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Abstract	<p>The document consists of an introduction to the topic, a concise discussion of ICT applications in urban planning and urban water planning and the research agenda which opens up for this project. We present two parts of our proposed analysis in the four KDCs – the water Governance Capacity Framework (GCF; section 3.1) as an assessment of the baseline governance situation, and an in-depth case study analysis of collaborative learning between citizens, local authorities and a multiplicity of other stakeholders in the KDCs (section 3.2). The GCF is a comprehensive analysis of the main enabling conditions that determine the governance capacity needed to address specific water challenges. In the analysis of collaborative learning, we focus on how collaborative learning takes place among diverse actors, and how particular socio-economic, political, cultural and technological circumstances influence the process and outcomes of information sharing and knowledge co-production When analysing these interactions, we focus on a broad range of stakeholders who include but are not limited to citizens, professionals, and politicians.</p>



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1 Executive Summary

The purpose of this deliverable is to outline the work within POWER Working Package 4 with the focus on the role of Information and Communication Technologies in promoting collaborative learning in urban water management in four Key Demonstration Cities (KDCs), namely, Leicester, Milton Keynes, Sabadell, and Jerusalem.

The document consists of an introduction to the topic, a concise discussion of ICT applications in urban planning and urban water planning and the research agenda which opens up for this project. It is then followed by section 3 in which we discuss two parts of our proposed analysis in the four KDCs – the water Governance Capacity Framework (GCF; section 3.1) as an assessment of the baseline governance situation, and an in-depth case study analysis of collaborative learning between citizens, local authorities and a multiplicity of other stakeholders in the KDCs (section 3.2).

The GCF is a comprehensive analysis of the main enabling conditions that determine the governance capacity needed to address specific water challenges. It aims at identifying main barriers and opportunities to improve urban water management by pointing to the most effective applications possibilities for the use of the Digital Social Platforms (DSP) in the local context. In the analysis of collaborative learning, we focus on how collaborative learning takes place among diverse actors, and how particular socio-economic, political, cultural and technological circumstances influence the process and outcomes of information sharing and knowledge co-production for dealing with various urban water challenges. When analysing these interactions, we focus on a broad range of stakeholders who include but are not limited to citizens, professionals, and politicians. Other important actors include citizen groups, private sector actors, policy entrepreneurs working in government organizations, and community leaders.

Section 4 offers some practical guidelines and implications for the KDCs and follower cities in terms of the desired input and collaboration for the work in Working Package 4, and section 5 discusses the connections of our Working Package (4) with other Working Packages in the project and outlines implication of our work for other project partners.

A number of Annexes then detail our approach and the expected outcomes of the work conducted in WP4.

2 Introduction

2.1 Deliverable aim and scope

The POWER project is a user-driven project that aims to share the knowledge and experience of water scarcity, security, and quality and water consumption-related issues in different EU local authorities and facilitating citizen engagement in meeting these challenges, thus creating an important tool for the EU water policy. Working package 4 has an important role in achieving this aim as it analyses the environmental, political and social impact of the DSPs and investigates how DSPs can be embedded into existing local governance interaction processes. The DSPs are most effective when focusing on existing governance gaps and improvement options at the local scale.

DSPs will always function within existing structures and procedures of interaction between local politicians, professionals and citizens as well as a broader set of stakeholders. It is therefore key to have a proper understanding of the current interactions between these stakeholders in order to ensure optimal DSP applications in Europe's municipalities and regions as well as reflecting on the role and potential that DSPs could have. This deliverable proposes a systematic governance analysis that investigates the potential success and failure of DSPs contributions to the local governance process and decision-making. It is essential to have a clear frame to investigate the existing governance gaps and barriers in each city in order to optimize the contribution of DSPs to a more inclusive, interactive, and resilient water management and governance within Europe's municipalities and regions. Consequently, we will focus on the KDCs of Leicester, Milton Keynes, Sabadell and Jerusalem. However, we will also identify the main governance barriers and opportunities in follower cities in order to explore the opportunities for DSP beyond the cities directly involved in the POWER project.

This deliverable proposes a clear guideline for the governance analysis in order to ensure optimal use of the DSPs within the KDCs and investigates the opportunities to apply the DSPs in the follower cities. Therefore, the aim of this deliverable is formulated as follows: Providing a well-structured analysis of UWCS governance that identifies the current barriers and window of opportunity in the KDCs in order to enhance an optimal use of DSP in solving urban water challenges in the KDCs, identify the success and failure of DSP application, and provide clear guidelines for follower cities to apply DSPs in their local context. In this process, a better understanding of how increasing reliance on ICT in the design, execution and monitoring of water-related services in cities influences collaborative learning and the governance capacity of multiple stakeholders to address water challenges, are considered essential for the possible success and failure of DSPs.

It is important to define the key stakeholders of urban water management whom we target to study and who will be the target groups of knowledge produced in this work package. The actors studied will by

definition be broader than the group of key decision-makers and knowledge users that the DSP targets. Thus stakeholders are all actors involved in management of water resources as well as those actors who are impacted by the decisions around water management. In a broad sense of the terms, these include national, regional and local governments, water companies, either public or private, insurance companies, elected politicians and government bureaucrats responsible for water service provision or regulation, non-governmental organizations, citizens and citizen groups, community leaders and independent experts and opinion-formers.

The broad range of actors studied in each of the research settings allows for the broadest possible range of information and knowledge perspectives collected in order to get the most comprehensive understanding necessary to critically analyse the role and potential DSPs may have in addressing water issues of flood risk, water quality, water conservation and water scarcity. We will analyse these different perspectives in order to understand how and whether multi-stakeholder and collaborative approaches meet urban water challenges, and can be strengthened through the reliance and integration of DSPs in the current management settings. A more targeted group of stakeholders who are the primary users of the knowledge generated in the project include politicians, water professionals and citizens.

2.2 ICT in urban water governance

The advent and wide spread of ICT applications in everyday life have changed the way people interact with each other, and also have an impact on the work of governments. Among many other areas, the rapid development of ICT has transformed the discussions in the literature on urban management, especially in the transportation sector and urban mobility in the past decade (e.g. Agyeman, 2013; Dameri and Rosenthal-Sabroux, 2014). Scholars and practitioners in such areas as electricity management and smart grids (e.g. Clastres, 2011), climate change adaptation in urban areas (e.g. Ospina and Heeks, 2010), public health (e.g. Palen and Liu, 2007), and urban planning more generally (Rathore et al. 2016) propose various conceptual schemes of ICT application.

In the field of urban water management, ICT applications have been linked to a promise of improved governance along the lines of building resilience of cities against floods and droughts; managing sustainable supplies of residential water; ensuring good water quality; and nudging populations to reduce water consumption or proof their houses against floods (Wesseling et al. 2014). Furthermore, ICT applications could be useful in tapping into the knowledge and skills that the population offers for managing urban water ecosystems, emerging urban agriculture and in detecting and responding to various failures or disasters with urban drinking water quality (e.g. Linders, 2012). Within this field of urban planning, the aim of our work package is as follows.

More specifically, we are interested in the impact of ICT facilitated governance on the role of public participation and collaborative learning for addressing urban water challenges. In focusing on public

participation, we distinguish two key interactions – one that takes place between citizens and local authorities responsible for the provision of services, and that between local regional politicians, officers and experts (municipal, academic and business) and local community participants. We draw broadly on the literature in urban planning and initiatives on smart city development in order to draw lessons for urban water governance.

A number of gaps in the literature justify our research and fieldwork. First of all, it is necessary to map the most relevant actors, processes and issues, and obtain comprehensive insight in the key governance conditions that encourage or limit the governance capacity to address the individual water challenges in each of the four KDCs. This will be conducted through the water Governance Capacity Framework (GCF). Then, key research questions pertaining to collaborative learning in particular contexts of four KDCs and four various water resources challenges need to be studied in-depth, as outlined in section 5. The KDCs include Leicester, Milton Keynes, Sabadell and Jerusalem, and the water challenges studied in these cities include flood risk management, water conservation, water reuse and stakeholder relations respectively. In such in-depth analysis, social, economic, cultural and political contexts will play an important role in constituting policy networks around ICT applications to govern local water issues in the cities. We are interested in both existing ICT innovations which have already been embedded into a societal setting, and new piloted ICT solutions which cause ripples in the context into which they have been introduced.

The work in this Work Package is closely linked to the work undertaken in other Work Packages. Our work is related to application of Digital Social Platforms (DSP) in the KDCs and drawing lessons from this process. It is important to mention that due to the novel character of the term “DSP” it does not feature prominently in the scientific or practitioner literature, and that is why we use the terms of “DSP” and “ICT applications” interchangeably in this document. Furthermore, we distinguish three key stages and components of our work as follows. First, we conduct an *ex-ante* assessment of conditions in the KDCs and broader institutional environment and features determining local governance capacity in order to promote a successful application of DSPs for urban water challenges in the KDCs. Secondly, we conduct an *in-situ* interpretative case study analysis of the processes and dynamics of the application of DSPs in each particular KDC. Hence, the translation of a technological model (i.e. DSPs) in a particular governance and socio-cultural context is analysed. Finally, we conduct a continuous *post-ante* examination and evaluation of the social impact after DSP applications within the limits afforded by the project in coordination with the work performed within deliverable 4.3 by EIPCM. The work of WP4 therefore is crucial for the development of DSPs (WP 2) in order to build in flexibility into the platforms, which could adapt to various contexts and challenges and be used in various ways. Furthermore, WP4 will provide information on how various stakeholders use DSPs, the data which will be collected and analysed in WP3, in particular task 3.5. WP4 is also crucial in prospective analysis of whether tangible governance and behavioural changes may occur as a result of DSP introduction. Last but not least, WP4 will provide a tentative list of generic conditions which may be associated with success and failure of applications of particular DSPs in particular governance

context. Such a list could be helpful in deliberations for the future use of DSPs in urban water governance beyond the project.

For clarity reasons, we specify that a theoretical framework identifies variables of interest and claims a particular relationship among them in a cause and effect fashion. We base our research on theories of deliberative governance and participatory planning which claim that more participation of stakeholders provide for more legitimate and effective governance (Feldman et al. 2008). The purpose of this deliverable is to provide an introduction to the issue at hand, as well as the theoretical, and analytical premises of our research. The methodological and logistical detail of the research, therefore, will be outlined in the Case Study Protocol (Annex 1).

2.3 Embedment in working package four

This deliverable is a guidance document for the analysis of UWCS governance in the four KDCs. Because it is one of the first deliverables of work package 4, we will not only describe governance analyses approach but also embed it into the other activities and tasks of work package 4 (Table 1; Figure 1). Before we can obtain a comprehensive understanding of the governance aspects of DSP applications, we first need to have an understanding of the current applications of ICT in water management and environmental management (D4.1) and the other tasks and deliverables (Figure 1).

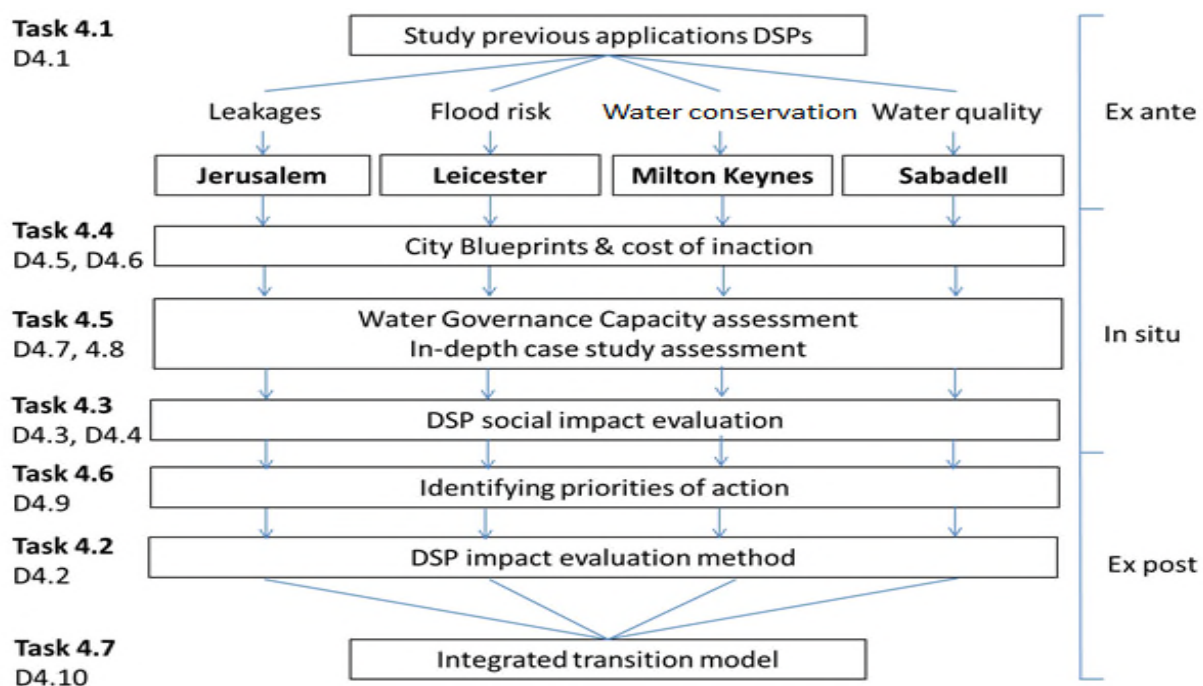


Figure 1 Overview task within working package 4

Task 4.1 is an ex-ante literature study of the applications of DSP and ICT tools in decision- making. Tasks 4.4, 4.5 and 4.6 are in situ assessments of the four KDCs. Finally, Tasks 4.2, 4.3 and 4.7 are ex post studies of the impact of DSPs and multi-objective transition mode for sustainable urban water management.

This *ex-ante* first step is key in exploring the possibilities and opportunities of the DSP application in various social constructions and facilitating different kinds of interaction, each with different purposes. Next, a City Blueprint analysis of the current state of urban water management is performed for the KDCs (D4.5). Based on this knowledge, we propose an approach to analyse the governance aspects of each of the four KDCs and explore opportunities for DSP to contribute in the process of addressing water issues. We do that by following two approaches:

- 1) Water Governance Capacity assessment: A positivistic approach with partly generalizable results, operationalised concepts and produces to certain extent replicable findings. It aims to provide a general overview of the governance situation in the KDCs and follower cities.
- 2) In-depth interpretive case study assessment: A qualitative case study approach with context-specific results, exploring the use of DSPs and urban water management issues as understood and enacted by stakeholders. It aims to provide a deeper understanding of the governance aspects of DSP applications in the KDCs with the focus on meaning-making by stakeholders themselves.

The follower cities are selected from a City Blueprint network, Netwerch20 and cities that signed the Dubrovnik declaration of intend. Hence, these cities already have shown interest in the topic of water. Within working package 4, a method will be developed to enhance post-project continuation of the DSPs. This method is based on workshops with different political, social and economic municipal groups in the four KDCs (D4.3 and D4.4). Based on the previous steps, priorities for action will be identified (D4.9). At the same time, a method will be developed to monitor and evaluate the impact of the platform usage. Finally, an integrated transition model is developed.

Table 1 Overview of deliverables related to the tasks in work package 4 (Figure 1).

D4.1	Report on the current situation regarding DSP applications	Lead: CTM
D4.2	Methodology to assess the social impact of DSP on different actors	Lead: EIPCM
D4.3	Report on the workshops	Lead: CTM
D4.4	Methodology for the implementation of the long-term visions	Lead: CTM
D4.5	Report on trends and pressures and City Blueprints of KDCs	Lead: KWR
D4.6	Review of cost and adaptation measures related to UWCS	Lead: KWR
D4.7	Guidance document for the analysis of UWCS governance in cities	Lead: KWR
D4.8	Report on the UWCS governance analysis in the KDCs and follower cities	Lead: UU
D4.9	Report on the socio-economic UWCS improvement options in the KDCs	Lead: KWR
D4.10	Guidance for an integrative multi-objective assessment method to enhance sustainable transitions	Lead: UU

2.4 Document outline

This document will first start with a description of the ICT applications in water and environmental management and governance. Next, two complementary governance analyses are proposed. First, the water governance capacity framework is introduced as a general governance assessment of the KDCs and following cities. Second, constructivist in-depth case study approach is explained that will dive into three main conditions of the governance capacity framework and explore them with respect to DSPs. For this part of analysis, we provide a theoretical and analytical framework for assessment of how ICT facilitated interactions take place b1) between citizens and local authorities (Figure 2); and b2) among all stakeholders making part of policy networks in a KDCs setting (Figure 3. Third, we elaborate on the practical guidelines for the role of KDCs during the governance analyses. Finally, we provide the main conclusions of this proposed guidance document for the analysis of water governance in the four KDCs and follower cities. In addition, our envisioned contribution of the deliverable on other project deliverables is discussed.

3 Examining Digital Social Platforms for Public Participation in Urban Planning and Governance

In the last decade, there has been a considerable wave of literature on potentially revolutionizing features of ICT technologies in improving the work of the government and in making it more democratic and open. A number of new and old terms describe this largely optimistic literature on how the Internet shifts public administration and the state-citizen relationships, such as “Wiki Government” (Noveck, 2009), “citizen crowdsourcing” (Linders, 2012), “citizen sourcing” (Torres, 2007), “collaborative government” (McGuire, 2006), “open government,” “do-it-yourself government” (Dunleavy & Margetts, 2010), and “government as a platform” (O'Reilly, 2010). Among the many possible impacts of ICTs on governance, one key argument centres on the importance to promote individual citizenship skills and capacity of individuals (Turnhout et al. 2014) rather than treat them as passive consumers, as is the case in the competing paradigm of New Public Management (NPM) (Dunleavy et al., 2005; Linders, 2012). ICTs, it is argued, may play a pivotal role as a great tool to cultivate such citizenship skills through skilful communication, public and online education initiatives, and co-production and planning activities (Linders, 2012; Dunleavy et al., 2005). We refer to Digital Social Platforms (DSP) in this project, which encompass ICT applications for a two-ways communication flow between an authority responsible for urban water management and the users of those water services, as well as other stakeholders involved in urban water management.

While possible advantages of ICT applications abound in the literature, there is a great diversity of approaches, terms, concepts and ideas on the particulars of such influence, which leaves much room for confusion about the terms and concepts and may be counter-productive (Linders, 2012). In this section, we first discuss the types of ICT facilitated interactions between citizens and local authorities, and then introduce the literature on policy networks and interactions where multiple stakeholders come together in partnerships to manage local challenges. We are specifically interested in how ICTs can help in managing such interactions within policy networks. In one of the few coherent reviews of the impact of ICTs on the government-citizen relationships, Linders (2012) offers a useful typology of such interactions along the three axes or flows of information and knowledge, namely, citizen-government, government-citizen, and citizen-citizen. In addition to those provided by Linders, we distinguish the fourth type of interaction which we call “collaborative learning”—in which ICT applications are used to collaboratively plan and learn with participation of both government officials and citizens. We further plotted these four axes against the three stages of public service development, namely, design, execution and monitoring of urban services. This resulted in a four to three matrix of ICT facilitated interaction between citizens and a government. We discuss examples for each of these four categories and provide a summary table at the end of this section (Table 2).

3.1 Citizen crowdsourcing in urban planning

The flow of information and knowledge may be directed from citizens to a government institution, which can be called "citizen sourcing". As Linders (2012: 447) put it, "in citizen sourcing, the public helps government be more responsive and effective". Here, the major provider of services is still government, but citizens contribute with their knowledge, ideas and constant monitoring of services in helping to execute them and in signaling their preferences as recipients of those services. Examples include the information citizens send to government on poorly functioning public services, such as breakage in water supply or water quality issues. Another example, which we will discuss at more length, is tapping into citizen knowledge and information before and during floods or other catastrophic events in order to plan and execute relief measures.

There are many examples of how citizens' input has been put to use for better public services by the businesses and governments. Crowdsourcing can be defined as "collective generation of media, ideas, and data undertaken voluntarily by many people" (Dodge and Kitchin, 2013: 19). One example is the use of OpenStreetMap (OSM) in which people produce geo-spatial content to contribute to building maps. Google Maps is also based on crowdsourcing, where the information and monitoring of its correctness is executed by public (Dodge and Kitchin, 2013).

