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scorewater

NAVIGATING SMART WATER PROJECTS: A GUIDE FOR MUNICIPAL INNOVATION

STAKEHOLDER INTERACTION, TECHNOLOGY DEVELOPMENT, AND DATA MANAGEMENT IN THE WATER SECTOR

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Dear reader,

We are pleased to present this easy-to-read handbook that collects the experiences from the SCOREwater project. This project is aimed at promoting innovation in the field of water management with ICT solutions.

The handbook is designed for municipalities interested in pursuing an ICT project within water management, whether to replicate something done in SCOREwater or with a different focus. The content is kept at a superficial level, with brief descriptions of the experiences from the project and a easy to use self-assessment tool by the end of the handbook in and appendix. We believe that there is no harm in repeating what “should” be obvious, as something that is obvious to one person may be less obvious to the next.

The examples from SCOREwater only mention a few of the actors involved in the situations they explain, if any at all, and are not detailed diary entries. Instead, they serve to illustrate the challenges and opportunities that arise in the implementation of ICT solutions in water management.

This handbook was made possible by the organization IVL, which authored the content, and Future City, which designed it. We hope that you find it useful and informative.

Sincerely,

Åsa Nilsson, Project Coordinator

Fredrik Hallgren, Project Coordinator

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Chapter 1
INTRODUCTION

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Introduction

This handbook shares some of the challenges and lessons learned from the EU funded H2020 innovation project SCOREwater, with an aim to help municipalities currently, or in the future, working on various ICT innovation initiatives.

The SCOREwater project

SCOREwater was carried out between 2019-2023 and focused on enhancing the resilience of cities against climate change and urbanization by enabling a water smart society, through three large-scale demonstrations cases (in the cities of Barcelona, Amersfoort, and Göteborg).

SCOREwater's mission is to connect governments, universities, and urban developers as well as technology professionals within the water sector to develop and test water-smart digital solutions and best management practices to strengthen cities' resilience. However, involving many partners and stakeholders with different types of expertise to co-create ICT solutions is complex and has resulted in many different types of challenges.

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

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Why is this guide for municipalities?

Many municipalities are working on various ICT innovation initiatives to improve their water management and are faced with various challenges. This guide is designed as an easy-to-use tool to help municipal organisations on their innovation journey towards an improved ICT support within water management and provides a basis for discussion. Furthermore, this guide is intended to be used by any organisation taking part in an innovation process and collaborating with municipalities. Since this guide is the first of its kind, it should provide a basis for ICT-related innovation and serve as a source for inspiration and valuable insights regarding potential challenges in interorganisational and interdisciplinary collaboration.

What is the purpose of this guide?

The purpose of this guide is to help municipalities on their unique journey towards a more engaged approach to innovation management activities for the purpose of improving ICT support for water management. The guide can be used as a support when it comes to handling common challenges during an innovation journey – by municipalities intending to improve an already existing ICT for water management strategy or by those just getting started on their journey.

Is this guide all about water management?

The short answer is no. This guide provides examples from the water sector, but many of the project experiences which are shared in the guide are not sector specific.

Where do the contents of this guide come from?

The contents of this guide are based upon the experiences from SCOREwater, a Horizon2020 Research and Innovation project financed by the EU commission under Grant Agreement 820751 (2019-2023). This project has produced more than 60 reports. Some of these reports, together with 18 exclusive interviews with stakeholders such as technology developers or employees at municipal organisations, are the basis for this guide.

The project was run as three geographically separate cases in the cities of Barcelona, Amersfoort, and Göteborg.

- The **Barcelona** case focused on sewer sociology and wastewater based epidemiology, mining information about pharmaceutical consumption and waste management practices from the city sewer system. The case also worked to raise public awareness about the importance of adequate lifestyle habits and waste management practices.
- In **Amersfoort** the activities were organized in different tracks. Firstly, a prediction model was developed to predict the risk of flash floods while also reducing their potential negative impact. A flood early warning system was developed and tested that allows organizations and people to take action to prevent damage in case of upcoming flash floods. Secondly, a soil moisture measurement was installed to improve greenery and combat drought in the city. Lastly, an integral part of the case involved active collaboration with citizens in a form referred to as citizen science. With these citizens, soil moisture was also measured and investigated, and interviews were held in the form of ‘thermal walks’ to investigate how people perceive heat stress on different days and different circumstances within the city.
- The **Göteborg** case focused on managing water pollution in the industrial construction sector based on the combination of meteorological data and water quality sensors, and predictive maintenance of local water treatment equipment. The Göteborg case also contributed by raising public awareness by developing science centre activities about the city´s waste-, surface-, and drinking water cycle and management.

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Limitations

This guide was developed with certain challenges and contexts in mind. Readers should thus be aware of its limits and ensure that it is not used for a purpose for which it was not designed:

- It has not been designed to give an overall measure of ICT innovation management.
- It cannot give municipalities a definitive 'answer' to the question on how to organize ICT innovation management – municipalities should find these answers themselves. This guide is merely a suggested framework to guide discussion and, point out common traps and thinking processes.
- It does not offer already formulated multi-context solutions. Municipalities need to adapt existing solutions or devise their own solutions suitable for their specific context, including aspects such as cultural, structural, or economic aspects.
- It was not designed to promote a specific ICT innovation strategy. It is designed to be used as a reflective tool to guide municipalities through their unique ICT innovation management journey. The included strategies should not be viewed as definite solutions, but as inspiration or perhaps a guideline.

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This handbook is not to be read page-by-page: start with a single challenge. You can repeat this journey for each challenge you want to solve.

The below table explains abbreviations and some of the terms present in this guide.

