaptation/resilience related publications) Active learning taking place at both institutional and community level Socio-economic and environmental patterns enhancing vulnerabilities are monitored (e.g. water and heat related stresses) 	Saja et al., 2019; Aldrich & Meyer, 2014; Marshütz et al., 2020; Mehmood, 2016; Sherrieb, Norris & Galea, 2010; Orhan, 2016; Hutter et al., 2013; Maguire & Hagan, 2007; Cox & Hamlen, 2015; Sharifi, 2016; Säumel, Reddy & Wachtel, 2019.
	Preparedness & Planning	<ul style="list-style-type: none"> Community and citizen vulnerabilities and risks are communicated to local government Evidence of localised, community-driven responses towards climate adaptation in place Evidence of shared goals and priorities between local government and communities in adaptation initiatives Community engagement strategy present in adaptation planning (city level) 	
	Homeostasis	<ul style="list-style-type: none"> Responsibilities of stakeholders and actors integrated into law for adaptation and resilience (e.g. joint action plans at city and community level) Climate adaptation integrated into other policy domains (e.g. urban policy, social policy, spatial planning) Communication channels in place and functioning between communities and institutions for adaptation dialogue Ecosystem services are well maintained by local institutions and communities (interplay between the two) 	
Absorption	Robustness & Buffering	<ul style="list-style-type: none"> Policy, infrastructural and spatial measures focus on climate and social impacts and adequate risk reduction which can reduce or lessen both climate and social impacts (e.g. the vulnerabilities of the urban area to water and heat related threats and extremes) 	Keck, 2012; Säumel, Reddy & Wachtel, 2019; Saja et al., 2019; Mehmood, 2016; Gallopín, 2006; Trump et al., 2017; Cox & Hamlen, 2015; Sharifi, 2016.
	Diversity	<ul style="list-style-type: none"> Multiple ways to fulfil a need or objective regarding adaptation in urban environment (i.e., functional diversity) Diverse range of stakeholders with a say and responsibility in how urban adaptation unfolds High variety of local organisations involved in promoting adaptation and resilience projects (i.e., local government, NGOs, communities, citizen groups, etc) 	
	Redundancy	<ul style="list-style-type: none"> Evidence of shared functions and governance responsibilities across scales and areas for climate adaptation Evidence of responsibilities for alternative pathways for essential city resources and services, and their maintenance being delegated to lower tier stakeholders (citizens, community associations, etc) 	
Recovery	Flatness	<ul style="list-style-type: none"> Presence of decentralised, non-hierarchical governance allowing competent, autonomous and community driven action for climate adaptation Active and broad participation in decision-making (communities, businesses, institutions) Evidence of community engagement in urban adaptation projects and initiatives 	Saja et al., 2019; Aldrich & Meyer, 2014; Maguire & Hagan, 2007; Sherrieb, Norris & Galea, 2010; Cox & Hamlen, 2015; Sharifi, 2016; Säumel, Reddy & Wachtel, 2019.
	High Flux	<ul style="list-style-type: none"> Signs of resource-full and flexible decision-makers in responses and strategies Evidence of allocation of resources and funding to adaptation initiatives, displaying a quick ability of mobilisation in response to persistent threat Local institutions facilitating widespread access to financial and human resources, information, and connections (e.g. the efficient funnelling or granting of resources for community driven/public projects) 	

Adaptability	Learning	<ul style="list-style-type: none"> Room for experimentation, innovation and learning-by-doing by citizens and communities (initiated help and awareness from public bodies and local government) Participatory learning from mistakes and experiences, through dialogue, meetings, and think-tanks Active application and implementation of new knowledge for future climate adaptation projects at the local scale (in collaboration with local government) in progress or under consideration Collaborative frameworks or strategies present or underway addressing instances of adaptation and resilience in city 	Frantzeskaki & Rok, 2018; Borgström, 2019; Saja et al., 2019; Endfield, 2012; Gallopín, 2006; Folke, Colding & Berkes, 2003; Cox & Hamlen, 2015; Sharifi, 2016; Säumel, Reddy & Wachtel, 2019.
	Flexibility	<ul style="list-style-type: none"> Flexibility in spatial planning (for future modification, adaptations, and recalibrations of urban landscape) Flexibility in measures (present adaptation measures can be scaled up or built on in future), especially community adaptation projects and initiatives Institutional flexibility (decision making and cooperation arrangements) 	
Transformability	Re-Invention	<ul style="list-style-type: none"> Promotion of inclusion and empowerment as elementary prerequisites to adaptation projects Acknowledgement and strengthening of intermediaries and local academia (e.g. NGOs, public bodies, local businesses, etc) Evidence of say in prioritisation in urban planning by citizens and communities (assuming a more engaged and active role) 	Wolfram, Borgström & Farrelly, 2019; Frantzeskaki & Rok, 2018; Romero-Lankao et al., 2018; Beer & Clower, 2014; Borgström, 2019; Glaas et al., 2019; Wamster & Riggers, 2018; Mattijssen et al., 2019
	Reflexivity	<ul style="list-style-type: none"> Instances of fostering collective learning through new self-assessment techniques at multiple layers of city (government, businesses, public bodies, and communities) Evidence of learning from past mistakes and acknowledgement of opinions from varying sources (e.g. intermediaries, R&D institutes, community resilience projects, etc) 	

Elements of the operationalisation for specific urban resilience principles from Wardekker and others' (2020) framework were modified by using insights and components from the social resilience and transformative studies literature. This was done for it to embody more social and citizen-based capacities within cities and interactions with local governments for the purpose of more holistic climate adaptation and resilience building. In, addition as discussed previously, a new capacity involving transformability was added.

Social elements including citizen and community engagement in adaptation and resilience projects, along with established communication avenues between multiple city stakeholders, were elaborated on in the preparedness and adaptive capacities to climatic stresses in cities (Wells et al., 2013). Moreover, the planning and homeostasis principles have been altered to embody more collaboration and synergies between social, institutional, and climatic goals through evidence of shared perceptions and dialogues between local governments and communities (Saja et al., 2019; Hutter et al., 2013). Diversity in the city context has been altered to focus on the volume and presence of local stakeholders in adaptation projects, along with a variety of initiatives tackling climatic stresses and threats (Frantzeskaki & Rok, 2018; Trump et al., 2017). Alterations to the adaptive capacity of urban resilience involved the incorporation of citizen and community views and input in the learning process of ongoing and previously implemented initiatives (Sharifi, 2016). Furthermore, evidence of workshops, training and information campaigns by local governments and community organisations on adaptation initiatives and projects was included (Saja et al., 2019).

The most notable addition to the framework is the transformative capacity which was derived from the social resilience and transformative studies literature, as well as a discussion with Arjan Wardekker at the initial stages of the study. It includes the principles of reinvention and reflexivity to adequately assess the progress being made in tackling underlying causes of cities' inability to deal with climate stressors and threats, along with the adequate inclusion of citizen perception and community goals in the process of transitioning to more resilient cities (Wolfram, Borgström & Farrelly, 2019). Instances of collective learning and the ability of contestation by public groups on resilience and adaptation projects enhances the transformative capacities of cities and the make-up of urban governance (Borgström, 2019). Furthermore, the presence of multi-governance approaches not only illustrates linkages between entities but the delegation of leadership opportunities and responsibilities to citizens and community for more societal, ecological, and technical robustness and inclusion (Wolfram, Borgström & Farrelly, 2019).

3. Methods

3.1 Research Strategy

In order to address SQ3 - *By applying the assessment framework to Amsterdam and Valencia, what can be learned about the performance of both cities in terms of their urban resilience?* - the research strategy for this thesis took the form of a comparative case study analysis (CSA) as an in-depth study was required between different locations. Utilising CSA as an evaluation method involves ‘learning about a complex instance, based on a comprehensive understanding of that instance obtained through extensive description and analysis for that instance and in its context’ (Morra & Friedlander, 1999: 2). The approach consisted of ‘constructing a case from a specified unit while remaining attentive to interferences that span similar units outside the formal scope of the investigation’ (Gerring, 2004: 353). A CSA was appropriate for this research because the principles and their operationalization emphasise and connect the key concepts necessary to address the RQ and provide insights into the factors and mechanisms rather than the causal effects of the cases. The unit of analysis for this study was the two cities of Amsterdam and Valencia, specifically policies, plans and initiatives that concern climate adaptation and resilience building in the urban setting. Additionally, an embedded sub-unit was added which involves a stakeholder or organisation at the forefront of working with adaptation and resilience from a citizens and community perspective in the cities, which are Amsterdam Rainproof and Las Naves. The reason that these organisations were chosen as the sub-unit has to do with their interest in inclusivity and transformability in urban areas, as well as their involvement in propelling forward instances of urban adaptation and resilience building on a more localised scale with citizen engagement. This is visualised in Figure 2.

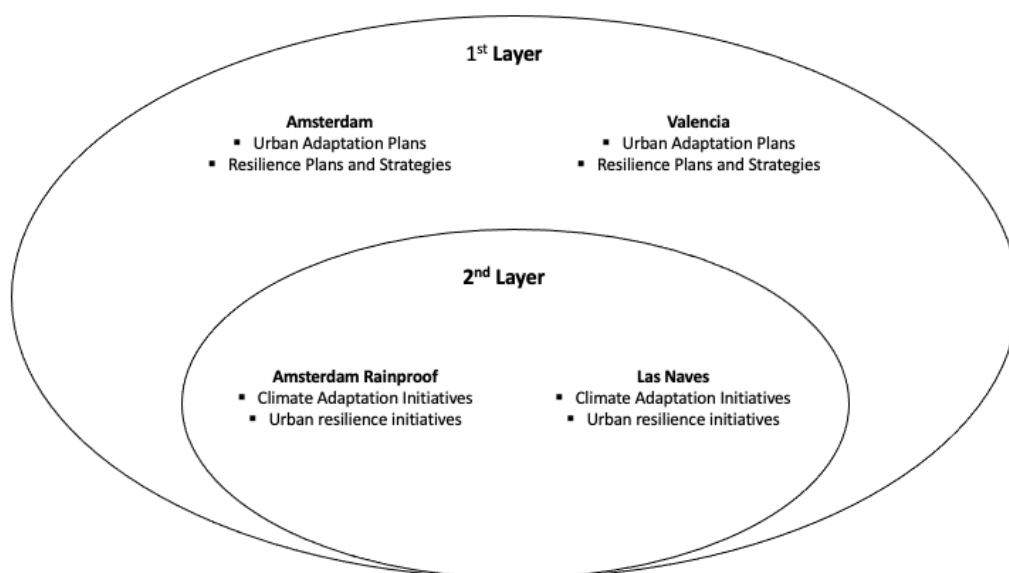


Figure 2: Two layers of CSA study (units and sub-units)

Investigating certain entities in the cities adds a second layer to the CSA selection, whereby the first layer involved the selection of the two cities along with their overarching city resilience policies and plans which was followed by the second layer (or embedded CSA) and the two organisations. This meant not studying everything that can occur in both cities (due to time constraints and feasibility issues) but zooming in more on two organisations as examples tied to urban resilience, citizen

engagement efforts and promoting local adaptation actions. The logic behind choosing these two cities was due to the belief that Amsterdam's reputation as a pioneering city when it comes to resilience and urban adaptation initiatives is at a more advanced stage compared to that of Valencia and other Mediterranean cities which currently lag. The first layer of the CSA explores where Amsterdam and Valencia are situated, their climate stressors, any major overarching adaptation and resilience plans at different scales, as well as looking at the emphasis on engagement from citizens and communities, and then complementing it with the sub-unit organisations.

The two organisations chosen for this study were those of Amsterdam Rainproof (Amsterdam) and Las Naves (Valencia). Amsterdam Rainproof is an initiative that attempts to empower citizens and community projects, improve public-private partnerships, and actively contribute towards making the city resilient to urban climate stresses (specifically water and extreme weather). Las Naves is an urban innovation centre in the city that works towards climate adaptation and resilience through projects in certain neighbourhoods and communities of Valencia. Both organisations are representative of wider developments and progress being made in both cities to address climate adaptation, citizen engagement, and urban resilience from a more bottom-up perspective. Amsterdam Rainproof and Las Naves were chosen to contribute to a better understanding of citizen-city interactions and urban climate governance with regard to adaptation and resilience. This study followed a practice-oriented research approach as it means to 'provide knowledge and information that can contribute to a successful intervention to change an existing situation that may be deemed more unsustainable' in either city or other EU cities facing similar challenges (Verschuren, Doorewaard & Mellion, 2010: 45).

To be able to evaluate and investigate the degree of resilience in these two cities, some information and data were needed. The type of information and data compiled came primarily in the form of qualitative information, grey literature, and previous empirical findings. Moreover, primary insights and quotations from interviewees in Amsterdam and Valencia were also filtered in so as to assess and score the cities' urban resilience capacities and principles.

3.2 Data Collection

As alluded to by Verschueren, Doorewaard and Mellion (2010) not all data and information required to meet the research aim and answer the RQ can be found in the existing literature. Hence, the resources utilised throughout the CSA consisted of literature, publications, reports, and online sources for secondary and qualitative data, for the most part. The main search engines used for literature and reports were Web of Science (WoS), WorldCat and Google Scholar. For relevant insights, papers, and perceptions on adaptation and resilience I reached out to members of local organisations, public bodies and some private entities in Amsterdam which included members from the Geemente Amsterdam (City of Amsterdam), Waternet, Amsterdam Green Campus, the Advanced Metropolitan Solutions (AMS) institute, Climate-KIC, University of Amsterdam (UvA), and Knowledge Mile Park. In Valencia these included members from the Ayuntamiento de Valencia (Valencia City Council), GrowGreen, the Polytechnic University of Valencia (UPV), INGENIO, Valencia Activa and Climate-KIC. Semi-structured interviews with members from these organisations were useful to extrapolate primary insights into overarching adaptation and resilience approaches (and attitudes) in both cities, and relevant plans from literature they suggested or were willing to share.

More specific insights from the embedded organisations chosen came from some of their members. For Amsterdam Rainproof my reference people were Lisette Heijke and Paulien Hartog whilst for Las Naves it was Francisca Hipoltio and Emilio Servera. The questions asked to the interviewees were inspired from the operationalisation criteria found in the analytical framework. They provided primary insights into the cities and organisations that were fed into the analytical framework and the corresponding capacities. These interviews and primary insights, along with other relevant grey literature found online from the initiatives helped consolidate insights into citizen engagement and social capacities in urban resilience and adaptation. A full list of interviewee names and organisations is available in Appendix 1.

The qualitative insights and primary knowledge from interviews consisted of 10 interviews for each city (20 in total) while leaving room for additional interviews and connections that could lead on from talks with interviewees. The number of documents amounted to roughly 25 to 30 for each city and primarily consisted of scientific reports, urban planning and adaptation documents, some legislation and policy briefings, and adaptation plans (national, regional, and local). Some of the interviews, as well as documents, were in Spanish and therefore, relevant insights were translated into English to feed into the analysis and scoring. As a native Spanish speaker, interpreting interviews and documents was manageable.

3.3 Data Analysis

The previously mentioned document analysis was utilised to compile and examine insights for both cities to provide an overview of their characteristics, as well as stakeholders involved. To be able to pinpoint stakeholders for both cities, a method for identifying and mapping out stakeholders for adaptation outlined by Andre and others (2012) was adopted. It involves four criteria: I. functional criterion, II. geographical location criterion, III. knowledge and abilities criterion, and IV. hierarchical level criterion. Table 4 provides a description of each.

Table 4: Description of criterion for stakeholder identification

Functional Criterion	'Stakeholders that are formally responsible for adaptation, for example, those who have to make decisions on, prepare for and/or implement adaptation and those affected by decisions on adaptation actions' (Andre' et al., 2012: 248)
Geographical Location Criterion	Complements functional criterion in 'the sense that actors with no clear function for adaptation might be highly relevant because of geographical exposure to climate risks' (Andre' et al., 2012: 249).
Knowledge & Abilities Criterion	'Stakeholders assumed to have certain knowledge and skills related to adaptation or expert knowledge on the climate system and climate risks' (Andre' et al., 2012: 250)
Hierarchical Level Criterion	Unlike functional criterion that focus on organisation with an explicit responsibility for adaptation, hierarchical level criterion 'enables the identification of decision makers and other types of influential stakeholders who indirectly could facilitate or hinder adaptation' (Andre' et al., 2012: 250)

Stakeholders can be classified as internal and external as alluded to by Ballejos and Montagna (2008). In this case, with the unit of analysis being the city, the internal stakeholders refer to those operating

at a local and regional level, whilst external stakeholders are those on a national and global level. It must be acknowledged, and has been by some scholars, that the adaptation process is influenced and effected by both internal and external stakeholders (Arnell & Delaney, 2006; Wamsler, 2017). Additionally, the abovementioned criteria can overlap but going through the identification process allows to analytically distinguish between them.

Following on, the operationalising of criteria is the process that researchers use to illustrate how they will measure the concept they are investigating. The revised urban resilience framework (Table 3) along with its operationalised criteria made up the relevant qualitative (and in a few instances quantitative) criteria and indicators assessed for Amsterdam and Valencia. In essence, the analytical framework made a start at operationalising the resilience principles based on the previously mentioned insights, secondary literature, primary information, and plans (Section 2.2). Once this was done for both cities, each principle was scored against the various operationalised criteria following a scoring system outlined by Wardekker and others (2020) which was adapted in Table 5.

Table 5: Scoring system to evaluate resilience capacities and principles in Amsterdam and Valencia, adapted from Wardekker et al (2020).

Current Situation					
Score	--	-	0	+	++
What do scores mean?	The current situation is significantly weak	The current situation is weak	The current situation is neutral	The current situation is strong	The current situation is significantly strong
Description	There are many weaknesses in most operationalised aspects, very limited strengths.	Overall weak or mix of weaknesses and strengths are still not significantly evident	A mix of weaknesses and strengths noticeable, overall neutral, or unclear effect	Overall strong or mix of strengths and weaknesses, with more strengths being evident	There are many strengths on most operationalised aspects, very limited evidence of weakness
Future Plans					
Score	--	-	0	+	++
What do scores mean?	Adaptation and resilience plans have very negative effect on principle	Adaptation and resilience plans have a negative effect on the principle	Adaptation and resilience plans have a neutral effect on this principle	Adaptation and resilience plans have a positive effect on the principle	Adaptation and resilience plans have a very positive effect principle
Description	Plans show to have a negative effect on most operationalised aspects, very limited positive effects, and potential.	The overall negative effect, or largely negative on aspects but limited evidence of neutral and positive effects	Plans have a balance of positive and negative effects. The total effect is unclear and could go either way	Overall positive effect or largely positive effect but limited evidence of neutral and negative effects	Plans have a positive effect on most operationalised aspects, very limited negative effects and potential

Wardekker and others (2020) differentiate between a 'baseline diagnosis' which looks to assess the current emphasis on resilience and an 'intervention diagnosis' assessing the impacts and prospects of proposed plans of action regarding resilience in the future. This research followed this line of reasoning for the scoring of both current situation (baseline diagnosis) and future plans (intervention diagnosis) according to details on policies, publications, plans, interviewees, and other relevant literature on adaptation and resilience. The distinction between current situation and future plans was done to evaluate what is currently implemented and being upheld in each city in terms of adaptation and resilience-building actions, and the prospects that each city has in the future due to stipulated measures or plans, and previous adaptation priorities. For each principle both Amsterdam and Valencia were scored against their operationalised criteria for the urban resilience capacities.

To make sense of the scoring system a three-tier scale was utilised to ease understanding of the results. These are:

- *Weak – Negative:* Weak evidence of principles being covered in the current and future plans; substantial gaps for improvements; illustrate a low degree of urban resilience.
- *Moderate:* Neutral evidence of principles in current and future plans, presence of conflicting strengths and weaknesses.
- *Strong – Positive:* Substantial evidence of principles between covered in current and future plans; only slight adjustments necessary to improve situation; high degree of urban resilience.

In addition, this scale was used to visualise the intentional or unintentional resilience pathway and to shed light on particular capacities emphasised in the cities' current and future approach.

The data accumulated during the document analysis, interviews with relevant stakeholders, and additional literature gathering was subsequently processed. To process the information and insights from the virtual interviews, Amberscript and Otter.ai software was utilised to transcribe all the interviews. Quotes and insights from interviewees were further synthesised in Word documents according to which question they addressed. Data and insights were compiled into Excel and Word to organise the operationalisation criteria per resilience principle, with two separate spreadsheets: one for Amsterdam, and another for Valencia. Once all relevant insights from documents, plans, grey literature, and interviews were compiled, the operationalised criteria for each principle were scored. This was done using Table 5 to assess their impact on the urban resilience capacities.

3.4 Research Ethics

The five main ethical principles that I have used during this study involve: (a) minimising the risk of harm; (b) obtaining informed consent; (c) protecting anonymity and confidentiality; (d) avoiding deceptive practices; and (e) providing the right to withdraw. These ethical principles were taken under consideration throughout the data collections process (interviews) and in the subsequent analysis of insights obtained and interpreted. Interview procedures were followed, and agreements made with interviewees on the confidentiality of qualitative insights obtained during the interview and its use later in the analysis. Anonymity was offered for each interviewee in case they were not comfortable having their identities known. All interviewees agreed to be named and cited in the final document.

4. Case Descriptions

The following section will describe the two case cities in this study. It will consist of a general overview of each city's climatic vulnerabilities, and a timeline of the city's climate adaptation and resilience plans and strategies. The main actions, measures, information, and relevant interview insights geared towards climate adaptation and resilience are presented. These actions in terms of resilience principles they weaken or strengthen are incorporated and evaluated later in Chapters 5 and 6.

4.1 Amsterdam

The capital of The Netherlands, Amsterdam is the biggest city in the country and home to close to 810,000 people within its city limits which is roughly an area of 219 km² but close to 2.5 million in its metropolitan area (Gemeente Amsterdam, 2020A). It is an economically open, global city that attracts close to 18 million tourists each year (prior to COVID) that come to visit its historic buildings, canals, museums, and cultural events (Statista, 2021). As a result of its popularity and economic draw, Amsterdam is the 6th largest metropolitan area, by GDP, in the EU with €182.7 billion in 2018 (Metropoolregio Amsterdam, 2021). Moreover, the metropolitan areas in the Netherlands account for roughly 54% of the country's GDP and 48% of its employment (OECD, 2018). For the last two decades, these metropolitan areas have generated about 64% of the Netherlands' GDP growth, with about half of that being generated in the Amsterdam area (OECD, 2018). The economic and social appeal of the city attracts many foreigners and locals from other parts of the country, which has contributed to a rapid densification of the city's core and peripheries (Savini et al., 2016).

4.1.1 Vulnerabilities and challenges related to climate change

The city's importance economically on a national scale is noteworthy, especially when you consider how vulnerable it is to the elements and the changing climate. Most of the city is situated approximately 2 meters below sea level, which has made the area significantly prone to flooding and water-related stresses over the decades (Kluck et al., 2015). From the start of the 20th century to safeguard its population, the country applied a technocratic approach to deal with its vulnerability to water and floods by investing in higher and stronger flood defences repeatedly (e.g. dikes, barrier dams, and levees) (Correlje & Broekmans, 2015). However, an important trigger event came in the form of a great flood in 1953 which took the lives of 1,836 people in the South-Western region of the Netherlands (Olsthoorn et al., 2008).

While the storm surge that caused the floods did not affect Amsterdam itself, the disaster was an important national trigger (wake-up call). It led the national government to appoint a team of technical experts in the Delta commission to help improve and standardise the management of the flood defences. What's noteworthy is that the public value that was most prominent at the time when flood protection was being promoted was to guarantee (almost) full protection of the population in economically valuable areas (e.g. Rotterdam and Amsterdam) (Correlje & Broekmans, 2015). The goal of full protection from that point onwards inspired the development of standards, instruments, and pathways, as well as systematising a division of responsibilities between the national government and the protected areas' populations (regional and municipal level) (Kluck et al., 2015). As a result, Amsterdam has garnered a good reputation for itself internationally for its pioneering water

adaptation and delta technologies (Van der Hoek, Hartog & Jacobs, 2014). This is also reflected by the good track record the country has of reclaiming land from the sea, strong water industry, innovative water engineering and agriculture (OECD, 2014).

Whilst there has been a lot of attention on climate-proofing Amsterdam to water stresses (which include rising sea levels and flooding), events like the summer heatwaves of 2018 and 2019 that plagued many regions in Europe have drawn more attention to the threat of heat and drought. Meanwhile, climate uncertainties and vulnerabilities have been noted as worsening as of late and at a faster rate than previously stipulated in projections and scenarios (KNMI, 2019; Gemeente Amsterdam, 2020A). The municipality has noted how the ‘effects of climate change are becoming increasingly visible in the city, with a mix of waterlogging caused by heavy downpours, as well as droughts and heatwaves becoming more unpredictable over the last couple of years’ (Gemeente Amsterdam, 2020A: 3). The Gemeente of Amsterdam is quite consistent with its updates and publishing of maps for heat, drought, and flooding, as well as hot spots for these climatic stresses in the city through its main website (Interview 1, 3). Figure 3 for instance illustrates the different levels of groundwater in different areas of the city, visualising the most vulnerable districts and neighbourhoods to drought which in this case seem to be centred around the Old Centre.

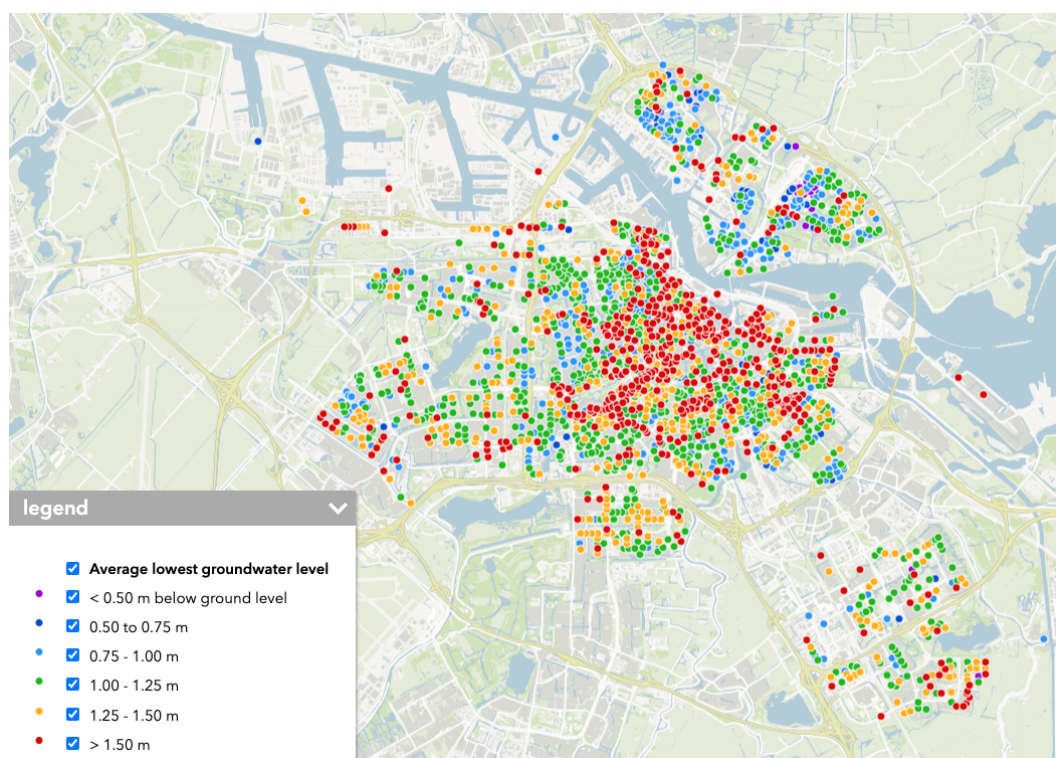


Figure 3: Groundwater levels in Amsterdam (Source: Gemeente Amsterdam, 2021B)

There are numerous risks associated with the increased occurrence of drought which include damage to the city’s local ecology and green spaces, as well as soil subsidence which poses problems to infrastructure foundations and network cables which are considerably old and outdated to cope with such climatic aggravations (Stouthamer et al., 2020; Gemeente Amsterdam, 2020A). Moreover, Figure 4 illustrates the areas most prone to excessively hot temperatures. The highest temperatures seem to be those in the streets and the industrial areas of the city as they make up most of the paved urban surface.

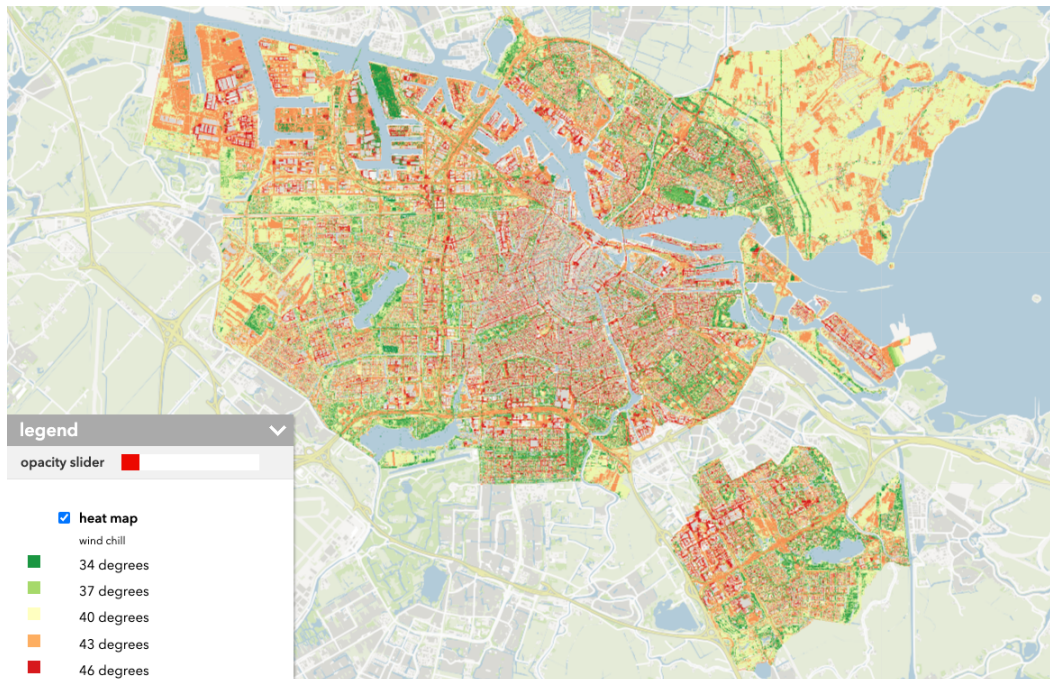


Figure 4: Heat map of the city of Amsterdam (Source: Gemeente Amsterdam, 2021B)

Organisations such as Rainproof, Waternet, and the AMS institute have contributed to the monitoring and researching of climatic stressors and raising awareness on water adaptation and resilience (Interview 2, 8, 9). Rainproof chooses to focus specifically on extreme rainfall and waterlogging and works alongside the Gemeente to monitor and accelerate adaptation in the city’s most vulnerable areas. Figure 5 illustrates the areas of Amsterdam that are at high risk of waterlogging due to the increasingly frequent showers and extreme downpours.