3.2 Government as a platform

The second major form of interaction may be called "government as a platform" in which the flow of information and knowledge occurs from the government to citizens. In this interaction, the government helps citizens in improving their productivity or achieving their goals, such as better healthcare, more sustainable water and electricity consumption, and better management of collective behavior. While first this may appear as not directed at public participation, this interaction plays a very important role in establishing government as open, encouraging and rewarding citizenship in individuals. The idea is to develop reflexive capacity of individuals and citizenship values as opposed to manipulate emotions and attitudes to produce a desired behaviour. Here, a government institution can disseminate information about its work and the challenges therein, and through such means, achieve public support in difficult tasks, such as, for example, in increasing public's trust in drinking tap water, or in overcoming the "yuck" factor in public perceptions with regard to wastewater reclamation, or other unpopular policy measures for flood risk management (e.g. Leong and Lejano, 2012).

3.3 "Do It Yourself" government

The third avenue of interactions is what could be called as "Do it Yourself Government (citizen to citizen)". Through such platforms as Facebook, Twitter, open source software, such as OpenStreetMaps (OSM) and various blogs, and virtual learning platforms (Medema et al., 2014), citizens can share useful information with each other in real time format and this potentially presents a substitute for traditional government

responsibilities to protect citizens. Such shifts occur mostly in the urban areas. Examples of such collective action of citizens include self-monitoring whereby citizens help each other by reviewing hotels, restaurants or government services (Linders, 2012). This requires some levels of social capital and the overall regulatory framework to enable such interaction between citizens and in making them productive.

3.4 Collaborative planning and software

One area not covered by Linders (2012) and other reviews on the subject (e.g. Chadwick, 2011), but nevertheless important in our view, is the emergence of participatory forms of planning and modelling where face-to-face interaction is key. Here, technologies may still play an important role in facilitation and qualitatively shifting the interaction processes. Examples of such ICT facilitated participatory processes include action research (Daniell, 2015), and participatory modelling (Forester, 2012). In such planning activities, face-to-face contact does not disappear but is enhanced through the use of social media, Web 2.0 capabilities and other technological possibilities. Further methods may include participatory forms of mapping; transect walks, focus group discussions producing knowledge, community-based mapping, and NGOs producing knowledge in contested local governance processes (Hoyt et al., 2005). A term “groupware” is used for software used in collaborative processes or “computer-based systems that support groups of people engaged in a common task (or goal) and that provide an interface to a shared environment” (Hanzl et al. 2007: 297).

In Table 2 below, we provide a summary of examples of how ICT in urban planning may be categorized in a typology in the two-to-two matrix of the type of interaction between governments and citizens on the horizontal axis, and the cycle of urban service development on the vertical axis with the design, execution and monitoring stages of a service. Below a conceptual description, we present real-life or hypothetical examples of how such an initiative may look in practice.

Table 2 Summary of Examples of Urban Governance Initiatives and DSPs. Adapted and modified from Linders (2012).

	Citizen Crowdsourcing	Government as a platform	“Do it yourself” government	Collaborative Planning
Design of Service	<p>Open government, comments and online deliberation on government policies and policy proposals</p> <p><i>Examples: eRulemaking, IdeaScale, eDemocracy party (e.g. Linders, 2012)</i></p>	<p>Informing and nudging, real time data on consumption, increasing awareness about habits</p> <p><i>Examples: crime mapping in neighborhoods, real-time information on public transportation, providing data on individual consumption (e.g. Seyranian et al. 2012)</i></p>	<p>Games in which citizens learn how to influence their built environment, carpooling</p> <p><i>Examples: sustainable community centres and platforms, (virtual learning platforms) (e.g. Medema et al. 2014)</i></p>	<p>Joint discussion of problems and solutions in neighbourhoods, action research</p> <p><i>Examples: participatory GIS mapping, conflict resolution through modelling tools, online workshops and town hall meetings (Pfeffer et al. 2011; Salter et al. 2009)</i></p>
Execution of Service	<p>Flood relief and emergency mapping or open source mapping more generally for everyday use.</p> <p><i>Examples: PetaJakarta, OpenSourceMaps, PeertoPatent (e.g. Aggrawal, 2016)</i></p>	<p>Making government data available to citizens, such as quality of hospitals, flood risk areas etc.</p> <p><i>Examples: GPS, Gov Open Sourcing (e.g. Wilk, 2006; Dawes, 2008)</i></p>	<p>Social media and online facilitated snow cleaning, car-pooling and community gardening</p> <p><i>Examples: self-organization for waste management or urban gardening (e.g. Agyeman, 2013)</i></p>	<p>Participatory policing, urban park guards, extension services for urban gardening</p> <p><i>Examples: Same community waste management programmes or urban planning, but with a facilitators from the government or business and third sector (hypothetical)</i></p>
Monitoring of Service	<p>Ranking of hospitals and schools (universities), real time discussion on particular urban services and feedback for improvement</p> <p><i>Examples: SeeClickFix, FixMyStreet, Singapore MRT app (e.g. Linders, 2012)</i></p>	<p>Open government, demonstrate little corruption and win back trust. Video and delivering information on how piped water is treated or how public meetings take place (live streaming).</p> <p><i>Examples: Publication of minutes of governmental task forces meetings, Open Government Acts, TV and online streaming of key meetings (e.g. Dawes, 2008)</i></p>	<p>Self-monitoring, online citizen testimonial systems replace the top-down systems of control of quality of service delivery in hospitals and local government</p> <p><i>Examples: online forums, commercial platforms with reviews (Airbnb, Tripadvisor), Yelp, NHS Choice. Foursquares.com (e.g. Linders, 2012)</i></p>	<p>Participatory monitoring of crime levels, social tensions, or integration levels in neighborhoods</p> <p><i>Examples: crowdsourcing, but with the preservation of face-to-face contact via planner-citizen contact via social-media, but also in person (e.g. Pfeffer et al. 2013)</i></p>

3.5 Discussion and research agenda for WP 4

The developments in the greater use of ICT in all aspects of governance have profound impacts for the role of the state in managing water governance processes. Linders (2012) proposed that the emerging “Digital Era Governance” (DEG) and “Transformational Government” paradigms are likely to shift the role of the government from the “doer” to a “facilitator”. He cites Dunleavy et al. (2005: p487) “citizens and businesses will increasingly co-produce most individual outputs using electronic processes, leaving agencies to provide only a facilitating framework”. Likewise, the Transformational Government model strongly emphasizes citizen empowerment, calling on government to provide the public with the “technology tools that enable them to create public value themselves” (CS Transform, 2010). This trend is in line with the general trend from government to governance and from one central actor to the multitude of various actors working together on governance. As the focus of the project is on governance, we examine both collaborative learning and multi-stakeholder partnerships and policy networks at work.

In both paradigms, government remains a mechanism for collective action, but often, in the words of Tim O'Reilly, as “a convener and enabler rather than the first mover of civic action” (2010).” These impacts on the role of the state, as well as non-state actors, are yet to be researched and understood. The transition to the new role for the state requires adaptations in structures it uses to run the government, but also, a new set of skills on the part of public managers and administrators. Such skills could include the ability to facilitate multiple ways of knowing and multiple perspectives provided by the citizens, an ability to close off deliberation processes based on various perspectives, and a skill in combining the digital and one-to-one contact with citizens in order to ensure fruitful interaction and policy deliberation.

On the other hand, this also means cultivation of new skills and motivation for citizens. An apparent skill is that of accessing online platforms and active engagement. Another important change would come with cultivation of what could be known as “environmental citizenship”, or a particular attitude in citizens which prompts them to weigh collective or community consequences of their individual actions in the realm of the environment and the city life. The evolution of environmental citizenship therefore is most important, and ICT facilitated urban water governance enables such transition in numerous ways.

One final remark is based on a sharp observation of Linders (2012: 453), who further writes that “it is clear that citizen coproduction's primary appeal is first and foremost about providing a shortcut to cash-strapped governments for addressing budgetary pressures rather than any attempt to “empower” citizens or improve performance”. This, of course, creates a challenge of promoting ICT applications in urban water planning not because this saves money and is seen as a “progressive” development, but because it promotes citizen-power and creates alternative ways for people and public to engage in governance processes. It would be wrong to put economic consideration for such a complex socio-political and technological transition as the major driving point and it would be likely to lead to a failure.

4 Proposed approaches to analyse the water governance in the key demonstration cities

This section introduces two approaches to governance analysis we employ in this research project. These approaches are complementary with each other. First of all, the water Governance Capacity Framework (GCF) will be conducted in the KDCs which will identify the governance baseline. Building on this baseline, an in-depth case study analysis will follow. Moreover, the GCF will be applied in a few follower cities in order to explore the governance barriers and window of opportunities in cities beyond the four KDCs involved in this project. This is key in finding a broader application of DSPs as a tool to facilitate citizen engagement within EU water policy. Section 3.1 explains the water governance capacity framework approach and section 3.2 – the complementary use of in-depth case study analysis that will be applied on the KDCs.

4.1 Water Governance Capacity Framework Analysis

DSPs may have the potential to be useful in enhancing collaborative learning, provided that they are well embedded in the local governance context and address the specific governance issues at hand. Water governance is defined by the Global Water Partnership (GWP) as “*the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society*” (UN Water 2007). An important component of governance capacity is institutional capacity: this generally focuses on how institutional setting, rules, and regulations enable actors to collaborate and address shared problems (UNDP 2008; Dang et al. 2016). Governance capacity is broader, also including resources and the role of discourses (Engle and Lemos 2010; Pahl-Wostl 2009). A few communalities regarding governance capacity can be identified. First, this capacity is about the ability of actors to continuously identify and jointly act on collective problems (Dang et al. 2016). Second, the capacity is determined by actors’ interactions formed by social-institutional settings and allocation of resources (Pahl-Wostl 2009). Third, actors’ frame of reference, including their interests, values, and culture, shape interactions and influence collective problem-solving (Adger et al. 2009). Therefore, no single governance condition is decisive. On the contrary, governance capacity is determined by a balanced set of conditions that need to be well developed. Each city or other collaborative entity is unique and there is no *one size fit all* solution. DSPs need to contribute optimally to broader collaborative structure and should address existing barriers in order to contribute to local decision-making processes. The following explorative research questions are formulated that are being elaborated and specified with respect to ICT application in the in-depth case studies:

1. Who are the most relevant stakeholders in each of KDCs? What are their interest and problem definitions? Which collaborative alliances do already exist? How do the three key target groups of

- the project (politicians, professionals and citizens) interact within the broader range of stakeholders that are directly or indirectly involved in addressing the water challenge?
2. Which governance conditions and indicators are most encouraging and limiting the governance capacity to address the water challenge in each of the four KDCs?
 3. Which governance conditions need to be addressed by applying DSPs, taking into account the most limiting governance conditions, the relevant actors involved and their interests regarding the water challenge?

The water Governance Capacity Framework (GCF) provides a comprehensive overview of the key governance conditions that may encourage or limit the governance capacity to address the water challenge that a city faces. The GCF will be applied on the four KDCs in order to provide a broader understanding of the governance interaction and reflect on the role, use and function of DSP as part of the governance interaction. The framework may serve as a knowledge translator that enhances cities and academia to share knowledge, experiences and best practices, and serves as a basis to explore the most feasible opportunities and strategies for applying DSPs in policy design, execution and monitoring stage. The GCF consists of nine conditions, each with three indicators. Annex 2 and 3 discuss each indicator in detail and embed them in the existing scientific literature. Here we provide a short summary for each condition.

The Governance Capacity Framework has been developed in connection with the BlueSCities project which has been completed in 2016. The networks of follower cities created and strengthened in the BlueSCities project, namely the NetwerCH2O and CityBlueprint network will be utilized in a) checking the results of the POWER project with the experiences of the members of these networks and in b) disseminating the outcomes of the project to the follower cities.

Condition 1: Awareness

Awareness refers to a more profound understanding of the causes, impact, and risks of governance challenges and forms the base for learning and action. Awareness is assessed by the indicators *1.1 community knowledge*, *1.2 local sense of urgency* and *1.3 behavioural internalization*. Community knowledge refers to the extent to which different stakeholders possess relevant knowledge about the challenges. Local sense of urgency reflects the perception of importance of the governance challenge, which may or may not result in actions and policies. Finally, behavioural internalization indicates that a higher level of knowledge affects actors' problem- framing, goals, values, and perceptions, changing their behaviour and increasing their commitment.

Condition 2: Useful knowledge

The field of information science distinguishes between data, information and knowledge. Data in itself is not necessarily informative, as useful knowledge can only be obtained by data interpretation and analysis. Useful knowledge consists of *2.1 information availability*, *2.2 information transparency*, and *2.3 knowledge cohesion*. Information availability refers to the extent that reliable knowledge is available. Information

transparency refers to the effective communication and sharing or co-creation of knowledge with all interested stakeholders. Finally, knowledge cohesion refers to the conformity of knowledge across actors, sectors, and administrative layers.

Condition 3: Continuous learning

Continuous learning is required, in order to adapt to changing situations with many uncertainties, complexities, and unknowns. Continuous learning is assessed by *3.1 smart monitoring*, *3.2 evaluation* and *3.3 cross-stakeholder learning*. Smart monitoring is a precondition for learning and may serve as tool for identifying alarming situations, clarifying underlying processes, and predicting future developments. Regular monitoring and evaluation are imperative for continuous learning and enhance preparedness for uncertain futures. In order to conceptualize evaluation, the regular review of current policy and practices with the aim of making adjustments to improve it. Finally, cross-stakeholder learning is crucial for learning in a public policy context, as the interaction among actors and their understanding of different perspectives lead to a more comprehensive evaluation and may prevent overly limited scopes or path-dependencies.

Condition 4: Stakeholder engagement process

The importance of stakeholder engagement is widely recognized. Active stakeholder engagement is generally more time-consuming than unilateral decision-making. However, this can be more than compensated for by time gains in the implementation phase. The stakeholder engagement process consists of *4.1 stakeholder inclusiveness*, *4.2 protection of core values* and *4.3 progress and variety of options*. Stakeholder inclusiveness refers to the extent to which the representatives are able to speak and decide on behalf of all relevant stakeholders in clear and transparent engagement processes. Protection of core values refers to the importance of ensuring that all stakeholders feel confident that their core values are not harmed, in order to create a safe environment for trust relationships. Therefore, it is essential that stakeholders become actively involved and commit to the process, rather than the outcome is predetermined. Moreover, stakeholders' contribution should influence the end-result. Progress and variety of options encompasses the prospect of gain for each stakeholder, which is ensured by clear and realistic procedures. Stakeholders should co-produce and, at the end of the process, select from a variety of options, to ensure learning.

Condition 5: Management ambition

Management ambition is a measure of the extent to which sustainable management and policy is interwoven with historical, cultural, normative, and political context. Management ambition is assessed by *5.1 ambitious and realistic management*, *5.2 discourse embedding*, and *5.3 management cohesion*. Ambitious and realistic goals need to be long-term, with intermittent measurable targets, all provided with sufficient resources and flexible mechanisms to deal with changing situations. Discourse embedding is important, as management ambitions need to match the dominant values, discourses, and principles, in order to be successful. Hence, the degree to which water challenges are embedded in the dominant discourse, strongly determines the effectiveness of ambitious management and policy. Management

cohesion assesses the level of integration between different sectoral policies and strategies, across governance levels, and between organizations. Often, the over-fragmentation of roles and responsibilities means that no single agency is in charge of water policy, and opportunities to create co-benefits are not seized.

Condition 6: Agents of change

The concept of agents of change is often described in the fields of organizational change, Adaptive Management, and innovation studies, although different terminology is used (e.g. leaders, policy entrepreneurs, institutional entrepreneurs. “Agents of change” refers to the intrinsic motivation of people, their willingness to take risks, and the support given to these efforts to change current approaches. The concept is therefore not limited to people in leading positions. For this condition, three types of agents of change are distinguished: *6.1 entrepreneurial agents*, who have the means and skills to gain access to resources, seek opportunities, and manage risks; *6.2 collaborative agents*, who have the skills to build bridges and coalitions between actors; and *6.3 visionary agents*, who envision long-term adaptive approaches and are able to steer current policy and actions.

Condition 7: Multi-level network potential

Flexible and dynamic networks are important, in order to deal with governance challenges with different interests and perspectives, and with stakeholders acting at different. Multi-level network potential consists of *7.1 room to manoeuvre*, *7.2 clear division of responsibilities*, and *7.3 authority*. Room to manoeuvre assesses the opportunity that actors have to explore different alternative pathways, develop knowledge, and put ideas into practice. This also involves the possibility and autonomy of actors to form new fit-for-purpose partnerships that can address unconventional and emerging challenges. Clear division of responsibilities refers to the accurate and clear division of tasks and roles for which stakeholders can be held accountable. Authority refers to the presence of legitimate forms of authority (e.g. embedded in policy or law), regulations, and policy networks that promote the necessity to address water-related challenges.

Condition 8: Financial viability

Addressing urban water-related challenges requires the assurance of long-term financial support, as short budgetary cycles prevent long-term thinking and will most likely substantially increase overall cost. Financial viability is characterized by *8.1 affordability*, *8.2 consumer willingness to pay*, and *8.3 financial continuation*. Affordability of water and climate adaptation services is assessed with a focus on the poor and marginalized groups. Consumer willingness to pay assesses how expenditure and risks are perceived. Often, trust in local authorities and their accountability, as well as the sense of urgency or worry, are key. Finally, financial continuation is needed for solving long-term challenges and avoiding resources being squandered as a result of uncoordinated investments.

Condition 9: Implementing capacity

Most studies mention policy implementation as crucial. Implementing capacity is substantiated through *9.1 policy instruments*, *9.2 statutory compliance* and *9.3 preparedness*. Policy instruments can be used to

stimulate desired behaviour and discourage undesired activities. Examples are the inclusion of the user-pays and polluter-pays principles in pricing. Continuous monitoring, evaluation, and adjustments are needed, to check and improve the effectiveness of instruments. Statutory compliance ensures that stakeholders respect and understand agreements, objectives, and legislation, which contributes to the accountability of authorities. Preparedness increases the implementation capacity, as the existence of action plans, procedures, and scripts supports policy and prepares the city for both gradual and sudden changes, events, and calamities.

These nine key conditions for good urban water governance are classified into three dimensions: knowing, wanting, and enabling. The “knowing” dimension refers to the need to be fully aware, understand, and learn the actual or possible risks and impacts of actions, policy, and strategic choices. We created the “wanting” dimension because actors need to commit to cooperate, express, and act upon ambitions, and apply their skills and capabilities to finding solutions. Finally, the “enabling” dimension was created because actors need to have the network, resources, and instruments to enable them to implement their ambitions. The resulting framework has nine governance conditions; an in-depth literature study for each condition yielded three indicators. The results are shown in table 3, below the findings from the literature research are described.

Table 3 The water Governance Capacity Framework (GCF). The GCF consists of nine conditions, each defined by three indicators. For each indicator, a Likert scoring scale has been developed, which ranges from very encouraging (++) to very limiting (--) to the governance capacity

Dimensions	Conditions	Indicators
Knowing	1 Awareness	1.1 Community knowledge 1.2 Local sense of urgency 1.3 Behavioural internalization
	2 Useful knowledge	2.1 Information availability 2.2 Information transparency 2.3 Knowledge cohesion
	3 Continuous learning	3.1 Smart monitoring 3.2 Evaluation 3.3 Cross-stakeholder learning
Wanting	4 Stakeholder engagement process	4.1 Stakeholder inclusiveness 4.2 Protection of core values 4.3 Progress and variety of options
	5 Management ambition	5.1 Ambitious and realistic management 5.2 Discourse embedding 5.3 Management cohesion
	6 Agents of change	6.1 Entrepreneurial agents 6.2 Collaborative agents 6.3 Visionary agents
Enabling	7 Multi-level network potential	7.1 Room to manoeuvre 7.2 Clear division of responsibilities 7.3 Authority
	8 Financial viability	8.1 Affordability 8.2 Consumer willingness to pay 8.3 Financial continuation
	9 Implementing capacity	9.1 Policy instruments 9.2 Statutory compliance 9.3 Preparedness

We provide more detail on each of these conditions and indicator in Annexes 2. Annex 3 provide the Likert scoring for each indicator which ranges from very encouraging (++) to very limiting (--) to the governance capacity need to address the water governance challenge. In the next section, we detail our approach to

analysing collaborative planning and learning for each of the case studies. The interpretive approach builds upon GCF, especially three key governance conditions researched in this part – awareness, continuous learning and stakeholder engagement process.

