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WATERNOMICS (ICT FOR WATER RESOURCE MANAGEMENT) METHODOLOGY AND WATER INFORMATION PLATFORM

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Abstract

WATERNOMICS is a three years EU funded research project and responded to the call FP7-ICT-2013-11. The partners variously specialize in ICT & Automation systems development, water sensors development, business model development, water system design, open source based platform, energy and sustainable management, exploitation, dissemination and communication activities. WATERNOMICS will provide personalized and actionable information on water consumption and water availability to individual households, companies and cities in an intuitive & effective manner at relevant time-scales for decision-making. Key project objectives include: to introduce demand response and accountability principles in the water sector; to engage consumers in new interactive and personalized ways that bring water efficiency to the forefront and leads to changes in water behaviors; to provide decision makers with the actionable information they need to get started in the implementation of a water management program. WATERNOMICS will develop a water information system that aims to raise awareness about efficient water management and it focuses on water efficiency at household, municipality and corporate level through the change behaviors of the end users to achieve reduced water usage and improved operation and maintenance by utilities. The innovative water information system, through its water platform and a standards based methodology, is the main instrument through which WATERNOMICS aims to change consumption behavior and effect changes in water resource management as it will provide a personalized and customizable solution and application to stakeholders.

Keywords: ICT, water management, water information platform, water consumption, raising awareness

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1. Introduction

Significant part of Europe suffers from water stress. Furthermore, the cumulative impacts of economic development and climate change are likely to aggravate the situation. ICT offers an untapped potential to improve the management of water resources by integrating real-time knowledge about water consumption. Into this challenge and opportunity, WATERNOMICS (ICT for water resources management) brings together ICT and water stakeholders in joint research to deliver this un-tapped potential via real-life testing and demonstration experiments. The Waternomics project aims to reduce the water consumption of municipalities, corporations and domestic users by providing water managers and consumers alike with timely and actionable information about water usage and water availability. Understanding the social, economic and environmental drivers for introducing the necessary smart water technologies helps shaping the architecture of a water information system. To get a better understanding of these drivers, Waternomics conducted workshops and interviews with various stakeholders from industry and municipalities in Greece, Italy, Ireland and the Netherlands. The results showed a wide range of ways in which water was managed and water conservation programs were implemented. From the research, the Waternomics water information system will be designed, developed and validated and will create a common process to lead water management. Currently the limited information available from the water services ecosystem is not interoperable or not presented effectively to stakeholders. Waternomics overcomes this problem by implementing a new level of smart meter and sensor technology associated with a simple water information platform and a standard based methodology. These decision support services are enabled by smart water technology, which (i) enables the detailed and real-time measurement of water flows and usage, (ii) informs analysis of water consumption patterns and (iii) provides key recommendations on how to increase water efficiency in a holistic context that includes governance, standards and local area policies and environmental conditions.

Project results will be validated and demonstrated in three high impact pilots:

1. Domestic: Households in the municipality of Thermi, Greece.
2. Corporate: Operator from Linate Airport in Italy.
3. Municipal: University and public school in Galway, Ireland.

Figure 1 provides an overview of the structure of the Waternomics project.

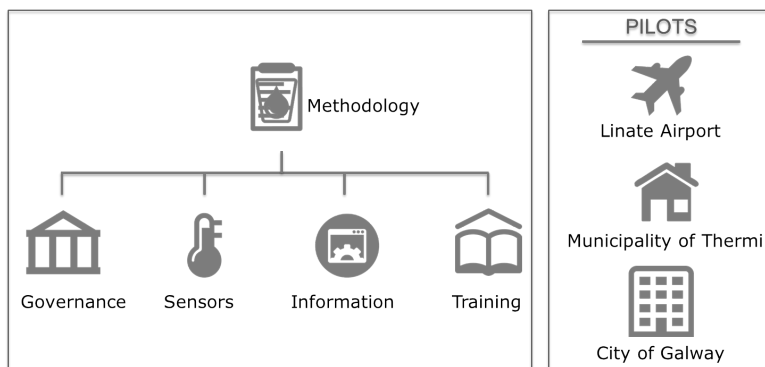


Figure 1: structure of Waternomics project

2. Objectives

The main objective of the WATERNOMICS project is to provide personalized and actionable information about water consumption and water availability to individual households, companies and cities in an intuitive and effective manner at a time-scale relevant for decision-making. Access to this information will increase end-user awareness and improve the quality of the decisions from decision makers regarding water management and water government. WATERNOMICS will accomplish this by:

- Combining water usage related information from various sources and domains to offer water information services to end-users (see Fig. 2);
- Making water usage related information accessible across devices and locations
- Supporting personalized interaction with water information services (see Fig. 2)
- Conducting knowledge transfer from energy management systems to water management systems
- Enabling sharing of water information services across communities of users

WATERNOMICS will use both new and state of the art sensors and water meters to provide new services (applications) and add new features like leakage detection, fault detection and water awareness games. These services will be bundled into the *WATERNOMICS Water Information Services Platform*, or short name, *WATERNOMICS Platform*. This software platform will be able to integrate (convergence layer) on top of existing water infrastructures or be employed using dedicated sensors fielded using the project methodology for water management system design.