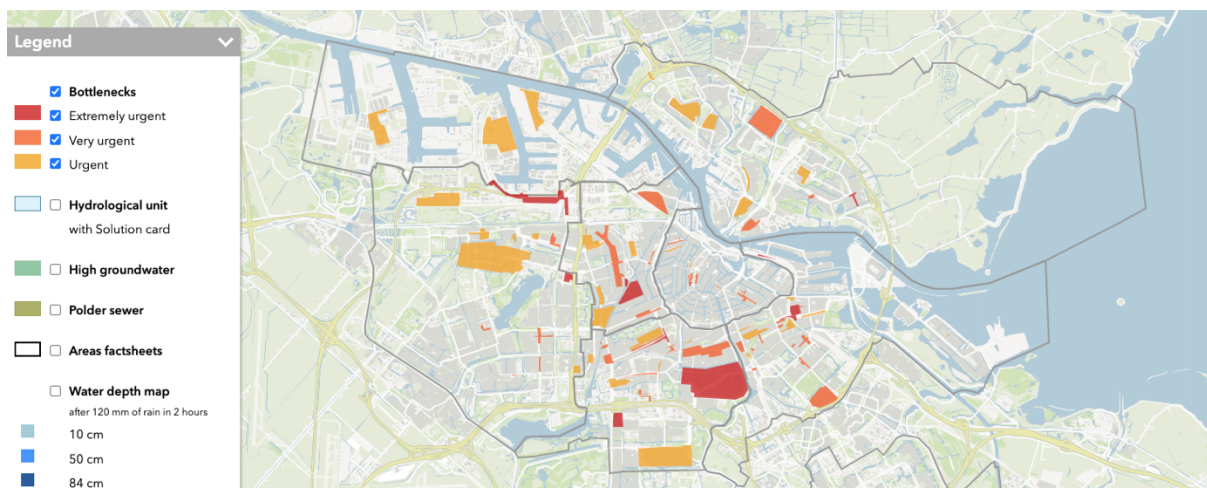


Figure 5: Map of areas at risk of waterlogging in Amsterdam (Source: Gemeente Amsterdam, 2021C)

Rainproof’s ambitions when it started off in 2014 were broader than just water stressors but team members were designated to ‘start with extreme rainfall because people can really feel that, see that in the streets’ making it less abstract (Interview 8). These organisations use soft policy instruments such as engaging, informing, and activating residents, business owners, local government officials and

knowledge workers to work on the design of roofs, pavements, gardens, parks, and squares that can better handle intensive rainfall and water filtration (Gemeente Amsterdam, 2020A; Rainproof, 2020).

4.1.2 Adaptation strategies and resilience planning

The Netherlands has significant experience with adaptation, but rather than having been focused purely on climate adaptation and resilience explicitly, the bigger focus has been on spatial adaptation and water management in the area over the years. Since 2010, several plans and strategies involving adaptation and sustainability have been adopted on a city, regional, and national level. Some for Amsterdam or relevant to this study are illustrated in Figure 6.

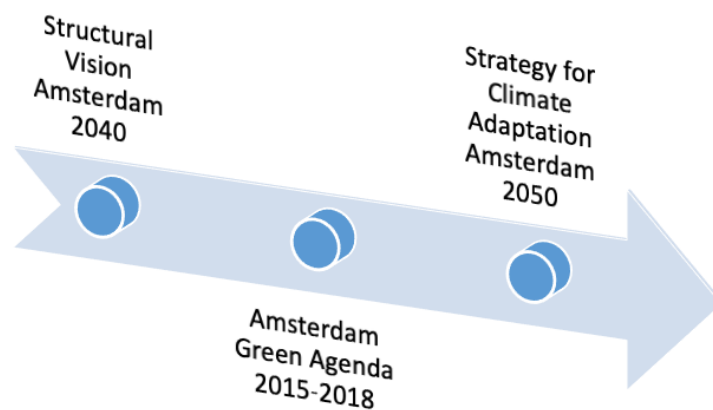


Figure 6: Adaptation Plans and Strategies in Amsterdam

The *Structural Vision Amsterdam 2040* was approved in 2011 and aimed at carrying forward the city's long tradition of spatial planning and adaptation. However, it diverged from previous structural plans as the emphasis had now shifted to a multi-functional vision for the city, with spatial elaboration and adaptation in policy and regulation playing an important role (Lauwers, Ponteyn & Van Zaren, 2011). Figure 7 provides the Structural Vision map outlined in the plan.

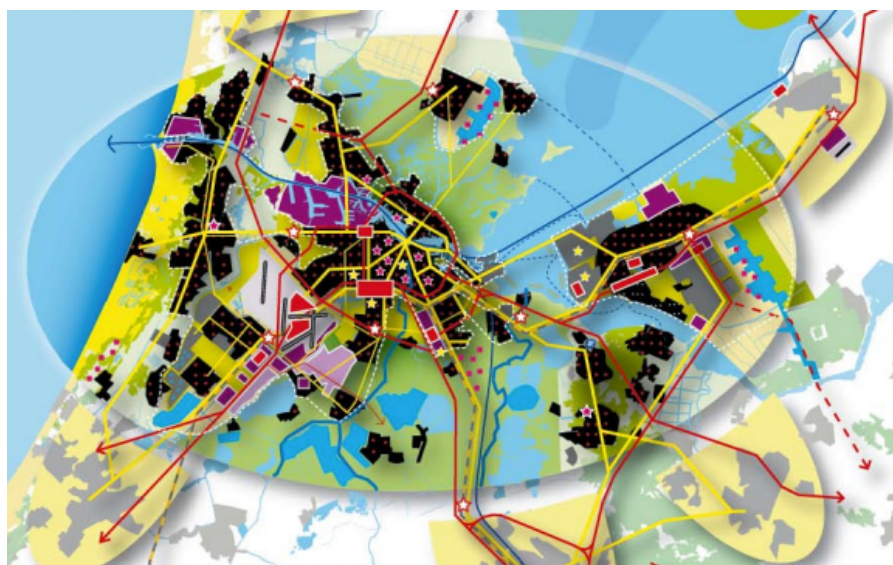


Figure 7: Structural Vision Map Amsterdam 2040 (Source: Lauwers, Ponteyn & Van Zanen, 2011: 7)

While previous plans and maps had been exclusively focused on spatial adaptation in Amsterdam's municipal territory, the Structural Vision map outlined a vision that encompassed the entirety of the metropolitan area as an interlinked system (Gemeente Amsterdam, 2021A). It was understood that to expand, densify and transform Amsterdam leading up to 2040, a Structural Vision had to set out concrete plans, allocation of land and investment, and projects throughout the city whilst being guided by insights on developmental patterns (inside and outside the city, meaning EU) and future scenarios for spatial development (Lauwers, Ponteyn & Van Zanen, 2011). Additionally, what set apart this vision plan was the manner it had been jointly devised through a period of consultation and formulation with city residents, social organizations, the private sector, and local governing entities. This consultation period spanned three years (2009-2011) and involved public campaigns such as that of the *binnen30minuten* (within 30 minutes) city and *Vrijstaat Amsterdam* (Free State of Amsterdam) (Lauwers, Ponteyn & Van Zanen, 2011; IABR, 2021).

While sustainability and biodiversity conservation were outlined as important objectives in green-space planning within the *Structural Vision Amsterdam 2040*, it was not made abundantly clear as to how those objectives were to be achieved. What was established was the importance of having a minimum amount of green space and spatial developments being stimulated if they complied with the Main Green Structure (Hoofdgroenstructuur, or HGS). The Main Green Structure maps out the minimum required amount of greenery that the city would like to safeguard and preserve as it densifies in the future (Gemeente Amsterdam, 2021B). There were minimal, explicit uses of climate adaptation in the vision, with one noteworthy mention being that 'climate adaptation projects can qualify for resources from the Delta Fund, and that it would come into operation as of 2020' (Gemeente Amsterdam, 2011A: 200 – translated from Dutch).

The *Structural Vision Amsterdam 2040* laid out an integrated view for the city of Amsterdam, one that set in motion planning that aimed to make it adaptable to future changes. In 2015 the *Amsterdam Green Agenda 2015-2018 (Agenda Groen)* was coupled to this vision and focused on nature-based solutions (NBS) and urban adaptation from a more environmental perspective. It stated that the city of Amsterdam provided a 20-million-euro Green Fund for green projects and adaptation initiatives geared towards climate-proofing (Gemeente Amsterdam, 2015). The agenda set out ambitious targets for projects and studies, such as working towards creating 15 new green play areas and 20 new postage-stamp-sized (or 'pocket') parks, as well as getting 50 000 m² of green roofs installed over the three-year period (Azarakhsh, Diasa & Koomen, 2016). The Green Funds were based on the principle of co-funding, with private individuals, NGOs, and companies having to invest their own money to then obtain a subsidy for greening projects or developments (Gemeente Amsterdam, 2015).

The agenda steered greening and adaptation towards four main areas: I. city parks, II. climate and biodiversity, III. greening in the neighbourhood, and IV. connections and accessibility (Gemeente Amsterdam, 2015). As the *Structural Vision Amsterdam 2040* had laid out an interwoven, integrated layout for the city's urban and natural area, focusing on how to protect green and natural spaces was an important complementary feature that served multiple functions. For instance, green spaces provide more permeable surfaces and groundwater storage whilst also acting as natural carbon sinks and recreational spaces for city inhabitants (Gemeente Amsterdam, 2015). In many ways, plans and the vision set forth spatial adaptation with a greater consideration and promotion of greening and

adapting urban territory which is why it has garnered increasing attention and praise. It was only recently in 2020 that the *Strategy for Climate Adaptation Amsterdam 2050 (Strategie Klimaatadaptatie Amsterdam 2050)* was passed and approved. The strategy provides the first coherent approach towards climate adaptation in the city. The urgency towards adapting to the increasingly uncertain and unpredictable climate was made clear, as was a more all-encompassing approach towards adapting to various climate and socio-economic stressors (Gemeente Amsterdam, 2020A). What is noteworthy is that the strategy's approach at starting to systematically include climate adaptation in aspects such as spatial policy, area development, health and well-being, and sustainability programmes displays an attempt at integrating sectors, disciplines, and policy domains. The goal of climate adaptation as stipulated in the strategy is twofold, 'firstly to ensure that there is coherence between different types of innovative projects, and secondly to help them expand' (Gemeente Amsterdam 2020A: 2).

Climate adaptation in the strategy encompasses four main climatic stressors and areas: I. waterlogging, II. flooding, III. heat, and IV. drought. It is noticeable that there has been a lot more emphasis and experience on dealing with waterlogging and flooding over the years in comparison with the knowledge and implementation of heat and drought measures (Dai, Wörner, & Rijswick, 2018; Gemeente Amsterdam, 2020A). The strategy sets out measures to start building on the adaptive capacity and resilience of the city across these four climatic themes, through instances of upscaling successful innovation projects, more explicit emphasis on health-related risks from heat, cross-sectoral learning and strengthening private-public partnerships (Gemeente Amsterdam, 2020A). As a result of the considerable investment in innovative projects (through instances like the Green Funds, Amsterdam Rainproof, and Innovation department of Gemeente) and experimentation that has gradually taken place, predominantly greening, and water-proofing the city, the municipality has a good selection of knowledge and expertise to draw from. A good example is Amsterdam Rainproof's experiments and projects that have promoted the retrofitting of surfaces (i.e., more permeable pavements and green spaces on private and public properties, and green-blue adaptation in public and private buildings to improve the multifunctionality of infrastructure for greater adaptation and resilience) (Gemeente Amsterdam, 2020A).

What is clear from the adaptation planning and strategies that have taken shape in Amsterdam over the course of the decade is that they have been predominately influenced by the spatial adaptation and policy ambitions for a more interconnected city and metropolitan area in the future (Lauwers, Ponteyn & Van Zanen, 2011). Urban adaptation through greener measures and standards has complemented the spatial planning that has taken place, which has emphasised and promoted adapting to water stresses such as flooding and waterlogging due to not only the historical background but also the urgency placed on these climatic threats. Furthermore, the explicit formulation of a clearer climate adaptation strategy took place recently and an implementation agenda is currently underway (Interview 2, 3, 8). Efforts have recently started gearing towards integrating the knowledge and expertise in spatial adaptation, greening, and waterproofing for a more holistic approach to tackle climatic and socio-economic uncertainties, as well as understanding their interconnectedness.

Adaptation strategies on a national and regional level have played a role in conditioning more local actions, with a few that are relevant and should be taken into consideration being outlined in Figure

8. Insights and efforts outlined from these will also filter into the scoring of the current situation and future plans in Chapter 5, with more specific information provided accordingly.

ADAPTATION PLANS & STRATEGIES			
NATIONAL CLIMATE ADAPTATION STRATEGY (NAS) 2016	DELTA PLAN FOR SPATIAL ADAPTATION 2018	NAS IMPLEMENTATION PROGRAMME 2018-2019	GREEN VISION AMSTERDAM 2050
<ul style="list-style-type: none"> National vulnerabilities, risks and measures synthesised into a strategy Water and heat related climatic threats spilling over, contributing to damaging property, disease, increased mortality, etc. NAS, combined with Delta Programme, to guide efforts in climate adaptation nationally More holistic climatic threats (water and heat) and prioritisation Participative process between public sector, R&D institutes, private sector, societal organisations and engaged individuals 	<ul style="list-style-type: none"> Water resilient and climate-proof by 2050 Introduction of more holistic climatic threats Localised strategies and action plans for vulnerabilities Municipalities tasked with creating own plans and implementation agendas Three steps for municipalities to take: <ol style="list-style-type: none"> Analysis (e.g. stress tests or risk dialogue) Ambition (e.g. drawing up adaptation strategies) Action (e.g. Rainproof or RESILIO) Expertise utilised to branch to other climate threats and risks 	<ul style="list-style-type: none"> Integrate climate adaptation into policy, implementation and relevant activities of governments, civil-society organisations, citizens, and businesses. Not legally binding, more like recommendations Responsibility for inventory of risks and formulation of visions delegated to regional and municipal entities (localised action) Encourages the implementation of climate adaptation measures and embedding climate adaptation within policy and legislation, 	<ul style="list-style-type: none"> Role green and nature have in the urban area with residents and private organisations Links made between greening, climate adaptation, health, and sectoral sustainability Shaping 'green character' amongst citizens, private companies, and neighbourhoods One of the building blocks of Amsterdam's Spatial Vision 2050 (being developed) Vision stresses citizens being at the very center of continued pushes towards greening and adaptation

Figure 8: Additional plans, measures, and strategies on adaptation. (Sources: Minister van Infrastructuur en Waterstaat, 2016; Delta Programme, 2018; Minister van Infrastructuur en Waterstaat, 2018; Gemeente Amsterdam, 2020B)

4.1.3 Stakeholders of relevance in Amsterdam

When focusing on Amsterdam and its task of adapting to climate change there are a multitude of stakeholders that influence how, to what degree and at what pace actions unfold. Relevant literature, insights from previously mentioned adaptation plans, strategies and interview insights were funnelled into Table 6. This was adapted from the abovementioned Andres and others (2012) stakeholder identification method, to give an overview of the stakeholders in adaptation for the local scale. This was done for all scales (national, regional, and local) with the full table available in Appendix 3, but as the focus of the study is on cities and localised action the local scale is of more importance and is illustrated.

Table 6: Adaptation stakeholder categorisation and roles for local scale

Selection criteria	Local
Functional	<ul style="list-style-type: none"> ▪ Gemeente Amsterdam ▪ Gemeente Vervoerbedrijf ▪ Regional Water Authority (Waterschap amstel gooi en vecht or Waternet) ▪ Private companies and businesses ▪ Insurance Companies (e.g., Ansva Insurance Company N.V) ▪ Citizens and neighbourhoods ▪ Energy, building and construction (e.g., Vattenfall, Budget Energie)
Geographical location	<ul style="list-style-type: none"> ▪ Gemeente Amsterdam ▪ Vulnerable groups and neighbourhoods ▪ Property owners ▪ Citizens ▪ Private companies and businesses ▪ Amsterdam Rainproof
Knowledge & Abilities	<ul style="list-style-type: none"> ▪ Amsterdam Institute for Advanced Metropolitan Solutions (AMS) ▪ Amsterdam Green Campus ▪ Amsterdam Rainproof ▪ Amsterdam Smart City ▪ Neighbourhood Associations (e.g., Knowledge Mile Park) ▪ Citizens
Hierarchical level	<ul style="list-style-type: none"> ▪ Gemeente Amsterdam ▪ Waternet ▪ Private individuals

On a national and regional level, most of the previously mentioned plans and strategies (Section 4.1.2) are predominately headed or signed off by different national ministries, in particular the Ministry of Infrastructure & Water Management and that of Economic Affairs & Climate Policy, who have different functions based on their working areas and specific responsibilities but are tasked with climate adaptation (PBL, 2014). This is due to there not being a single authority that has the overall responsibility for climate adaptation. Moreover, because of the urgency and attention given over time in the Netherlands to water and spatial adaptation, these ministries are the ones tasked with coordinating adaptation development on a national level and assisting regional (and municipal) entities with the rolling out of their strategies and plans (Gemeente Amsterdam, 2020A). These regional entities for the case of Amsterdam are the Regional Water Authority (or Waternet), the Gemeente of Amsterdam, and Amsterdam Metropolitan Area (AMA) who are tasked with carrying out the formulation and implementation of adaptation plans on that scale (Rainproof, 2021; Interview 2, 8). As the main unit of the study revolves around a more localised and city-based assessment, the focus is steered towards the local stakeholders as classified in Table 6.

Waternet is the main (and only) water company in the Netherlands which operates the entire water cycle that crosses regions and cities. In Amsterdam, its efforts are focused on improving the quality and availability of drinking water, transport, and treatment of wastewater, keeping surface water clean and maintaining dikes and flood defence systems (Van Leeuwen & Sjerps, 2015; Waternet, 2021). Whilst climate adaptation has gained prominence in the last 10 years, Waternet has already been working for '20 years or more on climate adaptation that then was called future proof or water management' (Interview 8). The organisation has recently expressed how adapting to the changing

climate 'through technological innovation can only be achieved if we pay sufficient attention to social innovations' (Waternet, 2020: 4). Waternet works a lot with the Gemeente of Amsterdam which is tasked with carrying out and maintaining the functions of the city through its departments (e.g. urban policy, greening, climate adaptation, waste) (Gemeente Amsterdam, 2020A). Additionally, it acts as a 'mediator of innovation within the city and holds an important role in the process of transitioning and adapting the urban area' (Interview 3). It recently created a climate adaptation department (as of 2019) to consolidate expertise on adaptation and to start collaborating with other departments and stakeholders which eventually led to the formulation of the *Strategy for Climate Adaptation Amsterdam 2050* (Interview 2, 8).

Apart from coordinating the maintenance of the city's public spaces, the Gemeente is tasked with carrying out climate stress tests on themes of heat, drought, flooding, and waterlogging, as well as providing insights and monitoring into constant developments and updates as new information becomes available on their official website (Gemeente Amsterdam, 2021B; Interview 3). To aid awareness building since the early 2010s on water and spatial adaptation on a more localised level, Waternet along with the Gemeente of Amsterdam launched Amsterdam Rainproof. It is an organisation that works on establishing a network of expertise, partnerships, and funding manoeuvrability among stakeholders for more local, neighbourhood, and community-based adaptation actions to waterproof the city (Rainproof, 2020). Quite a lot of people working for Rainproof are outsourced by the Gemeente or Waternet which illustrates significant ties between expertise and communication among the different organisations (Interview 6).

The network is comprised of private businesses, local green initiatives, knowledge institutes, housing corporation landscapers, citizens, and neighbourhood associations (Rainproof, 2021; Gemeente Amsterdam, 2020A). The organisation works on both private and public adaptation and innovation projects, with private projects for instance working to engage housing corporations, green centres, and voluntary organisations in removing paved surfaces and contributing towards green spaces (Gemeente Amsterdam, 2020A; Interview 2, 5). An example of their work in public spaces involves the coordination of retrofitting the square and sewage system of the Rivierenbuurt and Bellamybuurt neighbourhoods in the city. This was done through measures like raised thresholds to direct water flow and divert excess rainfall to green, vegetated spaces to temporarily hold excess rainwater (during extreme weather events) (Rainproof, 2021; Interview 2). Other localised adaptation project examples are one such as the green urban infiltration strips on streets and pavements (e.g. in Zuidelijke Wandelweg), polder roofs on top of buildings for greater permeable surfaces and recreation spaces for the inhabitants of buildings (e.g. in Vivaldistraat), and installing filter drains (or granudrain) in areas to update infiltration systems in neighbourhoods (e.g. in Stadionbuurt district) (Rainproof, 2021; Trell & Van Geet, 2019).

Within Rainproof's network there are several R&D institutes and universities for instance the AMS institute, Amsterdam Green Campus, UvA and KWR Water Research institute (Interview 2, 3, 10). Stakeholders with knowledge and expertise are linked up with private companies (e.g. housing companies) and citizens (e.g. homeowners or service users). For instance, along with the KWR Water Research Institute and private business, they launched the Smartroof 2.0 project which involves using sensors to measure the evaporation and energy balance of blue-green roofs to better understand the cooling capacity of these adaptation measures in the city (Gemeente Amsterdam, 2015; Gemeente

Amsterdam, 2020A). Similarly, they recently helped coordinate and promote the *Resilience nEtworK of Smart Innovative cLimate-adapative rOoftops* (RESILIO) research project (launched in 2020). The project aims at transforming 8,000 m² of roof space into smart blue-green roofs over a three-year period in areas like Kattenburg Island, Enburg, Indische Buurt, Oosterparkbuurt, RivierenBuurt and Sloterveer (Gemeente Amsterdam, 2020A; Rainproof, 2021).

R&D institutes and universities (e.g. AMS institute, UvA, Amsterdam Smart City, Amsterdam Green Campus, and Hogeschool van Amsterdam) play a role in educating younger generations and disseminating knowledge on adaptation, climate change, and resilience thinking (AMS, 2021; Interview 1, 10). In many ways, they act like networks of knowledge to connect science to societal challenges, establish partnerships, and develop solutions in a collaborative manner between urban stakeholders (Interview 1, 9). For instance, the AMS institute and Amsterdam Smart City act as platforms for communication and engagement from local governments, private companies, and citizens (e.g. students, house owners, and community associations) (Amsterdam Smart City, 2021; Interview 9). The innovative solutions usually are concerned with challenges such as smart urban mobility, urban energy, circularity, and digitization with climate resilience programmes more recently entering the sphere of action (AMS, 2021; Amsterdam Smart City, 2021). For instance, in the AMS, Interviewee 9 noted: ‘what we’re doing on resilience is building a team now. That’s what Gerben Mol intends to do. Build a team of resilience people that consolidate the knowledge and then can go to the city and pitch ideas’.

Lastly you have private parties and companies such as insurance firms, garden centres, housing corporations, and energy providers which contribute significantly to Amsterdam’s adaptation efforts when you consider that the ratio of private to public land in the city is about 50-50 (Gemeente Amsterdam, 2020A). Private entities are of structural importance in the urban system to reach larger proportions of city inhabitants or groups, specifically homeowners and consumers, which can contribute to a more well-rounded approach towards adaptation and resilience (Tompkins & Eakin, 2012; Doorn, Brackel & Vermeulen, 2021; Gemeente Amsterdam, 2020A). Everyday citizens and neighbourhood associations (e.g. Knowledge Mile Park, West-Indische Buurt in Transitie) contribute towards the expansion and upscaling of innovative climate-proofing and resilience projects with the support of local governments and companies (Interview 1, 2, 5).

4.2 Valencia

Valencia is the capital of the Valencian Community and Province, located on the East coast of Spain. It is the third-largest city in Spain after Madrid and Barcelona, and home to approximately 800,000 inhabitants in its administrative city limits (García et al., 2020). However, Figure 9 illustrates how its urban area (or metropolitan area) extends beyond the historical core to include farmlands, a natural park, and a population of around 1.5 million people (Lehoczky et al., 2017).



Figure 9: Districts of Valencia making up its metropolitan area (Lehoczky et al., 2017: 3)

The urban landscape greatly varies throughout the city, from its densely populated historical centre (Ciutat Vella – L'Eixample) with limited green parks and space to its outskirts which are made up of green, farmland and smaller peripheral clusters (Casselles, 1991). The unique green belt of farmland called L'Horta of Valencia surrounds the metropolitan areas and is made up of highly productive and historically fertile land (approximately 20,000 ha) (Garcia, 2015). Along with the Natural Park of the Albufera these two natural areas are of socio-cultural importance for organically connecting traditional agricultural farmlands to the urban core (Lehoczky et al., 2017; Map of L'Horta, the Albufera and Valencia available in Appendix 2). The city's long agrarian and provincial history has slowly transitioned over the decades into a sprawling regional capital, an emerging economic centre, and major tourism destination (Prytherch & V.B Maiques, 2009). Furthermore, Valencia is home to the biggest commercial container shipping port in the Mediterranean, making it a strategic city for trade in the region (Garcia, 2015). Roughly 40% of the containers that make up Spain's foreign trade (exports) pass through the Port of Valencia (UNCTAD, 2016). Therefore, it is vital for ensuring connectivity to the world's markets as well as contributing significantly to the national GDP.

4.2.1 Vulnerabilities and challenges related to climate change

Studies have noted how one of the regions most vulnerable and affected by climate change in the coming decades is the Western Mediterranean, precisely where Valencia is located (Linares et al., 2020). Over the last decade, the city has experienced higher warming trends and sporadic precipitation changes (as well as extreme weather events) (Llario et al., 2019). In the city's *Climate Change Adaptation Plan 2050* three main climate change impacts were noted for the city in the coming decades: I) extreme climate and weather events (like droughts and floods), II) increase of average temperature (e.g. heatwaves), and III) decreases in average yearly rainfall (Factor CO₂, 2016). This has been echoed by some interviewees, with there being clearly two powerful climatic effects, 'the one of the big phenomena, like huge storms, floods, and then the one related to droughts or heatwaves or cold-waves'....'All coming in a big package, which is climate change in itself' (Interview 13 & 15).

Much like Amsterdam, Valencia's more recent plans stress how vulnerable the city is to water and heat impacts due to how the city and its surrounding agricultural and natural areas are intertwined for urban functions (Lehoczky et al., 2017). This is important to note, as Valencia has had problems with the 'design of its borders, especially the contact between the city and its rural land (i.e. L'Horta and the Albufera) (Garcia, 2015: 13). Water resources in the two-river basin (Jucar and Turia) from which Valencia gets its supply are predicted to decrease in flow and capacity significantly due to rising temperatures inland and in the mountain range nearby (Suárez-Almiñana et al., 2020). Furthermore, sea level rise has also been noted as a prominent threat which could potentially redefine the management and adaptation of L'Horta and the Albufera (Factor CO₂, 2016). The Albufera lake levels, for instance, will need to be increased in the short term by around 0.16 m and in the long term by 0.8m to avoid sea water penetration (Estrela Segrelles, Pérez Martín, & Gómez Martínez, 2021). Potential salinization of the freshwater source would not only drastically alter the biodiversity of the natural area but also diminish the freshwater supply for irrigation by rice farmers in L'Horta and commercial use in the city (Dasi et al., 2018). The risk of disrupting this system (or ecosystem) could significantly threaten the city's food and agricultural security, something that has been of immense importance historically for the development of the city and region (García et al., 2020).

Rising and extreme temperatures will pose a threat to the robustness of infrastructure and the well-being of people, as urban heat islands (UHI) and heatwaves will occur more frequently (Factor CO₂, 2016). Based on insights and studies done on Valencia's surface temperature patterns between 1984 and 2013, there is a trend towards an increase in average temperature corresponding to 0.03 °C per year, or approximately 3.1 °C per century (Alonso et al., 2015). Assessment of certain risk areas and vulnerable spots have been mapped out by programmes such as Green Urban Data, Las Naves, and other innovative start-ups in the city (Interview 6, 7). For instance, Figure 10 illustrates the areas and infrastructure most vulnerable to heatwaves in Valencia, as of 2017.



Figure 10: Mapping of areas most vulnerable to heatwaves in Valencia 2017 (source: Urban Green Data, 2018)

Certain areas of the city are more prone to extreme temperatures (in red) due to their location and surroundings. Neighbourhoods that border “El Gardin del Turia” or the Turia Garden, a green corridor slicing the city from the North-West to the South-East, are less obstructed by buildings and have more open spaces (in blue) allowing more winds and breezes to circulate (Azizi & Javanmardi, 2017). This naturally cools down these areas while the denser and built-up areas pose a bigger threat to overheating and deteriorating people’s health (Lehoczky et al., 2017). The complex feedback processes and interactions that take place between the natural and urban area are of vital importance to enable the longevity of the city’s development. From its ‘historical past of torrential rains and extreme temperature events, it is relatively prepared but far from what it should be for what is happening now’ (Interview 12).

4.2.2 Adaptation strategies and resilience planning

Spain has some experience with mitigating and adapting measures in its territory, but the national interpretation of climate adaptation has been more along the lines of building towards climate neutrality and emission reductions (Interview 11, 15). Prior to 2010, there are some noteworthy instances and movements for adaptation that have influenced the city’s development. For example, ‘student movements, trade unions, and neighbourhood associations became a tool for the people to take sides in the social and political changes’ that were taking place in the country following the death of Franco in 1975 (Interview 17). In Valencia this was manifested against the proposal of a motorway that was being planned in the old Turia riverbed (Carmona González, 1997). Through a social movement with the slogan ‘el riu és nostre i el volem verd’ (the river is ours and we want it green) citizens put pressure on the government to change strategy and instead create a green corridor in the Turia riverbed (Carmona González, 1997). Two main drivers of the movement were the feeling that the river belonged to the citizens of the area and the need for more green spaces and parks in the city (Interview 12, 17).

Since 2010, several plans and strategies involving adaptation and sustainability have been formulated on a city, regional and national level. Some for Valencia or relevant to this study are illustrated in Figure 11.

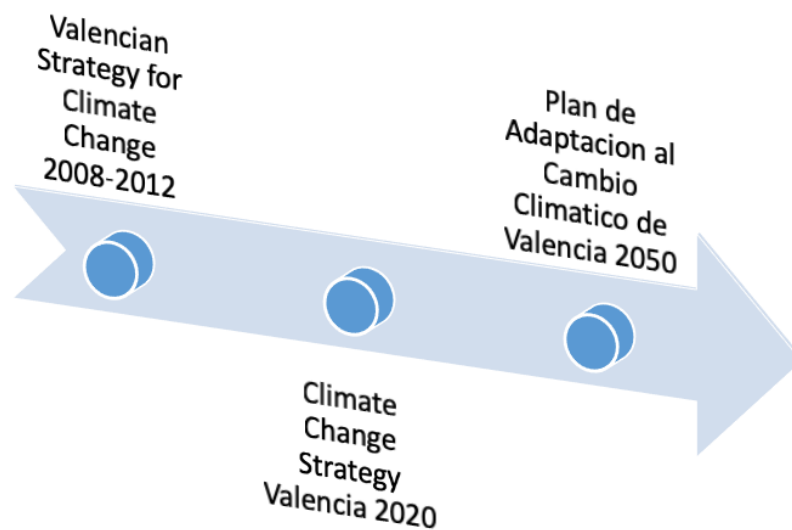


Figure 11: Adaptation plans and strategies for Valencia

As regards climate adaptation, this is a recent concept that few municipalities in Spain have begun to explore more in depth, let alone to engage in more explicit resilience building (Factor CO₂, 2016; Interview 15). The city of Valencia has some experience with climate action compared to others. It started gaining traction around 2008 when the *Estratègia Valenciana Davant el Canvi Climàtic 2008 – 2012 (Valencian Strategy to Combat Climate Change 2008-2012)* was published which outlined mitigation and adaptation measures to be taken in the wake of increasing greenhouse emissions and EU pledges for their reduction (Generalitat Valenciana, 2008). The strategy emphasised the importance of researching and working towards reducing emissions through energy saving, renewable energies, optimizing mobility, infrastructural recalibrations, and disseminating knowledge on risks associated with emissions and climate (Generalitat Valenciana, 2008). The strategy called for the regional and municipal governments to formulate their own climate action plan to localise the assessments of vulnerabilities and the climate action measures required.