4.2 Collaborative Learning and Participation through ICT in Urban Water Management (In-depth Case Studies)

In parallel with the efforts to evaluate governance in each of the cases, we will conduct an in-depth case study analysis of the pre-conditions for collaborative planning and learning. If section 3.1 looked at more general institutional framework to study and understand water governance, this section will sketch an approach to understand how institutions are geared towards collaboration and knowledge co-production. This is a prospective analysis. We will also conduct an analysis of the dynamic which take place when ICT applications are introduced in such settings, where appropriate.

Section 3.2 builds on the work completed in 3.1. Thus, our focus will be placed on two key conditions – learning and stakeholder engagement. We will research the third condition – awareness – as a part of the two others. If GCF is interested in making judgment on the alignment of core values in the process of stakeholder engagement, the interpretive approach will target the identification of such values through in-depth interviews and observation and study the process of negotiation and shifting which may be necessary in accommodating multiple conflicting values and interests. Furthermore, if GCF studies the extent to which such stakeholders are involved in decision making, the interpretive approach takes this further by asking the questions of perceptions of being involved, being listened to and the extent to which the participation fora and the format of these are conducive to articulation and deliberation of various positions. Similarly, we will build on the work of GCF in collaborative learning by taking an interpretive take on translation of various positions into a consensus in the process of collaborative learning, as well as perceptions and indicators of governance and behavioural change as a result of such events as manifested in lived experiences of stakeholders. The basis for such analysis will be the work on GCF on the condition “awareness”, which is further to be studied an interpretive perspective in terms of the worldviews and framing of problems at hand, solutions, connections often expressed in the form of narratives. This attention to narratives is key in interpretive policy analysis overall.

The case study approach will be both exploratory and interpretive in its nature (Schwartz-Shea and Yanow, 2012). This means that we are interested in the perspectives of actors and their own definitions and conceptualizations of research issues and phenomena rather than in pre-defined concepts and variables as in Governance Capacity Framework. Furthermore, interpretive policy analysis allows for major themes and research questions to emerge from the field in an abductive logic of research, which is both inductive and deductive. As a researcher spends a prolonged time in the field (longer than 4 weeks in our case), ideas and key issues start to emerge. These ideas then have to be examined in the context of the literature and various theories in order to provide a conceptual explanation and arrive at relevant questions. Such understanding guides further data collection and research. A defining feature of interpretive policy analysis

is the combined process of collecting and analysing qualitative data in a case study approach, and simultaneous exploration of various meanings, doubts, framings, and perspectives of actors and their analysis against theoretical propositions offered in the literature (Schwartz-Shea and Yanow, 2012).

When starting interpretive policy analysis, a researcher needs to have some propositions and claims informed by the literature research and theory, but these need not be taken as written in stone and the focus of research as well as its conceptualization and direction may change based on the data from the field. The same concerns the research questions which guide such research. For an interpretive qualitative policy analysis approach in this project, we start off with the following questions outlined below:

1. Is there a process of collaborative learning and information sharing between citizens and local authorities facilitated by ICTs with the focus on co-production of knowledge and trust? The dual role of local authorities as elected officials and expertise providers on water issues will be further problematized in the research settings.
2. What are the social, economic, cultural, political and technical conditions or variables which influence the capacity of citizens to participate in a) information sharing; and b) knowledge co-production in a particular area and issue?
3. What are the governance issues and institutions which encourage or discourage local governments and authorities to initiate information sharing and knowledge co-production?
4. How is the process of collaborative learning and deliberation organized? What happens in such events?
5. Who gets to participate in discussions? How are decisions made as a result of these interactions? What follows collaborative learning and decision making in practice after collaborative events?
6. How do ICT feature in this process and what can be changed and improved in this process?
7. What are the implications for the future research and practice in this field?

We base our exploration on two analytical frameworks, one on public participation in governance for citizen-government interactions, and another on policy networks and collaborative planning for a more multi-stakeholder approach. To reiterate, these frameworks are to provide the basis to start the research off, and while the initial focus on collaborative planning and the use of ICT in KDCs will remain, the trajectory of data collection and analysis and the final destination of the project will unfold in the process. More specifically, the research design is targeted to be flexible so that to allow for changes during the research process in order to follow up on the newly identified central challenges and problems in the way local authorities and water companies engage citizens in their work towards the resolution of water challenges with the use of ICT. We focus on collaborative learning which is both a process of interaction which produces trust and social capital and the products of learning, such as projects, news briefs, changes in behaviour and progress towards achieving a goal in water management in a setting.

The first model to conceptualize and think of collaborative learning and participation with the use of ICTs is the model presented by Fung (2006) who looks at the process of government-citizen interaction as a three-dimensional process which is based on a) who is invited to participate; b) how actively participation happens; and c) what happens after participation events in terms of political action. This is a more complete version of the famous Arnstein's ladder of participation (1969). See Figure 2 for the "democracy cube" as discussed in Fung (2006). The use of ICT in promotion of participatory decision making will be studied in all KDCs in two stages, in 2017 before the use of DSPs designed by the project, and in 2018 after DSPs designed by the project become functional.

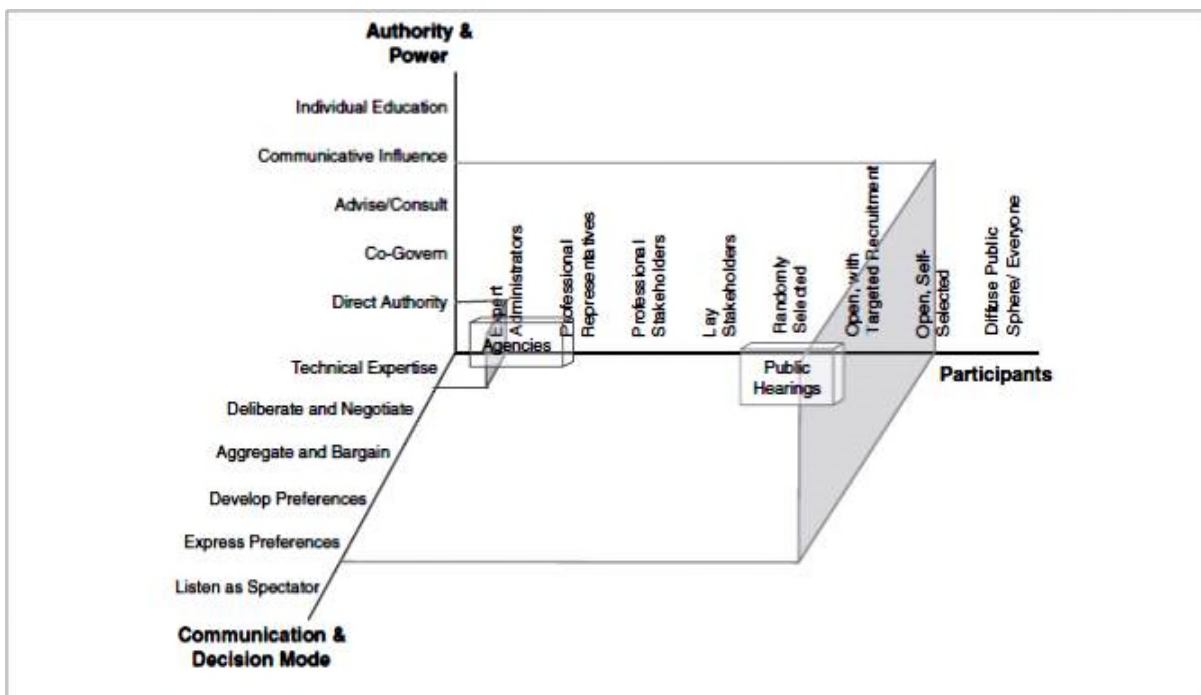


Figure 2 Public participation along three dimensions (Fung 2006)

The second framework for interpretive policy analysis is provided by Gerlak and Heikkila (2011) who focus on the structural, social, and technological features of collaboration which may foster learning and action during the interaction of various stakeholders in KDCs. Gerlak and Heikkila (2011: p5) define collaborative learning as follows:

Collective learning involves both (1) a "collective process," which may include acquiring new knowledge through diverse actions (e.g., trial and error), assessing information and disseminating new knowledge or opportunities across individuals in a collective, and (2) "collective products" that emerge from the process, such as new shared ideas, strategies, rules, or policies.

They also provide a very useful framework for collaborative learning which may help us define and methodologically operationalise the study of collaboration and learning through choosing the concepts

which help understand and explain collaborative learning and identify the measures of such concepts to be researched in KDC through qualitative research methods. The framework shown in figure 3 allows for focusing on particular elements in collaborative learning, in our case, with a specific focus on the role of “technology and functional domain” and the tools for information and knowledge sharing, storing and use. Here the researcher will focus on the structural elements in a policy setting where multiple stakeholders interact and identify if such structures are hierarichical, formal or informal, network-like or have a form of a market. The social dynamics concept is to identify and understand such important issues as trust, awareness of problems and issues, the presence of leaders and their strategies to mobilize support in promoting a particular vision. The technology and faunction domain focuses on the ICT and DSP solutions which enable interactions and learning. The interplay of the above-mentioned factors leads to the learning process and learning outcomes which are studied at the level of both an individual and the collective. The whole process of interaction is permeated by the series of external factors, such as the legal, policy, institutional and socio-cultural circumstances of a particular policy setting at hand. The focus and particular emphasis and narratives and the outcomes of learning will emerge inductively from the case studies, for which an ethnographically sensitive fieldwork is required. More details on the practicalities of the fieldwork can be found in the document titled “Case Study Protocol” presented in Annex 1. The characteristics of the collective setting will be provided by the water governance capacity framework analyses.

A Framework of Collective Learning

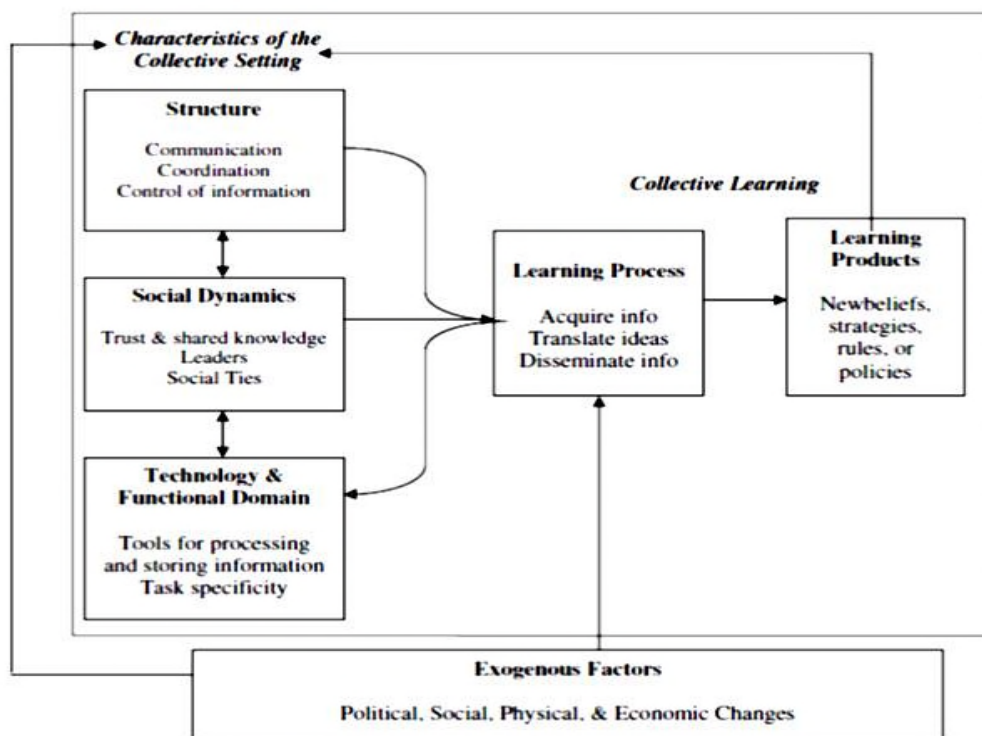


Figure 3 Framework of Collective Learning (Heikkila and Gerlak 2011: 6)

5 Governance Research overview

As mentioned in section 3.2., our two approaches for governance analysis are complementary and follow up one another. In this section, we present these two approaches visually in the form of a diagram in Figure 4. In this diagram, we show how the in-depth case study approach focuses on four conditions identified and studied by the water Governance Capacity Framework, namely awareness, useful knowledge, continuous learning, and stakeholder engagement. Taking these four conditions as a starting point, the in-depth case study analysis will research how DSP application in a particular socio-economic and governance context impacts these four governance conditions with a clear focus on a few dozens of research propositions outlined in Annex 5. Our model outlined in Figure 4 includes three key elements: a) policy model or DSP and its characteristics; b) policy context in each of the four cities as defined by the four conditions from water Governance Capacity Framework; and c) an interaction of a policy model and policy context in a process of policy translation of DSP in the context. We will study all three elements with a particular focus on the policy context at stage 1 (water Governance Capacity Framework analysis) and policy translation in relation to DSPs at stage 2 (in-depth case study analysis).

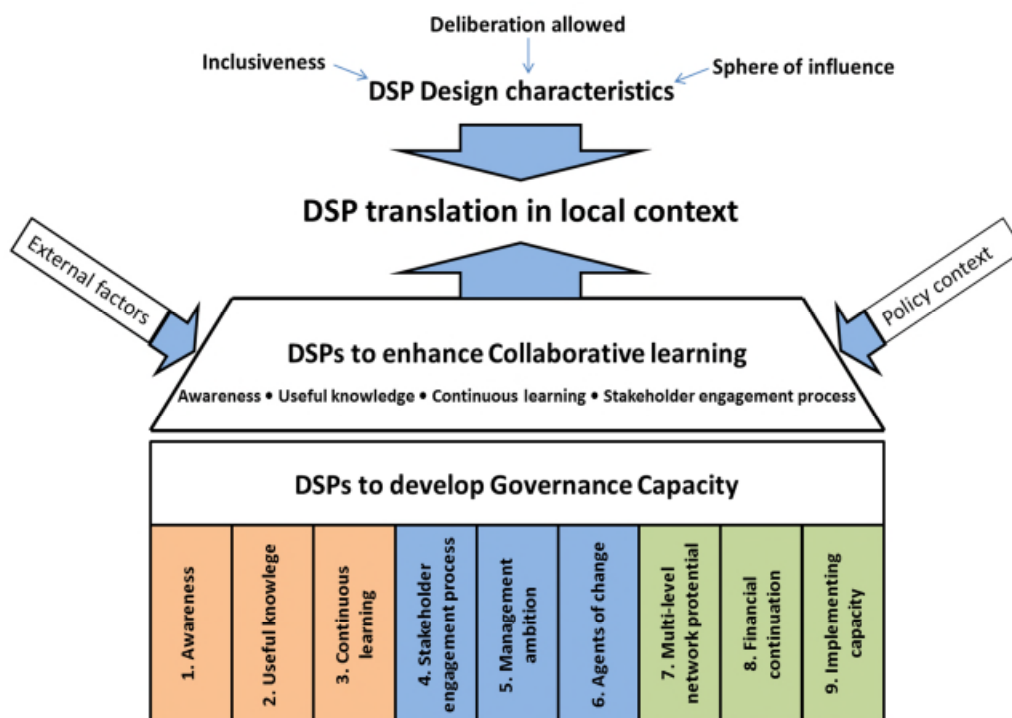


Figure 4 Overview of the proposed governance analyses in the KDCs

Very briefly we would like to articulate the important factors at play in our conceptual model of analysis per each of the three elements introduced:

- a) Policy model or DSP designed for stakeholder engagement and collaborative learning, will play an important role in either enabling or constraining such interactions. Following Fung's (2006) model presented in section 3, we distinguish between DSPs as enabling interaction of various quality along three lines – inclusiveness, the potential for deliberation, and potential for policy impact as a result of deliberations and collaborative learning. These are both characteristics of DSP and of the process of engagement, but we will focus on DSP's inherent qualities vis a vis these three qualities. This element is strongly interlinked with task 3.5 and provides important impute for the development for DSP engagement models;
- b) Policy context in order to enable collaborative learning through DSPs is an important subject of our analysis. Here we focus on four governance conditions as explained above, but also on two other important variables – namely the governance environment, such as laws and regulations and political culture; and what we call "external factors" such as socio-economic and cultural elements of population involved in terms of their everyday life and reaction to the issues of water management. The work of task 3.2. is indispensable in preparing this task since it covered the socio-technical requirements, including the regulatory context for the four water challenges;
- c) As a result of this interaction, policy translation of DSPs into a particular policy context will emerge which is best studied through in –depth case study analysis with the use of interviews, focus groups and ethnographic observations. Here all elements mentioned above come together in order to provide a process and outcome of collaborative learning with implications for management of a particular water challenge at hand.

Annex 5 provides important guidance to analysis through formulation of research propositions aimed to integrate the two parts of the WP4 analysis illustrated in Figure 4, namely the part on water Governance Capacity Framework and the part of Collaborative Learning. The work of collaborative learning will make use of the information collected for five governance conditions, namely "management cohesion", "agents of change", "multi-level network potential", "financial viability" and "implementing capacity". Research propositions are a necessary tool for qualitative research implemented in WP4 as a guiding block of data collection and analysis and constitute the same role as research hypotheses in quantitative research. In this annex we list our research propositions which will be used by students and researchers in analysing the role of DSPs for collaborative learning with the focus on the five governance conditions analysed by the GCF.

6 Practical guidelines governance analyses in the key demonstration cities

The practical details of research implementation are provided in Annex 1 “Case Study Protocol” and these sections aims to provide a shortcut to the KDCs in terms of support the WP4 researchers may need in research administration. The current plan includes the administration of the Leicester case study with Stef Koop completing water Governance Capacity Framework and Farhad Mukhtarov completing interpretive case study analysis (tentative planning for April – June 2017). Furthermore, the team of master students will be assigned to complete the assessment of Leicester, Milton Keynes, Jerusalem and Sabadell (2 students per KDC). They will be supervised by Farhad Mukhtarov, Kees van Leeuwen and Stef Koop. We have worked with master students in the past and have good experience. The main benefit is their time availability as well as the alignment of their Master thesis with the work in the project which provides win-win opportunities. They can spend half a year full time on one specific assessment. This often results in high quality research, depending on close and competent supervision. We will be in close contact with our v in order to keep them informed of our plans as well as ask for support in access to interviewees, research data and logistical support. At the stage of preparation for the fieldwork, we would kindly ask for support from the KDCs with the following key issues:

- Assistance with settling down for researchers and information on practicalities of living in a new city/environment
- Identification of key actors to interview and contact at the national, regional and local levels
- Assistance with contacting key policy actors at the local level, including citizen groups and their representatives
- Provision with information on local archives
- Assistance with work station (a desk) if possible (e.g. at a university in the city or a public library) if possible.

The Case Study Protocol outlines in more detail the logistical plan for both GCF and the case study approach, see Annex 1.

7 Conclusions

It is imperative to understand the type and nature of interaction between citizens, various societal stakeholders and governments because it points out what the current necessities for social interactions are and how these can be facilitated in DSPs. Hence, it is essential to analyse how DSPs can fit into the comprehensive interactive strategy to govern local water-related issues and understand what role this DSPs can play and how these are complementary to other canals of communication (i.e. face-to-face meetings, interactive workshops or focus groups) and types of interaction (informing, consultation and responsibility sharing or knowledge co-creation). Based on this knowledge, the roles and aims that DSP may fulfil can be understood. The work in WP 4 therefore has clear and direct implication for the project as a whole and particular work packages within it.