Term/Abbreviation	Definition
AI	Artificial Intelligence
BCASA	Barcelona Cicle de L'Aigua SA is a city council-created company managing the entire water cycle in Barcelona
Eurecat	The major Technology Centre of Catalonia, Spain
FIWARE	An open-source platform for the development of smart applications and services, particularly for smart cities
ICRA	The Catalan Institute for Water Research (Institut Català de Recerca de l'Aigua)
ICT	Information and Communications Technology
IERMB	The Barcelona Institute of Regional and Metropolitan Studies (Institut d'Estudis Regionals i Metropolitans de Barcelona)
NCC	A construction company in Sweden, stakeholders in the SCOREwater project.
SEWERNET	An open-source platform created by BCASA for the management and maintenance of its sewer system
SHS	Swedish Hydro Solutions
Swedish Hydro Solutions	Water purification expert company based in Alingsås, Sweden
WBE	Wastewater-Based Epidemiology

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CHAPTER 2
THE CHALLENGES

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Click on the challenge icon
you want to learn more about

A CHALLENGE
Communication

B CHALLENGE
Engaging stakeholders

C CHALLENGE
Managing Technology
Development

D CHALLENGE
Working with data collection
and data processing

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Challenge A

Communication

Why is this important?

Communication is generally acknowledged as an important factor for a successful project, and it is even more important when you combine a high number of participants with diverse backgrounds and competencies. Experiences from the SCOREwater project has shown how structuring of the communication can make the process easier, more efficient and enhance the result.

Due to the variety of organizations and their different expertise, it has been vital to sort out potential communication barriers and expectations before and during the projects. When communicating with stakeholders from different sectors and within different areas of expertise, one will encounter numerous routines and policies that should be considered. Participants are used to certain decision processes, meeting types/intervals, technical language, and information chains.

By bringing these challenges up for discussions early on, the team can set the right framework for how to work and communicate during the project - creating a procedure agreed by all partners which leverages the collected knowledge. It is equally important to follow up and keep the relevant people informed of the progress and eventual changes that might affect the work forward.

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TAKE ACTION

Use these instructions to assess Your organisations' progress within this Challenge. Once you identify a gap this Guide can provide insights and share experiences from the SCOREwater project.

CLICK THE BUTTONS FOR MORE INFO

- General communication
- Establish meeting and communication frameworks
- Communication between municipalities and other partners
- Talk about synergies and differences

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GENERAL COMMUNICATION

All organizations and the people who work within these organizations have different experiences and views on how one should communicate with each other. It is important to sort out any potential hinders or differences early in the project, to set rules for communication and an initial understanding for the participants' expectations.

CHECKLIST – GOOD PRACTICE:

- ❒ Talk about expectations early
- ❒ Decide on preferred communication channels
- ❒ Make sure to understand each other's internal processes
- ❒ Keep people informed and updated about progress and challenges
- ❒ Inform stakeholders and collaborating partners about changes within your organization
- ❒ Set meeting frameworks and frequency

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EXPERIENCES FROM SCOREWATER:

Information sharing needs to be frequent and easy to understand
If the information shared in meetings is difficult to understand and translate into the own organisation, or if there are long periods of no information, there will be an increased risk that the project partners feel that they are not contributing. Establishing clear definitions of terms used and deciding upon a communication frequency are risk mitigating measures.

Partners not delivering as promised are managed with personal reminders and internal pressure
One common obstacle with collaboration is the dependency on other partners' delivered work, and if this is not delivered as promised the plan will have a setback. This issue was primarily managed by sending personal reminders and secondarily by asking participants from the same partner to apply internal pressure.

Recurring meetings can facilitate future communication
Biweekly meetings were scheduled for the Barcelona case study, with specific meeting topics occurring on a need basis. Additional meetings were arranged between Eurecat and BCASA with the purpose to share knowledge about the more demanding technical topics such as Data Analytics and Machine Learning and their context in the project. These meetings helped define the necessary data for Eurecat.

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ESTABLISH MEETING AND COMMUNICATION FRAMEWORKS

Creating the structure, intervals and governance of the meetings will foster a good communication process throughout the project. All parties should know why the meeting is planned and what topics the meetings will answer, but also why they are present at the specific forum.

CHECKLIST – GOOD PRACTICE:

- ❒ Plan frequent information sharing activities or meetings
- ❒ Consider the respective benefits of meeting physically or digitally
- ❒ Before any meeting, consider the purpose of the meeting and the desired interaction with the meeting attendees
- ❒ Establish communication rules for when expectations on the collaboration are not met
- ❒ Interactive meetings with a larger number of active participants do better in a live setting
- ❒ Save the digital meetings for information updates or interactive meetings with a maximum of 3 participants
- ❒ Identify the main contact person and other roles for each organization

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EXPERIENCES FROM SCOREWATER

Digital meetings can be too formal
Perceived barriers relating to communication and stakeholder interaction after the summer of 2021 was partly due to the societal effects of the covid-19 pandemic. Based on an evaluation using surveys, it was found that physical meetings could have enhanced the ideation process and facilitated greater citizen participation. The use of digital meetings was perceived as more formal than physical meetings, which may have had a negative impact on participants' creativity and sense of participation.

Digital meetings can enable involvement of a broader audience
The inevitable digitalization of meetings following the covid-19 restrictions made it easier to organize meetings with citizens from different countries.

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COMMUNICATION BETWEEN MUNICIPALITIES AND OTHER PARTNERS

Collaborating with diverse actors, such as technology providers, in municipal projects can offer a wide range of competencies. Effective communication is key to leveraging the collective knowledge, but it can be challenging due to differences in terminology, knowledge gaps, and varying workflows. In some cases, direct connection between technology providers can enhance communication and maintain quality.

CHECKLIST – GOOD PRACTICE:

- ❒ Collectively agree on definitions of (technical) terms to be used
- ❒ Aim to understand your collaborators' perspectives
- ❒ Consider the possible gains from a closer collaboration
- ❒ Identify the relevant strengths and weak spots of your organization that might affect the project
- ❒ Promote 'technology provider-to-technology provider' communication

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EXPERIENCES FROM SCOREWATER

Understand and influence partner and stakeholder expectations
Technical terms can result in different expectations due to factors such as professional background, current field of expertise, and native language. Defining the technical terms used can mitigate the risk of undesired expectations not being met. Experiences from the SCOREwater showed a need to establish clear definitions of terms used such as: digital model, digital twin, groundwater model, hydrological model, flood alarm, test bed and sensor network.