Soon after in 2011, following social and environmental diagnostics, the *Estrategia Frente Al Cambio Climatico Valencia 2020 (Climate Change Strategy Valencia 2020)* was published (and adopted) and set up the city's first strategy to combat climate change. The strategy aimed at making Valencia an international benchmark for sustainability, working towards a new socio-economic model for the city in 2020, and creating new instruments for cooperation (Ayuntamiento de Valencia, 2011). In many ways, the approach in the strategy was one of the first instances of the city setting forth short-, medium- and long-term objectives to climate-proof the city with a more holistic consideration of its social, economic, and environmental elements. This is evident from the fact that the strategy relied significantly on planning instruments which had previously been adopted such as the *Environmental Action Plan Valencia 2010* and the *Sustainable Energy Action Plan Valencia 2010* to structure more cross-cutting and horizontal measures for interconnections (Ayuntamiento de Valencia, 2011).

Measures for mitigation and adaptation in the plan were steered by 5 pillars (I. Responsibility, II. Innovation, III. Governance, IV. Prevention, and V. Diffusion) to bolster environmental awareness,

quality of life and the social participation of citizens in discourses (Ayuntamiento de Valencia, 2011). While the measures were focused on improving the city and making more of its sectors (specifically mobility and energy) sustainable for the common well-being of the inhabitants and its development, most of the actions were headed by private organisations and the local municipality. Localised efforts mainly revolved around raising awareness and mobilising community sentiment in favour of energy sustainability, emissions reduction, and climate change (Factor CO₂, 2016; Interview 19).

It was at the beginning of 2017, when the *Plan de Adaptación al Cambio Climático de Valencia 2050 (Climate Adaptation Plan Valencia 2050)* was adopted, that climate adaptation was first explicitly mentioned and used to guide urban development. The plan outlined four main objectives to be pursued for adequate adaptation: I. Adapt people, II. Promote a sustainable green economy, III. Carry out responsible management, and IV. Design an attractive and efficient city (Alonso et al., 2015; Factor CO₂, 2016). In an effort to make these objectives more tangible, the plan outlines a set of 14 goals and 22 lines of action for sectors such as water, biodiversity, health and agriculture, as well as indicators for monitoring progress. For instance, some lines of action are centred on health implications and integration of climate adaptation in these sectors (e.g. to establish heat protocol, or establish communication lines between vital services) (Factor CO₂, 2016). Others on resilience building in the city, including the L'Horta and Albufera, for instance working on pilot and experiment projects, improving awareness of citizen engagement, and monitoring of vulnerabilities (Alonso et al., 2015; Factor CO₂, 2016).

It must be acknowledged that EU standards, agreements and funding have played a significant role in cultivating the national, regional, and local pathways for adaptation and what that entailed (Interview 11, 14, 15). In a large variety of plans the focus on tackling polluting sectors and optimizing them to reduce emissions and work towards carbon neutrality as the primary means of adapting to climate change are quite pronounced. In part, this can be attributed to the fact that environmental assessments and vulnerability tests emphasise heatwaves and UHI's as pressing climatic impacts and 'are directly linked to atmospheric pollution and mobility which worsen or alleviate heat impacts' (Interview 16). Additionally, the city's pledges to the Kyoto Protocol and Covenant of Mayors for Climate and Energy seem to have influenced the national sentiment towards climate action and the subsequent mitigation and adaptation measures appropriated.

Adaptation strategies on a regional and EU level have played a role in conditioning local actions previously (and as of late), with a few that are relevant and should be taken into consideration being outlined in Figure 12. Insights and measures outlined from these will also filter into the scoring of the current situation and future plans in Chapter 5, with more specific information provided accordingly.

ADAPTATION PLANS & STRATEGIES			
ESTRATEGIA VALENCIANA ANTE EL CAMBIO CLIMATICO 2013-2020 <ul style="list-style-type: none"> Configured as the fundamental instrument for guaranteeing the social and economic well-being of the citizens of the Comunitat in the future Strategy emphasised the importance of coupling mitigation and adaptation measures Elaboration on adaptation measures low Energetic saving and transition towards renewable energy through mitigation measures (in mobility, tourism, agriculture, industry, etc) Raise awareness and educate city inhabitants on climate change 	PLAN CLIMA Y ENERGIA SOSTENIBLE VALENCIA 2030 <ul style="list-style-type: none"> Aims centred on: I. Promotion of renewables, II. Energy efficiency, III. Energy transition culture and IV. Fighting energy poverty Establishes both mitigation and adaptation measures (along with indicators for monitoring) up to 2030 (more detailed mitigation than adaptation) Funding for these mitigation and adaptation plans still very small proportion of overall city budget Mitigation centred on emissions monitoring and references moving forward. 	MISSIONS VALENCIA 2030 <ul style="list-style-type: none"> Governance model for mission-oriented innovation projects that have an impact on the life of people interacting in Valencia Mobilised five helixes: Private sector, public sector, academia, civil society and the media Contribute towards making the city more I. sustainable, II. shared, III. healthy, and IV. entrepreneurial. Programme originates from the analyses and evaluations that the EU has been promoting since 2018 Las Naves leading and coordinating helixes, as well as partnerships 	ESTRATEGIA VALENCIANA DE CAMBIO CLIMATICO Y ENERGIA 2030 <ul style="list-style-type: none"> Aims at reductions in energy consumption, promotion of renewables, energy sufficiency, and cleaner transport Promotion of a territorial balance, without neglecting the role of carbon sinks as an instrument to reduce the emissions (among other things) L’Horta and the Albufera considered in metropolitan area and attempts at interweaving them with existing urban systems Sets out measures and indicators to assess the progression of efforts formulated

Figure 12: Additional plans, measures, and strategies on adaptation. (Sources: Generalitat Valenciana, 2013; Ayuntamiento Valencia 2019; Missions Valencia, 2020; Generalitat Valenciana, 2020).

4.2.4 Stakeholders of relevance in Valencia

When focusing on Valencia and its task of adapting to climate change there are a multitude of stakeholders that influence how, to what degree and at what pace actions unfold. Relevant literature, insights from previously mentioned adaptation plans and strategies, as well as interviews were funnelled into Table 7, adapted from Andres and others (2012), to give an overview of the stakeholders in adaptation for the local scale. This was done for all scales (national, regional, and local) with the full table available in Appendix 4, but as the focus of the study is on cities and localised action the local scale is of more importance and illustrated.

Table 7: Adaptation stakeholder categorisation and roles for local scale

Selection criteria	Local
Functional	<ul style="list-style-type: none"> ▪ Ayuntamiento de Valencia (Valencia City Council) ▪ EMT Valencia (Empresa Municipal de Transportes) ▪ Regional Water Authority (Tribunales de Aguas) ▪ Private companies and businesses ▪ Insurance Companies (e.g. Segurgent, Zurich) ▪ Citizens and neighbourhoods ▪ Energy, building and construction (e.g. Repsol, MDF Construcció)
Geographical location	<ul style="list-style-type: none"> ▪ Ayuntamiento de Valencia (Valencia City Council) ▪ Las Naves ▪ Property owners ▪ Citizens, vulnerable groups, and neighbourhoods ▪ Private companies and businesses ▪ Associations (e.g., Horta Viva, Valencia Activa, SME Terra I Xufa)
Knowledge & Abilities	<ul style="list-style-type: none"> ▪ Las Naves ▪ INGENIO ▪ Universidad Politecnica Valencia (UPV) ▪ Tecnalía ▪ Neighbourhood Associations (e.g., Horta Viva, Per L’Horta) ▪ Citizens
Hierarchical level	<ul style="list-style-type: none"> ▪ Ayuntamiento de Valencia (Valencia City Council) ▪ Private Companies ▪ Private individuals/citizens

On a national level, most plans and strategies relating to climate action (e.g. PNACC, EECCEL) are formulated and headed by the Ministries of Transport, Mobility and Urban Agenda, Ecological Transition, and the Demographic Challenge, and of Agriculture, Fisheries and Food (García et al., 2020; MITECO, 2020). Much like the Netherlands, this could be attributed to there not being a single authority that has the overall responsibility for climate adaptation. Therefore, there seems to be some interplay management between the different national ministries to concretize plans and adaptation avenues with the aid of the European Commission (Factor CO₂, 2016; Generalitat Valenciana, 2020). Moreover, because of the urgency and attention given over the last decade in Spain to emissions and air pollution, these ministries are tasked with coordinating mitigation and adaptation developments on a national level and assisting autonomous regions (or *Comunidades Autonomas*) and municipal entities with the rolling out of their strategies and plans (García et al., 2020).

On a regional level the main responsibilities for climate adaptation reside with the General Directorate of Climate Change which is linked to the Generalitat Valenciana and its departments (e.g. Regional Department of Agriculture, Rural Development, Climate Emergency and Ecological Transition) (García et al., 2020; Interview 11). They collaborate with the Regional Water Authority (*Tribunales de Aguas*) for water management, land use, and agricultural planning in the Valencian region (Hudson-Richards & Gonzales, 2013). The Generalitat also works towards localising risks and awareness of municipal climatic threats and adaptation possibilities to municipalities (Interview 11). As the main unit of the study revolves around a more localised and city-based assessment, the focus is steered towards the local stakeholders as classified in Table 8.

The Ayuntamiento de Valencia is the main local body which coordinates with the Generalitat Valenciana and Regional Water Authority to pursue development and adaptation on a localised level within the metropolitan area of the city (Missions Valencia, 2020; Interview 11). In 2009, it 'signed up to the Covenant of Mayors and has been working on reducing greenhouse gas emissions ever since' (Factor CO₂, 2016: 25). They are the ones who compiled, drafted, and published the *Missions Valencia 2030*, as well as the *Climate Adaptation Plan Valencia 2050* with the help of other city organizations like Las Naves and UPV (Factor CO₂, 2016; Missions Valencia, 2020). The city council has different departments of expertise and 'areas that have specific competencies in sustainability, energy, mobility and climate change. For instance, our area, which is the area of innovation and entrepreneurship, we do try to encourage business projects, start-ups or entrepreneurs with a triple impact' (Interview 14). The Ayuntamiento collaborates with other urban stakeholders through what is considered the 'four (or five) helixes: I. the public sector, II. the private sector, III. academia, IV. organised civil society, and more recently trying to include (V) the media to help transmit, involve, and empower citizens' (Missions Valencia, 2020; Interview 15, 17).

Through this collaborative network, expertise and insights are shared among these entities, especially between private, public, and academic stakeholders and organised society, with the recent inclusion of the media (as of 2020 with *Missions Valencia 2030* and gearing up to *Urban Agenda 2030*). In 2011, the Ayuntamiento opened Las Naves, a public centre for social and urban innovation of Valencia that reports to the city council, to help build awareness of climate change, emissions, and mitigation (Sales Ten & Margaix Cecilia, 2018; Interview 12, 15). The organisation acts in many ways like Rainproof, whereby it brings together civil and private stakeholders for co-funding and co-creation of innovation (e.g. programmes like GrowGreen, MATCHUP, Urban Green Data, Valencia Activa). For instance, GrowGreen works towards developing and monitoring a variety of NBS and green infrastructure initiatives in certain districts (e.g. Benicalap and Patraix) and in areas of L'Horta (García et al., 2020; Interview 12, 13). Las Naves acts to enable cross-sectoral and stakeholder learning as alluded to by Interviewee 11: 'the city is learning, and the city council is learning with las Naves. Las Naves do things that are pilots, that maybe aren't important, aren't interesting, but if they work, the city council is looking at them'.

The Ayuntamiento and Las Naves work alongside numerous R&D institutes such as the Universidad de Valencia, UPV, Fundacion Valencia Clima I Energia, and INGENIO to compile expertise, insights on vulnerabilities, and do emissions monitoring (Alonso et al., 2015; Factor CO₂, 2016). For instance, the UPV created La Cátedra de Cambio Climático (Climate Change Chair) in collaboration with the regional authority (Generalitat) to enhance climate change coordination. It also offers a variety of activities for students and citizens to engage on a smaller scale (e.g. training scholarships on climate change, information workshops on climate action) (García et al., 2020; Interview 13, 16).

Private individuals (e.g. homeowners), and companies (e.g. housing corporations, Repsol, Segurgent, SME Terra I Xufa) are important stakeholders in the maintenance, development, and adaptation of Valencia (Interview 15, 18). This is attributed to the change that is needed 'in the way the city approaches public space, and private space. Design with a plan in mind and an understanding of what a system means' (Interview 19). Citizens and civil society movements have previously contributed towards climate adaptation and policy (start of Section 4.2), with associations (e.g. CERAI, Per L'Horta)

and neighbourhoods engaging with social and environmental awareness building and conservation (García et al., 2020; Interview 12).

4.3 Overview of Cities

Table 8 gives an overview of some contextual conditions and characteristics for both cities to outline some comparisons and similarities.

Table 8: overview of contextual conditions for Amsterdam and Valencia

<i>Contextual Elements</i>	<i>Amsterdam</i>	<i>Valencia</i>
Population	810,000 in city – 2.5 million in metropolitan area	800,000 in city – 1.5 million in metropolitan area
Land area	219.4 km ²	628.9 km ²
Type of Governance Model	Decentralised – reach localised/city level	Decentralised – reach regional level
Adaptation Approach Emphasised	Water and Spatial Management/Adaptation	Emission reductions and targeted sectoral adaptation
Climatic Prioritisation	Heat, Waterlogging, Drought, and Flooding	Extreme weather events (extreme downpours), Heat, Lower Precipitation, and Sea Level Rise
Climate Resilience Plan or Strategy in Place?	No – Neither national nor local	No – Neither national nor local

While both cities have a similar population size, Valencia has almost triple the land area of Amsterdam in its metropolitan area. Both countries have a decentralised governance model, whereby the regions and municipalities are tasked with the formulation and implementation of their own adaptation and climate action agendas (aligned with national and EU targets). Regarding the adaptation focus and approach utilised in each city, Amsterdam has historically been more centred on water and spatial adaptation for tackling climate vulnerabilities and risks. On the other hand, Valencia has mainly prioritised the reduction of emissions and steered towards energy efficiency in some sectors (e.g. mobility and industry). The cities have similar climatic priorities that revolve around water and heat-related disturbances, with actions gearing up to tackle these in a more holistic manner in both contexts. Lastly, it is important to acknowledge that neither Amsterdam nor Valencia has adopted a localised resilience plan.

5. Amsterdam Case Evaluation

This chapter, as well as the following one (Chapter 6), seek to answer SQ3 - *by applying the assessment framework to Amsterdam and Valencia, what can be learned about the performance of both cities in terms of their resilience capacities*. Each principle is scored according to the scale in Table 5 and on the basis of current situations and future plans derived from the adaptation and resilience strategies studied. This was complemented by interview insights compiled from local stakeholders and other grey literature. An overview of the scores for each capacity (preparedness, adsorption, recovery, adaptability, and transformability) is presented and subsequently interpreted in a more in-depth manner for each principle. The scoring of all the results for Amsterdam is illustrated at the end in Table 14, while that for Valencia is given in Table 20.

5.1 Preparedness

As Table 9 shows, each of the preparedness principles received a neutral score for current situation which illustrates a neutral overall capacity to *prepare*. Future plans for anticipation and preparedness scored positively which illustrates positive prospects but homeostasis received a neutral score due to some concerns involving fragmentation.

Table 9: Score per principle, current situation and future plans, based on adaptation plans and interviews.

Principle	Current Situation	Reason/Why?	Future Plans	Reason/Why?
Anticipation & Foresight	0	Monitoring, accessibility, and learning on climate adaptation related knowledge evident, but still lack of awareness on holistic climate adaptation	+	Risk dialogues currently underway, more concrete actions for adaptation to climatic themes to follow along with active knowledge dissemination and insights into of heat related vulnerabilities
Preparedness & Planning	0	Lacking more concrete evidence of practical engagement measures, and general public awareness on holistic climate adaptation in plans (accessible to small proportion of city neighborhoods)	+	Focus on enhancing communicating and increasing awareness, local actions to be more concrete following implementation agenda for climate adaptation strategy and upscaling more community initiatives
Homeostasis	0	Lacking policy integration of climate adaptation into other policy domains and city sectors, interplay between communities and institutions still mainly revolves around water management	0	Established network of expertise with opportunities to branch out, commitment of plans towards integration of climate adaptation into other policy domains, and risk dialogues to improve communication but some internal fragmentation and low delegation of responsibilities still raise doubts

5.1.1 Anticipation and Foresight

The principle involves the presence (or evidence) of climate-related knowledge, vulnerabilities and patterns being monitored and accessible to a wide range of city stakeholders. Amsterdam obtained a neutral score (due to a mix of strengths and weaknesses present) for current situation, and a positive score for future plans.

Whilst knowledge, data, and insights on climatic risks like waterlogging and flooding have been developed and awareness raised with citizens in the city, there is still a need to elaborate further on vulnerabilities of heat and improve the formulation of actions. Thus, the current situation is neutral.

Climate risk assessments and climate stress tests have recently been conducted in the city. There has also been a stronger commitment in the more recent strategy to broaden climate adaptation know-how for varying climatic and socio-economic stressors. This could have a positive influence.

A first strength currently for Amsterdam and the Netherlands is that they have experience in disseminating knowledge and insights to anticipate water stresses and to climate-proof cities to climatic disturbances. These are integral to various plans and strategies (Minister van Infrastructuur en Waterstaat, 2018; Delta Programme, 2018; Gemeente Amsterdam, 2020A). Furthermore, climate stress tests and vulnerability mapping were done in Amsterdam as stipulated in the *Delta Plan for Spatial Adaptation 2018* which made it obligatory for municipalities to formulate their own adaptation strategies (Kennisportaal Klimaatadaptatie, 2021B). The plan set forth and adopted the *Analysis, Ambition, Action* approach and methodology (which built on the working method set down in the previous plan in 2014). This 'involved mapping out the vulnerabilities (analysis), then formulating goals and plans (ambition), and lastly setting to work on making the living environment water-resilient and climate-proof (action)' (Delta Programme, 2018: 32).

A second current strength is that Amsterdam already has some previous experience in embarking on actions, such as the Amsterdam Rainproof Initiative, to expand on the knowledge and collaboration towards climate proofing and adapting the city (Gemeente Amsterdam, 2020A). The organisation has actively collaborated with entities such as Waternet, the Gemeente and private companies to help link them to neighbourhoods. The approach that 'if you have a lot of awareness, people also ask for regulation'...'we said no, there's no awareness. You must not start with regulation' (Interview 8). Over the years since their creation the Rainproof principles have received praise to the point that they were integrated into the *Delta Plan on Spatial Adaptation 2018*, demonstrating its influence on and contribution to climate adaptation aligned with national goals (Rainproof, 2021). Rainproof and the Gemeente of Amsterdam actively provide data and maps for the areas of the city most prone to waterlogging and groundwater, with a more generalised monitoring of heat and drought patterns in the city through their official website (Gemeente Amsterdam, 2020A).

A weakness currently is that despite the city's experience in adapting to water-related stresses, climate adaptation as a more holistic and encompassing approach (as voiced more explicitly in the recent strategy) is still at its early stages and lacks more awareness. Some interviewees voiced how the 'whole sustainability department of the city of Amsterdam is still very vague'...'I don't think people really know what their responsibilities are' (Interview 5). Another weakness is that evidence of qualitative (e.g. risk dialogues) and quantitative (e.g. climate stress tests and vulnerability mapping) insights across sectors and certain climate themes (e.g. heat and the health sector) is currently lacking or in process of being acquired (Gemeente Amsterdam, 2020A; Interview 1, 3).

A strength moving forward could be that tackling in unison the four highlighted climatic themes over the course of the following years (and decades) will help in collecting insights, mapping local vulnerabilities, and disseminating more concrete actions to raise awareness within the city (Gemeente Amsterdam, 2020A). This could be aided by conducting risk dialogues with relevant city partners (such as housing corporation, farmers, nature managers, and private companies) which is another prerequisite, and follows the *analysis* phase to allow for a participatory process in consolidating a implementation agenda. Presently, Amsterdam has 'started risk dialogues with all kinds of groups in

the city, not only with other municipal entities as they are necessary, but also private groups, inhabitants, neighbourhoods' (Interview 8). The goal of these city risk dialogues is twofold: to raise awareness and inform on the region's vulnerabilities to climate extremes, and to be able to discuss, openly, how certain measures can reduce these (Delta Programme, 2018). Climate proofing and adaptation measures could benefit from more dialogue and active communication, and sharing of information to help mediate trade-offs, and potential conflicts whilst improving levels of trust between different city stakeholders (Cash et al., 2003; Kettle et al., 2014). Additionally, there are even talks in the Gemeente 'of not only going on with risk dialogues but also then work towards developing a kind of boundary subject like Rainproof for all these climate themes' (Interview 8). This development could mean 'the establishment of a new intermediary or rebranding of Rainproof into climate or something, that would make it bigger' (Interview 4).

5.1.2 Preparedness and Planning

The principle involves the presence (or evidence) of active communication, information exchange and dialogue between different city stakeholders on the significance of climate adaptation, as well as engaging communities and aiding coordination efforts for measures. Amsterdam obtained a neutral score (due to a mix of strengths and weaknesses present) for current situation and a positive score for future plans.

There is the presence of established avenues for communication and knowledge dissemination between local organisations (Gemeente Amsterdam, RainProof, Waternet, AMS, UvA), and experiences with localised climate-proofing initiatives (e.g. Rainproof, Knowledge Mile Park, and AMS). However, generally a small proportion of the city's population is aware of the responsibilities that communities have in engaging in climate adaptation and an explicit community engagement strategy is missing. Thus, current situation is neutral. Forecasted improvements in the communication and dissemination of insight on climate adaptation (across various sectors and climate stressors), as well as risk dialogues for the upcoming implementation agenda of the climate adaptation plan for the city will have a positive influence.

A strength currently is the participatory budgets that the city offers to districts, whereby 'independent of your level of engagement or education, it allows citizens to rank projects and contribute towards deciding the prioritisation of actions and where funding is allocated' (Interview 7). The projects range from social projects (e.g. healthcare optimizations to deal with excessive heat) or environmental projects (e.g. urban greening, blue-green infrastructure, etc), and the one with the highest votes is actioned as a pilot experiment in the specific district or urban area (Gemeente Amsterdam, 2020A; Rainproof, 2021). However, a weakness currently that several interviewees have expressed is the lack of awareness on climate adaptation and limited actions that can be carried out by communities or on private properties due to it still being considered quite a niche concept (Interview 2, 6). This could be because 'climate adaptation is still seen as a top-down programme in which the Gemeente raises awareness and urgency for the topics of climate change and climate variability' (Interview, 3).

That being said, a current strength is that localised community and neighbourhood initiatives and projects have taken place with the help of Rainproof and Waternet in neighbourhoods (e.g. Rivierenbuurt, Bellamybuurt, and Zuidelijke Wandelweg) involving climate proofing and adaptation

measures (see Section 4.1.3). Additionally, Rainproof principles are being adopted more by private companies, neighbourhoods, and the Gemeente which are a result of local pilot experiments, expertise, and knowledge compiled through Rainproof (Interview 2). However, with climate adaptation insights and awareness still being relatively low among citizens, the local government may feel like its role is to support and educate further before elaborating on their engagement in adaptation actions (Interview 6).

A strength moving forward is that in the *Strategy for Climate Adaptation Amsterdam 2050* they emphasise the importance of promoting climate adaptation measures as actions that concern the entire city. This is mainly since ‘half of the city’s territory is in private ownership, meaning that adaptation is both a public and private task’ (Gemeente Amsterdam, 2020A: 10). Another strength, as previously mentioned, involves the risk dialogues that are currently underway in the city for the subsequent formulation of the implementation agenda for climate adaptation (to take place in the coming year). These are expected to improve the understanding of local vulnerabilities, improving the *preparedness and planning* of city stakeholders. They could potentially contribute towards better encapsulating community and local risks into more practical and actionable measures that will enhance local resilience (Gemeente Amsterdam, 2020A).

Moreover, a strength is that Rainproof will continue to actively work on linking up businesses and citizens to carry out pilot experiments in climate-proofing measures on private property. For instance, helping to link up housing corporations to work ‘with garden centres and voluntary organisations to remove paved surfaces from gardens’ (Gemeente Amsterdam, 2020A: 13). The organisation has understood and promotes the shared responsibility of climate proofing the city, ‘so you can make it part of a wider urban regeneration development’ (Interview, 4). Lastly, a strength could also lie with Rainproof principles and the development of more standards by Rainproof (or an umbrella organisation) contributing towards coherent, shared priorities and actions for lower-tier stakeholders. This is vital as noted by Interviewee 3: ‘as the government or the local government part, I am not looking for an innovation. I am looking for new standard, vulnerability mapping or criteria so I can make new policy making and put it in my procurement requirements’.

5.1.3 Homeostasis

The principle involves the presence (or evidence) of climate adaptation policy being integrated into other policy domains, clearly defined responsibilities of stakeholders at different levels of city, and willingness for interplay among stakeholders in city upkeep. Amsterdam obtained a neutral score (due to a mix of strengths and weaknesses present) for current situation and a neutral score for future plans.

Whilst there have been instances of adaptation policy being integrated into other policy domains and some responsibilities for action designated to some citizen groups, climate adaptation as a more holistic approach to adaptation rather than the traditional one (water management) is still a novelty. Furthermore, efforts are still underway to create an implementation agenda for adequate urban stakeholder responsibilities. Thus, the current situation is neutral. There are clear intentions made in the city’s plans on enhancing integration across sectors, strengthening the existing networks of urban stakeholders sharing adaptation research and knowledge (Rainproof and AMS), and local risk

dialogues being conducted which could contribute positively. However, there are still questions of fragmentation internally and limited avenues for lower-tier stakeholders to participate in adaptation efforts. Therefore, the future plans received a neutral score.

An initial strength is that the integration of other climatic themes into policy domains such as spatial planning, water management and environmental policy have been mentioned previously in the city's *Green Agenda* and the national *Delta Plan on Spatial Adaptation 2018*. Additionally, the *Structural Vision Amsterdam 2040* and urban development approach set up requirements of minimum amounts of green space that the city must safeguard as prescribed in the Main Green Structure (Hoofdgroenstructuur, or HGS) (Gemeente Amsterdam, 2011A). Urban ecosystems services, especially green and water related ones have benefited from public and private attention because of the Green Funds, Green Agenda, and HSGs which have all contributed towards instilling the importance of the natural and urban system to combat water and spatial adaptation (Gemeente Amsterdam, 2020A). Amsterdam has a good track record with the upkeep of its ecosystem services due to the importance of water adaptation which provides a good base of expertise and climatic considerations for the introduction of more holistic climate adaptation measures. However, a weakness is that whilst these plans and measures have illustrated attempts at intertwining urban and spatial adaptations of the cities metropolitan area with greening and water-proofing measures and policies, most of the time they have been complementary to the vision and have also been less explicit as to the engagement of citizens and lower-tier stakeholders (Interview 9)

Moreover, there is also the weakness that emergent climatic themes, such as heat and drought, have only recently become more frequent, and thus there is a lack of formulated frameworks or approaches towards dealing with this branch of climate adaptation (Interview 2, 7). However, a strength is that there are already established networks and 'a considerable number of collaborations between different groups of stakeholders, especially regarding water management, and several knowledge institutes participating with local or national governments' such as Waternet, Rainproof, or Amsterdam Smart City (Interview 4). Organisations like the AMS institute and Rainproof, as well as other R&D institutions, have been noted as 'already starting to expand to these broader topics and include heat and drought', for example involving 'more health companies, different companies involved in the network which they did not previously have' from a public, private, and civil background (Interview 2).

On an optimistic note, clear and more explicit commitments in relation to more structural integration of climate adaptation have been made in the recent *Strategy for Climate Adaptation Amsterdam 2050*. As noted, 'structural integration into operations and management making climate adaptation the 'new normal' in relevant projects and activities will require a change in working practices. As new information becomes available and new standards are established, these must be integrated into work processes as much as possible' (Gemeente Amsterdam, 2020A: 25). This could be aided by the risk dialogues that are currently underway which would also allow for updated communication among city organisations (meaning local government, private companies, public entities, academia, and civil associations), which could subsequently advise the implementation agenda for climate adaptation measures across climatic themes and sectors. The municipality is said to be working towards a 'more active approach instead of just waiting for questions that come up and then just referring everyone to the website and saying, well you can do this or that. More like we really are going to reach out to

everyone’ (Interview 5). Furthermore, the implementation agenda and more concrete actions concerning adaptation to follow soon could enable a better designation of responsibilities and roles to public, private, and civil stakeholders in the city (Gemeente Amsterdam, 2020A).

That being said, there are two notable weaknesses that could hamper future plans. One is noted as being the existing fragmentation between departments and sectors which undermines the communication and sharing of expertise (Interview 5, 10). It leads to many working ‘on their own sustainability islands’ and sometimes impeding a more fluid cross-sectoral integration and collaboration among a diverse range of urban stakeholders (Interview 2). While the risk dialogues and commitments towards structural integration are evident, these concerns should be kept in mind. Another weakness is the apparent low delegation of responsibilities (in law and in practice) for climate adaptation and localised measures to lower-tier stakeholders (citizens, neighbourhood associations). This can be attributed in part to the fact that only recently has the urgency and attention shifted towards localising climate adaptation and formulating an implementable agenda in the city (away from national and regional) (Minister van Infrastructuur en Waterstaat, 2018). Additionally, this is conditioned by water and spatial management being ‘very public driven, where our state will take care of you, and you can go to bed without any stress about it’ (Interview 4). On an optimistic note, platforms like Rainproof and Amsterdam Smart City demonstrate active efforts towards making adaptation and resilience building more of a shared and inclusive responsibility which holds potential in helping roll out the implementation agenda and its comprehensive measures (Gemeente Amsterdam 2020A; Interview 2, 8)

5.2 Absorption

As Table 10 shows, Amsterdam scored quite well on its robustness (and buffering) but drew more neutral and weak scores for diversity and redundancy, respectively. This illustrates, for the most part, a neutral overall capacity to *absorb*. Future plans for robustness (and buffering) and diversity scored positively which illustrates good prospects but redundancy received a neutral score due to some concerns involving fragmentation.

Table 10: Score per principle, current situation and future plans, based on adaptation plans and interviews.

Principle	Current Situation	Reason/Why?	Future Plans	Reason/Why?
Robustness & Buffering	+	Strong evidence of infrastructural, spatial and policy measures focusing on spatial and water adaptation, vulnerabilities monitored and considered for long-run ambitions	+	Very solid foundation of spatial adaptation which will allow for fluid merger with actionable climate adaptation measures derived in implementation agenda and upscaling of successful pilot experiments
Diversity	0	Evidence of significant variety of city stakeholders but not all have equal weight when it comes to decision-making	+	Existing network of organizations and stakeholders will be beneficial for accommodating climate adaptation measures that are more multifaceted
Redundancy	-	Limited awareness of overlap between water and heat threats, integration is currently weak and still some doubts as to extent of delegating responsibilities to lower-tier stakeholders	0	Heat vulnerabilities and risks to different sectors and stakeholders being assessed, efforts towards structural integration and utilizing existing expertise/network, but some internal fragmentation present

5.2.1 Robustness & Buffering

The principle involves the presence (or evidence) of policy, infrastructural and spatial measures focusing on climate and social impacts, risk assessments and management in urban development. Amsterdam obtained a positive score for current situation and future plans.