First of all, the typology for DSPs in Urban Governance Initiatives provides a useful structure for the further development of the DSPs within the POWER project. It provides a frame that can help all project partners to structure the discussion and understand the social possibilities and limitations of DSPs in their cities, and formulate the DSPs designated role and purpose.

Secondly, we propose a governance analyses that includes two separate but complementary components:

- 1) a positivistic general overview, and
- 2) a qualitative in-depth case study approach.

These two components represent different types of knowledge creation that together form a more comprehensive knowledge base than each would have provided separately. The positivistic approach is designed to provide a more general overview that can quickly identify the main barriers and opportunities for cities to increase their governance capacity to address the identified water-related issue and explores opportunities for the application of DSP types. It also provides a frame that can identify cities with similar governance issues which facilitates the exchange of knowledge and experiences and may be very useful for the DSP distribution after its project test phase. The qualitative approach is key in fully understanding the local dynamics of interaction between citizens, stakeholders and multi-level governments. It is an in-depth study that investigates the strengths and weaknesses of the influence of DSPs on the intensity (e.g. enhancing or reducing cross-stakeholder interaction) and nature of local interactions (e.g. what is the influence of DSPs on the equity, legitimacy and accountability of local decision making and policy implementation). Thus, if DSPs are to be user-friendly and demand-driven, the design and use of DSPs need to take into consideration the specific context of the areas and communities for which the applications are design. The intermediate and final results of the governance analysis in WP4 will therefore provide such knowledge baseline for formulating and sharpening the designated role and purpose of DSPs and can facilitate the process of design and adaptation of these platforms.

Thirdly, in order to study how DSPs work in particular context within the POWER project with the focus on public participation and collaborative learning, the team applies a “learning by doing” approach because the nature of social interactions is too complex to anticipate all the limitations and barriers that the use of

DSP might reveal (Huitema et al. 2009). The governance analyses described in this document is therefore flexible and can be applied as an *ex-ante* (before the application of the DSP in the KDCs) or *in situ* (during the application of the DSPs in the KDCs). Thus, it is crucial for the success of the project that DSPs are implemented in these cities as soon as possible, but not later than 2018 in order to allow for an in situ governance analysis in WP 4.

Finally, we have described the methodological approach and provided the necessary practical information (section 4) in order to complete the governance analysis. It is of particular importance that the four KDCs as well as other project partners provide their kind assistance and feedback to the chosen approach and practicalities. We hope for further fulfilling and stimulating work within the project in the spirit of collaboration as has already been established by the consortium and would greatly appreciate support of our partners therein.

A baseline governance capacity analyses will also be done in a few follower cities in order to explore the governance barriers and window of opportunities in cities beyond the four KDCs involved in this project. This is key in fulfilling the overall project aim of finding a broader application of DSPs as a tool to facilitate citizen engagement within EU water policy. These follower cities will be selected from a City Blueprint network, NetwerCH20 and cities that signed the Dubrovnik declaration of intend. Hence, these cities already have shown interest in the topic of water. Deliverable 4.8 will be a report of the results obtained with the governance approach that we have proposed within this deliverable. The results from the baseline and in-depth study of water governance in the KDCs will be the main output. Furthermore, the results of baseline governance assessments in follower cities will be used to better interpret the results of these case studies and understand the possible success and failure of DSPs beyond the four KDCs.

Together with the assessment of DSP impact (task 4.2 and 4.3) and the assessment of urban water cycle services performances and pressures that may affect these services (task 4.4), we will be able to provide a clear overview of the impact of DSPs within the decision making and implementation process in the KDCs and provide clear lessons of success and failure for the DSP usage in follower cities. These efforts within working package four are inherently interconnected with working package 3 where community engagement and where social, technological, environmental, and political uptake is ensured. Finally, the intermediate and end results can greatly benefit the set-up and start-up of the DSPs in Working Package 2.

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Annex 1 Case Study Protocol for Governance Analysis in POWER

1 Introduction

This protocol is intended as a practical translation and articulation of the work conducted in Work Package 4 of the POWER project. The protocol is especially intended to structure the work during field research and collaborations with our Key Demonstration Cities (KDCs), which are Leicester and Milton Keynes (UK), Sabadell (Spain) and Jerusalem (Israel). The Digital Social Platforms (DSPs) are intended to promote collaborative learning and information sharing between local authorities responsible for the provision of urban water cycle services and citizens as consumers and beneficiaries of those services. This document aims to provide two key components of WP 4 research. First, its goal is to articulate a united theoretical approach within WP4 including the GCF (outlined in 4.1) and the collaborative learning approach (outlined in 4.2) to the four case studies with research questions and theoretical propositions to guide fieldwork. Secondly, it aims to provide a detailed guidance to practicalities of the field research in all four cases with the goal of establishing a consistent and scientifically rigorous approach.

This document is version 1 of a generic case study protocol, which will be elaborated into separate documents for the case study areas in each of the four case studies and result in case study reports. The protocol contains further information on the locus and focus of our work (§2), a model planning and advice on interpretive policy analysis (§3), guidance on document analysis (§4) and guidance on how our results should be registered and stored (§5). This set up can be expanded as the situation requires.

2 Locus and focus

At a generic level the researcher will analyse the process and outcomes of ICT facilitated collaborative learning and deliberation between local authorities providing urban water services and citizens and citizen groups. As an extension of the research, a focus on policy networks which enable policy action, such as inter-organizational networks, connections to NGOs and civil groups and businesses can also prove useful in all case study areas. They shall perform analyses at all governance levels implied in the discussion, doing work at the local, regional, and national levels. The influence of international actors will be evaluated only if they can be encountered at these three levels.

The governance analysis in each of the case studies will consist of two separate but complementary parts conducted by two separate researchers (students) per case study. Given that we have 4 case studies, the team will comprise of a number of Master of Sciences students in addition to a post-doctoral researcher and a Ph.D. student involved in data collection and analysis. The water Governance Capacity Framework (section 3.1) and the in-depth case study approach (section 3.2) will be analysed by two different researchers in order to produce independent results. The timing of both approaches is therefore also independent of each other. The first part revolves around assessing urban water governance in each of the four cities with the Governance Capacity Framework which is able to compare cities and identify key

barriers and foci for further capacity building and DSP application. The second approach is constructive approach based on an in-depth and contextual understanding of complex interactions between local governments and citizens, and broader policy networks of stakeholders involved. It is a good practice if students travel to case studies in pairs and follow similar guidelines for research with some modifications of §3 Model Planning.

Thus, the following **topics** are interesting from an analytical perspective in all four case studies:

- The policies, laws, and non-regulatory mechanisms applied in urban water governance of a particular issue in a particular case study, such as floods in Leicester, water scarcity in Milton Keynes, water reuse in Sabadell, and water infrastructure and water conservation variables in Jerusalem.
- Mapping stakeholders involved in the provision of the urban water services, bringing in picture both formal and informal networks, institutions, practices and challenges.
- Is there a process of collaborative learning and information sharing between citizens and local authorities facilitated by ICTs with the focus on co-production of knowledge and trust? How is the process of collaborative learning and deliberation organized? Who gets to participate in discussions? How are decisions made as a result of these interactions? What follows collaborative learning and decision making in practice after collaborative events? How do ICT feature in this process and what can be changed and improved in this process? What are the implications for the future research and practice in this field?

We expect a range of processes to guide citizen-government interactions in ICT facilitated urban water governance with the focus on public deliberation and collaborative learning. These processes need to be mapped and analysed for how they happen and how they could be improved. In all cases, an analysis will involve different stakeholders and processes and will focus on both formal and informal institutions at the local and national levels of governance.

3 Model planning

In this planning, the assumption is made that there are 10-12 weeks available for the field work. Before the field research a thorough research regarding the local governance context and stakeholder analyses are prerequisite. It is also advised to already schedule some interviews and arrange a reliable contact person who has the network to get you in contact with relevant actors. The governance capacity framework and the interpretive case study approach require more or less the same amount of time. Here we describe in detail the activities and their time planning for both approaches.

3.1 Water Governance Capacity Framework approach

The rationale of the schedule is to include all relevant public and private stakeholders into the analyses in order to get a comprehensive overview of governance with respect to a specific water challenge in the case study city. The research frame and data collection are structured in a concise and interactive manner in order to produce results that are applicable for the city, allows for comparison between cities and provides a frame wherein the interpretative case study approach can freely investigate specific governance interactions, and explore this with respect to collaborative learning and DSPs. These assessments will be done within month 17 until month 46 when the reported results need to be finalized as part of deliverable 4.8.

Weeks 1 – 4

- Getting acquainted with Governance Capacity Framework approach as well as the national and local institutional setting of the water challenge by studying reading materials and doing desk study of policy documents, reports and articles
- Make a preliminary scoring of the twenty-seven indicators based on desk study only
- Perform a stakeholder analysis and contact persons representing key stakeholders to schedule 5-7 interviews
- Prepare interview questions for semi-structured interviews

Week 5 - 8

- Arrival in the case city, settling
- Visiting city council and spending time to build rapport with managers and external network of service providers
- Linking up with host organization team and/or local students
- Perform 5-7 scheduled interviews and arrange 4-6 interviews via recommendations of local actors (snowball method). At least one person from organizations representing the state, market, civil society and knowledge institute/universities will be selected for interviews. Their recommendations for next interviews will be considerably different provided the different networks of these persons. In this way, it is aimed to avoid a bias in the interview selection.
- Conduct a preliminary indicator scoring right after each interview. The scoring includes interview results together with previous desk study findings. Email interviewees one or two days after the interview, and ask for feedback to improve the accuracy of the scores (i.e. feedback on interview interpretation and ask for supplementary information to support scores or support their feedback)

Week 9 – 12

- Going back home

- Compile the final indicator scoring and argumentation for these scores into a confidential report using a coding system for the interviewees. This exercise requires an independent point of view and explicit written argumentation for the indicator scoring.
- Write publicly available report (is/ can be part of a thesis). In the discussion and conclusion it needs to become clear how the results of this assessment may provide insight for effective and efficient activities or strategies to increase the governance capacity needed to address the water challenge
- Informing the city council and involved interviewees about the final results

§3.2 Advice on the water Governance Capacity analyses

We provide the researcher with advice regarding the interviews as it is key that these interviews are of high quality:

1. Ensure that you know who you are interviewing, what their role is and what their interests are. This makes you more aware of potentially biased answers.
2. Never literally ask pre-defined question! It is your task as a researcher to get all the information needed to answer these questions. It is your task to formulate your own questions taking into account the person in front of you.
3. Ensure that you start a comfortable conversation. It is very useful if you are well acquainted with the indicators and their meaning as it can help you to make the conversation more “natural” instead of only questions and reply structure. It is most convenient to apply the indicators in the same order of sequence as the framework itself.
4. Consider your first and second interview as an exercise. Moreover, some explorative interviews to get acquainted with the local governance situation can be useful.
5. Make sure that you record everything! You can listen to everything again in order to include all the details and nuances in your scoring and argumentations.
6. The real honest answers to some questions can be avoided by the interviewee. Make sure that you ask this question several times in a different way or get back on it at a later stage in the interview. Try to be friendly under all circumstances.
7. Try to stick to the specific “water challenge” as much as possible. Interviewees might reply your answer by talking about different issues or subjects. The indicators you score always specifically related to the ‘governance issue’.
8. Ask the interviewee to sign the informed consent form prior to the interview.
9. Be assertive and also ask important people for an interview. This is generally accepted and common practice.

3.3 Case study Approach and Interpretive Analysis

This analysis will take place from M16 until M34. The logic of the schedule is that the analysis at the local level needs to be in-depth and requires an extended period of time to get to know the surroundings and build rapport with informants. It is important to target diversity in terms of actors involved in governance and perspective on the various issues. In addition to the local level, good understanding of regional, national and international policy and legal framework is necessary for the research to be positioned in the literature building from the background knowledge in D3.2. It is possible that the students can revisit some of their work at the national and local levels before flying back. Thus, what we suggest is to first analyse policies and laws at the national levels including a number (less than 5) interviews with key stakeholders on that issue, followed by an extended case study analysis at the local level and a possible revisiting of the national level for refreshed probing and interviewing. This document sketches a typical model for a research.

Weeks 1 and 2

- Arrival in country, meeting up with host organization and settling in
- Visiting of host organization/university library to find literature on topic
- Linking up with host organization team and/or local students
- 5-7 interviews with decision makers at the national and regional level. Targeted interviewees (to be arranged beforehand): representatives of key national ministries involved, national and international NGOs, key scholars and experts on the issue.
- Archive research (official documents, media reports) on policy and legal framework.

Weeks 3 – 10

- Arrival in the case study city, settling
- Visiting city council and spending time to build rapport with managers and extended networks of service providers
- Linking up with host organization team and/or local students
- Around 15-20 in depth interviews with local authorities, citizens and other stakeholders. Ethnographic observations and participation in public hearings of participatory events. Focus groups discussions with citizens and their representatives.
- Archive research (official documents, media reports).

Weeks 11 and 12

- Revisiting the national (and regional) level for more interviews and checking up the newly gained insights from the local level also at the national level.

- About 3-5 interviews with those people who have been identified during the local city case study or revisiting experts.
- Archive research (official documents, media reports) on policy and legal framework.

Weeks 13 – 17 (after fieldwork)

- Going back home.
- Revisiting data and re-rewriting the first draft.
- Filling in the gaps in data by emails and telephone/Skype interviews (always ask for a possibility to revisit your informants after the research).
- Checking the report with some informants and experts in the field.
- Finalizing the draft.

§3.4 Advice on Interpretive Policy Analysis

1. One key advice is to have the theoretical ideas and the model planning in mind, but allow for surprises to happen and go with the flow of interesting and relevant ideas, stories and arguments emerge. The broad theme of what happens when ICTs facilitate citizen-government and the interaction of multiple stakeholders should remain the focus, however the direction of research may change depending on findings in the field.
2. Another key advice is to keep writing down everything one has obtained during interviews, but also through observations and casual reflection, as well as a more formal analysis of one's data. Importantly, this should take place at the same time with collecting data, not afterwards. In this way, more informed interviews, observations and case descriptions are possible as well as a more informed and gradual shifting of research as it progresses, in concert with the interpretive research design (Schwartz-Shea and Yanow, 2012).
3. The third key advice to researchers would be to keep in mind that their own backgrounds will inevitably impact the results of their analysis, and it is important to be aware and transparent about this both to oneself and to readers. One key concept is positionality – how others see a researcher influences what data that researcher is able to access and where he or she is taken. Another key concept is reflexivity – centered on the idea that researchers' beliefs, values and background will inevitably influence one's analysis and results – and therefore it is important to keep in mind the manner in which these "filters" influence knowledge claims.
4. Finally, in all interviews and focus groups, please use the specifically designed signed informed consent forms.

4 Document analysis

It will be helpful and necessary to gain access to some of the formal records pertaining to public participation procedures and events in case studies, such as reports on such events, minutes of meetings and results of these.

The added value of performing an analysis of the written record is that the written record was done at the time of the participatory event. Interviews tend to result in an image of the past that is coloured by current knowledge. Furthermore, please try to gain access to participation events or hearings/meetings during your field visit. Given legal obligations about transparency, etc. the written record also offers a good starting point to at least find out which formal reasons are given for certain decisions.

The document analysis in the case study areas can consist of the following aspects:

- If available, official plans pertaining to managing a particular issue (e.g. flooding, water conservation) in a particular setting.
- Independent and government reviews of the issue at hand.
- Meeting reports of representative bodies and councils.
- NGO reports/inputs to the decision process.
- Newspaper reporting on the case at hand. Often somewhat less reliable for scientific reporting as journalists often have to work quickly, but a good source for direct quotations and finding names of people to interview.

It is good practice to make digital copies of relevant documents. In some cases actual examination of the documents has to wait until the phase wherein the report is being written. Importantly, make sure that you carefully reference these documents whenever you make a statement or argumentation. For an outsider, it should be easy to get access to the background documents related to your findings.

5 Reporting and archiving

Good scientific analysis is transparent and allows for replication by other researchers. From that perspective it is important to make sure that records are kept of the analysis. The following will be applied in our analysis in accordance with the deliverables outlined in WP6, specifically in D6.2 and sections 4.3. and 4.4. on interviews and workshops data and DSP use data:

- Interviews and the copies of the signed informed consent forms will be digitally recorded and the files with those interviews will be stored securely at UU and KWR premises.
- The interviewer will make notes during the interview. These notes will be typed as a word file after the interview and as soon as possible after the interview to keep impressions and ideas of the researcher fresh. Where direct quotes are included in the interview report, these will be checked against the sound file for accuracy.
- The summary reports will be sent to the interviewees for comments with a deadline to come back.
- When interviewees want to remain anonymous this will be made possible. If their statements are referred to in the report, they will be described in general terms without revealing their identity.
- The summaries of all interviews will become part of the POWER project data files. When interviewees only wanted to speak on the basis of anonymity, these summaries will not be included in the files as those will possibly be made available for the general public and other researchers.

Annex 2 Assessing the governance capacity of cities to address challenges of water, waste, and climate change

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Abstract The challenges of water, waste, and climate change in cities are overwhelming and underpin the importance of overcoming governance issues impeding adaptation. These “*governance challenges*” typically have fragmented scopes, viewpoints, and responsibilities. As there are many causes leading to this uncertainty and disagreement, there is no single best approach to solve these governance challenges. In fact, what is necessary is iterative and requires governance capacity to find dynamic long-term solutions that are supported by flexible interim targets, so as to anticipate emerging barriers and changing situations. The literature contains a plethora of governance gaps, barriers, and capacities, which sometimes overlap, are contradictory and case-specific, and reflect disciplinary scopes. We argue that a balanced set of well-developed conditions is needed, to obtain the governance capacity that enables effective change. Therefore, we aim to obtain deeper understanding of the key conditions determining the urban water governance capacity, by developing an integrated empirical-based approach that enables consistent city comparisons and facilitates decision-making. We propose a governance capacity framework focusing on five governance challenges: 1) flood risk, 2) water scarcity, 3) urban heat islands, 4) wastewater treatment, and 5) solid waste treatment. Nine governance conditions, each with three indicators, are identified and empirically assessed using a Likert-type scoring method. The framework is illustrated by a case study on Amsterdam, the Netherlands. We conclude that our approach shows great potential to improve our understanding of the key conditions determining the governance capacity to find solutions to the urban challenges of water, waste, and climate change.

Keywords: Governance Capacity – Water governance – Water management – Climate adaptation – City Blueprint Approach – Social learning

1 Introduction

Governance challenges.

Cities face one of the largest global challenges: the issues of water, waste, and climate change in a rapidly urbanizing world (World Economic Forum, 2016; Koop and Van Leeuwen 2016). By 2030, the world will be experiencing an estimated 40% freshwater shortage (2030 WRG 2009). Sea-level rise, soil subsidence, and extreme river discharges pose risks to around 15% of the global population, mostly in urban areas, including almost all the world's mega-cities (Ligtvoet et al. 2014). Cities are particularly vulnerable to flooding by storm events, which are increasing in magnitude and frequency (EEA 2012). Furthermore, streams, rivers, and oceans are heavily polluted by insufficiently treated wastewater and solid waste (Derraik 2002; Ligtvoet et al. 2014), which is leading to losses of valuable resources such as phosphate (European Commission 2015). Finally, global warming is exacerbating heatwaves that pose serious health risks to people living in Urban Heat Islands (UHI): for example, it is estimated that in 2003 heatwaves were responsible for 70,000 deaths in Europe (Baccini et al. 2008). In order to combat UHI, vegetation and water bodies need to be intertwined in the urban infrastructure.

