



USE CASES AND EARLY REQUIREMENTS

SmartH2O

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Executive Summary

This deliverable, D2.1, contains the initial set of use cases and early requirements specified for the SmarH2O applications that will be developed.

In this document, early user-centred functional and non-functional requirements and use cases have been identified according to the two main application scenarios of the project:

- Saving water by social awareness.
- Saving water by innovative pricing schemes.

The document presents target users groups and initial consumer needs, which were identified through the review of relevant studies and reports, through exploratory interviews and workshops with representatives from the water supplier side of both case studies in the UK and Switzerland.

According to the exploratory analysis and interviews conducted, preliminary user stories have been developed. To elicit more specific user-centered requirements, they have been evaluated with end-users during workshops (both with water consumers in both case study areas and with water utility employees). Feedback on the technical scope and feasibility has also been collected in an additional workshop with technical partners.

This document also provides a preliminary user model and the early mockups for the different SmarH2O applications developed from the user stories:

- Basic customer portal: Visual water meter
- Advanced customer portal: Gamified water meter
- Games Platform
- Business dashboard

For each identified application element, the high-level functional and non-functional requirements have been specified based on the end-user feedback and according to revised user stories and mockups. Finally, an initial set of user-centred use cases and early functional requirements has been detailed.

The deliverable concludes with early software integration requirements that have been identified so far, focusing on the critical issues of integration and communication of the SmarH2O system with the existing infrastructure of the water utilities involved in the project.

1. Introduction

In this chapter we describe the overall approach that was used to formulate the use cases and early requirements for the SmartH2O applications. The so far elicited use cases and early requirements will be further revised, refined and completed (e.g. with final requirements, success criteria and sequence diagrams in the next requirements deliverable D2.2).

1.1 Application scenarios

The use cases and early requirements consider both application scenarios and their goals in the context of SmartH2O:

- Saving water by raising social awareness
- Saving water by innovative pricing schemes

The first scenario is related to saving water by raising social awareness. The main goal is to promote water conservation behaviours and achieve quantifiable water savings using social awareness incentives. The objective is to encourage a rational use of water, possibly changing users behaviour. Social networks and smart metering can be exploited to provide feedback to the users about their consumption patterns and tips to consume water more efficiently.

The goal of the first part of the scenario is to allow consumers to monitor their water usage online leveraging social gamification mechanisms, increasing individual and collective awareness. By connecting consumers in a network, they will be able to see good and bad practices of others and exchange tips on how to improve consumption. The goal of the second part of the scenario is to test different water demand management strategies, aiming at more sustainable consumer behaviour, and identify which of these strategies were most effective. The social gamified platform will be used to collect insights into customers' consumption behaviour.

The second application scenario is related to saving water by innovative pricing schemes. The ultimate goal will be to encourage discretionary consumption during off-peak times (e.g. washing machine outside of peak showering times) and during wetter seasons (e.g. filling the pool during rainy periods in summer for later use). It will consider how innovative pricing schemes could be published in a transparent and rapid way an integrated into social media communication with and by consumers. The goal of the first part of the scenario is the gamification of individual water consumption and pricing schemes (i.e. tariff schemes) such as blocking rates to raise awareness of water consumption and pricing schemes and stimulate water saving. The goal of the second part of the scenario is the prediction of customer water consumption response to specific pricing schemes such as blocking rates to maximize water savings.

1.2 Methodology

This deliverable describes the process and early outcome of the user-centred requirements analysis. The overall requirements analysis is planned as an iterative human-centred design process as defined in ISO 13497 (ISO 1999). The aim of this first deliverable is to elicit and define the early user-centred functional and non-functional requirements for each of the two SmartH2O application scenarios, both from the perspective of water consumers and water suppliers (see Figure 1). These requirements will be based on user needs, which are described in user stories and broken down into use cases. The requirements will be revised, refined and finalized in the next deliverable D2.2, e.g. by adding success criteria and sequence diagrams. The functional specifications will be described in D2.3.

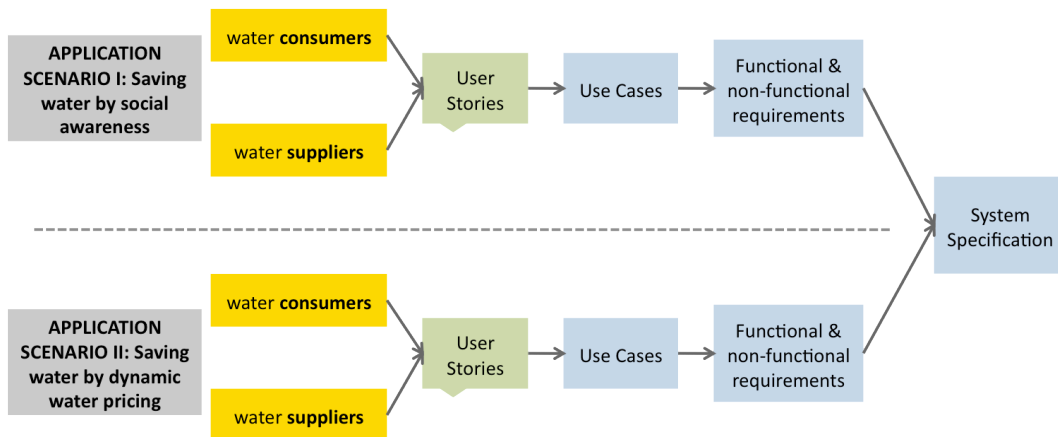


Figure 1. Process overview: eliciting requirements and the system specification based on user needs formalized as user stories and use cases

In the requirements analysis iterations, end-user feedback of water consumers and suppliers (*User pull*) is alternated with technical feedback (*Technology push*) based on which the requirements are refined. This cycle aims to construct requirements that are both technically feasible and grounded in user-needs. The cycle is displayed in Figure 2.

As this deliverable is focused on user needs, use scenarios, i.e. narrative descriptions of what people do and experience as they try to make use of a computer system (Carroll, 1995) are the primary point of reference. To avoid ambiguous terminology we use the term scenario to refer to the two SmartH2O application scenarios, while specific combinations of users, contexts, and computer-supported tasks – which can be seen as sub-scenarios – are referred to as user stories. Therefore, the use cases are rooted in the user-centred requirements studies that have taken place in the first months of the project. This document bridges the gap between high-level user needs and user needs based on specific use cases, which are specified to the extent that they impact the end users.

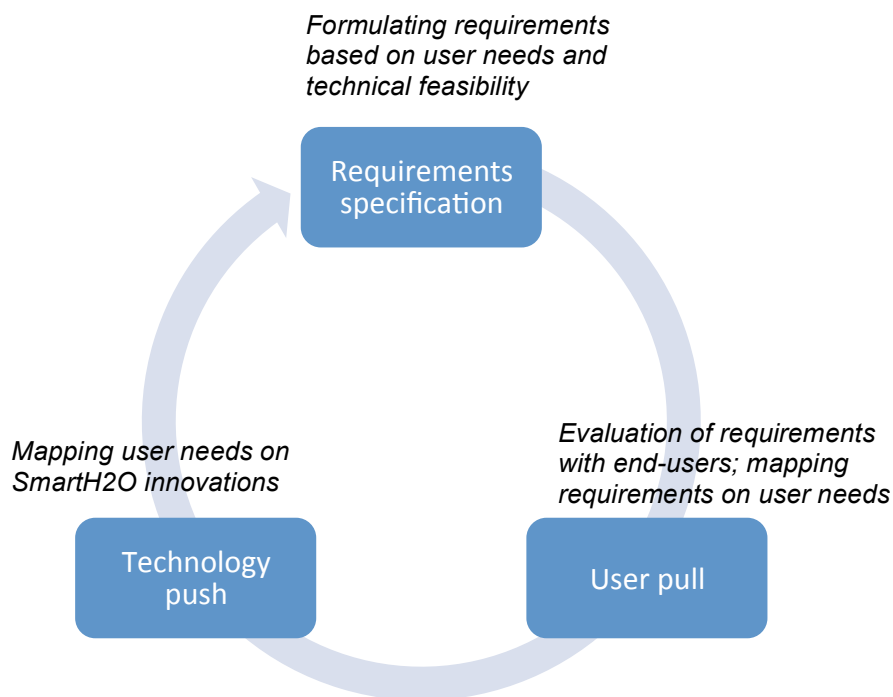


Figure 2. Requirements cycle driven by user pull and technology push

1.3 Outline of this deliverable

The details of the approach that led to the elicitation of the early requirements and use cases are described in chapter 2, including the specification of the target groups, the results of the exploratory analysis of user needs and interviews, the description of the construction of preliminary user stories and of the requirements workshops that were conducted with both target users and technical partners.

As a first main result, the user stories are listed for each application scenario in chapter 3, based on which visual mockups were designed to help elicit user needs with end users. They are presented in the consecutive chapter 4, followed by a description of the data model and the early user model in chapters 5 and 6. Chapter 7 provides an overview of the identified preliminary use cases, organized both by application and by user group. In chapters 8-12, early high level functional and non-functional requirements are described for each of the main SmartH2O applications, followed by the description of use cases and use-case-based early functional requirements. The final requirements including e.g. success criteria and sequence diagrams will be specified in D2.2, which is scheduled for M12.

Finally the early software integration requirements are introduced in Chapter 13. Detailed functional specification of the SmartH2O platform will be described in D2.3 scheduled for M12. Chapter 14 presents the conclusions of this deliverable.

2. User-centred design process

2.1 Outline of the approach

In this section we provide a high-level outline of the approach we took to identify the respective target groups, and to formulate and evaluate a number of user stories that fit well within the scope of Smarth2O and meet user needs. Based on these user stories, visual mockups were created to help elicit user needs and requirements with end users and be the basis for implementation. Consecutively, the user stories were broken down into a list of user-centred use cases and early requirements. Central to the approach is the development and evaluation of user stories. The diagram in Figure 3 summarizes our approach, and Figure 4 shows how this approach was realized in the detailed roadmap leading up to M8.

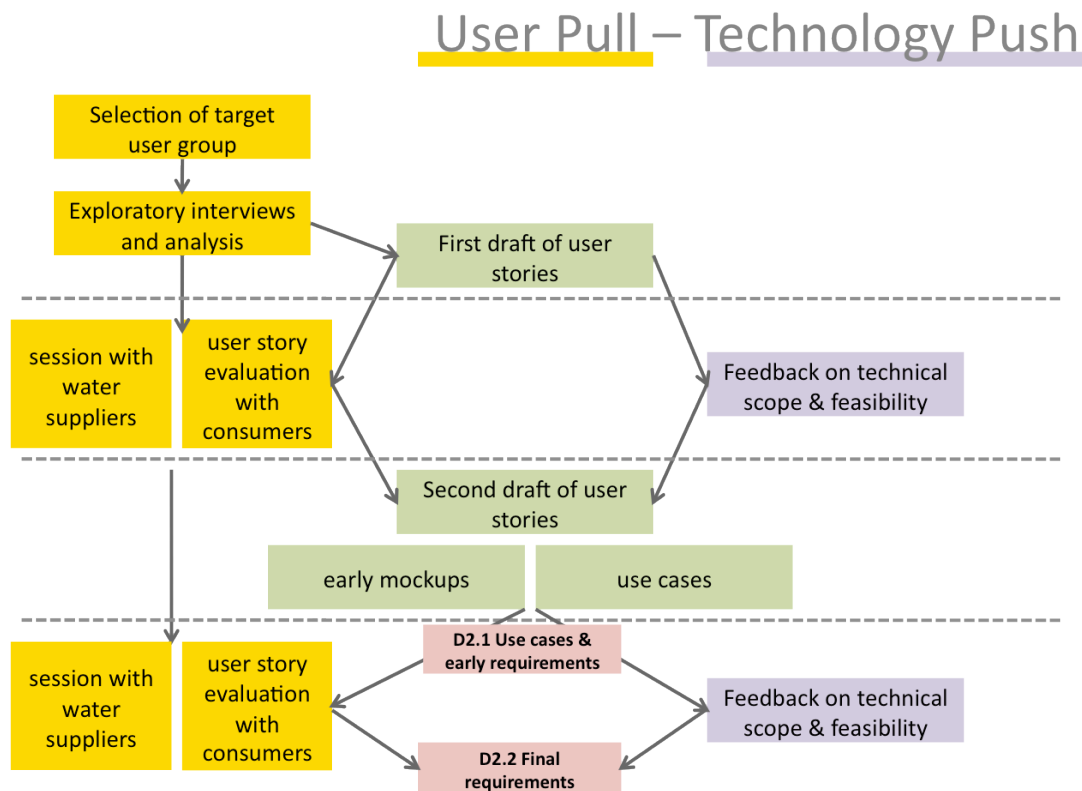


Figure 3. User-centred design approach summary

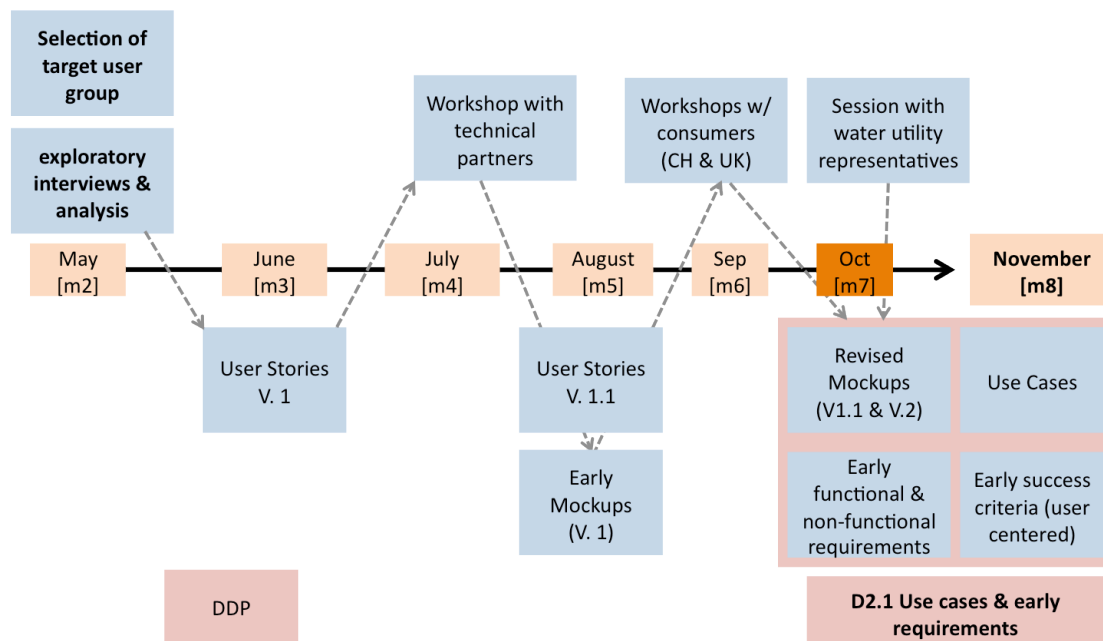


Figure 4. Roadmap of WP2 activities

2.2 Target user groups

The target users of the smartH2O platform can be divided into different groups and should be considered separately for the two case studies in the UK and Switzerland.

UK case study user groups:

- Water consumers in domestic households in Greater London, with a focus on the smart meter rollout sites in Reading (155'300 inhabitants) and Swindon (185'609 inhabitants).
- Water utility staff in Greater London (Thames Water).

Swiss case study user groups:

- Water consumers in domestic households in Southern Switzerland in the Locarno region (Canton of Ticino), with a focus on the smart meter rollout sites in Tegna (800 inhabitants) and Tenero-Contra (2'700 inhabitants; in total ~600 households will be equipped with smart meters).
- Electric utility staff in Southern Switzerland (SES).
- Municipal administrators in Southern Switzerland.

For both case studies, consumers in domestic households are sub-categorized in the following way:

- Single households.
- Couples households.
- Shared households (typically younger residents).
- Family households with younger children.
- Family households with older children (teenagers).

Households can be equipped with a smart-meter, an easily accessible standard meter, a non-accessible standard meter or no meter.

In addition to the type of household, the age of the private household target users is also an important factor, especially when considering potential target users for a digital-based

application such as Smarth2O.

For the design and implementation of innovative pricing schemes, target groups include policy makers such as water utilities and regulators at national and EU level and consumers at local/regional and national level. Table 1 below summarizes the benefits on each user analysis from saving water by innovative pricing schemes like dynamic pricing.

Target users	Benefits
Water utilities and regulators	<ul style="list-style-type: none"> - Reduction of water consumption - Monitor of water usage - Improvement of business operations - Improvement of resource efficiency - Increase in efficiency in communication
Consumers	<ul style="list-style-type: none"> - Reduction of water consumption - Monitor of water usage - Education and change of behaviour

Table 1. Benefits of target user groups regarding innovative pricing schemes

Further exploratory analysis of the target user groups to determine their roles and relevance in the Smarth2O project is described in the following sections, leading up to the user stories where the primary target groups for the early requirements are specified.

2.3 Exploratory analysis of user needs and interviews

A first analysis of user needs was based on existing literature and reports on the one hand and exploratory interviews with representatives from the water supplier side of both case studies on the other.

2.3.1 Studies of domestic water consumption behaviour

The following section presents studies of domestic water consumption in both case study areas.

A consumer survey conducted in the Gordola municipality in 2001/2002 (Räber and Truffer 2002) provided initial insights on water consumption in the Swiss case study area. According to the study, 2/3 of residential areas consist of one-family homes, which use more water than owner-occupied or rental flats. 60% of the homes have their own garden. Most survey respondents were from two- or four-person households. The survey showed that in about 50% of all households in Gordola there exists a kind of water saving installation, and 50% of all washing machines and dishwashers are less than 5 years old, reflecting some level of awareness of the need to save water or use water saving appliances.

When asked about their motivation to save water, saving the environment was reported to be the main incentive to do so or to put up water saving installations (see Figure 5).

Survey respondents also stated that they would prefer to undergo water saving measures in their own homes (66,5%) rather than exploiting additional springs (31,3%) or access groundwater (2,1%).

Incentives to save water

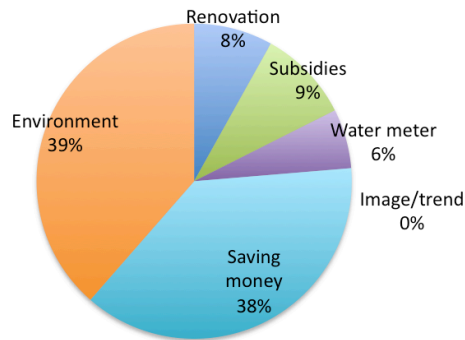


Figure 5. Incentives to save water of Gordola residents as reported in 2001/2002 survey. Source: R ber and Truffer (2002)

Also, according to SVGW (2001), the Swiss average per capita consumption in a domestic house household is approximately 162l/day, with the majority of the consumption originating from flushing the toilet (30%, see Figure 6). Other sources (e.g. Kraemer et al. 2007) give an even higher estimate of Swiss per capita water consumption (see Figure 7).

Domestic water consumption in Switzerland (average 162 l/ppd)

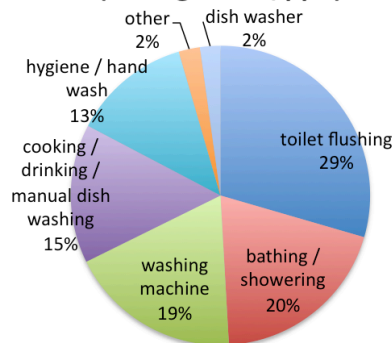


Figure 6. Domestic water consumption in Switzerland as reported by SVGW. Source: SVGW (2001)

Water consumption in the UK was also considered. According to Thames Water, the daily per capita water consumption in London is 164 l/ppd, which is high especially compared to the UK average at 147 l/ppd (see Figure 7).

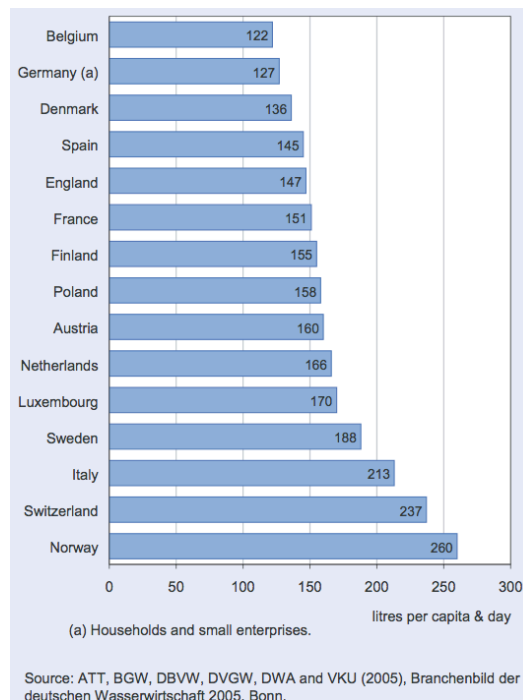


Figure 7. Water consumption average by households in Europe. Source: Kraemer et al. (2007)

Since 2001 (Kowalski and Marshallsay 2003), some trials investigating the distribution of water consumption among the end uses in UK households were run. Kowalski and Marshallsay (2003) examined domestic water consumption over a sample of around 250 properties, obtaining as outcome the breakdown distribution of the end uses represented in Figure 8.

This result basically confirms the statistics provided by the UK Environmental Agency. In addition, as it was obtained by the integrated use of smart meters and disaggregation software (therefore not just on the basis of static survey data), it points out the big potential of smart meters and analysis software as supporting tools for planning and monitoring activities of water utilities as Thames Water. Also, they represent essential tools for studying users' attitudes and behaviour, e.g. by comparing questionnaire data to estimated end use data (Figure 8), thus enabling the design of tailored feedbacks and communications with users.

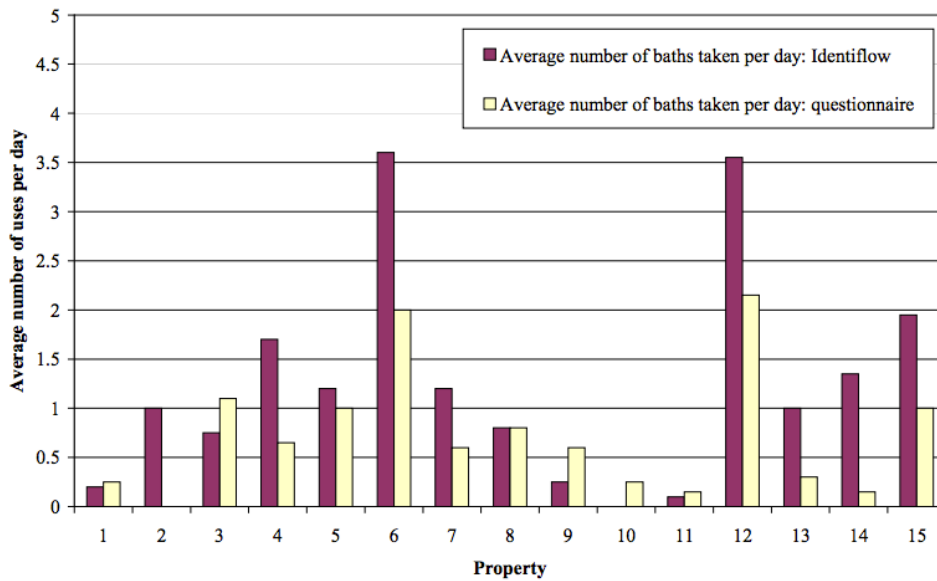


Figure 8. Comparison between consumption data obtained through disaggregation software and data obtained through questionnaires. Source: Kowalski and Marshallsay (2003)

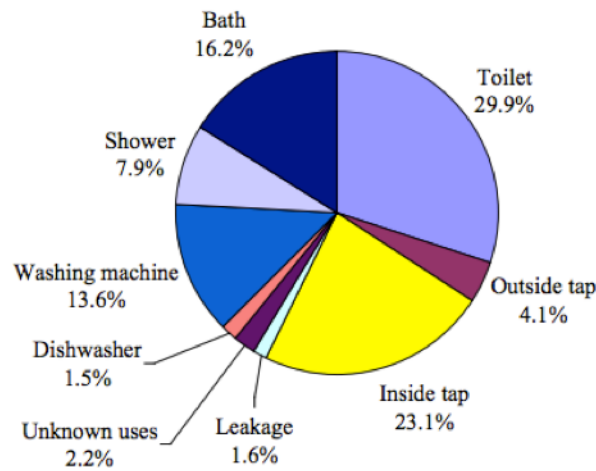


Figure 9. Water end use statistics obtained through disaggregation software. Source: Kowalski and Marshallsay (2001)

Other studies that were reviewed (e.g. EA 2008; Balnave and Adeyeye 2013) highlight (dis)similarity of water characteristics, attitudes and preferences for water efficiency, and water consumption characteristics across different regions in the UK. The greater London region is for example similar to North England, e.g. to the region near Manchester (see Figure 10, Figure 11, Figure 12).

