Projektakronym
iWater

Projektnamn
Water Monitoring Networks

Projektfakta

Sökt belopp från VINNOVA:	6 022 000 SEK
Sökande organisation (Koordinerande projektpart):	Stockholms Stad, Miljöförvaltningen Org. Nr. 212000-0142
Projektledare:	Juha Salonsaari, Stockholms Stad, Miljöförvaltningen
Övriga organisationer som deltar i projektet:	Ericsson AB Org. Nr. 556056-6258 Telia Sverige AB Org. Nr. 556430-0142 Kungliga Tekniska Högskolan Org. Nr. 202100-3054 Linköpings Universitet Org. Nr. 202100-3096 Stockholms Universitet Org. Nr. 202100-3062 Stockholm Vatten & Avfall AB Org. Nr. 556175-1867 (sense2bits AB Org. Nr. 559004-2379)
Projektperiod:	2018-05-15 till och med 2020-10-31

1 Sammanfattning

The scope of this proposed project is to further develop a digital water quality monitoring solution for the Smart Sustainable Cities of tomorrow, with focus on access to clean and healthy drinking water for citizens. Access to clean and healthy water is an emerging issue in many cities around the globe, both regarding water sources as well as fresh water distribution networks. Today, water monitoring is highly manual with regular sampling intervals at different locations over large areas. This is resulting in low temporal and spatial resolution where changes in the water quality can't be monitored and detected in a timely manner, resulting in poor mitigation efforts with risks for human health and the environment. The proposed solution would use cloud-based sensor technology and Artificial Intelligence to identify important events occurring in the water (e.g. algae bloom, bacterial contamination and industrial discharges) and thus serve as an early warning system for introduction of timely mitigation efforts. The project concluded a Proof of Concept (PoC) during 2017 and will now continue to develop smart algorithms to introduce Artificial Intelligence capabilities. The project will also investigate and develop business models and citizen engagement initiatives as well as evaluate integration with smart city processes, solutions and technical platforms. The project's estimated total budget is 12,1 MSEK and we are applying for 6,05 MSEK in financial support. The project is expected to start in May 2018 and continue until October 2020.

2 Projektets bakgrund

Access to clean and healthy water is an emerging issue in many cities around the globe where knowledge of the ecological and chemical status of rivers and lakes is an important tool to be able to secure safe water for citizens. In EU, water quality in lakes and rivers is

regulated through the Water Framework Directive[1]. However, recent studies show that many water areas in Sweden do not live up to the requirements in the directive and some have even deteriorated.[2] Furthermore, Sweden alone has about 70 700 km of drinking water distribution pipes.[3] These are only manually monitored, sparsely both in time and space, leading to a situation where it is often the citizens that function as human sensors with a very long response time to pathogenic pollutions.

To be able to take efficient mitigation efforts, continuous access to improved data and information of water quality is needed. Current methods, both in water sources and the distribution network, mainly rely on manual sampling and detection in laboratories, which takes time and hinders timely and efficient mitigation efforts and thus does not provide an early warning system for cities and water utilities.

With this project application, we propose to develop a digital real-time water quality monitoring solution for cities. The aim is to create engineering solutions that can monitor and detect changes in the water quality due to pollution or pathogenic contamination. These engineering solutions will be of easy interpretation toward end users and citizens. The main use cases are surface water control, drinking water monitoring and real time bath water information for citizens.

There are several different digital solutions on the market to monitor water quality in real time.[4] Common to these are high sensor costs and bulky solutions that are not suitable for large scale deployments. Furthermore, most suppliers do not have integrated IoT platform and cloud technologies with analytics and Artificial Intelligence (AI) capabilities to interpret the sensor data in a comprehensive way.

Hence, City of Stockholm has identified water quality issues as a prioritized area of concern, because many water areas are affected by previous and current industrial operations. Further on, risks in freshwater distribution networks need to be mitigated where identification of potential pathogens is a vital area. Digitalized water quality monitoring is therefore a tool to take sound water management actions with increased environmental and social benefit for the habitants of a city, as well as increased efficiency and lowered operational costs for the city itself. The scope of the project is to develop digitalized solutions to monitor potential pollution in the water bodies and storm water systems as well as to identify potential pathogens in the water distribution networks. Further on, there is a need to introduce real time bath monitoring information for citizens during the summer months. The scope with this use case is to both provide information on bath water quality as well as to educate and inform citizens on sound water management.