Altogether, urban areas face five main interrelated water challenges: 1) water scarcity, 2) flood risk, 3) wastewater treatment, 4) solid waste treatment, and 5) urban heat islands (EEA 2012,2016; UCCRN 2011). Meeting these challenges requires good governance, because it entails managing long-term, complex, uncertain, and imperfectly known risks that can have large impacts. Typically, multiple governance layers (OECD 2011) and a variety of stakeholders, sectors, and policies are involved, each with different time horizons and agendas (Segrave et al. 2013). Because there are many causes that can lead to the complexity, uncertainty, and disagreement, there is no single best approach to address these *governance challenges*. In fact, what is necessary is an iterative process that requires governance capacity to find integrated long-term solutions that are supported by flexible intermittent targets to anticipate changing situations and adapt to emerging barriers. Hence, it is essential to manage governance challenges in an integrative long-term approach (Patterson et al. 2013).

Knowledge gap

The need for integrated approaches is reflected in two main concepts: 1) Integrated Water Resources Management (IWRM), and 2) Adaptive Management (AM). IWRM aims to reshape institutional structures and redefine problems, to broaden scope. AM focuses on changing the way responsible authorities perceive and act, by emphasizing experimentation and the value of learning to adapt to changing and uncertain challenges such as climate change (Medema et al. 2008). Despite their important contributions, both approaches appear to be difficult to implement, as they are not very concrete, operate at multiple scales, and their explanations differ. Moreover, they tend to be focused on more technical solutions with lesser attention to governance processes (Medema et al. 2008; Rahaman and Varis 2005; Gregory et al.

2006). Therefore, these approaches sometimes fail to provide clear and effective guidelines for their concrete application (Gregory et al. 2006).

With respect to water management, the City Blueprint Trends and Pressure Framework and the City Blueprint Performance Framework provide integrated and strategic insights into the management performance of local authorities (Koop and Van Leeuwen 2015a,b). Furthermore, the OECD (2015a) principles of good water governance provide for an integrated network analysis of the fragmented water sector. They include analyses of international, national, and sub-national indicators and learning practices but do not focus on urban water governance.

A few worthy attempts have been made to compare organizations and institutions (Gupta et al. 2010; Ballard 2008; Engle and Lemos 2010). However, the rich literature on governance and transformation processes has a theoretical nature and only a few approaches have been reported as providing tangible results to facilitate decision-making (Kersberger and Waarden 2004). At the same time, there is a seemingly endless list of social factors and conditions that impede or enhance our ability to respond proactively to future changes (Biesbroek et al. 2013). They often reflect a disciplinary scope and focus on specific case studies, which limits their usefulness and learning value (Measham et al. 2011). Hence how socioeconomic factors actually influence urban governance processes largely remains an open question (Biesbroek et al. 2013) that can only be explored by applying a coherent framework that assesses different contexts consistently, provides empirical-based understanding of underlying governance processes, and searches for transferable lessons that enhance overall governance effectiveness.

Research aim

In many cases, organizations or institutions are taken as the point of departure for governance assessment, whereas in practice, organizations often tend to focus on sub-tasks, lacking a full notion of their interdependencies, and underestimating the need for cooperation in addressing shared goals (Emerson et al. 2012). We argue that this is a missed opportunity, because interaction and collaboration between all relevant actors is critical. Moreover, the urban scale is increasingly recognized as having a crucial role in finding the most suitable solutions to address context-specific climate vulnerabilities (Measham et al. 2011; OECD 2015c). So far, little effort has been made to consistently assess the urban water governance capacity. However, such an assessment creates great potential to understand specific (local) issues and underlying processes, can provide recommendations for stakeholders, and shape learning alliances in and between cities. Here we aim to provide a deeper, integrated, and empirically-based understanding of the most important enabling conditions that determine the governance capacity needed to continuously solve governance challenges of water, waste, and climate change in urban networks. To do so, we develop a cohesive, comprehensive, and applicable Governance Capacity Framework (GCF) for cities, which can

1. compare cities in order to develop a deeper empirical-based understanding of the key enabling governance conditions and identify transferable lessons.
2. reveal the limiting conditions and thereby formulate pathways for effective and efficient increase in the local governance capacity.

The paper is structured as follows. Section 2 provides a literature-based overview that frames and defines governance capacity. This definition is operationalized into a comprehensive framework in section 3. In section 4 a Likert-type method to score governance capacity is described. Section 5 provides an illustration of the first GCF pilot study in the city of Amsterdam, the Netherlands. Finally, section 6 presents the major discussion points and conclusions about the framework.

2 Framing governance capacity

Governance capacity has a rich literature in the fields of environmental governance, climate adaptation, capacity building, public administration, and water governance. An important component of governance capacity is institutional capacity: this generally focuses on how institutional setting, rules, and regulations enable actors to collaborate and address shared problems (UNDP 2008; Dang et al. 2016). Governance capacity is broader, also including resources and the role of discourses (Engle and Lemos 2010; Pahl-Wostl 2009). As it is widely recognized that governance capacity is context-dependent, definitions diverge considerably. Some emphasize integration (Emerson et al. 2012), others cooperation (Dang et al. 2016), yet others focus on flexibility (Termeer et al. 2015). We take the position that governance capacity is about enabling effective change.

The kind of change that is effective is context-dependent. For example, integration is needed whenever scopes are fragmented, whereas adaptive approaches are needed to address inflexibility, and anticipatory governance is required when responses are reactive (Segrave et al. 2016). Nevertheless, a few communalities regarding governance capacity can be identified. First, this capacity is about the ability of actors to continuously identify and jointly act on collective problems (Dang et al. 2016). Second, the capacity is determined by actors' interactions formed by social-institutional settings and allocation of resources (Pahl-Wostl 2009). Third, actors' frame of reference, including their interests, values, and culture, shape interactions and influence collective problem-solving (Adger et al. 2009). Therefore, no single governance condition is decisive. On the contrary, governance capacity is determined by a balanced set of conditions that need to be well developed. Importantly, the nature of actors' interactions is complex, unpredictable, and susceptible to external social-ecological developments. Hence, governance capacity per se does not lead to efficacious change, but rather is a precondition or enabler for effective change. Accordingly, we define water governance capacity as *“the key set of governance conditions that should be developed to enable change that will be effective in finding dynamic solutions for governance challenges of water, waste, and climate change in cities”*.

3 Constructing the Governance Capacity Framework

Policy actions often appear to be effective, and a wide range of governance gaps or barriers have been suggested as reasons for this (e.g. Biesbroek et al. 2013). The literature has identified normative principles (e.g. OECD 2015a) and enabling or adaptive capacities (e.g. UNDP 2008; Ford and King 2015). We make use of this rich knowledge base by selecting and redefining key conditions and their indicators that enable effective change, exploring their interrelations, assessing their relevance for urban water governance, and reformulating them into a well-balanced framework. We have also studied existing frameworks that analyze social processes that have inhibited or stimulated effective change have been studied in the field of urban water governance (Brown and Farralley 2009), river basins (Engle and Lemos 2010), water systems (Van Rijswick et al. 2014), or have a multi-level perspective (OECD 2011,2015a; Pahl-Wostl et al. 2010). Other frameworks that have been applied in the past have concerned the adaptive capacity of institutions (Gupta et al. 2010) and organizations (Ballard 2008), or have been scale-independent (e.g. Moser and Ekstrom 2010; Ford and King 2013).

We identified key conditions for good urban water governance and classified them into three dimensions: knowing, wanting, and enabling. The “knowing” dimension refers to the need to be fully aware, understand, and learn the actual or possible risks and impacts of actions, policy, and strategic choices. We created the “wanting” dimension because actors need to commit to cooperate, express, and act upon ambitions, and apply their skills and capabilities to finding solutions. Finally, the “enabling” dimension was created because actors need to have the network, resources, and instruments to enable them to implement their ambitions. The resulting framework has nine governance conditions; an in-depth literature study for each condition yielded three indicators. The results are shown in table 1, below the findings from the literature research are described.

Table 1 The Governance Capacity Framework (GCF). The GCF consists of nine conditions, each defined by three indicators. For each indicator, a Likert-type scoring scale has been developed, which ranges from very encouraging (++) to very limiting (--) to the governance capacity.

Dimensions	Conditions	Indicators
Knowing	1 Awareness	1.1 Community knowledge 1.2 Local sense of urgency 1.3 Behavioral internalization
	2 Useful knowledge	2.1 Information availability 2.2 Information transparency 2.3 Knowledge cohesion
	3 Continuous learning	3.1 Smart monitoring 3.2 Evaluation 3.3 Cross-stakeholder learning
Wanting	4 Stakeholder engagement process	4.1 Stakeholder inclusiveness 4.2 Protection of core values 4.3 Progress and variety of options
	5 Management ambition	5.1 Ambitious and realistic management 5.2 Discourse embedding 5.3 Management cohesion
	6 Agents of change	6.1 Entrepreneurial agents 6.2 Collaborative agents 6.3 Visionary agents
Enabling	7 Multi-level network potential	7.1 Room to manoeuver 7.2 Clear division of responsibilities 7.3 Authority
	8 Financial viability	8.1 Affordability 8.2 Consumer willingness to pay 8.3 Financial continuation
	9 Implementing capacity	9.1 Policy instruments 9.2 Statutory compliance 9.3 Preparedness

Condition 1: Awareness

Awareness is a prerequisite to enable effective change. It refers to a more profound understanding of the causes, impact, and risks of governance challenges (Raaijmakers et al. 2008). Awareness is both cognitively and emotionally felt by individuals, organizations, and society (Ballard 2008) and forms the base for learning and action (Adger et al. 2009). *Awareness* is assessed by the indicators 1.1 *community knowledge*, 1.2 *local sense of urgency* and 1.3 *behavioral internalization*. *Community knowledge* refers to the extent to which different stakeholders possess relevant knowledge about the challenges. This is the first step in achieving conscious behavior (Gifford 2011). *Local sense of urgency* reflects the perception of importance of the governance challenge, which may or may not result in actions and policies (O'Connor et al. 1999). Finally, *behavioral internalization* indicates that a higher level of knowledge affects actors' problem-framing, goals, values, and perceptions, changing their behavior and increasing their commitment to sustainable approaches (Gifford 2011).

Condition 2: Useful knowledge

The field of information science distinguishes between data, information and knowledge (Zins 2007). Data in itself is not necessarily informative, as useful knowledge can only be obtained by data interpretation and analysis (Zins 2007; Rowley 2007; Van Leeuwen 2007). *Useful knowledge* consists of 2.1 *information availability*, 2.2 *information transparency*, and 2.3 *knowledge cohesion*. *Information availability* refers to the extent that reliable knowledge is available. A lack of knowledge inhibits informed decision-making (Rowley 2007; Van Rijswijk et al. 2014). Many cities authorities recognize the lack of knowledge of how future trends, such as urbanization and climate change, will affect them (Amundsen et al. 2010). *Information transparency* refers to the effective communication and sharing or co-creation of knowledge with all interested stakeholders. The information needs to be good quality, credible, understandable, and accessible for non-experts, in order to prevent miscommunication, knowledge gaps, and fragmented policy (Lemos et al. 2012; Füssel 2007). Finally, *knowledge cohesion* refers to the conformity of knowledge across actors, sectors, and administrative layers.

Condition 3: Continuous learning

Continuous learning is required, in order to adapt to changing situations with many uncertainties, complexities, and unknowns (Folke et al. 2005). *Continuous learning* is assessed by 3.1 *smart monitoring*, 3.2 *evaluation* and 3.3 *cross-stakeholder learning*. *Smart monitoring* is a precondition for learning and may serve as tool for identifying alarming situations, clarifying underlying processes, and predicting future developments (Van Leeuwen 2007). Regular monitoring and evaluation are imperative for continuous learning and enhance preparedness for uncertain futures. In order to conceptualize *evaluation*, the theory of triple-loop learning is used, which has three levels: 1) single-loop learning is incremental learning to refine current management and policy; 2) double-loop learning refers to the critical investigation of assumptions and key relationships, which reframes problems; 3) triple-loop learning questions underlying

norms and values and can transform the wider social and institutional structure (Pahl-Wostl 2009). Finally, *cross-stakeholder learning* is crucial for learning in a public policy context, as the interaction among actors and their understanding of different perspectives lead to a more comprehensive, if not consensual, evaluation (Emerson et al. 2012). Furthermore, this can prevent overly limited scopes or path-dependencies (Termeer et al. 2015; Brown and Farrelly 2009).

Condition 4: Stakeholder engagement process

The importance of stakeholder engagement is widely recognized from a normative, substantive, and instrumental rationale (Glucker et al. 2013; OECD 2015a,b; UNDP 2008). Stakeholder engagement may lead to a more complete problem-framing and widely accepted optimized solutions for all parties involved (Pahl-Wostl 2009; Van Rijswick et al. 2014). Active stakeholder engagement is generally more time-consuming than unilateral decision-making. However, this can be more than compensated for by time gains in the implementation phase (Ridder et al. 2005). The *stakeholder engagement process* consists of 4.1 *stakeholder inclusiveness*, 4.2 *protection of core values* and 4.3 *progress and variety of options*. *Stakeholder inclusiveness* refers to the extent to which the representatives are able to speak and decide on behalf of all relevant stakeholders in clear and transparent engagement processes (Ford and King 2015; Ridder et al. 2005). *Protection of core values* refers to the importance of ensuring that all stakeholders feel confident that their core values are not harmed, in order to create a safe environment for trust relationships (Ridder et al. 2005; Pahl-Wostl et al. 2011). Therefore, it is essential that stakeholders become actively involved and commit to the process, rather than the outcome is predetermined or intermediate decisions are made early on (Folke et al. 2005). Moreover, stakeholders' contribution should influence the end-result. *Progress and variety of options* encompasses the prospect of gain for each stakeholder, which is ensured by clear and realistic procedures. Stakeholders should co-produce and, at the end of the process, select from a variety of options, to ensure learning and authoritative decisions (Ridder et al. 2005).

Condition 5: Management ambition

Management ambition is a measure of the extent to which sustainable management and policy is interwoven with historical, cultural, normative, and political context. This is measured by assessing the sustainability ambitions within policies. *Management ambition* is assessed by 5.1 *ambitious and realistic management*, 5.2 *discourse embedding*, and 5.3 *management cohesion*. *Ambitious and realistic management* need to be long-term, with intermittent measurable targets, all provided with sufficient resources and flexible mechanisms to deal with changing situations (Brown and Farrelly 2009). *Discourse embedding* is important, as management ambitions need to match the dominant values, discourses, and principles, in order to be successful (Van Rijswick et al. 2014). Hence, the degree to which the challenges of water, waste, and climate change are embedded in the dominant discourse, strongly determines the effectiveness of ambitious management and policy. *Management cohesion* assesses the level of integration between different sectoral policies and strategies, across governance levels, and between organizations. Often, the over-fragmentation of roles and responsibilities means that no single agency is in charge of

water policy, and opportunities to create co-benefits are not seized (OECD 2011,1015a; Head and Alford 2013)..

Condition 6: Agents of change

The concept of agents of change is often described in the fields of organizational change, AM, and innovation studies, although different terminology is used (e.g. leaders, policy entrepreneurs, institutional entrepreneurs; Pahl-Wostl et al. 2011; Ballard 2008; Brouwer and Biermann 2011). “Agents of change” refers to the intrinsic motivation of people, their willingness to take risks, and the support given to these efforts to change current approaches. The concept is therefore not limited to people in leading positions (Brouwer and Biermann 2011; Head and Alford 2013; Schultz and Fazey 2009). For this condition, three types of agents of change are distinguished: 6.1 *entrepreneurial agents*, who have the means and skills to gain access to resources, seek opportunities, and manage risks; 6.2 *collaborative agents*, who have the skills to build bridges and coalitions between actors; and 6.3 *visionary agents*, who envision long-term adaptive approaches and are able to steer current policy and actions (Termeer et al. 2012; Gupta et al. 2010; Ford and King 2015).

Condition 7: Multi-level network potential

Flexible and dynamic networks are important, in order to deal with governance challenges with different interests and perspectives, and with stakeholders acting at different levels (Pahl-Wostl 2009; Gupta et al. 2010; Moser and Ekstrom 2010). *Multi-level network potential* consists of 7.1 *room to manoeuvre*, 7.2 *clear division of responsibilities*, and 7.3 *authority*. *Room to manoeuvre* assesses the opportunity that actors have to explore different alternative pathways, develop knowledge, and put ideas into practice. This also involves the possibility and autonomy of actors to form ad hoc fit-for-purpose partnerships that can address unconventional and emerging challenges (Gupta et al. 2010; Folke et al. 2005). *Clear division of responsibilities* refers to the accurate and clear division of tasks and roles for which stakeholders can be held accountable (Mees et al. 2014). *Authority* refers to the presence of legitimate forms of authority (e.g. embedded in policy or law), regulations, and policy networks that promote the necessity to address water-related challenges (Van Rijswick et al. 2014).

Condition 8: Financial viability

Addressing urban water-related challenges requires the assurance of long-term financial support (OECD 2015c; UNECE 2009), as short budgetary cycles prevent long-term thinking (Ford and King 2015) and will most likely substantially increase overall cost (UNEP 2013; Koop and Van Leeuwen 2016). Two important aspects of financial viability are the costs and benefits of measures: e.g., who is affected, who benefits, and, therefore, who should pay (UNECE 2009). *Financial viability* is characterized by 8.1 *affordability*, 8.2 *consumer willingness to pay*, and 8.3 *financial continuation*. *Affordability* of water and climate adaptation services is assessed with a focus on the poor and marginalized groups (OECD 2011; UNDP 2008). *Consumer*

willingness to pay assesses how expenditure and risks are perceived. Often, trust in local authorities and their accountability, as well as the sense of urgency or worry, are key (Raaijmakers et al. 2008). Finally, *financial continuation* is needed for solving long-term challenges and avoiding resources being squandered as a result of uncoordinated investments (Adger et al. 2005).

Condition 9: Implementing capacity

Most studies mention policy implementation as crucial (Adger et al. 2005; Ekstrom et al. 2011; Van Rijswick et al. 2014). *Implementing capacity* is substantiated through 9.1 *policy instruments*, 9.2 *statutory compliance* and 9.3 *preparedness*. *Policy instruments* can be used to stimulate desired behavior and discourage undesired activities (Mees et al. 2014). Examples are the inclusion of the user-pays and polluter-pays principles in pricing. Continuous monitoring, evaluation, and adjustments are needed, to check and improve the effectiveness of instruments. *Statutory compliance* ensures that stakeholders respect and understand agreements, objectives, and legislation, which contributes to the accountability of authorities. *Preparedness* increases the implementation capacity, as the existence of action plans, procedures, and scripts supports policy and prepares the city for both gradual and sudden changes, events, and calamities (Gupta et al. 2010; Raaijmakers et al. 2008; Runhaar et al. 2016)..

4 Determining levels of Governance Capacity

Despite the rich literature on governance capacity which provides many clues, it remains in many aspects a puzzle to identify gradual levels of increasing governance capacity and only a few studies explicitly described them (e.g. Gupta et al. 2010; Ballard 2008). Hence, a better understanding of these gradual levels of governance capacity is needed to provide valuable insights into key governance processes. It should also be noted that a scaling system provides cities with a better and more nuanced indication of where they are, and what steps to take to improve their capacity. For each of the twenty-seven indicators we therefore developed a Likert-type scoring system, with scores ranging from very encouraging to the overall governance capacity (++) to very limiting to the overall governance capacity (--). The indicator levels were determined from a wide-ranging perusal of the literature, including AM theory (e.g. Folke et al. 2005; Engle and Lemos 2010; Gupta et al. 2010) in combination with specific theory for each condition. In addition, we included practical indicators from governance assessments and policy documents (BAGroep 2016; KING 2016). Table 2 illustrates the scoring methodology. Each of the twenty-seven indicators are scored by answering a predefined question, which are illustrated for the indicators belonging to condition 4 *stakeholder engagement process*. Next, the Likert-type scoring scale for indicator 4.2 *protection of core values* is provided. The Likert-type scoring levels, together with predefined questions, and the five main literature sources are available for each indicator at: <http://www.eip-water.eu/sites/default/files/Indicators%20of%20the%20Governance%20Capacity%20Framework.pdf> The Likert-type scoring scale for indicator 4.2 *protection of core values* is based on three main aspects which together ensure that stakeholders feel confident that their core values are not harmed (Ridder et al. 2005):

1. Stakeholders need to be asked to commit to the process rather than to a predetermined outcome or intermediate decisions early in the process.
2. The existence of clear rules and procedures that have been agreed upon before the start of the engagement process, in order to ensure a sound environment in which trust relationships can be developed.
3. The actual influence stakeholders have on the end-result is important. It is largely determined by the type of stakeholder interaction, which can be conceptualized into three layers. The first layer (*information supply*) indicates one-way communication. The second layer (*consultation*) indicates that stakeholders can give feedback on developed plans. The third layer (*active involvement*) actively involves stakeholders throughout the policy-making and implementation process (CIS Working Group 2.9 2003).