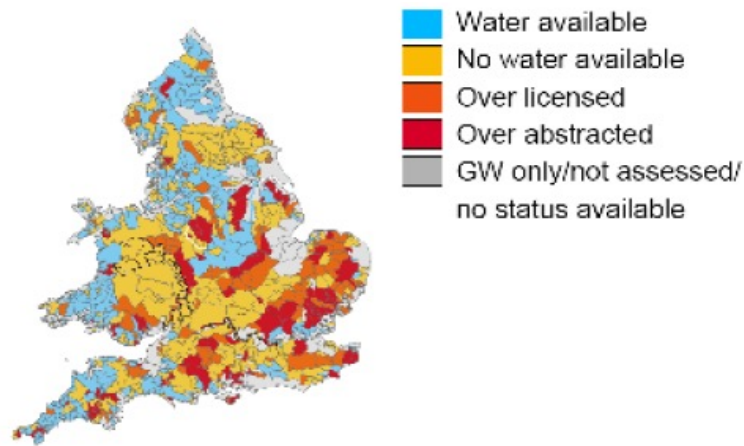


Figure 10. Water characteristics: Water available for abstraction, Source: EA (2008)

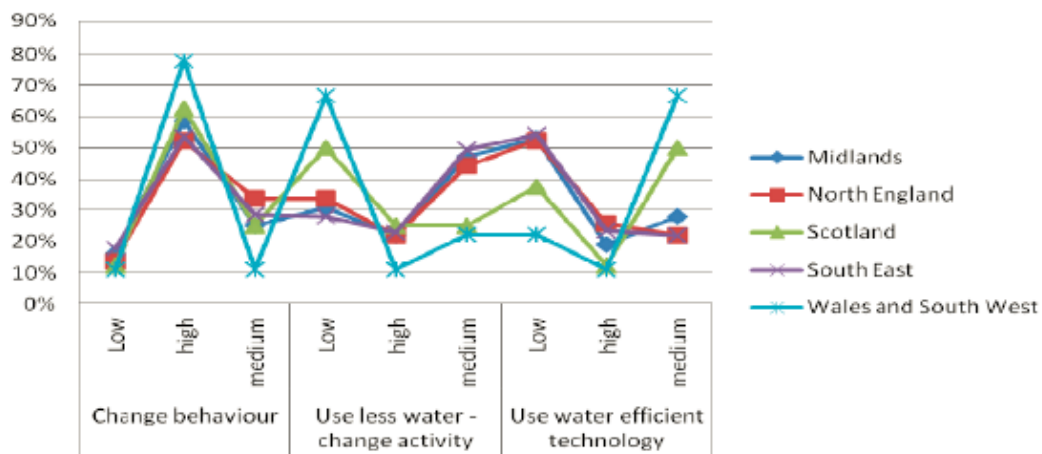
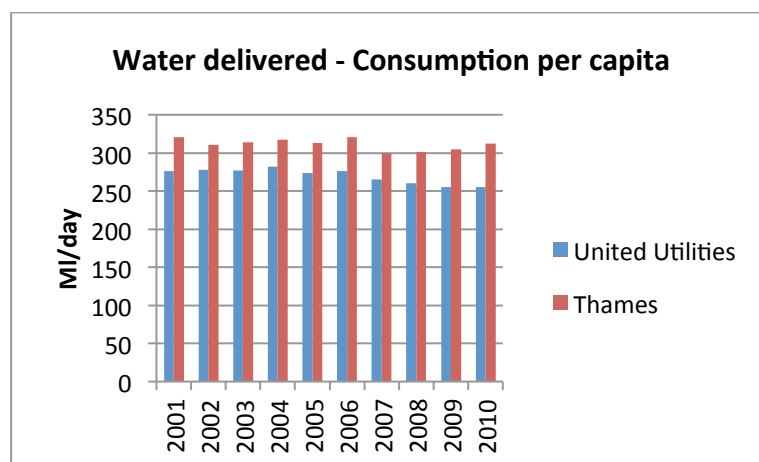


Figure 11. Attitudes and preferences for water efficiency based on location. Source: Balnave and Adeyeye (2013)



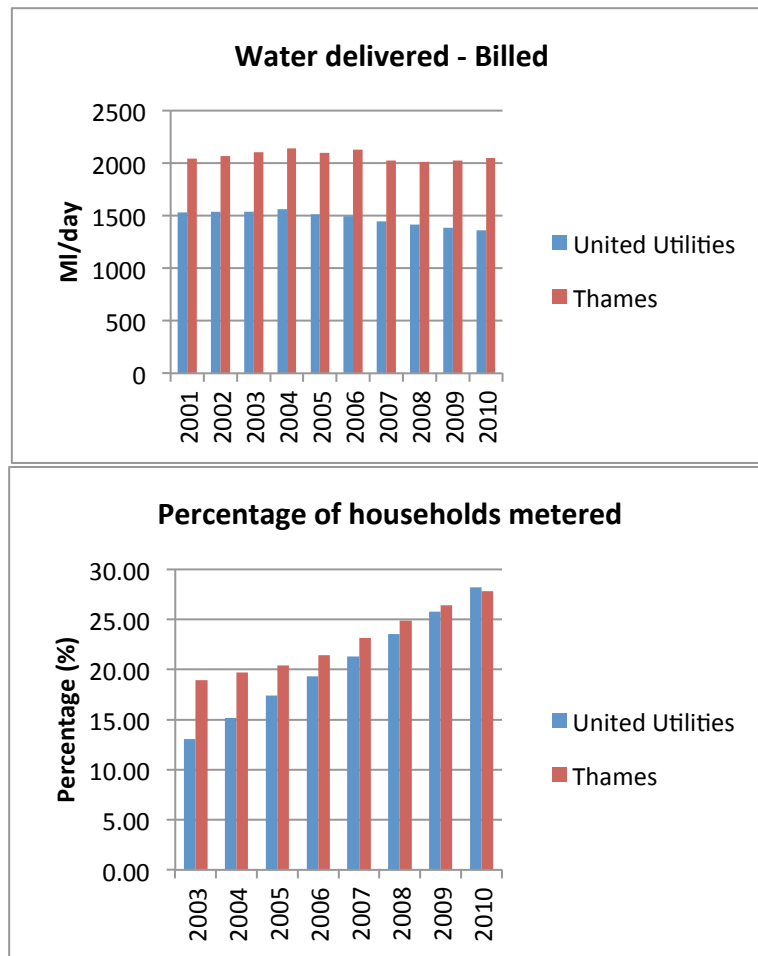


Figure 12. Water consumption characteristics. Source: Own elaboration with Ofwat's¹ June return data

2.3.2 Exploratory interviews with utility representatives

In addition to the review of relevant studies and reports, exploratory interviews with representatives from the water utility in the UK (Thames Water), the electric utility in Switzerland (SES) and the Municipality of Gordola in Canton of Ticino were conducted during the project kick-off in May to gain a more in-depth understanding of their needs and practices.

The main objectives for the Swiss utility and municipality representatives are to develop metering techniques for electricity, gas and water, and to make the customer an active and self-aware actor in the rational use of water and energy.

One of the main interview insights from the Swiss representatives is that in the region of Ticino, water is supplied via reservoirs and/or springs, i.e. no pumping is required and no electricity costs relating to pumping occur. The municipality's main cost is linked to removing leakage.

There can be water shortages in the area of Ticino, which is one of the main issues most residents are currently unaware of. Therefore, the municipality of Gordola wants to encourage its residents to use less water and to become more aware of these shortages.

¹ Ofwat: <http://www.ofwat.gov.uk/>, last seen 28/11/2014

However, their experience has shown that residents are easy to influence on a short-term basis with leaflets during acute periods.

Considering dynamic water pricing, they are interested in pricing models that could better regulate consumption during dry, hot periods (peaks) and such that would apply alternative tariffs for second homes (e.g. vacation homes which are only used in certain time periods of the year).

The representative from SES confirmed these insights. He also stated that they have been introducing a platform ("The Munx"²) that allows their customers to check their electricity consumption online, which has proven to be popular in other parts of Switzerland. He further stated that they are hoping to influence their customers towards a more sustainable consumption behaviour in general, and that they could well imagine a positive side effect on customers' power consumption when they become more aware of saving water and vice versa.

Regarding the water meter readings, they are considering to provide them as a service to municipalities.

According to the representative of Thames Water who we interviewed, the water utility is interested in more information on customers, their habits and installed utilities, and possibly their ethnic background, employment, number of people living in a household.

Especially consumption data of non-metered households should somehow be qualitatively measured.

One of the main goals of Thames Water is to raise their customers' awareness of the fact that certain areas in the UK, e.g. London, are actually water stressed. By 2020 there will be a shortage in this area if the growth while the consumption doesn't change. Their aim is a reduction of the overall water usage by the consumers (TWUL goal: from 160l to 125l / day).

Thames Water according to their representative want to provide tips to customers how to reduce water consumption. Consumers should also understand "what numbers represent", i.e. how to interpret numeric consumption data (e.g. 1l equals 1 min. shower).

In fact, hardware items that should help saving water are already available on the Thames Water website for free.

To raise awareness on a larger scale, they assume from experience that it would be better to do small targeted awareness campaigns rather than large untargeted which is the current practice.

Another main goal is to reduce leakage based on meter data. Also, in order to be more efficient and save energy costs on pumping, which they unlike the Swiss utilities rely on, they want to be able to better control the water pressure when pumping to get a constant flow, i.e. be able to react to peaks and lows.

2.3.3 Exploratory analysis and interviews regarding innovative pricing schemes

Water supplies are not unlimited – water is not a renewable source and securing water for the future is not certain due to increasing demand, population growth and climate change. Therefore, innovation to balance water demand and supply becomes of outmost important. Water efficiency options for reducing water demand such as leakage control, metering/smart metering and charging, education and information campaigns, and the need for developing new resources such as water trading, water re-use, desalination are examples that could be employed by water utilities and customers to deal with the above challenges. More particularly, in UK water utilities have already been engaged with their customers to elicit their views on the adoption of metering and smart metering for reducing water demand along with

² The Munx platform: <https://munx.ses.ch/it/>, last seen 19/11/2014

innovative pricing schemes such as blocking rates and seasonal tariffs and social tariffs. Results from ongoing metering and tariff trials from Wessex water company³ showed that standard meters help a lot with demand and leakage, smart meters could provide some extra help. However, the customers expressed concerns with respect to blocking rates and seasonal tariffs. But potentially huge benefits to customers, leakage and network management result when smart meters are combined with smart customer and network information and management. Similar results were reported by Southern Water⁴ company in their Water Resources Management Plan (Southern Water 2014) where less than a quarter of customers (22%) supported the introduction of a seasonal tariff, and more than half (56%) actually opposed it. There were also real concerns that tariff schemes could impact vulnerable customers. In their water resources management plan, Southern also reported that customers' most preferred option to secure water for the future was aquifer storage and recovery followed by water re-use and leakage reduction, whereas blocking and seasonal tariff schemes was the least ranked preferred scheme. Past research, however, suggests that tariff schemes such as blocking rates could reduce demand by up to 5 per cent on average across year so that less water is taken from the environment.

In line with the above respects, a meeting with our business project partners, Thames Water Utilities Limited (TWUL) was conducted in Reading on July, the 8th, 2014. The overall objective of the meeting was to explore TWUL's current pricing programmes and intended pricing trials. Representatives from TWUL (project manager on innovation metering, water efficiency manager, experts from demand and supply forecasting (WRMP)) stated that they would be interested in exploring three innovative schemes:

1. Standard charge, 2 block tariffs for basic and higher level of use.
2. No standing charge, 3 blocks tariffs for basic, normal and high use.
3. Seasonal tariffs (still debated).

TWUL's existing efforts to build a water consumption website and applications ('apps') were also presented such as MyMeter and TAP App (TAP = 'Talk and Products'). The former provides basic access to the consumption data from smart meter readings to the consumers. The latter is based on a slightly modified version of the EST (Energy Savings Trust) online calculator and app, which estimates annual water and 'energy for water heating' bill.

The findings from this initial, exploratory analysis are the basis for the first version of the user stories, which are described briefly in the next section.

2.4 Construction of preliminary user stories

Based on the initial exploratory analysis and the interviews that were conducted, we gained an initial understanding of possible user needs of both water consumers and suppliers. To discuss these ideas with target users ("is this what you really need?") on the one hand and to discuss the opportunities with the technical experts within SmartH2O in the other ("is this feasible?"), we developed high-level user stories acting as illustrations of specific scenarios of use of the envisioned system by the target user groups.

A scenario is a narrative description of what people do and experience as they try to make use of a computer system (Carroll, 1995). It consists of a set of users, a context and a set of tasks that users perform or want to perform. It blends a carefully researched description of some set of real ongoing activities with an imaginative futuristic look at how technology could support those activities better (Suri & Marsh, 2001, p. 152).

Using this technique offers several benefits for design teams. They help to integrate the user

³Wessex Water: <http://www.wessexwater.co.uk/>, last seen 28/11/2014

⁴ Southern Water: <https://www.southernwater.co.uk/>, last seen 25/11/2014

perspective with the technology perspective. It also places the system use in the broader context of everyday use (Kuutti, 1995; Ludden, 2010). Finally, Suri & Marsh (2001) point out that using scenarios individualize the user: scenarios bring to life specific imagined individuals as opposed to relying on abstract user characteristics only. In other words, this helps designers to empathize with the users.

To avoid ambiguous terminology we use the term *scenario* to refer to the two SmartH2O application scenarios, while specific combinations of users, contexts, and computer-supported tasks – which can be seen as sub-scenarios – are referred to as *user stories*.

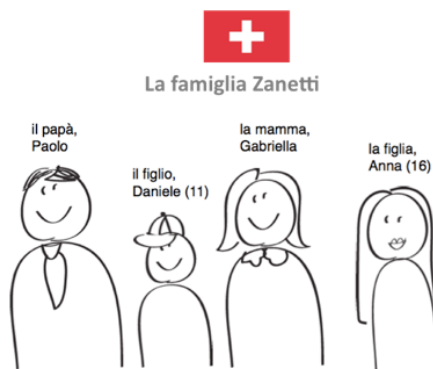
As a start we developed three main user stories, the first two describing the needs and functionalities envisioned for the water consumers in the two case study areas and one those envisioned for the water utilities.

To address the needs of several consumer types, the first two consumer user stories were written from the point of view of a family household. The members of each household were described as personas (see next section 2.4.1). The two consumer user stories are very similar with some specific differences, which we assume based on the exploratory analysis findings, e.g. a focus on gardening activities and the existence of a pool in the Swiss story. Possible further differentiation of the user stories are to be identified in requirements workshops with the target users (see Section 2.6).

2.4.1 Personas

For end users to better relate with the user stories, preliminary personas were developed for each case study. A persona can be described as “a fictitious, specific and concrete representation of target users” (Cooper 1999). It is a “collection of realistic representative information which can include fictitious details for a more accurate characterization” (Cooper and Reimann 2003), e.g. to help developers better understand user needs. In our case, the concept of personas is especially valuable to introduce the narrative user stories which describe how the created personas interact with the system that we envision for SmartH2O.

Swiss case study consumer personas

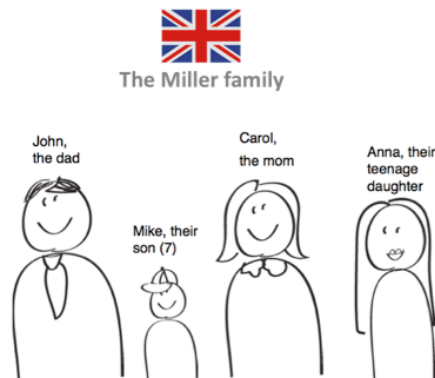


The Zanettis are a family of four living in their own four-bedroom house in a picturesque village in Switzerland. Mr Zanetti is the manager of a local supermarket; Mrs Zanetti works in the local tourist information. Their daughter Anna is 16 and goes to school in the next larger town. She likes to meet her friends in their favourite café and go swimming in the lakes in the summertime. Her younger brother Daniele is 11 years old and loves to spend time in their garden.

After installing a smart meter in their house, the municipality has informed Mr Zanetti via a brochure that they are providing a new online service that residents to monitor their water consumption and to

benefit from water saving actions: the gamified water meter application.

UK case study consumer personas



The Millers are a family of four living in their own four-bedroom house in a suburban neighbourhood. Both parents work at the same insurance company and commute to work. They have a 15-year-old daughter, Anna. Anna likes to meet her friends in the city centre and is always looking for the latest gadgets and apps. Mike has a lot of friends who he plays with frequently after school. The local water utility just installed a smart meter at their house and sent out a brochure about a new application available for PC and smartphone with which they could easily access the meter information themselves.

Utility employee persona:

John is a 48-year-old employee at a large water supply company in London. He has worked at the same company his whole life and likes it there.

2.4.2 Preliminary user stories for water consumers in Switzerland and the UK

The following section describes the preliminary user stories for water consumers. A basic mockup was created to illustrate the consumer user stories (see Figure 13). It takes into account the possibilities of the CUBRIK gamification engine (which has been made available to the SmartH2O project thanks to an agreement with WebRatio and CUBRIK) that has been considered as a possible technological basis for the gamification module of the platform.

The preliminary user stories are presented afterwards, explaining the envisioned features of the application for each case study area.

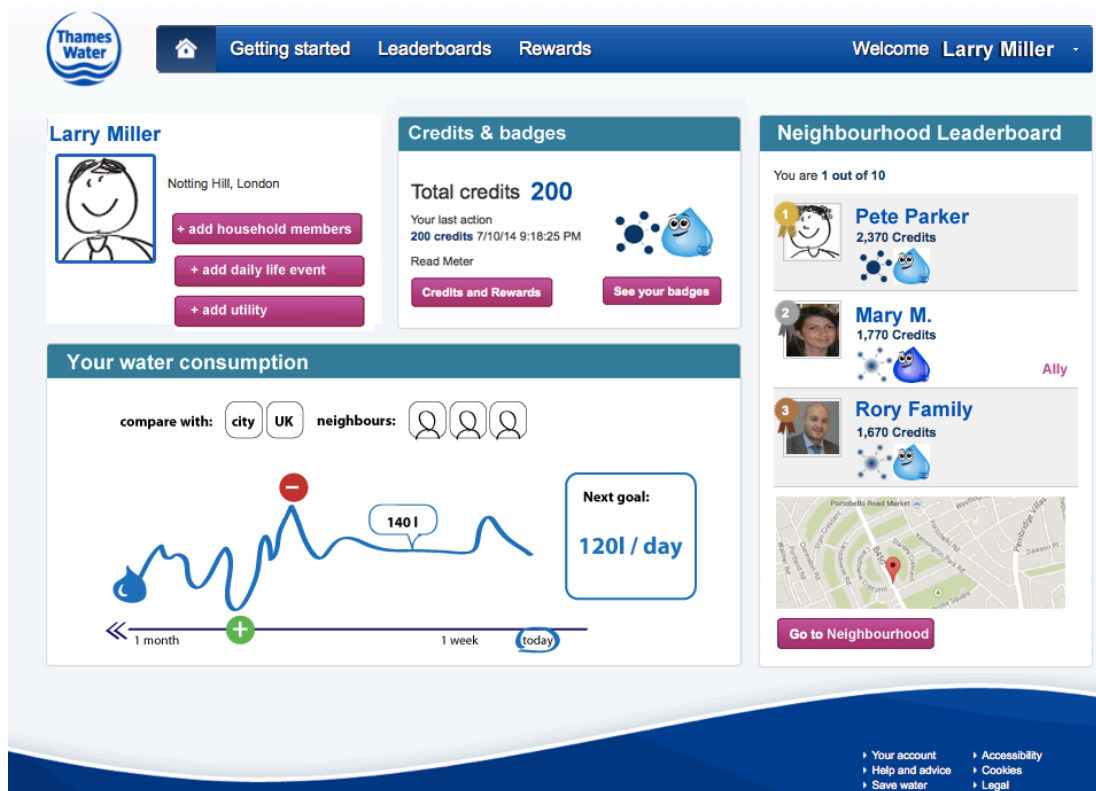


Figure 13 Basic mockup of the customer interface

Swiss user story

On his current water bill, Mr Zanetti is informed by his water and energy supplier that they are introducing a new billing system for their customers. Their water and energy consumption is linked together with a joint price which can be influenced both by lowering their energy as well as their water consumption. To better monitor their water consumption, customers can now use the **smart^{bill}** application, a link to which is provided on the paper bill.


Using his desktop computer in his home office, he follows the link that is printed on the paper bill to open up the **smart^{bill}** web app.

He signs in with his name and customer reference number and already on the home screen he sees how much water his family has consumed during the past day, week, and month and how much they have to pay for both energy and water. His consumption data is presented in a fun and interactive visual widget where he can see the peaks and lows of their water use over time. He can overlay their water use with statistics of his neighbors and with average consumption data of his city or country. The application challenges him with a water-saving goal each month to be achieved by performing different actions.

He also sees his current status as a *beginner saver* based on the number of credits he has (not yet) collected, and a leaderboard where his neighbors are ranked. He can even view where the other users live on his neighbourhood's map. Antonio from down the road is in the lead! "Antonio, I will take this title from you", he thinks to himself. The application even shows him which kind of actions he could undertake to get more credits than Antonio. To increase his chances, he goes ahead and forms a water saving alliance with Valeria from next door. Now they can team up against Antonio and each time one of them performs a water saving action, the other also gets some credits. It seems Valeria hasn't logged in this week, so he drops her a short virtual note in her mailbox to remind her to save some water this week. For the note he earns an extra point!


To increase his score some more, he can do several actions. If his family had not already a smart meter


installed for their flat, he could type in his meter data manually, add a new daily life event (e.g. “shower at 7am”) or complete his customer profile (e.g. how many family members there are, what kind of utilities they have). For each added daily life event, the application also provides information on how much water is usually consumed. For now, Mr Zanetti decides to watch a short presentation about the latest water saving tips, which earns him 10 credits. He is surprised how serious the water stress situation has been in his area in Switzerland in the past.