Currently, robustness and buffering are strong in Amsterdam due to the historical focus on spatial and water adaptation, as well as its complementary green and sustainable initiatives (Green Funds, Agenda Green, Sustainable Amsterdam). As a result, adaptation measures such as NBS, green-blue infrastructure, renewable mobility and smart-digitisation have been utilised and experimented with already, providing a good knowledge base for expansion of networks and measures into heat and drought (merge the water and heat related action). Future efforts look to build on this and provide more actionable measures that are multifunctional which could have a positive influence.

A current strength is that Amsterdam has a history of spatial and water adaptation, complementing these with greening measures. The *Structural Vision Amsterdam 2040* set out an integrated view and plan of the Amsterdam metropolitan area, with concrete considerations for climatic impacts (e.g. water related), and social impacts (e.g. connectivity, health, and well-being) in the continued expansion and densification of the city (Gemeente Amsterdam, 2011A). This vision for Amsterdam's urban and spatial planning came about due to the new national *Spatial Planning Act 2008 (Wet ruimtelijke ordening)* replacing the previous *Spatial Planning Act (Wet op de Ruimtelijke Ordening)* dating back to 1965 (Lauwers, Ponteyn & Van Zanen, 2011). The *Spatial Planning Act 2008* obliged the municipalities to enact a structural vision for the spatial planning and organisation of the municipality's territory (Gemeente Amsterdam, 2011A).

Adding to the previous strength, the *Amsterdam Green Agenda 2015-2018 (Agenda Groen)* was coupled with the *Structural Vision Amsterdam 2040* and focused on NBS and urban adaptation from a more environmental perspective. Green Funds amounting to €30 million were provided (both from the EU and regional organisations) for land development and urban adaptation which involved greening and building with nature as its goal (Gemeente Amsterdam, 2015). The focus mainly revolved around green spaces, city parks, biodiversity and connecting the city's landscape, with ambitious targets such as 15 new green play areas, 50 000 m² of green roof installations, 20 new postage-stamp-sized (or 'pocket') parks being outlined (Gemeente Amsterdam, 2015). Actions towards greening and waterproofing the city have been supported by Rainproof over the years which has helped create and empowered public-private partnerships through its platform and network 'to try and make it more like a shared responsibility' (Interview 4).

A weakness moving forward is that 'there are still no standards on heat and drought adaptation on a local scale', which is an important focus for vulnerability and climate stress tests in Amsterdam (Interview 8). Additionally, there is an inadequate knowledge and expertise base to derive new actions or understand which existing measures can be coupled to address instances of heat stress (Interview 2, 8). The main strengths involve the robust lay out Amsterdam has for an integrated city, along with the experiences with water and green adaptation which can potentially act as a substantial knowledge and planning base for the coupling of actions to deal with heat and drought that is currently being addressed and promoted. Experiences with blue-green roofs, research into green infrastructure

and NBS (e.g. through Rainproof projects like Smart Roof & RESILIO), and community gardens offer potential opportunities for the upscaling of projects and initiatives to combat climate change that deal with both water and heat stresses (Gemeente Amsterdam, 2020A). Additionally, the implementation agenda formulated in the coming year could potentially serve as another strength in that it could cement the actionable and necessary changes following the risk dialogue and communication between urban sectors and stakeholders.

5.2.2 Diversity

The principle involves the presence (or evidence) of functional diversity in measures, and a diverse range of stakeholders and organisation that are dealing with the adoption of adaptation and resilience building in the city. Amsterdam obtained a neutral score (due to a mix of strengths and weaknesses present) for current situation and a positive score for future plans.

Whilst there have been resources, research, and stakeholders collaborating towards water and spatial adaptation in the city, there are still knowledge gaps and barriers in diversifying towards heat, drought and health related adaptation which require their own network, measures, and considerations. Therefore, the current situation is neutral. The multifunctionality of adaptation measures, concretising responsibilities for stakeholder engagement and ongoing risk dialogues could have a positive influence in the future.

A current weakness is attributed to limited cross-departmental or organisational understanding of what adapting to both heat and water related threats entails for the time being (Interview 4, 3, 9). Additionally, whilst there are a variety of departments within the Gemeente, it is not clear as to how focused they are on 'climate adaptation and sustainability, or they have other challenges or political ambitions that are more important' (Interview 9). That being said, a current strength is the diversity of stakeholders collaborating previously on instances of water proofing (such as Waternet, Gemeente Amsterdam, Rainproof, Amsterdam Green Campus, AMS, and UvA) and raising awareness of the risks of water which provides a network within the city. However, an accompanying weakness is that they are targeted and visible to a small segment of the city only, with doubts about social justice and whether there is adequate consideration of the actual opinions that lower-level city stakeholders have in regard to local adaptation (Interview 9).

There is optimism as both municipal and local organisations (such as Rainproof) are gearing up towards heat and drought adaptation, as well as a greater consideration of the health sector (Gemeente Amsterdam, 2020A; Interview 2). For instance, Interviewee 3, from the Innovation Department of the city noted that 'it is elementary to figure out a way, in network approach or another kind of approach, that we involve not only citizens, but all stakeholders. Even investors, and that requires a completely new way of thinking about the things that we are doing right now'. Similarly, Rainproof 'is expanding to these broader topics and they also include heat and drought. I am working on helping expand the network in that direction. Different companies like health ones' (Interview 2). The approach is continuing to progress on the individual components of climate adaptation (heat, waterlogging, drought, and flooding) in parallel with the development of a broad-based approach resulting from the current *Strategy for Climate Adaptation Amsterdam 2050* (Gemeente Amsterdam, 2020A).

Another strength is once again tied to the risk dialogues and network expansion to get more stakeholders involved (e.g. housing companies, health companies, R&D institutes, neighbourhood associations) which could aid in diversifying the efforts for climate adaptation in the city (Gemeente Amsterdam, 2020A). However, greater diversification of stakeholders and people responsible for the implementation of adaptation brings with it added complexity in the city's urban management which will require a detailed and actionable implementation agenda to delegate responsibilities and roles of lower-tier stakeholders (Interview 6). This is currently being developed as alluded to by the Gemeente and some interviewees with the implementation agendas to guide sector and stakeholder specific measures based on their vulnerabilities which is a reason for optimism.

5.2.3 Redundancy

The principle involves the presence (or evidence) of shared functions and responsibilities across different areas, scales, and stakeholders for climate adaptation. Amsterdam obtained a weak score for current situation and a neutral score for future plans.

Whilst there are adaptation measures, established networks and partnerships, and some awareness among different levels of the city on water proofing, there are limited standards, measures or awareness on the risks drought and heat pose to the urban landscape (primarily on infrastructure and health). Furthermore, there is little experience in overlapping water proofing measures with more broadened climatic proofing and delegating adaptation responsibilities to civil entities (more public and private driven). Thus, the score is weak. The potential multifunctionality of water-proofing measures and expertise in relation to heat threats in the upcoming implementation agenda (*Strategy for Climate Adaptation Amsterdam 2050*), acknowledgement of network expansion (Rainproof) to tackle climate adaptation to broader climatic themes (both heat and water), and the upscaling potential for established pilots hold promise for improving the situation. However, these are significantly dependent on the adoption of the devised implementation agenda and concrete responsibilities appropriated by stakeholders and sectors. Therefore, the score for future plans is neutral.

There is evidence of shared monitoring, research and implementing power for the *Strategy for Climate Adaptation Amsterdam 2050* (by Gemeente Amsterdam, Waternet, and Rainproof) in response to extreme rainfall or flooding, displaying a high level of redundancy in these climatic themes. However, a current weakness is that heat and drought impacts are less known and fewer implementable actions are available across sectors (Interview 1, 2). Added to this weakness is the fact that there seems to currently be some confusion regarding governance responsibilities for climate adaptation and sustainability within the city, as 'everyone's working in quite a fragmented fashion and on their own projects' with quite often some not understanding the role of the climate adaptation and sustainability department, 'seeing it as vague' (Interview 5). This potentially stems from how recently these departments were created within the city and the limited time that has been spent interpreting and understanding climate adaptation as an approach that goes beyond traditional Dutch water adaptation and dike building (Interview 6).

A current strength is that there have been instances of shared functions for water proofing through projects conducted by Rainproof with the support of Waternet and through collaborations with private companies and citizens (as outlined previously in Section 4.1.3). However, this strength is currently overshadowed by the fact that the scope and attempts of pilot experiments at distributing responsibilities and functions for climate adaptation are still only accessible to a small proportion of citizens and neighbourhoods (Interview 2, 3, 10). Additionally, more actions and measures need to be taken on private property, as public entities ‘cannot only take measures on their own, in squares or streets, but also need to do this on private property’ (Interview 4).

A strength in the future is that Rainproof intends to work on this and understands the ‘need to start building more bridges between all these islands of sustainable topics and climate that we all need to make our world more beautiful’ (Interview 2). As noted previously in 5.1.3, Interviewee 4 expressed how ‘through platforms, like Amsterdam Rainproof, you can see how they try to make it more like a shared responsibility, so it becomes a joint task with both public and private parties’. This holds potential for further delegate responsibilities and expertise to citizens and communities. The *Strategy for Climate Adaptation Amsterdam 2050* adds to this strength through its prioritisation and commitment to upscaling successful adaptation programmes (of which Rainproof is explicitly highlighted) which has the potential to improve the reach of adaptation projects to citizens (Gemeente Amsterdam 2020A).

Another avenue for optimism is the fact that identifying areas of overlap with other urban issues (e.g. climate neutrality, circularity, or preservation) and processes (e.g. spatial vision, urban greening, or future asset management) is stipulated as an important step of the structural integration of all four climatic themes into operations and management as detailed in plans (Delta Programme, 2018; Gemeente Amsterdam, 2020A). Waternet and the Gemeente of Amsterdam would ‘like to pursue the Rainproof network approach, but they want to also apply this to other stressors’, so the ongoing risk dialogues and subsequent implementation agenda should make it clearer if ‘the team of Rainproof needs to apply the network to different stressors or if a new team has to be created to do so’ (Interview 4). That being said, these strengths are significantly dependent on the devised implementation agenda, which as noted in homeostasis (5.1.3), should be wary and take into consideration some existing fragmentation internally (between departments or sectors) (Interview 5, 9).

5.3 Recovery

As Table 11 shows, Amsterdam received a neutral score for current situation but positive score in future plans. High flux received a neutral score for both. This illustrates somewhat of a neutral overall capacity to *recover*.

Table 11: Score per principle, current situation and future plans, based on adaptation plans and interviews.

Principle	Current Situation	Reason/Why?	Future Plans	Reason/Why?
Flatness	0	Presence of varied stakeholder participation in climate adaptation projects and plans, but still at pilot or experimentation level which limits scope and actual engagement	+	Increased diversity of stakeholders, formulation of coherent climate adaptation implementation agenda, risk dialogues and commitments towards upscaling successful pilot projects will benefit principle
High Flux	0	Signs of resourcefulness and facilitation of information and expertise, but doubts about allocation towards citizen and community level climate adaptation (presently mainly pilots available)	0	The continued expansion of networks (Rainproof, AMS, private entities) as well as risk dialogues underway will help, but still doubts as to partnerships and legitimacy of citizen participation (meaning lowest levels)

5.3.1 Flatness

The principle involves the presence (or evidence) of broad participation of stakeholders in climate action efforts, a decentralised governance model for most autonomous and local decision-making, and communities engaging in adaptation projects (instance of hands-on experience and awareness). Amsterdam obtained a positive score for current situation and future plans.

Amsterdam has focused significantly on improving participation in climate adaptation initiatives and projects through a decentralised governance system. However, there are still questions as to the scope and legitimate participation of citizens and communities. Therefore, the score for current situation is neutral. It has upheld its importance in various plans from different domains (spatial adaptation, greening and waterproofing), as well as it being integral in the new, holistic climate adaptation strategy. The *diversity* of stakeholders in climate adaptation efforts will continue increasing (as noted in Section 5.2.2), as well as the support and encouragement from the city for promising pilot projects which indicate a positive future impact on this principle.

An important strength, as previously noted, is that Amsterdam is currently emphasising (and has historically emphasised) the importance of citizen and community participation in contributing to adaptation avenues and developmental plans for an integrated city (socially and systematically). This is visible, for instance, from the current participatory budgets (running each year since 2015) that ‘enable citizens, regardless of their level of engagement or education, to allocate and prioritise funding for social and environmental projects or propose projects yourself to then lead and be responsible for their execution (along with partners)’ (Interview 7). Furthermore, citizens along with public, private, and sectoral entities participated and collaborated to formulate prior plans (e.g. *Structural Vision Amsterdam 2040*, *Amsterdam Green Agenda 2015-2018*) which demonstrates consistent attempts at including varying urban stakeholder perceptions and engaging them. Another current strength has been that since 2014 Rainproof has worked at linking up private companies and neighbourhoods (e.g. Betondorp, De Baarsjes, Buiksloterham) to implement projects such as green rooftops, rain barrels, blue-green infrastructural modifications, and raise awareness among different areas of the city on ways to climate proof (even if mainly to water) (Rainproof, 2021; Gemeente Amsterdam, 2020A).

A noticeable current weakness, as previously noted (in 5.2.3), is the limited reach and accessibility of pilot experiments that distribute responsibilities and functions for climate adaptation and climate

proofing to citizens and communities (Interview 2, 3, 10). While there has been broad participation of varying governance levels in the formulation of prior plans (including citizens and communities), the upkeep of the services and functions has been predominately delegated to the public administration and the private sector (Gemeente Amsterdam, 2021B). This limits the true engagement and legitimate participation of these lower-tier stakeholders in adapting their urban areas to imminent climatic and socio-economic risks.

A strength moving forward is the mentioning of Rainproof branching out to encompass a network of expertise and stakeholders surrounding climate adaptation relating to all four climatic priorities (not specifically on extreme rainfall and flooding) which has the potential to help raise awareness, and contribute to more citizen participation (Interview 2, 8). Added to this, the city is looking to encourage and support collaborative efforts towards climate adaptation through a network of institutes, citizens, companies, and public bodies to designate and delegate responsibilities appropriable by sector and thematic (Gemeente Amsterdam, 2020A). With the Netherlands traditionally operating as a decentralised system, the proposed implementation agenda looking at deriving actionable concepts and measures for adaptation will be in line with historical efforts towards localising actions (Mees & Driessen, 2011).

There is also potential in the ongoing risk dialogues which could contribute towards updating communication, raising awareness about new risks and vulnerabilities (surrounding the four climatic themes), and incorporate findings into actionable measures in the upcoming implementation agenda (Gemeente Amsterdam, 2020A). Deriving localised or district level climate adaptation measures according to updated vulnerabilities and risks obtained from stress tests and risk dialogues (if done holistically) could be a considerable strength and improve flatness towards the four climatic stresses. It could potentially enable the upscaling of projects and pilots that have previously been developed and now require actionable measures and insights as to how and where they can be transplanted to within the city in the future (Interview 2, 3).

5.3.2 High Flux

The principle involves the presence (or evidence) of resourceful provision of knowledge, expertise, and financing for climate adaptation in the city to a variety of stakeholders (businesses, NGOs, citizens, neighbourhood associations). Amsterdam obtained a neutral score for current situation and future plans.

Amsterdam is considerably well connected to the regional, national and EU scale, which enables it to have a considerable network of knowledge, expertise, and funding. On the local scale there are relatively established networks of partners (academic, private, and public) and there is funnelling of funding into pilot experiments in certain neighbourhoods (Rainproof, Knowledge Mile Park) but the reach is still quite limited and prioritisation within the city is still questioned in respect to adaptation. Therefore, the current situation is neutral. The risk dialogues and expansion of partnerships in the city to tackle climate adaptation locally will help, but there are still questions as to the allocation of resources, awareness of citizens on climate adaptation and the concrete responsibilities of urban stakeholders. Therefore, future plans score neutrally.

A current (and historical) strength is that Amsterdam cooperates closely with other cities and municipalities, even hosting a global summit towards the end of 2020 on climate adaptation. It has several national agreements (e.g. Interbestuurlijk Programma, NAS) and is involved in various international partnerships, such as the C40 (Cities Climate Leadership Group) (Gemeente Amsterdam, 2020A). Another contributing element is the Knowledge Portal (Kennisportaal), developed in 2014, which is a platform on adaptation and acts as a central information channel to governments at various levels as well as other stakeholders like private firms, academia, and citizens (Kennisportaal Klimaatadaptatie, 2021A). On a local level, the municipality is involved in a 'triple helix collaboration to bring together active stakeholders from R&D institutes, private companies, and local governments to innovate towards climate adaptation in the city and new solutions' (Interview 3). This triple helix enables an efficient network of expertise between organisms like Rainproof, UvA, AMS, Waternet, Climate KIC, and the Gemeente. This helps in deriving actionable standards through collaborative efforts such as the Rainproof principles which are currently incorporated as requirements when climate proofing infrastructure or urban retrofitting projects (Gemeente Amsterdam, 2020A; Rainproof, 2021).

A current weakness is that whilst there is an overarching climate adaptation plan (national level) which is supposed to provide a standardised approach for the network of municipalities, it must be mentioned that 'there is no national standard or aspiration for climate adaptation' which makes concrete actions on climate adaptation currently a bit vague (Gemeente Amsterdam, 2020A: 11; Interview 5). Another weakness currently is that on a local level there are still doubts on the actual level of awareness and participation of low-level city stakeholders in climate adaptation measures (citizens and neighbourhoods). As acknowledged by Interviewee 6: 'Rainproof still goes primarily through projects, goes to certain neighbourhoods, through certain people they know, I guess. But that's you know, as a general citizen of Amsterdam, I hardly notice anything. I mean, there's hardly any communication about climate proof measures or these things.' This once again links to the lack of awareness which is also linked to other principles such as *preparedness* and *planning*, and *flatness*.

A strength moving forward is that considerations towards expanding the Rainproof network or utilising its network approach for an 'umbrella organisation' regarding climate adaptation (meaning all climatic themes) could help channel expertise, research and attention towards heat, drought, and health (Interview 2). Additionally, as mentioned previously, the risk dialogues could contribute towards updating vulnerabilities, raising more holistic awareness of climate adaptation themes and subsequent prioritisation of actions between sectors and stakeholders (Gemeente Amsterdam, 2020A). These elements have the potential to help steer away from 'climate adaptation being more of a top-down programme in which it's about raising awareness and urgency for the topics of climate change and climate variability' (Interview 3). Instead having an implementation agenda and thematic work can help lead to 'new standards or new criteria so I (local government) can make new policy and put it in my procurement requirements' (Interview 3). A weakness that needs to be acknowledged is that these previous strengths will be dependent on providing legitimate participation from all levels of the city, meaning private, public, academia and civil society. Especially in the ongoing risk dialogues and subsequent implementation agenda to avoid notions of internal or external fragmentation among those collaborating towards climate adaptation in Amsterdam (Interview 6, 10).

5.4 Adaptability

As Table 12 shows, Amsterdam scored quite well for both learning and flexibility for its current situation. This illustrates, for the most part, a positive capacity to *adapt*. Furthermore, future plans for both principles scored positively which illustrates positive prospects and planning to enhance the capacity to adapt.

Table 12: Score per principle, current situation and future plans, based on adaptation plans and interviews.

Principle	Current Situation	Reason/Why?	Future Plans	Reason/Why?
Learning	+	Significantly strong in learning, experimenting, and expanding on climate adaptation knowledge and expertise, even if lacking more coherent implementation plan	+	Branching out of Rainproof network, encouragement for pilots and commitments to upscaling, as well as extensive innovation and learning knowledge base will aid this principle
Flexibility	+	Evidence of flexible spatial measures that accommodate adaptation action and planning, as well as experience with flexible small, medium, and large-scale adaptation measures	+	Communication strategy and risk dialogues, expansion of network, commitments towards upscaling efforts and integrating expertise and measures will benefit this principle

5.4.1 Learning

The principle involves the presence (or evidence) of active learning taking place from an administrative and community level relating to climate adaptation, collaboration frameworks or strategies in place, and room for experimentation and learning by doing in urban areas. Amsterdam obtained a positive score for current situation and future plans.

Amsterdam is known as a reputable, international hot bed for innovation, learning and experimentation in sustainable and climate proofing advances for water management, spatial adaptation, and urban greening. The score for current situation is positive due to its expertise and experience with this on a local scale but one weakness is still its integration or merger of expertise to tackle more urgent climatic themes. There is potential for the knowledge and expertise gap to be addressed more through the *Strategy for Climate Adaptation Amsterdam 2050* and subsequent implementation agenda, the encouragement of pilot projects by city officials and the upscaling opportunities for existing innovative projects which could have a positive effect on this principle.

One strength of the city currently is the fact that major cities nowadays fare significantly well in an economy that is becoming increasingly more data and knowledge driven. Amsterdam is a reputable example of an innovative hotbed for pilot projects, experimentation, and knowledge that is connected both nationally and internationally to other cities (Gemeente Amsterdam, 2020A). Over the last decade, entities such as the Gemeente's Innovation Department, Rainproof and AMS institute have carried out various programmes especially in the pioneering phase and pilot phase (Interview 2, 3; Rainproof, 2020; AMS; 2020). Another strength is that over time there have been significant efforts at trying to build awareness and communication among private, public and community stakeholders, as well as projects into greening and blue-green infrastructure like RESILIO and others with private businesses (Interview 2, 3). There is also the newly developed department on climate adaptation in Waternet and the Gemeente which have started tackling climate adaptation more holistically (rather

than traditionally being based around water), even if their roles currently are still a bit vague (Interview 5, 6).

A current weakness and bottleneck involve the knowledge and expertise gaps on the vulnerabilities of the city to heat and drought, and upscaling projects that have shown success so far and those that can branch out to address other climatic stressors (multifunctional) (Interview 2, 3). Adding to this weakness is the fact that while there are successful pilot projects and innovations dealing with climate proofing, these are all at a 'small scale and are supportive of things like guerrilla gardening or small green space experiments, while it is something a lot bigger to work with neighbours to create spaces that have adequate water retention and green aspects' (Interview 6). This once again resonates with the notion of *limited awareness, reach and engagement* opportunities for citizens and communities, as well as the notion of a public-private dilemma.

A strength moving forward is that the *Strategy for Climate Adaptation Amsterdam 2050* stipulates its commitment to supporting and encouraging promising projects and pilots that are currently being carried out, as well as to implementing measures towards heat and drought adaptation in areas that are assigned as vulnerable or at risk (Gemeente Amsterdam, 2020A). Added to this is the fact that organisations such as Waternet and Rainproof have understood (or are understanding more) the importance of 'entering a new phase whereby learning-by-doing for climate-proofing works by merging water and heat related approaches' or 'through adequate prioritisation for localised action which will follow from the implementation agenda' (Interview 2, 8). As mentioned previously, the current efforts by the Gemeente's departments (e.g. sustainability, climate adaptation, and innovation) still seem to see climate adaptation as a 'top-down programme which still requires increased awareness and urgency on the subject of climate adaptation and climate variability' (Interview 3). The ongoing risk dialogues, and subsequent implementation agenda could contribute towards more actionable, bottom-up measures and standards for climate adaptation to be tackled across varying climatic domains and urban sectors which will improve the city's capacity to enhance its adaptive capacity (Gemeente Amsterdam, 2020A).

5.4.2 Flexibility

The principle involves the presence (or evidence) of flexible spatial and urban adaptation measures in place, and institutional flexibility towards change. Amsterdam obtained a positive score for current situation and future plans.

Amsterdam's background in spatial adaptation is evident. The *Structural Vision Amsterdam 2040* guided urban development and adaptation with the intertwined ecosystems and areas of the city's metropolitan area since 2010. This has contributed significantly to the flexibility of the city in accommodating measures towards adaptation. Thus, the score for the current situation is positive. Currently, institutions are trying to be more flexible with their measures and actions and are making efforts towards improving communication and networks (both internally and externally) which will take time but are under way. A more elaborate implementation agenda for localised climate adaptation could improve the interplay and flexibility of institutions, sectors and network of partners which could influence this principle in a positive manner.

A current strength of Amsterdam is that spatial adaptation and water-proofing efforts have been of utmost importance for climate action in the city and its flexible landscape. The *Structural Vision Amsterdam 2040*, from 2010, set out a clear vision of a creative and varied city, with an integrated mobility network, high-quality urban planning and investment in green space, water, and renewable energies (Lauwers, Ponteyn & Van Zanen, 2011). Planning and investing in urban development were spurred by the co-benefits of developing infrastructure and green space for the well-being of citizens, economic longevity of the city's functions and services, and creating a more liveable city (Gemeente Amsterdam, 2020A; Interview 7). Over the years there have been urban modifications whilst at the same time retaining a decent balance between green and built-up areas as the city has grown and densified (due to the HSG and green requirements).

Another current strength is that there are signs of institutional flexibility in terms of appropriating and incorporating climate proofing elements, such as the HSG and Rainproof principles, 'as they are now more institutionalised because the city of Amsterdam is refurbishing squares or streets taking these Rainproof principles very much into account, whereas previous Waternet always had a difficult time with putting a foot behind the door and raising this issue' (Interview 4). There is optimism in relation to the possibility that this could take place in relation to heat and drought, especially when you consider that the city 'officially said they we're going to embrace the Rainproof approach and apply it to other stressors' (Interview 4).

There are still questions as to the relatively low awareness among citizens and communities (Interview 7, 8). However, there is potential with the drawing up of a communication strategy for climate adaptation currently underway between stakeholders (e.g. housing companies, neighbourhoods, citizens associations) and other city programmes (e.g. Green Vision, Climate Neutral, Delta Programme, Rainproof). Additionally, the risk dialogues could bolster interactions and integration of thoughts and efforts in climate adaptation with a more diverse stakeholder representation. Furthermore, a strength the city has involves being able to make the most of existing expertise and networks to branch out (or upscale) and possibly contribute towards innovative advances in climate adaptation as a more holistic approach (Interview 2, 10).

5.5 Transformability

As Table 13 shows, Amsterdam scored neutrally for its current situation in relation to re-invention whilst scoring well for reflexivity. This illustrates, for the most part a positive capacity to *transform* currently. Future plans for reflexivity look promising but re-invention could be hampered by some traditional dependencies.

Table 13: Score per principle, current situation and future plans, based on adaptation plans and interviews.

Principle	Current Situation	Reason/Why?	Future Plans	Reason/Why?
Re-Invention	0	Mixed evidence on there currently being inclusion in urban re-invention and still lacking actionable measures for citizens in climate adaptation, but Rainproof and other organisations have been significantly active	0	Drafted measures in Climate Adaptation Strategy, risk dialogues, communication strategy and implementation agenda will contribute towards inclusion and actionable engagement (as well as strengthening Rainproof) but doubts as to some traditional dependencies with delegating responsibilities and prioritisation
Reflexivity	+	Significant evidence of reflective thinking and self-assessment in a variety of bodies, and by members of the triple helix collaboration, along with established international collaborations	+	Increased collective learning between different sectors and climate themes during risk dialogues, communication strategy and implementation agenda show potential in enhancing this principle along with uptake of standards such as the Rainproof Principles

5.5.1 Re-Invention

The principle involves the presence (or evidence) of inclusive adaptation, strengthening of local intermediaries and ability to contribute towards prioritisation of adaptation measures by communities and institutes. Amsterdam obtained a neutral score (due to a mix of strengths and weaknesses present) for current situation and future plans.

Amsterdam has previously and currently made efforts towards including a variety of sectors, programmes, and urban stakeholders in adaptation (e.g. Green Funds, Participatory Budgets, Rainproof) over the years but there are still questions tied to the reach of adaptation efforts and legitimate participation that emphasises a greater consideration for more vulnerable groups and neighbourhoods, and the degree to which communities have a say. Therefore, the current situation has a neutral score. Moving forward, the *Strategy for Climate Adaptation Amsterdam 2050* significantly emphasises and promotes the inclusion and empowerment of communities and citizens in its drafted measures, along with the acknowledgement of strengthening intermediaries such as Rainproof for other climatic threats and project upscaling. However, there are still doubts involving traditional dependencies of public entities handling water and spatial adaptation (rather than citizens) and how this will unfold as a more holistic climate adaptation approach is adopted. Therefore, future plans got a neutral score.

A current strength of the city is that it has experimented significantly with a variety of greening and water adaptation measures such as through Rainproof network connections and initiatives since 2014, or the Green Funds that ran from 2015 to 2018 which brought together funding from the city and partnering stakeholders (be they private or public) (Gemeente Amsterdam, 2015). Another strength is the fact that inclusion of varying urban perspectives and sectors is present in the *Structural Vision Amsterdam 2040* for an integrated metropolitan area. This has contributed to a substantial consideration for urban stakeholders (e.g. R&D institutes, private entities, neighbourhoods) in plans for urban development during the last decade (Gemeente Amsterdam, 2020A; Interview 10). However, a current weakness is that even though the funds and initiatives have been based on the principles of co-funding and co-creating with private individuals, companies, and public institutions, their reach has been limited. Some interviewees have mentioned the fact that these funds are only

accessible to a small segment of the urban population and with limited consideration of elements like social justice implications for different social classes in the urban setting (Interview 6, 7, 9). As expressed, 'there are a lot more researchers thinking about it, because it tends to be that it's too expensive for poor people, it tends to be for example that solar panels are only possible for people that own their houses, and people that own their houses are not poor people' (Interview 9). This weakness is also tied to the limited awareness, and hampers *participation* and *preparedness*, as well as *diversity* currently.

There is optimism as the *Strategy for Climate Adaptation Amsterdam 2050* is working toward making climate adaptation the 'new normal'. It emphasises inclusion and empowerment through measures like dialogue with city stakeholders (expanding network), encouraging and supporting promising projects and knowledge sharing, as well as communication (through risk dialogues and communication strategy) (Gemeente Amsterdam, 2015; Gemeente Amsterdam, 2021B). An additional strength is that Rainproof has been noted as being a reputable intermediary by the city and those involved in the organisation for experimenting, acting and formulating standards for climate proofing the city (e.g. Rainproof Principles) (Interview 2, 7, 8). Rainproof and the city will be working on upscaling successful pilot projects, as well as expanding the network to encompass partnership and expertise that ranges from water to heat-related adaptation (Gemeente Amsterdam, 2020A; Interview 2, 8).

In future plans and practices it must be acknowledged that actionable measures for re-inventing the urban adaptation approach (all four named climatic themes) will be dependent, in part, on the legitimate participation and inclusion of stakeholders from multiple levels in the risk dialogues (Interview 5, 7). Limiting structural and bureaucratic barriers for an efficient integration and mixture of measures for holistic climate adaptation is vital to avoid contributing further to fragmentation (Interview 1, 2). Furthermore, work towards shifting the attitude of citizens regarding public administrations handling adaptation (as has been the case previously with water and spatial adaptation) is underway but is of importance to continue delegating responsibilities to citizens and helping them appropriate information (Interview 3, 4).

5.5.2 Reflexivity

The principle involves the presence (or evidence) of collective learning taking place across multiple levels and learning from previous mistakes to continue innovating for climate adaptation. Amsterdam obtained a positive score for current situation and future plans.

Currently there is evidence that collective learning is taking place along a multitude of networks such as Rainproof and AMS, the triple helix collaboration within the city, and at regional and international collaborations (e.g. C40, Climate-KIC, Climate Portal) which positively influences current situation. Collective learning is noticeably at its lowest on a community level as currently there are limited actions and implementable measures, as well as little explicit delegation of responsibilities. This will be strengthened in the future by the implementation agenda for climate adaptation, risk dialogues, communication strategy and network expansion (e.g. within the Gemeente and Rainproof), having a positive effect.