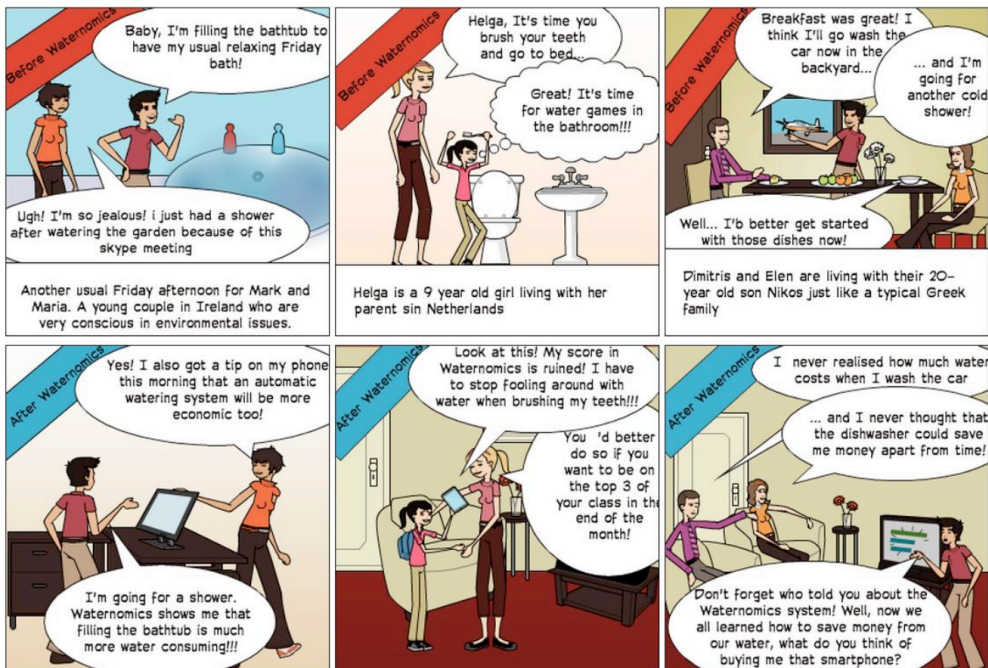


Figure 2: Example of supporting water utilities to engage end-users in a new ICT-enabled way
Technical Concept & Architecture of the Waternomics Platform

3. Outline of the work

The two main outcomes of The Waternomics Project are: (i) the Standards based Methodology adopted to guide the project phases, (ii) the afore mentioned Waternomics Platform.

- Waternomics Methodology: a standards-based methodology developed “*ad hoc*” for the development and implementation of ICT-enabled water management programs. This methodology will, given constraints, standards, corporate preferences, and key performance indicators (KPIs), provide decision makers and designers with a systematic way to select technologies, measurement points, data collection methods, and data management techniques for ICT-based water management systems.
- Waternomics Platform: the information platform of WATERNOMICS is an instrument that focuses mainly on water efficiency at household, municipality and corporate level through the change behaviours of the end users to achieve reduced water usage and improved operation and maintenance by utilities. Of course it is the main instrument through which WATERNOMICS aims to change water consumption behaviour and it will provide a personalized and customizable solution and application to end-users and doing so it will be able to help in changing water consumption behaviours and policies.

4. Materials and methods

The developed methodology, which in itself is a new development for the water sector, has five phases: Assess, Plan, Do, Check, Act. These phases are intentionally similar (with the exception of Assess being added as a first step to engage users) to those of ISO50001 (Energy Management Systems). In this way, environmental managers and the organizations, staff and service providers that work with them will immediately recognize the correlation between energy efficiency and the desired outcome of water efficiency. Other standards that many stakeholders will recognize include ISO50002 (Energy Audit), IPMVP (measurement and verification planning), and ISO14046 (Water Footprint). In this way, a comprehensive and holistic standards-based approach is established.

