Water -M Project

D1.6 Catalogue and analysis of Use Cases v1.4

History

Date	Version & Status	Author	Modifications
02/10/2016	V1.0	Francois Calvier (UJM) George Suciu Jr. (BEIA Consult), Ali Kafali (ACD) Aydin Can Polatkan (Mantis) Kamal Singh (UJM),	❖ First document
18/10/2016	V1.1	Kamal Singh (UJM) Mehdi Mani (ITRON)	❖ Corrected the numeration of use cases ❖ Added some more text for UC04 (merged with 5) ❖ Added UC 06
19/10/2016	V1.2	S. Dedeystere (IMT)	❖ Added image of UC completion follow-up.
03/11/2016	V1.3	S. Dedeystere (IMT) J.J. Busson (éolane)	❖ updated UC 01 from Mantis with reviewer comments (IMT) ❖ Updated UC 02 & UC 03 with reviewer comments (U. J. Monnet, éolane) ❖ Updated UC 04 with reviewer comments (éolane) ❖ Updated UC05 with reviewer comments (éolane) ❖ updated UC 06 from Mantis with reviewer comments (THL) ❖ updated UC 07 from U. Oulu and Savonia with reviewer comments (éolane) ❖ Struggled with updating numbers
16/12/2016	V1.4	J-H Lauret (Cityzen Data) Fabien Imbault (Evolution Energie)	❖ Added UC08 (Urban Farming)

Content

Abstract

This document describes the different user stories and application scenarios relevant to the Water-M project scope. Different use cases and application scenarios are specified in order to illustrate and specify the use of the envisioned Water-M platform. These specifications will be the basis for the development that will be carried out in other work packages.

1 Introduction

This document describes the following use cases that will be the basis for the development carried out in other work packages:

- Use Case 1: Leak Detection
- Use Case 2: Development of Water Management and Flood Risk Prevention Platform
- Use Case 3: River Tele-monitoring
- Use Case 4: Performance monitoring of water distribution network
- Use Case 5: Control and optimisation of the water distribution network
- Use Case 6: Coordinated management of networks and sanitation structures
- Use Case 7: Water Quality Monitoring
- Use Case 8: Urban Farming

2 Use Case 1: Leak Detection

2.1 General description

2.1.1 Presentation

Use case number	WATER-M UC 01
Use case name	Leak detection
Author/partner	GüvenKöse - Mantis Aydın Can Polatkan - Mantis Ali Kafalı – ACD Kamal Singh – TSE Abderraheman – City of St-Etienne
Summary	Pipeline networks are the most economic and safest mode for transporting clean water, waste water or fluid products. The long transport pipelines have to fulfil high demands of safety, reliability and efficiency, and thus, have to be properly maintained. One of the important requirements for an efficient working of water distribution is leak detection. Thus, we need Leak detection as a matter of fact in Water-M platform. In this use case, we describe leak detection using sensors and controllers working with wireless technology. Leak detection mechanism will detect possible points of leak and will provide an indication on the confidence of detection. The detection will also ensure a low amount of false positives in order to avoid unnecessary work.
Rationale	The rationale behind this use case are as follows: 1-Detection of loss of fluid and reduction is unaccounted water volumes; 2-Reporting real alarms correctly, detecting false alarms and detecting return to normal situation ; 3-Decrease in maintenance costs of water distribution network; 4-Protecting environmental hazards;

2.1.2 Use Case description

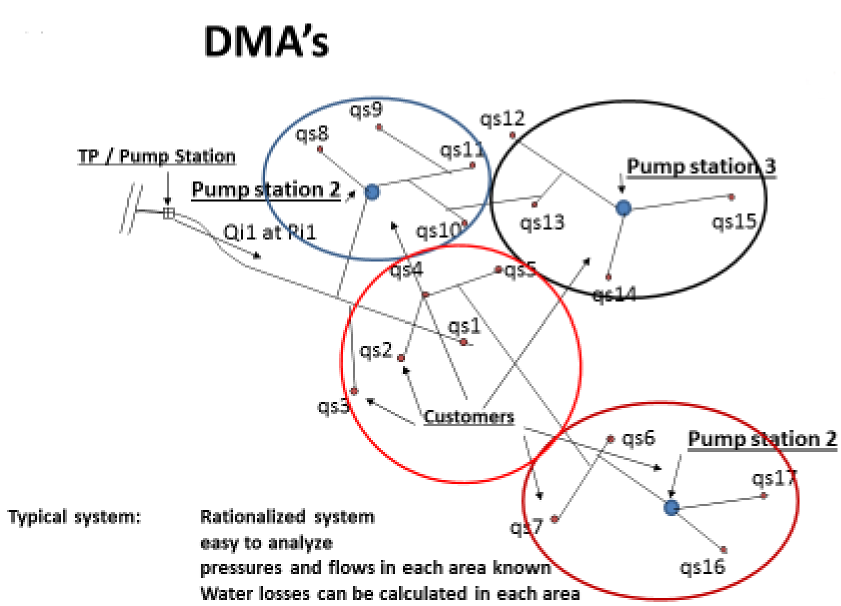
[Please enter a free form description of the use case. Pictures are also welcomed to illustrate the use case]

This use case concerns with fluid leak detection. A functionality to generate alarms will be provided. In case an alarm is generated, this use case will provide alarm type, alarm occurred date and time, flow, pressure, noise, fluid temperature to monitor internal pipe line parameters and take action according to an action plan. The impact of failures on the process of the pipeline will be explicitly known.

More effective ways to detect and have control on leak occasions has a significant meaning in enhancing distribution network operations. In Europe, the estimated average of water flows lost in leaks is about 30% of the total water flow volume. This is a remarkable cost and efficiency issue for both maintenance and fresh water production – as well as general aim to resource efficiency for water usage.

The way to proceed with UC is to create an DMA – District management area (see illustration), which provides possibilities to create a flow behaviour model. When adequate amount of historical data is collected, the formation of predictive consumption model with dynamic limit values can be created in order to understand normal and abnormal flow changes. Measuring pressure levels and noise levels are some ways to control leaks.

1. In a first step, the leak detection mechanism will provide areas where a leak is suspected with what confidence.
2. Then depending on the confidence, monitoring frequency of the suspect zones will be increased to zoom in to the leak location.
3. Moreover, pressure data will be combined with the noise data to have a better localisation of the leak

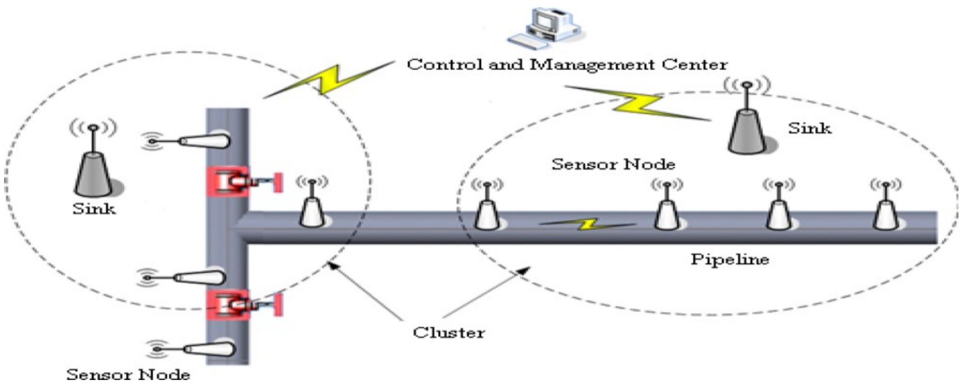


2.2 Contextual settings

2.2.1 Context description

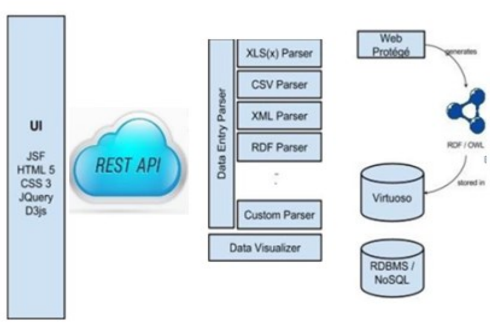
[Please enter a free form description of the context of the use case. Pictures or context diagrams are also welcomed to assist the understanding of the use case context]

As seen in the figure above, a pipeline network is very complex depending on where it is used. Pipeline network can feed either clean water or waste water. In any case main aim of the pipeline network is to transport the fluids from one place to another without any leaks and losses. The complex pipeline network must be monitoring and alarms should be generated in case of leaks. Thus some sensors must be used which are pressure sensors and noise sensors. In this use case we assume fluids will travel with fixed bar within the pipeline. Sensors must have analog or digital inputs in order to have connection with data transmission device. Data will include timestamp, pressure value and node location data which are defined in configuration file.



2.2.2 Actors

[Please identify the actors interacting with the system during the use case execution (e.g. human actorswith differentroles, otherservices and systems). For each actor, describe his/hers/its responsibilities in the use case execution]



Third party application communication model illustrated.

Actor name	Actor responsibilities
Authorized Person (AP)	AP needs to know the pipeline sensors and monitoring system is online action list and sensors defined in the system. Water utility representative has the possibility to make changes in distribution network operations and control, eg. controlling valves and pumps.
Third Party Application	This system must control the sensors, and pipeline systems. Third party companies who want to make communication should implement API with their software structure. TPA Has access to sensor data, but doesn't have straight access to network control systems.
Water Provider	Entity that is responsible to provide water and to manage the water network. He/she has a contract with the administrative agency to manage the water distribution and with the clients to provide water.

2.2.3 Security

[Please identify the security issues and explain what should be protected]

Water utility is the only actor who is allowed to make physical control operations on network, eg. control the operations for pumps and valves.

2.2.4 Resources

[Please envision the infrastructure, physical resources and software artefacts needed for the use case execution]

Physical connections: Sensors (pressure, noise), Plc, and communication devices.

Software: connectors must be loaded for heterogenic data reading because different Plc and sensors needs data translation into one single infrastructure.

IT network for information exchanges:

- Server and database for data recording or cloud implementation;
- Server protection issues firewall, virus protection;
- Modules that can aggregate the pressure data and noise data to detect leak;
- Event detection module;
- A controller that can increase or decrease the frequency of monitoring in online manner;

2.2.5 Frequency of use

[Please estimate the time frame and how often this use case will be executed (e.g. values such as 100 times per hour)]

Frequency of measurement can be pre-configured and then it can be adapted online depending on the customer needs. Sensors and alarms services must be online (it depends on the importance of the pressure data usage for example 10 times per 30 minutes depending on request).

A threshold can be configured which defines when a given sensor notifies the decreasing of the pressure in the pipeline network (i.e. under 10 bars) . Main goal of this use case is that giving alarms data and inserting log data into the database for the authorized person who needs this alarm.

2.3 Functional description

[Please describe the functional characteristics of the use case according to following table]

Preconditions and assumptions	1-Localisation of the sensors nodes ; 2-Sensors must be online and make (have the) definition of the sensors location on the network; 2-Sensors attached telecommunication devices; 3-Pressure sensors need power; 4-Software implementation;

Trigger	[Identify the event that initiates the use case] In case of leak occurring (pressure differences, noise differences) sensors notify this event and sends data to the system database in order to insert this data in the system database (this database located in the customers' servers) after inserting this data service application will be triggered in order to send defined messages to the authorized person, this notification can be done by using SMS, email. User can define warning or Alert pressure value for each node when sensor notify pressure down under defined value application will send Pressure value, sensor node location value, noise value and timestamp. Additionally, a complex event detection module can be used to detect leak events by processing different pressure and noise related events.
Normal flow	1-According to customer needs number of sensors and localisation will be decided ; 2-Each sensor must be defined in the database and localisation data in the system database; 3-Determination of the importance of the leaks and thresholds, definition of rules which will be used by the complex event detection module; 2-if there are third party application services must be online and consistent; 3-Test scenario must be implemented; 4-Database must be ready which holds events related with pressure; 5-API documentation should be done, API will provide communication with third party application; 6 Leaks should be detected 1. The leak detection mechanism will provide areas where a leak is suspected with what confidence; 2. Then depending on the confidence, monitoring frequency of the suspect zones will be increased to zoom in to the leak location; 3. Moreover, pressure data will be combined with the noise data to have a better localisation of the leak;
Alternative flow (optional)	False alarms will be logged with timestamps, pressure value with localisation data with different flag to understand false alarms in monitoring system.
Post-conditions	[Describe the state of the system after the use case has been used successfully] During the normal state of the network each sensor should send normal state value which is defined in the database.

2.4 Non-functional description

[Please describe the following quality viewpoint for the use case, if applicable. Consider all the elements of the use case, i.e. actors, the use case function, actor-use case relations and the use case environment]

Reliability	TBC
Availability	When use case software packages installed in the plant it gets ready to use depending on the configuration (Also a precondition). Sensors must be located where the water utility wants to know the pressure status of the pipeline network.if there are missing sensor node in the network data could not be send. Sensor node will communicate with data gateway through wireless network.
Performance	Performance test measurement depending on the number of sensors in the pipeline network. Each sensor nodes has own data and responsible to send data, for huge amount of sensor node we can send only false alarms to improve performance of the system.
Security	Security scenarios must be implemented. Sensors will be located in the pipeline network there might be some consequence like (stolen or malfunction of the node), in case of this situation we can send alive number of sensor node in the network for a defined time in the configuration file. In terms of the communication security there are internet security protocols like HTTPS, SSH protocols.
Interoperability	System can share information with enabled services and third party software with API communication. Rest API structure can be shared with third party companies who willing to use this type of data with authorized person.
Adaptability	Standard sensors and API software can adapt easily.
Variability	[Describe how the functionality of the use case can be varied to different situations] N/A
Scalability	According to customer needs it can be scaled very easily depending on the number of sensors and application. The calculations are targeting an area. The more areas you have the more calculation calculations you need. In this sense this is scalable. Now the limit might be the in the reception and in logging of the measurements every 3 minutes (also take into consideration you need historical data).
Personalization	The needed personalization for a given installation is : - API related to sensors type ; - Water Network information through GIS; - Localisation of the sensors on the network ; Installation will take time depending on the number of sensor node and localisation, software training will not take time more than 3 days.

2.5 Business properties

[Please describe the following attributes from the viewpoint of the functionality presented in the use case]

Customer segment	Customers are water treatment plants, water distribution company and municipality.
Value proposition	This use case will help for maintenance systems as an additional moreover decreasing the costs value besides hazard reduction, reduction of unaccounted water.
Channels	In the use case customers needs intelligent solutions (Water network managers). Sales department can offer the solution.
Customer relationship	Sales person can detect customer needs and make small demo for customer.
Revenue streams	New services purchased by the consumer: -Monitoring Management; -Alarms and Event management; -Licence sales and SaaS sales; -Service, maintenance;
Key Resources	-Alarm And Event management System; -Monitoring System; -Connectors for communication hardware devices;
Key Activities	Implementation of the system.
Key Partnerships	-Industrial Zones Management; -Companies who implement scada systems; -Municipality;
Cost Structure	Implementation costs + engineering costs + hosting (SAAS alternative) + management costs

2.6 Constraints

[Please identify constraints that may restrict the operations of an actor, execution of the use case or the interactions between actors and the use case, or are associated with the use case environment]

Location	Sensor location can make costs higher additional sensors can be added in the system when pipeline network needed. If there are existing sensors in the network these network should provide wireless connection.
Environmental characteristics	[Describe environmental settings outside the use case that should be taken into account (e.g. other actors in the environment or environmental attributes)] Sensors node can be influenced by the weather situation (i.e -50,+ 50 centigrad) choosen sensors should provide working in different environmental situation.

Domain	Main goal of this use case is to provide pipeline pressure notification for the network which can be used for clean water or industrial waste water system.
Legislation and standards	Standards developed by governmental organization and can be changed depending on the location, control parameters can be changed depending their urgent needs. Refer to **deliverable 1.3 "Analysis of Current Water Policies and EU Directives".**
Organisation	Clean Water companies and treatment Organization working due to governmental regulations, clean water resources controlled by Public health Care organization.
Other?	[Describe any other identified or emerged constraints for the use case]

2.7 Threats and exceptions

2.7.1 Misuse cases

[Please describe any threats that can be identified for the success of this use case. For example, identify malign/hostile actors (e.g. system abusers, hackers or viruses) and misuse cases, and describe how the use case is to respond to those threats]

In case of hacking the all system cannot be work there should be minimum standard security implementation (like firewall, gateway protections).

2.7.2 Exceptions

[Pleaseidentifyanyanticipatedexceptions anderrorconditionsthatcouldoccurduringexecution of theuse case, and describehowtheuse case is to respond to thoseconditions. Also describe or estimate the state of the system after the use case has not met its main goal]

In case of malfuntioning sensors, missing sensors or broken communication data can not be sent to the desired system.

2.7.3 Other relevant information

[Please provide here any other relevant information, if any that is not included in the other sections of this template]

3 Use Case 2: Development of Water Management and Flood Risk Prevention Platform

3.1 General description

3.1.1 Presentation

Use case number	UC 02
Use case name	Development of Water Management and Flood Risk Prevention Platform
Author/partner	George Suciu BEIA
Summary	[Please summarize the main goal of the use case. Describe what can be achieved by executing this use case] The main goal of this use case is to develop a Water Management and Flood Risk Prevention Platform that can be able to continuously monitor the water level along rivers.
Rationale	[Please describe the problem that the use case solves, and the importance and significance of the use case in the viewpoint of the whole system]

3.1.2 Use case description

[Please enter a free form description of the use case. Pictures are also welcomed to illustrate the use case]

The system is based on an underwater sensor network which is connected to a cloud platform by means of a reconfigurable wireless transceiver.

The sensor network integrates several low cost sensors that can measure different parameters such as water level, the water flow, temperature, pressure. The measured parameters will be transmitted through an operational communication node, which should be able to ensure a reliable communication with timing and variation delay constraints.

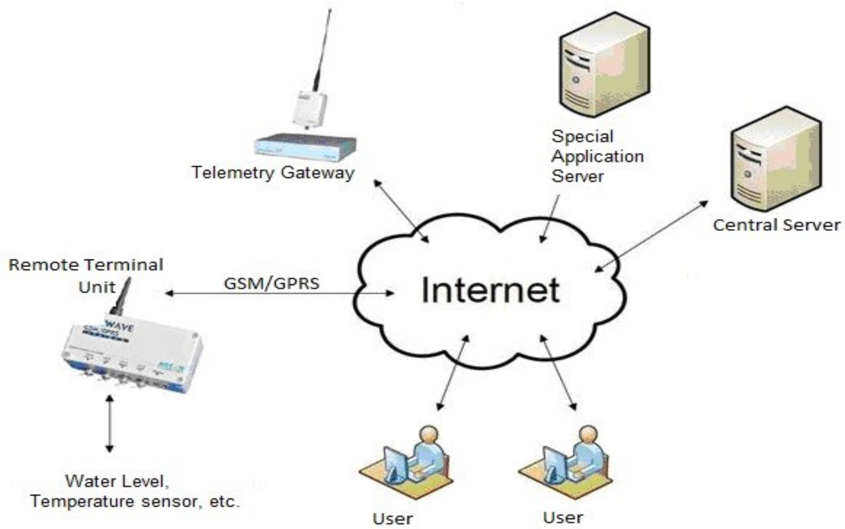
The sensors must be able to perform self-configuration and calibration, and also they have to adapt to these environment conditions. An Underwater Sensor Network (UWSN) offers a different vision, providing a real time visualization of the underwater events. All this information is available in a cloud platform responsible for the collection of environmental data. The platform provides an interface that users can access anywhere via Internet. We present the proposed network architecture for a UWSN composed by a low power sensor, a transceiver and an access point that provides the collected data to a cloud platform.

3.2 Contextual settings

3.2.1 Context description

[Please enter a free form description of the context of the use case. Pictures or context diagrams are also welcomed to assist the understanding of the use case context]

Diagram below illustrates the initial architecture of the system, remote monitoring installations, data concentration unit (gateway) and the Central Server. A special applications server will be utilized for tasks eventually situated outside the possibilities of the Central Server. Communication between the mentioned system parts as well as towards theusers goes throught he Internet, so that everything is easily and in any possible way relocatable and reconfigurable.



3.2.2 Actors

[Please identify the actors interacting with the system during the use case execution (e.g. human actors with differen troles, other services and systems). For each actor, describe his/hers/its responsibilities in the use case execution]

Actor name	**Actor responsibilities**
Administrator	Add/remove/edit the users access to the interface and maintain the system.
Operators	Generate reports and are responsible for the maintenance of the web interface.
Final users	Receive the alarms generated by the system.

3.2.3 Security

[Please identify the security issues and explain what should be protected]

- Utilization of an Identity Management module, which will cover a number of aspects involving users' access to networks, services and applications, including secure and private authentication from users to devices, networks and services, authorization & trust management, user profile management, privacy-preserving disposition of personal data.
- Utilization of SSH protocol instead Telnet to provide a secure (encrypted) management connection to a remote device.
- The users will use strong passwords and change them often.
- Will be avoided utilization of standard insecure HTTP websites, especially for login screens; instead use the more secure HTTPS.
- Will be implemented security hardware and software, such as firewalls.

3.2.4 Resources

[Please envision the infrastructure, physical resources and software artefacts needed for the use case execution]

- Sensors;
- RTUs;
- Gateway;
- Special Application server;
- Central server.

3.2.5 Frequency of use

[Please estimate the time frame and how often this use case will be executed (e.g. values such as 100 times per hour)]

Sensors are powered for short lapses of time and read by the RTU at every 3 minutes. At every 15 minutes, the RTU calculates an average from the 5 values measured during said interval.

At every hour, the RTU transmits to the gateway and furthermore to the server the 4 average values computed for each of the parameters measured (water level, water temperature, air humidity inside the RTU case as well as a lot of RTU-specific parameters, like battery voltage, internal temperature, transmission delays and error rates etc.).

The value that the system primarily delivers as water level at each location is the height of water above the level measuring sensor.

3.3 Functional description

[Please describe the functional characteristics of the use case according to following table]

Preconditions and assumptions	[Describe any preconditions and assumptions that must be true and valid when executing the use case] - The sensors are installed on the field. - The sensors are connected to the Remote telemetry unit (RTU) by wire. - The connection between Sensors and Gateway must be established. - Gateway is connected with Data Presentation Server through the Internet.
Trigger	[Identify the event that initiates the use case] In case of floods, people that may be affected, could be informed via an application installed on their mobile phone, or in case of earthquake, people who are trapped under rubble can be detected by means of a signal emitted by their phone.
Normal flow	[Enter the description of the normal flow of the successful execution of the use case] 1. Installation of thesensors on thefield. 2. Sensors are measuring the environmental parameters. 3. Connection of the sensors to the Remote telemetry unit (RTU) by wire. 4. The sensors sends data to Gateway via wireless network. 5. The water and underwater sensor is wireless connected to the transceiver, which is powered by a local battery and solar panel. 6. The transceiver stores the data and transmits at programmed intervals or when thresholds are reached in order to save battery power. 7. Data are sent to Gateway via wireless network. 8. Gateway is connected with Central Server through the Internet.