An important current strength is that Amsterdam has a history of exchanging and sharing insights on climate adaptation, at a regional level, to other municipalities and cities to disseminate water proofing and flood risk management expertise (e.g. knowledge and insights being funnelled into the Kennisportaal Klimaatadaptatie for all to use). Additionally, locally the Gemeente works alongside Waternet and other organisations (e.g. Rainproof, AMS, UvA, University of Applied Science Amsterdam) in what is considered as a triple helix collaboration between these city entities (Interview 3, 7). This collaboration enables open avenues for communication and expertise dissemination among these organisations and has shown signs of having fluid exchanges (Interview 2, 8). One current weakness is that there is less evidence of collective learning taking place between this triple helix collaboration and civil society. It does take place but only for the citizens and private individuals in small, localised projects like those from Rainproof, AMS institute and Amsterdam Smart City or students that take part in initiatives offered by Amsterdam Green Campus, UvA and AMS (Interview 5, 6). It must be noted that reflexivity is still currently hampered by *preparedness and planning, awareness* and *diversity* of stakeholders involved, as work still needs to be done to integrate new views, sectors, stakeholders, and actionable measures in the future. An important element of reflexivity must be the legitimacy of participation of civil society in the process of designing the implementation agenda.

Another strength is that over the course of the last year, Rainproof has done a lot of reflection and self-assessment on the reach and strengths of its pilot experiments and its Rainproof principles (Interview 2). There is optimism moving forward and with the next phase of the intermediary, as previously mentioned, which will be expanding its network to incorporate other stakeholders and climate themes (heat and drought) and has the city's support in the scaling up of innovative solutions in private and public spaces that have proven to be successful (e.g. RESILIO, Smart Roof 2.0, CitySports) (Gemeente Amsterdam, 2020A; Interview 1, 8). Moreover, funnelling existing knowledge and expertise towards threats related to heating and drought by Gemeente and Rainproof hold potential in formulating standards for heating and drought risk management that can be integrated structurally and into policy (Interview 3). Future plans and practices will benefit from the process of risk dialogues, communication strategy and vulnerability assessments that are currently underway. The Gemeente is in the process of collecting and learning from updated shortfalls and risks in the city which will steer the implementation agenda for the *Strategy for Climate Adaptation Amsterdam 2050*, improving its collective learning reflexivity and localising action (Gemeente Amsterdam, 2020A).

5.6 Overview

Table 14 gives an overview of the resilience capacities and emphases in Amsterdam.

Table 14: Overview of scores for each principle (current situation and future plans) in Amsterdam

Capacities for Resilience	Principles	Current Situation	Future Plans
Capacity to Prepare	Anticipation & Foresight	0	+
	Preparedness & Planning	0	+
	Homeostasis	0	0
Capacity to Absorb	Robustness & Buffering	+	+
	Diversity	0	+
	Redundancy	-	0
Capacity to Recover	Flatness	0	+
	High-Flux	0	0
Capacity to Adapt	Learning	+	+
	Flexibility	+	+
Capacity to Transform	Re-invention	0	0
	Reflexivity	+	+

Amsterdam has had significant experience and made considerable progress in climate proofing and creating a more resilient city compared to Valencia. Its attention towards defending and adapting itself to water stresses (flooding, extreme downpours, etc), as well as its spatial awareness and vision, has enabled it to cultivate a foundation for climate adaptation which contributes significantly to its overall capacity to *adapt and transform*. This foundation (or base) includes the networks, partnerships, successful pilots, and exchange of expertise within the city that has experience in localising instances of adaptation measures which benefit the *robustness, learning, flexibility, and reflexivity* principles.

The neutral capacity to *prepare* is currently attributed to the recent emergence of a more holistic climate adaptation approach (not only in the Netherlands but around the EU). Work still needs to take place in the integration of both sectors and stakeholders to tackle worsening climatic stresses, as well as more localised awareness of and engagement in urban vulnerabilities (particularly towards heatwaves, drought, and soil subsidence). Efforts and commitments towards expanding on existing strengths and expertise in plans and by officials has the potential to enhance the capacity to *prepare* through a more holistic approach to adaptation. Furthermore, previous experience in integrating adaptation in water and spatial management, along with an established network of stakeholders, provides potential opportunities for overlap and integration with less connected domains (e.g. health sector, fire departments, housing agencies, etc).

The most notable current shortfall is the *redundancy* within the city, with evidence of shared functions and responsibilities for city services being delegated to lower-tier stakeholders being particularly low and still primarily in the hands of local government or private companies. This also influences the *diversity* of local stakeholders involved in adaptation and resilience building, even if there is a high variety of local organisations involved in promoting adaptation and citizen engagement. Paying attention to the integration of climate adaptation measures and vulnerability tests across sectors, as well as the legitimate participation of stakeholders, have been stipulated in plans and by interviewees

which holds promise for the future. However, so long as these sectoral and stakeholder functions are not concretised in the upcoming implementable and strategic plans, there will still be doubts as to how to engage and who can engage in adapting the urban environment.

The doubts as to the low awareness, demarcated engagement of citizens and neighbourhoods, and sectoral integration of climate adaptation have limited the current ability to *re-invent* the city's urban area. There are also questions as to traditional dependencies that influence the willingness to branch out from the status quo (meaning from traditional water management and dike building to heat and health) and lower-tier urban stakeholders (e.g. neighbourhoods, private households) appropriating adaptation responsibilities. Commitments towards localising vulnerabilities and adopting implementation agendas that provide concrete roles for those involved (following risk dialogues and communication strategy) have the potential to improve collaborative efforts to *re-invent* practices and functions of the city with a greater representation of sectors, citizens and public entities in the future.

Whilst there are some neutral scores and visible shortfalls for the principles currently, most of them score quite positively in the future. It must be acknowledged that it is easier to write and formulate plans than to implement or put them into practice. However, previous experience with planning and adaptation contributes significantly towards the better outlook for Amsterdam in building towards resilience in its metropolitan area. Amsterdam's significant focus and tradition of planning and territorial management (and resilience) is evident and puts it in a favourable situation to accommodate more holistic adaptation among its urban sectors and stakeholders. Neutral scores for a few principles in future plans pinpoint the doubts and potential bottlenecks which have been raised during the study and insight compilation. These are later reflected on and discussed in Chapter 7.

6. Valencia Case Evaluation

6.1 Preparedness

As Table 15 shows, each of the preparedness principles received a weak score for current situation which illustrates a weak overall capacity to *prepare*. Future plans for anticipation (and foresight) and preparedness scored positively which illustrates good prospects but homeostasis received a neutral score due to some concerns involving inexperience with delegating responsibilities.

Table 15: Score per principle, current situation and future plans, based on adaptation plans and interviews.

Principle	Current Situation	Reason/Why?	Future Plans	Reason/Why?
Anticipation & Foresight	0	Evidence of instances of monitoring and climate related knowledge dissemination but still at early stages of raising the awareness of adaptation to a wider audience in the city	+	Focus on developing indicators and standards for localized action, engagement from citizens, and continued integration of more holistic climate adaptation will benefit this principle
Preparedness & Planning	-	Localized community adaptation quite limited in scope, lacking shared priorities between sectors and citizens, more consensus needed on integration of climate themes and risks	+	Communication strategy, cross-sectoral dialogue and learning, and the acknowledgement and continued inclusion of L'Horta and the Albufera into city vision will improve more comprehensive planning
Homeostasis	-	Evidence of communication avenues and platforms for knowledge dissemination but still at early stages of shared responsibilities between public and private stakeholders, as well integrating sectoral and urban urban functions for variety of stakeholders	0	Strengthening of communication networks and partnerships, and efforts towards a holistic stakeholder engagement and interplay regarding climate adaptation underway but doubts involving the limited experience with sectoral integration and legitimate participation opportunities

6.1.1 Anticipation and Foresight

The principle involves the presence (or evidence) of climate-related knowledge, vulnerabilities and patterns being monitored and accessible to a wide range of city stakeholders. Valencia obtained a neutral score for current situation and a positive score for future plans.

Compared to Amsterdam, Valencia has been significantly more focused on assessing vulnerabilities and adapting to emissions and heat-related impacts in various sectors, and less on water adaptation or spatial adaptation to accommodate its gradual densification and sprawl. While there is accessibility of climate-related information to neighbourhoods and citizens through targeted campaigns, there is consensus that this is still quite limited in scope. Therefore, the current situation is weak. Ongoing and future work together with plans and efforts relating to integrating climate adaptation more holistically across sectors show potential. Additionally, the focus on formulating localised indicators for adaptation and sustainability progress, as well as attempts at engaging (not solely informing) citizens have the potential to positively affect this principle.

One important weakness locally and nationally in Spain is that 'adaptation to climate change is a more recent concept that few municipalities in Spain have begun to explore in depth' (Factor CO₂, 2016: 25). Through its partnership with the Pact of Mayors and the EU, since the start of the 2010s, the main

climate action of the city has been geared towards lowering emissions and tackling polluting sectors (e.g. mobility, energy, infrastructure) (Generalitat Valenciana, 2008; Generalitat Valenciana, 2013). There are significant links between reducing air pollution and, by doing so, improving air quality, and lowering temperature, which helps mitigate heatwaves or UHI effects in cities (Zhang & Batterman, 2013; Schraufnagel et al., 2019). Therefore, an additional strength is that over the years the city has focused on mitigation efforts such as optimising transport (e.g. renewable fleet), expanding network infrastructure (e.g. city's cycling paths) conducting research by organisations (e.g. Las Naves, UPV, Fundación Clima I Energia, and INGENIO) into innovation ways to tackle emissions and energy efficiency (Interview 15, 16, 17).

However, a current weakness that has been noted is 'we have a fair, if not a bad record with the mitigation part, which is the most visible part to everyone (for example electric vehicles, energy efficiency, and so on). Even weaker has been our work on adaptation which is poorly focused' (Interview 11). Additionally, issues of very low awareness of climate adaptation actions that extend beyond reducing emissions (e.g. NBS, urban greening, blue-green infrastructure, and climate proofing) have also been noted and weaken the current situation (Interview 15, 19). Another weakness is that whilst there have been information campaigns and active dissemination of climate insights by organisations such as INGENIO, Valencia Activa, Climate KIC and Las Naves (e.g. Hackathon, Responsaludable, or Marítimo al Mundo) their scope is still significantly restricted to raising awareness with relatively limited reach (Interview 12, 15).

There is optimism as efforts are underway and in the future that look, for instance, at 'holding workshops or webinars to unveil tools developed by INGENIO and Tecnalia to improve the classification of climate and natural indicators for the metropolitan area of Valencia' (Interview 17). There also 'workshops lined up to work on a mass communication strategy for the climate and energy transition of Valencia, bringing together local government, representatives of business associations, NGOs, journalists and environmental information' (Interview 16). Moreover, the local government, especially the mayor, has voiced the importance of incorporating data from the bottom-up with real and concrete information on what is taking place locally, data that is comparable with the SDG indicators to monitor progress and whether targets are being met (Ayuntamiento de Valencia, 2021: Interview 17).

A strength in future plans is the fact that the *Climate Adaptation Plan Valencia 2050* emphasises the importance and work towards integrating bioclimatic criteria in infrastructure and urban development. The goal is being able to integrate sectors (infrastructure, mobility, and health) and climate adaptation vulnerabilities (as well as measures) more coherently to improve the resilience of citizens to high temperatures and extreme climatic events (Factor CO₂, 2016). This will be aided by the *Missions Valencia 2030* as they aim to mobilise mission-oriented innovation projects and the four (or five) helixes collaborating for innovative solutions. The four helixes consist of stakeholders from I) the private sector (e.g. large companies, SMEs, etc), II) the public sector (e.g. local government and instrumental institutions), III) universities (e.g. research centres and technical institutes), and IV) civil society (e.g. social movements, associations, etc) (Missions Valencia, 2020). A fifth stakeholder could be the media as expressed in plans and interviews. An additional strength is the workshops and dialogue meetings, the active dissemination of climate adaptive measures, and the coordination of

the four helixes that will be under the leadership of Las Naves, making it an important organisation within the city's adaptation ambitions and upscaling potential (Interview 7; Missions Valencia, 2020).

6.1.2 Preparedness and Planning

The principle involves the presence (or evidence) of active communication, information exchange and dialogue between different city stakeholders on the significance of climate adaptation, as well as engaging communities and aiding coordination efforts for measures. Valencia obtained a weak score for current situation and a positive score for future plans.

Valencia currently scores weakly for this principle. There are established communication avenues for dialogue and knowledge exchange between local organisations (Las Naves, UPV, Fundacion Clima I Energia, Ayuntamiento de Valencia) as well as very specific, localised pilot experiments (e.g. GrowGreen, energy communities). However, there is a noticeable lack of awareness of climate adaptation, as well as poor integration and consideration of the entirety of the metropolitan area (which also includes L'Horta and the Albufera). Additionally, there is limited engagement of citizens or communities in adapting the city. In the future, efforts underway in developing a communication strategy (as previously noted), plans to link cultural heritage (e.g. L'Horta and Albufera) and climate adaptation to mobilise communities more, and coordination protocols for extreme events, weather and drought have the potential to positively influence the principle.

Since 2011, the *Climate Change Strategy Valencia 2020* has provided the guiding tool for mitigation and adaptation in the autonomous community and capital of Valencia. A strength is that during this period the ambition was to utilise a governance mechanism that facilitates participation and coordination between different stakeholders implicated in climate change to develop a localised strategy to combat and adapt to it (Generalitat Valenciana, 2013). However, it has been noted that during this time the city has been carrying out very specific and targeted information and contact processes for climate adaptation on a localised level (Interview, 12). Much of the focus has been on sectoral adaptation for emissions reduction and neutrality (Interview 13, 16). This poses a weakness to current situation and scope.

Furthermore, a current weakness is that there are differing goals and priorities relating to spatial development and urbanization between sectors within the metropolitan city which hampers the *robustness* of Valencia. For instance, as expressed by Interview 19: "the expansion of the port of Valencia, because it would have a tremendous territorial impact on both natural and agricultural systems, but also on the public budget, and the administration is going ahead with it". In response, organisations such the Associació per L'Horta (association for the Horta), Las Naves and UPV as well as the Generalitat Valenciana have raised awareness, collaborating and working towards having these concerns debated publicly and put on the agenda 'as until now the port has been expanded in an opaque way, without transparency' (Interview 19). This favours the participation and engagement of a multitude of urban stakeholders in public affairs and strengthens current efforts.

Another current weakness is that public awareness (especially from the Ayuntamiento de Valencia) has only recently broadened in terms of climate adaptation giving a greater consideration for L'Horta and the Albufera as integral elements of the metropolitan area and adaptation efforts (Factor CO₂, 2016; Interview 11, 12, 19). This will benefit from L'Hortas' social and public functions having recently

been recognised by regional law (Article 4, Law 5/2018) as integral cultural, natural, and economic areas for the favourable development of the city (García et al., 2020). However, a potential weakness in the future involves the interconnectedness of Valencia's metropolitan area and its communities which have not been fully assessed but are currently underway (Interview 18, 11). To address this, the communication strategy being developed between different sectors of the city and the inclusion of climate risks and vulnerabilities in plans and emergency protocols show potential (e.g. the ones on extreme rainfall, or heatwaves and their impacts on the health sector). An additional strength is the broadened climate adaptation campaign in the city (through *Missions Valencia 2030* and the *Urban Agenda 2030*) which could enhance coordination, prioritisation and risk reductions in the future.

6.1.3 Homeostasis

The principle involves the presence (or evidence) of climate adaptation policy being integrated into other policy domains, clearly defined responsibilities of stakeholders at different levels of city, and willingness for interplay among stakeholders in city upkeep. Valencia obtained a weak score for current situation and a neutral score for future plans.

Current integration of climate adaptation policy has been relatively weak. This is due to several things. First, the lack of awareness among the public of operational measures for climate adaptation. Second, communication channels being in place between a triple helix collaboration but the previously mentioned four helixes involving civil society is still in its development stage. Third, ecosystem services are maintained mainly by private entities or public administration. Plans and commitments towards opening more communication channels and networking with civil society, integration of climate adaptation policy and impacts in sectors (e.g. urban spatial planning, infrastructure, urban agenda), and the communication strategy currently under development have potential. However, there are still doubts as to the limited experience in cross-sectoral integration and the legitimate engagement of stakeholders from civil society and neighbourhoods in adaptation (very small scope). Therefore, future plans got a neutral score.

A previously mentioned current weakness relates to awareness among citizens and communities being relatively low with actions being targeted and specific to very small segments of the city's population. Therefore, there is a limited interaction or understanding of social innovation and community involvement in climate adaptation and resilience building (Interview 13, 15). This weakness is complicated by the lack of actionable measures or strategies in place to improve the engagement of communities and the limited funding allocated by the Ayuntamiento and Las Naves, 'which usually covers the experimentation phase but often not the evaluation, monitoring or potential upscaling' (Interview 12).

Future plans could benefit from the incorporation and use of the four (or five) helix collaboration which could contribute towards the integration of civil society into the dialogue, network and partnerships between different sectors and city levels (Missions Valencia, 2020). Additionally, the *Marco Estratégico Valencia 2030 (Strategic Framework Valencia 2030)*, which is part of *Missions Valencia 2030*, aims to steer social and urban innovation to find more transversal policies and overlaps of measures among sectors (e.g. health, heat, agriculture and sea level rise) (Ayuntamiento de Valencia, 2021). An additional strength is that Las Naves and the Ayuntamiento have also committed

towards generating more demonstrative and transformative projects (such as GrowGreen). This could help generate a greater expertise and innovation knowledge base (on a local level) to be able to provide viable alternative pathways and develop standards (such as using more NBS, blue infrastructure, and solar) (Interview 15). As noted by Interviewee 15, representative from the Ayuntamiento, the ‘city council recently approved the strategic framework of the *Urban Agenda 2030*, with a series of guidelines and directives, affecting four sectors: the healthy city, the sustainable city, the integrated city, and the entrepreneurial city.’ This could enable the merger of policies and local research into overlapping functions between sectors, neighbourhoods, and landscapes of the city’s metropolitan area (Ayuntamiento de Valencia, 2021).

Lastly, future plans will benefit from the research and formulation of local data and standards which are being developed and disseminated on climate adaptation. This could facilitate their adoption or inclusion in other sectors and policies, as in the case of Amsterdam and the Rainproof principles. This could be enhanced by the current city government actively promoting and working towards building a network through the territorialisation of data for the city (Interview 15). This could help to see how public policies have a varied influence on the city’s districts and neighbourhoods and to be able to adjust them accordingly with coherent standards and criteria (Missions Valencia, 2020; Interview 11, 16).

6.2 Absorption

As Table 16 shows, the absorption principles received two weak and one neutral score for current situation which illustrates a weak overall capacity to *absorb*. Future plans for all principles got a neutral score. This illustrates a mixed outlook for the cities capacity to absorb.

Table 16: Score per principle, current situation and future plans, based on adaptation plans and interviews.

Principle	Current Situation	Reason/Why?	Future Plans	Reason/Why?
Robustness & Buffering	-	Outdated (not recently updated) spatial plans and limited adaptation measures, missing policy integration regarding climate adaptation, and some risk assessments for urban territory (but lacking holistic integration)	0	Vulnerabilities and risks (both climate and social) derived for sectors, waiting for integration and dialogue to continue but doubts as to how new plans and adaptation actions will mesh with existing spatial distribution
Diversity	0	Evidence of significant variety of city stakeholders but not all have equal weight, some bottlenecks administratively	0	Plans on expansion of network and more inclusive action amongst urban stakeholder’s but still doubts and rooted bottlenecks to consider
Redundancy	-	Evidence of responsibilities and functions being delegated to smaller scale stakeholders to pursue adaptation but still at pilot and experiment phase (limited inventory of successful projects), and lacking a clear understanding of multifunctional measures for climate action	0	Communication strategy between different sectors, the inclusion of L’Horta and Albufera in city adaptation planning, and the quadruple helix collaboration show potential, but doubts remain in relation to limited experience delegating responsibilities and inadequate participation thus far

6.2.1 Robustness and Buffering

The principle involves the presence (or evidence) of policy, infrastructural and spatial measures focusing on climate and social impacts, risk assessments and management in urban development. Valencia obtained a weak score for current situation and a neutral score for future plans.

Valencia is currently weak with regards to its spatial and infrastructural robustness. This is primarily attributed to outdated spatial and urban adaptation plans in the region of Valencia and a lack of territorial cohesion between its natural and urban landscapes. There is also the issue of less experience with coupling adaptation with other urban ambitions. Climatic vulnerabilities and risks in the agricultural, water, biodiversity, energy, health, transport, and spatial planning sectors have been prioritised in recent plans, and commitments made towards improving communication between these sectors. However, there are still doubts as to how devised standards and plans on climate adaptation will filter in structurally and mesh with existing spatial and infrastructural measures. Therefore, the effect on the principle in the future is neutral.

An important weakness (both historical and current) is that unlike the municipality of Amsterdam, the Valencian region has not updated its *Plan General de Ordenación Urbana* (or General Structural Plan – Structural Plan) since 1988. This plan dictates the spatial planning, distribution of land, and infrastructural requirements for development in Valencia's urban area and its surroundings (L'Horta and the Albufera) (Ayuntamiento de Valencia, 1988). This has been and is an important bottleneck for future plans like the *Climate Adaptation Plan Valencia 2050* or *Urban Agenda 2030*. This has been noted by Interviewee 19: 'You can put whatever you want in the *Missions Valencia 2030* and *Urban Agenda 2030*. What determines where buildings are built and where buildings are not built is what used to be called the *Plan General de Ordenación Urbana* and now it is called the Plan General Estructural. It is what marks where you are and aren't allowed to put buildings, where you are and are not allowed to have gardens and parks, where you are going to create and what you leave as an orchard, where you are not, and these are the things that have not changed since 1988'.

Moreover, another contributing element to a current weak robustness is spatial adaptation and considerations for climate and social impacts have been significantly side-lined by the infrastructure (construction) sector. It 'experienced a boom in the first part of this century and then the bubble burst, and lot of projects were abandoned' (Interview 14). The housing complexes and residences that were built in the south of the city (the Albufera area), for instance, 'were a complete disaster' as there had not been adequate land zoning, consideration for accessibility, building with the natural surroundings and proactive thinking (Interview 19). These developments appear to have limited the consideration and prioritisation of climatic and social impacts when urbanising and developing the city previously, other than those relating to emissions and energy efficiency in buildings (Interview 18).

Moving forward, vulnerability and risk dialogues relating to climate and social aspects are underway between different sectors and stakeholders in the *Climate Adaptation Plan Valencia 2050* and *Missions Valencia 2030* looking at improving the resilience of the surrounding natural and agricultural area, as well as the historical centre (Factor CO₂, 2016). Additionally, more recently there is a trend towards cultural heritage conservation in the region. In Valencia this involves L'Horta and the Albufera receiving more attention and consideration in urban plans and goals which could potentially bolster

the interconnectedness and awareness of the city's spatial vulnerabilities (Interview 11, 19). However, there are still some doubts as to how changes will be made without updating structural spatial plans that still dictate the allocation of space towards infrastructural development (Interview 12, 18). This is coupled with a traditional approach at maximising the most out of areas for profit and a very limited consideration for adaptation to climatic threats and their spill over into the surrounding environment (Interview 15, 19).

6.2.2 Diversity

The principle involves the presence (or evidence) of functional diversity in measures, and a diverse range of stakeholders and organisations that are dealing with the adoption of adaptation and resilience building in the city. Valencia obtained a neutral score for current situation and future plans.

In terms of diversity of resources, expertise and stakeholders involved in climate adaptation, the current situation is neutral. There is a significant network, in the city and its international links (Mayors Pact, Climate KIC), with experience and innovation in dealing with climate adaptation in specific sectors (e.g. mobility and health) and against some climatic threats (e.g. heatwaves). However, the functional diversity within the city has been noted as still rather fragmented when pursuing urban adaptation and resilience building. Efforts towards an intersectoral communication strategy and integration of more holistic climate adaptation understanding to make the city healthy, integrated, entrepreneurial and sustainable could help cement more implementable measures. Even so, there are still doubts and rooted bottlenecks that could hamper progress. Therefore, future plans got a neutral score.

A current strength is that the triple helix collaboration that exists in Valencia between the Ayuntamiento de Valencia, Las Naves and private companies has enabled a significant exchange and communication of expertise and knowledge concerning urban and climatic adaptation (Interview 12, 14, 18). Additionally, this has been enhanced by the work into innovative solutions by R&D institutes in the city (e.g. INGENIO, UPV, Fundacion Clima I Energia) which have also contributed towards collaborative projects with Las Naves and specific neighbourhoods of Valencia (e.g. Valencia Activa, GrowGreen). However, a current weakness is that some bottlenecks are noticeable, specifically 'bureaucracy in the city administration' (Interview 18) and a 'limited tradition, both in Spain and in the Valencian Community, of approaching the stakeholders only to extract information and then the decision-makers are others' (Interview 16). These aspects make it unclear as to the legitimacy of the current participation and functionality of the diverse organisation working to adapt or climate-proof the city.

An optimistic development for the future is the four (or five) helix collaboration outlined in the *Missions Valencia 2030* for mission-oriented innovation to enable more integrated and bottom-up actions. The incorporation of civil society (and maybe the media) could enable greater engagement from citizen associations and the more vulnerable neighbourhoods (Missions Valencia, 2020). Interviewee 15, from the Ayuntamiento, noted how this involves the 'public sector, the private sectors, academia, organised civil society and the media, understood as the sector that has to help transmit, involve and empower citizens'. Alongside the communication strategy underway between sectors with climatic vulnerabilities assessed, 'information, transparency and participation will be the

three fundamental ingredients when developing these new policies and measures of the *Climate Adaptation Strategy Valencia 2050* and *Urban Agenda 2030*' (Interview 15). However, other interviewees emphasised that the previously mentioned bottlenecks should be taken under consideration in the unfolding of future plans (Interview 16, 19). As expressed by Interviewee 16: 'these traditional blockages, of mistrust, of lack of cooperation, even at all levels, not only at the vertical level, but also at the horizontal level must be addressed because companies are not used to working in an ecosystem where challenges are shared, but rather individualistic'.

6.2.3 Redundancy

The principle involves the presence (or evidence) of shared functions and responsibilities across different areas and scales for climate adaptation. Valencia obtained a weak score for current situation and a neutral score for future plans.

Valencia's current situation is weak, as functions and responsibilities toward adaptation for lower-level city stakeholders is currently still at pilot, experimentation, and limited scale (the focus having been more on raising awareness and information sharing). The ongoing communication strategy between sectors, the commitment towards social and urban innovation (*Missions Valencia 2030*), EU connections and expertise sharing, and upscaling of projects hold potential for improving this capacity. However, there is low evidence of shared functions among sectors and between urban stakeholders previously, and questions of legitimate participation and responsibilities for lower-tier stakeholders. Therefore, future plans received a neutral score.

An important weakness current is that the notion of multifunctional measures and climate adaptation in Valencia is still very vague and at its early stages. This is due to the limited know-how on the overlapping roles of different levels (private sector, public and civil society), novelty of adaptation in the Spanish context, and the fragmented manner of previous developments towards tackling city development and issues in sectors (e.g. the focus on an emission format which mainly revolves around the transport and infrastructure sectors) (Interview 17, 18). A positive trend is that there are organisations such as Las Naves or Fundacion Valencia Clima e Energia which have worked towards localised, innovative solutions. For instance, Las Naves initiated the GrowGreen project to experiment with NBS in a couple neighbourhoods, or the Fundacion's experimentation with carbon neutral and energy communities) (*Missions Valencia, 2020*; Interview 12, 13). However, another weakness is that these organisations have not been able to break into the mainstream in any way yet to allow for overlapping roles and functions to be assessed or integrated properly (or have not been delegated enough power to influence this adequately) (Interview 12, 14, 16). The obstacle here is managing and facilitating the upscaling of existing pilots and community driven adaptation projects, which will benefit from European and state funds being aligned towards adaptation which took place as of 2018 (Interview 11).

A strength moving forward is the communication strategy that is currently being developed through talks, workshops and think-tanks with different sectors following the assessment of climatic vulnerabilities by sector that was previously conducted (Interview, 16, 17; Factor CO₂, 2016). This could benefit the understanding and overlap of functions. Additionally, this will be particularly important for expanding the knowledge base of the multifunctionality of adaptation which can take

place between the city’s core and peripheries (L’Horta and the Albufera) and enable the planning of more inclusive and self-reinforcing functions within the metropolitan area (Interview 19). Another point for optimism involves the four (or five) helix collaboration, if carried out in a *legitimate* and *transparent* manner. This potentially could improve the engagement of communities and citizens, raising awareness, and contribute towards ‘shifting the paradigm of governance and participation which has done a lot of damage in a territory like this, where there was no strong participatory tradition as there might be in some Northern European countries such as the Netherlands’ (Interview 16).

Furthermore, insights from the vulnerability assessments, communication between sectors, and the innovation taking place across organisations (e.g. Las Naves, UPV, Climate KIC and INGENIO) have contributed towards the strategic framework for Valencia and its innovation missions (Ayuntamiento de Valencia, 2021; Interview 15). This is ‘where they are blending SDGs, Urban Agenda and the Missions Valencia into a real, useful, and strategic framework which is basically what is needed’ (Interview 17). That being said, a weakness is that the local government has little experience in delegating responsibilities to citizens and communities for adaptation and urban development, with it mainly having been a public and private task (Interview 13, 15). For instance, the mitigation and adaptation measures enforced in previous plans for emissions reductions have mainly been delegated to public and private entities to retrofit buses, create pedestrian areas, or improve the efficiency of buildings (Alonso et al., 2015; Factor CO₂, 2016). Coupled with the low awareness among citizens and communities of how to act, contribute, and appropriate adaptation actions and behaviour (Section 6.1), these deficits could jeopardise improvements towards a more well-rounded absorptive capacity.

6.3 Recovery

As Table 17 shows, Valencia obtained a weak score for the principle of flatness and a neutral one for high flux. This illustrates current situation as steering towards weak overall for the capacity to *recover*. Both principles obtained a neutral score for the future plans which indicates doubts and work to address recovery.

Table 17: Score per principle, current situation and future plans, based on adaptation plans and interviews.

Principle	Current Situation	Reason/Why?	Future Plans	Reason/Why?
Flatness	-	Resounding doubt as to extent of participation, limited civil engagement and appropriation of climate adaptation actions and knowledge	0	Quadruple helix collaboration, communication strategy, and strategic framework are good but still doubts and questions of trust between civil society and acting bodies for adaptation (Ayuntamiento and Las Naves)
High Flux	0	Evidence of resourcefulness, expertise and network available but questions on administrative capacity, funding and limited engagement of citizen previously	0	While there are aims of facilitating and expanding resourcefulness there are still doubts from a funding and administrative point of view, and how things will be accommodated

6.3.1 Flatness

The principle involves the presence (or evidence) of broad participation of stakeholders in climate action efforts, a decentralised governance model for more autonomous and local decision-making, and communities engaging in adaptation projects (instance of hands-on experience and awareness). Valencia obtained a weak score for current situation and a neutral score for future plans.

Currently, Valencia scores weakly for this principle. Whilst there has been a gradual decentralisation towards climate adaptation from a national to regional government, locally in Valencia there are limited coherent measures or experiences in enabling adaptation to climate threats by citizens and communities. There are still questions on the extent and legitimacy of participation, as previously noted (Sections 6.2.2 & 6.2.3). Whilst the increasing diversity of stakeholders (four or five helix collaboration), commitment towards social innovation to combat climate change (*Missions Valencia 2030*) and formulation of implementable actions (and the strategic framework) have the potential to enhance this principle there are still instances of mistrust and inexperience with decentralised action. Therefore, the principal scores neutral for future plans.