Since he knows that he will not always have the time to login and participate in the water saving activities, he also adds his wife and daughter to the household. They now both get an invitation to join **smart**  **bill** via the web or mobile app to start saving water, too. Especially Anna really likes the smartphone app and challenges her friends to also sign up on behalf of their families.

Finally he checks his score again and sees that he only needs 150 more credits to his first “10% off at the cinema” voucher and 1350 more credits to get a water saving showerhead.

UK user story

On his current water bill, Mr Miller is informed by his water supplier that they are introducing a new billing system for their customers. From now on, customers do not only get their bill sent via post, they can also access their consumption data online via the **smart**  **bill** application.


Using his desktop computer in his home office, he follows the link that is printed on the paper bill to open up the **smart**  **bill** web app.

He signs in with his name and customer reference number and already on the home screen he sees how much water his family has consumed during the past day, week, and month and how much they have to pay.

His consumption data is presented in a fun and interactive visual widget where he can see the peaks and lows of their water use over time. He can overlay their water use with statistics of his neighbours and with average consumption data of his city or country. The water supply company challenges him with a water-saving goal each month to be achieved by performing different actions.

Mr Miller also sees his current status as a *beginner saver* based on the number of credits he has (not yet) collected, and a leaderboard where his neighbours are ranked. He can even see where the other users live on the neighbourhood map, which depicts their block of flats. Pete from the first floor is in the lead! “Pete, I will take this title from you”, he thinks to himself. The application even shows him which kind of actions he could undertake to get more credits than Pete. To increase his chances, he goes ahead and forms a water saving alliance with Mary from next door. Now they can team up against Pete and each time one of them performs a water saving action, the other also gets some credits. It seems Mary hasn’t logged in this week, so he week. For the note he earns an extra point!

To increase his score some more, he can do several actions. If his family had not already a smart meter installed for their flat, he could type in his meter data manually, add a new daily life event (e.g. “shower at 7am”) or complete his customer profile (e.g. how many family members there are, what kind of utilities they have). For each added daily life event, the application also provides information on how much water is usually consumed. For now, Mr Miller decides to watch a short presentation about the latest water saving tips, which earns him 10 credits. He is surprised how serious the water stress situation has been in the London area in the past.

Since he knows that he will not always have the time to login and participate in the water saving activities, he also adds his wife and son to the household. They now both get an invitation to join **smart**  **bill** via the web or mobile app to start saving water, too. Especially their son Mike really likes the smartphone app and challenges his friends to also sign up on behalf of their families.

Finally Mr Miller checks his score again and sees that he only needs 150 more credits to his first “10% off at the cinema” voucher and 1350 more credits to get a water saving showerhead.

The initial user stories did not consider innovative pricing models as such. However, the initial idea for the UK case study was to link the SmartH2O customer application to the customer bill and provide customers their billing information online, as an alternative or a

supplementary mean compared to standard paper bills which are only distributed on a max. quarterly basis (see description above).

In the Swiss case study, due to the special role of SES as an electric utility, a combined water and electricity billing system was envisioned.

2.4.3 Preliminary user story for water utilities

A basic mockup of the functionalities envisioned for water utilities is shown in Figure 14 and described in the following paragraphs. It addresses mostly the needs of Thames Water, as it is not clear yet what kind of functionalities would be needed in Switzerland, since SES is not a water supplier themselves but are instead planning to provide the meter readings as a service, e.g. to municipalities. An application for suppliers could be an additional benefit for providing such a service, and it is assumed that many of the functionalities that are required by Thames Water are also appreciated by municipal administrators operating the water supply. E.g. leakage detection were stated to be important aspects by both Thames Water and the municipal representative during the interview we conducted, and they also share the objective to lower consumption in their area and to raise customers' awareness towards a more economical consumption. However, further analysis will be needed to determine their exact needs.

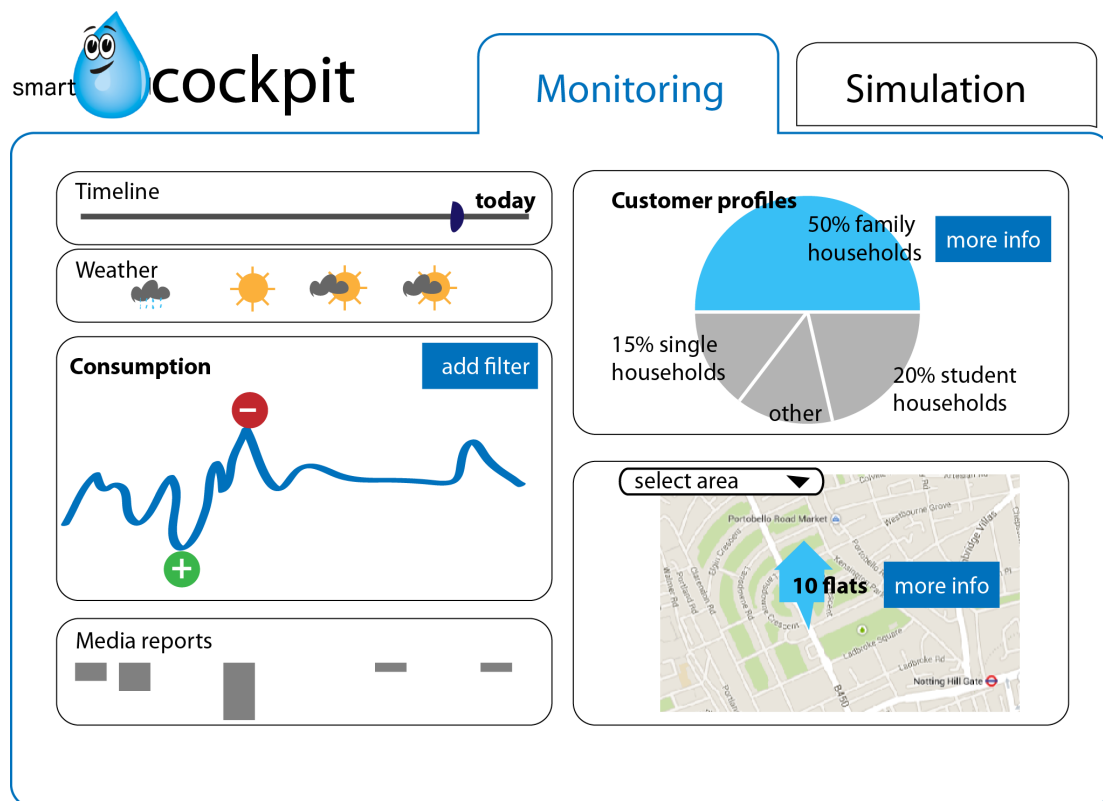


Figure 14 Basic mockup of the water utility interface

Utility user story

With his own user account, John logs onto **the smart cockpit** of his company, a large water supply company in London. He can choose between two modes, the monitoring and the simulation mode. In the monitoring mode, he is presented with statistics of their actual customer base and the actual water consumption in the areas they are supplying, as well as their current fixed supply and metering parameters that are e.g. determined by the specific kind of supply method used (e.g. pumping vs. natural reservoirs) or where and which type of meters are currently in use.

An interactive timeline and city map are enriched with contextual information about weather data, local and general incentive campaigns by the company and reports by the media on selected topics, e.g. droughts and other water-related events.

Based on the data collected by the smart meters, as well as by the **smart bill** system which the

company has recently introduced among their customers, John sees what kinds of customers there are and how much water they are consuming. For the respective neighbourhoods, he can e.g. view statistics on the types of households (socio-economic information) that dominate and their typical consumption patterns.

Navigating through the city map, he can select individual buildings and households to see their characteristics, billing data, utilities and actions linked to their water consumption.

He can identify peak hours of water consumption in a respective area as well as consumption lows. Based on this information, the company can adjust the pumping intensity to maintain a constant pressure level and save energy costs.

In real-time, he can monitor if there are any irregularities in consumption and react accordingly on a daily basis. For large irregularities, the system can also predict the likeliness of leakage in a certain area and whether it is on the customer side or somewhere else in the system. Thus leakages can be discovered and fixed more quickly.

In the simulation mode, John can influence the otherwise fixed parameters to see the effect that could be caused changing them, e.g. when considering new incentive models, pricing schemes etc. He can e.g. see if customers would be likely to change their current behaviour.

2.5 Requirements workshop with technical partners

As an initial feasibility check, the preliminary user stories were presented and discussed in a workshop with technical partners from the SmartH2O project. The workshop was organized at the premises of POLIMI in Como on July 25.

The technical partners considered the user stories technically feasible for most envisioned functionalities. However, some questions were raised to further clarify specific aspects, and few of the ideas are unlikely to be realized for different reasons.

One of the more technical issues that was raised was that households would have different kind of meters, varying from different kind of smart meters to standard meters and no meters. The application will have to accommodate different modalities and ensure equal conditions for participating customers.

Also, it was pointed out that Thames water is involved in another project related to SmartH2O, SmartWater4Europe, where e.g. an application called MyMeter is developed, a basic consumption information website for Thames Water customers. Therefore, touchpoints with the other project should be identified.

For the utility interface, the idea of responsive widgets with a widget library was discussed as one way of implementation and considered highly feasible.

The Swiss user story raised questions with respect to the role of SES as an electric utility. It was discussed whether a municipality could be involved more strongly as an additional stakeholder, as they will be the end user of the utility interface. No final decision was made in this direction, but will be considered later in the project.

2.5.1 Aspects of raising social awareness in the user stories

One of the aspects that will need to be made more explicit especially from the customer point of view is the benefit of engaging customers who are not metered or who have non-smart meters installed in their household. What could be their motivation to provide information to the utility?

Different gamification approaches were identified in the user stories, e.g. cooperation vs. competition. Further research will show if both should be included to address different types of users or whether the application should focus on one.

The idea of “teaming up” was well perceived among the partners, one idea being to involve schools as an entry point, e.g. by engaging different classes to compete against each other. Another discussed possibility was to stimulate competition between different communities, e.g. between the two test sites in each case study.

2.5.2 Aspects of games in the user stories

During the workshop, the other two SmartH2O assets, the physical card game “Drop!” and the corresponding digital mobile game were introduced as well.

As one of the main results of this presentation, it was decided that the mobile game and card game should be considered in the user stories.

Also, there should be a stronger link between the two game assets and the gamified water meter, possibly even a bi-directional communication. This could include the use of smart meter and other consumption information from the customer application in the mobile game, using the mobile game as a means of collecting consumption information or by enabling the exchange of points and results between the gamified customer application and the mobile game.

While the mobile game at this point is still closely linked to the card game, it was furthermore decided to create an alternative gaming mode in the same app, e.g. a Solitaire game, to also address those users who wish not to play the card game.

According to the feedback collected in the requirements workshop with the technical partners, the user stories were modified to include these aspects.

2.5.3 Aspects of innovative pricing models in the user stories

During the workshop, we also discussed how certain aspects of innovative pricing models could be integrated in the user stories.

Discussion of pricing in UK case study

Based on experience from the initial interaction with TWUL, during which they e.g. stated that they will run different tariff trials independently of the SmartH2O project, it was decided that real billing data should not be presented in the SmartH2O application. Instead, other means of informing customers about innovative pricing schemes should be considered in the user stories.

Discussion of pricing in Swiss case study

For the Swiss case study, the idea was to link together water and electricity prices. This idea might not be feasible for two reasons. For once, if e.g. blocking rates are chosen for both water and electricity, it might be mathematically infeasible to link a water tariff formula with an energy tariff. Secondly, SES will be providing the meter information as a service to municipalities rather than billing their own customers' water consumption. The case study in Switzerland will therefore not include real monetary incentives, unless a municipality is willing to get involved.

Following up with the workshop with technical partners in Como, a document was prepared which presented the advantages and disadvantages of pricing schemes, such as traditional two-part tariff, increasing blocking rates (IBRs), real time” dynamic pricing (DP) such as Critical-peak pricing (CPP) or Critical-peak rebates (CPR) and “Mild” dynamic pricing (DP) such as Seasonal pricing (SP) and Peak load pricing (PLP). In this document, some reflections were reported:

- As far as seasonal pricing, peak-load pricing, IBRs and real-time DP are concerned, econometric analysis on "historical data" are not feasible with UK data. Nevertheless current efforts to collect data should allow us to estimate the impact of increases in traditional tariffs and maybe IBPs in Switzerland.
- A meeting with Swiss utilities, similar to the Reading meeting with TWUL, can be helpful.

- IBRs are a significant price measure to study (e.g. blocking rates, number of blocks, thresholds etc.) also because it has not been researched in UK before. It can be combined with some concepts borrowed from milder DP options. Two option examples are as follows: (i) an IBR water tariff scheme could be potentially linked with the energy use and price; (ii) a volumetric penalty charge for high volume use can be implemented during peak hours.

These suggestions along with how to integrate pricing in user stories were further discussed among the technical partners. Therefore, it has been decided that increasing Block Rates will be included in a light simulation version into the gamified app for consumers. The idea is to visualize the effect that increasing block rates have on the users' bill if they had opted for this in real life. For each week or month, they could opt for either traditional pricing or block rates and collect points and rewards accordingly, while the app would also show if they had saved money or lost money with the chosen tariff compared to the other one.

2.6 Requirements workshops with target users

In this section, the performed activities and results of the three separate requirements workshops with target users (consumers in Switzerland and the UK, water utility managers and staff from Thames Water) are described.

The slightly modified version of the preliminary user stories, presented visually in a story telling way with a refined set of early mockups (see Section 3), were used as input for the workshops with the target users in order to elicit their feedback, requirements and ideas for the refined user stories corresponding to user needs.

2.6.1 Consumer requirements workshop for Swiss case study

To get feedback on the user stories and mockups from local residents in the Swiss case study area, a workshop was organized in the commune of Tegna as part of a public forum informing participants about the SmartH2O project and the new smart metering initiative in general. The workshop was attended by about 30 local residents, which was a great success.

The user stories and mockups were presented after the more formal introduction of the project by the project manager, mayor and a SES representative. During the presentation, participants were encouraged to note down positive and negative impressions as well as ideas and questions using a prepared template. The presentation was followed by a discussion.

The main insights that were gained in the discussion are:

- Some participants were asking how they would personally benefit from such an application from a more practical perspective. Such benefits may include online meter data access without having to access it manually in difficult places, much higher resolution gives more accurate and useful feedback, one can easier estimate the consumption costs and see what one could do to decrease it. Lesson learned: highlight most obvious benefits when introducing the concept before introducing e.g. gamification elements.
- Suggestion of additional basic functionalities like leakage alert was well received.
- A participant from a local environmental initiative suggested to include a water quality indicator which was also well received (non-drinkability alarm, there are regular controls throughout the year already⁵⁶).
- Idea to alarm residents via a smartphone app was considered a great potential benefit.

⁵ L'Associazione Acquedotti Ticinesi: <http://acquedotti.ch/> (last seen 27/11/2014)

⁶ Laboratorio Cantonale: <http://www4.ti.ch/dss/dsp/lc/laboratorio/> (last seen 27/11/2014)

- Participants were interested in knowing how much water and money everyone would save together in the municipality, and to have a possibility to make use of this saved water and money collectively for other communal projects and spending.
- Most participants found it useful to be able to visually compare their own average with that of others, being especially interested in the total average of the community rather than their neighbours'. Participants would also be interested in comparing their own average from the current year to the previous.
- The question was raised of how different types of consumers could be considered, e.g. those with large gardens. This could be targeted with different innovative pricing models (see 2nd Scenario on innovative pricing schemes).
- Interest for incentive schemes was shown, including point-based systems linked to different types of reward redeem schemes (e.g. water saving gadgets from the utilities).

Following the first insight of the need to better highlight more basic functionalities that could appeal to a larger group of users, we derived the requirement to divide the application into a more basic version providing information and alerts, and an advanced version that interactively involves those users that are more open to concepts like gamification. Accordingly, mockups of a basic water meter application were designed and presented in the consumer workshop for the UK case study.

2.6.2 Consumer requirements workshop for UK case study

To obtain feedback from UK residents, we conducted a workshop at the premises of the University of Manchester, as we can safely assume water characteristics, attitudes towards water efficiency and water consumption per capita in Manchester to be comparable to the case study area of Reading near London (see Section 2.3.1 for comparison between North and South England); 11 local residents attended the workshop.

User Stories and Mockups which have been adjusted according to some of the key insights from the Swiss Case study workshop were presented in two sessions, each of which was followed by a discussion to reduce cognitive workload for participants and be able to address different topics.

The first session aimed at explaining both the basic water meter application and the gamified, advanced version, by addressing the user as an individual who is focused on their own household consumption (e.g. fulfilling water saving goals, providing household information to the utility). The second session focused on those elements that should foster competition with other users and households, collective action by achieving common goals and teaming up with other users.

As possible incentives and rewards for accomplished goals, participants suggested several different ones and were in agreement that the best way was to provide different types to be able to stimulate different types of consumers. Rewards were considered potentially powerful to motivate users, especially for those not environmentally conscious and examples included:

- Monetary rewards: better rates, discount on bill
- Gadget rewards: water saving technology (showerheads etc.), filter for water quality improvement in the household (water quality / taste of drinking water is often not good)
- Other kind of rewards, e.g. discount on mobile phone plan
- Environmental incentive: donate your points to a water charity

Asked about their consumption in general, participants revealed that they knew little about how much water they used. They stated that tips for wise water using would be appreciated, as well as alerts: "Knowing that there is a water shortage would probably make people use less water".

Participants also stated that they were not really aware of any actions undertaken by the

utility, such as maintenance of the infrastructure. An application like this however could bring utilities closer to their customers and provide utilities with more direct communication channels.

The idea of a mobile app to monitor their water consumption was considered very appealing, especially for quick access and alerts, like a water quality alert pop-up. They also said that they would ideally like to have both a web and mobile application.

An interesting statement that was made and that was shared by the majority of participants was: "I would probably watch my consumption closely for 1 month or 2 and then once I understood the implications and cost I would adjust my behaviour and not use the app that much any more". This indicates that they would be willing to use it in the short-term, feeling like this would already improve their behaviour significantly. To keep users interested in the long-term, stimulating competition and cooperation among users can be the crucial factor. It can create a strong sense of community and ensure a more long-term engagement with even more effective learning effects.

One idea that was voiced and found sensible by most was to link rewards to individual user actions (e.g. watering plants saving measure, discount / bonus tied to this very action etc.). This concept strongly relates to a badge system and could therefore prove effective in the application.

In the second session, participants first of all were concerned of cheaters, something that had not come up in the first session, which only concerned their individual household. One participant e.g. asked: "What happens if you provide information you haven't actually done (taking a shower etc.)?"

Another concern that will need to be considered was how absence of the household would effect the competition: "What happens if you are away? Are you out of the competition? Do you get points because you are saving water by not consuming?" Such issues can be addressed with the consumption model that is planned as part of the SmartH2O project, which would allow verifying much of the information provided by users.

The notion of competing against neighbours was not particularly stimulating. However, they would consider competition with family and friends whom they feel they could trust more and would feel more connected to.

On the other hand, the idea of pursuing joint goals as a neighbourhood or community and of receiving common rewards, which was brought up during the workshop in Tegna, sparked enthusiastic responses. "Could be a good experience, Get to know your neighbours better, especially in urban areas people don't know their neighbours any more, nice to be a kind of community."

2.6.3 Utilities requirements workshop with Thames Water

Thames Water utility managers and staff were involved and asked to provide feedback during the second SmartH2O project meeting held in Reading. There, user stories and mockups of the customer and the utility interface were briefly presented during the main "Interaction with Thames Water" session which was attended by 18 Thames Water employees, while a smaller focus group workshop of five participants was arranged afterwards.

An important objective Thames Water is interested in is to better quantify consumption for customers to increase their awareness of how much water they consume and waste.

Enabling customers to compare their own consumption to the aggregated neighbourhood average was well received. It was also stated that preferences to distinguish those users who opt into neighbourhood competition from others would be needed.

A more general observation that was shared was that gardening also played an important role in consumption in suburban areas in Greater London, which is in parallel with one of the main issues in Tegna and which can therefore be considered for both case studies.

Including alert functionalities like leakage and water quality warnings for customers are not a

priority for Thames Water. Quality information is e.g. only available on a yearly basis as a kind of history. Such alerts will therefore be considered mainly for the Swiss case study.

Real billing data should be kept separate from the SmartH2O application. Instead, a kind of billing estimate should be presented that shows how much customers would be expected to pay according to the meter data and household information they provide.

Also, the smartH2O application development process should be synchronized with other existing Thames Water applications and initiatives, e.g. with those previously presented by Thames Water. It will also be important to apply the Thames Water Look and Feel to such a customer-oriented application.

In the utility interface, it could be feasible and provide valuable insights to compare consumption data with pumping data in the visual widget. Also, one of the most positively perceived functionalities was the simulation of the effect of different rewards for different customer clusters.

Finally, the functionality that would allow them to cluster customers based on their actions on the platform was very well received. E.g., Thames Water is very interested in being able to provide consumption advice to customers based on their habits and household attributes, such as addressing all “king gardeners”, and tailoring rewards to habits and behaviour, e.g. give them more specific devices.

3. User stories

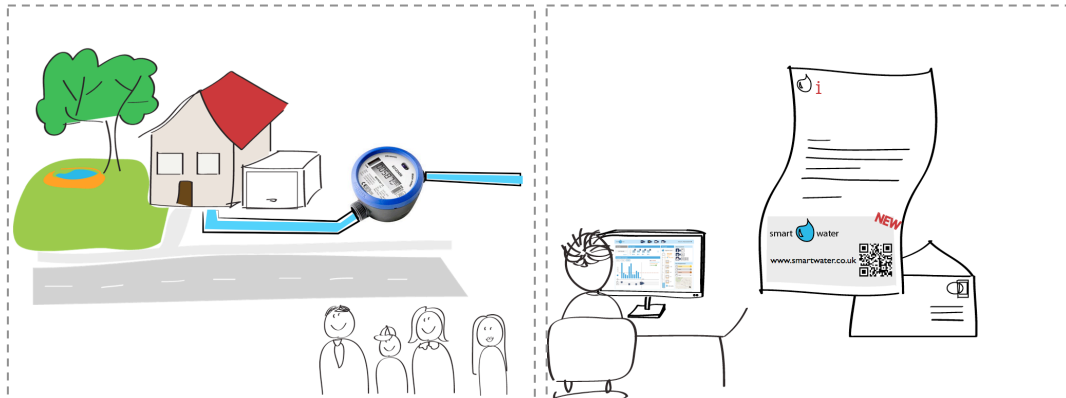
Based on the requirements workshop with target users and technical partners, the preliminary user stories were revised and divided into sub-stories. They were also illustrated to support the narrative during the workshops. This process resulted in the following list of user stories:

- | | |
|----|-----------------------------------------------------------------------------------|
| 1A | Visual exploration of water consumption data (consumer) |
| 1B | Visual exploration of water consumption at fixture/appliance level (consumer) |
| 2A | Earning rewards by water saving and information collection (consumer) |
| 2B | Saving water with family, friends and neighbours (consumer) |
| 2C | Saving water by playing augmented card games (consumer) |
| 3 | Monitoring customer consumption behaviour and household characteristics (utility) |
| 4A | Predicting water consumption behaviour by customer segment (utility) |
| 4B | Predicting appropriate customer response to specific rewards schemes (utility) |

3.1 Visual exploration of water consumption information (1A)

Goal: Raising individual water consumption awareness by visualizing metered consumption data and providing water saving tips.