Table 2 Illustrative overview of the GCF scoring methodology. First, an overview of the predefined questions for the indicators belonging to condition 4 *stakeholder engagement process* are given. Second, for indicator 4.2 *protection of core values* Likert-type scoring is provided as an illustration. The predefined questions, Likert-type scoring scale and a literature overview for each of the twenty-seven indicators are summarized [here](#).

Predefined questions for condition 4 <i>stakeholder engagement process</i>	
Indicator	Predefined question
4.1 Stakeholder inclusiveness	To what extent do stakeholders interact in the decision-making process interaction (i.e., are merely informed, are consulted, or are actively involved)? Are their engagement processes clear and transparent? Are stakeholders able to speak and decide on behalf of a group?
4.2 Protection of core values	To what extent 1) is commitment focused on the process instead of on early end-results? 2) do stakeholders have the opportunity to be actively involved? 3) are the exit procedures clear and transparent? (All 3 ensure that stakeholders feel confident that their core values will not be harmed.)
4.3 Progress and variety of options	To what extent are procedures clear and realistic, are a variety of alternatives co-created and thereafter selected from, and are decisions made at the end of the process in order to secure continued prospect of gain and thereby cooperative behavior and progress in the engagement process?

Likert-type indicator levels for indicator 4.2 <i>Protection of core values</i>	
Level	Description
Very encouraging (++)	Maximal protection of core values Stakeholders are actively involved and co-create the end-result. There are clear exit possibilities and clear process procedures. All relevant stakeholders are engaged and a variety of options are assessed. The final options are chosen at the end of the engagement process
Encouraging (+)	Demand for commitment to early output Stakeholders are actively involved and expected to commit to early process outcomes. Hence some relevant stakeholders are discouraged from committing, as not all options are being assessed and at this stage the stakeholders contribution might be small. The stakeholders have influence on the end-result

Indifferent (0)	Suboptimal protection of core values	Stakeholders are consulted or actively engaged for short periods. The number of options considered and influence on the end-result are limited. Exit rules are vague. Decisions mainly comply with the interests of the initiating party
Limiting (-)	Low influence on end-result	Stakeholders are kept informed or consultation meetings are taking place for already partly or fully elaborated plans. The influence on the end-result is small and resistance may be evoked
Very limiting (--)	Ignorance of core values	Stakeholders are hardly engaged, not informed or only informed after decisions have already been made. Resistance to implementation often occurs, as do distrust and lack of stakeholder participation, and no clear communication

5 Illustrating the Framework: Governance capacity in Amsterdam

Assessing the governance capacity

We applied the GCF to the five water governance challenges faced by the city of Amsterdam. Amsterdam has a complex hydrological setting: large areas are below sea level, many canals and sluices regulate the different water levels, and there is a sophisticated system for supplying drinking water, which involves infiltrating surface water into the nearby dunes. A triangular method was applied to score indicators according to the Likert-type method. First, an analyses of policy documents and reports provided preliminary scores. Second, at least fifteen interviewees, three for each of the five governance challenges, were selected. To this end, the most relevant stakeholders were identified and their interdependencies were plotted, and key persons from different levels of decision-making were selected (Reed 2009). As explained above, there were twenty-seven predefined questions that the research needed to answer: one for each indicator and each asked separately with respect to the five governance challenges. In this way, a consistent assessment approach was applied that enables basic comparisons to be made between, on the one hand, governance challenges, and, on the other hand, between cities. The interview questions were aimed to gather all the information needed to answer the predefined questions. They were open and non-technical, with follow-up questions to target specific elements, or to achieve further clarification. Finally, after the interviews, the participants received the predefined questions with the preliminary indicator scoring and were asked to provide constructive feedback and additional information to be included in the final scoring. The assessment was fully transparent, as the Likert-type scales, twenty-seven predefined questions, and the full list of references are publicly available.

Results

Each of governance challenges was separately assessed and scored: from very encouraging (++) to very limiting (--) to the governance capacity (Table 3). This first assessment suggests that Amsterdam excels in flood risk governance, and most indicators regarding water scarcity and wastewater treatment are encouraging. However, more governance capacity needs to be developed to address Urban Heat Islands (UHI), since the number of tropical days (>30 °C) in the Netherlands is predicted to rise substantially, from 4 days at present to 7-13 days by 2050 and 8-21 by 2100 (KNMI 2014). Interestingly, cities in Northern Europe appear to be most affected by the predicted rise in high temperatures, because here, temperatures will strongly exceeded the usual seasonal conditions (EEA 2012). Despite this, in the Netherlands, no separate policy on UHI has been developed so far. Consequently, Amsterdam lacks specific targets and policies regarding UHI. The lack of policy may explain the low multi-level network potential (condition 7) to address UHIs. Averaging the scores of the five challenges for each indicator yields a more general overview of Amsterdam's water governance capacity (Figure 1). It suggests that the knowledge level of communities (indicator 1.1) and the access to understandable information for non-experts (indicator 2.2) may slightly limit local support (indicator 1.2) and consumer willingness to pay (indicator 8.2). These results are in line with the OECD (2014) analyses of the Dutch water governance, which conclude that Dutch citizens take water services for granted and that this "awareness gap" tends to decrease public involvement and the willingness to pay for water services. Therefore, the most feasible way for Amsterdam to further enable effective policy change is to focus on improving the indicator scores found to be limiting (-) or very limiting (--) to the city's governance capacity.

Table 3 Overview of the twenty-seven governance indicator scores for each of the five water-related governance challenges for the city of Amsterdam. Scores range from very encouraging (++) to very limiting (--) to the city's governance capacity to find dynamic solutions.

	Water scarcity	Flood risk	Waste water treatment	Solid waste treatment	Urban heat islands
1.1 Community knowledge	-	0	-	0	-
1.2 Local sense of urgency	-	++	-	0	-
1.3 Behavioral internalization	+	++	++	+	-
2.1 Information availability	++	++	0	0	0
2.2 Information transparency	0	0	0	-	-
2.3 Knowledge cohesion	+	0	0	0	+
3.1 Smart monitoring	++	++	++	++	-
3.2 Evaluation	++	++	++	++	-
3.3 Cross-stakeholder learning	+	++	++	0	-
4.1 Stakeholder inclusiveness	++	++	++	0	++
4.2 Protection of core values	++	++	0	+	-
4.3 Progress and variety of options	++	++	0	0	0
5.1 Ambitious and realistic management	+	+	+	0	--
5.2 Discourse embedding	++	+	0	++	-
5.3 Management cohesion	++	+	++	+	-
6.1 Entrepreneurial agents	++	+	++	+	-
6.2 Collaborative agents	+	+	+	0	-
6.3 Visionary agents	+	++	+	0	+
7.1 Room to manoeuver	+	+	0	+	0
7.2 Clear division of responsibilities	+	++	+	0	--
7.3 Authority	+	++	+	++	--
8.1 Affordability	+	+	+	+	+
8.2 Consumer willingness to pay	-	+	0	0	0
8.3 Financial continuation	+	+	+	+	0
9.1 Policy instruments	+	+	+	+	0
9.2 Statutory compliance	++	++	++	+	0
9.3 Preparedness	+	++	+	+	--

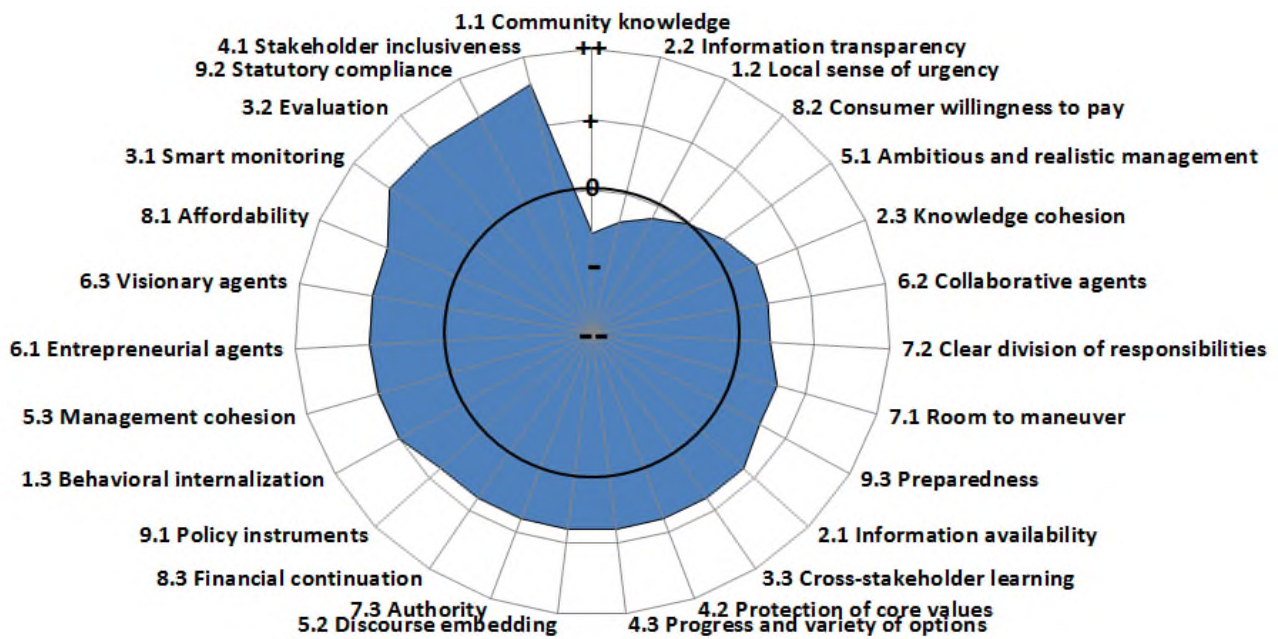


Fig. 1 Overview of the governance capacity of the city of Amsterdam. The twenty-seven indicators scores are ranked clockwise from low to high. Scores range from very encouraging (++) to very limiting (--) to the governance capacity that is a prerequisite for finding dynamic solutions to address the identified governance challenge

6 Discussion and conclusion

First, we will briefly discuss some limitations of the GCF. Next, we will outline the main contributions of the GCF to theory and practice and, more specifically, its role in connecting science, policy, and implementation.

Framework discrepancies and reproducibility

As governance processes are often interconnected, some of the conditions and indicators identified in our framework are inherently interrelated. Although each indicator is designed to provide an independent score, inevitably, a hypothetical “ideal” situation will not always result solely in very encouraging (++) indicator scores. For example, entrepreneurial, collaborative, and visionary agents of change (condition 6) are all relevant but their importance is context-dependent (Patterson et al. 2013): visionary agents, for example, may be more necessary in times of crisis, whereas collaborative agents are more valuable in initiating new joint activities in established collaborative networks, and entrepreneurial agents operate best in open governance networks that are ambitious and flexible (Patterson et al. 2013). Hence, situations may exist in which entrepreneurial and collaborative agents of change are very encouraging (++) while, as a consequence, visionary agents are less prominently active. Another important interrelation is between indicators 5.1 *ambitious and realistic goals* and 9.2 *statutory compliance*, as it is easier to comply with non-ambitious goals. Furthermore, indicators 6.1 *entrepreneurial agents of change*

and 7.3 *room to manoeuvre* are reinforcing, and their scoring is interrelated. Their main difference is that entrepreneurial agents of change focuses on actors' ability and skills to create and seize opportunities, whereas the score for room to manoeuvre represents the degree of freedom and existing opportunities that actors can utilize.

Bridging theory and practice

Different time frames, reward structures, process cycles, epistemologies, and goals impede the effective use of scientific knowledge in practice (Hegger et al. 2012). Scientific knowledge is often fragmented, as it is intertwined with values, discourses, disciplinary scopes, and traditions that are often context-specific. Therefore, existing knowledge often fails to provide applicable insights that can help decision-makers achieve their intended goals and objectives. The gap between science, policy, and implementation has been widely acknowledged in water governance (OECD 2011; Medema et al. 2008; Patterson et al. 2013). Our work provides three important contributions to improve the connection between scientific knowledge, policy, and implementation in the field of water governance, climate adaptation, and beyond:

1. **Integration:** The GCF is one of the first attempts to integrate the plethora of contradicting, overlapping, and fragmented governance gaps, barriers, and capacities with respect to prevailing urban water challenges. It may reveal more effective and efficient pathways for cities to increase their governance capacity. At present, our understanding of underlying interconnections and relations is often insufficient to provide overarching pragmatic insights that facilitate decision-makers.
2. **Communication:** The GCF is designed to be easy to understand and transparent, and has been developed with the end-users (who include decision-makers, stakeholders, and citizens) in mind. Information needs to be understandable for them. This is essential, to facilitate constructive discussions, knowledge co-production, and cooperation.
3. **City comparison:** The GCF provides a framework for comparison cities and the accumulation of empirical data that can improve our understanding of underlying governance processes that limit or encourage governance capacity. At the same time, it provides a practical framework for cities to exchange learning experience, knowledge, and good practices.

Because the framework is embedded in the literature of governance and transformation processes, it is possible to assess a broader range of issues that involve processes of change in multi-organizational networks. An empirical database is currently being developed, as the GCF is being used to assess the cities of Melbourne (Australia), Quito (Ecuador) (Schreurs et al. 2016), New York (USA) and Ahmedabad (India). Moreover, the results of the city of Quito (Ecuador) are about to be published (Schreurs et al. 2016). The GCF has the potential to act as a portal of communication for constructive cross-city, cross-sector, and

cross-stakeholder discussions and learning. Finally, the framework provides the basis for common understanding and action, by revealing the most effective and efficient pathways for increasing the governance capacity needed to address the challenges of water, waste, and climate change.

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Annex 3 Governance capacity scoring schemes

Condition 1: Awareness

Awareness is the understanding of causes, impact, scale and urgency of the water challenge.

Indicator 1.1: Community knowledge

Predefined question: To what extent is knowledge regarding the current and future risks, impacts, and uncertainties of the water challenge dispersed throughout the community and local stakeholders which may results in their involvement in decision-making and implementation?

++	Balanced awareness	Nearly all members of the community are aware of and understand the actual risks, impacts and uncertainties. The water challenge is addressed the local level. Local communities and stakeholders are familiar with or are involved in the implementation of adaptation measures
+	Overestimation	The community is knowledgeable and recognize the many existing uncertainties. Consequently, they often overestimate the impact and probability of incidents or calamities. The water challenge has been raised at the local political level and policy plan may be co-developed together with local communities
0	Underestimation	Most communities have a basic understanding of the water challenge. However the current risks, impacts and frequencies are often not fully known and underestimated. Future risks, impacts and frequencies are often unknown. Some awareness has been raised amongst or is created by local stakeholders and communities
-	Fragmented knowledge	Only a small part of the community recognizes the risks related to the water challenge. The most relevant stakeholders, have limited understanding of the water challenge. As a result, the issue is hardly or not addressed at the local governmental level
--	Ignorance	The community, local stakeholders and decision-makers are unaware or ignore the water challenge. This is demonstrated by the absence of articles on the issue in newspapers, on websites or action groups addressing the issue

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Indicator 1.2: Local sense of urgency

Predefined question: To what extent do actors have a sense of urgency, resulting in widely supported awareness, actions, and policies that address the water challenge?

++	Strong demand for action	There is a general sense of importance regarding the water challenge. There is continuous, active, public support and demand to undertake action and invest in innovative, ground-breaking solutions. This is evident, since the issue receives much media attention and action plans are implemented
+	General sense of urgency of long-term sustainability goals	There is increasing understanding of the causes, impacts, scale and urgency of the water challenge. It leads to general sense of urgency of the need for long-term sustainable approaches. However, measures requiring considerable efforts, budget, or substantial change with sometimes uncertain results are often receiving only temporal support. The water challenge is a main theme in local elections
0	Moderate willingness for small changes	There is growing public awareness and increasing worries regarding the water challenge. However, the causes, impact, scale and urgency are not widely known or acknowledged leading to the support for only incremental changes. It is a side topic in local elections
-	Raising of awareness by small groups	A marginalized group (e.g. the most vulnerable, environmentalists, NGOs) express their concerns, but these are not widely recognized by the general public. Adaptation measures are not an item on the political agenda during elections
--	Resistance	There is generally no sense of urgency and sometimes resistance to spend resources to address the water challenge. It is not an item on the political agenda during elections, as is evident from the lack of (media-) attention

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Indicator 1.3: Behavioral internalization

Predefined question: To what extent do local communities and stakeholders try to understand, react, anticipate and change their behavior in order to contribute to solutions regarding the water challenge?

++	Full internalization	Because actors are fully aware of the water challenge, their causes, impacts, scale and urgency, the it is integrated into long-term and joint strategy, practices and policies. All actors are encouraged to participate. At this point, the water challenge is integrated into everyday practices and policies
+	Moderate internalization	Awareness has evolved to mobilization and action. There are various incentives for actors to change current practices and approaches regarding the water challenge. The water challenge, however, is not yet fully integrated into clear strategy, practices and policies
0	Exploration	There is a growing awareness, often as a result of local, exploratory research regarding the causes and solutions of the water challenge. There are only incremental changes in actions, policy and stakeholder's behaviour
-	Recognized as an external pressure	The water challenge is partly recognized, mainly due to external pressure instead of intrinsic motivations. There is no support to investigate its origin or to proceed to action or changing practices
--	Unawareness	There is unawareness of the water challenge with hardly any understanding of causes and effects or how current practices impact the water challenge, the city or future generations

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Condition: 2 Useful knowledge

This condition describes the qualities of information with which actors have to engage in decision-making.

Indicator 2.1: Information availability

Predefined question: To what extent is information on the water challenge available, reliable, and based on multiple sources and methods, in order to meet current and future demands so as to reveal information gaps and enhance well-informed decision-making?

++	Comprehensive information enabling long-term integrated policy	A comprehensive and integrated documentation of the issue can be found on local websites and policy papers. It is characterized with adequate information, an integrated description of social, ecological and economic processes regarding the water challenge, as well as goals and policies. Furthermore, progress reports on effective implementation can be found
+	Information enhancing integrated long-term thinking	Strong effort is put in providing integrated information from various fragmented sources. Information gaps are identified and attempted to be bridged. This may be clear from extensive documentation on the long-term process. Also citizen knowledge may be taken into account
0	Information fits demand, limited exploratory research	Information on the water challenge is available. Knowledge on understanding or tackling the water challenge is progressing and is produced in a structural way. Knowledge gaps are hardly identified due to lock-in into existing disciplines and policy. This is apparent from the quantity of factual information, but the causes, risks and impacts of long-term processes are lacking behind
-	Information scarcity and limited quality	Limited information is available which does not grasp the full extent of the water challenge. In some cases not all information is of sufficient quality to generate a comprehensive overview
--	Lack of information	No information on the water challenge can be found. Or the scarce available information is of poor quality

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Indicator 2.2: Information transparency

Predefined question: To what extent is information on the water challenge accessible and understandable for experts and non-experts, including decision-makers?