Continuous communication helps getting familiar with technical terms
The meetings enabled sharing of needs on company level and for all involved partners to become familiar with the language and technical terms used within the project.

Aligning needs for efficient sewer maintenance and citizen satisfaction
In the City of Barcelona case, one of the main activities was to align the two needs of efficient maintenance of the city's sewers and reacting to citizens' complaints about odour. To achieve this, the city wanted to merge data from two currently used programs: one for sewer maintenance and the other for odour complaints from citizens. Eurecat and ICRA, both dedicated to research, collaborated with the municipal BCASA to achieve this objective.

Eurecat was responsible for the modelling to enable maintenance decisionmaking within the SEWERNET platform but had no previous experience working with the Barcelona sewer systems. This presented a challenge for BCASA, who needed to translate their needs and work methods across organizational and knowledge boundaries. Despite this challenge, the collaboration generated valuable knowledge and experiences for all participants involved.

Giving technology providers knowledge about municipality internal processes enables a wider understanding
Working together with actors in other industry sectors can be a good source for new knowledge. For Swedish Hydro Solutions, one of the SCOREwater project's technology providers, the collaboration with the City of Göteborg provided insights to how the internal processes in a large Swedish municipality can be shaped, as well as a better understanding for the governmental processes and the definition of requirements.

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TALK ABOUT SYNERGIES AND DIFFERENCES

Municipal organizations and technology providers may have different decisionmaking processes and procurement procedures. Technology providers may find it easier and quicker to make decisions or select suppliers, while municipalities may have more complex negotiation processes. To collaborate effectively, it's crucial to communicate and discuss these differences to understand each other's perspectives and underlying conditions.

CHECKLIST – GOOD PRACTICE:

- ❒ Never assume that the technology provider understands your internal processes
- ❒ Inform technology providers about your municipality's working conditions early on in the project
- ❒ Be open for unexpected synergies
- ❒ Discuss how potential differences will affect the workflow
- ❒ Explore how you can support one another with each other's challenges and needs
- ❒ Scout the local area for possible collaborations or sources for data
- ❒ Help each other communicate the results
- ❒ Ensure that municipal entities are aware of the limits of technology so as not to create false expectations

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EXPERIENCES FROM SCOREWATER

Synergies
Synergies were frequently mentioned as positive examples of communication and stakeholder interaction. In Barcelona, the wastewater sampling stations in some neighbourhoods allowed collaboration with other sewage epidemiology projects in the same area.

Communicating technological results can be challenging
One communicative challenge in the SCOREwater project was effective sharing of results, mainly communicating the technical functions and main results obtained by the data-driven model in an understandable way.

Communication between technology providers can facilitate technology development
Two of the project's technology providers exchanged knowledge which facilitated technology development of the test-bed technology and algorithm. Swedish Hydro Solutions contributed with technical knowledge about the water cleaning process in return for knowledge about AI possibilities from an expert in the field from Eurecat. This exchange of knowledge enabled technology optimisation for both parties.

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Challenge B

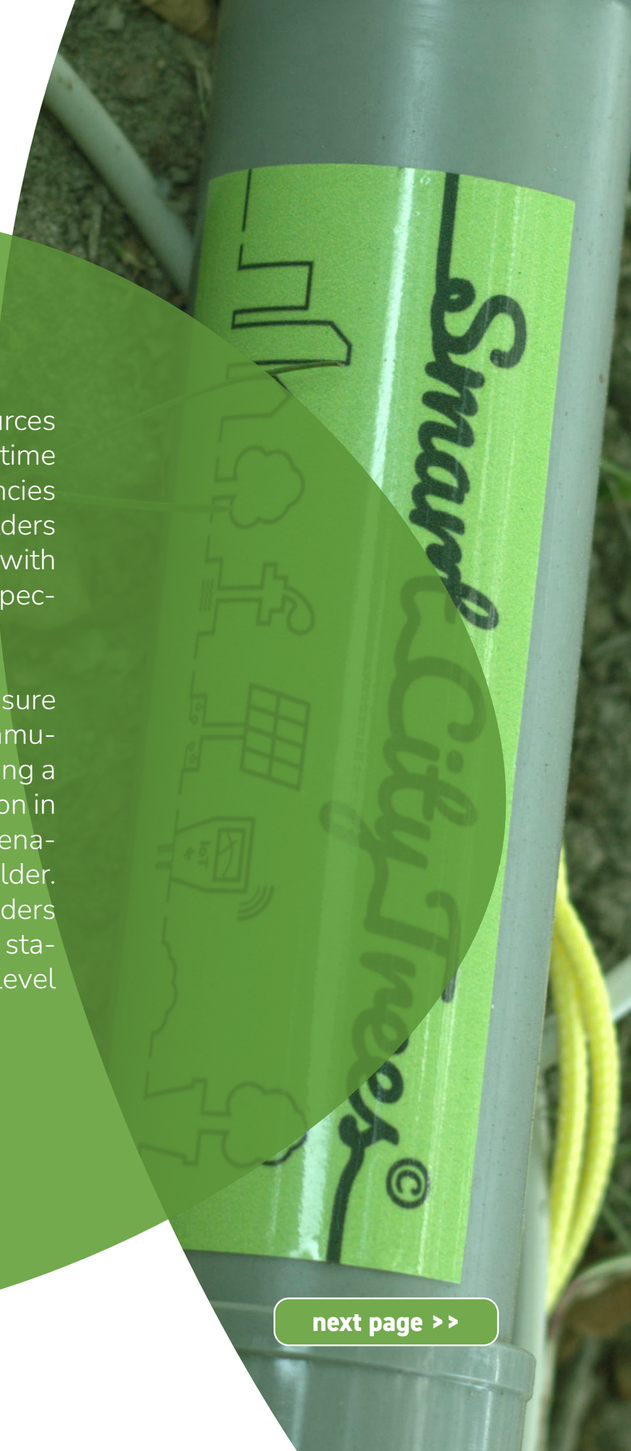
Engaging stakeholders

Why is this important?