A noticeable weakness presently is that while there has been a gradual shift towards climate action from a national to regional scale recently in Spain, on a local level this is still lacking in terms of a coherent implementation agenda or framework for climate adaptation engagement across different scales (Factor CO₂, 2016). The current lack of, or even novelty, of delegating responsibilities to citizens and communities is noted by Interviewee 12: 'think they are giving in a bit to some groups. The issue of L'Horta, for example. But even so, I think the feeling I have is that we are not a city that delegates a lot of responsibility or allows more local entities to participate. I think that's where we are, still a little bit bad.' Furthermore, while participatory budgets that exist in the city (since 2018) have enabled citizen and neighbourhood participation in the prioritisation of funding for urban projects and innovation, they have not really been engaged in their execution (Interview 14, 19). This is mainly because that responsibility mainly rests with private companies or the local government that end up providing most of the funding (Interview 11, 15). This is expressed by Interviewee 16: 'I think attention is being paid, but not at the level of citizens' agency. So, the agency of the individual has not improved, but the agency of groups and associations has improved a lot.'

A strength moving forward is that Las Naves has carried out urban adaptation projects (e.g. GrowGreen, MAtchUP) and provides a public accelerator platform for social innovation called 'Collab' (through EU and local funds). Collab has and will continue to contribute towards the active participation and engagement of certain neighbourhoods and citizen organisations in the city (e.g. Benicalap) (Interview 12). Added to this is the fact that the organisation holds an integral role in the *Missions Valencia 2030* where it will support (as well as lead) the four (or five) helix collaboration and the unfolding of the *Missions Valencia Strategic Framework 2030* to guide innovation and monitoring for missions in the city (Missions Valencia, 2020; Ayuntamiento de Valencia, 2021). That being said, there are questions of mistrust as noted by Interviewee 14: 'Previously there was a problem, about four or five years ago, and let's say it involved some disputes on technological innovation. Well, there is a certain bad taste in the mouth about the relationship with Last Naves'. This is mainly 'because of political issues but there is also another part of the population that does not see this type of social

innovation as something that is useful. In other words, they don't see them, they don't value this type of innovation' (Interview 19).

Since then, they have been working towards regaining that trust and the credibility of the organisation but it's a gradual process, taking time to cultivate a good brand again (Interview 14, 16). This mistrust of civil society in relation to Las Naves, and to a certain degree the local government, is an important bottleneck that the organisations have started to address but work is still needed (Interview 14, 15). Furthermore, the scope of prior and current localised adaptation efforts is significantly limited as previously mentioned which hampers the legitimate participation and engagement of stakeholders.

6.3.2 High Flux

The principle involves the presence (or evidence) of resourceful provision of knowledge, expertise, and financing for climate adaptation in the city of Valencia to a variety of stakeholders (businesses, NGOs, citizens, neighbourhood associations). Valencia obtained a neutral score for current situation and future plans.

Valencia is well connected to the EU and other cities (e.g. Mayors Pact, C40, Climate KIC) for exchange of expertise, funding, and urban innovation. While there is a local network established between the public (Ayuntamiento de Valencia, Las Naves), private and academic (UPV, INGENIO, Fundación Valencia Clima e Energie) domains, there are considerable administrative and resource deficits. Thus, the city got a neutral score for current situation. While there are ambitions for scaling up pilot experiments across climatic themes, integrating climate adaptation into other policy and frameworks (e.g. land-based disaster management) there is still the question as to the allocation of funding and investment, as well as the delegation of responsibilities of the four (or five) helixes as actionable measures are concretised (in the Strategic Framework and implementation agendas). Therefore, future plans obtained a neutral score.

A strength (historically and currently) is that since 2009, the city has taken part in the Pact of Mayors and worked significantly on the development of innovation (especially in regard to emissions, mobility, and urban regeneration) in its varying R&D institutes (which include Las Naves and UPV prominently) (Las Naves, 2021; Missions Valencia, 2020). Within the city, as noted as Interviewee 11, Las Naves acts as a 'flexible organisation that allows it to play and be the nexus of union. What is also important is that it depends on a policy actor. A town councillor who is has the competences in the matter. So it is not like a foundation that goes its own way and if I want to do this I do it. The City Council has a set of rules to follow.' However, a couple of current deficits have been emphasised. One is awareness and active dissemination of knowledge on adapting to climatic threats by private companies and civil society as 'they adopt or approach these problems as a question of barriers and not as a question of first adaptation and second mitigation' (Interview 13). The second is administration as there is a 'historical deficit in Spanish administration of civil servants, of technicians. Civil servants meaning part of the administration (Interview 19). This means, for instance, 'reviews of urban planning are not feasible, because it would collapse the administration even more. You could do a systematic review of all measures like that. It would be ideal, but it would not be realistic' (Interview 11).

There is optimism with the formation of a new local government for the 2019-2023 period, and its validation as well as approval of the *Missions Valencia Strategic Framework 2030* in 2021 (Interview 16). It has done so to mobilise expertise, connections and funding towards social innovation and existing pilot projects by Las Naves such as Urban Data (for system mapping and vulnerability tests for heat and water), GrowGreen (NBS), and MAtchUP (urban regeneration model) which could help improve future plans (Missions Valencia, 2020). However, there is still the doubt about the local administrative capacity mentioned earlier and how the greater *diversity* of stakeholders involved in climate proofing the city will be managed with its existing deficits (Interview 11). Additionally, there is also the weakness revolving around the lack of *trust* between not only civil society and Las Naves, a leading figure in facilitating mission-oriented adaptation and innovation in the city, but also the local government (Interview 14, 15). This poses a considerable bottleneck for greater infiltration of social innovation and community-based practices to reach a wider audience.

6.4 Adaptability

As Table 18 shows, Valencia currently obtains a neutral score for learning and a weak one for flexibility. This illustrates a weak capacity to *adapt*. Learning scores positively for future plans, whilst flexibility got a neutral score which illustrates some prospects but also avenues for improvement.

Table 18: Score per principle, current situation and future plans, based on adaptation plans and interviews.

Principle	Current Situation	Reason/Why?	Future Plans	Reason/Why?
Learning	0	Evidence of limited experimentation, collaborative efforts, as well as limited implementation of adaptation but a sufficient innovation and knowledge base is present	+	Mission-oriented projects, communication strategy, alignment of funding, and social innovation being promoted within the city for adaptation could improve situation in future
Flexibility	-	Spatial awareness, adaptation and flexibility is very low, faulty institutional flexibility and in need of integration (city has very little experience with accommodating urbanization in flexible and strategic manner)	0	Efforts towards integration, institutional flexibility and upscaling measures but doubts as to extent of structural and administrative elements being addressed in a timely manner to avoid bottlenecks

6.4.1 Learning

The principle involves the presence (or evidence) of active learning taking place from an administrative and community level relating to climate adaptation, collaboration frameworks or strategies in place, and room for experimentation and learning by doing in urban areas. Valencia obtained a neutral score for current situation and a positive score for future plans.

Valencia is considered a reputable hotbed for social innovation and over the years has left room for experimentation and learning from pilot projects (through las Naves, Fundacion Clima e Energia) and partnerships (e.g. the EU, Climate KIC). While there is the presence of learning from a public and private domain, there is still the issue of limited lack of awareness of adaptation by civil society as pilots and projects have previously targeted or been limited to very few neighbourhoods. Therefore,

the score for the current situation is neutral. Mission-oriented projects in the *Missions Valencia 2030*, communication strategy between sectors (*Climate Adaptation Plan Valencia 2050*) and the support for scaling up social urban adaptation initiatives will positively influence this principle.

A current strength is that Valencia is quite active in terms of international, regional, and local learning, as well as collaborative efforts. This is mentioned by Interviewee 11: 'the Generalitat has been involved in some European adaptation projects. I was in a project with the Valencia City Council, and las Naves called ARCH. I also coordinate a Climate Change Policy Coordination Commission with all the other departments at the regional level. In other words, mobility, with the territory on climate change issues. So, we also work on many of the areas at this level and with the city public sector'. The existing social innovation expertise is adequately distributed within the public sector, as 'las Naves is part of the municipal public sector, and 100% financed by the Ayuntamiento of Valencia which dictates its agenda' (Interview 12). One weakness present is that while las Naves actively disseminates knowledge, empowers community-based adaptation, and provides them with technical support their reach is still limited and conditioned by administrative priorities in the past (Interview 12, 17). The previously mentioned administrative deficits (Section 6.3.2) have also limited the room for more broadened experimentation, meaningful participation, and deployment of new solutions for climate adaptation in the city for the time being.

A strength moving forward is that developments and progress in climate adaptation and social innovation for Valencia will benefit from the increased alignment of national and EU funding. As noted by Interviewee 16: 'It is a mixture now. In any case, the local government is devoting much more funds, more funds than ever before. But it is true that they are looking at how to attract European funds for energy transition and social innovation'. With *Missions Valencia 2030* and its vision aligned with the EU, the implementation and funnelling of expertise and funding to empower stakeholders in the four (or five) helix collaboration, which includes civil society, have the potential to be enhanced (*Missions Valencia, 2020*; Interview 18). Furthermore, the integration of sectors encompassing the whole metropolitan area (L'Horta and Albufera included) and the ongoing communication strategy between them being developed under the *Climate Adaptation Strategy Valencia 2050* could propel forward a collaborative effort for cross-sectoral learning (Factor CO₂, 2016). However, a weakness to keep in mind for future plans is that Las Naves has been tasked with leading and coordinating the missions and the potential upscaling of pilots which could be hindered by the mistrust that was previously mentioned (in Section 6.3.1). Several interviewees stated that efforts are being made towards rebranding and regaining that trust through more transparent processes with citizens and partners (Interview 14, 15, 16). The rebranding could benefit from the international exposure of the *Missions Valencia 2030* and lead to more visibility and accountability from the side of Las Naves, to avoid traditional dependencies.

6.4.2 Flexibility

The principle involves the presence (or evidence) of flexible spatial and urban adaptation measures in place, and institutional flexibility towards change. Valencia obtained a weak score for current situation and a neutral score for future plans.

Valencia scores weakly when it comes to its current (and historical) spatial awareness, adaptation, and flexibility, along with its institutional flexibility also being significantly fragmented and in need of integration. Efforts are planned and an active approach by the city council and city stakeholders to address this, but outlooks are still in doubt (administrative deficit) and in need of structural recalibrations. Therefore, future plans score is neutral.

An important current (and historical) weakness is that Valencia has lacked vision when it comes to its spatial adaptation, which is significantly tied to the previously mentioned *Plan General De Ordenacion Urbana* dating back to 1988 (Interview 19). This is of importance when you consider that ‘there are sectors of the city, of neighbours who are fighting to recover spaces that are private, as they have more value as part of for instance green infrastructure or a natural belt because of their strategies location than as part of an urban development’ (Interview, 19). However, the spatial adaptation that took place over the last couple of decades has been done without careful consideration and integration of the surrounding landscapes (L’Horta and the Albufera) which currently weakens and hampers the flexibility of the metropolitan system (Interview 18, 19). This is reflected by the three most important sectors prioritised for climate adaptation In the *Climate Adaptation Plan Valencia 2050* being biodiversity, agriculture, and water. This is due to their vulnerabilities in relation to the pressing threats of heat, drought, and sea level rise, as well as the urgency to protect surrounding areas that provide a lot for the city (e.g. in terms of localised food source, green areas, and cultural heritage) (Factor CO₂, 2016). Additionally, there is also the weakness of the limited administrative capacity, which also influences the flexibility of the local government and institutions to allocate enough time and resources to adaptation (Interview 11, 15, 18).

There is optimism with Las Naves having been the main organisation within the city working with pilot experiments and innovative solutions, and its ties to the municipality demonstrate a coordinated institutional flexibility between the two (Interview 15). This is aided by the opportunities to upscale social innovation and urban adaptation, as previously mentioned, such as Urban Data, GrowGreen (NBS), and MAtchUP which could contribute towards building flexible measures and multifunctional solutions (Missions Valencia, 2020). Moreover, the provision of infrastructure dedicated to emergency management (e.g. land management and climate), and climate-proofing the city’s different sectors have been identified as goals in the *Climate Adaptation Strategy Valencia 2050* (Factor CO₂, 2016). However, while there are considerable developments planned, there is still the structural bottleneck of the outdated national spatial plan. This would need to be updated in accordance with the new urban requirements and land allocations as stipulated in the upcoming *Urban Agenda 2030*. Additionally, there are also doubts concerning traditional dependencies relating to the limited and ineffective participation of civil society in urban adaptation (Interview 16, 19)

6.5 Transformability

As Table 19 shows, Valencia obtained a weak score for re-invention and a neutral score for reflexivity. This illustrates a neutral capacity to *transform* currently. Future plans for reflexivity scored well but re-invention received a neutral score due to issues of mistrust and inexperience.

Table 19: Score per principle, current situation and future plans, based on adaptation plans and interviews.

Principle	Current Situation	Reason/Why?	Future Plans	Reason/Why?
Re-Invention	-	Limited tradition of reaching out to lower-tier stakeholders and including them in adaptation and planning, still lacking actionable measures for citizens and neighborhoods in climate and few instances of collective re-invention between triple helix collaboration	0	Strengthening of intermediary (Las Naves), mission-oriented focus on social innovation, communication strategy being developed, and engagement ambitions but questions involving mistrust of local government and Las Naves, as well as limited experience with shared prioritisation
Reflexivity	0	Some evidence of reflective thinking and self-assessment in a variety of bodies, and amongst members of the triple helix collaboration (as well as international collaborations) but only only as of now are garnering more attention	+	Increased collective learning between different sectors and climate themes in plans and strategies, integration commitments and continue enhancing of cross-sectoral learning (with Las Naves playing an integral role) show potential

6.5.1 Re-invention

The principle involves the presence (or evidence) of inclusive adaptation, strengthening of local intermediaries and ability to contribute towards prioritisation of adaptation measures by communities and institutes. Valencia obtained a weak score for current situation and a neutral score for future plans.

Valencia got a weak score for the current situation. Participation and engagement of citizens in adaptation measures in the city has occurred (e.g. cycling paths, and redevelopment of area of Mercado Central) and pilot project through Las Naves carried out, but on a small and demarcated scale (still low awareness and exposure). Furthermore, there are questions regarding the limited tradition of collective prioritisation and shared responsibilities taking place in city among urban stakeholders. The acknowledgment of strengthening Las Naves (also leading the *Missions Valencia 2030*), inclusion of citizens (adapt the city for them), and the promotion of social innovation in plans and organisations show potential. However, mistrust in the local government and Las Naves, and limited experience with bottom-up and network adaptation must be taken into consideration. Therefore, the score for future plans is neutral.

A current strength, as previously noted, is Valencia has utilised its participatory budgets since 2018 for 'landscaping, increasing garden areas, bicycle mobility and pavement retrofitting in the city' (Interview 14). While the adaptation measures for the most part are carried out by the public administration and make up a small proportion of the yearly budget, the prioritisation of measures has been done through a collaborative process between the sectors involved, the Ayuntamiento and citizen groups (Factor CO₂, 2016; Interview 14). However, a current weakness is that pilot projects from Las Naves, INGEIO or UPV that have been previously mentioned (Urban Data, GrowGreen, MATCHUP) have been hampered by scope, visibility, and funding which has limited the infiltration of innovative and more bottom-up initiatives (Interview 12, 15). Another weakness is there is limited experience with interacting and collaborating with citizen and communities unless it is for insights gathering (rather than active engagement and appropriation of adaptation issues) (Interview 16). Moreover, a current weakness that has been acknowledged previously (Sections 6.3.1 and 6.4.1), is

that even if Las Naves has been involved in empowering social innovation and bottom-up initiatives to adapt urban areas there are still issues of mistrust that have hampered a greater involvement of citizens and communities.

There is room for optimism as there is a considerable focus on inclusion and empowerment in plans such as the *Missions Valencia 2030* and *the Urban Agenda 2030* (still being developed). As noted by Interviewee 15: 'they require the collaboration or participation of what we call the four helixes. It is the public sector, the private sector, academia, and organised civil society with possibly a fifth being the media, understood as the sector that must help transmit, involve, and empower citizens. Information, transparency and participation.' Additionally, the communication strategy being developed between sectors in relation to climate adaptation measures and localised vulnerabilities could enhance the exchange of knowledge and degree of coordination when it comes to prioritisation of adequate measures (multifunctional and flexible) (Factor CO₂, 2016). However, it must be acknowledged that there is limited experience with cross-sectoral integration and collaborating with diverse stakeholders to prioritise actions and measures (mainly been headed by local government and private entities (Interview 13, 16).

An important strength for future plans is that not only has there been the notion of strengthening Las Naves' role and leadership for mission-oriented social innovation projects and their upscaling (as previously mentioned), but within the Ayuntamiento there is also thinking and working towards engagement from communities (Interview 11, 15, 18). As noted by Interview 15 in relation to las Fallas (traditional and historical festival): 'Well, if you notice, in every neighbourhood there are one or more fallas. So, if you get the falleros, let's say, to take up the gauntlet of participating, you would gain a lot, because the real, the most organised people in terms of citizen organisation, more than the ecologists, more than the cyclists, and so on, are the fallas, it's them.' Furthermore, tapping into the cultural and social heritage of the city is a guiding goal of the *Missions Valencia 2030*, as well as Las Naves whose main function has been that of an urban social innovation centre for local and European projects (Interview 12). This is vital for the increased awareness and appropriation of climate adaptation in the city, as noted by Interviewee 12: 'the series of innovation and social innovation variables that are being incorporated make management more complex. But I think that in the end the results are more satisfactory, however small the results may be. If people feel it is theirs.' However, once again the issues of mistrust between citizens and local government (as well as Las Naves) could linger and jeopardise advances and developments towards more collective adaptation.

6.5.2 Reflexivity

The principle involves the presence (or evidence) of collective learning taking place across multiple levels and learning from previous mistakes to continue innovating for climate adaptation. Valencia obtained a neutral score for current situation and a positive score for future plans.

Collective learning has been taking place across multiple levels through the triple helix collaboration, as well as between regional entities and European partnerships. Reflection of previous mistakes has taken place but in a rather fragmented way which has not enabled overlap in function or use of expertise between sectors or institutions. Therefore, the current situation obtained a neutral score. However, the communication strategy underway between sectors in response to climate adaptation

could enhance cross-learning and the multifunctionality of subsequent adaptation measures. Additionally, through the *Missions Valencia Strategic Framework 2030* for action across the four (or five) helixes there is the potential to enable awareness and learning from a community level that could have a more active role. Therefore, future plans obtained a positive score.

A strength (previous and current) is that since signing the Mayors Pact, Valencia has been connected to other EU cities and involved in the collective learning of innovations to address instances of emission reductions, energy saving in infrastructure, and renewables (Ayuntamiento de Valencia, 2011; Factor CO₂, 2016). Additionally, on a local level, the triple helix collaboration between the Ayuntamiento, research institutes (Las Naves, INGENIO, UPV) and private companies has established a network of expertise (Interview 13, 18). However, a weakness alluded to by interviewees is that often work between them is handled in isolation and with a limited citizen involvement in the learning process (which is also tied with limited awareness) (Interview 15, 17). As noted by Interviewee 15: 'both in an intra and inter level, work is done in an isolated way. In other words, there is a lack of integration and a lack of a holistic vision.' Furthermore, Las Naves being the main driver for social innovation and adaptation in the city has had its previously mentioned deficits and limitations which have also contributed to the poor collective learning on a community and citizen level (Interview 12). That being said, the organisation is significantly involved in self-assessing and evaluating the way it carries out experiments and pilot projects with communities and private partners, with insights gradually taken under consideration for the *Missions Valencia 2030* and *Urban Agenda 2030's* formulation (Interview 17, 18).

There is optimism with the *Missions Valencia 2030*, and the upcoming *Urban Agenda 2030* making up the main strategy for Valencia in the coming decade. As noted by Interviewee 15: 'one is the innovation strategy that we have defined based on Missions, which is aligned with the European Commission's strategy. There is an innovation strategy called *Missions Valencia 2030*. At the urban planning level, there are guidelines to improve the quality of life of citizens and to improve the urban quality of neighbourhoods. Then another plan, which is the COVID recovery plan'. These ambitions hold potential in enhancing awareness and giving agency to social innovations for climate adaptation in the city and working towards clearer guidelines as to responsibilities and avenues for citizen engagement (Interview 12, 15,18). Additionally, Las Naves will play an important role as an intermediary between the levels of collaboration established and contribute towards disseminating self-assessment and evaluation protocols to its existing and upcoming pilot projects, as well as new partnerships (Interview 11, 14).

A strength moving forward relates to the ongoing communication strategy, mentioned previously, which could help towards more collaboration frameworks and standards, such as a 'proposed unified framework for land-based disaster management and climate change' (Interview 17). Work towards the consolidation of expertise between local sectors and stakeholders for the city's upcoming urban adaptation plans, with the inclusion of L'Horta and the Albufera could also influence the collective learning of the systems (as a whole) which has previously been fragmented (Interview 19). It needs to be acknowledged that special attention must be given to the legitimate participation and learning of the community (also expressed in Sections 6.2.2, 6.2.3 & 6.3.1). Now more than ever plans emphasise their involvement and efforts are underway to establish frameworks to provide localised actions for easier appropriation (Missions Valencia, 2020; Interview 15).

6.6 Overview

Table 20 gives an overview of the resilience capacities and emphases in Valencia.

Table 20: Overview of scores for each principle (current situation and future plans) in Valencia

Capacities for Resilience	Principles	Current Situation	Future Plans
Capacity to Prepare	Anticipation & Foresight	0	+
	Preparedness & Planning	-	+
	Homeostasis	-	0
Capacity to Absorb	Robustness & Buffering	-	0
	Diversity	0	0
	Redundancy	-	0
Capacity to Recover	Flatness	-	0
	High-Flux	0	0
Capacity to Adapt	Learning	0	+
	Flexibility	-	0
Capacity to Transform	Re-invention	-	0
	Reflexivity	0	+

While there has been some emphasis on adaptation and resilience building among a very demarcated network of stakeholders within the city there are still significant deficits across multiple capacities. There are low signs that water and heat-related vulnerabilities have been addressed sufficiently within its metropolitan area, with the focus having been predominately centred on an emissions format and mitigation measures. The novelty of a more holistic climate adaptation and resilience building approach in Amsterdam is accommodated by a cushion of expertise, knowledge, network, and spatial flexibility. In Valencia the novelty of adaptation, in its most basic form, is considerably noticeable (Spain lagging in general) as well as limited instances of adaptation which are detrimental towards its capacity to *prepare*, *absorb*, and *recover* presently. Plans and commitments aim to tackle the raising of awareness and inclusion of sectors and stakeholders in more holistic climate adaptation, which hold promise in terms of more integrated planning within the city's spatial boundaries and a greater representation of diverse stakeholders (four or five helixes).

The city's poor scores in relation to its *homeostasis*, *redundancy*, and *flatness* all appear to stem from the very low experience in localising adaptation in sectors and among different stakeholders (public, private, and civil entities). This is in part attributed to the limited administrative capacities that local institutions and organisations have (relying significantly on the EU for research and development for local adaptation projects), and experience in integrating adaptation measures into other policy domains (e.g. agriculture, public policy, spatial policy). While these attributes within the city look to be addressed in plans and by sectors and organisations, these deficits could potentially be detrimental if allowed to endure.

Valencia's prominent issue is its weak *robustness* and *flexibility* in terms of adaptation measures and spatial awareness, which weakens its ability to *absorb* and *recover* from imminent climatic threats as a system (meaning its metropolitan area as a whole). This is once again influenced by the limited administrative and institutional capacities as well as attempts towards cross-sectoral integration among sectors and within the metropolitan area. Whilst there are commitments in place towards sectoral integration and innovation, the abilities to accommodate efforts will also be dependent on

the rethinking (and updating) of structural and territorial planning for the city's metropolitan area. This could potentially jeopardize the *flexibility* and *re-invention* within the city, as without updates to existing spatial plans and laws, new innovative solutions will have a harder time filtering into actions.

The capacity to *transform* is currently hampered by elements of mistrust between civil society and Las Naves (the main organisation for bottom-up, social innovation to adapt to urban issues) as well as limited opportunities for lower-tier stakeholders to engage in reflective processes (being more around local governments, academia, and some private entities). Plans, commitments and learning from other EU cities (through partnerships) could continue to enhance the transformative capacity, if a legitimate participation and awareness is distilled to citizens and neighbourhoods for urban adaptation. Improving the trust between civil and public entities in the city will be of utmost importance to help collectively *re-invent* the ways in which a *diverse* set of sectors and stakeholders adapt to local vulnerabilities.

In the case of Valencia, there are clearly more deficits currently (and previously) that lead to a mix of neutral and positive scores in the future. The neutral scores for future plans mainly concern the city's capacity to *absorb* and *recover* due to the limited presence of planning, spatial awareness, and flexibility of measures previously. Furthermore, the specific attention on air pollution and emission reductions as the main mitigation and adaptation objectives has limited the participation and engagement of lower-tier stakeholders, being in the hands mainly of public and private entities. The outlook for the city's capacity to *transform* its current situation and *prepare* itself in a more strategic manner in the future looks promising as these instances have been reiterated by interviewees and plans.

7. Discussion

This chapter seeks to discuss and reflect on the scoring and insights from the principles that took place in Chapters 5 and 6, to answer SQ4 – *What approaches, mechanism and factors can be inductively derived from the findings for both cities that may help understand the degree of resilience found?* The chapter is split in two. Section 7.1 looks into notable mechanisms and factors that were inductively derived that seem to hamper the degree of resilience of both cities (7.1.1 – 7.1.4), hamper one whilst enhancing another (7.1.5 & 7.1.6) and enhance the degree of resilience of both cities (7.1.7). These have been inductively derived from plans, strategies, documents, and noted by interviewees as being relevant toward explaining some of the cities’ capacities to build towards resilience. Furthermore, this chapter also links the findings of the previous chapters to existing literature and broader academic debates. Following on, Section 7.2 reflects on the research and analytical approach utilised in this paper. Reflections are made regarding the operationalisation of the urban resilience framework with social resilience elements (7.2.1), the urban resilience framework itself (7.2.2) and the limitations of this research (7.2.3).

7.1 Discussion of findings

To compare scores and provide an overview of findings, Figure 13 illustrates the overall scores for Amsterdam and Valencia’s urban resilience capacities.

Capacities for Resilience	Principles	Amsterdam - Current Situation	Amsterdam - Future Plans	Valencia - Current Situation	Valencia - Future Plans
Capacity to Prepare	Anticipation & Foresight	0	+	0	+
	Preparedness & Planning	0	+	-	+
	Homeostasis	0	0	-	0
Capacity to Absorb	Robustness & Buffering	+	+	-	0
	Diversity	0	+	0	0
	Redundancy	-	0	-	0
Capacity to Recover	Flatness	0	+	-	0
	High-Flux	0	0	0	0
Capacity to Adapt	Learning	+	+	0	+
	Flexibility	+	+	-	0
Capacity to Transform	Re-invention	0	0	-	0
	Reflexivity	+	+	0	+

Figure 13: Overall scoring for cities urban resilience capacities

For the most part, Amsterdam scores significantly better in terms of its overall resilience capacities compared to Valencia. Amsterdam’s attention and strengths lie with its **robust** and **flexible** planning, experience in adaptation (water and spatial), reputable intermediary (Rainproof), and some experience in successful local adaptation (even if at pioneering or pilot stage). These are all aspects that are currently lacking or not properly addressed in the city of Valencia which have hampered its current degree of urban resilience whilst also potentially jeopardising future plans.

There is significantly low awareness as to what adapting the urban environment entails and **anticipating, planning,** and working together (**homeostasis**) to *prepare* Valencia in the wake of worsening and uncertain climate threats (water and heat related). Amsterdam’s neutral capacity to *prepare* is attributed significantly to its experience, expertise, networks, and resources relating to

water adaptation, spatial awareness, and climate action (due to trigger events and its urgency previously) that provide a solid foundation and more opportunities to scale up knowledge and measures. This enables Amsterdam to be able to *absorb* disturbances and shocks and *recover* as a more integrated urban system compared to Valencia. However, concretising responsibilities and roles of urban stakeholders into implementable plans for more fluid interplay between public, private, and civil entities for localised adaptation appears to be lacking in both cities. This is why they each received a neutral score for the principle of **homeostasis**.

One noticeable deficit is that both cities struggle with the principle of **redundancy** currently, due to there still being questions as to the overlapping of functions and responsibilities for climate adaptation among urban stakeholders and between sectors which still requires more localised integration. There is significant **diversity** and collaboration between stakeholders in both cities (triple helix collaborations) with an active communication and sharing of adaptation expertise. However, without established implementation agendas or frameworks yet (underway) there are doubts as to the legitimate engagement and participation that lower-tier stakeholders can have in adapting their areas or neighbourhoods (besides pilot and experimentation projects through platforms like Rainproof, AMS, Las Naves, Climate KIC). Moreover, both cities have their own bottlenecks concerning their **re-invention**. Amsterdam's bottleneck is more tied to the traditional dependencies of its public institutions being responsible for water and spatial adaptation, while Valencia's revolves more around its lack of experience in delegating power and a sense of mistrust between civil and public entities (e.g. Ayuntamiento de Valencia & Las Naves).

The novelty of adaptation and resilience building on a national, regional, and local level in Spain has limited attempts at pursuing adaptation more holistically. Climate action has mainly been targeted at specific sectors (e.g. infrastructure, mobility, and energy sectors optimisation for emissions reduction) and prioritised mitigation measures. This is illustrated by the low – neutral capacity to *adapt* that Valencia has compared to Amsterdam that has considered territorial and urban adaptation to combat climatic (e.g. flooding, extreme rainfall) and socio-economic (e.g. increasing densification) issues for quite some time. However, it must be acknowledged that both cities have only recently adopted plans and strategies that explicitly target climate adaptation (Valencia in 2017 and Amsterdam in 2020) as the overarching objective locally. This illustrates a gradual shift towards adaptation and building resilience against more localised vulnerabilities and risks which holds potential in aiding the decentralisation of functions and responsibilities.

Future plans in terms of the capacity to *prepare* and *transform* for both cities look promising due to the national and regional urgency having trickled down considerably to the local/city level in the last couple years in terms of addressing climatic threats (e.g. heat, water) and social vulnerabilities (e.g. health vulnerabilities from climate and diseases). Commitments attempting to *transform* practices and actions among a **diversity** of urban stakeholders on a more local level hold potential in bolstering citizen and community engagement. However, the neutral scores for the capacity to *absorb* and *recover* for Valencia for future plans stem from the fact that while attention is gearing up to focus more on holistic climate adaptation, transforming urban systems and localising actions these capacities could be influenced by the lack of prior flexible, strategic, and resourceful planning in the city. The following subsections elaborate further on certain factors and mechanisms that potentially influence certain capacities or principles.

7.1.1 Low preparation levels due to low awareness and appropriation

A factor that was found to be a hampering mechanism in both cities was a low degree of awareness and appropriation of adaptation action. While climate action and adaptation in urban areas to combat persistent threats have taken place since the start of the 21st century, a holistic interpretation of climate adaptation in theory and practice is still novel across academic, institutional and community levels as alluded to by Meerow, Newell & Stults (2016). It was clear from interviewees and plans addressing climate adaptation in both Amsterdam and Valencia that local awareness is still low and limited due to the tailored scope and interpretation of what climate adaptation and resilience building means for each city (Interview 2, 6, 12, 16).

Low awareness is significantly conditioned, in both cities, by the urgency of local stresses and events. In Amsterdam, the urgency of adapting to water stresses has been and is quite pronounced due to the proximity and the vulnerability of the Netherlands to rising sea levels, flooding and extreme rainfall. Therefore, water adaptation has taken a prominent role in the city's spatial and urban development agenda because 'seeing stress elements in your daily work and life, it helps to get awareness that things are changing' (Interview 3). This has led awareness to focus on flooding and extreme rainfall, as well as having schemes and standards to tackle these climatic stresses, even though 'not everyone in the city can really act on it, as this sometimes needs more professional acting' (Interview 8).