The project is a part of the Digital Demo Stockholm initiative[5], led by the City of Stockholm with the aim to increase digitalization and innovation bas demanded by the needs of the city. A first Proof of Concept[6] (PoC) was initiated and finalized during 2017, where sensors were connected to a cloud solution to measure and catch data from lake Mälaren. This first PoC was developed by Ericsson, together with project partners from

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[1] http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060

[2] Destouni, G., Fischer, I., Prieto C., **Water quality and ecosystem management: Data-driven reality check of effects in streams and lakes**, *Water Resources Research*, DOI: 10.1002/2016WR019954, 2017

[3] [1]Livsmedelsverket, Rapport 19 – 2013, ”Mikrobiologiska risker vid dricksvattendistribution – översikt av händelser, driftstörningar, problem och rutiner”, 2013

[4] Solutions are mainly offered by sensor manufacturers such as YSI, Libelium and Eureka, but also from integrated service providers such as EHP Environment.

[5] https://www.digitaldemostockholm.com/

[6] The proof of concept received funding from Vinnova (Dnr. 2016-03908) under the Internet of Things call (Dnr. 2014-04033)

City of Stockholm, Stockholm Vatten & Avfall, Royal Institute of Technology (KTH) and Stockholm University (SU).

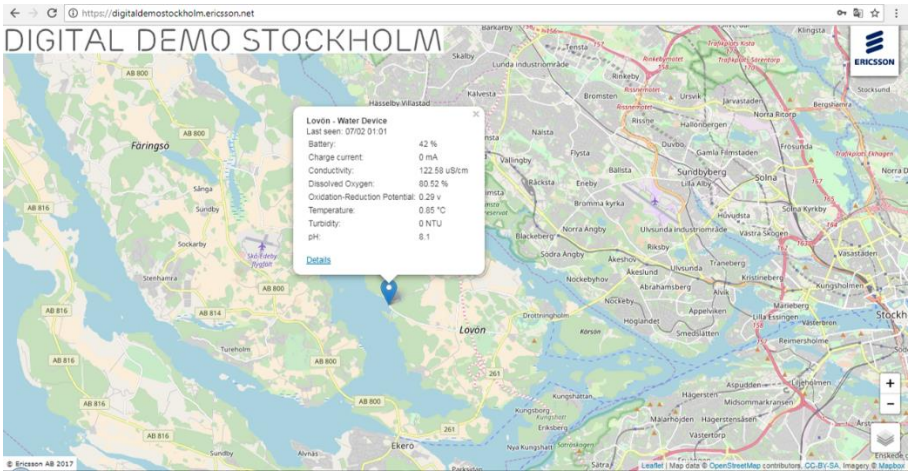

Figure 1. *Screenshot from the UI for the water monitoring PoC developed during 2017.*

The PoC was mainly focusing on the technical set-up and the architecture of the solution and resulted in better understanding of future needs and challenges. The main challenge identified is to convert sensor raw data to information that can be interpreted and used by cities and water utilities as a tool for overall understanding of water quality in a city's supply of water. Further on, there was also identified the need of understanding and development of data applications to be used by the city and the citizens. As a major continuation of the project, we now apply for grants to develop new algorithms and AI capabilities to monitor and detect changes in water quality based on sensor raw data. The availability of new AI methods, together with the deployment of new sensors is expected to provide groundbreaking results.

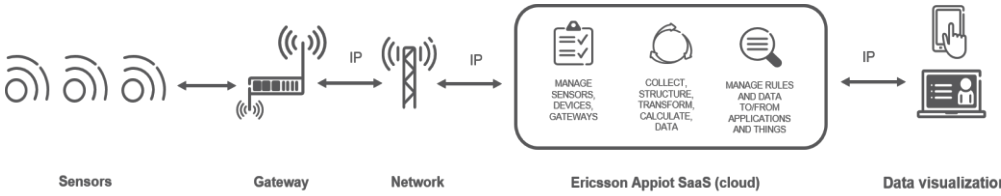

Figure 2. *High level architecture for the technical set-up of data catchment from sensors to cloud and visualization.*

3 Utvalt fokusområde och identifierade utmaningar

3.1 Projektets fokusområde

The focus area for the project is Smart Water solutions for Smart Sustainable Cities. The suggested development area is, as described under Section 2, a prioritized area for the city of Stockholm. Additionally, the city of Stockholm has adopted a strategy for digitalization[7], where IoT and digital solutions are important tools to mitigate environmental risks in the city. The project is complementing and is aiming to collaborate

[7] http://www.stockholm.se/PageFiles/130302/Strategi-for-en-smart-och-uppkopplad-stad-Stockholms-stad.pdf

with other existing water related projects, such as the existing LoV-IoT hub[8] and the Digital Demo Stockholm Water Leakage Mitigation project[9].