Innovation in the water sector takes place through networks of private and public actors at different levels and with different perspectives. These actors sometimes have conflicting goals and access to different strategies or instruments. It is beneficial to see the network of actors as a source for innovation, taking advantage of the combination of several stakeholders rather than focusing on one company. An engaged network of stakeholders (e.g. customers, suppliers, policy-makers) reduces and uncovers risks in the project, and so facilitates successful implementation of an innovation.

The network of involved stakeholders should carry different types of knowledge, competencies, and mandate. This includes different types of both technical and social expert competencies, as well as knowledge about the local citizens (e.g. demographics and behaviour). Working with a stakeholder network that has a wide basis of competencies and knowledge resources can enable faster project progression through less time spent on searching for complementing competencies later in the project. A wide network of stakeholders increases the collective reach across disciplines, with the possibility to leverage stakeholders' own respective contact networks.

Key in successful stakeholder engagement is to ensure that all stakeholders have clearly defined and communicated roles, responsibilities, and mandates. Having a defined purpose for each stakeholder's participation in the project can motivate active participation and enable more efficient time-planning for each stakeholder. By understanding the roles of the other stakeholders the project gains a more detailed context and each stakeholder can more easily understand the priority level of their participation.



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TAKE ACTION

Use these instructions to assess Your organisations' progress within this Challenge. Once you identify a gap this Guide can provide insights and share experiences from the SCOREwater project.

CLICK THE BUTTONS FOR MORE INFO

- Building the stakeholder network
- Raising and keeping the level of stakeholder engagement
- Working with citizens and end-users
- Establish effective playing rules for the involved stakeholders

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BUILDING THE STAKEHOLDER NETWORK

Networks are important for sharing experiences, getting access to information, and learning from other stakeholders. Solving complex problems in a socio-technical system requires a collaborative approach involving stakeholders in the system in an iterative process where solutions are discussed, tested, and adjusted. A common understanding of the problem/challenge and a shared vision for the future facilitates collaboration as it is based on common ground.

CHECKLIST – GOOD PRACTICE:

- ❒ Identify relevant stakeholders who could have a strategic role in fulfilling the goals of the project
- ❒ Use established frameworks or working methods to interact with stakeholders
- ❒ Arrange workshops and meetings to create a setting where knowledge and expectations can be shared
- ❒ Consider the value of stakeholder knowledge for not just the project, but for each participating actor – leverage this when recruiting more stakeholders to follow the project!
- ❒ Share needs and expectations in the stakeholder network and define necessary achievements
- ❒ Create an overview of the projects' areas of expertise and competencies

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EXPERIENCES FROM SCOREWATER:

Identifying stakeholders through already established relationships
Already established relationships with external stakeholders were utilised both in the early and latter stages of the project. Project partners had an initial idea of which other stakeholders were relevant for each city case. Additional relevant stakeholders were identified as the project went on.

Value chain or supply chain exercises to identify additional actors
Project partners were tasked to identify key relationships in their value chain in exercises with the two frameworks: the Value Proposition Canvas and the Business Model Canvas. The value chains relating to the SCOREwater project cases were then explored more in-depth by constructing theoretical value chains based on acknowledged stakeholders and the identified additional actors.

Defining stakeholder roles in an early workshop setting
A first stakeholder workshop in the Barcelona case introduced the SCOREwater project to the case participants. This first workshop was an opportunity to identify and explore stakeholder needs.
The process of identifying the network's stakeholder needs can be varyingly straight forward with clear goals identifiable early in the process or require several repeated meetings and activities. An early workshop setting also provides a good opportunity to create a common understanding on stakeholders' roles in the project.

Exploring stakeholder needs through workshops
A series of themed workshops using the Design Thinking methodology were conducted to identify the needs of various stakeholders in the water sector. Design Thinking is a problemsolving approach that focuses on understanding the user's needs and experiences, and using that understanding to create innovative solutions.
The first workshop ("Exploration") aimed to gather feedback on the strategic direction of the project from experts and involved a wide range of stakeholders from relevant fields. The second workshop

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("Ideation") engaged the entire BCASA team, which included 25 workers from different departments, to identify organizational issues and understand the workforce's vision for digitalization in the water sector. The third workshop ("Ideation") was conducted online and presented the research findings in the field of Wastewater-Based Epidemiology (WBE), followed by a discussion and brainstorming session on possible applications of WBE from a medical perspective. Including stakeholders from various backgrounds and utilizing the Design Thinking methodology helped the project team gain insights into the needs and perspectives of different stakeholders, and ultimately create innovative solutions that addressed their needs.

Complementary roles with a common focus
In Amersfoort, the stakeholders represent a wide variety of organizations, public bodies, research institutions and a residents' collective. Each participating stakeholder had their own reason to participate and role within the project but shared between them was the focus on climate adaptation.

Sharing needs and interests is important to create a shared view on necessary achievements
Within the Amersfoort case it was reflected upon the importance of sharing knowledge and insights but also needs and interests among the different stakeholders. Sharing these aspects ensured a shared view among the stakeholders which was needed to reach the own organisation´s but also the stakeholders´ goals.

Providing an overview over specialists´ work
When many technical specialists are involved in a project, such as the "measure your city" initiative in Amersfoort, it can be difficult to keep track of all the activities and identify opportunities for collaboration. In this case, the challenge was addressed by involving the communication team, who helped to provide an overview of the different activities.

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RAISING AND KEEPING THE LEVEL OF STAKEHOLDER ENGAGEMENT

Continuous engagement from stakeholders is necessary for successful project progress. The initial motivation that comes with starting a new and exciting project risks fading as the project progresses forward. As different stakeholders have roles that fill different purposes in the project, it is natural that the level of participation fluctuates throughout the project. Ensuring that stakeholders stay in the loop of the project and are motivated to contribute also in stages where they are not key contributors will benefit the entire project.

CHECKLIST – GOOD PRACTICE:

- ❒ Allow some flexibility in the project plan when possible
- ❒ Organise regular communication and continuous information sharing
- ❒ Work with the differences and arrange creative meetings or workshops with stakeholders
- ❒ Facilitate the exchange of knowledge between stakeholders
- ❒ Use the established exchange of knowledge as a selling-point for more collaborators
- ❒ Raise the stakeholder network's level of attractiveness for the participating stakeholders

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EXPERIENCES FROM SCOREWATER

Flexibility
A certain level of flexibility in the project plan will be useful to ensure ongoing commitment, participation, and enthusiasm of stakeholders.