	9. Central Server generate reports and send them to the system Administrator. 10. Diagrams, lists can be created and viewed. 11. LEDs on the box areused for notification. 12. Due to a violation of a sensor limit (thresholds) the "send alarm message" is triggered. 13. Protocol is proprietary over TCP connection. 14. SMS sent from the gateway directly to defined numbers on the gateway. 15. E-mail can be sent from the gateway directly.
Alternative flow (optional)	[Enter the description of an alternative flow, if any, of the successful execution of the use case]
Post-conditions	[Describe the state of the system after the use case has been used successfully]

3.4 Non-functional description

[Please describe the following quality viewpoint for the use case, if applicable. Consider all the elements of the use case, i.e. actors, the use case function, actor-use case relations and the use case environment]

Reliability	[Describe the characteristic required for failure free operation of the use case (e.g. failure prevention, detection and recovery considering data reliability, communication reliability, use case function reliability and environment reliability)] In case of floods, people that may be affected, could be informed via an application installed on their mobile phone, or in case of earthquake, people who are trapped under rubble can be detected by means of a signal emitted by their phone.
Availability	[Describe how to ensure that the use case function is ready for use when required] Communication between the RTU and the Gateway is realized through wireless network and through Internet: • In case the telemetry unit is situated in a place with no wireless network coverage, there will be used particular remote stations in the UHF band of 430-440MHz. The station will communicate with the data concentrator (gateway) through a bridge station which has to ensure data conversion between wireless network and UHF station.
Performance	[Describe characteristics that enable the use case to process a request in a reasonable time]
Security	[Describe the how the unauthenticated use of the use case is prevented] • SSH protocol • Utilization of an Identity Management module • HTTPS protocol
Interoperability	[Describe how the information sharing and co-operation with the rest of the system is enabled]
Adaptability	[Describe how the use case can be adapted to changes]

Variability	[Describe how the functionality of the use case can be varied to different situations]
Scalability	[Describe how the size or volume of the use case can be scaled in order to meet user needs]
Personalization	[Describe how the use case enables personalization according to single user's preferences] Some parameters can be customized depending on the urgent variables.

3.5 Business properties

[Please describe the following attributes from the viewpoint of the functionality presented in the use case]

Customer segment	[Describe who are the customers targeted in the use case] Citizens, Public Authorities
Value proposition	[Describe what kind of additional value is built for the customers in the use case and which customer's needs the use case fulfils]
Channels	[Describe which channels are used for distribution, sales and communication in the use case] • Participate at the events. • Publish research papers at different conferences, workshops and seminars. • Envision dissemination to students with innovative ideas in urban automation.
Customer relationship	[Describe what kind of customer relationships can be identified from the use case and how they are established and maintained]
Revenue streams	[Describe what kind of revenue streams can possibly resulting from the use case] A new Water Management and Flood Risk Prevention Platform
Key Resources	[Describe the key resources and assets in the use case] • Sensors; • RTUs; • Gateway; • Special Application server; • Central server.
Key Activities	[Describe the key activities of the use case]
Key Partnerships	[Describe what kind of partnerships could be formed in the use case]
Cost Structure	[Describe from what are the costs consisting of in the use case]

3.6 Constraints

[Please identify constraints that may restrict the operations of an actor, execution of the use case or the interactions between actors and the use case, or are associated with the use case environment]

Location	[Describe constraints for the location of the use case to execute] Locations with no wireless network coverage
Environmental characteristics	[Describe environmental settings outside the use case that should be taken into account (e.g. other actors in the environment or environmental attributes)]
Domain	[Describe the major domain concepts and their relationships that constrain or influence the use case. Identify domain regulations and customs that should be taken into account. Identify also domain ontologies, if any, that are intended to use]
Legislation and standards	[Identify the dominant laws that restrict the use case. Identify also common standards that should be followed / taken into account. Describe their influence to the use case] Standards developed by governmental organization and can be changed depending on the location, control parameters can be changed depending their urgent needs.
Organisation	[Describe organisational rules, policies and customs that should be considered in the case of the use case]
Other?	[Describe any other identified or emerged constraints for the use case]

3.7 Threats and exceptions

3.7.1 Misuse cases

[Please describe any threats that can be identified for the success of this use case. For example, identify malign/hostile actors (e.g. system abusers, hackers or viruses) and misuse cases, and describe how the use case is to respond to those threats]

3.7.2 Exceptions

[Please identify any anticipated exceptions and error conditions that could occurduring execution of the use case, and describe how the use case is to respond to those conditions. Also describe or estimate the state of the system after the use case has not met its main goal]

3.8 Other relevant information

[Please provide here any other relevant information, if any, that is not included in the other sections of this template]

4 Use Case 3: River Tele-monitoring

4.1 General description

4.1.1 Presentation

Use case number	UC 03
Use case name	River Tele-monitoring
Author/partner	George Suciu BEIA
Summary	The main goal of this use case is to develop an automatic system that can able to continuously monitor the level and water temperature along a river and some of its tributaries.
Rationale	[Please describe the problem that the use case solves, and the importance and significance of the use case in the viewpoint of the whole system] A critical aspect that imposed further expertise in the river monitoring approach consisted in improvement of knowledge on the contamination not perceivable within the framework of TNMN (persistent organic and inorganic micropollutants in sediment, biota and suspended solids).

4.1.2 Use case description

The tele-monitoring system will be automatic system that can able to continuously monitor the level and water temperature along a river and some of its tributaries.

The central elements of this tele-monitoring system can be seen in the figure below.

– Data concentrator (Gateway) performs communication with the remote telemetry units (RTUs) and also allows the configuration and management of all RTUs and sensors.

– Data presentation server is hosted on a computer with strong server features (such as safe unattended running 24/24 and 7/7. Server software is mainly focused on the presentation of data in various formats (tables and diagrams, for instance), which are entirely at the free choice of users. Changing data presentation formats is however allowed to those users only who have the right to make such changes; a very sophisticated rights hierarchy system does exist in the sotware. Data processed by the presentation server are also continuously and automatically exported towards ANAR’s central data and dispatcher systems.

At each monitoring location, a tele-monitoring installation was built-up. It mainly consists of a wireless remote telemetry unit (RTU), always mounted on an aluminium mast, and a water level sensor. At some of the installations, the water level sensor is a pressure probe, immersed in water through a stably-mounted aluminium & plastic pipe. The cable going through the pipe to the pressure probe always contains an air tube ensuring atmospheric pressure compensation. At other installations, a radar water level sensor hanging above water surface was preferred. The pressure sensor immersed in water offers the advantage of always being accompanied by a water temperature sensor. The radar sensor has, in turn, the advantage of being totally immune to problems like being clogged by dirt, sand, ice and other such things.

A solar panel powers the RTU and sensors at all tele-monitoring installations, while a combo sensor for air temperature and relative humidity can be found at the recently installed ones.

All sensors attached to a certain RTU are powered and read during short periodic time intervals. At every 15 minutes, the RTU computes results an average value from periodic measurement. At every hour, the 4 average values for every of the monitored parameters is sent by the RTU to the central gateway.

Virtually all communication within the tele-monitoring system are performed via the Internet, which brings important advantages to the system in what concerns investment and operation. Users, for instance, can have access to the data prepared by the presentation server anytime and anywhere, from any terminal able to access the Internet (PC, I-pad, smartphone etc.).

4.2 Contextual settings

4.2.1 Context description

[Please enter a free form description of the context of the use case. Pictures or context diagrams are also welcomed to assist the understanding of the use case context]

The primary value that the pressure probe type water level sensor delivers is the height of water column above the sensor. When the water level sensor is radar type, the primary value is the distance between radar and water surface. In both cases, the system allows alignment calculations, so that what is being finally delivered is the water level officially recognised by the “Romanian Waters” National Administration.

The data presentation server basically offers processed data such as diagrams, tables and even split-screens with diagrams and also data or events in table format. There are multiple ways to visualise diagram-form data over various time intervals in the past (from one day up to one year or more), with the possibility to read the punctual data at a chosen date and time. It is also possible to highlight a certain time interval over which the presentation server is able to calculate and clearly show the average, sum, min and max values.

4.2.2 Actors

Actor name	**Actor responsibilities**
Administrator	Add/remove/edit the users access to the interface and maintain the system
Operators	Generate reports and are responsible for themaintenance of thewebinterface
Final users	Receive the alarms generated by the system.

4.2.3 Security

Utilization of an Identity Management module, which will cover a number of aspects involving users' access to networks, services and applications, including secure and private authentication from users to devices, networks and services, authorization & trust management, user profile management, privacy-preserving disposition of personal data.

Utilization of SSH protocol instead Telnet to provide a secure (encrypted) management connection to a remote device.

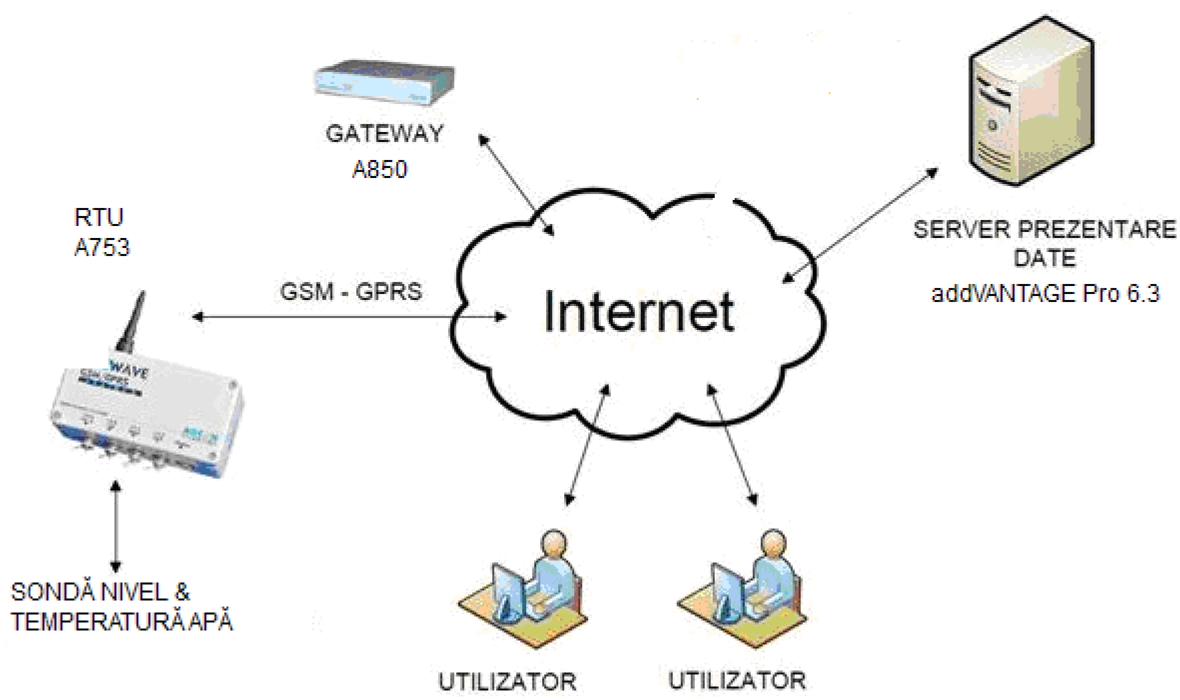
The users will use strong passwords and change them often.

Will be avoided utilization of standard insecure HTTP websites, especially for login screens; instead use the more secure HTTPS.

Will be implemented security hardware and software, such as firewalls.

4.2.4 Resources

In Figure below is presented the architecture of tele-monitoring system.



Resources needed:

- Water temperature and level probe sensors;
- RTUs:
- Gateway;
- Data presentation server.

4.2.5 Frequency of use

Level and water temperature sensors are powered for short lapses of time and read by the RTU at every 3 minutes. At every 15 minutes, the RTU calculates an average from the 5 values measured during said interval.

At every hour, the RTU transmits to the gateway and furthermore to the data Presentation server (PS) the 4 average values computed for each of the parameters measured (water level, water temperature, air humidity inside the RTU case as well as a lot of RTU-specific parameters, like battery voltage, internal temperature, transmission delays and error rates etc.).

The value that the system primarily delivers as water level at each location is the height of water above the level measuring sensor.

4.3 Functional description

Preconditions and assumptions	[Describe any preconditions and assumptions that must be true and valid when executing the use case] - The sensors are installed on the field.

	- The sensors are connected to the Remote telemetry unit (RTU) by wire. - The connection between Sensors and Gateway must be established. - Gateway is connected with Data Presentation Server through the Internet.
Trigger	[Identify the event that initiates the use case] LEDs on the box are used for notification. Due to a violation of a sensor limit the "send alarm message" is triggered. SMS sent from the gateway directly to defined numbers on the gateway. E-mail can be sent from the gateway directly.
Normal flow	[Enter the description of the normal flow of the successful execution of the use case] 1. Installation of the sensors on the field. 2. Sensors are measuring the environmental parameters. 3. Connection of the sensors to the Remote telemetry unit (RTU) by wire. 4. The sensors sends data to Gateway via wireless network. 5. Gateway is connected with Data Presentation Server through the Internet. 6. Data Presentation Server generate reports and send them to the system Administrator. 7. Diagrams, lists can be created and viewed.
Alternative flow (optional)	[Enter the description of an alternative flow, if any, of the successful execution of the use case]
Post-conditions	[Describe the state of the system after the use case has been used successfully] System will control water level and temperature by means of input and output values and give alarms and events defined action parameters.

4.4 Non-functional description

[Please describe the following quality viewpoint for the use case, if applicable. Consider all the elements of the use case, i.e. actors, the use case function, actor-use case relations and the use case environment]

Reliability	[Describe the characteristic required for failure free operation of the use case (e.g. failure prevention, detection and recovery considering data reliability, communication reliability, use case function reliability and environment reliability)] In case of level and water temperature along the river and some of its tributaries are abnormal, then affected people, could be informed via an application installed on their mobile phone.
Availability	[Describe how to ensure that the use case function is ready for use when required]
Performance	[Describe characteristics that enable the use case to process a request in a reasonable time]

Security	[Describe the how the unauthenticated use of the use case is prevented]
Interoperability	[Describe how the information sharing and co-operation with the rest of the system is enabled]
Adaptability	[Describe how the use case can be adapted to changes] Communication between the RTU and the Gateway is realized through wireless network and through Internet: • In case the telemetry unit is situated in a place with no wireless network coverage, there will be used particular remote stations in the UHF band of 430-440MHz. The station will communicate with the data concentrator (gateway) through a bridge station which has to ensure data conversion between wireless network and UHF station.
Variability	[Describe how the functionality of the use case can be varied to different situations]
Scalability	[Describe how the size or volume of the use case can be scaled in order to meet user needs]
Personalization	[Describe how the use case enables personalization according to single user's preferences] Some parameters can be customized depending on the urgent variables.

4.5 Business properties

[Please describe the following attributes from the viewpoint of the functionality presented in the use case]

Customer segment	[Describe who are the customers targeted in the use case] National Administration "Romanian Waters" (ANAR)
Value proposition	[Describe what kind of additional value is built for the customers in the use case and which customer's needs the use case fulfils]
Channels	[Describe which channels are used for distribution, sales and communication in the use case] • Participate at the events. • Publish research papers at different conferences, workshops and seminars. • Envision dissemination to students with innovative ideas in urban automation.
Customer relationship	[Describe what kind of customer relationships can be identified from the use case and how they are established and maintained]
Revenue streams	[Describe what kind of revenue streams can possibly resulting from the use case] A new river tele-monitoring system.

Key Resources	[Describe the key resources and assets in the use case] • Water temperature and level probe sensors; • RTUs: • Gateway; • Data presentation server.
Key Activities	[Describe the key activities of the use case]
Key Partnerships	[Describe what kind of partnerships could be formed in the use case]
Cost Structure	[Describe from what are the costs consisting of in the use case]

4.6 Constraints

[Please identify constraints that may restrict the operations of an actor, execution of the use case or the interactions between actors and the use case, or are associated with the use case environment]

Location	[Describe constraints for the location of the use case to execute]
Environmental characteristics	[Describe environmental settings outside the use case that should be taken into account (e.g. other actors in the environment or environmental attributes)]
Domain	[Describe the major domain concepts and their relationships that constrain or influence the use case. Identify domain regulations and customs that should be taken into account. Identify also domain ontologies, if any, that are intended to use] Water administration
Legislation and standards	[Identify the dominant laws that restrict the use case. Identify also common standards that should be followed / taken into account. Describe their influence to the use case] Standards developed by governmental organization and can be changed depending on the location, control parameters can be changed depending their urgent needs.
Organisation	[Describe organisational rules, policies and customs that should be considered in the case of the use case]
Other?	[Describe any other identified or emerged constraints for the use case]

4.7 Threats and exceptions

4.7.1 Misuse cases

[Please describe any threats that can be identified for the success of this use case. For example, identify malign/hostile actors (e.g. system abusers, hackers or viruses) and misuse cases, and describe how the use case is to respond to those threats]

4.7.2 Exceptions

[Please identify any anticipated exceptions and error conditions that could occur during execution of the use case, and describe how the use case is to respond to those conditions. Also describe or estimate the state of the system after the use case has not met its main goal]

4.7.3 Other relevant information

[Please provide here any other relevant information, if any, that is not included in the other sections of this template]

This use case will be applied to the Danube River.

5 Use Case 4: Performance monitoring of water distribution network

5.1 General description

5.1.1 Presentation

Use case number	UC 04
Use case name	Performance monitoring of water distribution network.
Author/partner	City of Saint-Etienne, Telecom Saint Etienne, Stéphanoise des eaux/Suez, ITRON
Summary	The goal of this use case is to monitor the performance of the distribution network which includes several performance indicators and performance variables. A water dashboard will display these performance indicators pertaining to the distribution network. The network sensors send measurements to the WaterM platform. The WaterM system treats these individual measures with additional information provided by the knowledge base describing the static information of the network. This results in a database which can be exploited for network management using static as well as dynamic queries. All the data sources will be exploited in real time for water network and distribution management. Additional information about energy (electricity and fuel) and material (devices) prices can be acquired by the monitoring system through third party communication (additional data).
Rationale	The performance monitoring of the water distribution network is necessary to economize water resources as well as to provide a good service to the end users. Water wastage in an area can be reduced if there is awareness about the state of the water distribution network. Within this scenario, we are monitoring sensor data and are considering real-time visualization of several performance variables and indicators that are defined in this use case. Those performance indicators are used for Leak Detection (UC 01), Control and optimisation of the water distribution network (UC 05)
Version n°	1

5.1.2 Use case description

[Please enter a free form description of the use case. Pictures are also welcomed to illustrate the use case]

In this use case, the WaterM platform takes into account the water provider needs and requirements by real time monitoring of the water distribution network and allowing the water provider to manage and control different devices in the network.

The water provider uses a set of performance variables and indicators to manage the network in the optimal way. It integrates data related to:

- direct measurement (consolidation data)
- indirect measurement (context data)

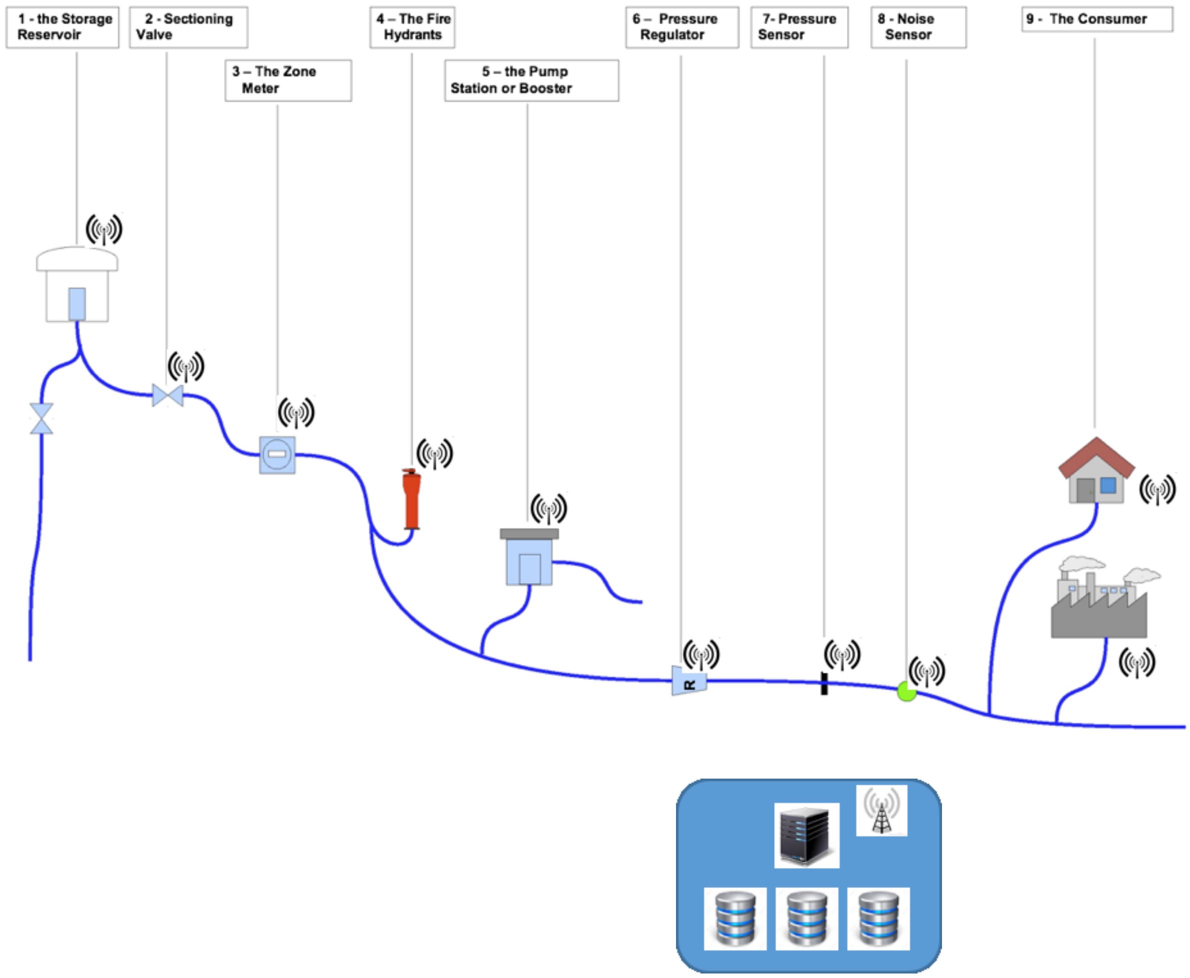
The water network is equipped with sensors that provide measured data. WaterM exploits those measures to process and display the multiple scale values of the different performance indicators and their evolution.

5.2 Contextual settings

5.2.1 Context description

[Please enter a free form description of the context of the use case. Pictures or context diagrams are also welcomed to assist the understanding of the use case context]

Water providers are currently equipping water equipment with sensors. This investment aims at dealing with early leak detection and efficient equipment management that are major cause for concern and important cost sources. The idea is to enable sensor enabled automatic monitoring and control of the water network.



Water-M System

Thanks to these sensors, it is possible to obtain real time information about performance variables and indicators. Those indicators are displayed on a dashboard to be exploited by the water network manager. Moreover, real time stream processing of performance variables and indicators values can help detecting some complex events in real time.

The performance variables are the basic data used to calculate indicators to evaluate the effectiveness of an infrastructure and the performance of the service. Some of the variables called "consolidation" correspond to the measurements made on the infrastructure. Others may be termed as "context data". The information which is not directly measurable, is used in the calculation of indicators, which in turn are intended to describe the context of the service (number of users, length of the water network ....).