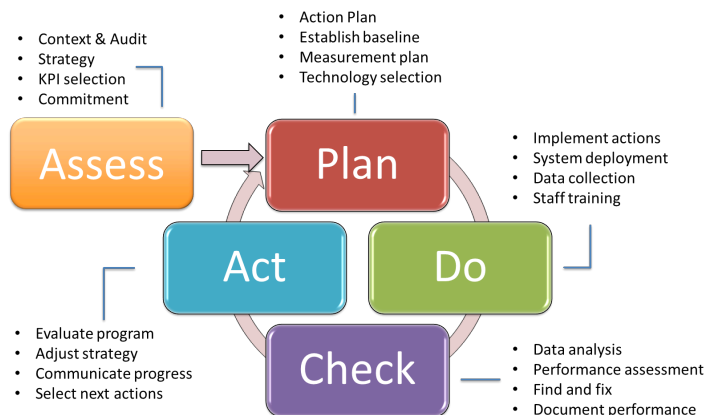


Figure 3: Waternomics Methodology Overview

In order to identify and describe key features that a Waternomics Information Platform should include during its first months, WATERNOMICS followed an eight steps method to provide a final set of three scenarios. In the last stages of this method a cycle of iteration in the development process begun including user tests using paper prototypes of the potential applications of the platform. Overall, scenario development has been based on three sets of guidelines and criteria. The set of final scenarios should:

- be based on end-user perceived value,
- be based on business value,
- cover all target functionality of the WATERNOMICS project, i.e., be compatible with the Description of Work (DoW) document,
- be technically innovative.

To achieve that, we used a zoom-in method, and as such the process was mainly bottom-up. By this we mean that we started by collecting a large set of functionalities and features as basis for the WATERNOMICS scenarios. Then we filtered these features, based on the criteria mentioned above, in a step-by-step way. The final results have been integrated in three scenarios that each covers a part of the WATERNOMICS project from a different perspective and together cover the complete scope of the project.

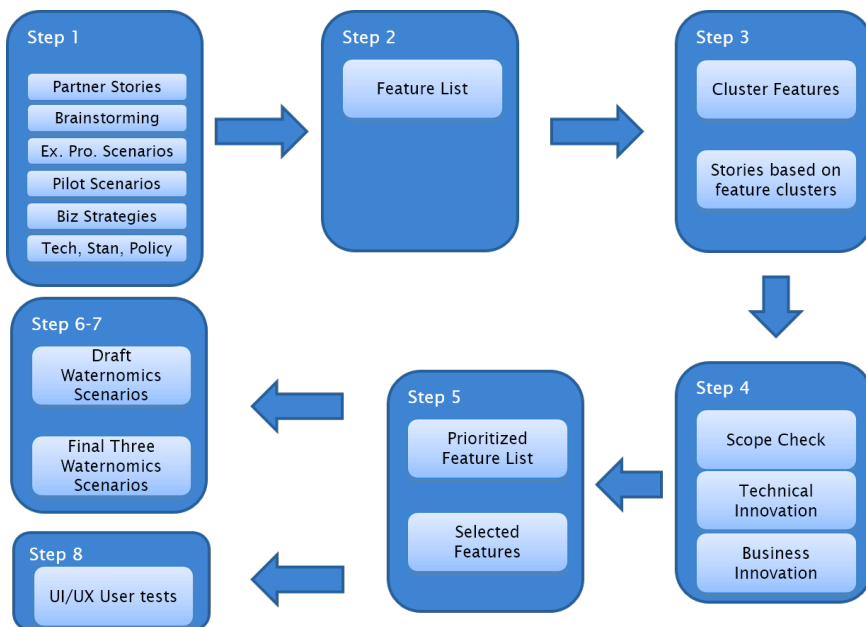


Figure 4: Scenario development methodology

5. Results and discussion

Waternomics leads to the project methodology which creates a common standards-based methodology for the design and implementation of ICT enabled water management systems. It should be noted that such a methodology is sorely lacking in the water sector and thus this document is an important step in ensuring water efficiency measures can be implemented in a similar way that energy efficiency measures have been. The culmination of

the methodology work is a 5 phase methodology (Assess, Plan, Do, Check, Act). The methodology draws strong inferences from and integrates the principles of ISO50001 (Energy Management Programs), ISO 50002 (Energy Audits/Diagnosis), IPMVP (International Performance Measurement & Verification Protocol) and ISO14046 (Water footprint) into a holistic framework. This is coupled with project activities toward the development of a water information system, directed at the challenge of water resource management. Several of the associated standards are recent (ISO50002 and ISO14046) and furthermore the focus of several is energy (ISO50001 and ISO50002). The application and adaptation of such standards in a holistic framework is innovative and new. It should be noted that the authors did not confine their research to just energy and water based standards but also looked across other disciplines. However, the energy-based standards were found to be most relevant and applicable to this sector. Added to the PDCA cycle is an initial “Assess” phase. Because end users may be less aware of water efficiency, water scarcity and how/why it affects them, the Assess Phase in the Waternomics methodology is a deliberate attempt to engage and educate the end user. In assembling relevant standards and in constructing the Waternomics methodology, it is noted that many standards have overlapping aspects and as such a direct overlay of each of the steps from the standards would produce redundancies. It is also true that terminology is not yet completely harmonized across the various standards and that some propose themselves as an umbrella to group other available standards. Regardless of any sticking points, we instead found it most useful to look at what each standard was trying to do to and then to assemble those intents in a logical way from initial consideration of the problem to its definitive conclusion and/or iterative loop. The result is a logical process (the five phases) where it was not constrained to have a one-to-one mapping between a standard and phases (e.g. each phase does not correspond to only one standard). Figure 5 shows a more refined and full view of the Waternomics methodology. In specific, the activities, desired outcome, and related standards are shown for each phase.