Using his desktop computer, John Miller opens the **visual water meter** app. He signs in with his name and customer reference number and sees how much water his family has consumed during the past day, week, and month and how much they would pay if their household was billed according to the metered consumption. Their consumption information is presented in a fun and interactive visual widget where he can also see different metrics, e.g. the peaks and lows of their water use over time. He can overlay their water use with statistics of his neighbourhood and with average consumption data of his city or country. Looking at the consumption from the last month, he is shocked to see a strong peak marked as a very bad performance, especially in comparison to his neighbours. Then he remembers guiltily that it was the days following their son's birthday, where it had for once been very hot, which led them to water the garden twice as often. The app also shows some water saving tips and alerts John in case of emergency, like low water quality, leaks or water shortage.



3.2 Visual exploration of water consumption at fixture/appliance level (1B)

Goals:

- Raising end use water consumption awareness by visualizing end use consumption
- Providing personalized feedback for water saving.

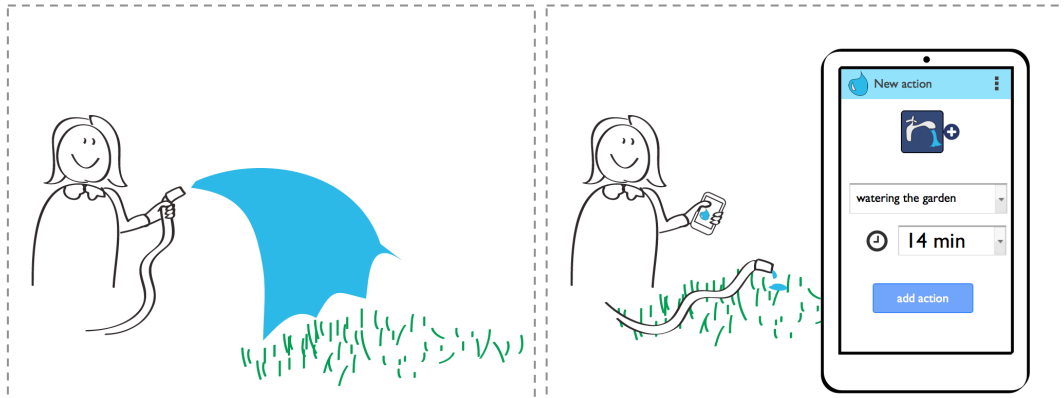
The app provides John a detailed report on the end use water consumption in his house, which allows understanding the fraction of water consumed by each appliance/fixture in a given period of time (e.g., how much water has been used for gardening, dish washing, clothes washing, or showers). Looking at the disaggregate end use water consumption, John realizes that the water used for showers is almost double then the consumption by his neighbours. Therefore, he suggests his wife to have shorter showers, and he plans to substitute the showerhead with a water-saving one. The app also informs John that his family is using an old low-efficient washing machine, and it quantifies the financial saving that he might have by replacing his washing machine with a new high efficiency one.

3.3 Earning rewards by water saving and information collection (2A)

Goal: Gamification of individual water consumption and household data provision through points, goals and rewards to raise individual awareness of water consumption and stimulate water saving

In addition to the visual water meter, customers can activate the **gamified water meter**. There, the water utility company challenges them with a water-saving goal each month to be achieved, e.g. staying under a certain consumption average or taking specific water saving actions.

When activating the gamified water meter, John also sees his current status as a beginner saver based on the number of points he has collected. The application even shows him which kind of actions he could undertake to get more points. E.g. he can type in his meter data manually, add a new water consumption action (e.g. “watering the garden for 15 min”) or complete his customer profile (e.g. how many family members there are, what kind of appliances they have). For each added consumption action, the application also provides information on how much water is usually consumed. For now, Mr Miller decides to watch a short presentation about the latest water saving tips, which earns him 10 points. He is surprised how serious the water stress situation has been in the London area in the past. When Mr Miller checks his score again he sees that he only needs 150 more points to redeem a “10% off at the cinema” voucher as a reward and 1350 more points to receive a high quality water saving showerhead.



3.4 Saving water with family, friends and neighbours (2B)

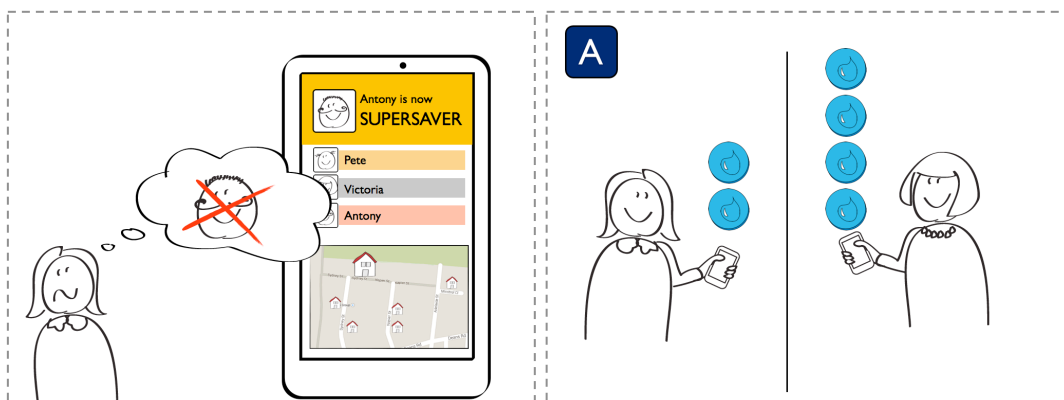
Goal: Raising water consumption awareness collectively by saving water with family, friends and neighbors

Instead of saving water by himself, John can invite the rest of his family to join, and save water collaboratively with friends, family and neighbors.

Since John knows that he will not always have time to login and participate in the water saving activities, he also adds his wife and teenage daughter to the household. They both get an invitation to join the **gamified water meter** via the web or mobile app to start saving water, too. Especially the daughter really likes the smartphone app and challenges her friends to sign up on behalf of their families.

After signing up, John's wife Carol also opts in to share her score with other users. Now she sees where the other users who have also opted for this feature live on the neighbourhood's map and who out of their circle of friends is participating. She sees that Anthony from down the road is in the lead! The application even shows Carol which actions she could undertake to get more points than Anthony. To increase her chances, she forms a water saving alliance with Valeria from next door. This means that from now on, they benefit from each other's water saving actions. They team up and have soon caught up with Anthony because each time one of them performs a water saving action, the other also gets some points.

There is also a common neighbourhood water saving goal for each month for which they can collaboratively work together to achieve it. If they hit their target consumption average, they get a special community reward from the utility.



3.5 Learning interactively about innovative pricing (2C)

Goal: Gamification of individual water consumption and pricing schemes (i.e. tariff schemes) such as blocking rates and seasonal tariffs to raise awareness of water consumption and

pricing schemes and stimulate water saving

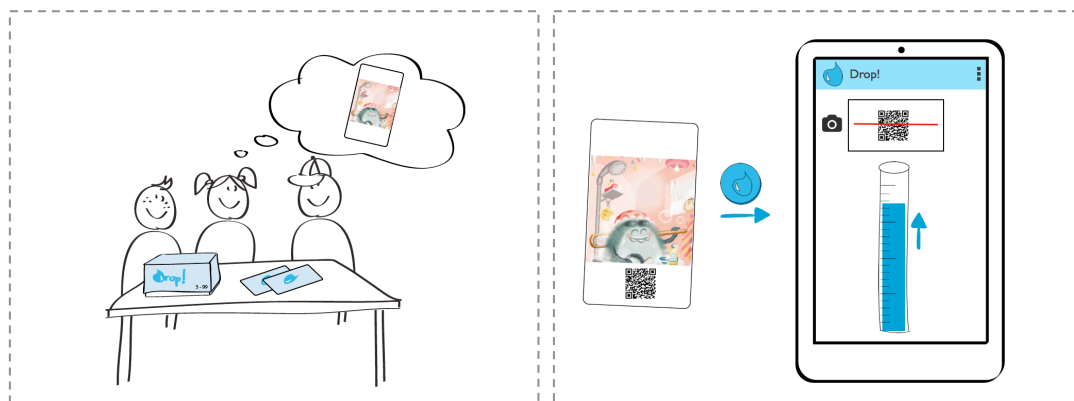
After having visualized the water consumption profile of his family, John Miller can gain knowledge on the exact cost of the amount of water they consume. If they are charged through a flat water tariff, Mr Miller will be soon aware of the unresponsiveness of the bill to his family achievement in terms of water saving. At this stage, however, he has the chance to compare the cost of water consumption among different pricing schemes. In this way, he will discover that if they were charged through an increasing block rate scheme, the prospective bill would have been 10% less costly.

3.6 Saving water by playing augmented card games (2D)

Goal: Raising water consumption awareness of younger children to motivate the family as a whole to save water

As a thank you for signing up, the utility sends out the “push your luck” card game **Drop!** that can be played by the whole family. It’s all about avoiding the water waster monster with his bad habits! **Drop!** can also be played in combination with a mobile app, where the users can teach the monster how to improve his bad habits and provide additional household information for the utility. When successful, they earn points. Family members can log in with their **gamified water meter** account to redeem the **points** earned in the mobile game.

The Millers’ son loves the **Drop!** monsters and shows the game to his friends at school. Together, they form an even bigger water saving alliance than John and Valeria – the whole class is the alliance – and they are playing to achieve a common goal to earn a reward for their whole class.



3.7 Monitoring customer consumption behaviour and household characteristics (3)

Goals:

- Identifying e.g. leakage or consumption metrics of customers to take action (e.g. adjust pumping, fix leaks, adapt pricing schemes)
- Identifying specific customer segments to provide more appropriate and targeted incentives

Mark is a 48-year-old employee at a large water utility company in London. Mark logs onto the smart water **business dashboard**. He can choose between two modes, the monitoring and the simulation mode. In the monitoring mode, he is presented with statistics of their actual customer base and the actual water consumption in the areas they are supplying, as well as their current fixed supply and metering parameters that are e.g. determined by the specific kind of supply method used (e.g. pumping vs. natural reservoirs) or where and which type of meters are currently in use.

An interactive timeline and city map are enriched with contextual information about weather data, local and general incentive campaigns by the company and reports by the media on selected topics, e.g. droughts and other water-related events.

Navigating through the city map, he can select individual districts and households to see their characteristics, billing data, utilities and actions linked to their water consumption. He can identify peak hours of water consumption in a respective area as well as consumption lows. Based on this information, the company can adjust the pumping intensity to maintain a constant pressure level and save energy costs.

In real-time, he can monitor if there are any irregularities in consumption and react accordingly on a daily basis. For large irregularities, the system can also predict the likeliness of leakage in a certain area and whether it is on the customer side or somewhere else in the system. Thus leakages can be discovered and fixed quickly.

Based on the data collected by the smart meters, as well as by the **gamified water meter** system which the company has recently introduced among their customers, Mark sees what kinds of customers there are and how much water they are consuming. For the respective neighbourhoods, he can e.g. view statistics on the types of households (socio-economic information) that dominate and their typical consumption patterns. He can also identify specific customer segments and define tailored reward schemes for them.

3.8 Predicting water consumption behaviour by customer segment (4A)

Goal: water consumption prediction by customer segment based on past information and customer segment def. from information available in the app

In the simulation mode, Mark can influence the otherwise fixed parameters (e.g., weather data, increased demographics, increased usage of low-flow and high-efficiency plumbing fixtures). Based on behavioural models from customers' past behaviour on the gamified water meter system, e.g. undertaken actions and consumption behaviour, the system can predict likely consumption behaviour for individual customer segments, thus proposing personalized social awareness campaigns/incentives for each customer segment. Furthermore, Mark can also see the aggregate short- and long-term water demand forecast at a district scale. Based on the predicted water consumption, Mark can compare the current water supply and the future water demand. Thus, he can plan corrective actions to bridge the gap between supply and demand, such as time-of-day tariffs to incentivize customers to differ the usage of some water appliances to peak-off hours.

3.9 Predicting customer response to specific rewards schemes (4B)

Goal: prediction of customer water consumption response to specific reward scheme / incentive

Based on behavioural models from customers' past behaviour on the gamified water meter system, e.g. undertaken actions and consumption behaviour, the system can predict likely consumption behaviour for individual customer segments based on different incentive schemes, e.g. different kinds of rewards mechanisms.

Based on the past and predicted water consumption, Mark can gain knowledge about current water supply and future water demand. In this way, he will plan corrective actions for saving water and will explore the different reward schemes e.g. discount on his bill that he can receive when water savings are achieved.

3.10 Predicting pricing models for specific customer segments (4C)

Goal: Prediction of customer water consumption response to specific pricing schemes such as blocking rates and seasonal tariffs.

Based on pricing models from customers' past behaviour on the gamified water meter system, the system can predict likely consumption behaviour for individual customer segments based on different pricing schemes, e.g. blocking rates.

Accordingly, in the simulation mode Mark can choose the pricing policy on which he wants to run the simulation and get the predicted water consumption. In addition, he can apply different pricing policies to different customer segments. This will allow him to target pricing policies in order to maximize water savings.

4. Early mockups

The next section presents and explains the early mockups, which are based on the refined user stories.

4.1 Customer portal

The smarth2O customer portal provides customers access to their water consumption information. It will be available as a basic version that focuses on the basic water meter access, and an advanced version (see Figure 15). The latter will be a gamified platform, which enables interactive water saving, raises customers' individual awareness of their consumption and their social awareness by enabling them to compare themselves directly with others. Gamification mechanisms like collecting points, badges and rewards and comparing one's consumption to others via e.g. leaderboards are leveraged to accomplish these goals.

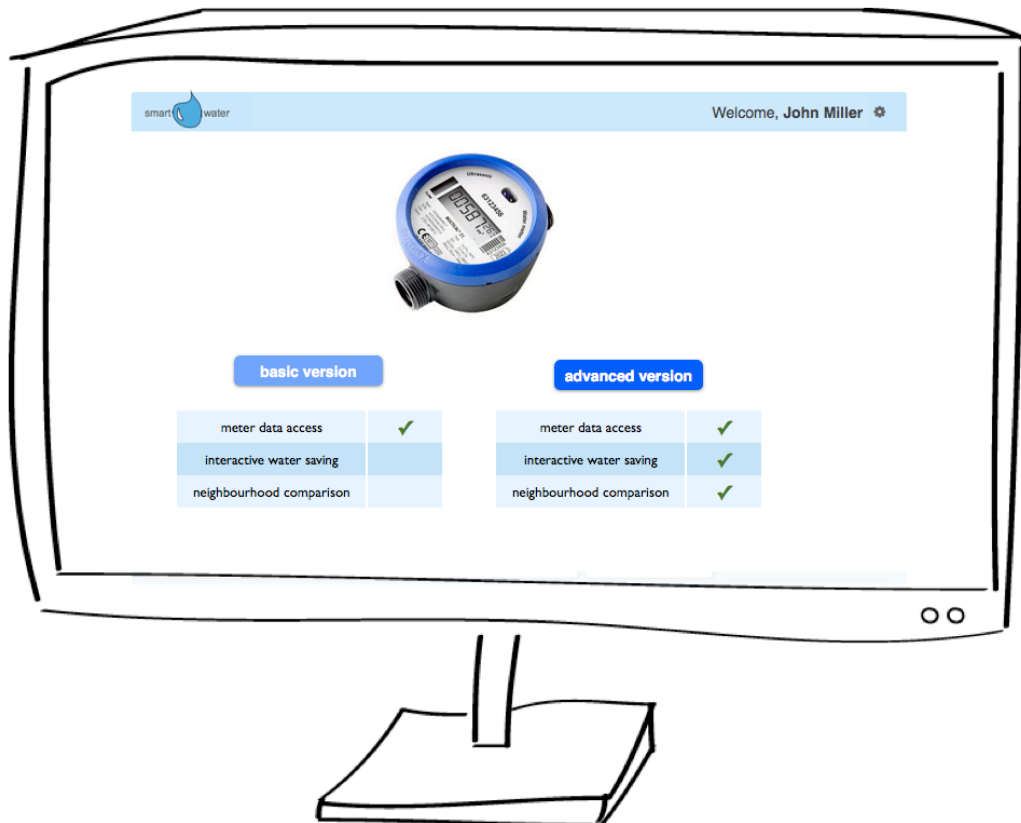


Figure 15. Customer portal home page, which links both to the basic and the advanced, gamified version.

4.1.1 Basic customer portal: Visual water meter

User stories: 1A, 1B

The visual water meter provides customers with the most basic access to their consumption information. It connects to the meter data that is either collected automatically via smart meters, or provided manually by customers who have easily accessible standard meters and want to use the application as well.

A visual widget displays the consumption over time and calculates the average consumption of the user's household (see Figure 16). It can also calculate other important metrics like peak hours. These average can also be compared to other aggregated consumption information, e.g. to the neighbourhood's or town's consumption average. Based on the consumption information, the application can calculate a "virtual bill" that shows how much a household would have to pay approximately if it was billed based on the smart meter information.

Secondly, the basic application can also provide alerts, e.g. warning the user about possible leaks or bad water quality. As found out in the requirements workshops, these alerts are more important for the Swiss case study. Additionally, the application can also display water saving tips and info material like videos providing information about topics related to water saving.



Figure 16. Mockup of visual water meter.

4.1.2 Advanced customer portal: Gamified water meter

User stories: 1A, 1B, 2A, 2B, 2C

Besides the functionalities that are available in the basic visual water meter, the gamified water meter provides much more interactive and “gamified” means for customers to learn about water saving and contribute and benefit from additional information (see Figure 17 for an overview of the application).

The application should be available as a web version and a mobile application, each providing the same functionalities (see Figure 18 for mobile application mockups).



Figure 17 Mockup gamified water meter web application.



Figure 18. Mockups of gamified water meter mobile application.

Gamifying such an application means that besides learning about their consumption,

customers can earn credit points for each action they perform in the application. With these points they can reach different levels and earn badges, and based on their status, they can eventually redeem the points for different kinds of rewards, e.g. water saving gadgets (see Section 2.6.2 for other possible rewards). The collected points are visualized in a way that also suggests users a series of action that would lead to reaching the next level (see Figure 19).

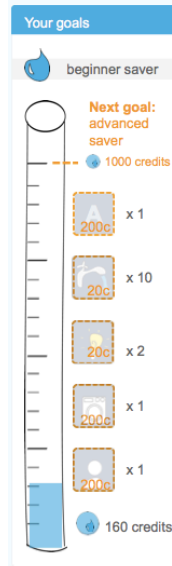


Figure 19. Visualization of collected points.

Possible user actions as envisioned for the gamified water meter application are described below.

User action: Providing household information like number and demographics of household members (see Figure 20), number and kinds of appliances (see Figure 21) or general information like number of rooms, size of garden (see data model in section 5 for the full list of customer attributes that could be considered).

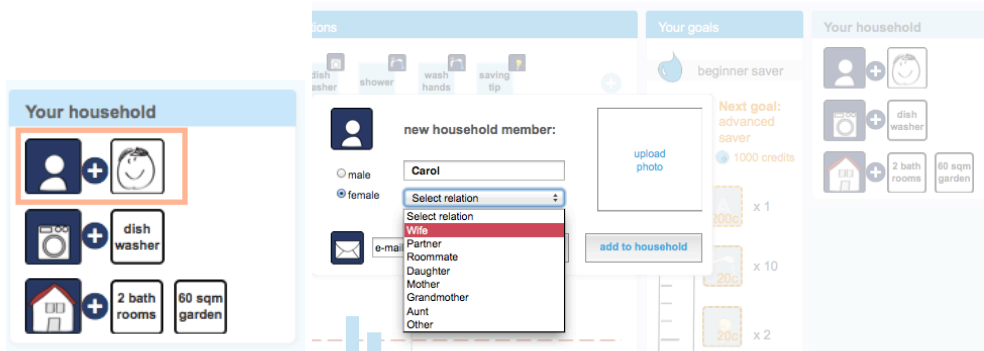


Figure 20. User action: providing household information – adding a household member.

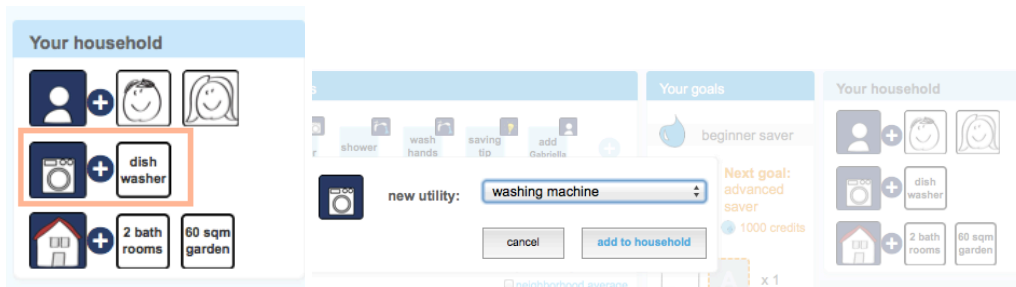


Figure 21. User action: providing household information – type of appliances.

User action: Providing consumption information of specific end use events like “10 min. shower at 7am” or “14 min. watering the garden”.

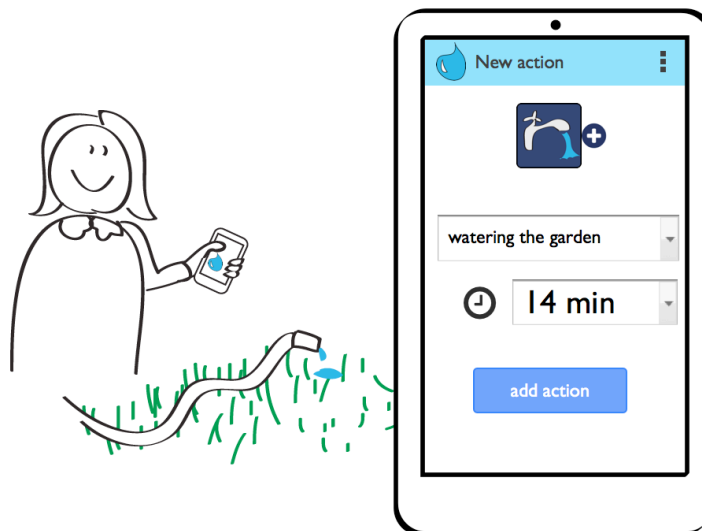


Figure 22. User action: providing consumption information – specific end use events.

User action: Fulfilling consumption goals that were set either by the utility or the customers themselves (see Figure 23).

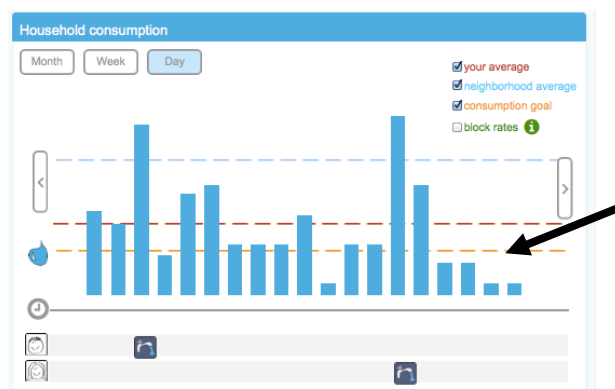


Figure 23. User action: fulfilling consumption goals based on consumption average.

User action: Reading / watching / listening to water saving tips in separate section that provides info material like videos or slide shows on water saving and sustainable consumption (see Figure 24).