++	Easy access to cohesive knowledge	Information is easily accessible on open source information platforms. There are multiple ways of accessing and sharing information. Information is often provided by multiple sources and is understandable for non-experts
+	Sharing of partly cohesive knowledge	All interested stakeholders can access information. Action has been taken to make knowledge increasingly understandable. Still, it is a time-consuming search through a maze of organizations, protocols and databases to abstract cohesive knowledge and insights
0	Sharing of very technical knowledge	There are protocols for accessing information; however, it is not readily available. Although information is openly available, it is difficult to access and comprehend because it is very technical. The water challenge is reported on local websites and reports
-	Low sharing of fragmented knowledge	Information is sometimes shared with other stakeholders. However, information is inaccessible for most stakeholders. Furthermore, knowledge is often technical and difficult to understand for non-experts. The water challenge may be addressed on local websites
--	Not transparent and inaccessible knowledge	Information is limitedly available and shared. sharing may be discouraged. The information that is available is difficult to understand. The water challenge is not addressed on local websites

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Indicator 2.3: Knowledge cohesion

Predefined question: To what extent is information cohesive in terms of using, producing and sharing different kinds of information, usage of different methods and integration of short-term targets and long-term goals amongst different policy fields and stakeholders in order to deal with the water challenge?

++	Implementation of cohesive knowledge	Stakeholders are engaged in long-term and integrated strategies. Information can be found that is co-created knowledge and will contain multiple sources of information, multiple and mixed methods taking into account the socio-, ecological and economic aspects of the water challenge
+	Substantial cohesive knowledge	Sectors cooperate in a multidisciplinary way, resulting in complete information regarding the water challenge. Besides multiple actors, multiple methods are involved to support information. Too many stakeholders are involved, sometimes in an unbalanced way. Knowledge about effective implementation is often limited
0	Insufficient cohesion between sectors	Data collection within sectors is consistent and is sustained in multiple projects for about two to three election periods. Knowledge on the water challenge, however, is still fragmented. This becomes clear from different foci of the stakeholders as stated in their organisation's strategies and goal setting
-	Low-cohesive knowledge within sectors	Information that is found is sector specific and information is inconsistent within and between sectors
--	Non-cohesive and contradicting knowledge	A lack of data strongly limits the cohesion between sectors. Information that is found can even be contradictory

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Condition 3: Continuous learning

Continuous learning and social learning is essential to make water governance more effective. The level of learning differs from refining current management, critical investigation of fundamental beliefs or questioning underlying norms and values.

Indicator 3.1: Smart monitoring

Predefined question: To what extent is the monitoring of process, progress, and policies able to improve the level of learning (i.e., to enable rapid recognition of alarming situations, identification or clarification of underlying trends)? Or can it even have predictive value?

++	Useful to predict future developments	Monitoring system is recognizes alarming situations, identifying underlying processes and provides useful information for identifying future developments. Reports of monitoring will display discrepancies between fundamental beliefs and practices. The monitoring is changed in order to act upon these findings by altering the fundamental beliefs. Often regulatory frameworks are changed, new actors are introduced, new risk approach are used
+	Useful to recognize underlying processes	The abundant monitoring provides sufficient base for recognizing underlying trends, processes and relationships. Reports of monitoring will display discrepancies between assumptions and real process dynamics. Acting upon these findings by altering the underlying assumptions characterizes this level of smart monitoring. Often also system boundaries are re-defined, new analysis approach introduced, priorities are adjusted and new aspects are being examined
0	Quick recognition of alarming situations	Monitoring system covers most relevant aspects. Alarming situations are identified and reported. This leads to improvement of current practices regarding the technical measures. There is only minor notification of societal and ecological effects
-	Reliable data but limited coverage	The monitoring system does not cover all facets of the water challenge, with sometimes incomplete description of the progress and processes of technical and policy measures. Monitoring is limited to singular effectiveness or efficiency criteria and cannot identify alarming situations
--	Irregular, poor quality or absent	There is no system to monitor the water challenge or monitoring is irregular

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Indicator 3.2: Evaluation

Predefined question: To what extent are current policy and implementation continuously assessed and improved, based on the quality of evaluation methods, the frequency of their application, and the level of learning?

++	Exploring the fitness of the paradigm	Frequent and high quality evaluation procedures fully recognize long-term processes. Assumptions are continuously tested by research and monitoring. Evidence for this is found in sources (primarily online documents) that report on the learning process and progress. Uncertainties are explicitly communicated. Also, the current dominant perspective on governance and its guiding principles are questioned
+	Changing assumptions	There is continuous evaluation, hence continuous improvements of technical and policy measures and implementation. Innovative evaluation criteria are used. This is evidenced by reports containing recommendations to review assumptions or explicitly indicating the innovative character of the approach
0	Improving routines	The identified problems and solutions are evaluated based on conventional (technical) criteria. Current practices are improved. This becomes clear from information of the used and existing criteria, the small changes recommended in reports and short-term character
-	Non-directional evaluation	Evaluation is limited regarding both frequency and quality. Evaluation occurs sometimes, using inconsistent and even ad-hoc criteria. Also the evaluation is not systematic. There is no policy on the performance of evaluations, only the evaluation(s) itself are reported
--	Insufficient evaluation	There is no evaluation of technical or policy measures regarding the water challenge. Otherwise it is not documented

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Indicator 3.3: Cross-stakeholder learning

Predefined question: To what extent are stakeholders open to and have the opportunity to interact with other stakeholders and deliberately choose to learn from each other?

++	Putting cross-stakeholder learning into practice	There is recognition that the water challenge is complex and that cross-stakeholder learning is a precondition for adequate solutions and smooth implementation. This is evidenced by broad support for policy measures and implementation. Moreover, continuous cross-stakeholder learning programs are in place or may be institutionalized
+	Open for cross-stakeholder learning	Stakeholder interaction is considered valuable and useful for improving policy and implementation. Various initiatives for cross-stakeholder learning have been deployed, yet the translation into practice appears difficult. The programs may not be structural and the learning experience may not be registered and shared
0	Open for stakeholder interaction	Stakeholders are open to interaction, though not much learning is going on due to the informative character of the interaction. Often, a number of stakeholders, that do not necessarily share interests or opinions, are involved in the decision-making process
-	Small coalitions of stakeholders with shared interest	Interaction occurs in small coalitions based on common interests. Opinions of those outside the coalition are generally withheld. Only information for the shared point of view is sought. This is evidenced by the finding of only one perspective regarding the water challenge or few perspectives that are supported by means of circle-referencing
--	Closed attitude towards cross-stakeholder learning	There is no contact with other parties, contact may even be discouraged. This is apparent from limited sharing of experience, knowledge and skills. No information is shared outside organisation and sector, nor is external information used

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Condition 4: Stakeholder engagement process

Stakeholder engagement is required for problem framing, gaining access to a wide variety of resources and creating general support that is essential for effective policy implementation.

Indicator 4.1: Stakeholder inclusiveness

Predefined question: To what extent are stakeholders interact in the decision-making process interaction (i.e., are merely informed, are consulted or are actively involved)? Are their engagement processes clear and transparent? Are stakeholders able to speak on behalf of a group and decide on that group's behalf?

++	Transparent involvement of committed partners	All relevant stakeholders are actively involved. The decision-making process and the opportunities for stakeholder engagement are clear. It is characterised by local initiatives specifically focussing on water such as local water associations, contractual arrangements, regular meetings, workshops, focus groups, citizen committees, surveys
+	Timely, over-inclusive and active involvement	Stakeholders are actively involved. It is still unclear how decisions are made and who should be involved at each stage of the process. Often too many stakeholders are involved. Some attendants do not have the mandate to make arrangements. Stakeholder engagement is abundantly done for often overlapping issues
0	Untimely consultation and low influence	Stakeholders are mostly consulted or informed. Decisions are largely made before engaging stakeholders. Frequency and time-period of stakeholder engagement is limited. Engagements are mainly ad hoc consultations where stakeholders have low influence on the end-result
-	Non-inclusive involvement	Not all relevant stakeholders are informed and only sometimes consulted. Procedures for stakeholder participation are unclear. If involved, stakeholders have but little influence
--	Limited supply of information	No stakeholders are included, or their engagement is discouraged. Information cannot be found on the extant decision-making process.

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Indicator 4.2: Protection of core values

Predefined question: To what extent 1) is commitment focused on the process instead of on early end-results? 2) do stakeholders have the opportunity to be actively involved? 3) are the exit procedures clear and transparent? (All three ensure that stakeholders feel confident that their core values will not be harmed.)

++	Maximal protection of core values	Stakeholders are actively involved and have large influence on the end-result. There are clear exit possibilities and leading to more stakeholders more committed to the process. The participation opportunities and procedure of implementation are clear.
+	Requisite for early commitment to output	Stakeholders are actively involved and expected to commit themselves to early outcomes in the process. Hence relevant stakeholders may be missing in contractual arrangements as they do not want to commit themselves to decisions to which they have not yet contributed. At this point involved stakeholders have influence on the end-result and therefore the output serves multiple interests
0	Suboptimal protection of core values	As stakeholders are consulted or actively engaged for only short periods, alternatives are insufficiently considered. Influence on end-result is limited. Decisions comply with the interests of the initiating party primarily. There are no clear exits in the engagement process
-	Non-inclusive and low influence on results	The majority of stakeholders is engaged, but the level of engagement is low (informative or sometimes consultative). There is a low influence on the result which invokes resistance, for example on internet platforms and newspapers
--	Insufficient protection of core values	Because stakeholders are hardly engaged or informed, core values are being harmed. Implementation and actions may be contested in the form of boycotts, legal implementation obstructions and the invoking of anti-decision support. There may be distrust and an absence of participation

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Indicator 4.3: Progress and variety of options

Predefined question: To what extent are procedures clear and realistic, are a variety of alternatives co-created and thereafter selected from, and are decisions made at the end of the process in order to secure continued prospect of gain and thereby cooperative behavior and progress in the engagement process?

++	Active engagement with choice selection at the end of the cooperation	There is active engagement of all relevant stakeholders and clarity of participation procedure and realistic deadlines. The range of alternatives is fully explored and selection of the best alternatives occurs at the end of the process. Reviews of stakeholder meetings provide the alternatives addressed. Stakeholders are engaged throughout the whole process as specified in contractual agreements
+	Active involvement with abundant choice variety	Stakeholders are actively involved and there is sufficient room for elaborating alternatives. Procedures, deadlines and agreements are unclear. There is no or few specification on deadlines. Due to inexperience with active stakeholder engagement, decisions are taken too early in the process leading to the exclusion of arguments. Hence, decisions may not be fully supported
0	Consultation or short active involvement	There is a clear procedure for consultation or short active involvement of stakeholders, but the opportunities to consider all relevant alternatives is insufficient. Decisions are therefore still largely unilateral and solutions suboptimal. The suboptimal character of a solution can be observed from evaluations or difference in opinions
-	Rigid procedures limit the scope	Informative and consultative approaches are applied, according rigid procedures with low flexibility. The period of decision-making is short with a low level of stakeholder engagement. These unilateral decision-making processes may lead to slow and ineffective implementation. The latter can be observed from critique via public channels
--	Lack of procedures limit engagement and progress	The lack of clear procedures hinder stakeholder engagement. This unilateral decision-making limits progress and effectiveness of both decision-making and implementation. It might result in conflicting situations. Often, much resistance can be found online and implementation may be obstruct

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Condition 5: Policy Ambitions

Policy ambitions assesses if current policy is ambitious, feasible, well-embedded in local context and if it forms a cohesive set of long-term and short-term goals within and across sectors.

Indicator 5.1: Ambitious and realistic goals

Predefined question: To what extent are goals ambitious (i.e., identification of challenges, period of action considered, and comprehensiveness of strategy) and yet realistic (i.e., cohesion of long-term goals and supporting flexible intermittent targets, and the inclusion of uncertainty in policy)?

++	Realistic and ambitious strategy	Policy is based on modern and innovative assessment tools and policy objectives are ambitious. Support is provided by a comprehensive set of intermittent targets, which provide clear and flexible pathways. Assessment tools and scenarios analyses identify tipping points that may be found in policy documents
+	Long-term ambitious goals	There is a long-term vision that incorporates uncertainty. However, it is not supported by a comprehensive set of short-term targets. Hence, achievements and realistic targets are difficult to measure or estimate. Visions are often found online as an organisation's strategy. They often entail a description of the water challenge and need for action
0	Confined realistic goals	There is a confined vision of the water challenge. Ambition are mostly focused on improving the current situation where unchanging conditions are assumed and risk and scenarios analyses are lacking
-	Short-term goals	Actions and goals mention sustainability objectives. Actions and goals are "quick fixes" mainly, not adhering to a long-term vision or sustainable solutions. Uncertainties and risks are largely unknown
--	Short-term, conflicting goals	Goals consider only contemporary water challenges, are short-sighted and lack sustainability objectives. Goals are arbitrary and sometimes conflicting and the character of policy is predominantly reactive

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Indicator 5.2: Discourse embedding

Predefined question: To what extent is sustainable policy interwoven in historical, cultural, normative and political context?

++	Embedding of sustainable implementations	Local context is used smartly to accelerate policy implementation. Innovations are subdivided into suitable phases which are more acceptable and effectively enables sustainable practices. Effective policy implementation is enabled by a general consensus that long-term integrated policy is needed to address the water challenge
+	Consensus for sustainable actions	There is a consensus that adaptation is required, but substantial effort is necessary as there is little experience in addressing the water challenge in a long-term integrated approach. Furthermore, the decision-making periods are long as trust relations with new unconventional partners need to be built
0	Low sense of urgency embedded in policy	Current policy fits the local context. The water challenge is increasingly identified, framed and interwoven into local discourse, but the disregard of uncertainty prevents a sense of urgency that is necessary to adopt adequate adaptation measures. Decision making often results in very compromised small short-term policy changes
-	Persistent reluctance and poor embedding	Actors feel reluctant to execute current policy as it conflicts with their norms and values. Policy hardly takes the local context and existing discourses into account. And the policy does not correspond with societal demands. This may lead to distrust between actors, inefficient use of resources and ineffective overall implementation
--	policy mismatch	Cultural, historical and political context is largely ignored, leading to arduous policy implementation. Actors may not understand the scope, moral or to whom it applies or how to implement it (total confusion)

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Indicator 5.3: Policy cohesion

Predefined question: To what extent is policy relevant for the water challenge, and coherent regarding 1) geographic and administrative boundaries, and 2) alignment across sectors, government levels, and technical and financial possibilities?

++	Cohesive synergetic policies	Policies are coherent and comprehensive within and between sectors. There is an overarching vision resulting in smooth cooperation. Goals are jointly formulated, evaluated and revised to adapt to new challenges. This is evidenced by thematic instead of sectoral approaches. Many inter-sectoral meetings, interdisciplinary reports and cohesiveness in goals and strategies are formulated
+	Overlapping comprehensive policies	There is cross-boundary coordination between policy fields to address the water challenge. Policies are cohesive, but have not yet resulted in broad multi-sectoral actions. Efforts to harmonize different sectors are evident by employee functions or assignments and protocols
0	Fragmented policies	Policy is fragmented and based on sector's specific scope and opportunities for co-benefits are hardly explored. However, effort may be made to balance the resource allocation between sectors
-	Opposing sectoral policies	Overall water and climate adaptation policy is characterised by fragmentation and imbalance between sectors. The majority of resources is spent on the dominant policy field and overlap between sectors lead to inefficient use of resources
--	Incompatible policies	Policies between and within sectors are strongly fragmented and conflicting. This is evidenced by contradicting objectives and the squandering use of resources

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Condition 6: Agents of change

In order to drive change, agents of change are required to show direction, motivate others to follow and mobilize the resources required.

Indicator 6.1: Entrepreneurial

Predefined question: To what extent are the entrepreneurial agents of change enabled to gain access to resources, seek and seize opportunities, and have influence on decision-making?

++	Long-term support for entrepreneurship	There is recognition of the need for continuous innovation, hence applied research is enabled that explores future risk management and supports strategy formulation. The experiments yield increased benefits and new insights. This is recognized by other actors, thereby providing access to new resources. Continuous experimentation is secured by long-term and reliable resource allocation
+	Tentative experimental entrepreneurship	There is a growing understanding of the water challenge's uncertainty, complexity and need for innovative approaches that entail a certain level of risk. Tentative experimental projects set in but are paid by conventional resources. Projects are small-scale pilots
0	Conventional and risk-averse entrepreneurship	Entrepreneurial agents of change are better able to seize low-risk opportunities. Therefore opportunities for innovative approaches and synergies are hardly pursued. Small changes can be observed
-	Room for short-sighted entrepreneurship	Agents of change struggle to gain access to resources to address imminent water challenges. Windows of opportunity to identify and to act upon perceived risks are limited. Opportunities to address stakeholders with potential access to resources are rarely seized
--	Insufficient entrepreneurship	Ignorance for risk and threats leads to ineffective rigid governance and lack of opportunity for entrepreneurial agents to enable improvements. Moreover, distrust by other actors and potential investors, further decrease access to resources

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Indicator 6.2: Collaborative

Predefined question: To what extent are actors enabled to engage, build trust-collaboration, and connect business, government, and sectors, in order to address the water challenge in an unconventional and comprehensive way?

++	Agents of change enhances wide-spread synergetic collaboration	There is on-going build-up of productive and synergetic collaborations. Facilitators may even be administered to coordinate this through mediation and authority. There is a conception of the ideal collaboration composition
+	Agents of change can push for collaboration between new stakeholders	There is an understanding that water challenges requires long-term and integrated solutions. Hence, wide-spread collaborations between a variety of stakeholders and sectors are being established. New collaborations with unconventional actors, result, more and more, in valuable new insights and effective networks
0	Agent are enabled to enhance conventional collaboration	Traditional coalitions are preserved to maintain status quo. There is trust within these coalitions. There is limited space to create new collaborations. If new collaboration occurs solutions are still mostly sectoral and short- to mid-term
-	Insufficient opportunities for collaborative agents	There is insufficient opportunity for agents of change to go beyond conventional collaboration. The current collaborations are deemed sufficient to deal with the water challenge whereas the vision is limited to ad hoc command and control approaches
--	Lack of collaborative agents	Collaboration is discouraged, because of a strong hierarchical structure. There is distrust between stakeholders and the willingness and thereby opportunities for collaborative agents are largely lacking

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Indicator 6.3: Visionary

Predefined question: To what extent are actors in the network able to manage and effectively push forward long-term and integrated strategies which are adequately supported by interim targets?

++	Long-term vision supported by short-term targets	Visionary agents of change in different positions and with different backgrounds actively and successfully promote a sustainable and long-term vision regarding the water challenge, that is communicated clearly. Short-term targets fit the long-term visions. There is interest and employment in trend analysis.
+	Long-term vision with flawed communication	There is a clear long-term, integrated and sustainable-oriented vision. There is still some discrepancy between short-term targets and implementation strategies and the long-term vision from visionary agents of change. This means that agents are not always clear in their formulation regarding the effect and impact of envisioned strategies
0	Defense of status quo	The visions of the existing agents of change are limited to promoting the business as usual. They do not oppose nor promote long-term, integrative thinking. Interest or employment in trend analysis is limited
-	Unilateral and short-term vision	There is a unilateral vision regarding the water challenge, which considers a limited groups of actors. The vision often has a short-term focus, with a maximum of 3 to 4 years
--	Deficient sustainability vision and short-term focus	There is a lack of visionary agents that promote change towards a long-term, sustainable vision regarding the water challenge. Diverging expectations and objectives of stakeholders are the result. This may be evidenced by indecisiveness or even conflicts. Long-term and integrative initiatives may also be blocked

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Condition 7: Multi-level network potential

Urban water governance involves a plethora of actors and interests from all levels of government, organizations and (private) stakeholders. For sustainable solutions, working in networks is an essential determinant for effective solutions.

Indicator 7.1: Room to manoeuvre

Predefined question: To what extent do actors have the freedom and opportunity to develop a variety of alternatives and approaches (this includes the possibility of forming ad hoc, fit-for-purpose partnerships that can adequately address existing or emerging issues regarding the water challenge)?