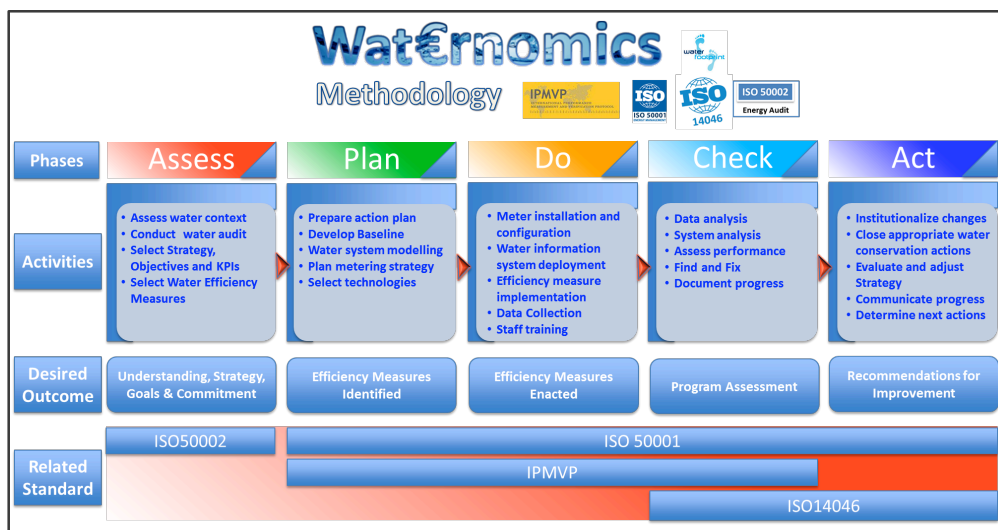


Figure 5: The Waternomics Methodology (full view) which includes activities, outcomes and its relation to the assembled standards

Each of the five phases has approximately roughly five activities which are the steps and methods associated with each phase. The approach is general enough to be applicable to the different targeted stakeholders (domestic, municipal, corporate) but also detailed enough to be useful and actionable. Deliberately and by design, the methodology is based on standards so that the approach overall has a higher likelihood of adoption, uptake and replication. The

use of ICT is the second cornerstone of the methodology and overall the methodology is branded as a “Standards based approach for the implementation of an ICT-enabled water management program.”

WATERNOMICS leads to develop an integrated information platform for water use means as an instrument that can be immediately understood by operational decision makers to achieve the water efficiency and use reduction. Indeed as almost always happens, a mere graph of the probability density function is usually not immediately understood by decision makers, so the aim of the WATERNOMICS platform is to collect all the available data dealing with water consumption. The platform will be designed in order to satisfy the main needs and preferences of its end-users. The users needs have been explored by conducting user tests based on face-to-face interviews and paper prototypes. In particular there were 3 applications which include

- A monitoring dashboard
- A news portal
- A simulation tool

In addition to these 3 applications a set of home pages for the platform was designed. Figure 6 and Figure 7 present some options for a home designed for the WATERNOMICS platform.



Figure 6: Example of the home page



Figure 7: Example of monitoring dashboard

The development of the Waternomics Platform is an ongoing work, Waternomics project is in its first year of operation and the total duration is three years.

6. Concluding remarks

This paper presents and discusses some important results in terms of outputs of the WATERNOMICS project: the water information platform and the standard based methodology.

With respect to the Waternomics methodology and developed content, the research and interaction with stakeholders have shown a clear need for this project development. Waternomics is developing tools, references and resources to assist in the construct and implementation of water management programs and the execution of water efficiency measures. Waternomics standards-based methodology offers an innovative way of merging together the main standards of the water and energy sector and by providing the end users a step-to step guide to follow in implementing their water saving programs.

With respect to the Waternomics Information platform, the research and interaction with stakeholders highlighted a clear need for a simple ICT tool that can provide useful information about end users water consumption, water saving, water consumption prediction and new ways to raise people awareness.

All the Waternomics Team strongly believes in the potential of this project and is investing heavily in the development of this new ICT technology. In the following months we will develop the Waternomics Information platform and the applications to provide the water information to the end users.

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