Consolidation Variables:

Starting from buffer tank, providing mains pressure, till the final consumer, a distribution network can be outlined as follows:

The storage reservoir: After treatment, the water is stored in two types of reservoirs: the tarps on the ground or half-underground and reservoirs on towers called water towers. The choice depends on the location of the reservoir. To permit water delivery to consumers in good conditions, it is necessary that the difference in height between the reservoir and the housing is sufficient to have a correct pressure at the tap. The delivery of water is in general by gravity. A difference of ten meters between the reservoir and the distribution point corresponds to 1 bar of pressure. A pressure of "comfort" for the users is about 3 bar.

Furthermore, reservoirs ensure a buffer stock, an interface between synced production and water needs of the users. Because water is an alimentary product, it is necessary to specifically preserve its quality. Thus, it is necessary to ensure:

- That the water residence time in the reservoir is not too significant that may require varying the level in the reservoir, and ensure that they are not always at maximum capacity;
- Water disinfection (usually using chlorine) to kill bacteria. Chlorination has a residual effect that gives the water a bactericidal property throughout the distribution network;
- That the access to the reservoir is limited to one manager in order to prevent malevolent contamination;
- To monitoring the safety of the officer involved in this type of infrastructure.

Also in the reservoirs, it is beneficial to monitor the following variables:

- sensor of presence detects and signals the intrusion into the reservoir;
- flow entering the tank;
- pressure in the final pipes;
- level in the buffer reservoir(s);
- overflow sensor to detect overflow in the reservoirs;
- flow rate of water exit;
- residual rate of disinfectant in the distributed water;
- turbidity of the distributed water;
- local surrounding temperature;
- temperature of the distributed water;
- state of the ventilation system i.e. whether on or off, working properly or not and the air quality;
- position of the various valves fitted to the reservoir;
- sensor detecting power failure.

Sectioning Valve: After leaving the reservoir, the network is divided in sections to serve all users of the service. Each section usually starts with a block valve to isolate a section of the network for its particular maintenance.

For each valve it would be interesting to know:

- its status: open or closed;
- its opening percentage.

The Area/Zone/District Meter: The daily concerns of network operators consist of monitoring water volumes traversing their networks, leaks, cost savings and the reduction of unbilled water volumes. The monitoring of section counter offers the most effective solution to this ongoing challenge.

Water volumes measured at the input and output of each sector can refine the knowledge of the network:

Thus, it is necessary to know the following at regular intervals:

- The volumes measured at each section counter.

The fire hydrants and valves: Protection against fire is one of the skills provided by public officials, which is commonly provided by hydrants fed by water systems. To be fully effective the hydrant must be able to issue a certain flow at a minimum pressure (in France at least 60 m^3 / h at 1 bar pressure or more depending on the risks to be covered).

The fire hydrant post is equipped with a foot valve for maintenance. The hydrants are usually protected in locked chests whose keys are with the rescue services.

Often these devices are not metered. In France any consumption of drinking water should be charged to the user with the exception of that used for the defense against fire. The water used is treated as a leak from the network while in fact it has been used for a specific purpose.

These facilities must be operational at all times. Irregular practices are sometimes observed. The boxes are opened, the valves are opened and it also even happens that the post is damaged (in case of a collision).

Thus, for each fire hydrant post it would be interesting to know:

- The position of the foot valve (open, closed, pinched);
- The flow passing through the pole and its consumption;
- The dynamic pressure at the foot of pole;
- The state of the lid protecting water intakes (open or closed);
- The state of the water hydrant post (upright or inverted).

The pump station or booster: Ensuring the required water pressure and supply to users is routinely carried out by the water reservoirs. Depending on the topography of the area supplied, sometimes it is necessary to use pumping to increase pressure and flow rate; the solutions usually take three distinct forms:

- Booster: Following this equipment, the users are provided directly by the pumps taking the water reserve and inflating a sealed bladder ensuring a minimum buffer stock. When the pressure within the bladder drops below a set value the pumps are again put in operation;

- Pumping station: The network supplies a reserve. The water is pumped from this reserve to supply a new water reservoir located higher. The reservoir provides supply to a new area;
- Accelerator: when the flow Transited in the network is sufficient, but the pressure is too low to ensure a comfortable distribution for users, a pump is arranged in series to pump water into the upstream network or in the downstream network.

The efficiency of these devices depends on the continuity of water distribution to the users. It appears necessary to have the following information:

- Presence sensor indicating intrusion into the pumping station;
- State of the pumping unit (operation / stop);
- Pump rotation speed;
- Pressure of hydrophore tank (if booster);
- Inflow Speed;
- Outflow Speed;
- Inlet pressure;
- Outlet pressure;
- Energy consumption reporting;
- State of power grid (functional / defective);
- Noise;
- Temperatures (local, motor, water).

The supply of these pumps is, in some cases, secured by an autonomous generator, which must be monitored to be operational when needed. It therefore seems necessary to know:

- The group status (off or on);
- The level of fuel available in the tank;
- The oil temperature;
- Noise;
- Air Quality and state of ventilation system i.e. whether it is working or not ;
- Operating time;
- Fuel consumption.

The pressure or speed regulator: When the system pressure is too high due to the topography of the site, it is necessary to reduce it before serving users. Thus, a pressure reducer is arranged on the network.

Similarly, in areas with the most significant topography, the pressure may be very high, and a piping rupture can generate a very high flow rate of transit damage at this case. To limit this risk we put up a speed limiter on the network, which cuts power when the flow exceeds a set value.

For these devices it may be interesting to have the following elements:

- Pressure;
- Upstream flow;
- Downstream flow transited.

Pressure sensor: The pressure in the network indicates the water load in the pipes upstream. Excessive pressure may endanger infrastructure (particularly in the network or at users' place), too low pressure highlights a malfunction in the network (a pipe breakage, for example) the water is no longer properly distributed to the subscriber. At several points, it may be appropriate to have a pressure sensor that provides information on the network operation.

It is therefore necessary to send the pressure of the network after regular intervals of time.

Noise sensor: Leaks in distribution networks represent average loss of 20% of the water produced. Note that leak detection is tackled in UC 01 with another solution (pressure sensor). Here, we provide some more details.

To avoid drawing carelessly from precious water resources, finding leakage is a key issue. This hunt for leaks in networks responds to three needs:

- Health needs: a network in poor condition affects the continuity of service or the quality of Water,
- Environmental need: leaks force the system to draw more from precious water resources,
- Economic need: A well maintained network helps control the investments and thus stabilize the water prices.

Through their resurgence on natural terrain, major leaks are easier to detect and therefore to repair. The smallest leaks are however more difficult to find. Thus, because they are less easily repaired, they represent (long term) the bulk of the leakage of a water network. Acoustic sensors disposed on the network that can record the noise caused by the movement of water. A rate increase (due to a leak, for example) generates a different noise. Thus a comparative analysis of noise in terms of a noise "average" to determine or locate a leak accurately could be interesting. Therefore, it is essential to be able to sense

- The noise generated on the network

In the home: The water meter is the body that links water service to the user. It allows knowing the water consumption of a user and as a reference for establishing water and sanitation bills by the subscribers.

Generally, the process of collecting the meter readings is once a year, in case, there are large number of meters to be handled in the city. Moreover, many of these meters are located in private and sometimes even directly into homes. Or the subscriber is not necessarily present at his home during that day. In this case, the user is asked to inform by himself his meter reading.

Because it is the important device on which is established the economic water supply and sanitation service, meter is a particularly strategic element. It is not uncommon for users to "unscrupulously" dismantle their meters, to turn it upside down and reduce irregular water consumption and so their bills.

Leaks on private networks, after the meter are also possible. If the leak is not detected in time, it can put the user in a difficult economic situation. It is therefore important to detect any abnormal consumption by comparing the meter reading frequently.

Thus, it is interesting to be able to frequently transmit:

- the meter reading;
- Any intervention on the meter.

The water service is beholden to a minimum pressure (in France the Code of Public Health sets a minimum pressure of 0.3 bar can be raised locally according to the services and commitments of retailers) and a minimum water quality. The community is not responsible for the private network, it is important to legally ensure that the water meets drinking water standards at the delivery point (the meter). So it can be important to know:

- The pressure delivered to the user;
- Quality (bacterial and chemical physicochemical) of water supplied in the event of litigation.

Finally, some users have, parallel to the public resources, personal resources (wells, rain water recovery), which they use in addition to public water. This water rarely has a sanitary quality comparable to that of the water supplied on the group networks. In case of overpressure in domestic networks, private water flow back in the public network, which is feared because, it could contaminate the water quality.

Context data

To calculate the performance indicators that measure the quality of service, it is necessary to provide context data on the network once per year, which may not be directly measurable.

• Cost of service (fixed, meter rental price m^3, charges and taxes);

• Nature of the resources used (surface or underground sampling);

• Volumes collected from each resource;

• Volumes produced from each resource;

• Number of samples taken for microbiological analysis;

• Number of samples taken for microbiological analysis nonconforming;

• Number of samples taken for physicochemical analysis;

• Number of samples taken for physicochemical analysis nonconforming;

• Length of the network (excluding connections);

• Service Volume (used for network purges, the analysis continues ....);

• Volumes consumed without counting (estimated volumes corresponding to tank cleaning, other various unrecognized needs);

• Length of the renewed network;

• Complete information on each network segment (diameter, material, year of installation);

• Location and identification of interventions (repairs, purges, renewal work);

• Number of subscribers by type (domestic subscribers, industrial, group ..);

• Number of people served;

• Localized claims of the users.

The network devices are also described (sections, location and function of the various devices and sensors)

Performance indicators:

Each year, the state services demand a set of performance indicators. Some of them are used to compare different services having some similarities, to be able to have some references. Continuous measurements of the different parameters could be used to find these items at much higher frequencies for the purpose of better monitoring of the network and in the perspective of an ever more efficient service provided to users.

Network efficiency (R): Network efficiency parameter allows establishing network performance and evaluating leaks in distribution pipes. The higher the yield, the lower the overall leakage losses. In fact, withdrawals from water resources are correspondingly reduced. In France, communities that do not meet a minimum level of performance in relation to the consumption of their service may be penalized.

R = (Domestic volume recorded + Non-domestic volume recorded + Volume consumed without counting + Service Volume + Volume sold to other water services) / (produced Volume + Volume purchased at other water services) * 100

The primary performance of the network (RP): The primary performance of the network is used by organizations to determine the effectiveness of the network in terms of it being leak-proof as well as in terms of metering efficiency.

Unlike network performance, it neither takes into account the service volumes nor the volumes that were consumed, but not counted during metering.

RP = (Domestic volume recorded + Non-domestic volume recorded + Volume sold to other water services) / (produced Volume + Volume purchased at other water services) * 100

Linear consumption index (ILC): This ratio, set annually, is used to assess compliance network performance. If performance does not reach a threshold value, the linear consumption index is reviewed and must meet other reference value.

ILC = (Domestic and Non-domestic volume recorded + Volume consumed without counting + Service Volume + Exported Volume) / (network's linear measurement) / 365 days

The linear index of network loss (ILPR): The linear index of network loss estimates the losses due to leaks in the distribution network, by relating them to the length of pipelines (excluding connection).

ILPR = (Produced Volume + Volume purchased at other water services – Volume sold to other water services – Domestic volume recorded – Non-domestic volume recorded – Volume consumed without counting (estimated) – Service Volume) / (network's linear measurement) / 365

Linear Index of uncounted volumes (ILVNC): Linear Index of uncounted volumes evaluates the sum of leakage losses and volume of water consumed in the distribution networks that are not subject to metering, are divided by the length of pipelines (not connected).

This indicator differs from the linear index of network's losses that only includes losses by leakage. This indicator is always superior than the linear index of network's losses.

ILVNC = (Produced Volume + Volume purchased at other water services – Volume sold to other water services – Domestic volume recorded – Non-domestic volume recorded) / (network's linear measurement) / 365

Average turnover of the drinking water network (TMRR): This indicator gives the annual percentage average of drinking water network renewal in relation to the total length of the network that is not connected.

TMRR = Renewed network's linear measurement / network's linear measurement

Rate of occurrence of unplanned downtime (TOISNP): This indicator measures the continuity of drinking water service by following the number of unorganized water cuts for which the subscribers concerned have not been notified at least 24 hours in advance, relative to 1000 subscribers.

TOISNP = (Number of unscheduled service interruptions) / (Subscriber Number) * 1000

Compliance rate levies on water supplied made in relation to quality limits with regard to microbiology (TCMB): This indicator evaluates compliance with regulatory limits for water quality distributed to the users. It concerns the bacteriological parameters (the presence of pathogenic bacteria in the water). It refers to the measures taken by national authorities and those of the operator networks.

TCMB = (Number of nonconforming sampling performed for microbiological analyzes) / (Number of sampling performed for microbiological analyzes)

Compliance rate levies on water supplied made in relation to quality limits with regard to the physico-chemical parameters (TCPC): This indicator evaluates compliance with regulatory limits on the quality of the water supplied to the user regarding the physico-chemical parameters such as pesticides, nitrates, chromium, and bromate. It refers to the measures taken by national authorities and those of the operator networks.

TCPC = (Number of nonconforming sampling performed for physicochemical analyzes) / (Number of sampling performed for physicochemical analyzes)

Service Price per m³ for consumption of 120 m³ (PS): The price per m³ is calculated for an annual consumption of 120 m³ (national reference). Fixed by government agencies, the price depends particularly on the nature and quality of water resources, geographic conditions, population density, level of selected service quality, service renewal policy, realized investments and their financing.

This price includes all components of the service (production, transfer and distribution) and royalties of Water Agencies, State and VAT.

PS = (HT amount of the invoice of 120 m³ of January 1 back to the community and if applicable the operator + amount of taxes and fees related to service in the bill of 120 m³) / 120

Claim rate (TR): This indicator expresses the level of written complaints recorded by the water service for every 1,000 subscribers.

TR = (Number of reclamation received by the collectivity and the operator / Number of subscriber * 1000

Linear density of subscribers (DLA): This ratio is used to measure the similarities or differences between two services. The linear density of subscribers reflects urban concentration and puts into perspective the linear index of network losses. Indeed, in a given network the branching connections are all risks for leak. More the linear density of subscribers, the greater the risk of leaks is high.

DLA = (Number of subscriber) / (network's linear measurement)

Average consumption per subscriber (CMA): This ratio is, too, used to measure the similarities or differences between services. It is obviously linked to the service. Thus:

• Services with large consumers will have a very high ratio;

• Services with essentially domestic consumption, the ratio, a priori, corresponds to the average consumption of a household;

• For the services located in a tourist area, this ratio will probably be quite low and will vary with the seasons (which is why its high frequency evaluation may be interesting).

CMA = (Domestic and non-domestic consumption accounted) / (Number of subscriber)

Ratio inhabitants per subscriber (RHA): This ratio is used to measure the similarities or differences between any two services. This is used to compare several drinking water services.

RHA = (Estimation of inhabitants' number) / (Number of subscriber)

5.2.2 Actors

[Please identify the actors interacting with the system during the use case execution (e.g. human actors with different roles, other services and systems). For each actor, describe his/hers/its responsibilities in the use case execution]

Actor name	Interactions	Responsibilities
User	Water provider	Domestic, industrial or community client consuming water. He/she has a contract with the water provider.
Administrative agency	User Water provider	Municipalities, basin committees and water agencies responsible for the various technical and legal aspects of water management. He/she needs to get access to the data to check law respect.
Water provider	User Administrative agency Energy provider	Entity that is responsible to provide water and to manage the water network. He/she has a contract with the administrative agency to manage the water distribution and with the clients to provide water.
Energy provider	Water provider	Entity that sell to the water provider the energy needed to enable the water network.

5.2.3 Security

[Please identify the security issues and explain what should be protected]

5.2.4 Resources

[Please envision the infrastructure, physical resources and software artefacts needed for the use case execution]

- Sensor data from the water network (at least flow, pressure and volume);
- Information about the network (geolocation and characteristics of the water devices);

- IT network for sensor exchange;
- Global monitoring System: algorithms monitoring the network, platform / data base layout / CEP/ stream processing /Human–computer interaction / data integration layout / Network layout.

5.2.5 Frequency of use

[Please estimate the time frame and how often this use case will be executed (e.g. values such as 100 times per hour)]

Water network monitoring is a permanent task. Significant data can be produce for frequencies of every hour, every day, every week, every month, every trimester, every semester and every year. The last one is mandatory. Currently, sensors provide data every day. It is not relevant to process values of performance indicators without any new data.

5.3 Functional description

[Please describe the functional characteristics of each entity for the use case and according to the following table]

Preconditions and assumptions	[Describe any preconditions and assumptions that must be true and valid when executing the use case] Sensor measurement available, Network connection
Trigger	[Identify the event that initiates the use case] A water supplier initiates its network monitoring
Normal flow	[Enter the description of the normal flow of the successful execution of the use case] 1. Sensors from the water network transmit their measurements to the monitoring system 2. Received data is collected in a data base 3. Collected data are enriched with data from the knowledge base and performance variables and indicators are computed (back ground data) 4. Computed data are stored in database and can be used as input of step 3 or exploited in a report 5. Stream processing system will detect for complex events in real time using standing queries and a time window defined by the user.
Alternative flow (optional)	[Enter the description of an alternative flow, if any, of the successful execution of the use case]
Post-conditions	[Describe the state of the system after the use case has been used successfully] Performance variables and indicator are computed in real time and kept reliable for further use

5.4 Non-functional description

[Please describe the following quality viewpoint for the use case, if applicable. Consider all the elements of the use case, i.e. entities, the use case function, actor-use case relations and the use case environment]

Reliability	[Describe the characteristic required for failure free operation of the use case (e.g. failure prevention, detection and recovery considering data reliability, communication reliability, use case function reliability and environment reliability)]
Availability	[Describe how to ensure that the use case function is ready for use when required]
Performance	[Describe characteristics that enable the use case to process a request in a reasonable time]
Security	[Describe the how the unauthenticated use of the use case is prevented]
Interoperability	[Describe how the information sharing and co-operation with the rest of the system is enabled] • leak manager exploits the production of this use case as a reference dataset • device manager exploits the production of this use case to plan device change
Adaptability	[Describe how the use case can be adapted to changes] This use case is adapted to any kind of monitored network. Performance variables and indicators may be redefined.
Variability	[Describe how the functionality of the use case can be varied to different situations]
Scalability	[Describe how the size or volume of the use case can be scaled in order to meet user needs] Data storage must meet the data production of the sensors
Personalization	[Describe how the use case enables personalization according to single user's preferences] A user may define performance variables and indicators

5.4.1 Business properties

The revenue model for the water distribution companies relies on the balance between water devices renewal and water device performance. Aged water devices have a worse transportation ability and leak exposure. Transportation ability losses imply an extra use of pump and thus energy purchase. Leaks imply high costs of renewal. On the other hand, device renewals also have a cost. The aim is to define the optimal use of a device avoiding leaks.

[Please describe the following attributes from the viewpoint of the functionality presented in the use case]

Customer segment	[Describe who are the customers targeted in the use case] Customers are water supplier which want to optimise their network
Value proposition	[Describe what kind of additional value is built for the customers in the use case and which customer's needs the use case fulfils] The use-case must produce the performance variables and indicators for the customers
Channels	[Describe which channels are used for distribution, sales and communication in the use case]
Customer relationship	[Describe what kind of customer relationships can be identified from the use case and how they are established and maintained] The water provider has a contract with the administrative agencies and with the clients.
Revenue streams	[Describe what kind of revenue streams can possibly resulting from the use case] Water network optimisation: • Device management • Energy management. • Leak detection
Key Resources	[Describe the key resources and assets in the use case] • Sensor data • Water monitoring system, Algorithms • Energy market
Key Activities	[Describe the key activities of the use case] • Sensor data collection • Enriched data production
Key Partnerships	[Describe what kind of partnerships could be formed in the use case] • Water supplier • Administrative agencies
Cost Structure	[Describe from what are the costs consisting of in the use case] • Information system development, maintenance and operation • Data acquisition

5.5 Constraints

[Please identify constraints that may restrict the operations of an actor, execution of the use case or the interactions between actors and the use case, or are associated with the use case environment]

Location	[Describe constraints for the location of the use case to execute]
Environmental characteristics	[Describe environmental settings outside the use case that should be taken into account (e.g. other actors in the environment or environmental attributes)]
Domain	[Describe the major domain concepts and their relationships that constrain or influence the use case. Identify domain regulations and customs that should be taken into account. Identify also domain ontologies, if any, that are intended to use] Water distribution

Legislation and standards	[Identify the dominant laws that restrict the use case. Identify also common standards that should be followed / taken into account. Describe their influence to the use case]
Organisation	[Describe organisational rules, policies and customs that should be considered in the case of the use case] European commission, water agencies, basin committees, municipalities
Other?	[Describe any other identified or emerged constraints for the use case]

5.6 Threats and exceptions

5.6.1 Misuse cases

[Please describe any threats that can be identified for the success of this use case. For example, identify malign/hostile actors (e.g. system abusers, hackers or viruses) and misuse cases, and describe how the use case is to respond to those threats]

Water distribution meets water consumption inside the home of the end-client. Some of them can be tempted to modify the measures transmitted by the meter sensor.

5.6.2 Exceptions

[Please identify any anticipated exceptions and error conditions that could occur during execution of the use case, and describe how the use case is to respond to those conditions. Also describe or estimate the state of the system after the use case has not met its main goal]

5.7 Other relevant information

[Please provide here any other relevant information, if any, which is not included in the other sections of this template]

6 Use Case 5: Control and optimisation of the water distribution network

6.1 General description

6.1.1 Presentation

Use case number	UC 05
Use case name	Control and optimisation of the water distribution network
Author/partner	City of Saint-Etienne, Telecom Saint Etienne, Stéphanoise des eaux/Suez
Summary	This use case will focus on device management and energy optimisation. Through a series of sensors and actuators placed across the water system, constant monitoring and control of the network is done to obtain a desired performance. Water-M platform systems allow the water provider to control the water distribution network and optimise its energy consumption
Rationale	The performance monitoring of the water distribution network is done in UC 04. This monitoring data is used to detect unwanted events and take action to control these events which if uncontrolled could degrade the performance of the distribution network. This use case will also allow for the optimisation of the energy consumption of different devices in the network.
Version n°	1

6.1.2 Use case description

[Please enter a free form description of the use case. Pictures are also welcomed to illustrate the use case]

In this use case, the Water-M platform takes into account the water provider needs and requirements by effectively monitoring the health of the water distribution network.

1. An authentication mechanism allows the water provider to access the real time monitoring data.
2. Water provider wants an automated management of the network devices and optimisation of the energy consumption.
3. Water provider defines rules related to:
    a. events to detect
    b. geo spatial and temporal boundaries for detecting the events
    c. actions to take in case of detection of unwanted events which could be
        i. commands to the devices
        ii. switching ON/OFF of some devices
    d. time scale of the action in terms of latency (water provider can ask for low latency control loop)
4. Water provider may also ask for adapting the monitoring frequency of some parameters.
5. WaterM platform is capable of
    a. implementing the above rules,
    b. detecting the desired events,
    c. knowing which data corresponds to the defined geospatial and temporal boundaries
    d. informing the Water Provider about the events
    e. respecting the latency

    f. increasing the monitoring frequency of the selected sensors
6. A 3rd party application can help in energy optimisation
    a. It accesses energy consumption data through selective authentication.
    b. It can use the services of the platform to analyse this data
    c. It can provide some recommendations to water provider such as selective ON/OFF of some devices when they are not being used.
7. Water-M platform is able to provide selective data access to 3rd party applications and provides an interface for these applications to use its data analyses services

6.2 Contextual settings

6.2.1 Context description

[Please enter a free form description of the context of the use case. Pictures or context diagrams are also welcomed to assist the understanding of the use case context]

Water providers are currently equipping water equipment with sensors. This investment aims at dealing with early detection of unwanted events and efficient energy as well as equipment management, which in turn are major causes for concern and important cost sources. The idea is to enable sensor/actuator enabled automatic monitoring and control of the water network.