On the other hand, Valencia has pursued emissions reduction more urgently due to the alignment of national and international agendas for climate action. Therefore, awareness and the focus has been on instances of 'installing a series of photovoltaic pergolas on public buildings, which in the end is a commitment to renewable energies, or installing electric vehicle chargers, which in the end means reducing CO2 emissions' (Interview 18). However, as noted by Interviewee 16, 'the agency of the individual has not improved, but the agency of certain groups and associations has improved' as it is a small segment of the city's population that is proactively engaged due to the narrowed and sectoral scope of climate and resilience actions presently.

Moreover, it seems that for both cities, the low awareness of citizen and city inhabitants is linked to the rather passive dissemination and elaboration of climate action and resilience building that can be taken by lower-tier stakeholders. This is in line with what Iturriza and colleagues (2020: 1) allude to, as 'even if plans have boosted new synergies and partnerships (e.g. public-private partnerships), they have failed to transform cities' passive behaviour towards climate change into proactive behaviour due to providing too abstract information far from daily activity'. This could be in part due to, as previously acknowledged in Sections 4.2.2 and 5.3.2, there are no national standards or aspirations for climate adaptation or resilience, which makes it harder to formulate comprehensive actions and measures. This is something that has been noted by previous studies, for instances Van den Ende, Hegger, & Mees' (2020) found similar findings during their research in the Utrecht city region.

Low awareness can also be attributed to the lack of a coherent climate adaptation plan in both cities until recently (Valencia in 2017, and Amsterdam in 2020) that enables a more explicit, holistic approach towards climate action across multiple themes and sectors. Climate change and adapting to it is a complex challenge that requires managing uncertainty and preparing for known, as well as unknown climatic scenarios (Intergovernmental Panel on Climate Change, 2018). While 'developing

awareness about climate change has proven to be key in the resilience building process, as it encourages partnerships and a transformation in behaviour,' if it does not filter to the lowest tiers, you are still targeting a very small proportion of the city's stakeholders (mainly public and private entities) (Iturriza et al., 2020: 1).

Lastly, the low awareness can be seen as hampering the actual engagement of citizens and communities of the cities. In Amsterdam, as pointed out by Interviewee 3 that works for the Gemeente, 'climate adaptation is more of a top-down programme in which we raise awareness and urgency for the topics of climate change and climate variability'. This corroborates with findings from Butler and colleagues (2015), whereby a top-down approach is appropriate for the dissemination of knowledge, expertise and raising of awareness to private and civil stakeholders. However, it hampers a considerable bottom-up engagement due to the centralized nature of implementable actions and measures (which as previously noted in both cases still require professional or other help than that of citizens). In both contexts, there is potential and a need to scale up the most successful innovations, whilst also building up the broader awareness and delegating tasks to lower-tier stakeholders to make them appropriate it more and make it feel like it is theirs (Interview 7, 12).

Demonstrations of best practices, through media campaigns and educating citizens (e.g. training, education curriculum, etc), have been outlined as good measures for raising awareness among citizens about urban climate adaptation and resilience building measures (Lenzholzer, et al. 2020). These types of demonstration of best practices localise the abstract ideas of urban climate interventions, which has been identified as crucial by a variety of scholars in relation to climate adaptation awareness in general (Wirth et al., 2014; Sheppard, 2015; Mees et al., 2018). Promoting and upscaling these efforts, as stipulated in both cities plans, has the potential to improve the reach of localised adaptation action and attempts at passing more practical avenues for involvement and engagement from citizens and communities.

7.1.2 Implementation gap hampering urban planning, re-invention, and transformation

A second mechanism that turned out to be hampering climate resilience in both cities is an implementation gap. In both cities, even if there are different levels of expertise, networks, technologies or know-how, there is still the issue of implementable agendas, plans and frameworks. These are important to coherently understand how to streamline climate adaptation and its integration into other sectors, policies and disciplines that are headed or governed by private or local governments. They will help in then being able to derive adequate responsibilities for lower-tier stakeholders (i.e., citizens, neighbourhoods, and citizen associations). This was voiced explicitly by interviewee 20: 'one of the gaps, especially in cities where they really need to deliver every day, is that they have a lack of implementation capacity'. In many way 'they don't know how to decide. And if there is anything connected to awareness about socio-technical systems or understanding of relations in the system that can help them to facilitate the decision-making process for the ongoing process, that is already policy and is actually very good policy' (Interview 20). Confusion as to how to act on climate adaptation on an internal level (those currently tasked with the management and development of urban areas) filters to the external level (urban system, its citizens, and inhabitants) and can be linked in part to the fragmentation that there is between sectors and urban stakeholders (Interview 6, 12, 18).

Implementable climate adaptation measures have been primarily carried out by local governments and private companies (public-private partnerships), with the consideration of expertise from academia and R&D institutes through triple helix collaborations within the cities (Interview 3, 8, 13, 18). Citizens and civil associations have been engaged through organisations such as Rainproof or Las Naves, but on a more experimental basis and demarcated scope which has limited the reach and awareness towards what can be done to tackle adaptation by lower-tier stakeholders (Missions Valencia, 2020; Interview 2, 8, 12). Furthermore, private entities hold significant power and influence regarding what is implemented within their areas. However, as noted by Interviewee 13: ‘without public support they (private entities) run up against administrative barriers, lack of licences, lack of permits, lack of support.’ Similarly, ‘without the private sector, it (the public) can't do it. It is left alone. Its voice has no echo, no impact. In other words, public-private collaboration is needed’ (Interview 13). Moving forward, the notion of having citizen, private and public entities onboard with urban innovation and adaptation is noted by Interviewee 3 from the Gemeente: ‘people are usually involved in the beginning of innovation. And if you don't take them with you, how can they implement it within their assignment, because they are the ones that help scale up. We are helping to create a foundation of scale’. Similarly in Valencia, plans centred around citizen and social innovation (Missions Valencia 2030, Agenda Urbana 2030) for adapting the city to climate stressors on a more localized scale through more public-private collaborations have the potential to address this gap.

The most useful tool (or approach) to address this gap involves the implementable agendas that are currently being developed through the vulnerability and stress tests, risk dialogues, and communication strategies between differing sectors for the *Strategy for Climate Adaptation Amsterdam 2050* and *Climate Adaptation Plan Valencia 2050*. This is echoed by Alves and colleagues (2019) as implementation agendas and frameworks for climate adaptation have the potential to provide more coherent measures and actions for differing stakeholders and aid the integration of climate adaptation policy into other domains. That is of utmost importance as ‘there is something in policy that is called implementation, and it's not just jumping into design and talking with ministries and long-term transformation but also about implementing programmes and actions’ (Interview 20). When we talk about policy ‘there is design, implementation, monitoring and so on. You can work with very small interventions or awareness exercises as part of the ongoing process of implementation, and that is doing policy’ (Interview 20). This approach at urban resilience and climate policy on a more localised level has the potential to contribute positively towards mainstreaming adaptation and resilience building actions, with an improved representation of urban stakeholders and sectors (e.g. their risks, vulnerabilities, and challenges).

7.1.3 Gentrification exacerbating equity and justice concerns

A third factor that was found to be a hampering mechanism in both cities was that increasing gentrification exacerbates equity and justice concerns. This is in line with what scholars, such as Meerow and Newell (2019) and Ziervogel and colleagues (2017), have alluded when it concerns building towards urban resilience. It is often critiqued for its conceptualisation being primarily rooted in engineering and ecological theories, with an inadequate tackling of politics and social elements (e.g. equity, justice). In Amsterdam, this was outlined by Interviewee 9: ‘there is a feeling social justice is forgotten about. In the transition towards renewables and adaptation, it's a prominent issue now.’ An example of what tends to happen in Amsterdam is that adaptation projects or measures are ‘too

expensive for poor people' (Interview 9). For instance, as expressed by Interviewee 9: 'Normally solar panels are only possible for people that own their houses, and people that own their houses are not poor people. These people are the ones paying less electricity. People allowed to retrofit are usually people that own their house. So, they are better off'. In cities this can be attributed to a few mechanisms which worsen or improve the situation: thick injustices, institutional capacities, and technocratic urban governance.

Thick injustices are rooted 'in historical processes and are a legacy of past plans or policies that continue to affect the participation opportunities, engagement, and outcomes of decisions surrounding land use planning and public services' (Hughes, 2013: 6). Amsterdam's tradition of water adaptation and the prominence of spatial adaptation for integrated urban planning have established a more robust land use in its metropolitan area (Lauwers, Ponteyn & Van Zanen, 2011). The opposite can be said for Valencia, that has had a tradition of construction and uncontrolled urban development, without a strategic vision like the one Amsterdam adopted in 2011. Amsterdam's vision was jointly devised through a period of consultation with city residents, social organisation, the private sector, and governing entities over a considerable period (three years). That being said, there are still questions as to the actual engagement of lower-tier stakeholders as over the last decade projects headed by citizens and neighbourhoods have still very much been at a pilot or pioneering stage (Interview 3, 4, 7).

Institutional capacities (elaborated on in 7.1.5) involve local governmental institutions often lacking the administrative, technical, or financial capacities to successfully develop and implement new policies and programmes (Hudson, Hunter & Peckham, 2019). This is of vital importance as 'urban institutions determine the access of individuals and groups to certain fundamental means towards many ends, such as particular kinds of power, statuses, and resources' (Moroni, 2020: 253). This is noticeable as Valencia's limited administrative and institutional capacities on a local level seem to have hampered its ability to formulate and implement measures in a timely (or efficient) manner on an internal level whilst also limiting the filtration of this to the external level (which is deemed as civil society and private) (Interview 15). In Amsterdam on the other hand, there is a sense that adaptation and urban development is a 'very public drive, where our state will take care of you. You can go to bed without stressing about this' (Interview 4). Therefore, the upkeep of urban functions and services has predominately been left in the hands of local governing bodies (Gemeente Amsterdam, Waternet), with experimentation and pilots being steered and targeted at specific neighbourhoods (e.g. Knowledge Mile Park, RESILIO, Rainproof standards). Therefore, there are traits of social exclusion when it comes to previous and current efforts at instilling adaptation and resilience building in areas that need it the most in both cities (more frequently in Valencia than Amsterdam).

Regarding technocratic governance in cities, the prominence of technical information in decision-making and policy formulation can marginalise groups that are either not familiar with, using or included by the information that has been disseminated (Evans, 2007). For example, it has been noted by scholars that ecological restoration and climate-proofing projects that rely mainly on environmental data, and exclude community needs and motivations in the implementation, often are more controversial and less successful (Eden & Tunstall, 2006; Sigmna & Elias, 2021). Sentiments echoed by these scholars are visible in Amsterdam and Valencia, as while they have made efforts to actively disseminate knowledge and insights on climate adaptation and resilience building initiatives

the scope and reach has been noted as having been particularly limited (Valencia more than Amsterdam) (Interview 2, 4, 12, 15). In Valencia, as expressed by Interviewees 11: 'people are not prepared at the level of language or to work in a different way when it comes to climate adaptation'. This is reinforced by Interviewee 15: 'it's a bit geeky to talk about things like nature-based solutions (NBS) or energy transition. People don't speak this language, but if you are able to transform the common language, the idea, then of course people understand it and people share it'.

Both cities should pay attention to the issues of redistribution, recognition, and participation during the development and implementation of climate adaptation measures, as alluded to by Fitzgibbons (2019), if any developments are to advance resilience building and justice simultaneously. This can come in the form of ensuring that technical materials are accessible and configured for use to those with limited understanding and technical skills (more generalised connotations), and more diverse sources of information included (especially localised stress insights and narratives). Additionally, these advances could be bolstered by giving greater consideration (or representation) to employees and homeowners for adaptation actions, as they also come under the sphere of citizens and civil society.

7.1.4 Recovery and re-invention conditioned by fragmentation from specialisation

Lastly, a factor that was found to be a hampering mechanism in both cities with regards to climate adaptation and resilience building is fragmentation, both internally and externally. Fragmentation in this case is what is described by several authors as the *anomic division of labour*, when increasing differentiation and specialisation leads to isolation, and eventually to alienation (Thomas & Katsberg, 2015). In the case of Valencia and Amsterdam, the urgencies that have steered their adaptation trajectories over time have slowly led to the specialisation of technologies, methods, or measures (Amsterdam involving water adaptation, Valencia emissions and mobility). However, now that plans and strategies are gearing towards more holistic climate adaptation and coherent implementation agendas (*Strategy for Climate Adaptation Amsterdam 2050 & Climate Adaptation Plan Valencia 2050*) there is a need to integrate expertise, enable cross-sectoral learning and increase the diversity of stakeholder. As mentioned clearly by Interviewee 2, in Amsterdam 'there is a need for topics like climate adaptation and sustainability to get off their islands'...'we need to start building more bridges between all these islands of sustainable topics'. Similarly for Valencia, Interviewee 18 from the Ayuntamiento noted 'when an adaptation or redevelopment project is led by a specific administrative body, let's say that the others find it difficult to do it or there is a lot of fragmentation because they think that with everything I have to do, I'm going to have to stop doing my own things to do something that really belongs to the City Council'.

Specialization does have the benefit of a significant level of expertise and technical know-how as to adaptation and climate-proofing in certain or between certain sectors which aids the preparedness and absorptive capacity of a city. For instance, Rainproof, Gemeente Amsterdam, and Waternet have displayed some experience with blending waterproofing principles with infrastructural projects, as well as neighbourhood renovations. Prime examples are the Rivierenbuurt and Bellamybuurt neighbourhoods of the city where sewage systems and public spaces were upgraded through a variety of measures (e.g. raised thresholds to direct rainwater towards a local square and temporarily held in specially excavated areas of vegetation and green) to shield vulnerable areas and recalibrate the layout of the neighbourhoods (Rainproof, 2021; Gemeente Amsterdam, 2020A). However,

fragmentation between sectors and stakeholder groups has a significant impact on efficient communication and planning urban spaces. This has also been noted in Amsterdam, by Interviewee 5, 'people don't communicate enough because also with like planting trees, suddenly there were trees planted in an area where we were supposed to do reconstruction and we were like, what are these trees doing here? And then it's a whole different project, of course, and nobody knows who's responsible'.

Specialization of different technologies (e.g. climate neutral, energy efficiency, blue-green infrastructure, green roofs, photovoltaic grids, etc.) has its benefits as it targets more specific sectoral developments, as previously noted with Amsterdam and its infrastructural, spatial and water adaptation. In Valencia, because of the specific focus of emission reductions to combat climate change the mobility and energy sector have been of prime focus for renewable and sustainable adaptation. As of recently, 'mobility is changing a lot in the city of Valencia with the pedestrianization and the network of bicycle lanes' (Interview 11). Additionally, infrastructural rehabilitation projects by Las Naves and INGENIO have ramped up, for example 'three carbon neutral energy districts in the North of the city' as well as the retrofitting of the energy grid for the main building of Las Naves close to the port (project called 'Las Naves Brillen') (Interview 13). However, much like Amsterdam, there is a need in Valencia to integrate expertise and know-how between sectors to develop a coherent framework (or implementation agenda) for coordinated action. Often 'it's difficult to achieve effective stakeholder engagement. I mean more people come to a meeting, but when you must go down to the ground and practicalities, sometimes they get left a bit on the sidelines' (alluding to citizens, associations, and NGOs) (Interview 18).

It has been noted by Interviewee 20, working at Climate KIC, that to 'different degrees Amsterdam and Valencia are already very mature in experience regarding advances in system-mapping and knowledge communities.' They have established knowledge-based economies and networks within the cities and internationally which provides a very good foundation for certain climate themes and adaptation technologies. However, certain scholars, such as Biesbroek (2014) and Thomassen and Kastberg (2015), have alluded to the fact that increased specialization of knowledge is a contributing factor of increased fragmentation, which is something noticeable in both cities in this study. Often organisations must streamline, focus their perspectives, strengthen their core, and redirect resources towards more specific targeted activities in order to obtain a competitive advantage, financial stability or market leads in a volatile urban environment (Thomassen & Kastberg, 2015). As more players and stakeholders enter, pressures on specialised and unique knowledge increase which could contribute towards more isolated work between many local organizations. This is what appears to be taking place in Amsterdam and Valencia (as well as in other EU cities).

7.1.5 Planning and adaptation influenced by institutional and administrative capacity

A factor hampering the adaptation and resilience building taking place in both cities, but in Valencia to a greater extent than Amsterdam, is the limited administrative and human resource capacities local government and public administrations have at their disposal or allocate. For instance, in Valencia, as noted by Interviewee 11, 'in terms of new planning. What we don't do is a review of any urban planning because it would collapse the administration even more. You could do a systematic review of all of them, that would be ideal, but it is not realistic'. While this is in part attributed to the limited

human resources funnelled towards adaptation and resilience in the city (Interview 11), it is also influenced by what are considered as *administrative traditions*. This is when there is a certain status quo and internal rules that prevent timely action, and which in return 'reinforce behavioural routines rather than facilitating flexible and innovative action' (Biesbroek, Peters, & Tosun, 2018: 777). This is in line with insights from Valencia, as you must be wary of the existing 'institutional inertia there is involving a limited tradition of approaching stakeholders only to extract information and then for others to make the decisions' (Interview 16). This further hampers the public administration's capacities to effectively pursue and push forward adaptation in the city, as it not only lacks resources but also does not proactively engage lower-tier stakeholders to help build the city's resilience.

The limited human resources in Valencia that are funnelled towards adaptation and resilience building by the public administration (local government and institutes) has influenced the significant dependency on EU projects and funding to carry out projects or research programmes locally (Interview 11, 12, 15). Valencia has benefitted from aligning its climate action with EU standards on emissions and energy efficiency, and focused adaptation measures along those lines and sectors. However, these institutional inertias and administrative traditions have led to adaptation policies and measures being perceived as 'lacking a certain willingness to experiment and innovate, and instead focus more on efficiency service delivery rather than creating the redundancy that may be necessary for successfully manage severe climate change-related challenges' (Biesbroek, Peters, & Tosun, 2018: 777).

In Amsterdam, rather than having limited administrative capacities, the issues revolve more around the prioritisation and delegation of funds and human resources. An example was given by Interviewee 9: 'I know that the city had to decide between quays and walls restoration or resilience. And 95% of the money went to quays and walls, because it's just how it goes. It's more urgent, some quays are starting to fall into the water, one of them did. So, it's very urgent to do that. And this is millions of euros they need to spend to fix it. So, it's just how it is. Its priorities.' These priorities in part reflect the urgency of water-related adaptation in the city, as well as the institutional inertia and 'infrastructure traditions that there have been in the Netherlands over the years' which in many ways have dictated the course of action for adaptation and resilience building (Interview 6).

The administrative and resource capacities to address water-related stresses, especially flooding, extreme rainfall and waterlogging, in Amsterdam have enabled there to have been significant research, experimentation and projects pursuing climate-proofing and resilience building developments. This is expressed by Interviewee 10, when saying 'Amsterdam has had the financial capacity to stimulate pilots and innovate. So, I'm happy that they're doing it if it leads to co-create answers and new frameworks and guidelines that are applicable.' The current administrative obstacle involves the upscaling of pilot projects and efforts, as well as the re-allocation of resources to different sectors according to their most pressing climatic vulnerabilities (water or heat related) which means a more complex network of stakeholders tackling adaptation and resilience in the city. This once again as mentioned in 7.1.2 could be significantly dependent on the implementation agendas being formulated.

7.1.6 Adaptive spatial planning enhancing Amsterdam's flexibility and robustness

A crucial factor that was found to be a stimulating mechanism in Amsterdam, bolstering its capacity to *absorb, recover, adapt, and transform* compared to Valencia's is its spatial planning, awareness, and vision. This is vital and in line with findings from Brunetta and colleagues (2019), whereby adaptation must be framed within the wider context of land use change and not just climate change alone to effectively build territorial resilience (extending from its core to peripheral areas). The formulation and adoption of the localised *Structural Vision Amsterdam 2040*, back in 2011, laid out a systematic allocation and planning of space, as well as budgeting, for the purpose of creating an integrated metropolitan area (Gemeente Amsterdam, 2021A). Expanding, densifying, and transforming Amsterdam's approach by intertwining the urban and natural spaces has greatly benefitted the city's capacities to allocate enough attention to areas such as water adaptation, greening and infrastructural networks (especially in mobility through electrification and cycling paths) (Gemeente Amsterdam, 2020A). This has further been aided on a national level as noted by Interviewee 4: 'Also on the national level, you have to I think it's called the spatial adaptation plan, for example. So also, adaptation has received much more attention and awareness in the last couple of years'. Additionally, the Delta Programme, whose focus has traditionally been more on water safety and freshwater, since 2014 has gradually shifted its focus more towards incorporating spatial adaptation, 'the process, the physical change process that's needed in cities, was put on the agenda' (Interview 8).

The spatial planning and expertise in the city have been able to accommodate adaptation and resilience building (relating to water and greening) measures and a mapping of the city's most vulnerable areas in its connected metropolitan area. With the city being 'in the low part of the Netherlands, it is often too wet or too dry, this is really a new part of climate adaptation for Amsterdam' (Interview 8). With a more holistic climate adaptation approach being implemented in the city it is important to be considerate and avoid technological lock-ins, the idea that the more a society adopts a certain technology, the more unlikely users are to switch to accommodate new ones (UNCTAD, 2020). This ties into remarks made previously in Section 7.1.4 with regards to specialisation and fragmentation.

Valencia on the other hand, has significant urban spatial lock-ins and a rigid planning vision. This is particularly attributed to the outdated nature of the *Urban Spatial Planning Act* (known as *Plan General de Ordenación Urbana* or *Plan General Estructural*) which has not been updated since 1988 (Ayuntamiento de Valencia, 1988). This was echoed by Interviewee 19, when saying this plan 'marks where you are going to put buildings, where you are not going to put buildings, where you are going to have gardens, where you are not going to have gardens. Where you are going to create, to leave this as an orchard, where you are not, and these are the things that have not changed since 1988.' Along with other acts and plans during that time on a national level (*Law regulating Land and Town Planning 175, Soil System Act and Ratings 1998*) they were in favour of making land available for development. This increased the price of land and housing whilst weakening planning as a regulatory tool and led to the further expansion of urban sprawl, often without accompanying services and infrastructure (Górgolas, 2019).

The legacy of unmonitored and unregulated construction for rapid urbanisation over the years has led to 'sectors of the city and neighbours fighting to recover spaces that are private but are more valuable as part of the green infrastructure because of their strategic location than as part of urban development projects like the ones that took place in the South of Valencia, which have been a complete disaster' (Interview 19). Furthermore, Valencia has neglected the spatial planning required to accommodate a more holistic approach towards adaptation and building with its surrounding natural areas (L'Horta and the Albufera) which is only now starting to filter into the proposed plans and strategies (Interview 11, 18). Therefore, there is a lot of work to be done on a planning and a spatial adaptation level in Valencia to accommodate measures for climate adaptation and resilience building for the entirety of its metropolitan area.

7.1.7 Enhancing adaptive and transformative approach through resilience intermediaries

Finally, a factor that was found to be a stimulating mechanism in both cities involves the presence of and work done by intermediaries to bolster local adaptation and resilience building efforts. As regards Las Naves and Rainproof, the fact is that these two intermediaries or mediators are involved in proactively engaging stakeholders, carrying out pilot projects, and experimenting with climate-proofing innovation making them considerably important assets in the cities. Rainproof has been a lot more tailored towards water proofing, adaptive management, and resilience building around water risks (Rainproof, 2021; Gemeente Amsterdam, 2020A). Las Naves on the other hand has been more focused on addressing emission reduction in targeted sectors (mobility and energy) and mobilising social innovation to combat climate change instead of a stronger focus on water and heat stresses to the city (Interview 16, 17). Scholars such as Anenberg and colleagues (2020) have noted that dealing with emissions and air pollution is interlinked with heat and health related risks, but there is still a need for a holistic climate adaptation approach in Valencia. This is alluded to by Interviewee 11: 'we have a fair, if not a bad record with the mitigation part, which is the most visible part to everyone (for example electric vehicles, energy efficiency, and so on). Even weaker has been our work on adaptation which is poorly focused'.

At the end of the day, these organisations are extensions of their respective city councils when it comes to more bottom-up, social innovation concerning climate adaptation and resilience building, due to them being directly connected administratively to the local government or directly financed by them (Interview 6, 8, 11, 12). However, a significant difference between the two is that Rainproof has managed to develop principles (standards) for water proofing and resilience building (along with guidelines) which have been adopted by the Gemeente and Waternet for ongoing retrofitting or new infrastructural projects in the city (Rainproof 2021; Interview 2, 4). This means the institutionalisation of a standard formulated with the engagement of private and civil stakeholders has taken shape in the city. This is vital as expressed by Interviewee 3 from the Gemeente: 'as the government or the local government, I am not looking for an innovation. I'm looking for new standards or new criteria so I can make new policy and put it in my procurement requirements. I can scale up by measurement or knowledge institutes and the new knowledge, about having more students, more awareness, having it more publicized.'

These two organisations in many ways function as intermediary networks which, as alluded to by Kivimaa and colleagues (2019) and Gustafsson and Mignon (2020), aggregate expertise and foster

learning horizontally across varying contexts (e.g. governmental branches, social perspectives, or geographical spaces), or vertically whilst also offering help, support to build capacities and connect levels of governance. It is not until these networks can develop concrete, localised standards and frameworks that filter into and are appropriated by the internal level of local governments, that you start seeing the validity and the credibility these organisations have as proactive disseminators and facilitators for climate adaptation. The recognition of these organisations and their forecasted upscaling, with Rainproof branching out to other climatic threats and Las Naves playing a leadership role in *Missions Valencia 2030*, have the potential to strengthen their contributions towards implementing and monitoring more holistic climate adaptation measures.

7.2. Reflection on research and analytical approach in relation to existing literature

This section reflects on the operationalisation and analytical framework, as well as on the usability of the resilience capacities framework. It must be acknowledged that there are different approaches in literature to study urban climate adaptation, with those taking a resilience angle or perspective representing but a part of the whole. There are those that approach it by means of mainstreaming mitigation and adaptation in policy and sectors to improve national, regional, and local efforts towards climate-proofing and safeguarding areas (Runhaar et al., 2018). This is either through the integration of mitigation and adaptation objectives into existing policies or through separate policy dedicated to them. Others approach urban adaptation through the interactions that citizens have with their cities in terms of co-production, co-creation, and cross-learning for adaptation and more decentralised bottom-up actions (Wamsler & Riggers, 2018; Mees et al., 2019). The current multi-disciplined nature of urban development and adaptation leaves a significant need for more holistic and system-based approaches towards evaluating and diagnosing cities' vulnerabilities (both climatic and socio-economic).

Taking a resilience perspective and approach has been useful in attempting to combine socio-ecological and socio-technical elements and enabling a comprehensive overview of the interconnectedness in urban systems (Meerow et al., 2016). Furthermore, resilience is a helpful concept to frame scientific, social, and political discourses in cities and aid in paving the way for cross-sectoral urban strategies (Crichton, Ramsay, & Kelly, 2009; Yamagata & Sharifi, 2018). Regarding Wardekker and colleagues (2020), designating urban resilience according to capacities helped to systematically categorise and subsequently diagnose the areas where the cities displayed deficits or strengths. In many ways the capacities could be interpreted in a sequential format, whereby they each have a fall-on-effect on the next until finishing the cycle (e.g. preparedness influencing the degree of absorption and recovery the city has towards certain climatic and socio-economic stresses before needing to adapt and transform once more). This meshes with the fact that an evolutionary conception of resilience was adopted in this study rather than one embodying traits of 'bouncing back' (Davoudi et al., 2012; Chelleri et al., 2015), and potentially illustrates how resilience entails continuous change and transformations for improvements in urban systems.

7.2.1 Reflection on Social Resilience Operationalisation

After the development and operationalisation of the urban resilience capacities framework with a greater representation of social resilience elements in Chapter 3, the insights and results from

Chapters 4, 5, and 6 indicate that, for the most part, the framework and operationalisation of criteria was applicable for diagnosing Amsterdam and Valencia's resilience capacities, and outline strengths and deficits. However, a few recalibrations to the operationalised framework can be recommended and concretised for future research, with an altered framework illustrating these modifications included in Appendix 5 (revised framework after empirical confrontation).

As concerns climate adaptation and resilience building in both cities, cross-sectoral expertise, and co-creation of standards or guidelines is of vital importance for developing a stronger capacity to *prepare* and *plan* for the uncertain climate and socio-economic future. The *legitimate* participation of citizens and community stakeholders is hampered by the lack of cross-sectoral expertise and integration that is currently needed (and is under way) to develop coherent implementation agendas for localised action (i.e., making actions more practical rather than leaving them abstract). Future use of such an assessment framework would benefit from revising the implementation agendas that are developed in the cities' climate adaptation plans, along with interviews with the stakeholders involved.

In plans and interviews for both cities, there was a substantial emphasis on the role that communities and citizens have in a more decentralised and bottom-up approach for climate action and resilience, but also on the role of private individuals and companies in adaptation. Private organisations and businesses make up a considerable amount of the physical urban land and are therefore the ones that dictate the measures and requirements in place for development in these areas. Prioritising adaptation requirements and actions in public-private collaborations, and their upscaling hold the potential to bolster adaptation measures (e.g. blue-green infrastructure, NBS, energy efficiency, renewables, and electrification) and continue diversifying efforts in a wider spatial area than there currently is in both cities (for enhanced *flexibility*). This element was not covered in depth for this study but would be viable for future research through a targeted study into specific sectors or private organisations and an assessment of their influence on the resilience of the city where they operate.

Improving the awareness that lower-tier stakeholders have on how to contribute towards climate adaptation and resilience is highlighted in both contexts. The low awareness was already discussed in 7.1.1 and would benefit greatly from the strengthening of established networks (e.g. Rainproof and Las Naves) and cross-sectoral interplay to increase the communication of localised vulnerabilities and risks (climatic and sectoral ones). Communication and raising awareness should no longer be confined to the dissemination of knowledge but geared more towards engagement and appropriation of knowledge. Appropriation of climate adaptation expertise and responsibilities by local communities is important for more proactive citizen involvement and engagement. This would improve *preparedness and planning* of the urban setting and contribute towards more collective *recovery* and innovative *re-inventions* of administrative and social traditions.

Ensuring a greater *diversity* of stakeholder and sectors in the planning and implementation of adaptation seems to penetrate most of the framework's capacities. As mentioned previously, more legitimate participation has the potential to enhance the exchange of expertise, knowledge, and functions, leading to more instances of co-creation of measures which bolsters the *absorptive* capacity of a city. However, the increased *diversity* of urban stakeholders needs to be accommodated systematically and the exchanges that take place to culminate in prioritised and designated actions

for more localised and autonomous efforts to *recover* and *adapt* for all entities (public, private, and civil).

The spatial integration of natural and urban landscapes was noted by interviewees as an important element for climate adaptation planning and resilience building (especially territorial resilience) and influences the *absorptive* and *adaptive* capacity of the city. The plans and actions taken by Amsterdam so far involved considerable attention to intertwining urban sprawl with the surrounding natural area. Those for Valencia on the other hand have to a significant extent ignored the surrounding natural areas and lack an integrated spatial vision of its metropolitan area. This is important for the maintenance of local ecosystem services and natural functions, which enhances *homeostasis* and *flexibility* of the surrounding area. A balance between green and built-up land area is evident in Amsterdam for accommodating both water and heat related threats, whilst lacking in Valencia and leaving room for improvement.