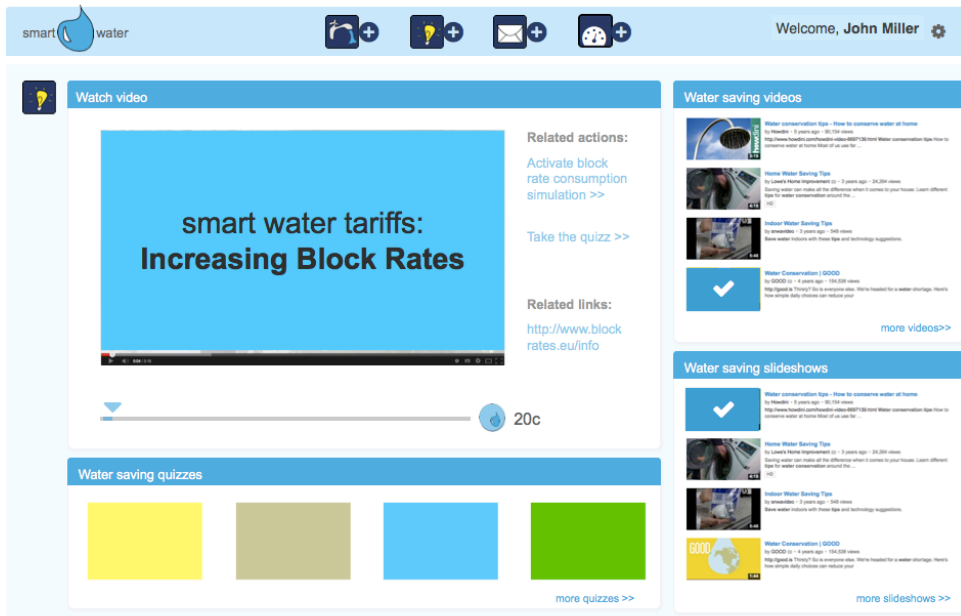


Figure 24. User action: consuming information material like videos, slide shows, and other water saving tips.

User action: Learning about innovative pricing models by simulating tariff blocks rates in the visual widget. Thus, customers can understand the potential impact of innovative pricing models if they were to be applied to their current consumption (see Figure 25).

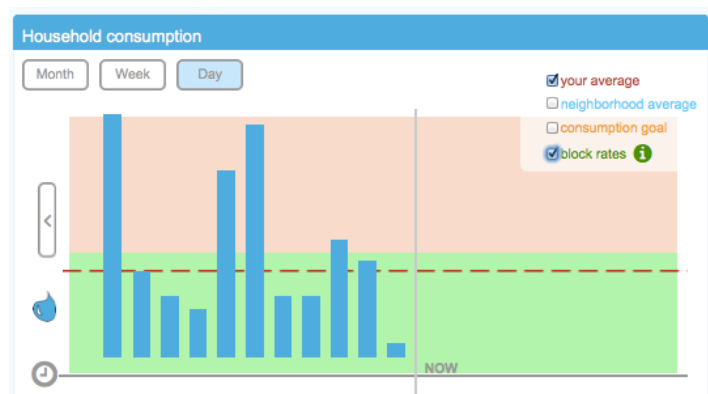


Figure 25. Innovative pricing simulated in gamified water meter (here: block rates).

In addition to considering ones own actions, users can compare themselves directly with family, friends and neighbours by allowing the application to show them in the leaderboard. There, each user is listed with his level and total of points (see Figure 26). Top ranking users can be identified and rewarded in addition to their individual rewards.

Users can also team up with others to benefit from each others' points, and work towards achieving common goals as a target group of users, e.g. a circle of friends or all inhabitants of a participating town.

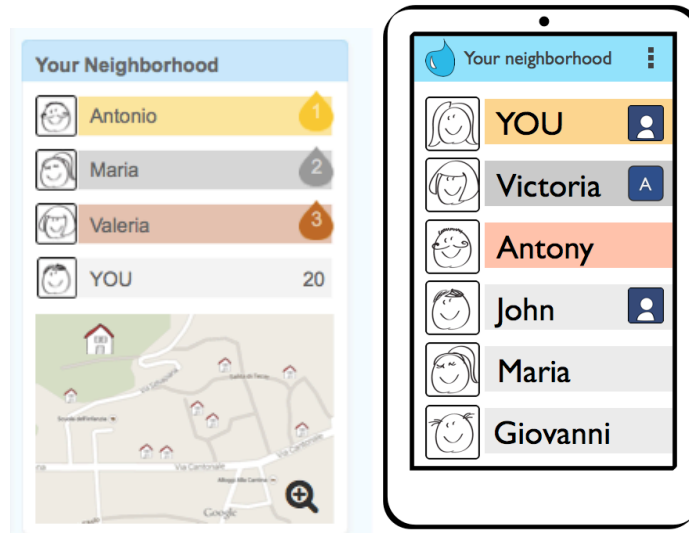


Figure 26. Leaderboard in web and mobile app.

4.2 Games Platform

User stories: 2D

The games platform connects a physical card game called “Drop!” with a digital mobile app. Points earned in the mobile game can also be used in the gamified water meter applications, if the accounts are connected.

The goals of the games platform are to leverage game techniques of a card game and augment them with a digital mobile app to:

- Raise awareness of water saving and of how to prevent wasteful water consumption among younger children
- Engage all members of a family household
- Gather useful data for the specific utility to be used to base marketing and commercial decisions upon.

The overall concept of the game is about the story of a kid and his monster. The two are always together playing and messing around. When playing, they encounter many different water-related activities and while the kid, remembering his parents' teachings, adopts water-saving behaviour, the monster is always so clumsy that he wastes a lot of water. Therefore, the kid tries to teach the monster not to waste water and along the way the player will be in charge of this teaching as well.

With the playful graphics, we want to leverage on the juvenile adventure nostalgia on the grown ups and in a direct engagement in the young players.

4.2.1 Drop! card game

The card game Drop! is based on a system known as "push your luck": Technically speaking, this is a game where you get points only if you stop at the right time, before hitting a penalty that makes you lose everything. The mechanism has been adapted to the type of audience and introduces the possibility of winning thanks to his fortune or at the misfortune of others. It consists of regular playing cards, which have different numeric values, and “bad” cards

showing the water wasting monster and a unique QR code (see Figure 27). The rules of the card game are the following:

1. Shuffle the deck and choose who starts (usually the younger one)
2. The current player takes the deck and declares how many good cards she will be able to flip without finding the monster.
3. The player on her left has two choices: taking the deck and declaring an higher number of cards to be flipped or challenge the current player to flip the cards
4. If the current player is challenged and is able to flip the declared number of cards, he scores points based on the value of the cards flipped, but only counting each number once (e.g. 2 cards showing 7 count just as 7 points).
5. If a monster card is flipped, the current turn stops. The current player keeps the monster card in front of him, while the player that has challenged him distributes a card among the ones that have been flipped to each player.
6. It is possible to keep scores with coins put in front of the players.
7. The good cards are ALWAYS shuffled back into the deck that is then shuffled again to start a new round.
8. The monster cards on the other hands are always kept in front of the player that has drawn them and count as -10 points at the end of the match. The negative score can be turned in positive points by using the app and scanning the qr code on the card; trivia questions will be given to the players as a challenge in order to convert the points.
9. The match ends when 8 monsters out of the 15 present in the deck have been flipped.



Figure 27. Drop! card game prototype.

4.2.2 Mobile game app

The accompanying mobile app will deliver different features aiming at engaging the user, which are all accessible via the start screen (see Figure 28). The main goals of the app are:

- Getting the user on board.
- Get information about users' behaviours and habits.
- Teach good behaviours by Baby Step techniques (Fogg 2011).
- Deliver a single player game experience.
- Enhanced card game experience.

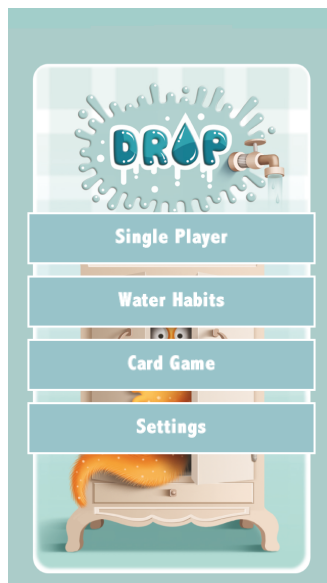


Figure 28. Start screen mockup of mobile game app.

The card game concept requires a connection with the app as follows:

As soon as the board game finishes, all players that ended up with monster cards can try to convert them into points.

The process requires that with the app, the player scans the card she wants to convert with the smartphone camera. The app reads the QR code and launches a mini-game (see Figure 29, left screen).

The mini-game will be composed of two parts.

Part 1) Skill game: The monster was not a great water saving buddy and now his fur is full of water. In order to recover the water and save it, the player will need to tap as fast as he can on the monster. At each tap some water from the monster's fur will be squeezed into a tank. Saving at least 80% of the water will earn the player 5 points.

Part 2) Trivia: As soon as the skill game ends, the trivia will pop up and a question will be asked with 3-4 answers (see Figure 29, centre screen). Providing the correct answers will grant the user 5 more points.

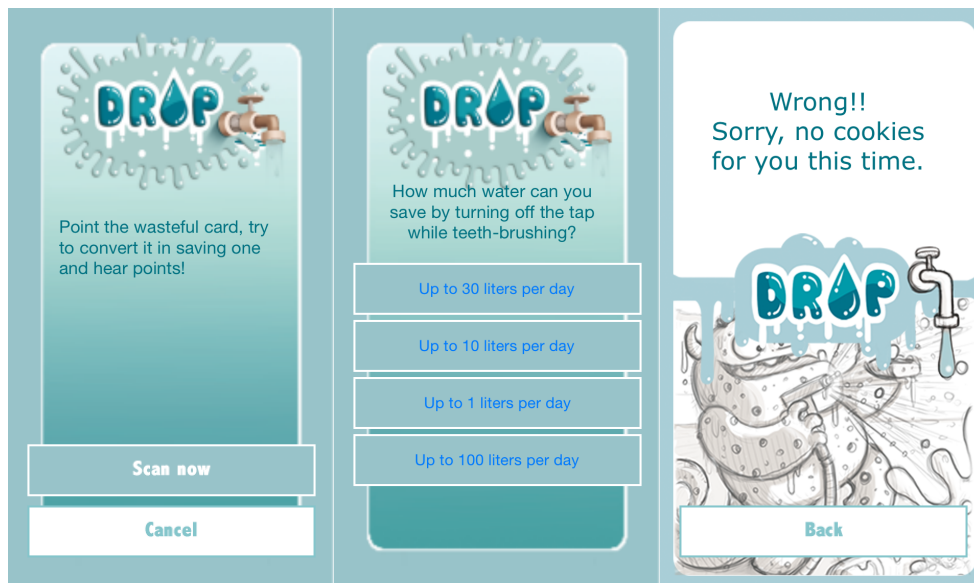


Figure 29. Mobile app mini-game mockup: It connects with the card game. The user scans the water monster card (left) and answers trivia question to earn extra points (centre). Wrong answers result in no points (right).

The single player game will be a “Pipe” game (see Figure 30, left). The player will be guided through 35 levels of increasing difficulties (see Figure 30, right). Each level represents a drop of water on its journey through a labyrinth of pipes, undertaken by the user and the monster. Every complete level will earn the user a “drop” to be used as a reward on the gamified water meter. The levels will not be stand-alone levels but have to be completed in a path-like style.



Figure 30 Single Player mobile game mockup: journey of the drop of water through the pipes in a level (left) and level selection (right)

Game Play of single player game: At the start of the level the board of unordered and messy pipes will be laid down. Water will start to flow from the top pipe and as soon as it will start to leak because the pipe is not connected to another one, the level ends. The player needs to rotate the pipes, some will be turns and others will be straight pipes, in order to

guide the water from the tank to the recycler. The higher the level, the higher will be the number of rotated pieces and the number of rotation of each.

4.3 Business dashboard

The Business Dashboard for water utilities consists of a monitoring application and a simulation application. They are described in the following sections.

4.3.1 Business dashboard: Customer consumption monitor

User story: 3

As one of two applications that make up the Business Dashboard for water utilities, the Customer Consumption Monitor aggregates and visualizes the data that is collected via the smart meters and the customer portal. With the Monitor, utility staff can easily access and explore this information (see Figure 31 for an overview of the application mockup).



Figure 31 Mockup Customer consumption monitor

Based on a selected geo-location, the utility user can view consumption data on different resolutions, e.g. aggregated information for a whole city or district (borough), or even per household level (see Figure 32). The can compare different consumption metrics, including the amount of water consumed vs. the amount of water pumped into a certain area. Exogenous information like weather data can also be displayed.

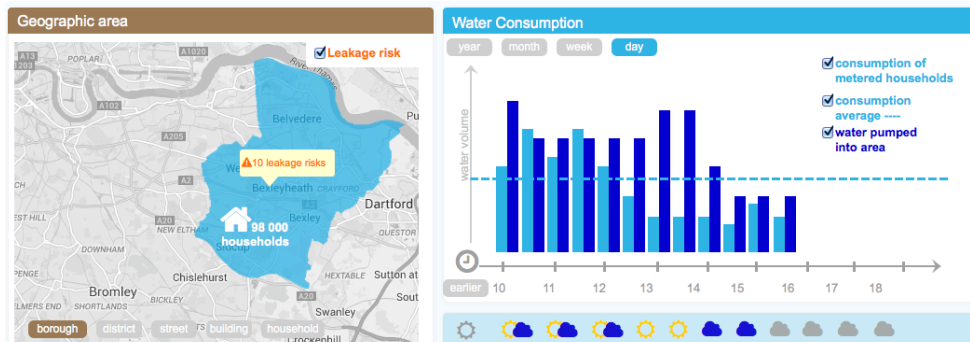


Figure 32 Visualizing consumption information based on geo-location

The Monitor furthermore provides information about customer activity on the Gamified Water Meter (see Figure 33). E.g. utilities can identify most active users (“super savers”. They can also see which kind of attributes these users share, allowing them to identify more specific customer segments based on their activity on the portal.

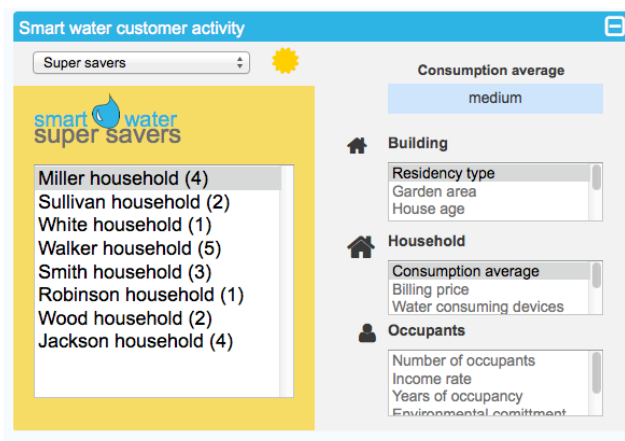


Figure 33. Monitoring user actions on the Gamified Water Meter.

Utilities can also identify and specifically monitor customer segments or customers groups by selecting shared average household data from customers in the selected geo-location, e.g. all customers who have a low environmental commitment, a medium shower consumption and no garden (see Figure 34). The household data is collected both by smart meters and by the Gamified Water Meter application. The possible attributes are those specified in the Data Model (see Section 5). Each of the configured customer segments can be saved and thus monitored continuously. Utilities can also assign specific consumption goals for a defined customer group (see Figure 35).

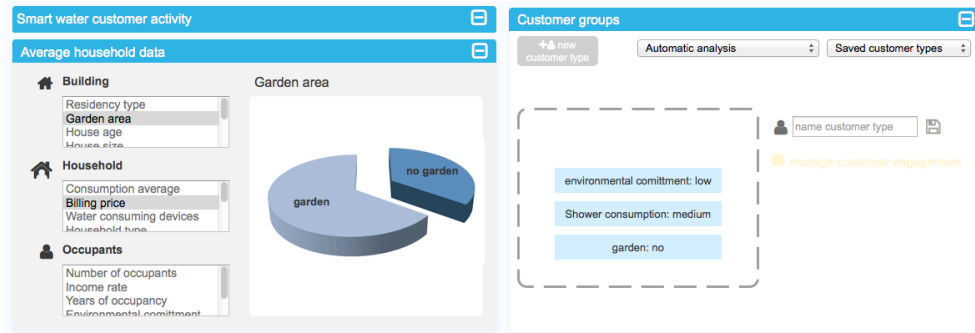


Figure 34. Identifying customer groups by selecting common household attributes.

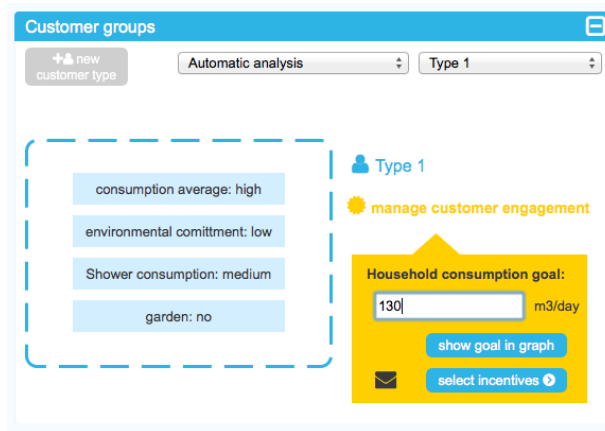


Figure 35 Assigning consumption goals for specified customer groups

4.3.2 Business dashboard: Customer consumption simulator

User stories: 4A, 4B, 4C

The Customer Consumption Simulator enables utilities to not only monitor actual water consumption, but to simulate consumption based on changed parameters (see Figure 36 for an overview of the application). E.g. they could change exogenous data like weather conditions and simulate possible consumption patterns for a specific geo-location and customer group under these new conditions. They could also change reward schemes, e.g. by setting consumption goals, or by applying different tariffs as a kind of monetary incentive, to see how this may affect the consumption behaviour of specific customer groups (see Figure 37).

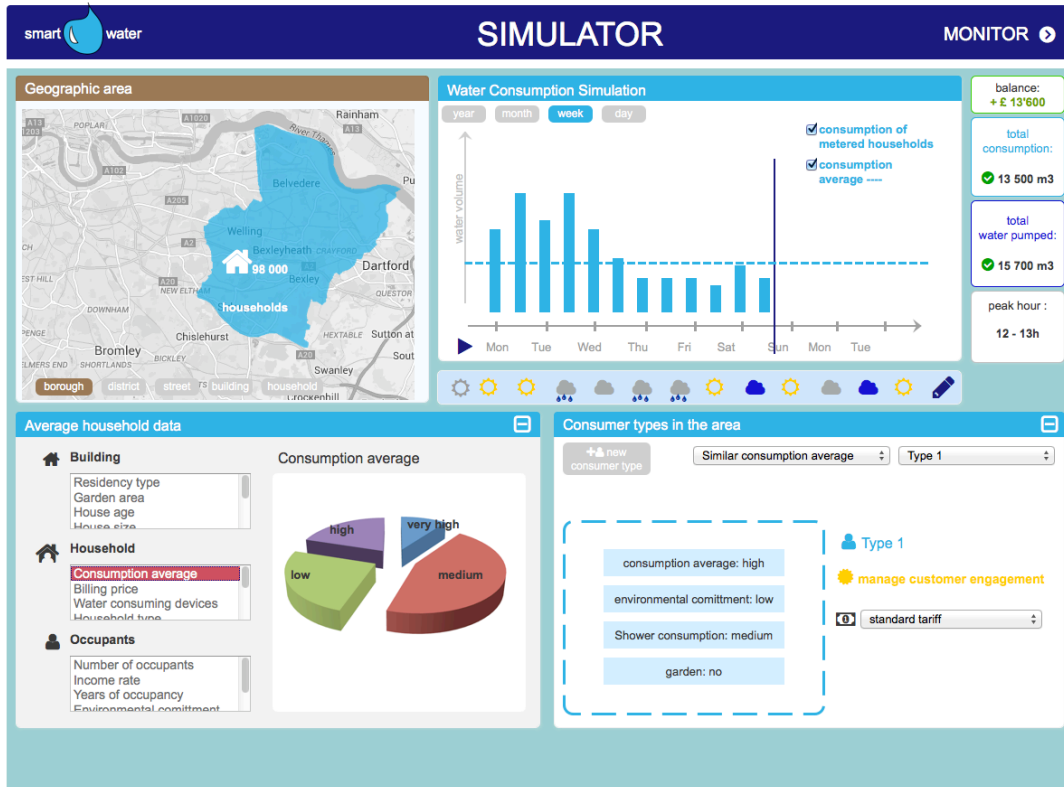


Figure 36. Mockup Customer consumption simulator.

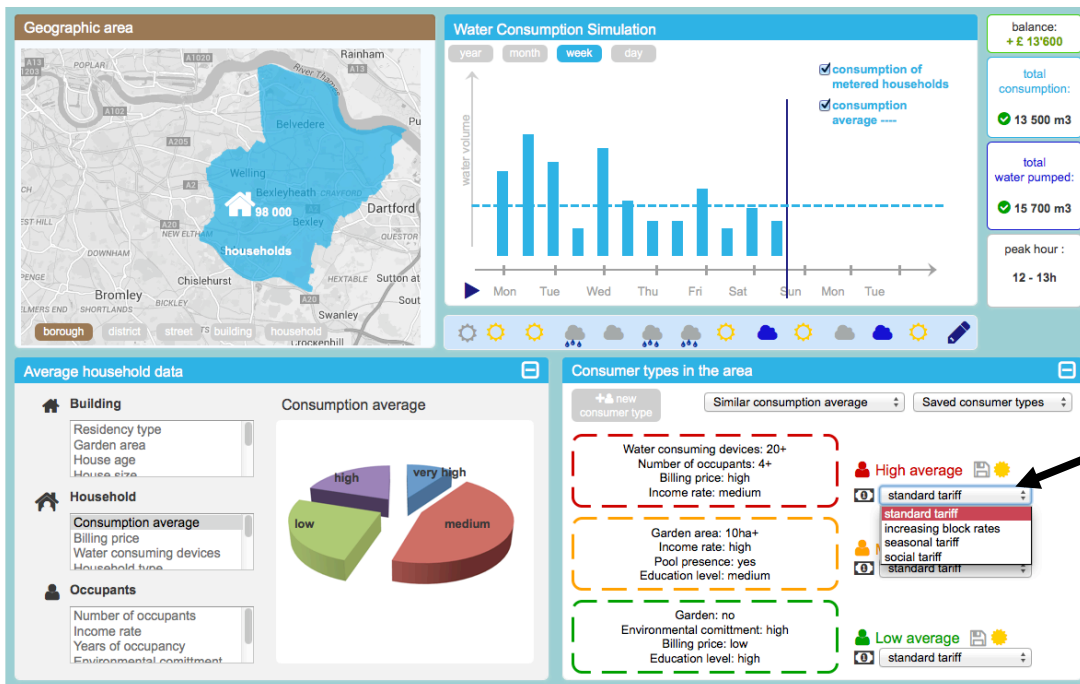


Figure 37. Simulating innovative pricing by applying different tariffs in the customer consumption simulator.