Further on, the participating companies to this project application are developing commercial solutions within Smart Water. The focus area is important for many cities and regions, both in Sweden as well as globally. Other interesting areas can be air quality management, increasing a city's resilience to urban flooding as well as improved traffic management. In the project we will focus on development of the water quality monitoring solution, but also investigate how the solution could interact with other data generating solutions such as rainfall measurement and traffic monitoring tools, and how these solutions could be combined, implemented and integrated in a city's existing processes.

3.2 Identifierade utmaningar

Water quality monitoring in cities today is highly manual with regular sampling intervals at different locations over large areas – both in the source waters as well as in the distribution networks. The challenge related to this way of working is that the data generated from the analysis only gives a snapshot of the status of the water and takes long time to receive a quality result due to manual laboratory analyses. Hence, actions to mitigate any negative impacts in the water environment can take time to implement and no information is received about the water quality between the sampling and examination dates.

To be able to receive continuous information of the water status, we are now in the position to introduce digitalized solutions where sensors can continuously measure the different parameters of the water quality. Today, existing solutions only monitor individual parameters with different time scales, such as conductivity, dissolved oxygen, turbidity and temperature. Individually, these parameters don't give operators or end users any real time and comprehensive information of the water quality and how the water quality is changing over time and in space. To be able to identify changes in the water, more advanced methodologies need to be introduced, such as multivariate analysis and algorithm modelling[10].

Thanks to the new sensors, their deployment at different locations, and their wireless connectivity, advanced analysis of data can potentially alert end users if any changes in the water quality are occurring where further measures are needed, as well as can detect other relevant events. Examples could be algae bloom, bacterial contamination or industrial discharges. Further on, a large deployment of sensors will also lead to a greater amount of information, where pollution movements in the water can be identified and thus also pollution sources. However, how the deployment and accuracy of the sensors, and how the network affect the data collection and analysis is a largely open challenge.

Another identified area of challenges is the sensor market, where today most sensors manufactured for advanced water quality measurements and are not cost efficient due to high procurement costs and high level of maintenance. However, during the past year, Ericsson has been in contact with various sensor manufacturers to discuss low cost and

[8] http://www.loviot.se/

[9] The DDS Water Mitigation Project is also applying for funds under this IoT Sweden call. These projects already collaborate in knowledge sharing activities, where such activities would be intensified in the IoT Sweden hubs.

[10] Zulkifli, S. N., Rahim, H. A., & Lau, W.-J. (2018). Detection of contaminants in water supply: A review on state-of-the-art monitoring technologies and their applications. Sensors and Actuators B: Chemical, 255, 2657-2689. doi:https://doi.org/10.1016/j.snb.2017.09.078

high reliability sensors, where many manufacturers have initiated projects to develop new devices of easier implementation and management.

The final identified challenge is how digitalized water quality monitoring can be implemented in cities current processes as well as integrated in other smart city solutions. We believe that a water monitoring solution cannot be a standalone system but needs to be integrated in other processes of the smart city to become efficient and provide value for citizens and city's authorities.

Altogether, identified challenges are:

- How to process the water quality data from sensors to be useful for end users, i.e. how to identify spatial and temporal changes in the water in an accurate and real time manner.
- How to design algorithms to identify important events occurring in the water (e.g. algae blooms).
- Devices must become more financially sustainable to be introduced for massive IoT and smart city solutions.
- Digitalized water monitoring solutions must be introduced in city processes as well as integrated in other smart city systems to become viable and efficient.