Such needs can arise all along the water distribution network and here are some cases:

1. After treatment, the water is stored in reservoirs which ensure a buffer stock, an interface between synced production and water needs of the users. Because water is an alimentary product, it is necessary to specifically preserve its quality. Thus, it is necessary to ensure:

    a. That the water residence time in the reservoir is not too significant that may require varying the level in the reservoir, and ensure that they are not always at maximum capacity

    b. Water disinfection (usually using chlorine) to kill bacteria. Chlorination has a residual effect that gives the water a bactericidal property throughout the distribution network.

    c. That the access to the reservoir is limited to one manager in order to prevent malevolent contamination

    d. To monitoring the safety of the officer involved in this type of infrastructure.

    Most of the above cases are alarms from exceeding a sensor value (threshold) or the change of sensor state (intrusion). Thus, for each sensor we need to define a simple rule.

2. After leaving the reservoir, the network is divided in sections to serve all users of the service. Each section usually starts with a block valve to isolate a section of the network for its particular maintenance. Thus depending on events such as contamination or pressure increase the block valves can be put into action.

3. Ensuring the required water pressure and supply to users is routinely carried out by the water reservoirs. Current devices manage these values locally and automatically using very fast control loops, thus, this use case will set the control goals over higher short-mid term time durations. Depending on the topography of the area supplied, sometimes it is necessary to use pumping to increase pressure and flow rate; the solutions usually take three distinct forms:

a. Booster: Following this equipment, the users are provided directly by the pumps taking the water reserve and inflating a sealed bladder ensuring a minimum buffer stock. When the pressure within the bladder drops below a set value the pumps are again put in operation.

b. Pumping station: The network supplies a reserve. The water is pumped from this reserve to supply a new water reservoir located higher. The reservoir provides supply to a new area.

c. Accelerator: when the flow Transited in the network is sufficient, but the pressure is too low to ensure a comfortable distribution for users, a pump is arranged in series to pump water into the upstream network or in the downstream network.

4. When the system pressure is too high due to the topography of the site, it is necessary to reduce it before serving users. Thus, a pressure reducer is also arranged on the network.

5. Similarly, in areas with the most significant topography, the pressure may be very high, and a piping rupture can generate a very high flow rate of transit damage at this case. To limit this risk we put up a speed limiter on the network, which cuts power when the flow exceeds a set value.

6. Finally, some users have, parallel to the public resources, personal resources (wells, rain water recovery), which they use in addition to public water. This water rarely has a sanitary quality comparable to that of the water supplied on the group networks. In case of overpressure in domestic networks, private water flow back in the public network, which is feared because, it could contaminate the water quality and thus the pressure should be controlled. This may be detected using difference in the pressure values and sensing the water flow direction, etc.

6.2.2 Actors

[Please identify the actors interacting with the system during the use case execution (e.g. human actors with different roles, other services and systems). For each actor, describe his/hers/its responsibilities in the use case execution]

Actor name	**Interactions**	**Responsibilities**
Water provider	User Administrative agency Energy provider	Entity that is responsible to provide water and to manage the water network. He/she has a contract with the administrative agency to manage the water distribution and with the clients to provide water.
Municipality	Water Provider	Municipalities, basin committees and water agencies responsible for the various technical and legal aspects of water management. He/she needs to get access to the data to check law respect.
Energy provider	Water provider	Entity that sell to the water provider the energy needed to enable the water network.
3rd Party	Water provider	Entity that develops 3rd party applications. It needs selective access to the data in order to analyse it and provide recommendations to the water provider. Such recommendations could be related to energy optimisations.

6.2.3 Security

[Please identify the security issues and explain what should be protected]

The safety of the officer involved in this type of infrastructure should be ensured.

The access to the data should be based on an authentication mechanism, which may selectively or fully provide access to the data.

6.2.4 Resources

[Please envision the infrastructure, physical resources and software artefacts needed for the use case execution]

- Sensor data from the water network
- Information about the network (geolocation and characteristics of the water devices)
- IT network for sensor exchange
- Data analyses services
- Complex event processing for event detection based on the rules provided by the water provider
- Authentication mechanisms, which may selectively or fully provide access to the data for a given user
- Mechanisms to send the commands to the actuators
- Low latency control loops

6.2.5 Frequency of use

[Please estimate the time frame and how often this use case will be executed (e.g. values such as 100 times per hour)]

Some control functionalities will require low latency control loops or the order of seconds.

6.3 Functional description

[Please describe the functional characteristics of each entity for the use case and according to the following table]

Preconditions and assumptions	[Describe any preconditions and assumptions that must be true and valid when executing the use case] Rules defined by the water provider for event detection and control actions Sensor measurement available, Network connection, access to the data,
Trigger	[Identify the event that initiates the use case] A water supplier initiates its network control application
Normal flow	[Enter the description of the normal flow of the successful execution of the use case] 1. An authentication mechanism allows the water provider to access the real time monitoring data. 2. Water provider wants an automated management of the network devices and optimisation of the energy consumption 3. Water provider defines rules related to event detection, control actions, time windows, geo-spatially targeted regions, etc. 4. Water provider may also ask for adapting the monitoring frequency of some parameters. 5. WaterM platform uses complex event processing to detect events and control rules are used to automatically undertake some control actions 6. Water provider may also manually send some control commands 7. A 3rd party application is able to help in energy optimisation by providing recommendations based on the data and platform services

Alternative flow (optional)	[Enter the description of an alternative flow, if any, of the successful execution of the use case]
Post-conditions	[Describe the state of the system after the use case has been used successfully] The unwanted events are controlled and the performance indicators return to their normal operating ranges

6.3.1 Non-functional description

[Please describe the following quality viewpoint for the use case, if applicable. Consider all the elements of the use case, i.e. entities, the use case function, actor-use case relations and the use case environment]

Reliability	[Describe the characteristic required for failure free operation of the use case (e.g. failure prevention, detection and recovery considering data reliability, communication reliability, use case function reliability and environment reliability)] For failure free operation, erroneous data should be processed to remove errors, latency of control loops should be respected, local nodes should be capable of taking actions without relying too much on the communications network which can go down.
Availability	[Describe how to ensure that the use case function is ready for use when required] It should be available with the water dashboard
Performance	[Describe characteristics that enable the use case to process a request in a reasonable time] Low latency control loops, low delays between when the command is send and is executed
Security	[Describe the how the unauthenticated use of the use case is prevented] By default, an authentication mechanism is used which can allow for selective or full access to the data.
Interoperability	[Describe how the information sharing and co-operation with the rest of the system is enabled] • Different interfaces are designed: water provider-platform, 3rd party – platform • Open data models are used
Adaptability	[Describe how the use case can be adapted to changes] In case of some changes, such as devices changes, the platform should automatically update the information and the data analyses systems should be able to accommodate these changes. Moreover, as the use case requires a pre-definition of rules, these rules can be adapted to the changes by the water provider.
Variability	[Describe how the functionality of the use case can be varied to different situations] This use case is adapted to different types of distribution networks and devices. The rules defined by water provider should be realised using a general framework.
Scalability	[Describe how the size or volume of the use case can be scaled in order to meet user needs] Data storage must meet the data production of the sensors

Personalization	[Describe how the use case enables personalization according to single user's preferences] As mentioned before, the water provider will define the rules and thus is able to personalise these rules

6.4 Business properties

New ideas are emerging to rebuild the economic model by making remuneration proportional to the water distribution performance achieved, therefore partially detaching the remuneration from the volumes sold. The municipality pays the operator directly based on performance measured through precise evaluations. The remuneration is proportional to the objectives respected as well as the volumes of water sold. Thus, water provider has a monetary interest in control the performance variables of the network.

This model overcomes an old principle that "water pays for water" since it establishes a financing of water utilization by the taxpayer and the subscriber, but does not depends exclusively on the latter. This economic model, which is more qualitative, already exists in some American water services for which water resources are particularly fragile. This perspective requires the availability of novel tools to assess and analyze the service performance.

[Please describe the following attributes from the viewpoint of the functionality presented in the use case]

Customer segment	[Describe who are the customers targeted in the use case] Customers are municipalities and water suppliers who want to optimise their networks
Value proposition	[Describe what kind of additional value is built for the customers in the use case and which customer's needs the use case fulfils] The use-case provides a semi-automated as well as flexible control to a water provider over water distribution network. This functionality can help the water provider to optimise the performance of the distribution network.
Channels	[Describe which channels are used for distribution, sales and communication in the use case]
Customer relationship	[Describe what kind of customer relationships can be identified from the use case and how they are established and maintained] The water provider has a contract with the administrative agencies and with the clients.
Revenue streams	[Describe what kind of revenue streams can possibly result from the use case] Water network optimisation: • Device management • Energy management. • Market for new devices and actuators • Market for 3rd party applications for energy optimisation
Key Resources	[Describe the key resources and assets in the use case] • Sensor data • Water monitoring system, Algorithms • Energy market • Complex event processing • Authentication • Interfaces with the platform

Key Activities	[Describe the key activities of the use case] • Sensor data collection • Actuation • Semi-automated device control with low latency • Event detection • Energy optimisation
Key Partnerships	[Describe what kind of partnerships could be formed in the use case] • Water supplier • Administrative agencies
Cost Structure	[Describe from what are the costs consisting of in the use case] • Information system development, maintenance and operation • Data acquisition

6.5 Constraints

[Please identify constraints that may restrict the operations of an actor, execution of the use case or the interactions between actors and the use case, or are associated with the use case environment]

Location	[Describe constraints for the location of the use case to execute] Underground locations can hamper Telecommunications and make it costly to renew sensors and devices. The distribution network can be very long. Thus, connectivity conditions and available bandwidth can vary.
Environmental characteristics	[Describe environmental settings outside the use case that should be taken into account (e.g. other actors in the environment or environmental attributes)] Power supply may not be available in some places so battery operated nodes will have to be considered. Energy prices dictate the gains obtained through energy optimisation.
Domain	[Describe the major domain concepts and their relationships that constrain or influence the use case. Identify domain regulations and customs that should be taken into account. Identify also domain ontologies, if any, that are intended to use] Water distribution, water devices
Legislation and standards	[Identify the dominant laws that restrict the use case. Identify also common standards that should be followed / taken into account. Describe their influence to the use case]
Organisation	[Describe organisational rules, policies and customs that should be considered in the case of the use case] European commission, water agencies, basin committees, municipalities
Other?	[Describe any other identified or emerged constraints for the use case]

6.6 Threats and exceptions

6.6.1 Misuse cases

[Please describe any threats that can be identified for the success of this use case. For example, identify malign/hostile actors (e.g. system abusers, hackers or viruses) and misuse cases, and describe how the use case is to respond to those threats]

If the authentication mechanism is weak then hackers can gain un-authorised access to the distribution data.

6.6.2 Exceptions

[Please identify any anticipated exceptions and error conditions that could occur during execution of the use case, and describe how the use case is to respond to those conditions. Also describe or estimate the state of the system after the use case has not met its main goal]

Failure of intermediating nodes and errors in the data can lead to failure.

6.6.3 Other relevant information

[Please provide here any other relevant information, if any, which is not included in the other sections of this template]

7 Use Case 6: Coordinated management of networks and sanitation structures

7.1 General information

7.1.1 Presentation

Use case number	UC 06
Use case name	Coordinated management of networks and sanitation structures, improving and securing the operation of sanitation facilities, “real time" knowledge of volumetric flow.
Author/partner	Ali Kafalı - ACD Aydın Can Polatkan – Mantis GüvenKöse - Mantis
Summary	The main goal of this use case is to detect given the control limitation of the harmful materials according to standards within the waste water treatment plant. This water treatment plant located in the industrial zone and wastewater must be treated in real time while creating alarm detection in case of producing wastewater originating from heavy industry. This early warning system must be connected with third party application and devices.
Rationale	Heavy industry produces huge amount of wastewater, which include heavy metals and pollution. As water treatment becomes more important in the industrial zones because after treatment of the wastewater can be used for cultivated area as irrigation water thus wastewater treatment must be done according to standards.
Version n°	1.1

7.1.2 Use case description

[Please enter a free form description of the use case. Pictures are also welcomed to illustrate the use case]

This use case concerns water treatment plants used by:

-Municipality

-Public Health Care Organization

-Industrial zone water treatment plants

In general, these plants have existing scada systems for controlling the measurement data. However these data cannot be controlled online alarms and event generation depending on the defined parameters and actions.

This use case will provide treatment plants (clean or waste water) online monitoring alarms and event generation by means of defining parameters.

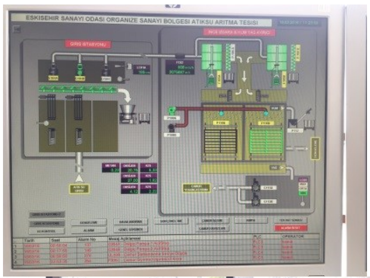
As an added benefit of this use case, discharge of the water treatment plants will provide defined standard value and environmental purposes, alarms action and root cause of the problematic definition automatically.

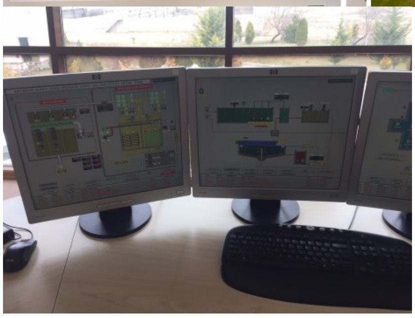
7.2 Contextual settings

7.2.1 Context description

[Please enter a free form description of the context of the use case. Pictures or context diagrams are also welcomed to assist the understanding of the use case context]

Some views from a waste water plant :






7.2.2 Actors

[Please identify the actors interactingwith the system during the use case execution (e.g. human actors with different roles, other services and systems). For each actor, describe his/hers/its responsibilities in the use case execution]

Actor name	**Actor responsibilities**
Authorized Person(AP)	AP needs to know the input water if the systems are online and energy available.
Laboratory Person	LP needs to check the water ingredients control values.
Third Party Application	This system must provide and control the sensors, Plc and pump systems. Third party companies who implement scada system should explain the devices, (like Plc, sensors and scada) structure.

7.2.3 Security

[Please identify the security issues and explain what should be protected]

Measurement Data: this data must be check and validated in system, which protected by the servers Internet firewalls and virus protection.

Authorized Person: Measurement data value must be validated and check only authorized person.

7.2.4 Resources

[Please envision the infrastructure, physical resources and software artefacts needed for the use case execution]

Physical connections: Sensors, Plc, Pump and motor connection.

Software: Connectors must be loaded for heterogenic data reading because different Plc and sensors needs data translation into one single infrastructure.

Database: input and output value must be loaded into one database.

IT network for information exchanges:

- Wlan network for data transmission;
- Server and database for data recording;
- Server protection issues firewall, virus protection.

7.2.5 Frequency of use

[Please estimate the time frame and how often this use case will be executed (e.g. values such as 100 times per hour)]

Sensor data, which are most important parameters, must be real time measurement secondary importance data can be controlled 2 times per hours or 1 time per day.

7.3 Functional description

[Please describe the functional characteristics of the use case according to following table]

Preconditions and assumptions	[Describe any preconditions and assumptions that must be true and valid when executing the use case] 1- Water treatment plant has sensors and Plc devices for controlling the parameters defined in the system. 2- Define control parameters upper and lower limits. 3- Accessing sensors and controller Plc devices by reading relevant protocols and data. 4- Real time measurement data must be recorded by date time and value. 5- Action plan must be defined in the system (authorized person phone number, email etc.). 6- Sensors location, Plc location, pumps location and id number created. 7- Sensors calibration. 8- Network audit.
Trigger	[Identify the event that initiates the use case] Creating Alarms and events depending on the parameters value (minimum, maximum, hysteresis value,..) defined by authorized person in water plant management.

Normal flow	[Enter the description of the normal flow of the successful execution of the use case] 1- Huge amount of wastewater flows into the water treatment plant. 2- Data needs to be recorded and measured. 3- Measurement parameters need to be controlled. 4- Depending on the controlled parameters needs to be created alarms and events. 5- Alarms and events must be sent to authorize person via email, SMS or noisy buzzer. 6- Describe the action in the system after alarms and events produced.
Alternative flow(optional)	[Enter the description of an alternative flow, if any, of the successful execution of the use case] Alternative ways of use case is to make measuring in laboratories with takes time and costs.
Post-conditions	[Describe the state of the system after the use case has been used successfully] System will control heavy metal, chemical and toxic substance by means of input and output values and give alarms and events defined action parameters.

7.4 Non-functional description

[Please describe the following quality viewpoint for the use case, if applicable. Consider all the elements of the use case, i.e. actors, the use case function, actor-use case relations and the use case environment]

Reliability	[Describe the characteristic required for failure free operation of the use case (e.g. failure prevention, detection and recovery considering data reliability, communication reliability, use case function reliability and environment reliability)] Alarm system must be online and be sure connected devices are on position. In case of failure event of the alarm system authorized person must be sure to on position.
Availability	[Describe how to ensure that the use case function is ready for use when required] When use case software packages installed in the plant it gets ready to use depending on the configuration.
Performance	[Describe characteristics that enable the use case to process a request in a reasonable time] This use case communicates with existing scada system. Scada systems can control different sensors and probes. After established a communication with scada systems and installing database use case will get ready to use within a week.
Security	[Describe the how the unauthenticated use of the use case is prevented] Standard security systems can be implemented for the customer usage.
Interoperability	[Describe how the information sharing and co-operation with the rest of the system is enabled]

	System can share information with enabled services and third party software.
Adaptability	[Describe how the usecase can be adapted to changes] This use case is adapted by any kind of devices working in the treatment plant.
Variability	[Describe how the functionality of the usecase can be varied to different situations]
Scalability	[Describe how the size or volume of the use case can be scaled in order to meet user needs] Depending customer needs parameters can be changed.
Personalization	[Describe how the use case enables personalization according to single user's preferences] Some parameters can be customized depending on the urgent variables.

7.5 Business properties

[Please describe the following attributes from the viewpoint of the functionality presented in the use case]

Customer segment	[Describe who are the customers targeted in the use case] Customers are water treatment plants, which are located in cities, urban area and industrial zones.
Value proposition	[Describe what kind of additional value is built for the customers in the use case and which customer's needs the use case fulfils] This use case will help for maintenance systems as an additional.
Channels	[Describe which channels are used for distribution, sales and communication in the use case] In the use case wastewater plants needs intelligent solutions. Sales department can offer the solution for the industrial wastewater plants.
Customer relationship	[Describe what kind of customer relationships can be identified from the use case and how they are established and maintained] Sales person can detect customer needs and make small demo for customer.
Revenue streams	[Describe what kind of revenue streams can possibly resulting from the use case] New services purchased by the consumer - Monitoring Management - Alarms and Event management
Key Resources	[Describe the key resources and assets in the use case] - Alarm And Event management System - Monitoring System including the sensors - Connectors for communication hardware devices

Key Activities	[Describe the key activities of the use case] - Communication for sensors and Plc data - Monitoring Management including calibration and maintenance of sensors - Alarms and Event Management
Key Partnerships	[Describewhat kind of partnerships could be formed in the use case] - Industrial Zones Management, - Companies who implement scada systems
Cost Structure	[Describe from what are the costs consisting of in the use case] Implementation costs + engineering costs + management costs

7.6 Constraints

[Please identify constraints that may restrict the operations of an actor, execution of the use case or the interactions between actors and the use case, or are associated with the use case environment]

Location	[Describe constraints for the location of the use case to execute] Due to location of the treatment plant cannot be reached any time because of restricted zones.
Environmental characteristics	[Describe environmental settings outside the use case that should be taken into account (e.g. other actors in the environment or environmental attributes)] Environmental settings very important for this use case. Vegetables plant areas uses outcomes of this plant. Result of the outcomes very important for the arable land.
Domain	[Describe the major domain concepts and their relationships that constrain or influence The use case. Identify domain regulations and customs that should be taken into account. Identify also domain ontologies, if any, that are intended to use] Major concepts of this use case is to provide industrial waste water is not easy to use again but controlling the input parameters and output parameters up on the desired value is very important for re using waster industrial water.
Legislation and standards	[Identify the dominant laws that restrict the use case. Identify also common standards that should be followed / taken into account. Describe their influence to the use case] Standards developed by governmental organization and can be changed depending on the location, control parameters can be changed depending their urgent needs. Usage of ISO standards if available.
Organisation	[Describe organisational rules, policies and customs that should be considered in the case of the use case] Treatment Organization working due to governmental regulations, clean water resources controlled by Public health Care organization.

Other?	[Describe any other identified or emerged constraints for the use case] In order to get the appropriate data existing scada systems may not be controlled by software connectors to read heterogeneous data.

7.7 Threats and exceptions

7.7.1 Misuse cases

[Please describe any threats that can be identified for the success of this use case. For example, identify malign/hostile actors (e.g. system abusers, hackers or viruses) and misuse cases, and describe how the use case is to respond to those threats]

Malfunction of sensors causing false alarms. This might be due to inadequate maintenance of sensors.

7.7.2 Exceptions

[Please identify any anticipated exceptions and error conditions that could occur during execution of the use case, and describe how the use case is to respond to those conditions. Also describe or estimate the state of the system after the use case has not met its main goal]

Use case has not met its main goal :

1- if not accessing scada system that controls the waste water plant
2- if not controlling measurement data
3- if not existing sensors, probes in the plant
4- if not written collected data into database for monitoring

7.7.3 Other relevant information

[Please provide here any other relevant information, if any, that is not included in the other sections of this template]

This use case can help plant maintenance purposes for example motors, belt, motoroil, pressure, erosion of pomp, erosion of motors etc..