Unwillingness to change everyday workflows a potential hinder
Early on, unwillingness to change workflows in the stakeholder's day-to-day operations was identified as a potential hinder. A suggested method to mitigate this issue was to maintain long-lasting and continuous communication updates on SCOREwater project updates.

Identifying common denominators
Identifying common denominators between the different cases and stakeholders within the project, e.g. regarding what can be done in the platform and under which conditions, was highlighted as important for collaboration in the project.

Combine interdisciplinary competencies of stakeholders
The interdisciplinary competence of stakeholders helped to define a clear and attractive business case for the construction companies in the Göteborg case. The different competencies were combined in a workshop exploring the future possibilities to combine technical and organisational enablers to improving resilience in the cities and to increase the value of proxy indicators with the use of AI.

Iterative design process involving all stakeholders of the case
A design process was undertaken to develop a business case, two checklists, and a resilience baseline for the release of worksite water. The process was iterative and began with an e-mail agreement among all stakeholders on the tasks and responsibilities of each party. The stakeholders collaborated to define the scenario and objectives for measuring resilience, and an initial checklist was created by the administrative stakeholder. After a workshop involving all stakeholders and organizations, the checklist was revised and refined to better suit the project's needs.

Exchange of knowledge can attract or motivate collaborators
The project achieved positive outcomes by collaborating with a research agency that specializes in public health. Involving the research agency provided access to their scientific expertise on effectively managing greenery in urban areas. As a result, the project was able to benefit from their knowledge and experience. Additionally, the research agency gained valuable feedback from the project and gained insights into how to make their knowledge more accessible.

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WORKING WITH CITIZENS AND END-USERS

A city's water management impacts commercial and municipal organisations in a city as well as its inhabitants. Innovating in areas with direct impact on citizens thus benefits from including the citizen perspective in the research and development stage. End-users and citizens are also a possible resource for competencies and both quantitative and qualitative data. They can contribute to the creation of custom-made solutions to fit the target group, by providing the necessary information for decision-making in the technical development.

CHECKLIST – GOOD PRACTICE:

- ❒ Seek out ongoing research projects or initiatives which have already managed to engage citizens and consider possible synergies
- ❒ First consider the purpose of the interaction with end-users and citizens, and secondly design the interaction
- ❒ Involve users with different types of expertise and competence
- ❒ Base the development process upon an analysis of users' everyday practices
- ❒ Transform identified user/customer expectations and needs into requirements – experiment and brainstorm

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EXPERIENCES FROM SCOREWATER

An existing citizen science initiative was the foundation for citizen engagement in the SCOREwater project

The Amersfoort case leveraged an ongoing project 'Measure Your City', launched in 2015, involving residents in the effects of climate change by having citizens run research projects and collect data. More than 100 citizens were already collecting temperature and humidity measurements at the start of the SCOREwater project. On this basis the data collection was extended with water measurements via the SCOREwater platform in which the data was visualized. The citizen collective was considered a key stakeholder and helped ensure that activities were properly aligned and that the volunteering citizens remained motivated. The level of motivation and availability of volunteers cannot be fully planned beforehand, suggesting a high value for previous experiences and the flexible engagement of the citizen collective.

Methods depend on the target audience and purpose

For the science center Universeum, in the Göteborg case, engaging end-users is a common practice in a product development process. In the SCOREwater process this was done with the target end-user group in mind. For the target group 'School children', Universeum initially conducted interviews with class teachers. Further along in the product development process the same classes of School children participated in prototype testing in two rounds with subsequent evaluation of the prototype test results and following improvements.
For the target group 'citizens' or 'families with school-aged children' general visitors to the Universeum facility were targeted with market surveys conveying their general level of happiness with Universeum (Swedish: NKI, nöjd-kund-index).

Survey results can complement other data sources

Market survey was also the choice for IERMB in the Barcelona case, where local citizens were asked to respond to certain questions. The survey data was collected for the purpose of complementing data collected from the SCOREwater project's measuring stations in Barcelona.

Translate user needs to requirements

After the end-user or customer needs have been identified, the results should be translated into requirements. This is a subjective process that can take the form of creative meetings and brainstorming activities. The generated ideas and requirements are based on, but not identical to, end-user experiences and communication.

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ESTABLISH EFFECTIVE PLAYING RULES FOR THE INVOLVED STAKEHOLDERS

Once the stakeholders' engagement and motivation are sufficient, the next objective is ensuring a good collaboration. Establishing rules for communication and information sharing has the potential to build stronger collaborative relationships. All collaboration arrangements are unique and should set their own playing rules.

CHECKLIST – GOOD PRACTICE:

- ❒ Arrange for early introductory meetings – do not wait for better times
- ❒ Translate internal work methods and terms used for communication – these do not automatically translate without misconceptions
- ❒ Establish a structure and communication routine for following up on deadlines
- ❒ Consider stakeholder competencies and promote closer collaboration where beneficial synergies are probable

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EXPERIENCES FROM SCOREWATER

Early introductory meetings facilitate collaboration
Establishing roles and building on group dynamics early on in the project is beneficial for smooth collaboration. Understanding wants and needs of each involved party is essential and having set a good foundation for communication at the project start is an enabler. In the Göteborg case, the stakeholder NCC experienced that the initial meetings gave them a good foundation for following other project stakeholders' work.

Collaborating with research focused organisations requires the translation of needs and work methods
One main activity in the City of Barcelona case was to align the two needs: 1) efficient maintenance of the city's sewers, and 2) reacting to citizens' complaints about odour. The city wanted to merge data from an open-source platform (SEWERNET) created by BCASA and from a platform used for sewer maintenance and odour complaints from citizens. This objective engaged actors fully dedicated to research, Eurecat and ICRA, in collaboration with the municipal BCASA. Eurecat was responsible for the modelling to enable maintenance decisionmaking within the SEWERNET platform but had no previous experiences working with the Barcelona sewer systems, challenging BCASA to translate their needs and work methods across the organisational and knowledge boundaries.