4 Beskrivning av projektet

The long-term aim of the project is to develop a digital real-time solution to identify potential pollution and pathogens in the entire water supply chain of a city:

- ***Water bodies and sources****:* focus on identifying changes to the water composition to detect and trace pollution and discharges and to serve as an early warning system. Identify needs for bath water quality control and citizen engagement initiatives.
- ***Water distribution systems****:* monitoring of drinking water from treatment plant to consumer taps to detect possible pathogens and any potentially polluting substances.
- ***Storm water networks****:* monitoring of water in storm water system to be able to detect pollution. Investigate potential flooding due to rainfall, where flow measurements could be used coupled with rainfall detection solutions. This part of the project will investigate collaboration with other ongoing storm water related projects.

The main purpose of this part of the project is to develop analytics and algorithms based on sensor raw data, to create an AI solution for water quality monitoring. The project will also investigate business models and alternative use cases and applications for water monitoring solutions. One identified area is bath water quality monitoring for citizens, where this solution will be investigated and evaluated during the summer months. Further on, the project will investigate how water monitoring solutions can be used in cities as well as integrated in their processes. The project will also examine how water quality monitoring can interact with other smart city solutions. One idea is to investigate potential benefits in connecting water quality monitoring with rainfall measurement and flood warning systems, where Ericsson is developing a digitalized

tool for real time rain measurement.[11] If there is a case identified for integration of these solutions, the scope for water monitoring could be expanded to also include flow measurements in source waters and storm water systems.

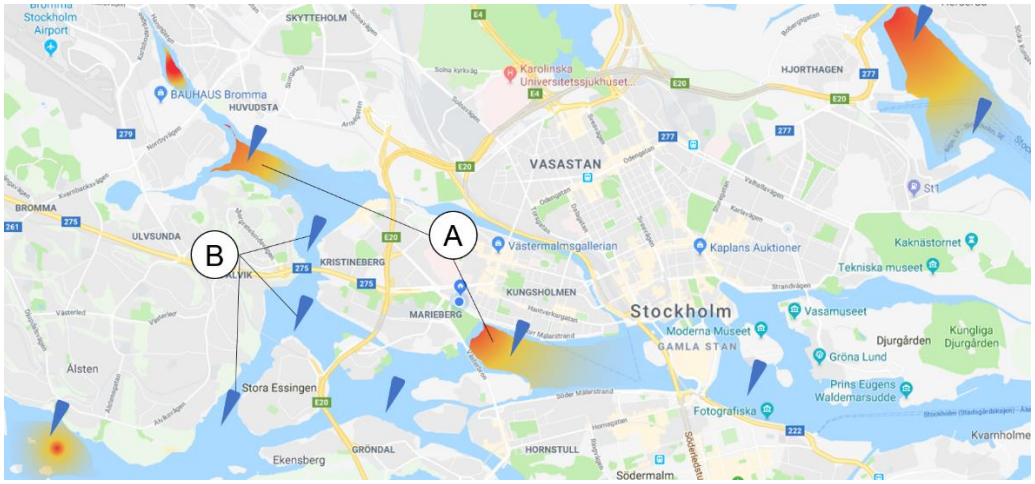

Figure 3. *Example of how the visualization of the water monitoring solution could be developed, where the red areas (A) are potential pollution. The blue pointers (B) are sensors in the network.*

Finally, the project will investigate how citizen engagement for water related issues can be evolved. The scope is to change behavior through digitalized solutions, such as social consumption patterns, littering behaviors on solid waste generation etc., where we expect that bath water monitoring can be a good information delivery tool.

The project has previously deployed sensors in lake Mälaren where water quality related data has been obtained. In this second part of the development, we will continue to gather data from these sensors as well as introduce new sensors for specific parts of the solution development. For example, we will introduce bacteria sensing devices for distribution networks and bath water monitoring.

4.1 Potential

A successful project will increase the efficiency in organizations working with water quality related issues. This can be cities and municipalities with responsibility to measure, report and implement mitigation efforts related to water management. Further on, a comprehensive water monitoring tool can be used by water utilities, governmental agencies as well as Non-Governmental Organizations (NGO) and industries to identify pollution and discharges. The main efficiency gains are related to spatial and temporal effects, where the water can be continuously monitored at several locations and any relevant changes in the water can be detected and early warnings can be sent to decision makers. Hence, it is expected that real time water monitoring could decrease operational expenditures for cities due to potentially reduced amounts of manual sampling efforts as well as due to the introduction of early mitigation efforts minimizing potential future decontamination costs.