5. Data model

The Smarth2O data model comprises the set of entities and relationships that express knowledge about user data made available by the water utilities (smart metered or billed). This knowledge, which is used for analysis purpose, can be automatically produced by smart meters, obtained from on-line bills, or manually produced by users that interact with the gamified water meter system. We describe the main entities of the data model here in the context of the requirements and use cases, as it has strongly informed the process of eliciting them (information desired from customers, and for the monitoring and simulation of customer consumption behaviour and incentive response). The complete data model has already been described in detail in Deliverable D3.1 'Databases of User Information'

In essence, the Data Model of Smarth2O, whose data are organized into a database designed following the Entity-Relationship model and represented in the following figure, contains entities for:

Houses: each house has an identification [Code], an address [Address], a description of the type of residence [Residence Type], the size [Size], the number of occupants [Number Occupants], the presence of pets, if any, [Number Pets], a flag stating if the Head of household is either a tenant or an owner [Ownership], and the area of the garden (if any) [Garden Area] and the volume of the pool (if any) [Pool Volume]. Each house has also associated, through the **Location** relationship, the zip code and the country of the district where the house is located.

Head of household: the many to many relationship associates to each house the identifier of the head of household, and stores also the start and end date of validity of the relationship.

Devices: each device is identified by its name and the code of the house, through the **Equipment** relation, where it is located (i.e. Device is a weak entity). Each device has associated the number of pieces of that device present in the considered house.

Bills: each bill is identified by the account number [Account Number], the date [Date] and the company [Company] which invoiced the bill. Moreover, for each bill we store the charge for water supply [Volume Charge] and the charge for service supply [Service Charge]. Each bill is association with the house the bill is referring to, through the **charge** relation.

Districts: each district is identified by a Zip code [Zip Code] and the name of the country [Country].

Meteo Conditions: the entity stores, for a given interval [Period], the quantity of rain [Rain Fall] and the Average Temperature [Average Temperature] in a certain District, through the **Exogenous Data** relation.

Meter Readings: for each smart meter, identified by its number [Meter ID], we store the timestamp [Reading Date Time] and actual reading [Total Consumption]. Each reading is associated to the house where the smart meter is installed, through the **consumption** relation.

Device consumptions: for each device, the entity stores the used volume [Device Consumption] in a given period [Period], obtained from the meter reading.

Users: for each user, identified by a numeric key [Code], we store his/her educational level [Educational Level] and the economic level [Income Rate].

Billing Prices: for each month [Month], year [Year] and company [Company], it stores the monthly service charge and volume charge.

Price Compositions: the many to many relationship stores for each bill the billing price composition.

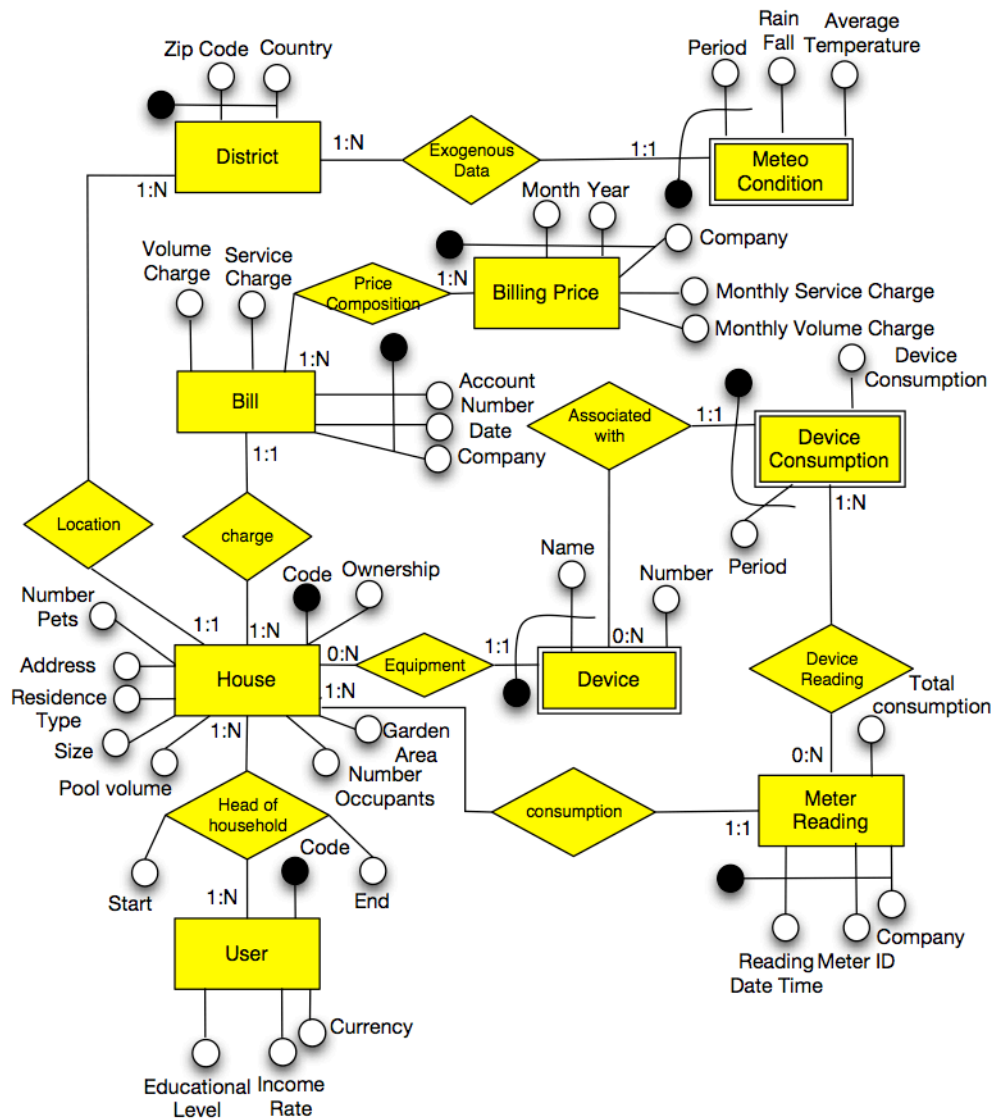


Figure 38. Data Model.

Data requirements for modelling responses to innovative pricing schemes

Data needed for modelling innovative pricing is based on the Data Model described above and on data related to policy (non-pricing) and price data. Policy (non-pricing) data are presented in the table below and are related to water restriction use policies, incentives policies and information policies. The price (i.e. billing price in Figure 14) data are presented in more detail as well.

Policy data

NAME	DESCRIPTION	UNIT
Water restriction use policies	Presence, thresholds and period in which water use restriction policies were active, if some were adopted	[L/day usage threshold]
Incentives policies	Presence, type and period in which incentives for water	[day incentives were active], [amount of £ for incentives]

	efficient devices were active	
Information policies - 1	Consumption history of the bill	{same period in the previous year; all periods of the previous year; other; any}
Information policies – 2	Conservation message (type and communication media)	{on the bill; through other media in the observed period; other; any}

Price data

NAME	DESCRIPTION	UNIT
Number of blocks	Number of price blocks	[-]
Water quantity at kink	Water quantity beyond which users switch to the following price block, only if IBPs or DBPs	[L/month]
Block 1, 2, ... rate	Price charged for one liter in each block, only if IBPs or DBPs	[£/L]
Number of periods	Number of time periods only if Time-of-Use	[-]
Time period 1,2,... rate	Price charged for one liter in each period	[£/L]

Table 1. Data requirements for modelling responses to innovative pricing schemes.

From a methodological point of view, the provision of the above data and data from the previous section will allow us to estimate a water demand model to assess the impact of prices and other exogenous factors on the water consumption. The estimated price elasticity of residential water demand, i.e. the responsiveness of water consumption to changes in prices could potentially allow us to design and implement innovative pricing schemes such as blocking rates and seasonal tariffs. Alternatively, if the acquisition of the above data is not feasible, a meta-regression analysis will be employed to explain the variations in the price, income and household size elasticities in the residential water demand based on existing studies from selected EU studies.

6. User Model

The following section describes the early user model as visualized in Figure 39. For the detailed specification, see Appendix A.

A first distinction among user groups is between **Consumer** and **Admin**: the former is the generic user who can access the services provided by the SmartH2O system; the latter is instead in charge of managing the services provided by the SmartH2O system.

Consumers are partitioned into sub-groups based on which services they access.

- **Player** users are the ones who play the Games provided by the SmartH2O system. They can be:
 - **Casual Players**: they are not registered visitors interested in playing a game.
 - **Registered Players**: they are registered to the Games platform.
- **Customer** are users registered to the Consumer Portal, who access in order to monitor their water consumption and water bill. They can be:
 - **Smart metered** users: they are customers having smart meters system installed in their house. The water meter measures the customer's water consumption automatically.
 - **Standard metered** users: they are customers not having smart meters system installed in their house. They need to manually input consumption data into the gamification engine.
 - **Competitor** users: they are the ones who accepted to participate to the gamification mechanisms, including execution of actions, acquisition of badges and redemption of rewards.
 - **House holder** user: he/she is the responsible of a specific house. He/She can add other family members to the Gamification Engine and create collaborations with neighbours.
 - **CustomerPlayers** are users who are registered both to the Gamification Engine and the Games Platform. They have the possibility to collect points either by performing actions provided in the gamification engine or by playing the available games.

Admin users are partitioned into sub-groups based on which services they manage.

- **Content Editors** are administrators in charge of creating the content of the applications composing the smart water system.
 - **Gamification Engine Content and Rules Editors**: they are in charge of creating the content related to the gamification platform (the one used by Competitor users) such as actions, rewards and goals. They are also in charge of defining the rules to assign the suitable amount of points to each action.
 - **Consumer Portal Content Editors**: they are in charge of creating the content related to the platform used by Customer users, such as tips to improve water saving, teaching videos.
 - **Games Platform Content Editors**: they are in charge of creating the content related to the games, such as the questions provided in a quiz game related to generic water consumption topics.

- **Utility Games Platform Content Editor:** they are a specialization of the Games Content Editor users, related to a specific utility game. For example they manage the specific questions provided in a quiz game.
- **Supervisor** are administrators in charge of monitoring and managing system data. They can be:
 - **Consumption Supervisor:** they are in charge of modelling users consumption.
 - **Gamification Engine Supervisor:** they are in charge of profiling users, making available users clusters that can be used to suggest the most suitable actions to perform.

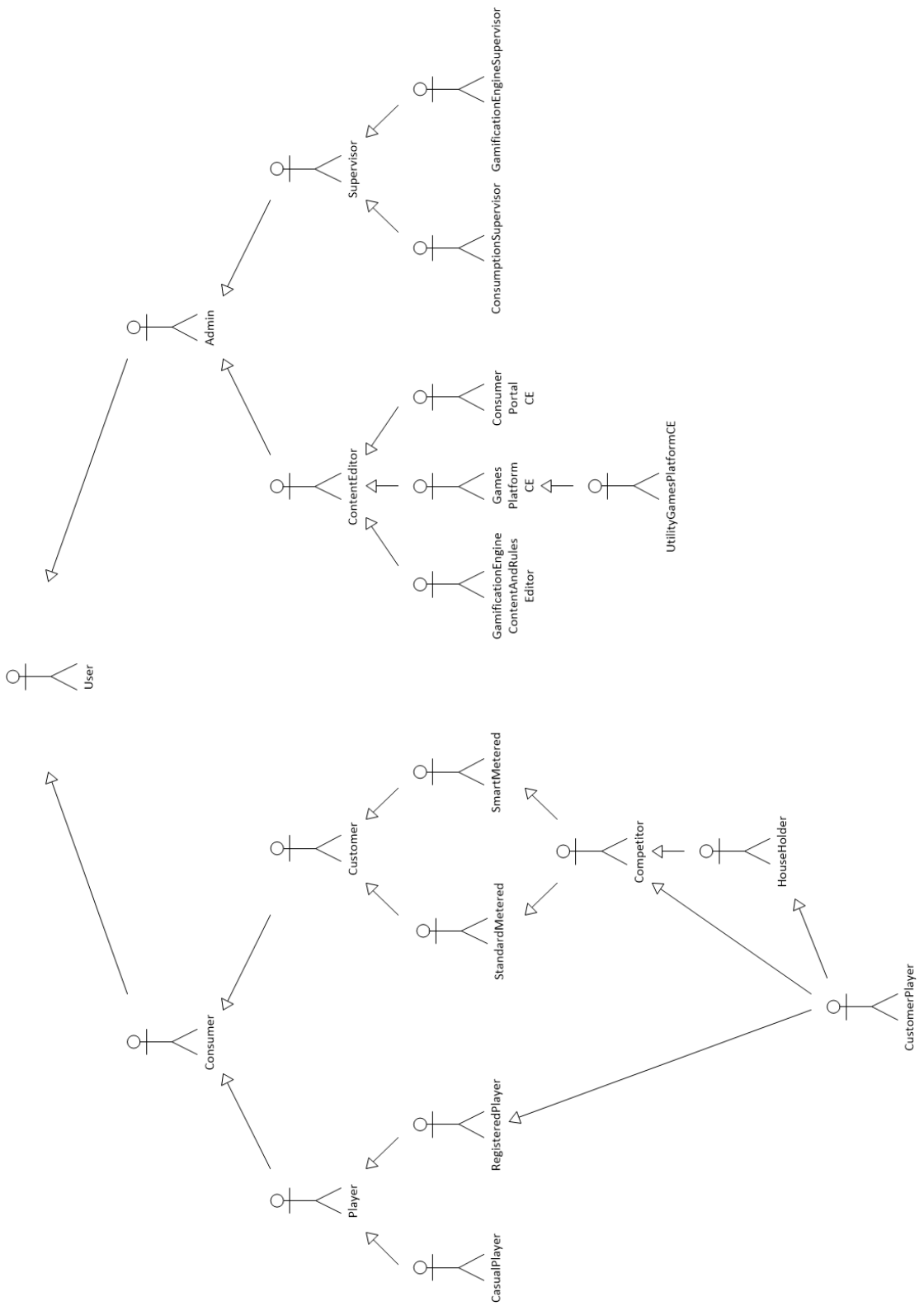


Figure 39. Preliminary user model.

7. Use cases overview

The following table lists all use cases. The use cases are described in detail in the following sections.

#	USE CASES
	Use cases of basic customer portal: Visual water meter
8.1	Use case: Customer Portal Signup
8.2	Use case: Collecting consumption data
8.3	Use case: Manually collecting consumption data
8.4	Use case: Visual exploration of water consumption information
8.5	Use case: Visual exploration of water consumption at fixture/appliance level
8.6	Use case: Providing water consumption alerts
8.7	Use case: Setting water consumption tips
8.8	Use case: Providing water consumption tips
8.9	Use case: Verifying manually inserted consumption data
8.10	Use case: Providing feedback on consumption disaggregated data
8.11	Use case: Modifying User Settings
8.12	Use case: Customer Portal Unsubscription
	Use cases of advanced customer portal: Gamified water meter
9.1	Use case: Gamification Engine Signup
9.2	Use case: Setting consumption goals
9.3	Use case: Self setting consumption goals
9.4	Use case: Fulfilling consumption goals
9.5	Use case: Implementing water saving actions
9.6	Use case: Contributing household and user profiling information
9.7	Use case: Declaring water consumption and action information
9.8	Use case: Exploring gamification actions
9.9	Use case: Setting action types and reward types
9.10	Use case: Comparing achievements with family, friends and neighbours

9.11	Use case: Inviting another user to join a collaboration
9.12	Use case: Collecting achievements collaboratively with other family members
9.13	Use case: Collecting achievements collaboratively with neighbours
9.14	Use case: Achieving goals collaboratively with other users
9.15	Use case: Making actions and earning digital points with the Games Platform
9.16	Use case: Converting game actions into rewards
9.17	Use case: Leaderboard self opt-in
9.18	Use case: Leaderboard self opt-out
9.19	Use case: Leaderboard family opt-in
9.20	Use case: Leaderboard family opt-out
9.21	Use case: Geolocation opt-in
9.22	Use case: Geolocation opt-out
9.23	Use case: Defining family composition
9.24	Use case: Defining water consumption distribution rule among family members
9.25	Use case: Learning interactively about innovative pricing models
	Use cases of Games Platform
10.1	Use case: Games Platform signup
10.2	Use case: Playing a standard mobile game
10.3	Use case: Playing the card game and its digital game extension
10.4	Use case: Gaining power-ups based on the Gamification Engine credits
10.5	Use case: Connecting player profile to the Gamification Engine
10.6	Use case: Setting content of game questions
10.7	Use case: Setting content of questions for a given utility game
	Use cases of business dashboard: Customer consumption monitor
11.1	Use case: Visualizing aggregate household consumption information by geo-location
11.2	Use case: Calculating behavioural attributes for user profiling
11.3	Use case: Identifying customer segments
11.4	Use case: Setting action and reward types for specific user segments/groups

	Use cases of business dashboard: Customer consumption simulator
12.1	Use case: Modelling behaviour based on consumption
12.2	Use case: Predicting customer segment consumption behaviour
12.3	Use case: Modelling behaviour based on incentive response
12.4	Use case: Predicting behaviour based on incentive response
12.5	Use case: Modelling behaviour based on response to pricing scheme
12.6	Use case: Predicting customer response to pricing schemes

Use cases by user group

USER	USE CASES
Consumer	8.1 Customer Portal Signup 10.1 Games Platform Signup
Customer <i>(extends Consumer)</i>	8.6 Providing water consumption alerts 8.8 Providing water consumption tips 8.11 Modifying user settings 8.12 Customer Portal Unsubscription 9.1 Gamification Engine Signup 9.25 Learning interactively about dynamic pricing models 12.2 Predicting customer segment consumption behaviour <i>Inherited Uses Cases:</i> <ul style="list-style-type: none"> • 8.1, 10.1 from Consumer
StandardMetered <i>(extends Customer)</i>	8.3 Manually collecting consumption data 8.4 Visual exploration of water consumption information <i>Inherited Uses Cases:</i> <ul style="list-style-type: none"> • 8.6, 8.8, 8.11, 8.12, 9.1, 9.25, 12.2 from Customer • 8.1, 10.1 from Consumer
SmartMetered <i>(extends Customer)</i>	8.2 Collecting consumption data 8.5 Visual exploration of water consumption at fixture/appliance level <i>Inherited Uses Cases:</i> <ul style="list-style-type: none"> • 8.6, 8.8, 8.11, 8.12, 9.1, 9.25, 12.2 from Customer • 8.1, 10.1 from Consumer
Competitor <i>(extends SmartMetered, StandardMetered)</i>	9.3 Self setting consumption goals 9.4 Fulfilling consumption goals 9.5 Implementing water saving actions 9.7 Declaring water consumption and action information

	<p>9.8 Exploring gamification actions</p> <p>9.10 Comparing achievements with family, friends and neighbours</p> <p>9.11 Inviting another user to join a collaboration</p> <p>9.12 Collecting achievements collaboratively with other family members</p> <p>9.13 Collecting achievements collaboratively with neighbours</p> <p>9.14 Achieving goals collaboratively with other users</p> <p>9.17 Leaderboard self opt-in</p> <p>9.18 Leaderboard self opt-out</p> <p>9.20 Leaderboard family opt-out</p> <p><i>Inherited Uses Cases:</i></p> <ul style="list-style-type: none"> • 8.3, 8.4 from <i>StandardMetered</i> • 8.2, 8.5 from <i>SmartMetered</i> • 8.6, 8.8, 8.11, 8.12, 9.1, 9.5, 9.25, 12.2 from <i>Customer</i> • 8.1, 10.1 from <i>Consumer</i>
<p>HouseHolder (<i>extends Competitor</i>)</p>	<p>8.10 Providing feedback on consumption disaggregated data</p> <p>9.6 Contributing household and user profiling information</p> <p>9.19 Leaderboard family opt-in</p> <p>9.21 Geolocation opt-in</p> <p>9.22 Geolocation opt-out</p> <p>9.23 Defining family composition</p> <p>9.24 Defining water consumption distribution rule among family members</p> <p><i>Inherited Uses Cases:</i></p> <ul style="list-style-type: none"> • 9.3, 9.4, 9.5, 9.7, 9.8, 9.10, 9.11, 9.12, 9.13, 9.14, 9.17, 9.18, 9.20 from <i>Competitor</i> • 8.3, 8.4 from <i>StandardMetered</i> • 8.2, 8.5 from <i>SmartMetered</i> • 8.6, 8.8, 8.11, 8.12, 9.1, 9.25, 12.2 from <i>Customer</i> • 8.1, 10.1 from <i>Consumer</i>
<p>Player (<i>extends Consumer</i>)</p>	<p>10.2 Playing a standard mobile game</p> <p>10.3 Playing the card game and its digital game extension</p> <p><i>Inherited Uses Cases:</i></p> <ul style="list-style-type: none"> • 8.1, 10.1 from <i>Consumer</i>
<p>CasualPlayer (<i>extends Player</i>)</p>	<p><i>Inherited Uses Cases:</i></p> <ul style="list-style-type: none"> • 10.2, 10.3 from <i>Player</i> • 8.1, 10.1 from <i>Consumer</i>
<p>RegisteredPlayer (<i>extends Player</i>)</p>	<p>10.5 Connecting player profile to the Gamification Engine</p> <p><i>Inherited Uses Cases:</i></p> <ul style="list-style-type: none"> • 10.2, 10.3 from <i>Player</i> • 8.1, 10.1 from <i>Consumer</i>
<p>CustomerPlayer</p>	<p>9.15 Making actions and earning digital points with the Games</p>

<p><i>(extends Householder, RegisteredPlayer, Competitor)</i></p>	<p>Platform</p> <p>10.4 Gaining power-ups based on the Gamification Engine credits</p> <p><i>Inherited Uses Cases:</i></p> <ul style="list-style-type: none"> • 8.10, 9.6, 9.19, 9.21, 9.22, 9.23, 9.24 from <i>Householder</i> • 9.3, 9.4, 9.5, s 9.7, 9.8, 9.10, 9.11, 9.12, 9.13, 9.14, 9.17, 9.18, 9.20 from <i>Competitor</i> • 8.3, 8.4 from <i>StandardMetered</i> • 8.2, 8.5 from <i>SmartMetered</i> • 8.6, 8.8, 8.11, 8.12, 9.1, 9.25, 12.2 from <i>Customer</i> • 10.5 from <i>RegisteredPlayer</i> • 10.2, 10.3 from <i>Player</i> • 8.1, 10.1 from <i>Consumer</i>
<p>GamificationEngine ContentAndRules Editor</p>	<p>9.2 Setting consumption goals</p> <p>9.9 Setting action types and reward types</p> <p>9.16 Converting game actions into rewards</p>
<p>GamesPlatformCE</p>	<p>10.6 Setting content of game questions</p>
<p>UtilityGamesPlatform CE <i>(extends GamesPlatformCE)</i></p>	<p>10.7 Setting content of questions for a given utility game</p> <p><i>Inherited Uses Cases:</i></p> <ul style="list-style-type: none"> • 10.6 from <i>GamesPlatformCE</i>
<p>ConsumerPortalCE</p>	<p>8.7 Setting water consumption tips</p>
<p>ConsumptionSupervisor</p>	<p>11.1 Visualizing aggregate household consumption information by geo-location</p> <p>11.3 Identifying customer segments</p> <p>11.4 Setting action and reward types for specific user segments/groups</p> <p>12.2 Predicting customer segment consumption behaviour</p>
<p>GamificationEngine Supervisor</p>	<p>12.4 Predicting behaviour based on incentive response</p> <p>12.6 Predicting customer response to pricing schemes</p>

8. Use cases of basic Customer Portal: Visual water meter

This set of use cases describes the basic interaction of the customer with the consumption visualisation functionalities of the visual water meter, including the input options and the verification of inserted or aggregated data.