++	Freedom to develop innovative solutions	There is a common and accepted long-term vision for dealing sustainably with the water challenge. Within the boundaries of this vision, actors are given the freedom to develop novel and diverse approaches and partnerships, resulting in continuous improvements and exploration. These partnerships are most likely institutionalized
+	Redundancy to address uncertainty	There is recognition that a high degree of freedom is necessary to deal with complex situations in the form of experiments and looking for new unconventional collaborations. There is a dynamic mix of cooperative partnerships and a redundant set of diverging alternative solutions. A clear overall vision to steer research is however lacking
0	Limited room for innovation and collaboration	Actors are given the means to perform predefined tasks for dealing with problems that are framed with a narrow, short-term and technical-oriented scope. There is limited room to deviate. Solutions are sought in own sectoral field and expertise
-	Limited autonomy	Only a few actors receive some degree of freedom, there are limited opportunities to develop alternatives, and there is hardly any opportunity to form partnerships with unconventional actors
--	Strictly imposed obligations	The actions of stakeholders are strictly controlled and there are rigid short-term targets. Freedom to form new partnerships is strongly limited as actor network composition is fixed and small. There are no resources made available for exploring alternatives that might be more effective or efficient whereas many actors that are affected by the water challenge do not have a voice

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Indicator 7.2: Clear division of responsibilities

Predefined question: To what extent are responsibilities clearly formulated and allocated, in order to effectively address the water challenge?

++	Dynamic, fit-for-purpose cooperations	There are many synergetic cooperations within the urban water network that can provide solutions for the water challenge. The roles and responsibilities are clearly divided amongst actors. These cooperations are dynamic and result in fit-for-purpose problem solving necessary to solve complex, multi-level and unknown challenges
+	Innovative cooperative strategies	Actors recognize that knowledge and experience are scattered within the local network. Therefore, extra effort is made to bundle the scattered expertise and to reach fit-for-purpose division of clear roles and responsibilities. New cooperation compositions are explored
0	Inflexible division of responsibilities	Responsibilities are divided over a limited set of conventional actors. Opportunities for new cooperation and more effective division of responsibilities are not seized or even recognized. Sometimes conventional actors get more tasks to deal with new water challenges
-	Barriers for effective cooperation	Authorities are fragmented or they lack interest. Moreover, miscommunication and lack of trust are causes that block effective water governance
--	Unclear division of responsibilities	There is an unclear division of responsibilities and often the relationships are over-hierarchical. Everybody expects someone else to make required effort and trust is hardly found

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Indicator 7.3: Authority

Predefined question: To what extent are legitimate forms of power and authority present that enable long-term, integrated and sustainable solutions for the water challenge?

++	Strong well-embedded authority	Long-term, integrated approaches regarding the water challenge are well embedded in policy and regulatory authorities. Authoritative figures receive much support both politically and by society. Their opinions and statements also receive much media attention
+	Stirring authority	There is recognition of the need for long-term and integrated approaches by both the public and the political arena. Sustainability approaches regarding the water challenge are now implemented as declarations of intent and sustainability principles in policy and regulation. Legitimate authorities are assigned to coordinate long-term integrated policy and implementation
0	Restricted authority	The water challenge is addressed as long as the status quo is not questioned. Long-term policy visions are limited and new policy mainly needs to fit into existing fragmented structure. This means small (technical) changes are occurring
-	Unfruitful attempts	The water challenge is put forward by individuals or a groups of actors, but there is only little interest which is also fragile due to poor embedding of sustainability principles in current policy mechanisms, interests, and budget allocation. The challenge may have been mentioned in reviews or reports but left unaddressed
--	Powerlessness	The addressing of the water challenge is regularly overruled with contradicting and competing interests and so it is hardly included in policy, regulation or administrative principles

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Condition 8: Financial viability

Sufficient financial resources are crucial for good water governance. Willingness to pay for water challenge adaptation services is important to gain access to reliable funding for long-term programs. At the same time, water and climate adaptation services need to be affordable for everyone including poor people or people being disproportionately affected.

Indicator 8.1: Affordability

Predefined question: To what extent are water services and climate adaptation measures available and affordable for all citizens, including the poorest?

++	Climate adaptation affordable for all	Programs and policies ensure climate adaptation for everyone. This includes public infrastructure and private property protection. The solidarity principle is clearly percolated in policy and regulation
+	Limited affordability of climate adaptation services	Serious efforts are made to support climate adaptation for everyone, including vulnerable groups. There is often recognition that poor and marginalized groups are disproportionately affected by the water challenge. This is increasingly addressed in policy and regulation
0	Unaffordable climate adaptation	Basic water services are affordable for the vast majority of the populations, however poor people and marginalized communities have much difficulty to afford climate adaptation measures to protect themselves against impacts such as extreme heat, flooding or water scarcity.
-	Limited affordability of basic water services	A share of the population has serious difficulty to pay for basic water services such as neighbourhoods with low-income or marginalized groups. There is hardly any social safety net regarding water services, let alone for climate adaptation measures
--	Unaffordable basic water services	Basic water services are not affordable or even available for a substantial part of the population. This may be due to inefficient or obsolete infrastructure, mismanagement or extreme poverty

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Indicator 8.2: Consumer willingness to pay

Predefined question: How is expenditure regarding the water challenge perceived by all relevant stakeholders (i.e., is there trust that the money is well-spent)?

++	Willingness to pay for present and future risk reductions	The water challenge is fully comprehended by decision-makers. There is political and public support to allocate substantial financial resources. Also expenditure for non-economic benefits is perceived as important. There is clear agreement on the use of financial principles, such as polluter-pays- and user-pays- or solidarity principle
+	Willingness to pay for provisional adaptation	Due to growing worries about the water challenge, there are windows of opportunity to increase funding. However, the perception of risk does not necessarily coincide with actual risk. Financial principles, such as polluter-pays principle, may be introduced. Due to inexperience, implementation is often flawed. Focus groups decide on priority aspects regarding the water challenge, but there is confusion regarding the extent and magnitude of the water challenge
0	Willingness to pay for business as usual	There is support for the allocation of resources for conventional tasks. There is limited awareness or worries regarding the water challenge. Most actors are unwilling to financially support novel policies beyond the status quo. Generally, there is sufficient trust in local authorities
-	Fragmented willingness to pay	Willingness to pay for measures addressing the water challenges are fragmented and insufficient. The importance and risks are perceived differently by each stakeholder. Generally, their estimates of the cost are substantially lower than the actual costs
--	Mistrust and resistance to financial decisions	There is a high level of mistrust in decision making of resource allocation. At this level financial decisions are based on prestige projects, projects that benefit small groups or specific interests. As expenditures often do not address the actual water challenges, there is a high degree of resistance regarding resource allocation

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Indicator 8.3: Financial continuation

Predefined question: To what extent do financial arrangements secure long-term, robust policy implementation, continuation, and risk reduction?

++	Long-term financial continuation	There is secured continuous financial support for long-term policy, measures and research regarding the water challenge. These costs are included into baseline funding. Generally, both economic and non-economic benefits are considered and explicitly mentioned
+	Abundant financial support with limited continuation	Abundant financial resources are made available for project based endeavours that are often exploring new solutions but lack long-term resource allocation or institutionalized financial continuation. Hence, long-term implementation is uncertain
0	Financial continuation for basic services	Financial resources are available for singular projects regarding basic services of the water challenge. The allocation of financial resources is based on past trends, current costs of maintenance and incremental path-dependent developments. Costs to deal with future water challenges are often not incorporated. Limited resources are assigned for unforeseen situations or calculated risks
-	Inequitable financial resource allocation	There are potential resources available to perform basic management tasks regarding the water challenge, but they are difficult to access, are distributed rather randomly and lack continuity. No clear criteria can be found on the resource allocation. Resources allocation is ad hoc and considers only short-time horizons
--	Lack of financial resources	There are insufficient financial resources available to perform basic tasks regarding the water challenge. Financing is irregular and unpredictable leading to poor policy continuation

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Condition 9: Implementing capacity

Implementing capacity is about the effectiveness of policy instruments with respect to the water challenge. Part of the effectiveness is also due to the level of compliance to policy and regulation and the familiarity with (calamity) action plans.

Indicator 9.1: Policy instruments

Predefined question: To what extent are policy instruments effectively used (and evaluated), in order to stimulate desired behavior and discourage undesired activities and choices?

++	Effective instruments enhance sustainable transformations	There is much experience with the use of policy instruments. Monitoring results show that the current use of instruments proves to be effective in achieving sustainable behaviour. Continuous evaluation ensures flexibility, adaptive capacity and fit-for-purpose use of policy instruments
+	Profound exploration of sustainability instruments	Instruments to implement principles such as full cost-recovery and polluter-pays principle, serve as an incentive to internalize sustainable behaviour. The use of various instruments is explorative and therefore not yet optimized and efficient. The use of instruments is dynamic. There are a lot of simultaneous or successive changes and insights
0	Fragmented instrumental use	Policy fields or sectors often have similar goals, but instruments are not coherent and may even contradict. Overall instrumental effectiveness is low and temporary. There is sufficient monitoring and evaluation leading to knowledge and insights in how instruments work and actors are getting a more open attitude towards improvements
-	Unknown impacts of policy instruments	Instruments are being used without knowing or properly investigating their impacts on forehand. The set of instruments actually leads to imbalanced development and inefficiencies that are hardly addressed
--	Instruments enhance unsustainable behavior	Policy instruments may enhance unwanted or even damaging behaviour that opposes sustainability principles, e.g., discount for higher water use stimulates spilling and inefficiency. There is hardly any monitoring that can be used to evaluate the counterproductive effects of these policy instruments

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Indicator 9.2: Statutory compliance

Pre-defined question: To what extent is legislation and compliance, well-coordinated, clear and transparent and do stakeholders respect agreements, objectives, and legislation?

++	Good compliance to effective sustainable legislation	Legislation is ambitious and its compliance is effective as there is much experience with developing and implementing sustainable policy. Short-term targets and long-term goals are well integrated. There is a good relationship among local authorities and stakeholders based on dialogues.
+	Flexible compliance to ambitious explorations	New ambitious policies, agreements and legislations are being explored in a "learning-by-doing" fashion. Most actors are willing to comply. Some targets may be unrealistic and requires flexibility
0	Strict compliance to fragmented legislation	Legal regulations regarding the water challenge are fragmented. However, there is strictly compliance to well-defined fragmented policies, regulations and agreements. Flexibility, innovations and realization of ambitious goals are limited. Activity may be penalized multiple times by different regulations due to poor overall coordination
-	Moderate compliance to incomplete legislation	The division of responsibilities of executive and controlling tasks is unclear. Legislation is incomplete meaning that certain gaps can be misused. There is little trust in local authorities due to inconsistent enforcement typically signalled by unions or NGO's
--	Poor compliance due to unclear legislation	Legislation and responsibilities are unclear, incomplete or inaccessible leading to poor legal compliance by most actors. If legislation is present it enjoys poor legitimacy. Actors operate independently in small groups. Fraudulent activities may take place

Five most consulted sources

Bryson JM, Crosby BC and Stone MM (2006) The design and implementation of cross-sector collaborations: Propositions from the literature. *Public admin review* 66:44-55

Fiorina MP (1982) Legislative choice of regulatory forms: Legal process or administrative process? *Public Choice* 39:33-66

Müller M and Siebenhüner B (2007) Policy instruments for sustainability-oriented organizational learning. *Business Strategy and the Environment*, 16:232-245

Roy AH, Wenger SJ, Fletcher TD, Walsh CJ, Ladson AR, Shuster WD, Thurston HW and Brown RR (2008) Impediments and solutions to sustainable, watershed-scale urban stormwater management: Lessons from Australia and the United States. *Environ Manage* 42:344-359

Van Rijswijk M, Edelenbos J, Hellegers P, Kok M and Kuks S (2014) Ten building blocks for sustainable water governance: an integrated method to assess the governance of water. *Water Int*

Indicator 9.3: Preparedness

Predefined question: To what extent is the city prepared (i.e. there is clear allocation of responsibilities, and clear policies and action plans) for both gradual and sudden uncertain changes and events?

++	Comprehensive preparedness	Long-term plans and policies are flexible and bundle different risks, impacts and worst case scenarios. They are clearly communicated, co-created and regularly rehearsed by all relevant stakeholders. The required materials and staff are available on short-term notice in order to be able to respond adequately. Evaluations on the rehearsals or reviews on dealing with calamities are available
+	Fragmented preparedness	A wide range of threats is considered in action plans and policies. Sometimes over-abundantly as plans are proactive and follow the precautionary principle. Awareness of risks is high, but measures are scattered and non-cohesive. They may be independent or made independently by various actors. Allocation of resources, staff and training may therefore be ambiguous
0	Low awareness of preparation strategies	Based on past experiences, there are action plans and policies addressing the water challenge. Actions and policies are clear but actual risks are often underestimated and the division of tasks is unclear. They are not sufficient to deal with all imminent calamities or gradually increasing pressures. Damage is almost always greater than is expected or prepared for
-	Limited preparedness	Action plans are responsive to recent calamities and ad hoc. Actual probabilities and impacts of risks are not well understood and incorporated into actions or policies. Reports can be found on how the water sector deals with recent calamities
--	Poor preparedness	There are hardly any action plans or policies for dealing with (future) calamities, uncertainties and existing risks. The city is highly vulnerable

Five most consulted sources

Allen KM (2006) Community-based disaster preparedness and climate adaptation: Local capacity-building in the Philippines. *Disasters* 30:81-101

Amundsen H, Berglund F and Westskogh H (2010) Overcoming barriers to climate change adaptation-a question of multilevel governance? *Environment and Planning C: Government and Policy*, 28:276-289

Brody SD (2003) Are we learning to make better plans?: A longitudinal analysis of plan quality associated with natural hazards. *J Plann Educ Res* 23:191-201

Evans B, Joas M, Sundback S and Theobald K (2006) Governing local sustainability. *J Environ Plan Manage* 49:849-867

Raaijmakers R, Krywkow J and Van Der Veen A (2008) Flood risk perceptions and spatial multi-criteria analysis: An exploratory research for hazard mitigation. *Nat Hazards* 46:307-322

Annex 4 Envisioned Scientific Publication Work Package 4 POWER

1. Review of ICTs in Urban Water Governance Initiatives worldwide. The key point of the article is that most forms of DSP facilitated citizen-government interactions are not high on democratic participation and deliberation spectrum and comprise lower forms of participation such as being informed and taking part in monitoring. Public managers and policy networks need to reform for closer stakeholder engagement. This fits the tasks D4.1 and D4.7
2. One in-depth case study paper (Leicester – with the focus on the process and outcomes of functioning ICT applications in the city and ex ante analysis for future introduction of DSPs). This is directly related to tasks 4.5 and 4.7.
3. A comparative paper with four cases studies in terms of implementation of DSPs based on deep case study approaches. Here we will need 6 Master students to carry out the work in Milton Keynes, Sabadell and Jerusalem (2 students per case study). This is directly related to tasks 4.5 and 4.7.
4. An in-depth case study of behavioural change in Milton Keynes for water conservation using survey methods and an attempt for environmental communication through DSP mediated environmental communication. This is directly related to tasks 4.5 and 4.7. it also has relevance with task 4.3. and will be written in collaboration with EIPCM.
5. A methodological paper on mixed methods in studying water governance which combines urban governance capacity assessment and in-depth case studies with the example of Leicester. The paper targets methodological contribution to water governance analysis with a key question if and how two ontological and methodological approaches can be complementary and to what extent these can be integrated. This is directly related to tasks 4.5 and 4.7.
6. A follow up paper on studying the actors, strategies and processes around packaging ICTs and DSP in the form of a policy narrative with subsequent impacts in Europe and around the world. A study of the rise of the new discourse in water governance. This is directly related to tasks 4.6 and 4.7.

Annex 5 Research Propositions as a Starting Point of Work Package 4 Research

Annex 5 is aimed to integrate the two parts of the WP4 analysis, namely the part on Governance Capacity Framework and the part of Collaborative Learning. The work of collaborative learning will make use of the information collected for five governance conditions, namely Management cohesion, Agents of change, Multi-level network potential, Financial viability and Implementing capacity. Research propositions are a necessary tool for qualitative research implemented in WP4 as a guiding block of data collection and analysis and constitute the same role as research hypotheses in quantitative research. In this annex we list our research propositions which will be used by students and researchers in guiding their data collection and analysis in order to confirm or falsify the statements/propositions and get insights into the role of DSPs for collaborative learning with the focus on the five governance conditions analysed by the GCF.

Research Propositions for the water Governance Capacity Framework Assessment

This focuses on the propositions of conditions 5, 6, 7, 8 and 9 of the framework. Propositions for condition 1, 2, 3 and 4 are being elaborated in the next section about collaborative learning.

Condition 5 Management cohesion

5.1 DSPs can enhance a better balance between on the one hand ambitious (i.e., identification of challenges, period of action considered, and comprehensiveness of strategy) and on the other hand realistic (i.e., cohesion of long-term goals and supporting flexible intermittent targets, and the inclusion of uncertainty in policy) goals.

5.2 DSPs can contribute to policy that is more embedded and interwoven in historical, cultural, normative and political context which may enhance the implementation.

5.3 DSPs may enhance a better alignment across sectors, government levels, and technical and financial possibilities.

Condition 6 Agents of change

6.1 DSPs may enable entrepreneurial agents of change to gain access to resources, seek and seize opportunities, and have influence on decision-making.

6.2 DSPs stimulate the ability of actors to engage, build trust-collaboration, and connect business, government, and sectors, in order to address the water challenge in an unconventional and comprehensive way.

6.3 DSPs can enable visionary actors to manage and effectively push forward long-term and integrated strategies which are adequately supported by interim targets

Condition 7 Multi-level network potential

7.1 DSPs can lead more freedom and opportunity to develop a variety of alternatives and approaches?

7.2 DSPs can reveal unclear division of responsibilities that can in turn be addressed.

7.3 DSPs may legitimate authority for long-term, integrated and sustainable solutions for the water challenge

Condition 8 Financial viability

8.1 DSPs may provide information that increases the affordability of water services and climate adaptation measures

8.2 DSPs can enhance the consumer's willingness to pay for water services by increasing their awareness and enhancing trust in local governments (i.e., trust that the money is well-spent).

8.3 DSPs can contribute to a more secure the long-term financial continuation of current projects and efforts.

Condition 9 Implementing capacity

9.1 DSPs can enhance the effective use of policy instruments effectively, in particular instruments that aim to focus on behavioral change.

9.2 DSPs can enhance a better coordination and transparency of existing legislation and may create understanding of the objectives in order to improve the statutory compliance of actor

9.3 DSPs may enhance the preparedness of citizens and local authorities to both gradual and sudden uncertain changes and events

Research Propositions Collaborative Learning in Case Studies (connected with GCF conditions)

Condition 1 Awareness

1. The greater the extent of awareness of stakeholders regarding the current and future risks, impacts, and uncertainties of the water challenges, the more the interest and engagement of stakeholders in collaborative learning through and thus more potential for DSP application
2. If there is an active forum and procedure for information sharing between citizens and local authorities facilitated by DSPs, more citizen support to government policies can be expected
3. The more reliable, diverse and available the information on the water challenges, the more intensive is the potential for collaborative learning and thus also for DSP application

Condition 2 Useful knowledge

4. Neo-liberalization of economies and subsequent decentralization policies have mostly discourages information sharing and knowledge co-production at the local level due to capacity limitations (ind. 2.3 knowledge cohesion)

Condition 3 Continuous learning

5. The greater the commitment to focus on procedural features of collaborative learning instead of exclusively on the end-results of stakeholder engagement, the greater the intensity of collaborative learning through DSPs
6. The “flatter” the interactions between stakeholders and the more discussion, the more learning takes place and therefore better outcomes for water management on the ground?
7. The greater the extent of the monitoring of process, progress, and policies able to improve the level of collaborative learning (i.e., to enable rapid recognition of alarming situations, identification or clarification of underlying trends), the greater the potential for DSP application
8. The greater the extent of current policy implementation being continuously assessed and improved, the greater the intensity of collaborative learning through DSPs

Condition 4 Stakeholder engagement process

9. The greater the extent of stakeholders open to and able to interact with other stakeholders, the greater the intensity of collaborative learning through DSPs
10. Social, economic, and cultural conditions are important indicators of the capacity of citizens to a) participate in information sharing; and b) engage in co-production of knowledge
11. The more inclusive the participation in DSPs the better the outcomes for water management issues at hand through more intensive collaborative learning