There is today no comprehensive solution utilizing real time data collection and transmission from sensors combined with advanced analytics and algorithms to detect changes in water quality. Based on the results from the PoC developed during 2017,

[11] https://www.smhi.se/en/services/professional-services/micro-weather-live-data/. The MicroWeather project is under its final development, where grants have been provided by Vinnova (Dnr. 2017-03297).

Ericsson has investigated the market potential for IoT water quality monitoring and received interest from potential customers in Sweden, US, Thailand, Russia and Canada. Hence, we believe that a successful project would be a commercially sustainable solution, where the main market would be industrialized countries. However, we also believe that the main advantage for this solution would be developing countries where the need for water monitoring solutions, especially for drinking water, might be the largest. In the business development of the solution, a track for development countries will be included.

Water quality monitoring per se is expected to be gender neutral. However, the visualization of the solution (i.e. end user experience) will be used by women and men and thus these aspects are needed to be taken into consideration. In any design of user interfaces and functions, we will actively ensure that test groups are representative based on gender equality. We will also include an equality perspective in the development of business strategies. Further on, the project will strive to be gender equal regarding participating project members. All participating partners to the project, have active and well-established work programs to promote gender equality at the work place and to promote an even distribution of men and women in different positions.

To be able to develop a gender-neutral solution, we will accomplish a workshop with the aim to identify gender issues within the project, where both the project team as well as the project solution will be scrutinized. Relevant outcome from the workshop will be implemented in the respective work packages of the project as well as to establish a task group to monitor gender issues throughout the project and to promote an even distribution of men and women among the project members

Hence, we believe a successful project would develop a unique solution with business potential globally, with efficiency gains both from a commercial and sustainability point of view.

4.2 Aktörer

The project will be coordinated by the City of Stockholm, who will be the main interface towards Vinnova and other external stakeholders. The technical coordination and development will be managed by Ericsson. Other partners at this stage are Telia Sverige AB (Telia), Royal Institute of Technology (KTH), Stockholm University (SU), Stockholm Vatten & Avfall (SVOA), Linköping University (LiU) and sense2bits[12] (s2b).

- **City of Stockholm:** Environment and Health Administration will be responsible for the overall coordination and be participating with detailed knowledge of water quality issues in the water sources as well as defining the overall requirements for the solution.
- **Ericsson:** will lead the project from a technical development perspective and contribute with IoT platforms and integration of sensors, analytics and UI concept development.

[12] Sense2bits is a start-up spin-off company from Linköping University with the scope to commercialize the Electronic Tongue (bacteria sensing device). The company has at presence no formal employees and thus no salaries costs. Hence, sense2bits will participate in the different work packages but will not contribute with any financial costs or grants to the project.

- **Telia:** will contribute with cellular connectivity, participate in UI concepts development, analytics and AI capabilities development as well as business models and smart cities integration evaluation.
- **KTH Electrical Engineering**: will have the main responsibility for the development of algorithms and analytics solutions for data interpretation. Further on, KTH EE will provide expertise in IoT networks.
- **SU, Department of Physical Geography:** will co-lead the development of algorithms and analytics solutions for data interpretation. Further on, SU will provide expertise in hydrology and land- and water resources.
- **KTH Water Resources Engineering:** will contribute with an overall knowledge of water management and smart cities inclusion.
- **LiU:** will participate from the Department of Physics, Chemistry, and Biology, with innovative sensor solutions for water monitoring that will be tested and further developed. LiU will lead the algorithms development for bacteria sensing devices.
- **SVOA:** the water company of the city will be participating with knowledge of water management and water supply in the city as well as defining the requirements for the solution.
- **s2b:** will participate with sensor knowledge and business development for sensor solutions for smart water distribution systems.

The different actors within the project will contribute with expertise within their fields. IoT expertise will mainly be contributed by Ericsson and KTH, water management and environmental management by the city of Stockholm, SVOA and academia and sensor system expertise by LiU as well as KTH and s2b. Further on, the end user needs and wanted outcome for the water monitoring solution, are defined by the public partners to the project.