8 Use Case 7: New redox monitoring

8.1 General information

Use case number	UC 07
Use case name	Water Quality Monitoring
Author/partner	University of OULU, Kajaani University of Applied Sciences (prev. Measurepolis), THL, Savonia, EHP Tekniikka
Summary	The goal of this use case is to monitor the quality features of the water as performance indicators. The Use Case thus forms a part of Use Case 005, which describes network performance indicators in more general level. We focus the quality questions in this case to monitoring changes in redox and heavy metal traces, as well as temperature, pH, EC turbidity, heavy metals and DO. The aim is to create model for real-time water safety protocol including novel data transfer. New data-analysis tools will be implemented to create models and predictions of the water quality. Today, monitoring is made by manual sampling and this is not providing enough safety for consumer nor it isn't cost-effective way to monitor.
Rationale	Water safety and quality are fundamental to society development and well-being. Providing access to safe water is one of the most effective instruments in promoting health. It is vitally important to create cost-efficient tools and service platforms to ensure good water quality to citizens. Novel methods, outstanding from legislation requirements, for online monitoring on quality parameters offer water utilities a possibility to understand and control different phenomenon at water supply network at totally new level. This helps to respond the goals for European and global water management set in eg. Water Framework Directive 2000/60/EC, Drinking water directive 98/83/EC and expert group outlines like The Value of Water-report (Water supply and sanitation technology platform WssTP 2016). The Groundwater Directive 2006/118/EC has been developed in response to the requirements of Article 17 of the Water Framework Directive. ORP stands for oxidation-reduction potential, which is a measure of millivolts, of the tendency of a chemical substance to oxidize or reduce another chemical substance. Oxidation is the loss of electrons by an atom, molecule or ion. The redox is an indicative parameter to describe changes in water, and act as an early-warming trigger for more detailed analysis on possible events and consequences. Traces of metal may occur in eg. situations, where pressure suddenly changes and causes loosening of corrosive layers (soft deposits) in pipelines. Redox sensor attached to new data transform platform are able to monitor water quality in real-time and new services such as early-warning protocols can be implemented in these systems.
Version n°	1.0

8.2 Use case description

[Please enter a free form description of the context of the use case. Pictures or context diagrams are also welcomed to assist the understanding of the use case context]

Water safety and quality are fundamental to society development and well-being. Providing access to safe water is one of the most effective instruments in promoting health. It is vitally important to create cost-efficient tools and service platforms to ensure good water quality to citizens. Novel methods, even outstanding from legislatory requirements, for online monitoring on quality parameters offer water utilities a possibility to understand and control different phenomenon at water supply network at totally new level. This helps to respond the goals for European and global water management set in eg. Water Framework Directive 2000/60/EC, Drinking water directive 98/83/EC and expert group outlines like The Value of Water-report (Water supply and sanitation technology platform WssTP 2016). The Groundwater Directive 2006/118/EC has been developed in response to the requirements of Article 17 of the Water Framework Directive. Groundwater constitutes the largest reservoir of freshwater in the world, accounting for over 97% of all freshwaters available on earth (excluding glaciers and ice caps). The remaining 3% is composed mainly of surface water (lakes, rivers, wetlands) and soil moisture. Until recently, focus on groundwater mainly concerned its use as drinking water (e.g. about 75% of European Union (EU) residents depend on groundwater for their water supply), and recognising that it is also an important resource for industry (e.g. cooling waters) and agriculture (irrigation). It has, however, become increasingly obvious that groundwater should not only be viewed as a water supply reservoir, but should also be protected for its environmental value.

The parameters for describing water quality were chosen to be redox, selected heavy metal traces, temperature, pH, EC turbidity, ORP and DO. ORP stands for oxidation-reduction potential, which is a measure of millivolts, of the tendency of a chemical substance to oxidize or reduce another chemical substance. Oxidation is the loss of electrons by an atom, molecule or ion. The redox is an indicative parameter to describe changes in water, and act as an early-warming trigger for more detailed analysis on possible events and consequences. Traces of metal may occur in eg. situations, where pressure suddenly changes and causes loosening of corrosive layers (soft deposits) in pipelines.

Water quality sensor attached to new data transform platform are able to monitor water quality in real-time and new services such as early-warning protocols can be implemented in these systems.

This use case concerns water treatment plants used by: -Municipality, water utilities and industry.

The need for this use case has become from water utilities. Monitoring is done mainly today as manual sampling and problems occurring with to water quality can lead to hazards for health and it also big economical drawbacks for water utility. In water-depended industry (e.g. dairy, brewery, …) any abnormal changes in water quality are extremely challenging. Thus the interest for cost-efficient, safe and rapid monitoring and new ICT-based service platforms is increasing.

8.3 Contextual settings

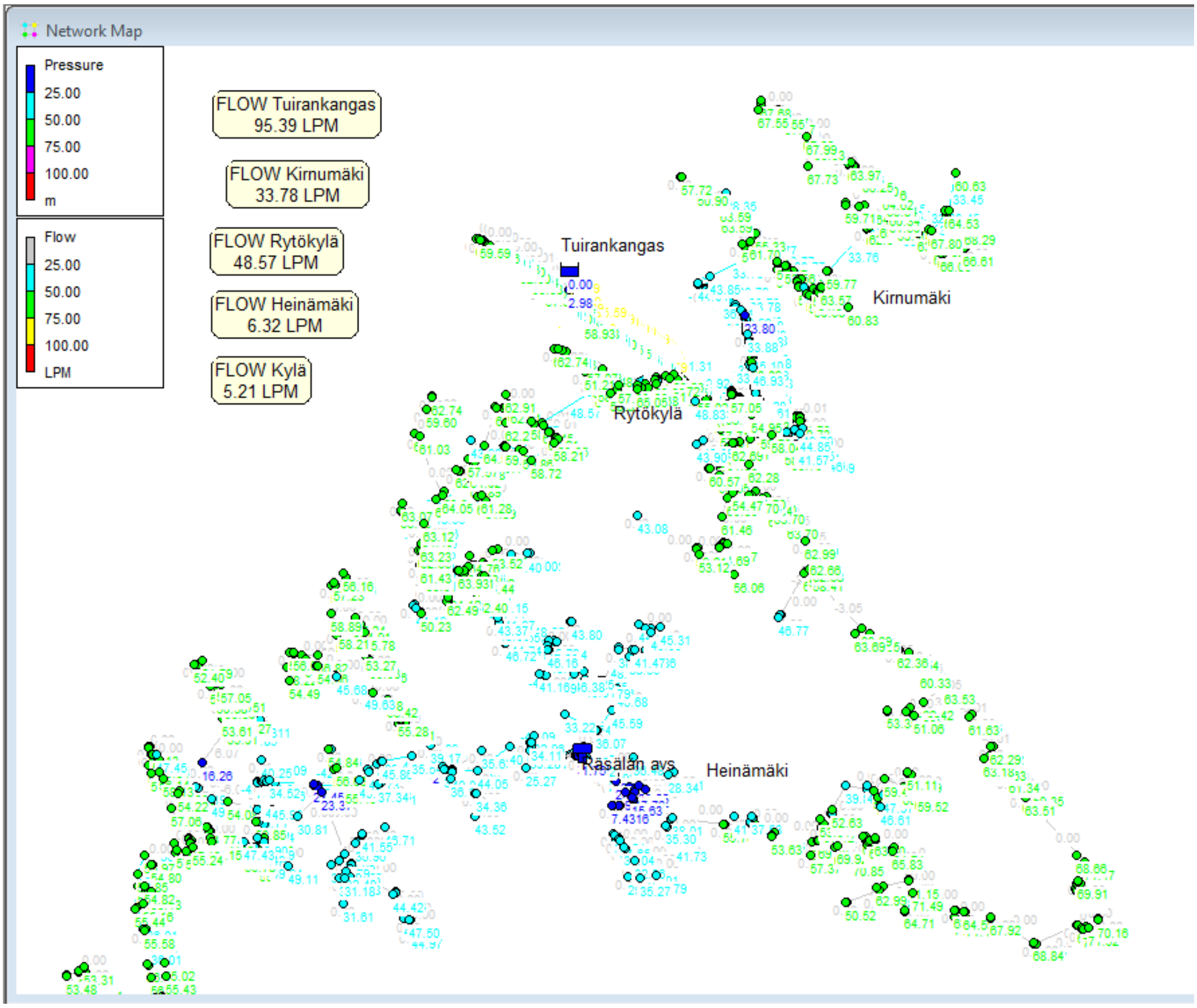
8.3.1 Context description

[Please enter a free form description of the context of the use case. Pictures or context diagrams are also welcomed to assist the understanding of the use case context]

The set-up for water quality monitoring follow the similar procedure as Use Case 01, leak detection. Firstly the DMA (district management area) is defined and measurement points are selected. This provides the possibility to monitor phenomenon for selected quality parameters occurring during the supply, not only by the water well. The relevant parameters are selected according to target area characteristics and needs, eg.

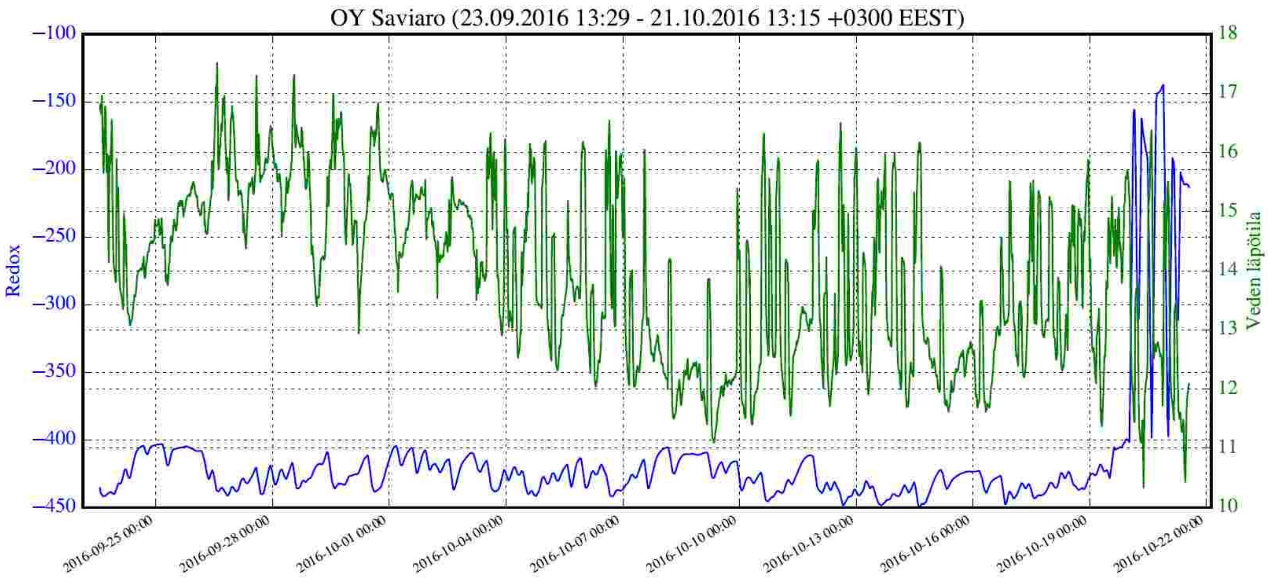
on characteristics on geology affecting to ground water or pressure changes causing loosening of corrosive layers (soft deposits) in pipelines. The basics on DMA area and hydraulic model is presented in illustration. Quality parameter sensors attached to new data transform platform are able to monitor water quality in real-time and new services such as early-warning protocols can be implemented in these systems.

The examples on continuous redox and ORP measurement data is presented in illustration. As comparison, a normal quality control protocol with manual sampling only represents one spot in timeline and doesn't provide a solid image on wawing/drifting behaviour by time. As well, example of continuous heavy metal monitoring is presented in figure below.

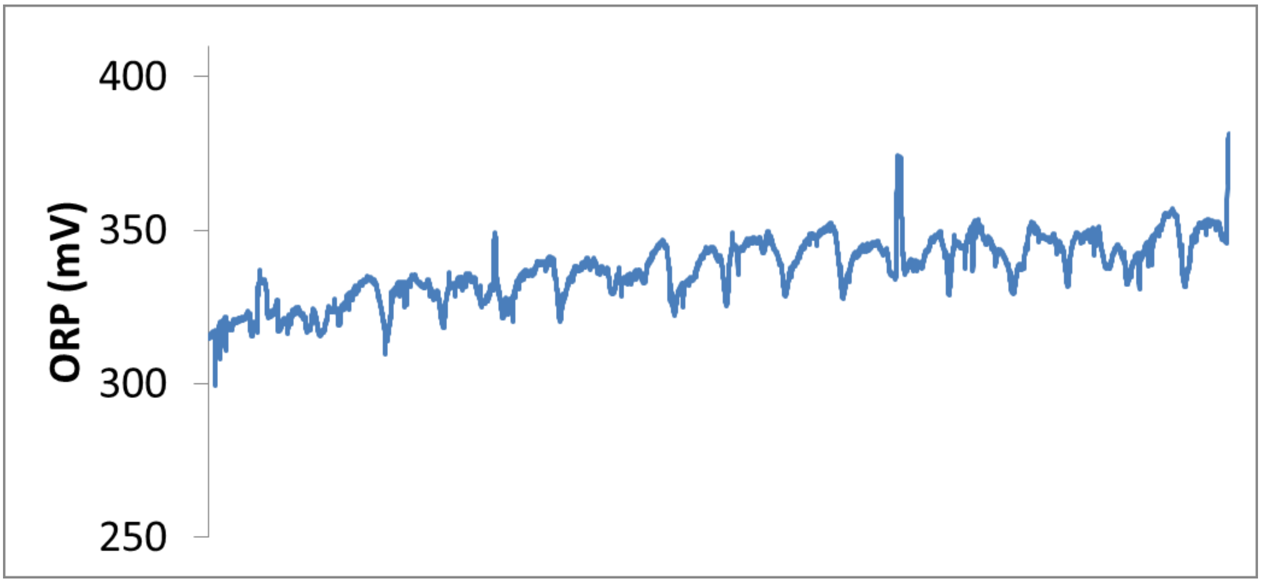


DMA-area with hydraulic modelling

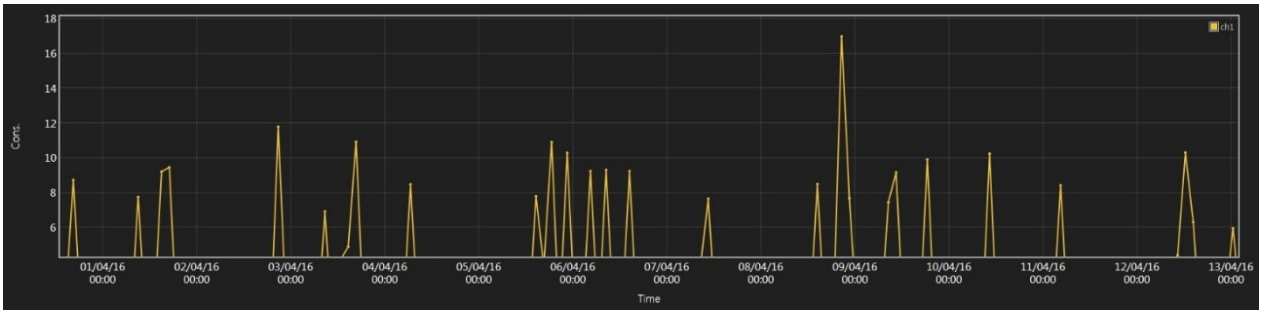
Installation set-up



Example on continuous redox monitoring data



Example on continuous redox monitoring data



Example on continuous copper monitoring data

8.3.2 Actors

[Please identify the actors interacting with the system during the use case execution (e.g. human actors with different roles, other services and systems). For each actor, describe his/hers/its responsibilities in the use case execution]

Actor name	**Actor responsibilities**
Water utility (WU)	WU needs to ensure water safety. Early-warning/real-time signals about water quality changes are needed.
Laboratory Person (LP)	LP is performing the manual sampling. Right-timing (cost-efficient) of sampling.
Third Party Application	Health authorities are involved if problems occur in water safety. Third party sensor and service platform can be integrated in measurement concept. Real-time picture of water quality in the distribution network.

8.3.3 Security

[Please identify the security issues and explain what should be protected]

There are different options in understanding the security issues for water quality: on the other hand a good quality is an asset and utilities will – and are required - to provide public information related to quality. On the other hand errors or problems in long-term reliability for monitoring would lead to misunderstandings and result an incorrect picture of current state of water quality. The automatic update is thus usually not allowed, but the validated data will only be published.

The characteristics on security for different viewpoints are defined as follows:
Measurement Data: is protected in commercial data service and readable with properly authorized person
Measurement location: Locked and un-authorized person cannot entry
Validation: The results are validated by comparison with laboratory analytics.

8.3.4 Resources

[Please envision the infrastructure, physical resources and software artefacts needed for the use case execution]

Physical connections: Sensor, Data transfer system, water side stream/in-line instalments
Software: Wireless communication, Data analysis programs
Database: Data collected in security service and can be monitored by authorized users via Web based interface
IT network for information exchanges:

- Server and database for data recording.
- Server protection issues firewall, virus protection.

8.3.5 Frequency of use

[Please estimate the time frame and how often this use case will be executed (e.g. values such as 100 times per hour)]

Sensor data is collected every 30 minutes (shorter intervals can be applied) and transferred to database and web interface.

8.4 Functional description

[Please describe the functional characteristics of the use case according to following table]

Preconditions and assumptions	[Describe any preconditions and assumptions that must be true and valid when executing the use case] 1. Water intake line has selected quality parameter units monitoring water quality in 30 minutes intervals 2. Defined upper and lower limits 3. Protocols to data transfer and data storage 4. Warning protocol if changes are monitored
Trigger	[Identify the event that initiates the use case] Creating Alarms if pre-set limit values are exceeded

Normal situation	Monitored values are within set limits
Alternative situation	Protocol with user if changes are monitored
Post-conditions	[Describe the state of the system after the use case has been used successfully] System will monitor water quality continuously and data transfer is successful

8.5 Non-functional description

[Please describe the following quality viewpoint for the use case, if applicable. Consider all the elements of the use case, i.e. actors, the use case function, actor-use case relations and the use case environment]

Reliability	[Describe the characteristic required for failure free operation of the use case (e.g. failure prevention, detection and recovery considering data reliability, communication reliability, use case function reliability and environment reliability)] Alarm is triggered if limits are exceeded or data transfer is not functional. Regular calibration of sensors and validation of measured data
Availability	[Describe how to ensure that the use case function is ready for use when required] LP person takes manual auditing samples and proper actions are taken
Performance	[Describe characteristics that enable the use case to process a request in a reasonable time] Protocol for response is determined
Security	[Describe the how the unauthenticated use of the use case is prevented] Standard security systems can be implemented for the customer usage.
Interoperability	[Describe how the information sharing and co-operation with the rest of the system is enabled] System can share information for authorized person with use names and passwords
Adaptability	[Describe how the usecase can be adapted to changes] This use case can be adapted for any water utility and selected quality parameters can be changed according to needs. Data transfer protocol is depended on location
Variability	[Describe how the functionality of the use case can be varied to different situations] Calibration of sensors with certified standards.
Scalability	[Describe how the size or volume of the use case can be scaled in order to meet user needs] More sensors can be integrated to system. Different data transfer protocols can be implemented
Personalization	[Describe how the use case enables personalization according to single user's

	preferences] User can personalize the web interface and data can be integrated to different user systems. The selected parameters can be personalized.

8.6 Business properties

[Please describe the following attributes from the viewpoint of the functionality presented in the use case]

Customer segment	[Describe who are the customers targeted in the use case] Customers are water treatment plants, which are located in cities, urban area and industrial zones. Industry using water in their production.
Value proposition	[Describe what kind of additional value is built for the customers in the use case and which customer's needs the use case fulfils] Real-time and cost-efficient water monitoring unit which allows access to continuous monitoring data to prevent and rect quickly to quality problems.
Channels	[Describe which channels are used for distribution, sales and communication in the use case] Sales can be arranged globally via areal distributors. Service can be done by customer in most cases. Publications in both scientific and commercial journals.
Customer relationship	[Describe what kind of customer relationships can be identified from the use case and how they are established and maintained] Distributors should be selected so that they have sufficient contacts to industry and potential customers.
Revenue streams	[Describe what kind of revenue streams can possibly resulting from the use case] 10 000 -20 000 potential customers globally. Price estimation 3000 euros. Monthly based fees for data transfer and web interface.
Key Resources	[Describe the key resources and assets in the use case] - Sensor providers - Data services
Key Activities	[Describe the key activities of the use case] - Monitoring - Early warning - Data management and data service
Key Partnerships	[Describewhat kind of partnerships could be formed in the use case] Collaboration with data service providers, data transfer companies and sensor manufacturers
Cost Structure	[Describe from what are the costs consisting of in the use case] Implementation costs + monthly based cost for data transfer and data service

8.7 Constraints

[Please identify constraints that may restrict the operations of an actor, execution of the use case or the interactions between actors and the use case, or are associated with the use case environment]

Pricing	[Describe constraints for the location of the use case to execute] Customers cannot calculate benefits of the system against the existing cost
Legislation and standards	[Identify the dominant laws that restrict the use case. Identify also common standards that should be followed / taken into account. Describe their influence to the use case] Council Directive 98/83/EC on the quality of water intended for human consumption defines the minimum requirements of the quality of drinking water within the EU. The purpose of the directive is to protect consumers of drinking water within the European Union and to make sure that water is aesthetically clean and without unpleasant taste, odor or color. The basic idea of the monitoring is to confirm the adequate quality of drinking water throughout the year and in different parts of the network. As a SoA, the legislation does usually not require online solutions due to relatively limited expertise on factors affecting the measurement results for long-term use. In addition to legislation, the guidelines set in BAT/BREF documents should be taken into account. As a BAT conclusion eg. the online monitoring for PH and temperature are guided to be operated on continuous basis. Due the lack of expertise and experiences, the authorities setting water quality control protocols have in general not enough confidence for real-time measurements and early-warning concepts.
Organisation	[Describe organisational rules, policies and customs that should be considered in the case of the use case] Water utilities often rely on water quality control protocol set by authorities, which very often as SoA is based on manual sampling and laboratory analysis due to relatively limited expertise and experiences of continuous monitoring. Thus water utilities don't have very often possibility to invest without connection to supervising authorities. In order to get the online solutions used as common practise, there is a need for real-life pilots and discussions for advantages and reliability issues with stakeholder group. European Commission has accepted the revision of the Annexes II and III of the Directive 98/83/EC. In the revised text, the Annex II grants a certain degree of flexibility in performing audit and check monitoring. Also, the conditions of monitoring and monitoring techniques have been assessed in the light of scientific progress.

8.8 Threats and exceptions

8.8.1 Misuse cases

[Please describe any threats that can be identified for the success of this use case. For example, identify malign/hostile actors (e.g. system abusers, hackers or viruses) and misuse cases, and describe how the use case is to respond to those threats]

Data security	The quality factors for water are usually considered as confidential, but not secret. It is a common practise to publish the results for public use in order to increase visibility and to make citizen involvement possible. In case of misuse, monitoring results can create false alarms but are not straightly connected to operational control, which diminishes the consequences of misuse. Open data for example to the authorities responsible for safety of drinking water may result high added value to the local community.
Reliability	The online solutions for quality monitoring area on a very limited use today, and validation methods for long-term reliability and expertise for monitoring setups and affecting factors do not usually exist. Also factors like sensor surface might affect drift in results and need to be taken in consideration.
Protocols	Responsing to alerts is done following the protocol in UC 006, control and optimization of distribution network.

8.8.2 Exceptions

[Please identify any anticipated exceptions and error conditions that could occur during execution of the use case, and describe how the use case is to respond to those conditions. Also describe or estimate the state of the system after the use case has not met its main goal]

The online solutions for quality monitoring area on a very limited use today, and validation methods for long-term reliability and expertise for monitoring setups and affecting factors do not usually exist. Also factors like biofilm formation on sensor surface might affect drift in results and need to be taken in consideration. The validation on long-term reliability doesn't have a common protocol, but is normally validated with parallel on-line solutions and/or manual sampling and laboratory analysis.

If the use case does not meet its goal in providing reliable solutions to monitor quality parameters, the quality control is carried out as nowadays SoA shows; based on manual sampling and laboratory analysis carried out with the sequence proposed in EU drinking water directive 98/83/EC and its Annexes.

8.9 Other relevant information

[Please provide here any other relevant information, if any, that is not included in the other sections of this template]

Two pilot installments based on the use case are on-going at 5/2016-12/2016 and new implementations will be made to platform during fall 2016.