As mentioned previously (in 2.1.2), incorporating and understanding the social elements within urban resilience and governance is considered important to highlight how working closely with citizens and communities enables more transformative developments in terms of building resilience and withstanding uncertain climatic and socio-economic stresses (Sharifi et al., 2017; Wamsler & Riggers, 2018; Mattijssen et al., 2019). It must be noted that incorporating a transformative capacity into the original framework was done not only due to it being mentioned in social resilience literature but also because it came up in discussions with Arjan Wardekker during the initial and final stage of my study. The addition of this capacity attempted to represent the key principles of *re-invention* and *reflexibility* that contribute towards transforming systems and behaviour. From the findings of the study it can be noted that these two principles apply just as much to public and civil entities as they do to private ones. While it is clearer that reflective and innovative processes are being investigated and promoted by local governments (Gemeente Amsterdam & Ayuntamiento de Valencia), public entities (Rainproof & Las Naves) and civil organisations in Amsterdam and Valencia, it is less clear as to the extent that this is being done by the private sector which poses issues relating to *preparedness and planning* in the future.

In sum, a holistic approach to resilience ‘involves considering not only environmental and infrastructure risks, but social and societal risks too.’ (Martin-Moreau & Ménascé, 2018: 11). Wardekker and colleagues (2020: 11) expressed how the ‘capacity to co-operate and coordinate resilience actions between city departments, different stakeholders and citizens in making choices on resilience is a key aspect of urban resilience’. Therefore, a social scope was warranted to attempt to shed light on ways of diagnosing what is being done (and is planned) to localise vulnerabilities and delegate responsibilities adequately with consideration of social, ecological and technical elements collectively.

7.2.2 Reflection on the Urban Resilience Capacities Framework

Operationalising urban resilience into various capacities, and their respective pathways based on current situation and future plans has been useful in diagnosing the different capacities and their interaction. It does what Wardekker and others (2020: 11) intended it to do, which is act ‘not as a resilience assessment or standardised resilience scores, but instead make the choices regarding

resilience principles transparent and more explicit to enable informed choices on which principles seem to matter most for the local experts and stakeholders.’ The distinction between current situation and future plans made it possible to differentiate between focuses and priorities in plans, strategies and policies over time, which illustrates what each context has been conditioned by and where they are attempting to go. It must be acknowledged that while numerous plans and strategies examined mitigation and adaptation in Amsterdam and Valencia, as of now there are no explicit and concrete resilience plans or strategies in place locally (noted previously in Section 4.3).

There are some interesting elements of the framework to be considered in the future. Firstly, the sequential nature of the capacities (mentioned in 7.2). In many ways, the *learning, reflexivity, and re-invention* that is harnessed in the adaptive and transformative capacities funnels back to the *preparedness* and *planning* capacity. This could come in the form of localised vulnerabilities, stakeholders’ networks, standards, and implementable action plans filtering into new planning and goals. Secondly, the cascading effect of measures. For instance, the active implementation of knowledge and expertise into *preparatory* actions bolsters *homeostasis* which in return has an impact on the degree of absorption and recovery (e.g. NBS filtering into spatial and infrastructural planning for improved recovery with a greater integration of functions and stakeholders). Thirdly, the interdependencies between principles is important but the complexity of capacities and principles does not enable links or inter-connections (or overlaps) to be seen clearly. This limits the understanding of urban resilience as a systems approach, as the urban system and its linkages are not as noticeable (Van Aswegen, Drewes & Van der Linde, 2020). Additionally, this is reflected by the sometimes-overwhelming operationalisation criteria incorporated for the purpose of diagnosing urban resilience through capacities.

Urban resilience as a concept is still considerably abstract and complex for many to grasp in decision-making spheres, among academics and the public (Meerow, Newell & Stults, 2016). The concept is increasingly shifting from its ecological roots to embody more socio-ecological-technical components to better understand the urban setting (Van der Leer, Timmeren, & Wandl, 2018). The urban resilience framework attempts to diagnose and categorise resilience capacities to allow for more practical interpretations of everyday needs and prioritisation from a rather complex system (which in this case is the city). While this could be considered a simplification of a complex system, it attempts to make it more manageable whilst contributing towards learning and planning for resilience which is still scarce in urban planning due to the limited implementable plans and policies (Coaffee & Clarke, 2015; Salizzoni et al., 2020). There are trade-offs to be made with the use of resilience, with it being an important holistic perspective for tackling complex system issues whilst also being able to be demarcated and reduced for more practical uses (and extrapolation of insights). Some scholars have also noted how one major challenge for practitioners is explicitly injecting values and navigating trade-offs in resilience between groups, timescales, and locations (Tanner, Bahadur & Moench, 2017). This is often due to the broad nature of frameworks and indices for resilience that have still not trickled down or been condensed to more local levels where they can be acted upon more effectively (Amaratunga et al., 2019).

What is illustrated through this framework is how resilience is ‘a cycle rather than just a post-disaster reduction stage, which considers not only environmental and infrastructure risks, but social and societal risks’ (Martin-Moreau & Ménascé, 2018: 11). There is continuous learning, integration,

communication, and recalibration needed to enable an urban area to adapt and transform in the wake of increasing uncertainty (both climatic and socio-economic). Within cities, place-based governance approaches are vital to facilitate the integration of local knowledge, overview local vulnerabilities and develop inspiring narratives to help boost that sense of place and appropriation of urban threats by local citizens to enable transformations (Hölscher & Frantzeskaki, 2021). The focus should be placed more on prioritising actions and transforming governance than debating resilience goals and policy as these are still lofty and abstract in nature (Interview 20). As emphasised by Interviewee 20: ‘when you get dirty in policy, there’s something that is called implementation, and researchers always think that working with policy is helping the national ministries to change the policy for the next 50 years. It doesn’t work like that, like a policy solves implementation.’ Therefore, climate adaptation and resilience building should be a result of a transformative, localised and integrated governance approach in a city rather than being considered on its own, in an isolated policy domain.

7.2.3 Validity of Research and Limitations

All in all, the internal validity of the study can be deemed as moderate. This is because if the analytical framework were to be used with a greater representation of urban stakeholders and a more explicit compilation of adaptation and resilience plans (currently limited for both cities but work is underway to produce such localised plans) similar results and messages would be obtained. Expanding the number of interviews and specifically incorporating a greater representation of private entities would benefit future attempts at applying the analytical framework utilised due to the pivotal role private individual and entities have in climate adaptation and resilience building. Furthermore, the moderate internal validity is attributed to data saturation not having been reached in this study, interviewees bringing up new issues that could influence the cities’ resilience in the future, and this study not having covered all aspects of the topic sufficiently.

It is important to note that this study is an initial attempt at merging social and urban resilience literature and capacities through a modified framework. That being said, as outlined in Chapter 2, social and urban resilience capacities from existing literature have been noted to overlap and complement each other to enable a more holistic assessment of urban dynamics and governance. It must be acknowledged that COVID has influenced the data collection process and research as having no face-to-face interaction with the interviewees acted in some ways as a barrier for fluid and natural conversations. While face-to-face interviews would have enabled more open discussion surrounding urban resilience and climate adaptation, had the interviews been carried out in person that would have posed even more constraints on time and resources due to case study locations being in two different countries.

While Amsterdam and Valencia represent specific cases and trajectories, the insights and discussion points relating to their resilience capacities from Chapters 5, 6, and 7 could be applicable on a broader scale, thus enhancing this study’s external validity. Firstly, bridging social and urban resilience could help better understand the holistic nature of climate adaptation and building resilience, not only to multiple climate threats but also for the well-being of stakeholders which is slowly becoming more prominent in urban policy and practice. Secondly, there could be better understanding and consideration of the contextual differences that condition approaches in cities, but that all steer towards the same objective of integrated and resilient urban areas in the future. Lastly, understanding

of the relationship between urban resilience and transformative urban governance could be enhanced.

However, a noticeable limitation is that the evaluation of over 24 urban resilience principles (12 per city) was quite overwhelming in the timeframe and boundaries of a thesis of this nature. Therefore, there is some loss in utility of the framework due to the extensive resources and time needed to compile, process, and analyse the insights gathered (Wardekker, et al., 2020). Demarcating the operationalised criteria to just a couple that best represent the principle (meaning 2 instead of 3 or 4) would help synthesise the framework further. Furthermore, to help readers and interviewees better interpret what the urban resilience capacities entail, it would be good to visualise and present them in a cyclical manner as shown in Appendix 6. This would help clear up doubts as to how these capacities feed into each other and act as a continuous cycle through which resilience in urban areas is developed.

As acknowledged at the start of this section, if this study were to be repeated with a greater representation of private organisations and interviewees, the results would be more representative than they are currently due to the focus having been more on public, academic and civil organisations. This more limited representation resulted from this being a 30-credit thesis where there were time and resource constraints that hampered the ability to conduct a more in-depth study. Attempts were made to compensate for this by including a variety of interviews (20) with stakeholders involved in the triple helix collaborations of each city (local government, private entities, and R&D institutes) as well as various plans and strategy documents. However, the demarcated focus on these stakeholders could have led to biased responses. Furthermore, while there was a pronounced focus on citizens and communities, their representation in the interviews was limited due to COVID and to a limited number of responses from civil organisations. This was compensated by the document analysis and the embedded focus of organisations like Rainproof and Las Naves which are on the frontline when it comes to citizen interactions with administrative bodies for adaptation and innovation in the cities. Future research with a broader incorporation of these stakeholders would be beneficial but would add to the complexity of managing and planning more localised adaptation measures.

Wardekker and others (2020) urban resilience capacities framework was useful in outlining negative and positive feedbacks for the urban systems in these cities. While the study could have been focused more on a particular climate threat or area of the cities for a more profound study, it 'can be applied at a general, holistic level (all-round resilience, city scale, or specified per topic and/or neighbourhood)' (Wadekker et al., 2020: 12). This was beneficial as it permitted a broader focus on city resilience, even though there is the possibility that *trimming or reducing* the complexity of urban resilience can be beneficial for more targeted diagnosis of specific sectors (which would be beneficial for more concrete insights and measures). This was mentioned by several interviewees who were overwhelmed by the extensive nature of the framework and its details, suggesting its application would be more viable on a sector basis to diagnose implementable measures and progress within those boundaries. That being said, the case studies showed that the framework is viable to diagnose the strategic choices that have been made in the past and the plans in place. Discussions on the nature of these choices and prioritisation, and their implications were possible which shed light on certain urban mechanisms and factors that enhance or hamper a holistic pursuit of adaptation and resilience in the cities.

8. Conclusion and recommendations

8.1 Conclusion

Climatic conditions are becoming increasingly uncertain and extreme in cities and urban areas around the EU. Adapting and building resilience is attracting greater attention within cities but there is a need to better understand and assess citizen-city interactions, and ways in which to bolster engagement for a more coordinated pursuit of urban resilience among all relevant parties. This research attempted to address this knowledge gap and contribute to this discourse by answering the main research question - *How resilient are Amsterdam and Valencia, and what governance strategies can enhance their resilience with a greater engagement of communities and citizens?* This study attempted to evaluate the urban resilience of Amsterdam and Valencia by turning to capacities, as developed and operationalised in Chapter 2. The framework conceptualising urban resilience capacities (capacity to prepare, absorb, recover, and adapt) was modified and operationalised to embody more social resilience and transformative elements through an overview of strategies, literature, and documents (from Chapter 2 & 4). The modified framework was utilised in Chapter 5 and 6 to analyse and score the urban resilience capacities that Amsterdam and Valencia display towards persistent climate threats.

From the findings (Chapters 5 & 6) and their discussion (Chapter 7) it can be said that Amsterdam has demonstrated to be more resilient than Valencia towards uncertain climate threats, both currently and potentially in the future. From these chapters, some factors have been found that contribute towards Amsterdam and Valencia's degree of resilience. Firstly, their adaptation and resilience emphasis. Amsterdam's resilience emphasis is on its capacity to *prepare, adapt* and *transform*. Experience in cross-sectoral cooperation in spatial and water adaptation, risk management relating to water stresses (flooding and extreme rainfall) and an extensive network of urban expertise and stakeholders has contributed towards more instances of coordinated planning. On the other hand, Valencia's resilience emphasis is particularly hard to pinpoint but would be currently its capacity to *transform* as it seems to have emphasised climate action, innovation, and mitigation across several sectors (mobility and infrastructure) previously. However, it has a poor track record of adaptive spatial planning, administrative and institutional capacities, and experience in adaptation measures on a more localised level. What also influences each of these deficits is the overarching lack of awareness of climate adaptation towards both water and heat related stresses.

Secondly, having prior experience in planning and preparing towards uncertain climate and socio-economic futures contributes significantly towards resilience building efforts. Amsterdam, and the Netherlands in general, have dedicated a considerable amount of time, funds, expertise, and resources into pursuing adaptive approaches in their spatial and water planning. This urgency to adapt stems from the country's historic vulnerabilities to water (flooding and downpours) and attempts at reclaiming land area for developmental purposes (as expressed in 4.1.1). This in many ways distilled adaptive traits institutionally and structurally before the term 'climate adaptation' and 'resilience thinking' became more prominent among policymakers and practitioners in recent decades. Valencia, and Spain in general, still lag in understanding and interpreting what it means to plan and adapt local cities and territories to climatic and socio-economic trends. Their knowledge and insights on adaptation and resilience have been significantly conditioned by external information

through collaborations with the EU and international organisations, with a noticeable lack of more local conceptualisation and assessment of vulnerabilities.

Thirdly, intermediaries play an important role in bolstering adaptation and resilience thinking on a localised level. Local governments in Amsterdam and Valencia have designated and rely on resilience intermediaries or mediators to promote and propel local adaptation. Rainproof in Amsterdam provides a platform that continuously works to bring together public, private, and civil entities for the collective formulation and implementation of waterproofing projects in the city. Similarly, Las Naves focuses on bridging urban stakeholders to co-produce social and urban innovative solutions for more localised action. However, while there is potential for Rainproof's consolidated network of expertise to upscale and branch out to other climatic stresses and urban areas, Las Naves still has work to do in expanding its reach and building up trust with citizens and communities.

Fourthly, one of the key messages in this study is that even if Amsterdam has more experience in adapting its urban area compared to Valencia, both cities struggle with the legitimate engagement of citizens and communities. This is due to a lack or vagueness of actionable measures and awareness (in the form of appropriation and to some degree ownership) of the holistic nature of adaptation in urban settings (as expressed in 7.1.1 & 7.1.2). This confirms notions that citizen involvement and engagement locally is important for resilience building but that there is still room for improvements in both contexts. Each city has pledged to boost more inclusive and bottom-up adaptation efforts and has commenced the integration of sectors (as well as stakeholders). However, the lack of implementable agendas to address this constitutes an important bottleneck for transforming urban governance and facilitating citizen-city interactions.

Lastly, plans and interviewees in both cities have emphasised the power that private entities have in bolstering local adaptation and resilience building alongside public and civil entities. In Amsterdam and Valencia, public-private partnerships and interactions appear to have historically contributed to the course of action and those tasked with adaptation efforts (i.e., the state and companies will take care of you). To integrate and develop cities around the needs of citizens (as committed to in plans) greater interplay between not only public administrations and citizens but also citizens and private companies need to take place.

In sum, this study has contributed to the existing literature base on urban climate governance and resilience thinking. Bridging urban and social resilience elements in this paper's analytical approach has helped to illustrate an evolutionary perception of resilience building in cities (as expressed in 2.1.2 and 7.2). This is reinforced by the potential sequential (or cyclical) nature of the urban resilience capacities assessed for Amsterdam and Valencia. Scoring and discussing findings (in Chapter 7) relating to instances of mainstreaming, integration, and citizen-led adaptation contribute towards better comprehending how to collectively intervene to confront climatic and social uncertainties in cities. Now more than ever, tackling these uncertainties requires sectors and stakeholders to play their part and learn how to work together in cities to improve their contributions towards improving climate action rather than exacerbating it further in the future.

8.1 Policy and practical recommendations

Some key recommendations can be made regarding factors and mechanisms that potentially contribute towards more collective urban adaptation and resilience, with adequate representation and engagement of citizens as well as private and public entities.

Firstly, the need for **implementation agendas and standards** that integrate local sectoral and stakeholder vulnerabilities. As previously acknowledged, local vulnerabilities of stakeholders and sectors towards climatic threats (water and heat related), along with risk dialogues and communication strategies should filter into implementation agendas for more actionable measures and legitimate engagement opportunities for all relevant stakeholders identified. This could help address the implementation gap (Section 7.1.2), enhance awareness in terms of actual appropriation of knowledge and responsibilities (Section 7.1.1) and strengthen the role of intermediaries (Section 7.1.7) which could all contribute to more localised action by lower-tier stakeholders (citizens, neighbourhoods, house owners). The purpose of the implementation agenda should be to provide a blueprint for the coupling of adaptation measures with local vulnerabilities and potentially lead to less confusion and barriers for engagement in transforming the urban systems in the coming years. Assessing and monitoring the climate adaptation implementation agendas devised in the coming months (or year) for both cities will be crucial.

Secondly, **resilience intermediary organisations**, in this case Rainproof and Las Naves, play a facilitative role that local governments cannot currently uphold due to administrative and institutional constraints (Section 7.1.5). The role that resilience intermediaries have within the city (Rainproof and Las Naves) is vital to help integrate levels of urban governance (local administration, private business and civil society) and continue contributing towards improving the coordination of adaptation and resilience projects (as well as their upscaling). These organisations hold potential in aiding the decentralisation of actions and contribute towards transformative urban governance through more instances of co-creation and genuine opportunities for engagement from all urban stakeholders in climate adaptation and resilience building. While both Rainproof and Las Naves have the chance to upscale projects and initiatives, Las Naves must still overcome issues of trust which could be improved with its vital role in leading and coordinating upcoming missions, as well as increased support from the public administration.

Lastly, prioritising the **legitimate involvement of not only citizens but also urban sectors** (e.g. infrastructure, mobility, etc) and **private companies** (e.g. housing companies, private households) in adaptation efforts and assessing their contributions accordingly through resilience assessment frameworks is vital. The increasing urban land space that is managed by private entities in cities requires a more active appropriation of resilient measures and solutions from their part, as the reach of local administrations extends only up to public spaces. Everyday citizens quite often do not have the ability to participate (Section 7.1.3) or get involved. This is due to, for instances, them being tenants and renting which leaves them with limited or no say in modifying their households (responsibility and power lies with the housing agency) or not having control over their energy use (headed by a private energy company). Therefore, adequately integrating sectoral priorities and climatic vulnerabilities with those of citizens and public entities is important for a more holistic and well-rounded approach, which is why cities are consolidating their related implementation agendas.

9. References

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10. Appendix

Appendix 1: Interviewees for Qualitative Data Collection

Amsterdam	Valencia
1. Jannes Willem (UvA)	1. Tomas Gomez (UPV)
2. Paulien Hartog (Waternet)	2. Emilio Servera (VIU/Las Naves)
3. Anne Jet Niermeijer (Knowledge Mile Park/Twenty50)	3. Francisca Hipólito (Grow Green/Las Naves)
4. Roos van Maanen (Amsterdam Green Campus)	4. Sergio Segura (INGENIO)
5. Lisette Hejke (Amsterdam RainProof)	5. Ernesto Faubel-Cubells (Ayuntamiento de Valencia)
6. Mendel Giezen (UvA)	6. Javier Mateo Garcia (Valencia Activa)
7. Sacha Stolp (Gemeente Amsterdam)	7. Jose Ignacio LaComba (Ayuntamiento de Valencia)
8. Caroline van der Kooi (Balance/Gemeente Amsterdam)	8. Celsa Monrós (Regional Ministry of Agriculture, Rural Development, Climate Emergency and Ecological Transition)
9. Savitri Groag (Climate KIC)	9. Josep Gavalda (Per L'Horta)
10. Raphael Klein (AMS institute)	10. Christian Matti (Climate KIC)

Appendix 2: Map of metropolitan area of Valencia



(Source: Gómez et al., 2011)

Appendix 3: Amsterdam adaptation stakeholder categorisation for local, regional, and national scale

Selection criteria	Local	Regional	National - International
Functional	<ul style="list-style-type: none"> ▪ Gemeente Amsterdam ▪ Gemeente Vervoerbedrijf ▪ Regional Water Authority (Waterschap amstel gooi en vecht or Waternet) ▪ Private companies and businesses ▪ Insurance Companies (e.g. Ansva Insurance Company N.V) ▪ Citizens and neighborhoods ▪ Energy, building and construction (e.g. Vattenfall, Budget Energie) 	<ul style="list-style-type: none"> ▪ Regional Water Authority (Waterschap amstel gooi en vecht or Waternet) ▪ Gemeente Amsterdam ▪ Amsterdam Metropolitan Area (AMA) ▪ Association of Netherlands Municipalities (VNG) (<i>Vereniging van Nederlandse Gemeenten</i>) ▪ Rijkswaterstaat (Directorate General for Public Works and Water Management) 	<ul style="list-style-type: none"> ▪ Ministry of Infrastructure and Water Management (Ministerie van Infrastructuur en Waterstaat) ▪ Ministry of Economic Affairs and Climate Policy (Ministerie van Economische Zaken en Klimaat) ▪ Association of Netherlands Municipalities (VNG) (<i>Vereniging van Nederlandse Gemeenten</i>) ▪ Ministry of the Interior and Kingdom Relations (<i>Ministerie van Binnenlandse Zaken en Koninkrijksrelaties</i>) ▪ Dutch Water Authorities (Unie van Waterschappen)
Geographical location	<ul style="list-style-type: none"> ▪ Gemeente Amsterdam ▪ Vulnerable groups and neighbourhoods ▪ Property owners ▪ Citizens ▪ Private companies and businesses ▪ Amsterdam Rainproof 	<ul style="list-style-type: none"> ▪ Royal Netherlands Meteorological Institute (KNMI) ▪ Regional Water Authority (Waterschap amstel gooi en vecht or Waternet) ▪ KWR Water Research Institute 	<ul style="list-style-type: none"> ▪ KWR Water Research Institute ▪ Ministry of Infrastructure and Water Management (Ministerie van Infrastructuur en Waterstaat) ▪ Royal Netherlands Meteorological Institute (KNMI)
Knowledge & Abilities	<ul style="list-style-type: none"> ▪ Amsterdam Institute for Advanced Metropolitan Solutions (AMS) ▪ Amsterdam Green Campus ▪ Amsterdam Rainproof ▪ Amsterdam Smart City ▪ Neighbourhood Associations (e.g. Knowledge Mile Park) ▪ Citizens 	<ul style="list-style-type: none"> ▪ University of Applied Sciences (Hogeschool van Amsterdam) ▪ University of Amsterdam (UvA) ▪ Private consultancies (e.g. Sweco and Balance) 	<ul style="list-style-type: none"> ▪ Royal Netherlands Meteorological Institute (KNMI) ▪ PBL Netherlands Environmental Assessment Agency ▪ IPCC ▪ Climate KIC ▪ Ministry of Infrastructure and Water Management (Ministerie van Infrastructuur en Waterstaat)
Hierarchical level	<ul style="list-style-type: none"> ▪ Gemeente Amsterdam ▪ Waternet ▪ Private individuals 	<ul style="list-style-type: none"> ▪ Regional Water Authority (Waterschap amstel gooi en vecht) ▪ Association of Netherlands Municipalities (VNG) (<i>Vereniging van Nederlandse Gemeenten</i>) 	<ul style="list-style-type: none"> ▪ Ministry of Infrastructure and Water Management (Ministerie van Infrastructuur en Waterstaat) ▪ Ministry of Economic Affairs and Climate Policy (Ministerie van Economische Zaken en Klimaat) ▪ EU policy and guidelines

Appendix 4: Valencia adaptation stakeholder categorisation for local, regional, and national scale

Selection criteria	Local	Regional	National - International
Functional	<ul style="list-style-type: none"> ▪ Ayuntamiento de Valencia ▪ EMT Valencia (<i>Empresa Municipal de Transportes</i>) ▪ Regional Water Authority (<i>Tribunales de Aguas</i>) ▪ Private companies and businesses ▪ Insurance Companies (e.g. <i>Segurgent, Zurich</i>) ▪ Citizens and neighborhoods ▪ Energy, building and construction (e.g.) 	<ul style="list-style-type: none"> ▪ Regional Water Authority (<i>Tribunales de Aguas</i>) ▪ Ayuntamiento de Valencia ▪ Generalitat Valenciana ▪ General Directorate of Climate Change ▪ Regional Department of Agriculture, Rural Development, Climate Emergency and Ecological Transition 	<ul style="list-style-type: none"> ▪ Ministry of Transport, Mobility and Urban Agenda (<i>Ministerio de Transportes, Movilidad y Agenda Urbana</i>) ▪ Ministry for the Ecological Transition and the Demographic Challenge (<i>Ministerio para la Transición Ecológica y el Reto Demográfico</i>) ▪ The Ministry of Agriculture, Fisheries and Food (<i>Ministerio de Agricultura, Pesca y Alimentación</i>) ▪ European Commission
Geographical location	<ul style="list-style-type: none"> ▪ Ayuntamiento de Valencia ▪ Las Naves ▪ Property owners ▪ Citizens, vulnerable groups, and neighborhoods ▪ Private companies and businesses ▪ Associations (e.g. <i>Horta Viva, Valencia Activa, SME Terra I Xufa</i>) 	<ul style="list-style-type: none"> ▪ Committee for the study of Climate Change in Valencian Community. (<i>Comité de Estudio del Cambio Climático de la Comunitat Valenciana</i>) ▪ Regional Water Authority (<i>Tribunales de Aguas</i>) ▪ Advisory and Participatory Environmental Board (CAPMA) 	<ul style="list-style-type: none"> ▪ Spanish National Office for Climate Change (Oficina Española de Cambio Climático or OECC) ▪ Ministry of Transport, Mobility and Urban Agenda (<i>Ministerio de Transportes, Movilidad y Agenda Urbana</i>)
Knowledge & Abilities	<ul style="list-style-type: none"> ▪ Las Naves ▪ INGENIO ▪ Universidad Politecnica Valencia (UPV) ▪ Tecnalía ▪ Neighbourhood Associations (e.g. <i>Horta Viva, Per L'Horta</i>) ▪ Citizens 	<ul style="list-style-type: none"> ▪ Universidad Politecnica Valencia (UPV) ▪ Advisory and Participatory Environmental Board (CAPMA) ▪ Private consultancies 	<ul style="list-style-type: none"> ▪ Spanish National Office for Climate Change (Oficina Española de Cambio Climático or OECC) ▪ IPCC ▪ Climate KIC ▪ Ministry of Transport, Mobility and Urban Agenda (<i>Ministerio de Transportes, Movilidad y Agenda Urbana</i>) ▪ Plataforma sobre Adaptación al Cambio Climático en España (AdpateCCA)
Hierarchical level	<ul style="list-style-type: none"> ▪ Ayuntamiento de Valencia ▪ Private Companies ▪ Private individuals/citizens 	<ul style="list-style-type: none"> ▪ Regional Water Authority (<i>Tribunales de Aguas</i>) ▪ Regional Department of Agriculture, Rural Development, Climate Emergency and Ecological Transitions ▪ Generalitat Valenciana 	<ul style="list-style-type: none"> ▪ Ministry of Transport, Mobility and Urban Agenda (<i>Ministerio de Transportes, Movilidad y Agenda Urbana</i>) ▪ Ministry for the Ecological Transition and the Demographic Challenge (<i>Ministerio para la Transición Ecológica y el Reto Demográfico</i>) ▪ European Commission and policy

Appendix 5: Revised framework after empirical confrontation

Capacities	Principles	Operationalisation
Preparedness	Anticipation & Foresight	<ul style="list-style-type: none"> Climate-related knowledge and information is published and accessible to wide range of city stakeholders (e.g. through information campaigns and consistent adaptation publications) Cross-sectoral learning taking place between public, private, and civil organisations Socio-economic and environmental patterns enhancing vulnerabilities are monitored (e.g. water and heat related stresses)
	Preparedness & Planning	<ul style="list-style-type: none"> Citizen and private company vulnerabilities and risks are communicated to local government Evidence of localised, community-driven responses towards climate adaptation Evidence of shared prioritisation between local government, communities, and private entities in adaptation initiatives Community engagement strategy present in adaptation planning (city level)
	Homeostasis	<ul style="list-style-type: none"> Responsibilities of stakeholders and actors integrated into law for adaptation and resilience (e.g. joint action plans at city and community level) Climate adaptation integrated into other policy domains (e.g. urban policy, social policy, spatial planning) Communication channels in place and functioning between communities and institutions for adaptation dialogue Ecosystem services are maintained by local institutions and communities (interplay between the two)
Absorption	Robustness & Buffering	<ul style="list-style-type: none"> Policy, infrastructural and spatial measures focus on climate and social impacts and adequate risk reduction which can reduce or lessen both climate and social impacts on public and private ground (e.g. the vulnerabilities of the urban area to water and heat related threats)
	Diversity	<ul style="list-style-type: none"> Multiple ways to fulfil a need or objective regarding adaptation in urban environment (i.e. functional diversity) Diverse range of urban stakeholders with a say and responsibility in how adaptation unfolds and what is prioritised High variety of local organisations involved in promoting adaptation and resilience projects (i.e. local government, NGOs, communities, citizen groups, etc)
	Redundancy	<ul style="list-style-type: none"> Evidence of shared functions and governance responsibilities between public, private, and civil entities for adaptation Evidence of responsibilities for alternative pathways for essential city resources and services, and their maintenance being delegated to lower tier stakeholders (citizens, community associations, etc) Instances of co-creation of measures and actions for adaptation (public, private, civil)
Recovery	Flatness	<ul style="list-style-type: none"> Presence of decentralised, non-hierarchical governance allowing competent, autonomous and community driven action for climate adaptation Active and broad participation in decision-making for adaptation (communities, businesses, institutions) Evidence of community engagement and appropriation of urban adaptation initiatives and efforts
	High Flux	<ul style="list-style-type: none"> Signs of resource-full and flexible decision-makers in responses and strategies Evidence of allocation of resources and funding to adaptation initiatives, displaying a quick ability of mobilisation in response to persistent threat Local institutions facilitating widespread access to financial and human resources, information, and connections (e.g. the efficient funnelling or granting of resources for community driven/public projects)
Adaptability	Learning	<ul style="list-style-type: none"> Room for experimentation, innovation and learning-by-doing by citizens and communities (initiated help and awareness from public bodies and local government) Participatory learning from mistakes and experiences, through dialogue, meetings, and think-tanks Active application and implementation of new knowledge for future climate adaptation projects at the local scale (in collaboration with local government) in progress or under consideration Collaborative frameworks or strategies present or underway addressing instances of adaptation and resilience in city
	Flexibility	<ul style="list-style-type: none"> Flexibility in spatial planning (for future modification, adaptations, and recalibrations of urban landscape) Flexibility in measures (present adaptation measures can be scaled up or built on in future), especially community adaptation projects and initiatives Institutional flexibility (decision making and cooperation arrangements)
Transformative	Re-Invention	<ul style="list-style-type: none"> Promotion of inclusion and empowerment as elementary prerequisites to adaptation projects moving forward Acknowledgement and strengthening of intermediaries and local academia (e.g. NGOs, public bodies, local businesses, etc) Evidence of say in prioritisation in urban planning by citizens and communities (assuming a more engaged and active role) Evidence of willingness to change business and private company practices in city
	Reflexivity	<ul style="list-style-type: none"> Instances of fostering collective learning through new self-assessment techniques at multiple layers of city (government, businesses, public bodies, and communities) Evidence of learning from past mistakes and acknowledgement of opinions from varying sources (e.g. intermediaries, R&D institutes, community resilience projects, etc)

Appendix 6: Suggested Urban Resilience Capacities Cycle for better interpretation