Linked to the project will be a group of reference partners, with a consultative role towards the project and the Work Packages. The following reference partners have confirmed their participation:

- Tekniska Verken, Linköping
- Länsstyrelsen i Stockholm
- VA Syd
- Oslo University

During the entire project period we will encourage further external actors to be involved as reference partners to the project. We have until now received an interest from and planned to invite the following actors: City of Singapore, Telefonica UK, UN Habitat, Sida, Race for the Baltics, Havs- & Vattenmyndigheten and City of Malmö.

Since the project is a part of the DDS initiative, there is a strong foundation and commitment from all partners. Under the DDS platform, the project has access to support in business development, project management and questions related to legal issues. The estimated budget for the project is 12,1 MSEK and the project will be running for 29 months. The main aim for the participating companies is that the project will contribute to existing product development within the IoT and water

management area. Hence, a main part of the costs will be taken by the participating companies as well as the city of Stockholm. If approved, the total amount of funds provided by Vinnova would be 6,02 MSEK, resulting in a total contribution to the project by 49,9%.

At the start of the project, it will consist of seven men and seven women and the aim will be to keep the gender balance within the 60-40 ratio during the entire project life time.

4.3 Genomförbarhet

The project will be built on the results and experiences obtained from the initial PoC in 2017, and to be delivered in several phases, where existing sensors in Mälaren will be supplemented by further sensor deployments.

Data gathered during the PoC, as well as during this project, will be examined and analyzed, where comparisons will be made with other existing data (such as laboratory data). Based on these analyses, algorithms will be developed to identify significant changes in the water quality as well as to identify various events likely to occur in the water (e.g. algae bloom). Further on, bacteria sensing devices[13,14] will be installed in the water distribution network for data catchment, analysis and data interpretation.

Parallel to the data interpretation work packages, a business development and business integration work stream will be developed. The main objective will be to identify overall business aspects (such as market coverage but also alternative use cases for the solution) as well as to identify how water monitoring can be integrated into other smart city solutions. In these work packages, it will also be defined how to integrate citizen information and engagement.

The project is expected to start during May 2018 and continue until October 2020. A detailed overview of the project time plan can be found in Annex 1. During 2018, we will initiate two parallel work streams; Data Catchment and Business Development, where Ericsson will be the main contributor. The project will continue during late 2018, where the Sensor Data Interpretation work stream will commence, with the aim to develop Analytics and Algorithms for the water monitoring solution. During 2019, we aim to start the Solution Integration with the development of an User Interface solution as well as to deploy bath water sensors and the development of an App for citizen engagement. The final phase of the project will be to investigate Business Integration, where it will be explored how Water Monitoring can be integrated in other relevant digital solutions and processes in a city.

Arbetspaket

Work Package	**Deltagare**
WP 1, Project Management, (3100 h; 2 496 000 SEK)	*City of Stockholm*
The overall project will be coordinated by city of Stockholm. Key project management activities include organizing meetings and monitoring progress of all tasks to ensure timely output and reporting. Four yearly steering committee	*All*

[13] The Electronic Tongue is developed by Linköping University: https://liu.se/forskning/kemiska-sensorsystem

[14] http://www.svensktvatten.se/globalassets/utbildning/konferenser-och-seminarier/rok2017/dag2/2_9-mats-eriksson.pdf

meetings gathering all project partners will be arranged. In addition, regular online progress meetings will be held. This WP will also manage contacts with reference group members, where there will be held two workshops related to the project, its progress and potential outcome. Under this WP, the overall gender analysis will be performed. Finally, an overarching report summarizing the main activities, outputs and conclusions of the project will be written.	
Outputs: - Quarterly steering group meetings. - Regular online progress meetings. - Workshops (2) with reference group members. - Integration of gender analysis, including one workshop on gender analysis. - Progress reports and final project report.	