9 Use Case 8: Urban Farming

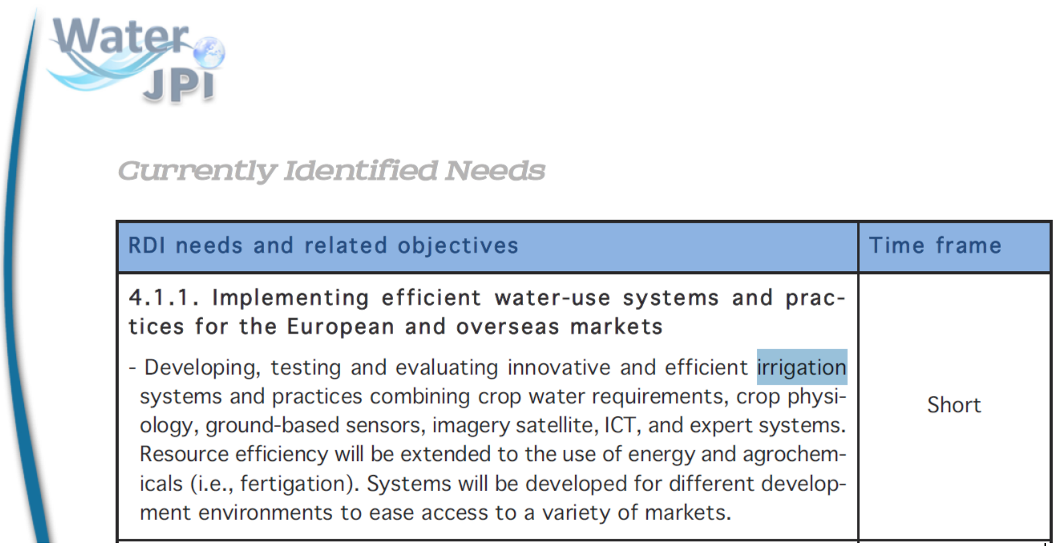
9.1 General description

Urban farming/gardening is often the small-scale, agricultural use of urban areas within settlement areas or in their direct surroundings.

Sustainable management of horticultural systems, environment-friendly production and conscious consumption of agricultural products are at the forefront.

9.1.1 Presentation

Use case number	UC 08
Use case name	Urban farming
Author/partner	Evolution Energie, Cityzen Data, group of third party SMEs
Summary	The proposed use case is an optimised Irrigation & Nutrition based project for urban farming.



RDI needs and related objectives	Time frame
4.1.1. Implementing efficient water-use systems and practices for the European and overseas markets - Developing, testing and evaluating innovative and efficient irrigation systems and practices combining crop water requirements, crop physiology, ground-based sensors, imagery satellite, ICT, and expert systems. Resource efficiency will be extended to the use of energy and agrochemicals (i.e., fertigation). Systems will be developed for different development environments to ease access to a variety of markets.	Short

Fig.1 - Implementing a Water-Wise Bio-Based Economy [Water_JPI] – EC - 21 Oct.'14

The use case aims to build, and then validate through field trials an Irrigation innovative ICT services platform to operate within an off-grid / (or on-grid) water & energy compound ecosystem.

Rationale	Feeding growing global population is a formidable challenge. To boost food production together with a freeze to the environmental footprint of agriculture all along the food value chain is one way to address this challenge. **Unlocking the potential of millions of small producers could be part of the solution to feed the planet.** Moreover, Water, Energy, Fertilizer and Phytosanitary Chemicals efficient resources' management through the optimised irrigation system shall support the transition to a green economy and a sustainable agriculture. This results directly in preserving the biodiversity in a Homeostasis approach, guarantee for preserved quality of life to all the species.

9.1.2 Use Case description

[Please enter a free form description of the use case. Pictures are also welcomed to assist the understanding of the use case]

The main target of this use case project is to work out a Water command control system for water based on:

- open source building blocks on Premise servers (inside cities),
- Public cloud offering with extremely reasonable OpEX

The expected innovation outcomes of the use case:

1. **to succeed to make the Irrigation Services optimize resources of the water, the energy (also the phytosanitary treatments); and**
2. **to deliver an optimised scalable open-source solution to urban farmers' communities matching a low-cost economic model, with know-how transfer and training tools**.

The use case is scoped to use the most innovative technology enablers consolidating LPWN, IoT, Cloud Computing, Expert Systems selected building blocks and the system integration know-how of the project partners.

9.2 Contextual settings

9.2.1 Context description

[Please enter a free form description of the context of the use case. Pictures or context diagrams are also welcomed to assist the understanding of the use case context]

Irrigation has increased productivity significantly, but in some cases has also increased water scarcity downstream. Irrigation is sometimes poorly monitored and managed, and groundwater may be pumped faster than it is recharged, calling into question its sustainability – Fig.2 - [WWF_LPR_2014].

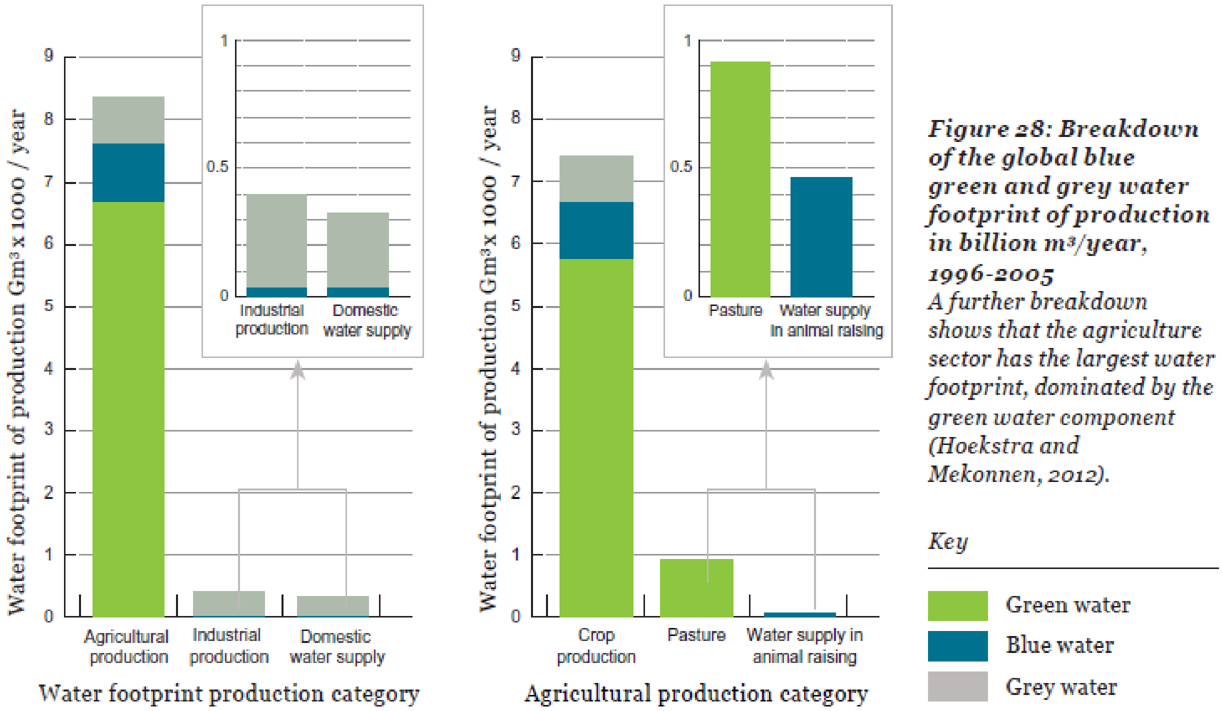


Fig.2 – Water Footprint - Source: WWF Living Planet Report 2014 – page 48

Over three-quarters of the territory of Europe is agricultural or wooded land. While there is a great diversity in environmental values and land uses from Mediterranean to Sub-Artic regions, a significant level of interdependence between agriculture and conservation of the environment is evident throughout the EU [EC_Agri_CAP].

The European Commission reports that on average, 44 % of total water abstraction in Europe is used for agriculture. Southern European countries use the largest percentages of abstracted water for agriculture. This generally accounts for more than two-thirds of total abstraction. In northern member states, levels of water use in agriculture are much lower, with irrigation being less important but still accounting for more than 30 % in some areas.

Irrigation helps improve crop productivity and reduce risks due to dry periods, making it possible to grow more profitable crops. However, irrigation is also the source of a number of environmental concerns, such as the excessive depletion of water from subterranean aquifers, irrigation-driven erosion and increased soil salinity [EC_Agri_Water].

The United Nations World Water Development Report 2014 points to the deep interlinkage between water resources management and energy operational cost. With the exception of large dams, water infrastructure systems are usually at the agricultural community or city scale. Where energy infrastructure spans the entire nation or the whole continent [UN_WWDR_2014].

The coordinated approaches to water and energy called throughout the UN World Water Development Report 2014 requires the generation and harmonization of data concerning the supply and use of water versus energy production. This would facilitate decision making to allocate the most appropriate irrigation amount with an optimization exercise for water & phytosanitary resources usage in relation to energy resources availability.

Certain rural development measures support investments for improving the state of irrigation infrastructures or irrigation techniques that require the abstraction of lower volumes of water, as well as actions to improve water quality.

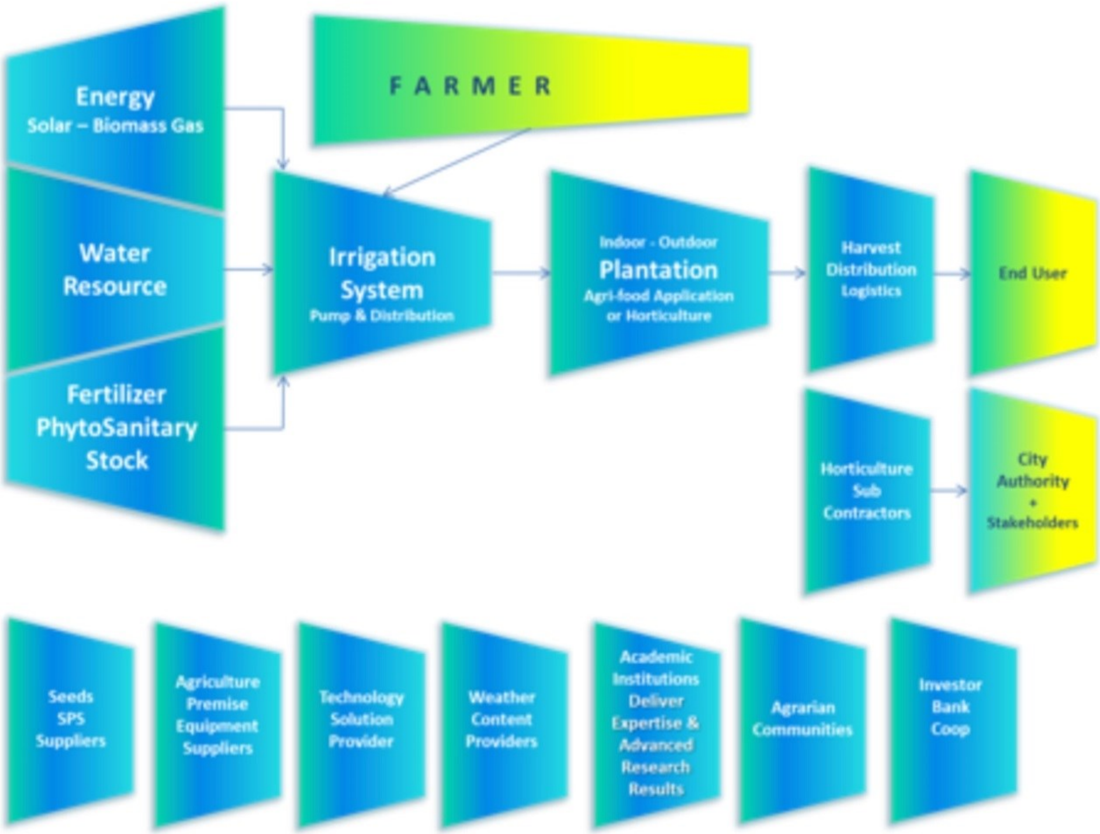


Fig.3 - Irrigation Value-Chain before Implementation

9.2.2 Actors

[Please identify the actors interacting with the system during the use case execution (e.g. human actorswith differentroles, otherservices and systems). For each actor, describe his/hers/its responsibilities in the use case execution]

With a target to obtain the best yield for diverse plant type cultivation indoor and outdoor, we have decided to address with the Water-M proposed Trial project the irrigation constrained conditions induced by water, energy and phytosanitary scarce resources within Urban situation – Fig.4.

Leaf, soil moisture and temperature data associated with weather forecasts allow farmers to control timely the irrigation system.

The use case aims to build an innovative irrigation services platform; field proof performances with a low-cost installation and operation model, and then disseminate it toward agrarian communities.

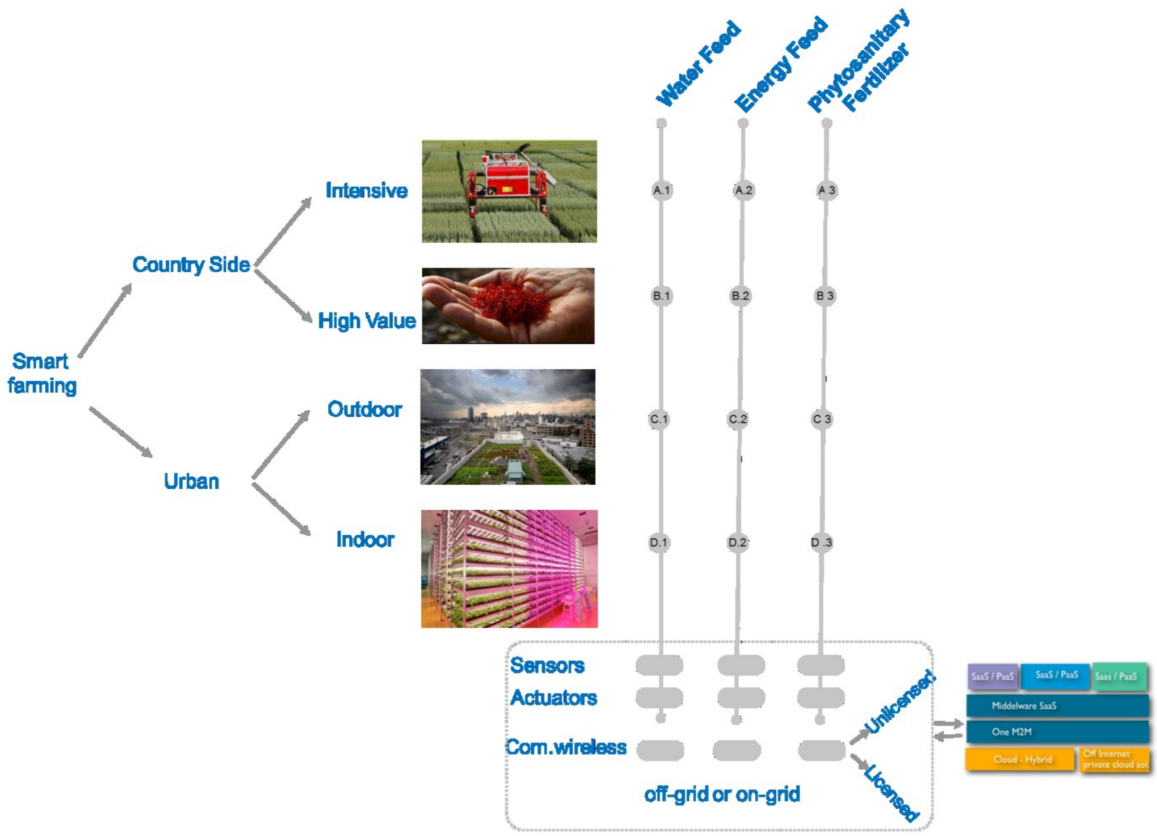


Fig.4 - Use-case Ecosystem & Irrigation System Structure

The use case project will bridge between advanced research in M2M, IoT, Cloud Computing, Expert Systems and the commercialization gap of these technologies in order to be integrated in a stable platform to deliver to agrarian communities.

9.2.3 Security

[Please identify the security issues and explain what should be protected]

Security issues will be treated in the Work package 2 "System Architecture".

9.2.4 Resources

[Please envision the infrastructure, physical resources and software artefacts needed for the use case execution]

The use case aims to transfer ICT up-to-date IT enterprises to the agrarian communities to optimize use of scarce natural resources : Water, Energy, Fertilizer and Phytosanitary in Irrigation applications in an urban situation.

We aim to build an end-to-end standardized ICT platform for optimized Irrigation at a low-cost Capex and Opex with target to enable a new market and to benefit to agrarian communities including remote territories and to urban farming within smart cities.

Based on Water-M development progress, the consortium will interact with Standardization organizations, see f. ex.recently drafted IoT/M2M standards toward better interoperability matching agriculture & water management requirements.

The use case will contribute to develop an harmonized Irrigation system for common horticultural applications at international level to economically benefit with increased yield, higher plants growth rate, improved environmental footprint, lower infrastructure TCO and better plants' quality.

The urban farming Water-M use case shall contribute to transform the Irrigation value-chain to a better performing agrarian ecosystem - Fig. 5.

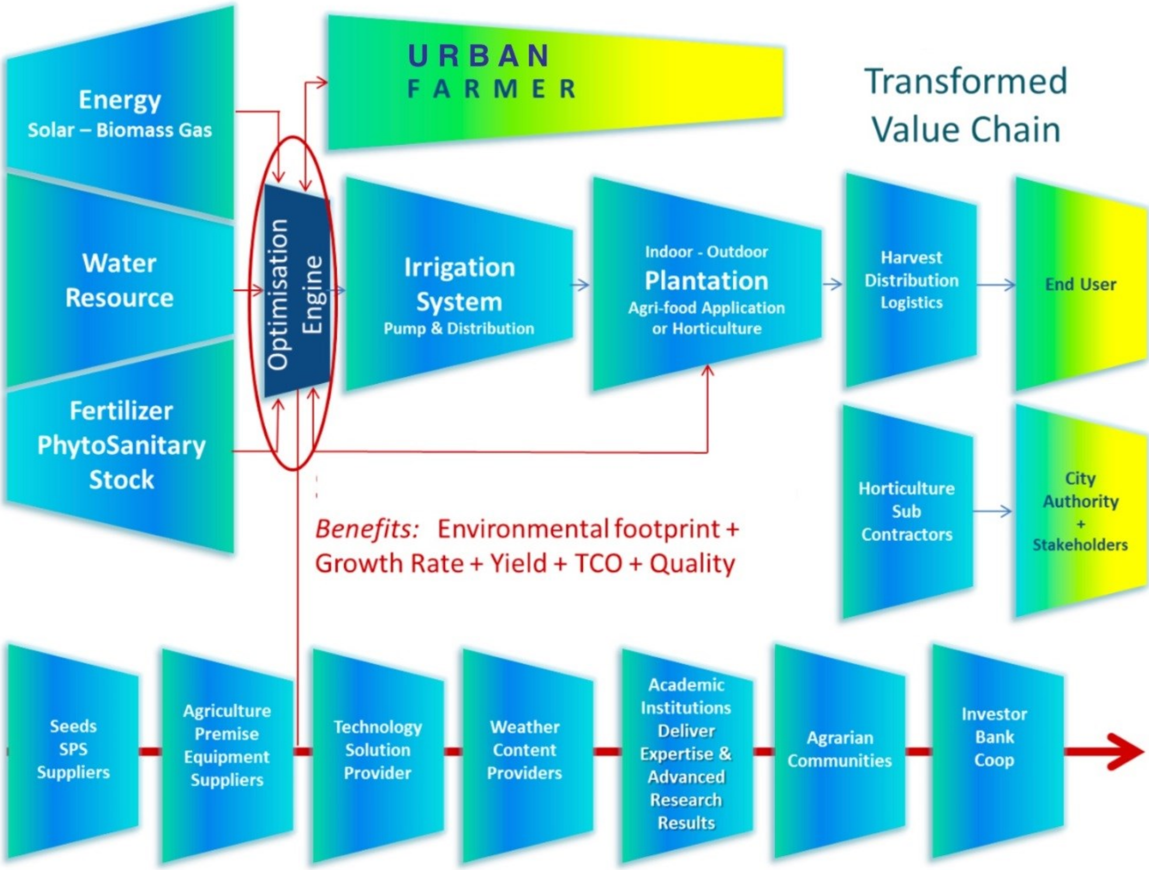


Fig.5 - Transformed Irrigation Value-Chain with Implementation

9.2.5 Frequency of use

[Please estimate the time frame and how often this use case will be executed (e.g. values such as 100 times per hour)]

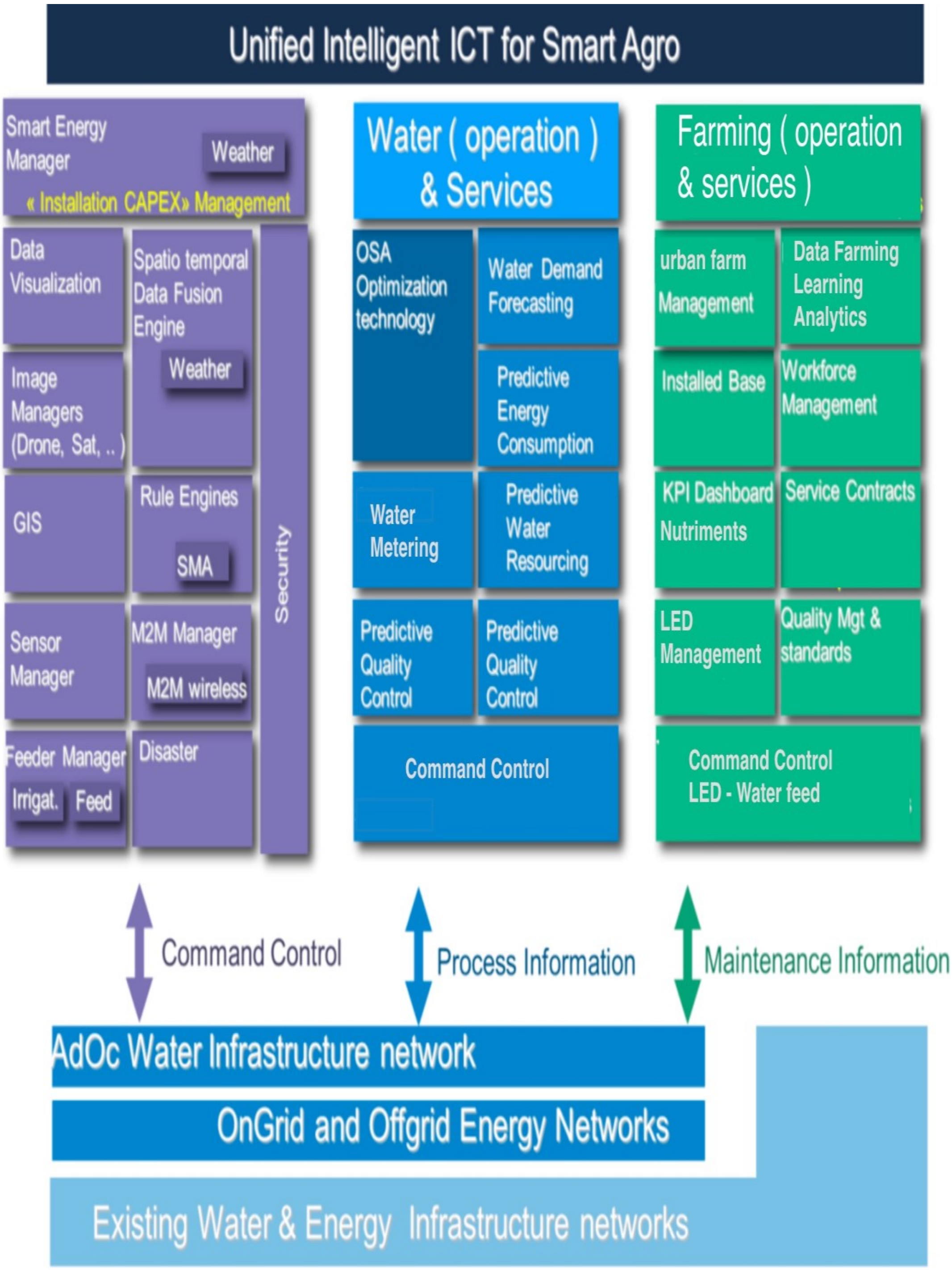
The smart farming solution should be adopted in irrigation applications in an urban situation.