Follow up long-term deadlines
A challenge working in long-term projects with different partners is to align the project work with the daily work in the participating organisations. Within the Amersfoort case the prioritisation of other projects with deliverables close in time was described as an obstacle for the work progress in the SCOREwater project. Thus, a recommendation was to continuously follow up that long-term deadlines are not neglected.

Consider the project partners' previous project experiences
Universeum expressed that there was great value in the administrative support received from project partners with previous experiences from EU project participation. This is an example of complementing experiences from two project partners enabling work.

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Challenge C

Managing technology development

Why is this important?

Technology development refers to the improvement, invention, or design of new types of products or equipment. This process can be resource heavy and require large financial investments in human capital and physical goods such as equipment and material. Ensuring that a technology development process is using resources efficiently has the potential to increase the generated value and help the project forward. Managing technology development as an integrated, yet separately defined, part of an ICT development project can make it easier to distribute time and resources.

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TAKE ACTION

Use these instructions to assess Your organisations' progress within this Challenge. Once you identify a gap this Guide can provide insights and share experiences from the SCOREwater project.

CLICK THE BUTTONS FOR MORE INFO

- Working with innovation
- Cooperating with experts in the water sector
- Technology ownership and components
- Design and development

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WORKING WITH INNOVATION

Innovation in its essence is about making new ideas and technical findings available to society by implementing them as e.g., new products, processes, or business models, and creating impact. Implementing an innovation is considered the final step of the innovation process, but the interaction with the users of an innovative product or business model should not start here. It can be valuable to consider the potential end-users of an innovation product in an early project phase, to guide the work forward. As the innovation project progresses forward new findings and insights are likely to unfold (technological, organizational, or other). Early objectives and problem definitions are valuable, but their value can decrease over time if they are not re-verified in a dynamic surrounding or if the project takes a technological leap.

CHECKLIST – GOOD PRACTICE:

- ❒ Specify clear objectives, target end-users, and resources in early stages
- ❒ Review objectives and target end-users when reaching new major insights
- ❒ New technology often requires organizational adaptations
- ❒ Technology can enhance and improve daily work
- ❒ Have dedicated resources

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EXPERIENCES FROM SCOREWATER

Don't forget the end-users
An internally clear objective, a specified targeted end-user and relevant resources for the specified product development and deliverables should have been formulated at the project start. In that way each participating partners' contribution, both to SCOREwater and internal business plans, would have the conditions to be of greater proportions.

Technological development requires organizational adaption for usefulness
Technological advances, such as improved sensor capability and AI solutions, took place in the project for the goal of improving water management resilience to release of contaminated stormwater. However, new or improved technological solutions are not sufficient on their own if they are implemented in an environment that is not ready to adapt. In the Göteborg case, stakeholders communicated that improving organizational capacities to make use of technological development is a necessity for an overall resilience improvement.

New technologies can enable new work routines and potential changes to regulations
Added value of the technological solutions were the potential to improve current practices at construction sites and provide arguments for more stringent regulations in the future. Examples of organizational adaptations to the technology are new workplace routines for acting upon alarms and more frequent reporting to authorities, based on real-time data and AI enabled proxy indicators.

Organizational capabilities to use technical improvements and data are key
Organizational capabilities to make use of the data and technical improvements (in sensor capability and AI solutions) were considered key for the improvement of overall resilience.

Knowledge about both innovative technology and organizational principles is beneficial
Defining the problem, establishing a general problem definition, is not always a straightforward process. The problem definition can be vague or not recently verified and an obstacle for disruptive innovations. Actors offering innovative technologies often have limited knowledge about the organizational mechanisms and constitutional responsibilities within municipal organizations.

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COOPERATING WITH EXPERTS IN THE WATER SECTOR

Technology development in the water sector is dependent on the input from those whose tasks are made easier by the technology, or whose workflow is impacted by the process automation. Understanding the field of operation, tempo, and playing rules of the water sector, is necessary for applied research and the development of use-ready solutions. The involvement of stakeholders and potential users of the ready solutions is a necessary step in the process of design and development. Field experts can play an important role in this process as well as with identifying whom to involve next and which questions to ask.

CHECKLIST – GOOD PRACTICE:

- ❒ Involve in-field experts (and plan when and how to do so)
- ❒ Don’t underestimate the complexity
- ❒ Work closely and integrated
- ❒ Use platforms to meet and exchange knowledge creates value
- ❒ Beware of the gap between different disciplines, e.g., computer engineering vs. water engineering

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EXPERIENCES FROM SCOREWATER

Digitalization in the water sector is complicated
The most important lesson learned is that digitalisation of the water sector is more complex than initially thought and that organisational issues are a significant part of this complexity. This complexity necessitates a more integrated way of working, which can be challenging for large and layered municipal organizations.

Meeting platforms enhance the co-creation
A better platform is needed for theory and practice to meet and exchange experiences in these issues. Implementing a more integrated way of working in the city can improve the utilization of necessary competencies, facilitating the implementation of new technology and digitalisation in the water sector.

Digital transformation
To ensure a successful digital transformation in the water sector, it is crucial to align the data and services being developed with the corresponding internal expertise and stakeholder assignments. This requires a careful consideration of the complexity involved in the digitalization process.

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TECHNOLOGY OWNERSHIP AND COMPONENTS

Implementing new technology solutions to a problem can involve several rounds of trial and error. Components purchased for a technical solution may not function as expected or software integration may be challenging. It's crucial to have access to and understand the technology components and software, even after the project is completed. Planning for the market launch of a new product is a potential outcome of an innovation project, which brings up questions of technology ownership and continuous supply of components. Additionally, the management and maintenance of systems after the project's completion should be discussed and decided upon before the project reaches its final stage.