Arbetspaket
WP 2, IoT-Hubb
WP 2a **Skala,** spridning (627 h; 491 000 SEK) City of Stockholm and SVOA will use the knowledge from the project to understand and evaluate digitalized solutions for water monitoring. Further on data from the project will be used to better understand the temporal and spatial variation in conventional environmental monitoring data to enhance models used to calculate pollutant loads and make predictions of measures more accurate. The project is also a key part to the Digital Demo Stockholm initiative to be able to explore the possibilities with IoT, digitalization and innovation within the city. A successful outcome of the project will result in a potential full implementation, through a public procurement, of digitalized water monitoring in Stockholm. The public partners (city of Stockholm and SVOA) will participate in know-how transfer activities to other cities and municipalities, mainly in Sweden but also within EU when appropriate. The city network within the Race for the Baltic initiative will be used to transfer project ideas and progress to other cities in the Baltic Sea region. The project will utilize the Reference Partner network as well as existing commercial relations to evaluate the potential spreading of the results. A successful project will be implemented as a commercial offering for the participating companies, hence the project results will be spread through commercial operations, where the solution can be sold directly to customers or indirectly (mainly through Mobile Network Operators). The project will utilize the Digital Demo Stockholm platform for any legal matters (such as IPR, public procurements, data protection and privacy) where legal experts from all DDS parties take part. Communication for results spreading will be integrated in WP2b.
Outputs: - Increased knowledge in IoT and digitalization opportunities for the public partners (city of Stockholm and SVOA) as well as substantial contribution to the DDS initiative. - Potential procurement opportunities in Stockholm, for a full-scale integration. - Commercialization of water monitoring solutions for the participating companies. - National and global spreading of the results integrated in communication activities in WP2b.

WP 2b **Synlighet***, kommunikationsplan,* (627 h; 491 000 SEK)

Communication will be an integrated part of all activities. Communication will be direct (with customers and stakeholders), through events and industry fairs (such as World Water Week and Mobile World Congress), academic conferences and workshops as well as via massive communication (i.e. web, external media, press releases, academic papers and company yearly reports).

Further on, the communication channels of the Digital Demo Stockholm platform will be utilized as well as all the project partners external communication channels.

The participating companies will develop sales communication and offerings generation communication to spread the results from a commercial perspective. The solution will be implemented in respective company's sales offerings and sales communication channels.

The project will, together with the communications group within DDS, develop a detailed communication plan, during the first phase of the project. The project will participate in all relevant events organized by IoT Sweden as well as to establish regular meetings with the program office.

Outputs:

- Communications plan.
- Participation in events, fairs and conferences.
- Media coverage.
- Direct customer contacts and presentations.

WP 2c **Stärkt konkurrenskraft***, värde,* (626 h; 490 000 SEK)

This WP will be developed in parallel with WP6 and WP7. At a successful outcome of the project, participating companies aim to commercialize their relevant parts of the solution as well as to integrate the solution as a comprehensive offering to potential customers. Water monitoring offerings are evaluated in Ericsson, and a successful project would highly contribute to the development of such offerings. Further on, Telia is investigating Smart City solutions where environmental monitoring offerings are highly interesting offerings towards potential customers.

Value for participating public organizations will be created through an increased efficiency as described under Section 4.1 in this application. For the academic institutions, value will be created through increased research and knowledge of IoT related aspects as well as new opportunities for research within digitalized environmental monitoring, network connectivity and device development.

Further on, a successful project is expecting to generate IPR for the partners, where any potential patent applications would be filed.

Outputs:

- Business and application development opportunities linked to WP6 and WP7.
- Potential commercial offerings from participating companies depending on the success and outcome of the project.
- Increased efficiency and experience in transformative digitalization projects for participating public partners.
- Research opportunities and increased IoT knowledge for participating academic institutions.
- Potential generated IPR and patent applications.

WP 3, Data Catchment, (1 800 h; 1 440 000 SEK)	*Ericsson*
During 2018: Data from already deployed sensors will be utilized (as well as previously gathered data). Further on, the project will deploy 2—3 additional devices in Mälaren as well as bacteria sensing devices in the water distribution network. The sensors will be connected through cellular technology to Ericsson's cloud based IoT platform where data is stored. *During 2019:* Devices will be deployed in Stockholm for bath water monitoring (bacteria, temperature and conductivity sensors), and connected to Ericsson's IoT platform. Sensor data is stored in a cloud-based environment, where project partners have access to download device data (raw data readings, time and location). Narrow Band IoT (NB-IoT) connectivity technology will be tested during the project period, if possible and available.	*Telia* *KTH* *SU* *Ericsson* *LiU*
Outputs: - Deployment and integration of sensors to monitor water in Mälaren. - Deployment and integration of sensors to monitor water in distribution network. - Deployment and integration of sensors for bath water monitoring. - Data catchment and delivery of data to relevant partners. - NB-IoT tests.	