In particular, these use cases regard:

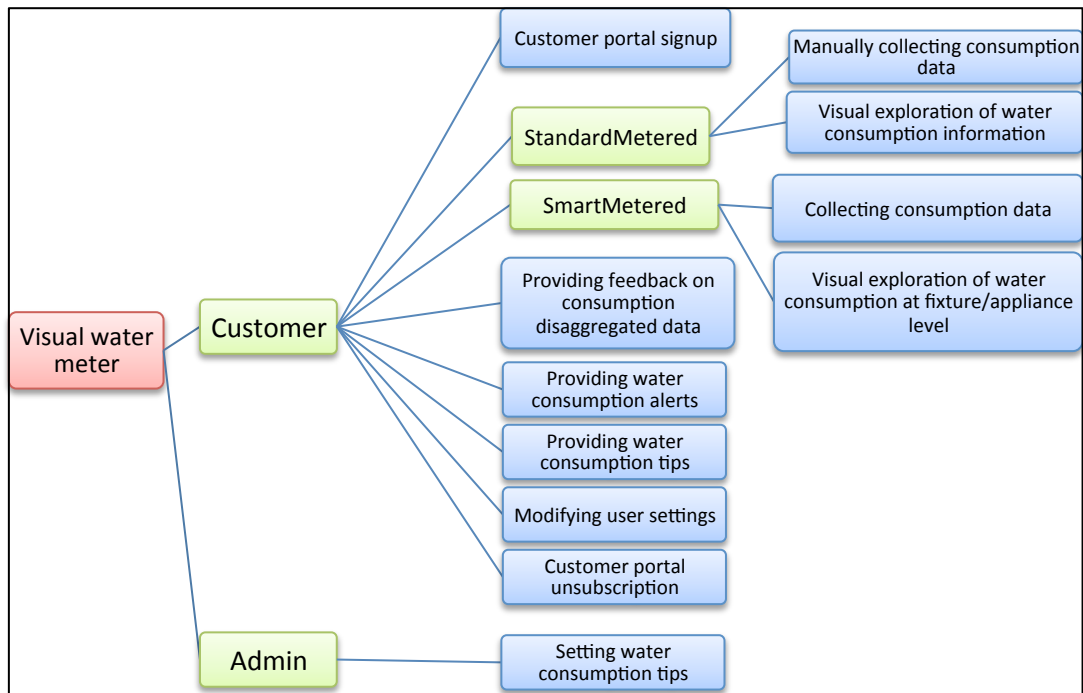
- The collection of water consumption data, either manually (for StandardMetered users) or via smart meters,
- The visualisation of the water consumption, not only in total but also at fixture/appliance level (when smart meters exist)
- The verification of manually inserted data from the system, as well as feedback from the consumer regarding the validity of aggregated data.

The set is extended also in respect to water tips and alerts and the management of the consumer's account to the Customer Portal.

#	High Level functional requirements
VF1	The application should show the consumption data visualized by different periods of time
VF2	The application should provide some typical consumption metrics, e.g. peak, average of the metered household
VF3	The application should provide some typical aggregated consumption metrics, e.g. peak and average, of the neighbourhood or municipality to compare to
VF4	The application should provide water consumption data a fixture/appliance level
VF5	The application should provide some basic water saving tips
VF6	The application should be available as a web and mobile app.

#	High Level non-functional requirements
VNF1	The application shall be accessible and useable for non-technical audiences
VNF2	The application shall be well documented and described
VNF3	The application shall be transparent
VNF4	The application shall be easy to use

Use cases overview



8.1 Use case: Customer Portal Signup

Use case: Customer Portal Signup		
Goal in Context	Providing the User with an application for registering to the Customer Portal	
Preconditions	The consumer is a customer of utility managing the portal.	
Success End Condition	The user becomes a Customer user, who can access the Customer Portal.	
Failed End Condition	The user does not become a Customer user and cannot access the Customer Portal.	
Primary, Secondary Actors	Consumer user	
Trigger	Consumer accesses the Customer Portal registration area.	
DESCRIPTION	Step	Action
	1	The user accesses the registration page from the public area of the Customer Portal.
	2	The user inputs the required personal information.
	3	The user confirms the registration.

Use case: Customer Portal Signup		
	4	The system checks the validity of the provided information: No duplicate of username, Correctness of email, of utility customer code...

Early functional requirements

#	Functional requirement
1	The application should provide a graphical interface to allow the consumer to register to the Consumer Portal, providing authentication information and some personal information about household.
2	The application should be able to store user data in the platform database, creating a new profile for the consumer.

8.2 Use case: Collecting consumption data

Use case: Collecting consumption data		
Goal in Context	Collecting consumption data via smart meters	
Preconditions	Water consumption of customer household is metered (smart meters) for the reference interval of time	
Success End Cond.	The system stores in the Smarth2O platform database the consumption data for a reference interval of time	
Failed End Condition	The system is not able to store in the Smarth2O platform database the consumption data for a reference interval of time despite the process has been correctly initiated by the Water utility	
Primary, Secondary Actors	SmartMetered user, smart meter and system	
Trigger	The water utility has uploaded to the Smarth2O server via SFTP the file containing the consumption data for a reference interval of time	
DESCRIPTION	Step	Action
	1	The smart water meter measures the customer's water consumption. The consumption data is collected by the Water utility automatically (smart meter). The Water utility creates a file with water consumption data in a pre-agreed format.
	2	The water consumption data is transmitted to the Smarth2O platform where it is received, validated, processed and stored.
	3	The result of processing the collected consumption data by the Smarth2O platform is saved in a Log file that can be visualised online by the water utility or by the platform administrators.

Early functional requirements

#	Functional requirement
1	The application should be able to receive the file containing the water consumption in a pre-agreed format and make a safe copy on the server storage
2	The application should be able to save a record in the platform database for each water meter reading of the file containing the water consumption
3	The application should be able to match the water meter reading records against the data records already stored in the database
4	The application should be able to present a Log file describing the outcome of processing the smart metered consumption data

8.3 Use case: Manually collecting consumption data

Use case: Manually collecting consumption data		
Goal in Context	Collecting consumption data by manual input	
Preconditions	Water consumption of customer household is metered (easily accessible standard meters) for the reference interval of time	
Success End Cond.	The system stores in the SmartH2O platform database the consumption data for the current registration time	
Failed End Condition	The system is not able to store in the SmartH2O platform database the consumption data for current registration time despite he correctly accessed the system and provided the consumption data	
Primary, Secondary Actors	StandardMetered users and system	
Trigger		
DESCRIPTION	Step	Action
	1	The user logs in into the Customer Portal
	2	The user and access a view in the Visual Water Meter front end where s/he can provide the readings of his standard meters for the current registration time
	3	The user saves the readings into the platform

Early functional requirements

#	Functional requirement
1	The application should provide a graphical interface to allow the standard metered user to manually register water consumption at the current registration time
2	The application should be able to store in the platform database the water consumption provided by the user
3	The application should be able to allow the user to correct the last registration of the water consumption

8.4 Use case: Visual exploration of water consumption information

Use case: Visual exploration of water consumption information		
Goal in Context	Raising individual water consumption awareness by visualizing metered consumption data	
Preconditions	Customer household is metered and linked to user account.	
Success End Cond.	Water consumption is visualized.	
Failed End Condition	Water consumption is not visualized.	
Primary, Secondary Actors	StandardMetered user and system	
Trigger	User opens visual water meter application.	
DESCRIPTION	Step	Action
	1	The system visualizes the metered water consumption data of the household linked to the user profile
	2	Estimated cost is calculated and visualized
	3	The user can interact with the visualization by choosing different zoom levels of the data (hourly, daily, monthly)
	4	The user can compare his own consumption metrics to a set of available aggregate metrics (e.g. municipality, district)

Early functional requirements

#	Functional requirement
1	The application should display a detailed visualization of the water consumption
2	The application should provide the option to adjust the view settings of the visualization to different time intervals
3	The application should provide the option to compare the consumption with the average consumption of the neighbourhood, the municipality or the district.
4	The application should provide a visualized comparison of the current consumption with the past measurements

8.5 Use case: Visual exploration of water consumption at fixture/appliance level

Use case: Visual exploration of water consumption at fixture/appliance level		
Goal in Context	Raising individual water consumption awareness by visualizing end use consumption	
Preconditions	Customer household is metered and linked to user account.	
Success End Cond.	Water consumption is displayed at a fixture/appliance level	
Failed End Condition	Water consumption is not displayed at s fixture/appliance level	
Primary, Secondary Actors	SmartMetered user and system	
Trigger	User opens visual water meter application.	
DESCRIPTION	Step	Action
	1	The system visualizes the water consumption data of the household at a fixture/appliance level
	2	Cost associated to the use of each appliance is calculated and visualized
	3	The user can interact with the visualization by choosing different zoom levels of the data (hourly, daily, monthly)
	4	The user can compare his own end use consumption to the other users.

Early functional requirements

#	Functional requirement
1	The application should display water consumption data a fixture/appliance level

2	The application should show the end use consumption data visualized by different periods of time
3	The application should provide some typical end use consumption metrics, e.g. peak and average, of the neighbourhood or municipality to compare to

8.6 Use case: Providing water consumption alerts

Use case: Providing water consumption alerts		
Goal in Context	Warn user about problems related to water supply	
Preconditions	Data for alerts is available, e.g. for household leakage alert: household is smart metered; for water quality alert: quality is measured. Utility wants to provide the information.	
Success End Cond.	Alert is triggered.	
Failed End Condition	Alert is not triggered.	
Primary, Secondary Actors	Customer user and system	
Trigger	Measured attributes are below defined threshold.	
DESCRIPTION	Step	Action
	1	The system notifies the user via alerts in case of water consumption distress, e.g. when water leakage is detected in household, when overall water quality is bad, when water shortage occurs

Early functional requirements

#	Functional requirement
1	The application should be able to provide alerts in case of water shortage.
2	The application should be able to provide alerts in case of consumption peak.
3	The application should be able to provide alerts in case of leakage.
4	The application should be able to provide alerts relating to the water quality.

8.7 Use case: Setting water consumption tips

Use case: Setting water consumption tips	
Goal in Context	Raising individual water consumption awareness by providing water saving tips

Use case: Setting water consumption tips		
Preconditions	none.	
Success End Cond.	Tip has been inserted into the system.	
Failed End Condition	Tip has not been inserted into the system.	
Primary, Secondary Actors	ConsumerPortalCE user and system	
Trigger	The user Standard Platform Content Editor selects the option to set a new water saving tip.	
DESCRIPTION	Step	Action
	1	The user sets water saving tips (e.g. text snippets, videos, quizzes).

Early functional requirements

#	Functional requirement
1	The application should provide the Admin the possibility to create a database with water management tips.
2	The application should provide the Admin options to insert, modify or delete water consumption tips.
3	The application should provide different input data formats for the water management tips, including text, images and video files formats.

8.8 Use case: Providing water consumption tips

Use case: Providing water consumption tips		
Goal in Context	Raising individual water consumption awareness.	
Preconditions	none.	
Success End Cond.	Tip is displayed.	
Failed End Condition	Tip is not displayed.	
Primary, Secondary Actors	Customer user and system	
Trigger	User opens the visual water meter; User requests new tip.	
DESCRIPTION	Step	Action
	1	System provides user with different water saving tips (e.g. text snippets, videos, quizzes).

Early functional requirements

#	Functional requirement
1	The application should provide a 'tip of the day' mode for a random water management tip displayed every day.
2	The application should provide a 'tip request' mode, with which the user can go through all available water management tips, by a 'next' button or end the session by 'I got it'.
3	The application should provide the user the option to disable the functionality of water management tips.

8.9 Use case: Verifying manually inserted consumption data

Use case: Verifying manually inserted consumption data		
Goal in Context	Collecting truthful consumption data by manual input	
Preconditions	Water consumption of customer household is metered (easily accessible standard meters) for the reference interval of time	
Success End Cond.	Consumption data are validated	
Failed End Condition	Consumption data are not validated	
Primary, Secondary Actors	System	
Trigger	Reception of the periodical report with the official consumption data.	
DESCRIPTION	Step	Action
	1	The system periodically verifies manually inserted data stored into the system, according to the consumption data available from the periodical report.

Early functional requirements

#	Functional requirement
1	The application should be able to receive a periodical report about user consumption.
2	The application should be able to match received data and manually inserted data in order to compare them.
3	The application should be able to validate correct data, the ones matching reported data, and to invalidate incorrect data.

8.10 Use case: Providing feedback on consumption disaggregated data

Use case: Providing feedback on consumption disaggregated data		
Goal in Context	Disaggregating household consumption data	
Preconditions	Water consumption of customer household is metered (smart meters) for the reference interval of time	
Success End Cond.	Disaggregated data are validated by the customer.	
Failed End Condition	Disaggregated data are not validated by the customer.	
Primary, Secondary Actors	HouseHolder user	
Trigger	User receives the results of consumption disaggregation performed by system models.	
DESCRIPTION	Step	Action
	1	The system notifies to the user the results of consumption disaggregation, in terms of percentage values (e.g. washing machine consumption percentage).
	2	The user provides a feedback about the correctness of the disaggregating percentages computed.

Early functional requirements

#	<i>Functional requirement</i>
1	The application should display the percentages of disaggregated household consumptions.
2	The application should allow the user to confirm the disaggregating percentages computed.
3	The application should provide the option to adjust the percentages and save changes.

8.11 Use case: Modifying User Settings

Use case: Modifying User Settings		
Goal in Context	Customizing and managing personal profile and application settings.	
Preconditions	The user is registered to the system.	
Success End Cond.	Changes to user profile or settings are applied.	
Failed End Condition	Changes to user profile or settings are not applied.	
Primary, Secondary Actors	Customer user	
Trigger	The user accesses the settings area.	
DESCRIPTION	Step	Action
	1	The user accesses the settings area.
	2	The user inputs changes to the personal profile (e.g. email, address) or to the general application settings (e.g. notifications, privacy).
	3	The user confirms and changes are applied.

Early functional requirements

#	<i>Functional requirement</i>
1	The application should provide a graphical interface to allow the user to modify his profile.
2	The application should provide a graphical interface to allow the user to modify settings. User should be able to opt-in/opt-out notifications and change the more general settings of the application (e.g. language, privacy).

8.12 Use case: Customer Portal Unsubscription

Use case: Customer Portal Unsubscription		
Goal in Context	Allowing the user to unsubscribe from the system	
Preconditions	The user is registered to the system.	
Success End Cond.	All content related to the user is permanently deleted from the system.	
Failed End Condition	The user is still in the system, deletion of all content related to the user failed.	
Primary, Secondary Actors	Customer user	
Trigger	The user clicks to unsubscribe	
DESCRIPTION	Step	Action
	1	The user requests to be deleted from the system.
	2	All data related to the user is permanently deleted from the system.

Early functional requirements

#	<i>Functional requirement</i>
1	The application should be able to allow the user to unsubscribe from the system.
2	The application should be able to permanently delete all content related to the user from the platform database, including user profile and all consumption data.

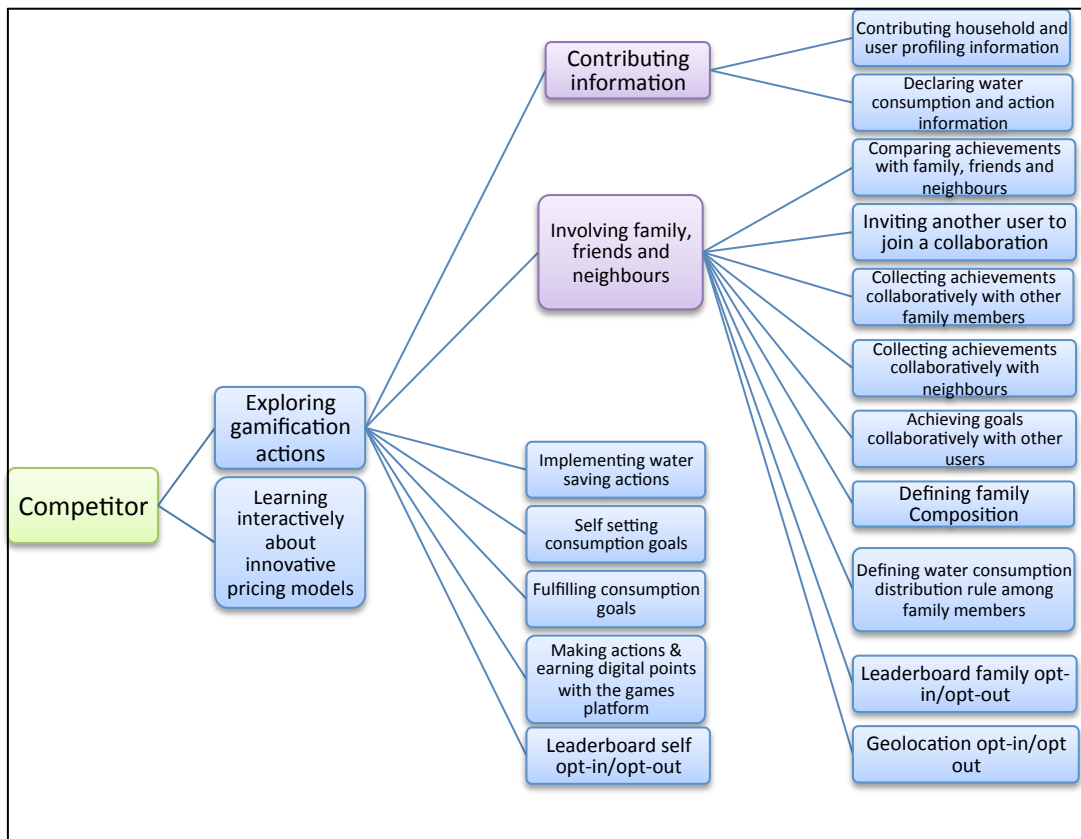
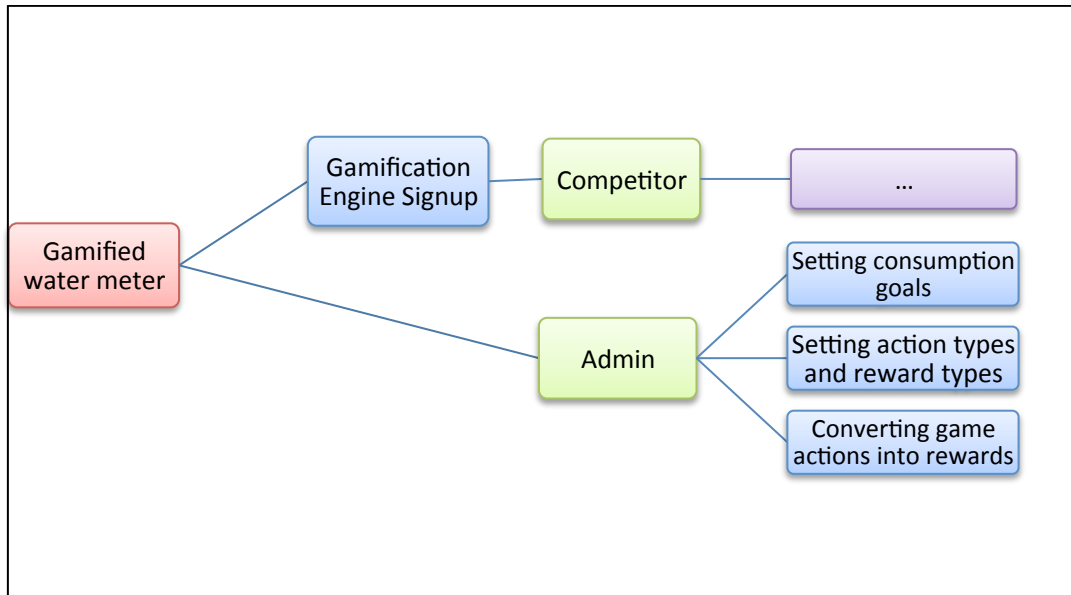
9. Use cases of advanced Customer Portal: Gamified water meter

This set of Use Cases contains all the customer interactions with the Gamification Engine. It comprises the basic gamification actions of a registered user, which involve the setting and fulfilling consumption goals, performing water saving actions, learning about innovative pricing schemes as well as his contribution with profiling and consumption information. Additionally, it comprises a subgroup of Use cases that describe particularly the actions when the user's circle (family, friends, neighbours) gets also involve and enter the Gamification Engine, like collaborative goals and achievements.

#	<i>High Level functional requirements</i>
GF1	The application should enable the user to provide household information
GF2	The application should enable the user to provide information about their water consumption habits
GF3	The application should enable the user to record water consumption events
GF4	The application should incentivize the user to perform actions by awarding points and rewards.
GF5	The application should enable users to set their own water consumption goals.
GF6	The application should enable utilities to set external water consumption goals.
GF7	The application should reward users who meet water consumption goals.
GF8	The application should be available as a web and mobile app.

#	<i>High Level non-functional requirements</i>
GNF1	The application shall be accessible and useable for non-technical audiences
GNF2	The application shall be well documented and described
GNF3	The application shall be transparent
GNF4	The application shall be easy to use

Use cases overview



9.1 Use case: Gamification Engine Signup

Use case: Gamification Engine Signup		
Goal in Context	Stimulating water saving by providing gamification mechanisms to the water utility customer.	
Preconditions	The user is a customer registered to the customer portal	
Success End Cond.	The user becomes a Competitor customer and can exploit the gamification extension of the customer portal.	
Failed End Condition	The user does not become a Competitor user, and can not exploit the gamification extension of the customer portal.	
Primary, Secondary Actors	Customer user	
Trigger	The customer decides to participate to the gamification mechanism and accesses the Gamification Engine registration area.	
DESCRIPTION	Step	Action
	1	The user accesses the registration page from the Customer Portal.
	2	The user inputs the required personal information.

Early functional requirements

#	Functional requirement
1	The application should provide a graphical interface to allow the customer to register to the Gamification Engine, providing the additional information required to participate to the gamified competition.
2	The application should be able to store user data in the platform database, updating the customer profile.

9.2 Use case: Setting consumption goals

Use case: Setting consumption goals	
Goal in Context	Stimulating water saving by setting consumption goals
Preconditions	Customer household is metered and linked to user account.
Success End Cond.	Consumption goal was set
Failed End Condition	Consumption goal was not set
Primary,	GamificationEngineContentandRulesEditor user and system

Use case: Setting consumption goals		
Secondary Actors		
Trigger	Gamification Engine Content and Rules Editor sets consumption goal.	
DESCRIPTION	Step	Action
	1	The user can set a consumption goal for different kind of households to stimulate better consumption.

Early functional requirements

#	Functional requirement
1	The application should enable the admin user to set consumption goals.
2	The application should provide the option to set different consumption goals for different areas or different household profiles
3	The application should enable the admin user to inform the customers when a new consumption goal is set

9.3 Use case: Self setting consumption goals

Use case: Self setting consumption goals		
Goal in Context	Stimulating water saving by setting consumption goals	
Preconditions	Customer household is metered and linked to user account. The customer participates in the gamified competition.	
Success End Cond.	Consumption goal was set	
Failed End Condition	Consumption goal was not set	
Primary, Secondary Actors	Competitor user and system	
Trigger	User sets consumption goal.	
DESCRIPTION	Step	Action
	1	The competitor user can set a consumption goal for himself, to stimulate better consumption.