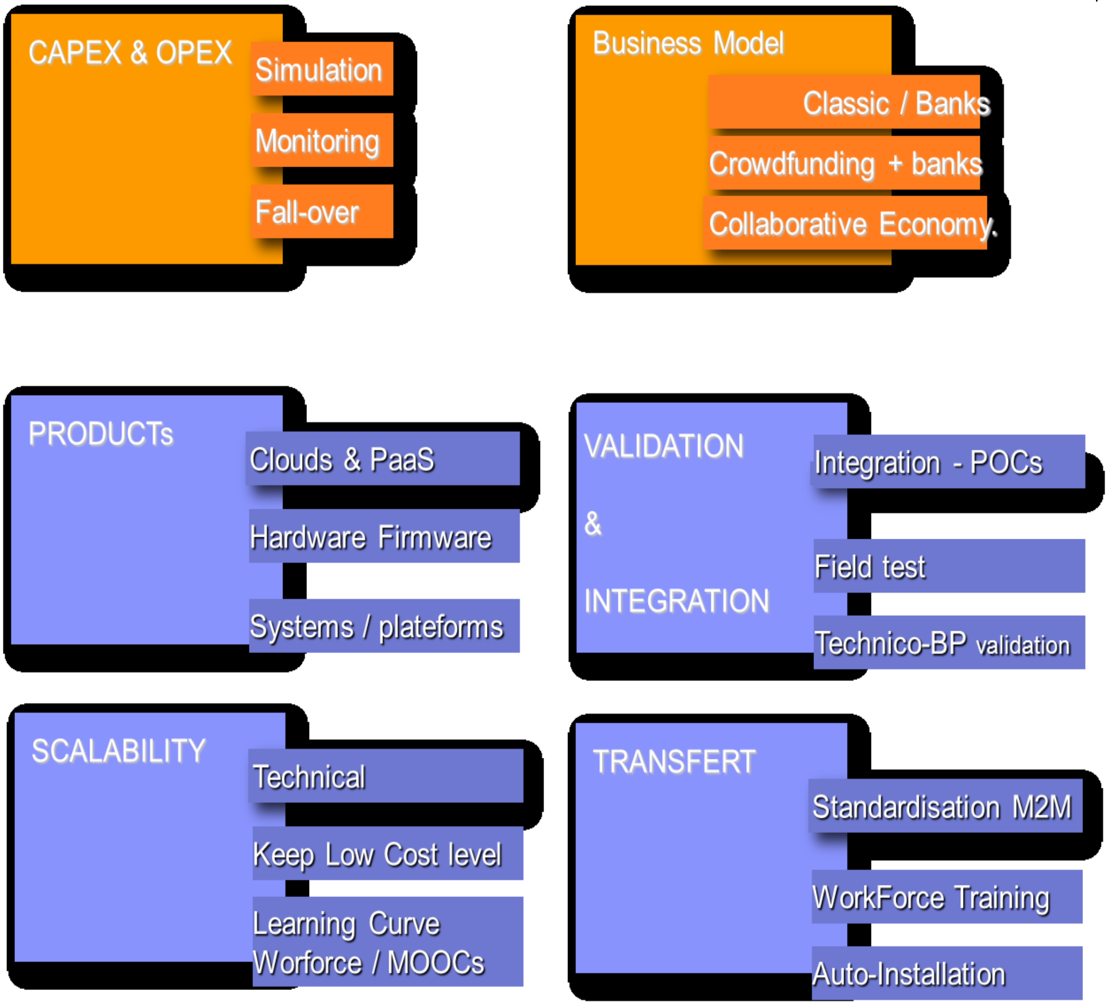
9.3 Functional description

[Please describe the functional characteristics of the use case according to following table]

Preconditions and assumptions	[Describe any preconditions and assumptions that must be true and valid when executing the use case] Technologies building blocks are in profusion to integrate an Irrigation optimized software and hardware platform, some are proprietary stacks and interfaces; others follow open standards offered on open source licenses terms. The use case project requires an IoT/M2M standardized solution for its sensing and actuation part. The proposed Wi-SUN and LoRA IoT radio solution make sense: • LPWAN technologies such as LoRa developed by Cie (EOLANE, the think networks, …) or other providers are reaching maturity and acceptable cost level with high semiconductor chipset integration. The under 300 $ LoRA Gateway CapEX enable large diffusion of the proposed solution. Even IP68 other gateway are nowadays under 1300 $ enable diffusion. • We might also use Wi-SUN if ITRON brings use solution
Trigger	[Identify the event that initiates the use case] The skills to architecture the platform, select the core technologies; key building blocks and develop the glue middleware are the most important part of a successful project. The integration phase of the complex distributed software processes in a real-time data environment is really challenging, often interoperability gaps are found at different levels delaying the project deliverables, and it requires lots of know-how to circumvent them.
Normal situation	Monitored values are within set limits.

Alternative situation	There are different architectures approaches depending on the industry vertical (here water / energy / chemicals / agriculture) and the size of the actors (major IT corporate with energy utilities vs. SME system integrators with farmers' cooperatives) to design and develop the target system. Multi-agent architectures that have been used in Water management platforms. However, data requirements imposed for the deployment of those solutions are not specifically addressed.



Post-conditions	[Describe the state of the system after the use case has been used successfully] Scalable IT Architecture:  **Fig. 13 – pre-Study of the architecture solution**

9.4 Non-functional description

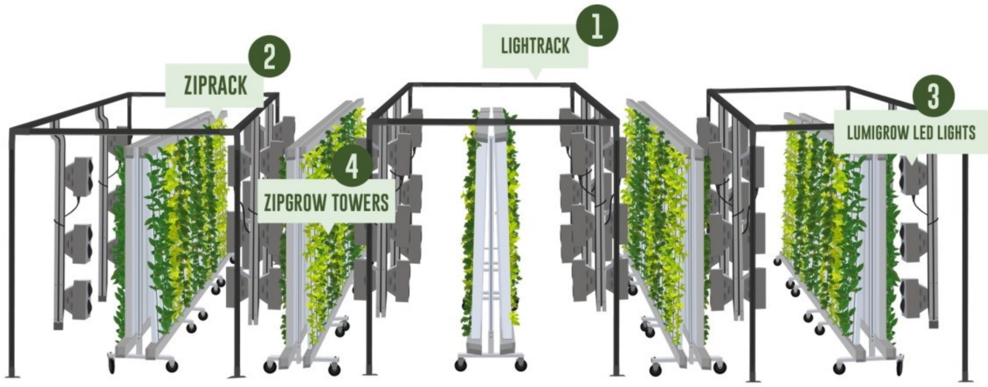
[Please describe the following quality viewpoint for the use case, if applicable. Consider all the elements of the use case, i.e. actors, the use case function, actor-use case relations and the use case environment]

Reliability	[Describe the characteristic required for failure free operation of the use case (e.g. failure prevention, detection and recovery considering data reliability, communication reliability, use case function reliability and environment reliability)] As expected, industry actors of irrigation showed their interests to be involved in the consortium. Furthermore, the consortium shows sufficient R&D competence and competitiveness, and the added value of every partner is well identified. This large number of partners from different countries and the interest demonstrated by them to join the consortium shows the importance of the project and its relevance for its application at a European and worldwide scale. The project detailed objectives are not yet defined and quantified, they will be set by the consortium during the FPP preparation phase based on partners' consolidated knowledge in the main fields that the project covers to define the reachable goals, the critical paths and the KPIs.
Availability	[Describe how to ensure that the use case function is ready for use when required] The Urban agrarian irrigation applications offer extreme physical environmental conditions to the devices (sensors, actuators, edge computing and radio communications module), this should be taken into account when selecting the technology modules interfacing with the water, the soil, the plant, the chemicals and the energy source. We have high expertise within our partners to make the best selection and adaption of these technologies to input to development.
Performance	[Describe characteristics that enable the use case to process a request in a reasonable time] Protocol for response is determined.
Security	[Describe the how the unauthenticated use of the use case is prevented] Standard security systems can be implemented.
Interoperability	[Describe how the information sharing and co-operation with the rest of the system is enabled] The principal objective of the project is to work out the interoperability issues of heterogeneously standardized services platforms' building blocks, with simultaneous feedback to related standardization organizations.
Adaptability	[Describe how the usecase can be adapted to changes] The project can be adapted to different pilot sites and farming structures in urban territory.

Variability	[Describe how the functionality of the use case can be varied to different situations] One outcome will be to succeed in making the Irrigation Services Platform optimize resources of the water, the energy and the phytosanitary treatments.
Scalability	[Describe how the size or volume of the use case can be scaled in order to meet user needs] The objective is to deliver an optimized scalable open-source solution to farmers' communities.
Personalization	[Describe how the use case enables personalization according to single user's preferences] The developed solution needs to be matching a low-cost economic model, with know-how transfer and training tools for concerned farmers and parameters that can be personalized.

9.5 Business properties

[Please describe the following attributes from the viewpoint of the functionality presented in the use case]

Customer segment	[Describe who are the customers targeted in the use case] Customers are local authorities and Farmers. 1. Initial indoor farming solution (individual customers, farmers, shops, supermarkets)  2. Scale up within a project with local authorities (Paris Region and North regions) 

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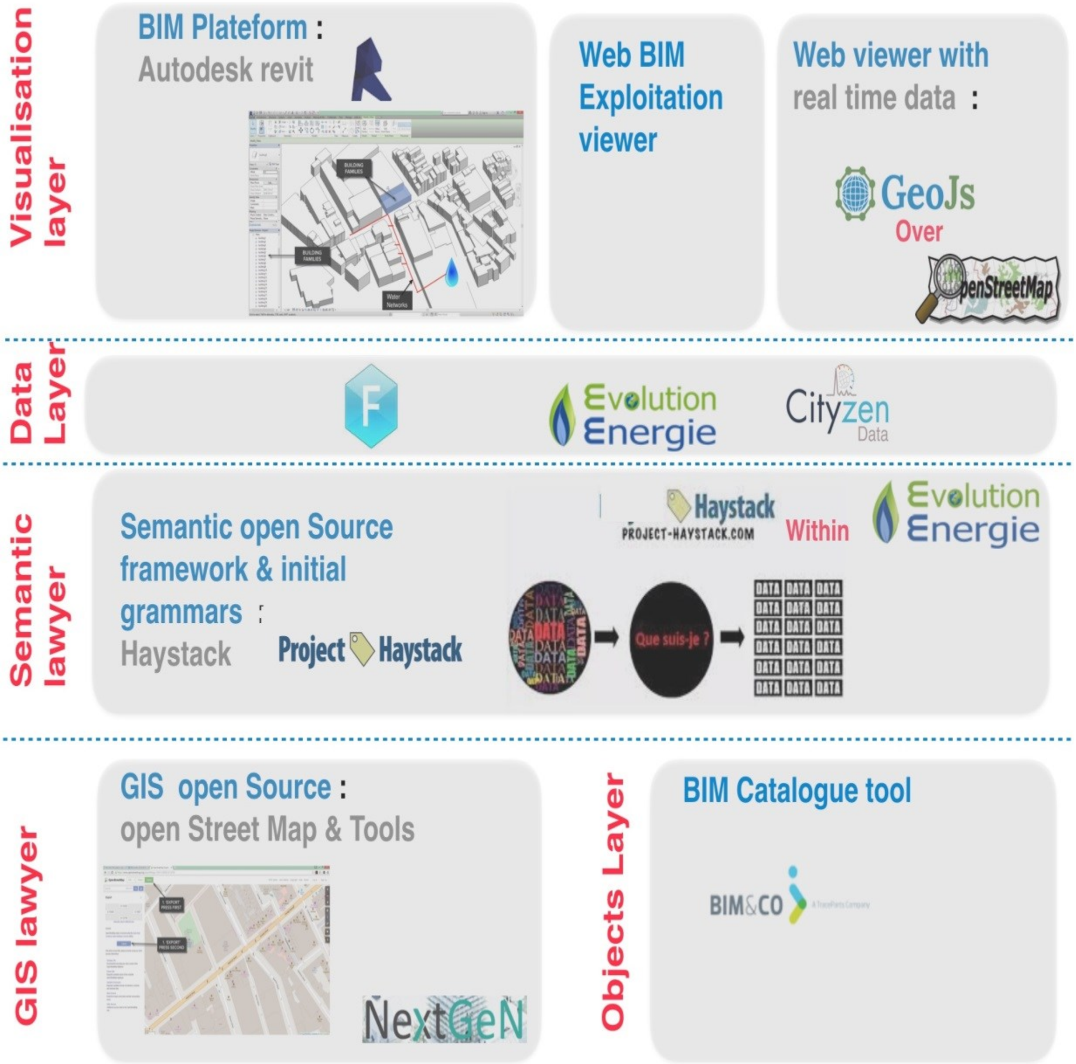
<td>Value proposition</td>
<td>[Describe what kind of additional value is built for the customers in the use case and which customer’s needs the use case fulfils]

Proposed IT architecture. Under a proposition of various layers

Urbanistic description through GIS (open street Map, …)-
Building Information model and Object in BIM formats (Urban Farming modules)
Semantic Lawyer (proposed open source frameworks : Haystack, implementation by Evolution Energie as an open source library)
Data Layer (using FLUX IO + Tools and platform from Evolution Energie and Cityzen data)
Visualization layer with static Viewer (Autodesk revit) or dynamic (BIM Exploitation 3B viewer) or dynamic view over GIS (GeoJS over GSM)



Concerning the Data Layer we propose to use FLUX IO + Tools and platform from Evolution Energy and Cityzen data)
PS/ A partner of Evolution energy, BIM&Co and NeXT GEN are using Additionnal tools mention under enables also advanced Parametric programatic design through Dynamo or Grasshopper</td>
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<td>Channels</td>
<td>[Describe which channels are used for distribution, sales and communication in the use case]

Sales can be arranged globally via the network of the partners. Different publications or show rooms will be organized to for dissemination of the solution.

The project is a stepping-stone to enable industrial members' better penetration of the agrarian irrigation and urban farming water management market. The consortium has at least five concordant scenarios to catalyze & accelerate Go-To-Market:
1) through the field trials results' evangelization (field trials foreseen in all partners countries),
2) the project industrial partners have the capabilities to reach mass-manufacturing (Eolane-France) of the key components of the platform, with all the design quality and reliability requirements to operate in the severe agrarian environment,
3) the activities at standardization fora that will implicate larger communities of stakeholders investing technical resources to advance the smart Water & Irrigation platform related standards & interoperability,
4) the end-to-end integration for direct portability of the platform to allow Urban Agrarian System Integrators fast TTM project completion,
5) the readiness of the training tools to accompany the platform will augment its widespread adoption.

We believe that the successful operation of the platform, its proven performances will give confidence and encourage agrarian cooperatives to adopt it. The well-kept CAPEX & OPEX costs with a promise for yield increase will break the reluctance of investors to invest

Several partners participating (e.g. field trial in France, Singapore – T) have direct access to agrarian cooperatives that are keen to trial the platform.</td>
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<tr>
<td>Customer relationship</td>
<td>[Describe what kind of customer relationships can be identified from the use case and how they are established and maintained]

Distribution of the smart farming solution will also be taken in coherence with connected previous and/or current collaborative research projects:

Project Name Cooperative Programme Time period (approx.) Technical Focus Relationship
IWIDGET ICT-2011.6.3 2012-11-01 2015-10-31 Improved water efficiency through ICT technologies for integrated supply-demand side management. focuses on the software infrastructure to manage all the information in the irrigation system.
URBANWATER ICT-2011.6.3 2012-12-01 2015-05-31 Intelligent Urban Water Management System. Middleware for service integration is coincident in both projects. However Use-case goes a step further and proposes an event- based architecture to support extreme processing and real-time data management and analytics.
WATERP ICT-2011.6.3 2012-10-01 2015-09-30 Water Enhanced Resource Planning "Where water supply meets demand". Main goal is build an open platform based on SOA and multi-agents to integrate water management services.

Table 1: Related collaborative research projects.</td>
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<td>Revenue streams</td>
<td>

[Describe what kind of revenue streams can possibly resulting from the use case]

Determining the right amount of water to irrigate the plants without stressing them is a science. This domain has developed in the past years as Precision Agriculture. Several global corporates such as IBM and John Deere have addressed the Precision Farming market with IT proprietary solutions designed for very large crops field, though they have had difficulty to penetrate the European market missing to get proximity with the agrarian communities.

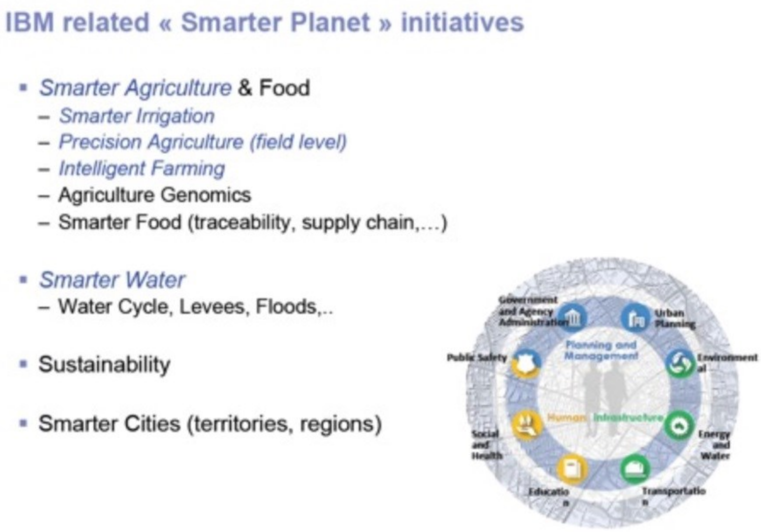

Fig. 6 - Illustration of IBM Corporation initiatives for Precision Farming

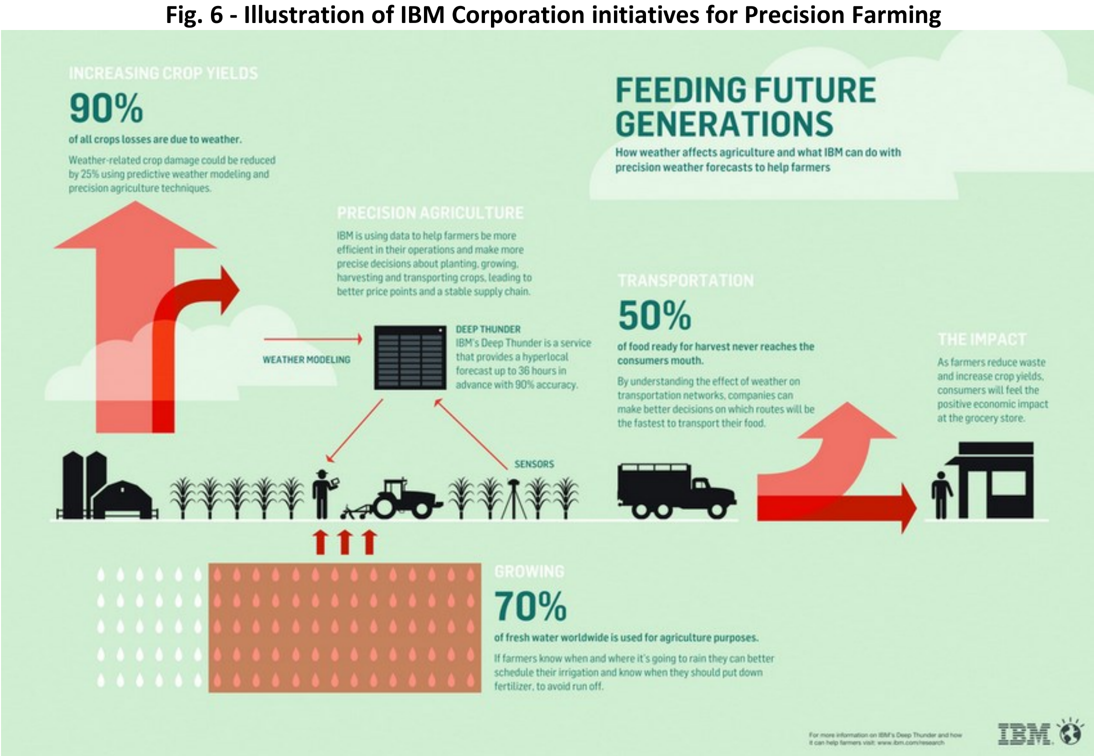

Fig. 7 - IBM Corporation Precision Farming foreseen value-chain

The Precision Agriculture market is at its initial development in Europe, around the Mediterranean sea and the Baltic region when compared with north-America [Precision farming for sustainable agriculture].