WP 4, Sensor Data Interpretation, (3 300 h; 2 640 000 SEK)	*KTH/LiU*
Sensor raw data from deployed sensors in lake Mälaren, obtained from WP3 will be analyzed using new Machine Learning methods. The results of these methods will be compared with other water quality data (such as lab analyses) to find correlations and identify significant changes in the water quality. Algorithms will be developed for automatic data analysis and detection of anomalies and potential events that can trigger early warning functionalities. . How these algorithms are affected by the communication networks will be investigated. KTH will take the lead role to develop these algorithms in cooperation with SU and with participation from Ericsson and Telia. Sensor data from deployed bacteria sensing devices (WP3) will be analyzed and existing algorithms will be further developed to increase accuracy and reliability. LiU will take the lead role to develop these algorithms. The algorithms developed shall be in such format to be readily deployable in Ericsson's IoT platform.	*KTH* *SU* *LiU* *Ericsson* *Telia*
Outputs: - Algorithms developed for source water monitoring. - Algorithms for drinking water monitoring providing a real-time anomaly output signal - Algorithms developed for bacteria sensing units.	

WP 5, Solution Testing, (2 367 h; 1 861 600 SEK)	*Ericsson*
The algorithms in WP3 will be tested for integration in the overall solution, where the Ericsson IoT Accelerator platform will be the main host for these. Based on the outcome from WP4 (i.e. what information we can obtain through analytics and algorithms) the UI concept will be developed. The scope is to develop a simple and user-friendly solution for easy identification of events and changes in the water composition, where users can make informed decisions to implement any mitigation efforts. In this WP, we will include workshops with end user groups to identify visualization needs and challenges, including gender analysis. We aim to use the skills available in these groups to ensure that the application is best designed based on the needs and usefulness of different groups.	*Telia* *KTH* *SU* *LiU* *s2b* *City of Stockholm* *SVOA*
Outputs: - Test to integrate algorithms and analytics functionalities in IoT platform. - Workshops for end user needs, including gender analysis for end users. - Concept development of UI– web and apps for professional users as well as citizens.	

WP 6, Business Development, (1 372 h; 1 065 600 SEK)	*Ericsson/Telia*
The main track has been to develop the water monitoring solution for cities and water utilities. However, there are many other industries, organizations and groups that could benefit from a better knowledge of water quality. Identification of applications and application models will be one part of this WP, where user groups as well as how to use data will be investigated. Further on, this WP will also investigate how developing countries could benefit from digitalized water quality solutions, the market potential as well as use cases for developing markets. The second part of this WP will investigate sustainable business models for implementation of the solution for different end users. The scope is that the solution shall be a commercial offering, where Mobile Network Operators and sensor vendors could be partners in offering the solution towards potential customers.	*KTH* *SU* *LiU* *s2b*
Outputs: - Identification of user groups and applications for water monitoring solutions for other users than cities and water utilities - Potential business models identified and partner roles and responsibilities for future commercial sustainability defined	

WP 7, Smart City Technical Platform Concept, (1 032 h; 793 600 SEK)	*Ericsson*
This WP will investigate how a water monitoring solution can be a component in an overall smart city ecosystem. In what areas can water monitoring solutions be used and what kind of water related data is needed to improve decision making within cities and industries. Examples could be to integrate water monitoring solutions with air quality measurements, meteorological measurements, connected transport platforms and urban planning decision tools. Further on, the role of citizens and how they can be incentivized to minimize negative environmental impact on the water resources will be scrutinized. In this WP, at least one seminar will be arranged where relevant stakeholders, such as city officials, industry representatives, academia, citizen representatives and	*Telia* *KTH* *SU* *LiU* *City of Stockholm* *SVOA* *s2b*

NGO's will be invited to discuss water monitoring and its role in an integrated smart city.	
Outputs: - Workshop on smart cities and the role of water monitoring. - Identification of smart city technical platforms. - Identification of solutions to integrate. - Conclusions for a suggested development of a comprehensive water monitoring solution for smart cities.	

5 Projektets kostnader och finansiering

The total budget of the project is estimated to 12,1 MSEK, where we are applying for 6,02 MSEK in grants within this call. A detailed budget for each partner and Work Package is attached to this application (Appendix 1).

6 Övrigt och referenser

Please find the proposed timeline for the project in Appendix 2, attached to this application.