CHECKLIST – GOOD PRACTICE:

- ❒ Beware that bureaucratic issues with purchasing of components and other permits can require more work and time than first anticipated
- ❒ Proactively plan to make sure the technology works
- ❒ Have a plan in place for situations where technology components do not work as well as anticipated
- ❒ Don't forget that maintenance and management have costs after the project ends – a sustainable business model can incentivise companies to offer the developed solutions to interested governments

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EXPERIENCES FROM SCOREWATER

Proactively plan to make sure the technology works
Some technology components purchased for the project have not worked as expected. The underperforming components had to be replaced with alternative products to get the desired performance. While being aware of this possibility and the availability of alternative products can help reduce the risk of unforeseen events, it cannot be completely eliminated.

Management responsibility after the project ends
When considering the responsibility for the continued management of the developed ICT solution one can benefit from understanding the differences between information technology (IT) and operational technology (OT) and where these two converge for the application in question. Should the technology be managed mainly by suppliers of IT solutions or by suppliers of operational (physical) solutions such as plumbers? Or perhaps by both or an actor in-between?

Understanding of public procurement law varies
Non-governmental organisations might only know of public procurement laws on a principal level, and not fully understand the implications in an innovation project setting. This was a topic of discussion during the project and by some partners this was considered a major challenge with innovating in the water sector.

The project will still have costs after the project ends
After the project ends the cost of maintaining the data structures must be transferred from the project. Considering this before the project has ended is crucial if a data structure is expected to be up and running continuously. Discuss the cost structure and consider who has incentives to maintain the structure and take the cost after the project ends.

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DESIGN AND DEVELOPMENT

Involving stakeholders such as end-users and in-field experts in the design and development of products and services has the potential to improve efficiency in the project process. The design and development process is usually an iterative process with back-and-forth communication between the responsible person, the technical developers, and a reference group (typically users). End-users and experts with different types of expertise and competence can add different value in various stages of this process. Involving stakeholders in the process also opens for possibilities to test early concepts and prototypes on relevant stakeholders, and in otherwise inaccessible environments.

CHECKLIST – GOOD PRACTICE:

- ❒ Use an iterative process to spend available resources more efficiently
- ❒ Involve end-users, experts, stakeholders, and partners
- ❒ Involve users with different types of expertise and competence
- ❒ Some experts might not have an abundance of time available to work in innovation projects
- ❒ Make sure to test the technology in real life environment

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EXPERIENCES FROM SCOREWATER

In-field experts are needed throughout the project
Teamwork and consideration of the local context by incorporating both local inhabitants and governments are crucial, according to a social impact evaluation of potential future implementations of ICT solutions in water management. For a successful implementation of new technology in the city it is beneficial to involve in-field experts and intended end-users throughout the entire project. In the Göteborg case, there were some challenges related to how the City of Göteborg is organised today and working together in innovation project. City employees working on a strategic level in these innovation projects are dependent on other people for the in-field end-user knowledge that is necessary for a successful project.

Iterative design process involving all case stakeholders in stages
An iterative design process took place to create a business case, two checklists, and a resilience baseline for the release of worksite water. The process started with an agreement through e-mail corresponding between all involved project partners on what to do and by whom. The scenario and goals for resilience measurement was set by the involved partners and a preliminary checklist was created by the administrative partner. The checklist was adjusted after a workshop with the involved partners and stakeholders.

In-field experts are limited resources
The in-field experts bring in very important knowledge to the project and their previous experience are enablers to implement new technology. However, while on the one hand in-field experts are key-people in innovation projects— on the other hand they seldom have time to work in innovation projects.

Workshop: stress-test
A stress-test based upon an actual event was made possible due to the participation of the construction company NCC, working on the West Link Project in Göteborg. The stress-test measured the effects on functionality from a real event. Together, one project partner and one stakeholder defined functional elements to measure during the stress-test. The list of indicators was further revised by stakeholders and project partners.

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Challenge D

Working with data collection and data processing

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Why is this important?

Working with ICT systems in the water sector has the potential to generate large amounts of data. Theoretically, there are numerous possible applications for analytical models on water management data. However, decisions in the water sector are made at several levels, and the processed data that forms a decision basis might not work at all levels.

Decisionmakers and stakeholders working with ICT in the water sector, as well as innovators collaborating with them, are tasked with collaborating across disciplinary boundaries. They manage projects and technology development and deal with the implications of organizational differences and expectations. Adding data collection and management to the mix does not necessarily increase the level of difficulty, but because it is a field of knowledge in its own right, data collection and processing should be considered an additional aspect of the project that impacts the project as a whole.

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TAKE ACTION

Use these instructions to assess Your organisations' progress within this Challenge. Once you identify a gap this Guide can provide insights and share experiences from the SCOREwater project.

CLICK THE BUTTONS FOR MORE INFO

- Data collection by measurements
- Data collection from external data sources
- Analysing data

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DATA COLLECTION BY MEASUREMENTS

Data collection in the water sector is a lot about collecting measurement information at various locations in the water utility. Measurements can be human observations, laboratory data, or collecting and sending data from online sensors. When developing a sensor network it is necessary to consider how the data can be used to support decisions at all levels and in emergency situations. Short-term decisions (such as process automation) and long-term decisions (e.g., infrastructure planning) can require different amounts of data and different requirements on properties such as collection frequency, exactness, and quality. It is important to understand the available options before deciding on which sensor to purchase or develop.

Today measurements from sensors and laboratory data are extensive in larger wastewater plants, while smaller plants are not so well instrumented. In the wastewater network there are very few measurements made by sensors, measurements by laboratory data are made but mainly measurements are made by observations.

CHECKLIST – GOOD PRACTICE:

- ❒ Define different situations in which the measured data is going to provide a basis for decisions
- ❒ Identify if the measurements are for short-term or long-term decision making
- ❒ Understand the expectations on the data from decision-makers on different levels in the water sector
- ❒ Investigate alternative sensors before purchase – weight upsides and downsides, and consider which sensor properties are the most important for the application at hand
- ❒ Establish procedures for maintenance of the deployed sensors
- ❒ Establish procedures for the interpretation of sensor signals and for filtering invalid data from online sensors (example: dirt on turbidity sensors)
- ❒ Decide who can access the information and why
- ❒ Access to measuring locations might need approval from several departments
- ❒ Make sure to be updated if any changes to the locations will be made

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EXPERIENCES FROM SCOREWATER:

Identifying stakeholders through already established relationships

Setting up measuring stations on locations not owned by the project. The placement of sensors on various locations in the city required arrangement with the owners of the location. In the Göteborg case, the involvement of certain stakeholders thus facilitated the implementation of sensors and made it easier to access data from the construction sites.