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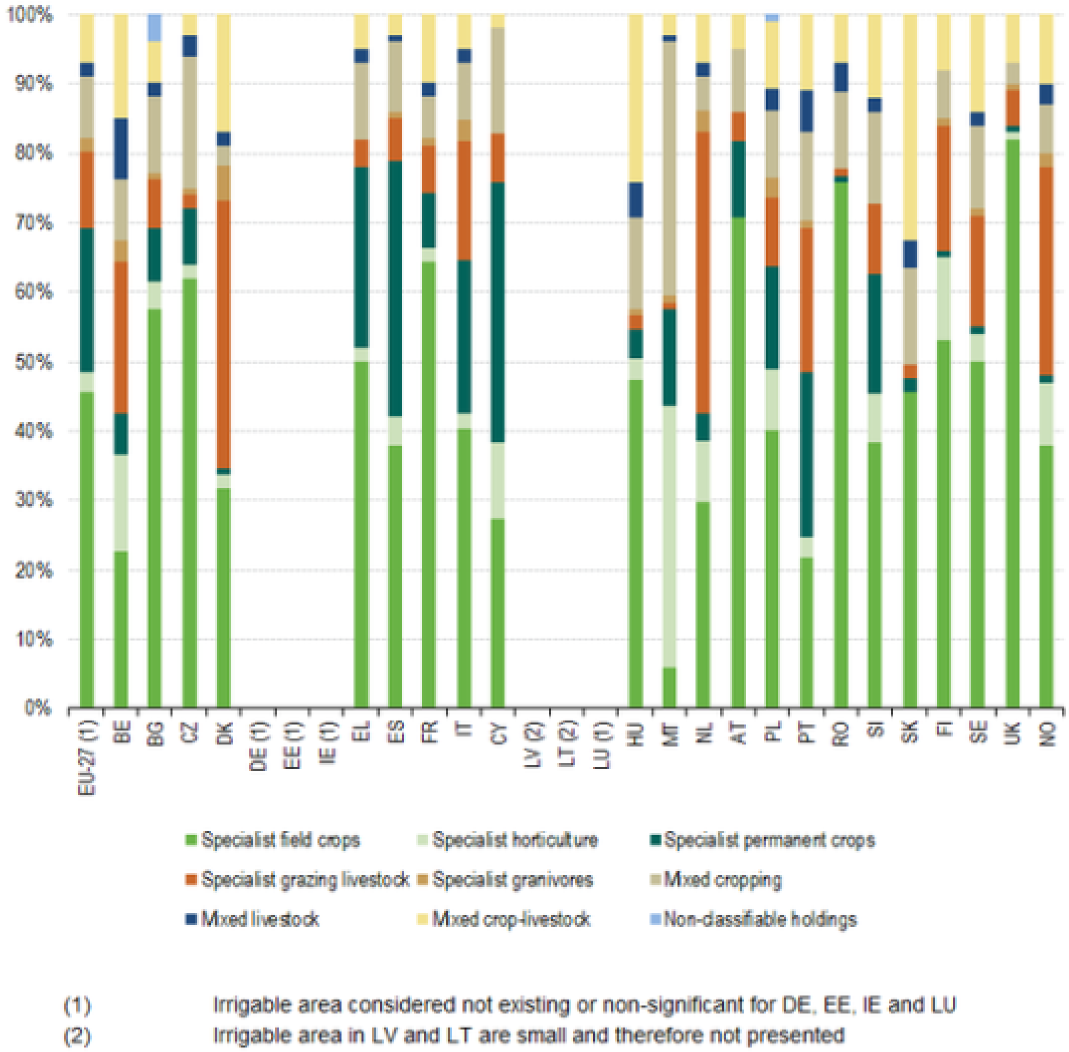


Fig. 8 - Share of irrigable areas managed by different farmtypes - 2007 – source: **Eurostat**

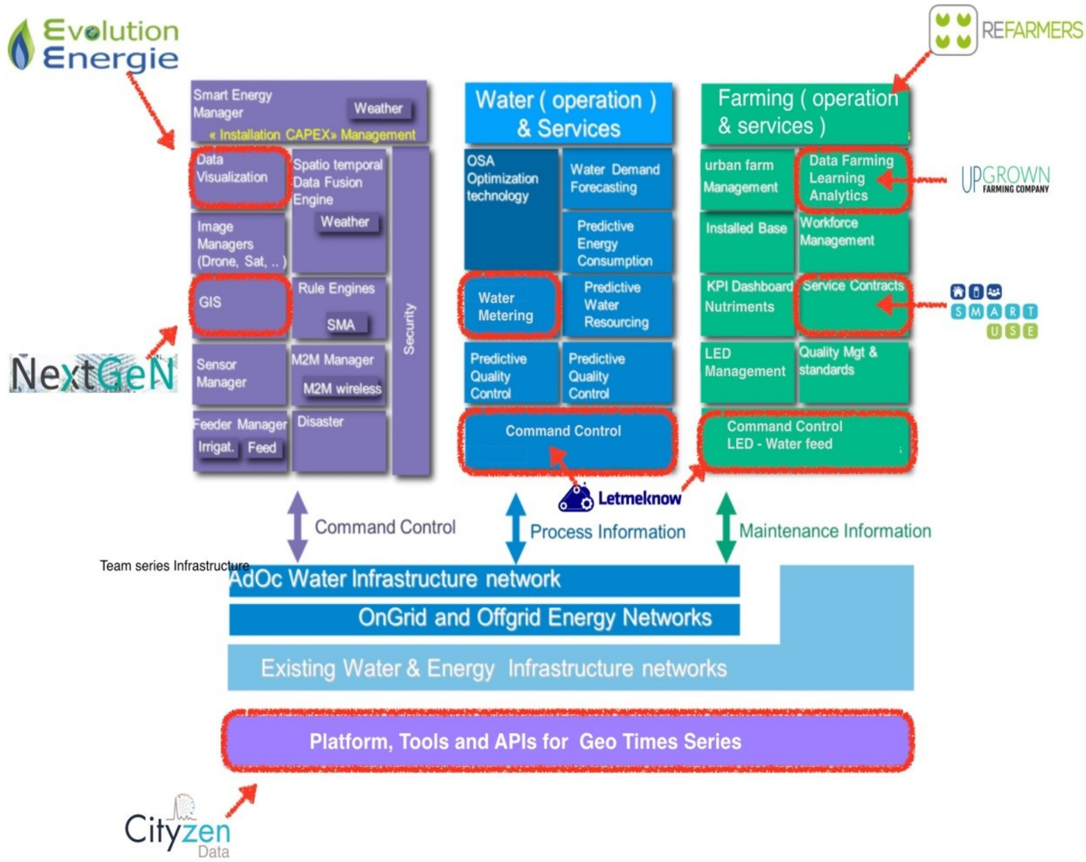
The irrigation has a considerable impact on plants yield, protein content, fertilization cost and the environment. The irrigation flow should be based on the temporal environmental conditions of the plants' ecosystem.

Use-case is taking the challenge to address this market with latest ICT technologies development held by the project partners.

Key Resources	[Describe the key resources and assets in the use case] The used case intends to gather the advances in computer science technology design such as LPWN, Edge Computing, Fog Computing, IoT Cloudlet, Expert Systems enabling the fit of these technologies in one-of-a-kind low-cost Irrigation Platform - fulfilling the project narrowed precision agriculture uses cases, - with a future-proof scalable architecture, - selecting the best of breed open source software and hardware modules, - integrated in a harmonized stack with glue software, - field tested with tangible pilot farms, - interacting with standardization fora and agrarian communities for harmonization, dissemination and market adoption.
Key Activities	[Describe the key activities of the use case] - System development - Simulation, monitoring - Know-how transfer via training tools - Low cost modelling

Key Partnerships

[Describe what kind of partnerships could be formed in the use case]



Partner Use-case WP Contributions Map

Partner	Requirements	Architecture	System Development	Integration & Validation	Management
Cityzen Data – FR		X	X	X	X
Evolution Energie - FR			X	X	X
NeXT GEN Village - FR		X	X	X	X
Smart Use- Fr	X			X	
LetMeKnow - FR		x	X	X	
BIM&Co-FR		X	X	X	
Upgrow Farming - SG		X	X	X	X
ReFarmer - FR	X			X	

Fig. 15 – Consortium Participation vs. the set Work Program

Cost Structure

[Describe from what are the costs consisting of in the use case]

Implementation costs + monthly based cost for data transfer and data service

9.6 Constraints

[Please identify constraints that may restrict the operations of an actor, execution of the use case or the interactions between actors and the use case, or are associated with the use case environment]

Pricing	[Describe constraints for the location of the use case to execute] Customers cannot calculate benefits of the system against the existing cost
Legislation and standards	[Identify the dominant laws that restrict the use case. Identify also common standards that should be followed / taken into account. Describe their influence to the use case] The project could address to the European Commission set policies for sustainable water resources management.
Organization	[Describe organizational rules, policies and customs that should be considered in the case of the use case] The project is in line with the Water Joint Programming Initiative SRIA1.0 – Fig.1 - [Water_JPI].

9.7 Threats and exceptions

9.7.1 Misuse cases

[Please describe any threats that can be identified for the success of this use case. For example, identify malign/hostile actors (e.g. system abusers, hackers or viruses) and misuse cases, and describe how the use case is to respond to those threats]

Data security	The quality factors for water are usually considered as confidential, but not secret. It is a common practise to publish the results for public use in order to increase visibility and to make citizen involvement possible. In case of misuse, monitoring results can create false alarms but are not straightly connected to operational control, which diminishes the consequences of misuse. Open data for example to the authorities responsible for safety of drinking water may result high added value to the local community.

Reliability	The partners will endeavour to challenge the technical and interoperability gaps to stabilize the platform and get achieve the set performances during field trial. Fig.14 - describes a map of some of the foreseen technology gaps to challenge during the project roll-out. <u>Main Technology Challenges Tackling:</u> Waterproof Radio Modules LPWAN Sensors Actuators Power Consumption & Calibration Stable Platform Integration IoT Semantic Interoperability IoT for Water Standardisation Low Cost Model Fig. 14 – unlocking technology challenges for Use-case
Protocols	Responding to alerts is done following the protocol in UC 006, control and optimization of distribution network.

9.7.2 Exceptions

[Please identify any anticipated exceptions and error conditions thatcould occurduring execution of the use case, and describe how the use case is to respond to those conditions. Also, describe or estimate the state of the system after the use case has not met its main goal]

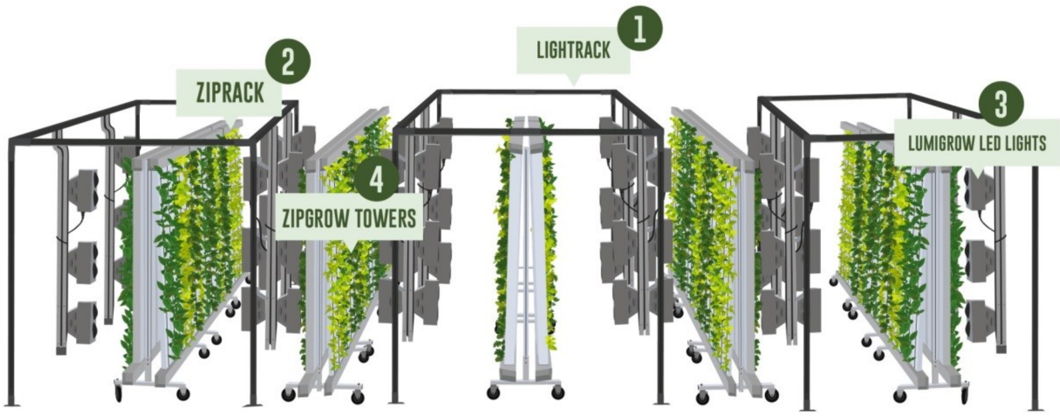
The online solutions for quality monitoring area on a very limited use today, and validation methods for long-term reliability and expertise for monitoring setups and affecting factors do not usually exist. Also factors like biofilm formation on sensor surface might affect drift in results and need to be taken in consideration. The validation on long-term reliability doesn't have a common protocol, but is normally validated with parallel on-line solutions and/or manual sampling and laboratory analysis.

If the use case does not meet its goal in providing reliable solutions to monitor quality parameters, the quality control is carried out as nowadays SoA shows; based on manual sampling and laboratory analysis carried out with the sequence proposed in EU drinking water directive 98/83/EC and its Annexes.

9.7.3 Other relevant information

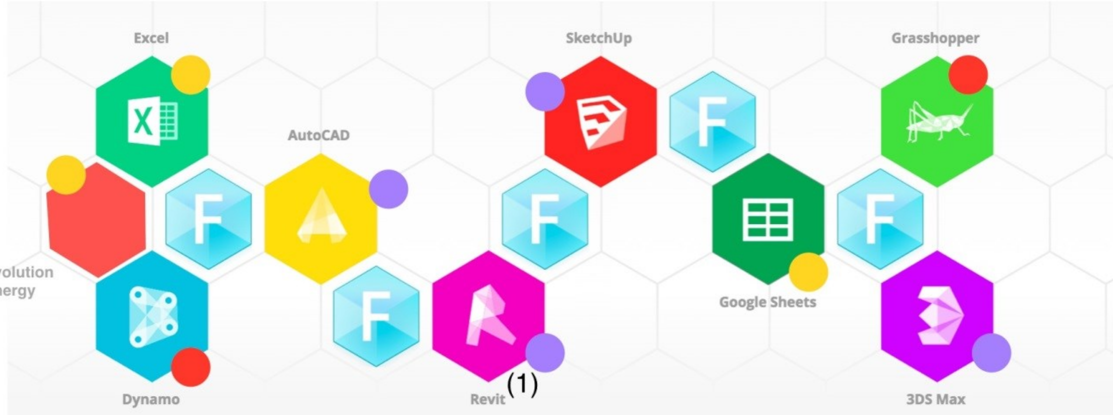
[Please provide here any other relevant information, if any that is not included in the other sections of this template]

A. LED System on Urban Farming (6000 plants over 50 m2)

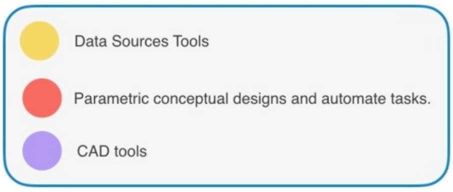


B. Inclusion of BIM Exploitation

Proposed architecture for moving toward BIM * Exploitation principe



Plugins send and receive data seamlessly between existing design tools

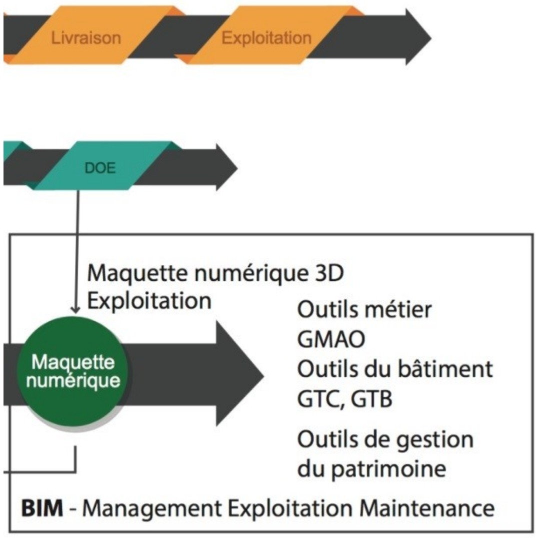


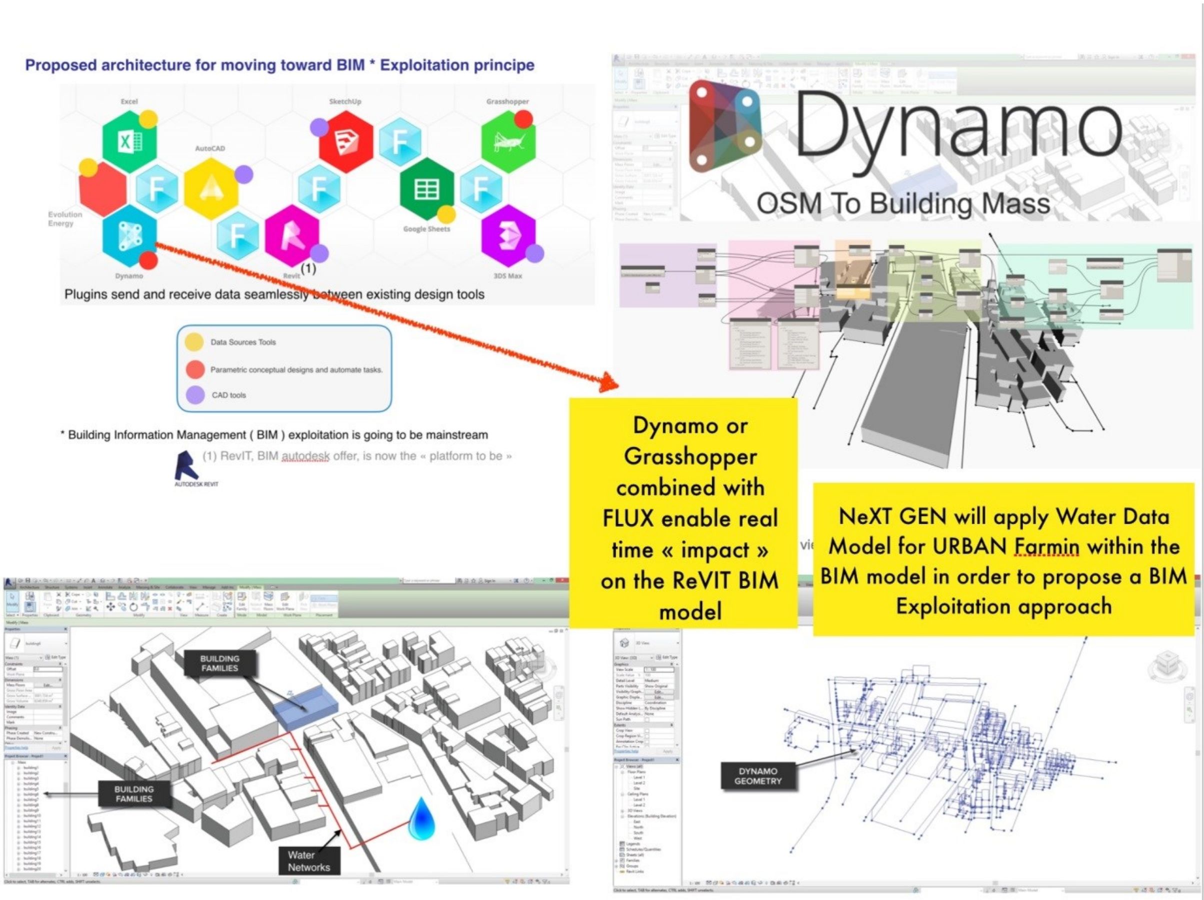
* Building Information Management (BIM) exploitation is going to be mainstream

(1) RevIT, BIM autodesk offer, is now the « platform to be »

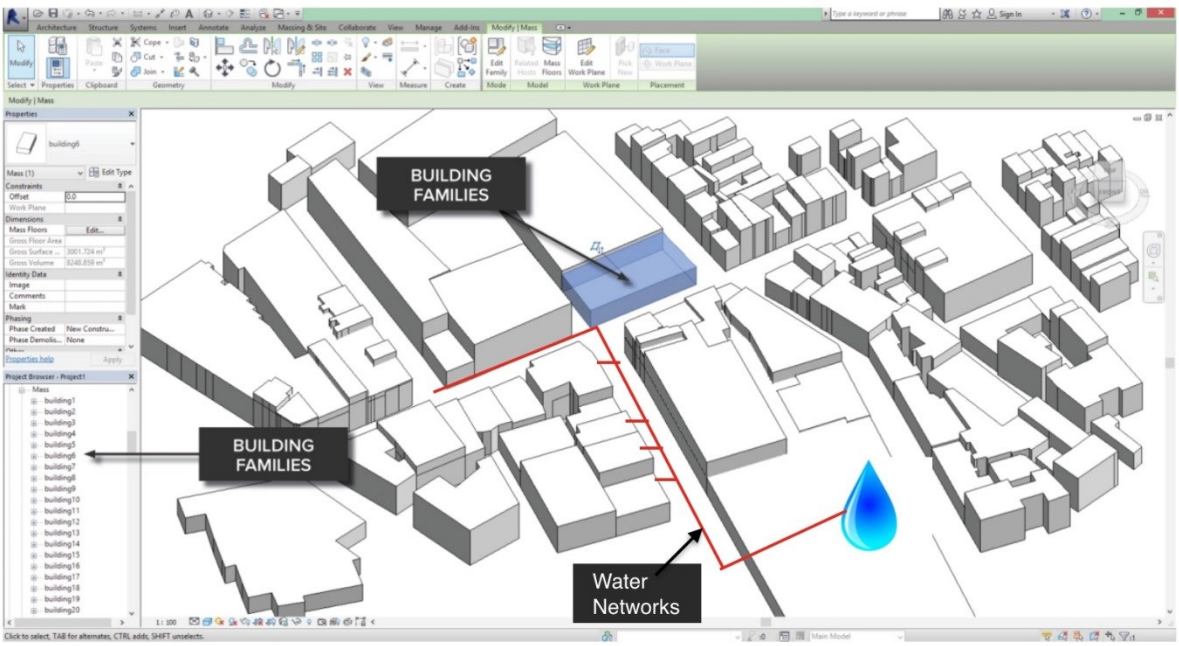
AUTODESK REVIT

The idea for those partner is to define a consistent BIM exploitation frameworks and tools around it.

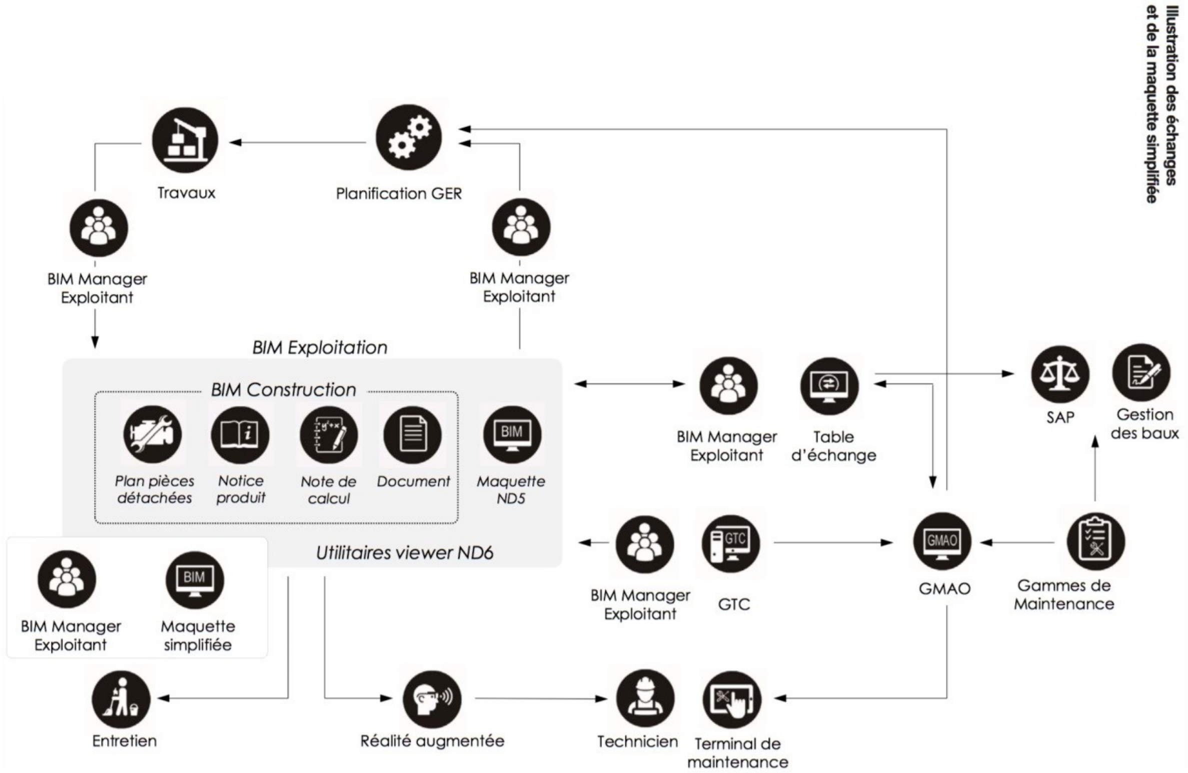




With the help of those companies we aims to be able to get BIM compliant visualisation within the leading BIM plateform ReVIT (under)



The Urban Farming BIM EXPLOITATION proposition will be included within a global BIM approaches with attached services. The under figure position BIM EXPLOITATION within a global view.



9.7.4 Reference and external link

[Water_JPI] Water JPI SRIA1.0-**Water challenges for a changing world** presented on 21 Oct.'14

http://www.waterjpi.eu/

http://user-djz3y9a.cld.bz/Binder1#1

[WWF_LPR_2014]

http://wwf.panda.org/about_our_earth/all_publications/living_planet_report/

[EC_Agri_CAP]

http://ec.europa.eu/agriculture/cap-history/agenda-2000/com99-22_en.pdf

[EC_Agri_Water]

http://ec.europa.eu/agriculture/envir/water/

[UN_WWDR_2014]

http://www.unwater.org/worldwaterday/world-water-development-report/en/

[Precision farming for sustainable agriculture]

https://www.youtube.com/watch?v=nrixH9tFxoA

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