Access to measuring locations required approval from different municipal departments

Locating good geographical spots for deploying sensors for data collection is one thing. Another thing is to access those geographical spots and obtaining permission to do so. For the Göteborg case, the process of accessing locations owned by the city often involved people from different departments within the city. This resulted in more administrative tasks which had to be handled internally within the project, which were managed with flexibility and problem solving by the project leaders (a non-municipal research institute).

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DATA COLLECTION FROM EXTERNAL DATA SOURCES

Limited access to data can also limit project possibilities, so considering how to access certain types of data can be a natural early step in a project. At other times, the question of data access may initially occur when an issue arises. Measuring data from real-world geographical locations can require permissions for data collection or sensor placement. The hardware used to collect data can limit data compatibility.

CHECKLIST – GOOD PRACTICE:

- ❒ Consider which stakeholders can deliver data and under which premises
- ❒ Create agreements with the owners of the installation locations
- ❒ Beware of lock-in effects from proprietary data sources
- ❒ Collectively agree on a process for collecting data
- ❒ Access to measuring locations might need approval from several departments
- ❒ Make sure to be updated if any changes to the locations will be made
- ❒ Decide who can access the information and why

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EXPERIENCES FROM SCOREWATER

Sources and open-source work
The Amersfoort case ran into trouble when combining their open-source work with proprietary sensors purchased by the municipality from one of their suppliers. Historically, all of the digital tools used by the citizen science collective project "Measure your city!" (Meet je stad!) have been open source. The proprietary sensors, used for collecting data on rain, had limited use due to the project not having access to open-source code.

Different organizational logics and processes
Coordinating different organizational logics across partners and stakeholders can be challenging and require appropriate process facilitators such as data gathering agreements. Tasks otherwise viewed as simple can in this new setting be demanding and benefit from established processes and tools.

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ANALYSING DATA

The collected data from sensor measurements and external sources create the most value after it has been processed. Collecting data and storing data in databases is a fairly straightforward process, but transforming it into a basis for decisionmaking is a more challenging task. For data to be a basis for decision, the data first needs to be in a state which answers the question(s) behind the decision. In a project setting, many different perspectives are present on the possible use of data and benefits of various methods for analysis. Working creatively with methods and being apprehensive to the needs of involved stakeholders is advised.

CHECKLIST – GOOD PRACTICE:

- ❒ Determine the focus of the analytical model
- ❒ Formulate questions to be answered and supported by the analysed data
- ❒ Build a collective understanding of the system
- ❒ Establish procedures for recalibration of the model and various uses
- ❒ Establish procedures for documentation of insights
- ❒ Make sure to have a harmonized data collection i.e., regarding data format, location of storage, data processing, and data tagging
- ❒ Together agree on the level of information
- ❒ Define expectations on data

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EXPERIENCES FROM SCOREWATER

Organizations must have the right tools to understand the data

When the data is coming in later in the project, these complexities will also require a matching organizational readiness for change, i.e. choosing and preparing the appropriate users for analysis and evaluation.

Digital transformation

The digital transformation of the water sector is complex and requires alignment between the data being collected and the services being developed, as well as the corresponding division of expertise and stakeholder assignments. When data is introduced later in the project, it becomes even more crucial to have an organizational readiness for change, including the selection and preparation of appropriate users for analysis and evaluation. When the data is coming in later in the project, these complexities will also require a matching organizational readiness for change, i.e. choosing and preparing the appropriate users for analysis and evaluation.

Modifying a platform to fit three different city cases was challenging

The project's platform developer had the goal to create a platform based on FIWARE principles. The three cases provided technical and use case data showing how the platform can be further improved. One of the main challenges in the platform development was getting all the data from the three cases and packaging it into one user friendly platform.

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Final thoughts

Throughout this handbook, we have shared our experiences and insights gained from the SCOREwater project. Our aim was to enable municipalities to pursue ICT projects within water management and replicate successful examples from our project. We have categorized the topics into four chapters, namely communication, engaging stakeholders, managing technology development, and working with data collection and data processing.

As we reflect on our learnings, we realize that collaboration and communication are critical for the success of any project, and many challenges are not technical but organizational. The diversity of perspectives and professions within a team can create valuable outcomes, but it also requires time and patience to achieve effective collaboration.

We acknowledge that our journey has not been an easy one, and we hope that our experiences can provide valuable insights for those who embark on a similar path. Do not be discouraged by the complexity of innovation and ICT in the water sector. SCOREwater contributed to enhancing the resilience of cities against climate change and urbanization and working towards a water smart society, and we believe that you can do the same.

Finally, we would like to express our gratitude to all the contributors from our partners and stakeholders who participated in interviews and provided valuable insights. We would also like to thank those who reviewed the contents of this guide. We hope that this handbook will serve as a useful tool for municipalities and contribute to a more sustainable future.

Fredrik Hallgren

visit:
scorewater.eu

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Self-Assessment Tool

Finally, we like you to assess how ready your municipality is to implement ICT solutions in water management. We are introducing you to a 9-step easy-to-use tool. It works best for a specific well-defined need. By using this tool you can assess what level you are on now and see what steps are necessary to go through to be ready for implementation. You can also use the tool to keep track of your progress. It is not until level 9 your municipality can build an adapted answer to the expressed need and introduce ICT that will work in the organization.

Level	Description of readiness to implement ICT solutions
1	Occurrence of a feeling that ”something is missing”.
2	Identification of a specific need.
3	Identification of expected functionalities for a new product/service.
4	Quantification of expected functionalities.
5	Identification of system capabilities.
6	Translation of expected functionalities into needed capabilities to build a response.
7	Definition of necessary and sufficient competencies and resources.
8	Identification of the experts processing the ’competencies
9	Building the adapted answer to the expressed need in the market

Partners

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