Early functional requirements

#	Functional requirement
1	The application should enable the customer to set his own goal
2	The application should enable the user to choose among goals proposed by the water utility
3	The application should be able to visualize the progress of the household in respect to the

	consumption goal
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9.4 Use case: Fulfilling consumption goals

Use case: Fulfilling consumption goals		
Goal in Context	Saving water by fulfilling consumption goals and receiving awards	
Preconditions	Customer household is metered and linked to user account.	
Success End Cond.	User is awarded points and achieves the badge related to the completed goal, if provided	
Failed End Condition	User does not collect points and does not achieve a badge	
Primary, Secondary Actors	Competitor user and system	
Trigger	User has performed a number of actions, collecting enough credits to fulfil a goal.	
DESCRIPTION	Step	Action
	1	The system logs whether the users achieve their consumption goals (e.g. stay below a certain average within a defined period)
	2	The user is awarded points when achieving a goal
	3	If the goal is associated to a badge type, the user achieves the badge.

Early functional requirements

#	<i>Functional requirement</i>
1	The application should be able to monitor and display the progress of a goal.
2	The application should display which are the possible actions the user could perform to achieve the goal.
3	The application should be able to log when a goal has been achieved, notifying the user.
4	The application should verify if the goal is associated to a badge, and if it occurs the system should assign the new badge and notify the user.

9.5 Use case: Implementing water saving actions

Use case: Implementing water saving actions		
Goal in Context	Stimulating water saving by rewarding water saving actions	
Preconditions	Customer household is metered and linked to user account. User profiles and segments are available in the system. The system is able to proposed personalized water saving tips for each customer segment based on identified user model.	
Success End Cond.	The systems rewards the users based on the implemented water saving action	
Failed End Condition	The user is not rewarded.	
Primary, Secondary Actors	Competitor user and system	
Trigger	User reports a water saving action	
DESCRIPTION	Step	Action
	1	The user reports that he implemented a water saving action based on one of the water saving tips, e.g. installing more efficient appliances
	2	The system verifies that the user has actually implemented the water saving action
	3	The user earns points for implementing the action

Early functional requirements

#	<i>Functional requirement</i>
1	The application should provide the user personalized water saving tips.
2	The application should enable users to set their own water consumption goals.
3	The application should enable utilities to set external water consumption goals.
4	The application should be able to verify if the user has actually implemented the proposed water saving action
5	The application should reward users who meet water consumption goals.

9.6 Use case: Contributing household and user profiling information

Use case: Contributing household and user profiling information

Use case: Contributing household and user profiling information		
Goal in Context	Gaining insights on customer households and water consumption	
Preconditions	Consensus of customer user to disclose information to utility.	
Success End Cond.	User collects credits for providing useful data.	
Failed End Condition	User does not collect credits.	
Primary, Secondary Actors	HouseHolder user and system	
Trigger	User provides information	
DESCRIPTION	Step	Action
	1	The user can collect points by providing information about their household (e.g. number of occupants, types of appliances).

Early functional requirements

#	Functional requirement
1	The application should provide a graphical interface to allow the user to input information about his household.
2	The application should be able to store household information provided by the user in the platform database.
3	The application should assign points to the user who contributed specifying useful information.

9.7 Use case: Declaring water consumption and action information

Use case: Declaring water consumption and action information		
Goal in Context	Gaining insights on customer consumption	
Preconditions	Consensus of customer user to disclose information to utility.	
Success End Cond.	User collects credits for providing useful data.	
Failed End Condition	User does not collect credits.	
Primary, Secondary Actors	Competitor user and system	
Trigger	User provides information	
DESCRIPTION	Step	Action

Use case: Declaring water consumption and action information		
	1	The user can collect points by providing information about water consumption (meter reading) and water consumption actions (e.g. shower duration, watering the garden)

Early functional requirements

#	Functional requirement
1	The application should provide a graphical interface to allow the user to input information about water consumption.
2	The application should be able to store consumption information provided by the user in the platform database.
3	The application should assign points to the user who contributed specifying useful information.

9.8 Use case: Exploring gamification actions

Use case: Exploring gamification actions		
Goal in Context	Stimulating water consumption awareness through gamification	
Preconditions	The user participates to the gamified competition.	
Success End Cond.	User visualizes data related to his past gamification actions.	
Failed End Condition	User can't to visualize data related to gamification actions.	
Primary, Secondary Actors	Competitor user and system	
Trigger	User completes action on system or accesses the gamification results area.	
DESCRIPTION	Step	Action
	1	The user can collect points through his actions on the platform.
	2	User can achieve badges based on collected points.
	3	User can redeem collected points for different kind of rewards based on a defined early reward model
	4	User can also visualize past actions, badges and rewards.

Early functional requirements

#	Functional requirement
1	The application should display the possible actions the user can perform.

2	The application should display badges the user can achieve, and the amount of credits required.
3	The application should display available rewards and credits required to redeem them.
4	The application should display user progress, in terms of badges and credits collected.
5	The application should notify the user in case of achievements.
6	The application should display the list of past actions performed by the user.

9.9 Use case: Setting action types and reward types

Use case: Setting action types and reward types		
Goal in Context	Stimulating water consumption awareness through gamification	
Preconditions	None.	
Success End Cond.	New action type or reward type is inserted into the system	
Failed End Condition	No action type or reward type is inserted into the system	
Primary, Secondary Actors	GamificationEngineContentAndRulesEditor and system	
Trigger	The user accesses the area for managing actions and rewards and provides data	
DESCRIPTION	Step	Action
	1	The user can insert new actions or rewards in the Gamified platform

Early functional requirements

#	Functional requirement
1	The application should provide a graphical interface to allow the user to input a new action type into the system or to modify an existing one.
2	The application should display the list of the available actions.
3	The application should provide a graphical interface to allow the user to input a new reward type into the system or to modify an existing one.
4	The application should display the list of the available rewards.

9.10 Use case: Comparing achievements with family, friends and neighbours

Use case: Comparing achievements with family, friends and neighbors

Use case: Comparing achievements with family, friends and neighbors		
Goal in Context	Encouraging competition to stimulate water saving	
Preconditions	Consensus of customer user to disclose information to other users; User has reached at least the first level.	
Success End Cond.	User is ranked on leaderboard with other users.	
Failed End Condition	User is not ranked on leaderboard.	
Primary, Secondary Actors	Competitor users, their social environment and system	
Trigger	User opts in to share his achievements with specific social circles.	
DESCRIPTION	Step	Action
	1	User is ranked on leaderboard with friends, family and/or neighbours based on points he scores in system
	2	Top ranking users can expect extra awards

Early functional requirements

#	<i>Functional requirement</i>
1	The application should ask for user's permission to be ranked on leaderboard.
2	The application should rank user on leaderboard according to the total points he collected.
3	The application should award top ranking users.
4	There should be a separate leaderboard for each social circle (family, friends and neighbours)

9.11 Use case: Inviting another user to join a collaboration

Use case: Inviting another user to join a collaboration		
Goal in Context	Encouraging collective water saving action	
Preconditions	Consensus of customer user to disclose information to other users	
Success End Cond.	The selected user receives an invitation to join a collaboration from the sender user	
Failed End Condition	No invitation is sent	
Primary, Secondary Actors	Competitor user	
Trigger	The user selects another user he wants to invite in the collaboration	
DESCRIPTION	Step	Action
	1	The user visualizes the possible users to invite (family members, neighbours, friends).
	2	The user selects the user to invite.
	3	The selected user receives an invitation to join the collaboration.

Early functional requirements

#	<i>Functional requirement</i>
1	The application should display the list of candidate users who could join a collaboration.
2	The application should allow the user to select a user from the list of available collaborators.
3	The application should notify the candidate collaborator selected by the user, inviting him to join the collaboration.

9.12 Use case: Collecting achievements collaboratively with other family members

Use case: Collecting achievements collaboratively with other family members		
Goal in Context	Encouraging collective water saving action	
Preconditions	Existence of more than one member of the family.	
Success End Cond.	All family members receive extra points for actions and achievements of one member.	
Failed End Condition	Family members do not receive extra points for actions and achievements of one member.	
Primary, Secondary Actors	Competitor user, family members of user and system	
Trigger	User collects points or earns rewards.	
DESCRIPTION	Step	Action
	1	Members of the same household receive points for each others' water saving actions.

Early functional requirements

#	<i>Functional requirement</i>
1	The application should reward users for positive actions of their family members.
2	The application should notify all family members about positive actions of any individual member.

9.13 Use case: Collecting achievements collaboratively with neighbours

Use case: Collecting achievements collaboratively with neighbours	
Goal in Context	Encouraging collective water saving action
Preconditions	Consensus of customer user to disclose information to other users.
Success End Cond.	All team members receive extra points for actions and achievements of one team member.
Failed End Condition	Team members do not receive extra points for actions and achievements of one team member.

Use case: Collecting achievements collaboratively with neighbours		
Primary, Secondary Actors	Competitor user, the social environment of competitor users and system	
Trigger	User sends team-up request to other competitor user.	
DESCRIPTION	Step	Action
	1	Users can team up with other users in their circle of friends or neighbours.
	2	Members of the same team receive points for each others water saving actions.

Early functional requirements

#	Functional requirement
1	The application should reward users for positive actions of their team members.
2	The application should notify all team members about positive actions of any individual member.

9.14 Use case: Achieving goals collaboratively with other users

Use case: Achieving goals collaboratively with other users		
Goal in Context	Encouraging collective water saving action.	
Preconditions	Consensus of customer user to disclose information to other users.	
Success End Cond.	Users achieved a goal collaboratively.	
Failed End Condition	No common goal was achieved.	
Primary, Secondary Actors	Competitor user, their social environment and system	
Trigger	Common goal is set.	
DESCRIPTION	Step	Action
	1	Social circles (e.g. all members of a neighbourhood) work towards a common goal.
	2	When goal is met, all active contributors receive a common reward (e.g. neighbourhood bbq).

Early functional requirements

#	Functional requirement
1	The application should provide the option to invite one or more users to a collaborative goal.
2	The application should display open invitations from other users to collaborative goals.
3	The application should provide the option to accept, reject or postpone (?) an invitation to a collaborative goal
4	The application should display a short and clear description of the collaborative goal with every invitation before the user selects an action

9.15 Use case: Making actions and earning digital points with the Games Platform

Use case: Making actions and earning digital points with the Games Platform		
Goal in Context	Provide water saving participation tools for children	
Preconditions	Smart phone available. User profile on the Games Platform is linked to the one on the Gamification Engine	
Success End Cond.	User collects points on the Gamification Engine	
Failed End Condition	User does not collect points on the Gamification Engine	
Primary, Secondary Actors	CustomerPlayer user, system	
Trigger	User reaches a goal on the Games Platform and the game result is forwarded to the Gamification Engine.	
DESCRIPTION	Step	Action
	1	User plays physical card games or one of the available games on the platform.
	2	User earns extra points with digital game extension of card game (mobile app) or with the standard mobile games.
	3	User redeems points on Gamification Engine

Early functional requirements

#	Functional requirement
1	The application should be able to communicate gaming actions to the Gamification Engine platform.
2	The application should assign points to the user on the Gamification Engine for the performed gaming actions.

9.16 Use case: Converting game actions into rewards

Use case: Converting game actions into rewards		
Goal in Context	Provide means of participation in water saving for younger children	
Preconditions	Games Platform possible outcomes have been defined.	
Success End Cond.	Games results converted into gamification engine actions.	
Failed End Condition	Games results are not converted into gamification engine actions.	
Primary, Secondary Actors	GamificationEngineContentandRulesEditor user, system	
Trigger	A new Games Platform action is available and it needs to be mapped in the Gamification Engine.	
DESCRIPTION	Step	Action
	1	User converts games platform achievements into gamification engine actions. User manually inputs formulas to convert inputs (game achievements and credits) into outputs (Gamification Engine actions).
	2	User can assign specific rewards for games-related actions.

Early functional requirements

#	<i>Functional requirement</i>
1	The application should provide a graphical interface to allow the user to define the rules applied to convert gaming actions into Gamification Engine actions.
2	The application should allow the user to manually input formulas to be applied in the conversion phase.
3	The application should allow the user to define the rewards a user can redeem performing gaming actions.

9.17 Use case: Leaderboard opt-in

Use case: Leaderboard opt-in		
Goal in Context	Stimulating water saving by providing gamification mechanisms to the utility customer.	
Preconditions	Customer is registered to the Gamification Engine portal.	
Success End Cond.	User appears in the public leaderboard.	
Failed End Condition	User does not appear in the public leaderboard.	
Primary, Secondary Actors	Competitor user	
Trigger	User decides to participate in public gamified competition.	
DESCRIPTION	Step	Action
	1	User consents to participate to the public competition and disclose information to other competitor users.
	2	User will now appear in the public leaderboard.

Early functional requirements

#	Functional requirement
1	The application should ask the user to accept to participate to the public competition and disclose information with other users.

9.18 Use case: Leaderboard opt-out

Use case: Leaderboard opt-out		
Goal in Context	Stimulating water saving by providing gamification mechanisms to the utility customer.	
Preconditions	Customer is registered to the Gamification Engine portal.	
Success End Cond.	User no longer appears in the public leaderboard.	
Failed End Condition	User appears in the public leaderboard.	
Primary, Secondary Actors	Competitor user	
Trigger	User decides to avoid participating in public competition.	
DESCRIPTION	Step	Action
	1	User does not consent to participate to the public competition

Use case: Leaderboard opt-out		
		and to disclose information to other competitor users.
	2	User will not appear in the public leaderboard.

Early functional requirements

#	Functional requirement
1	The application should allow the user to decline to participate to the public competition and disclose information with other users.

9.19 Use case: Leaderboard family opt-in

Use case: Leaderboard family opt-in		
Goal in Context	Stimulating water saving by providing gamification mechanisms to the utility customer.	
Preconditions	Customer is registered to the Gamification Engine portal.	
Success End Cond.	User family appears in the public leaderboard.	
Failed End Condition	User family does not appear in the public leaderboard.	
Primary, Secondary Actors	HouseHolder user	
Trigger	User decides his family will publicly participate to the gamified competition.	
DESCRIPTION	Step	Action
	1	User agrees that his family is involved in a public competition and accepts to disclose information to other competitor users.
	2	User family will now appear in the public leaderboard.

Early functional requirements

#	Functional requirement
1	The application should ask the user to accept that his family is involved in a public competition and accept to disclose information with other users.

9.20 Use case: Leaderboard family opt-out

Use case: Leaderboard family opt-out		
Goal in Context	Stimulating water saving by providing gamification mechanisms to the utility customer.	
Preconditions	Customer is registered to the Gamification Engine portal.	
Success End Cond.	User family no longer appears in the public leaderboard.	
Failed End Condition	User appears in the public leaderboard.	
Primary, Secondary Actors	Competitor user	
Trigger	User decides that his family will not publicly participate to the gamified competition.	
DESCRIPTION	Step	Action
	1	User does not agree that his family is involved in a public competition disclosing information to other competitor users.

Early functional requirements

#	<i>Functional requirement</i>
1	The application should allow the user to decline that his family could be involved in a public competition disclosing information with other users.

9.21 Use case: Geolocation opt-in

Use case: Geolocation opt-in		
Goal in Context	Encouraging competition to stimulate water saving	
Preconditions	Customer is registered to the Gamification Engine portal.	
Success End Cond.	User location is visible to other utility users.	
Failed End Condition	User location is not visible to other utility users.	
Primary, Secondary Actors	HouseHolder user	
Trigger	User decides to disclose information about his house geo-location.	
DESCRIPTION	Step	Action
	1	User consents to disclose information about his house location to other competitor users.

Use case: Geolocation opt-in		
	2	House location will appear on a map, visible to other users.

Early functional requirements

#	Functional requirement
1	The application should ask the user to accept to disclose his geo-location, appearing on a map visible to other users.

9.22 Use case: Geolocation opt-out

Use case: Geolocation opt-out		
Goal in Context	Encouraging competition to stimulate water saving	
Preconditions	Customer is registered to the Gamification Engine portal.	
Success End Cond.	User location is no longer visible to other utility users.	
Failed End Condition	User location is visible to other utility users.	
Primary, Secondary Actors	HouseHolder user	
Trigger	User decides to avoid to disclose information about his house geo-location.	
DESCRIPTION	Step	Action
	1	User does not consent to disclose information about his house location to other competitor users.
	2	House location will not appear on a map, visible to other users.

Early functional requirements

#	Functional requirement
1	The application should allow the user to decline to disclose his geo-location, appearing on a map visible to other users.

9.23 Use case: Defining family composition

Use case: Defining family composition		
Goal in Context	Gaining insights on customer households and water consumption	
Preconditions	Customer is registered to the Gamification Engine portal.	
Success End Cond.	Declared family members are candidates to become new users registered to the gamification engine platform.	
Failed End Condition	Declared family members are not candidates to become new users registered to the gamification engine platform.	
Primary, Secondary Actors	HouseHolder user	
Trigger	User provides information	
DESCRIPTION	Step	Action
	1	The user can add a family member to the gamification system, specifying the role of the new user (e.g. wife, son).
	2	The declared family member receives an invitation to join the Gamification Engine.

Early functional requirements

#	Functional requirement
1	The application should provide a graphical interface to allow the user to add a family member.
2	The application should notify the new family member, sending him an invitation to join the Gamification Engine.
3	The application should be able to store all the information about family members, their roles and their contributions to family achievements.

9.24 Use case: Defining water consumption distribution rule among family members

Use case: Defining water consumption distribution rule among family members	
Goal in Context	Gaining insights on customer households and water consumption
Preconditions	Customer is registered to the Gamification Engine portal.
Success End Cond.	Household water consumption is distributed among family members.
Failed End Condition	Household water consumption is by default uniformly distributed among family members.

Use case: Defining water consumption distribution rule among family members		
Primary, Secondary Actors	HouseHolder user	
Trigger	User provides information about family water consumption	
DESCRIPTION	Step	Action
	1	The user can modify the distribution of water consumption among the family members, expressed by percentage values. By default, consumptions are uniformly distributed among family members if no rule has been specified.

Early functional requirements

#	Functional requirement
1	The application should display the current distribution of water consumption among family members.
2	The application should provide a graphical interface to allow the user to modify the consumption distribution rule.

9.25 Use case: Learning interactively about innovative pricing models

Use case: Learning interactively about dynamic pricing models		
Goal in Context	Gamification of individual water consumption and pricing schemes (i.e. tariff schemes) such as blocking rates and to raise awareness of water consumption and pricing schemes and stimulate water saving	
Preconditions	Customer household is metered and has provided consumption information	
Success End Cond.	A significant share of app users opt for exploring how pricing policies work and develop awareness of how much water costs	
Failed End Condition	A negligible share of app users opt for exploring how pricing policies work and develop awareness of how much water costs	
Primary, Secondary Actors	Customer user and system	
Trigger	Consumer chooses the pricing scheme e.g. blocking rates application	
DESCRIPTION	Step	Action
	1	Estimated cost is calculated and visualized for each pricing scheme
	2	The customer has the option to see and compare the cost of

Use case: Learning interactively about dynamic pricing models		
		water consumption among pricing schemes
	3	The customer has the option to see and compare water savings in monetary terms among pricing scheme

Early functional requirements

#	Functional requirement
1	The application should allow users to simulate pricing schemes
2	The application should allow users to visualize the estimated cost for each pricing scheme
3	The application should allow users to visualize the estimated water savings in physical and monetary terms for each pricing scheme

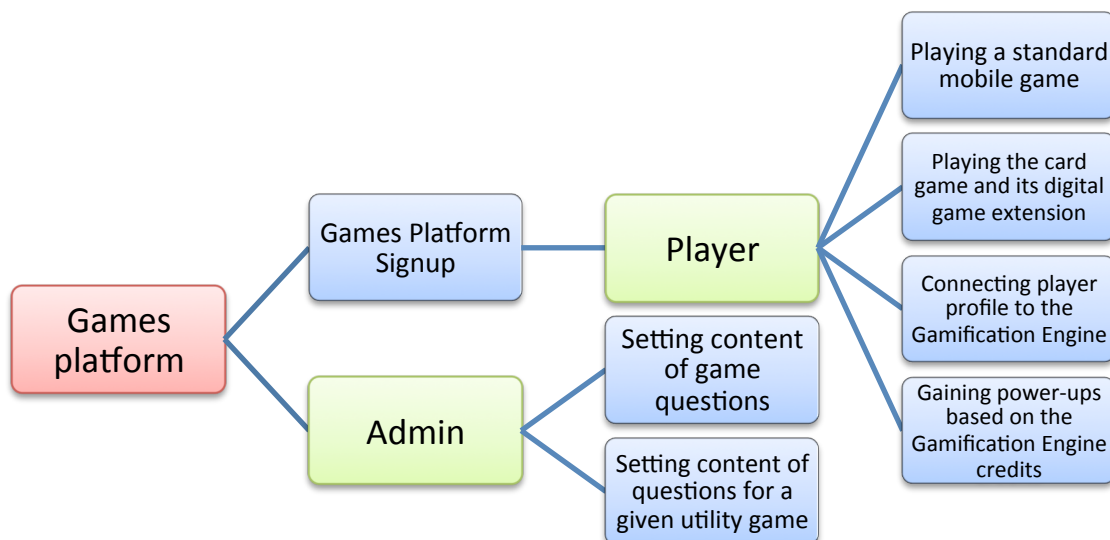
10. Use cases of Games Platform

The Games Platform set of use cases contains the main interaction cases of the consumer with the Games Platform and the possibility to link his/her player also to the Gamification Engine. This set describes the choices of the consumer to get involved in available SmartH2O games (board game, its digital extension and mobile game) and aims to stimulate water consumption awareness.

#	<i>High level requirements</i>
GF1	The application should incentivize the user to play games, awarding points and rewards.
GF2	The application should enable content editors to set games content and questions.
GF3	The application should incentivize the joint use of games and gamification services provided by the utility.

#	<i>High Level non-functional requirements</i>
GNF1	The application shall be accessible and useable for non-technical audiences
GNF2	The application shall be well documented and described
GNF3	The application shall be transparent
GNF4	The application shall be easy to use

Use cases overview



10.1 Use case: Games Platform Signup

Use case: Games Platform Signup		
Goal in Context	Stimulating water consumption awareness through gaming activities.	
Preconditions	None.	
Success End Cond.	User profile is created in the Games platform system	
Failed End Condition	User profile is not created in the Games platform system	
Primary, Secondary Actors	Consumer user	
Trigger	Player inputs information in order to register.	
DESCRIPTION	Step	Action
	1	The user accesses the registration area.
	2	The user inputs personal information required by the registration procedure.
	3	The user confirms the registration.

Early functional requirements

#	<i>Functional requirement</i>
1	The application should provide a graphical interface to allow the player to register to the Games Platform, providing authentication data.
2	The application should be able to store user data in the platform database, creating a new profile for the player.

10.2 Use case: Playing a standard mobile game

Use case: Playing a standard mobile game	
Goal in Context	Stimulating water consumption awareness through gaming activities.
Preconditions	None.
Success End Cond.	The user plays a game session
Failed End Condition	The user does not play a game session
Primary, Secondary Actors	Player user
Trigger	The user accesses the Game Portal and chooses to play one of the available games

Use case: Playing a standard mobile game		
DESCRIPTION	Step	Action
	1	The user accesses the Game Portal and selects the game to play.
	2	The user is redirected to the selected game, where a new game session starts.

Early functional requirements

#	Functional requirement
1	The application should be able to display the available games on the platform.
2	The application should be able to manage new game sessions, started by casual or registered players.
3	The application should store information retrieved during the game sessions.

10.3 Use case: Playing the card game and its digital game extension

Use case: Playing the card game and its digital game extension		
Goal in Context	Stimulating water consumption awareness through gaming activities.	
Preconditions	Smart phone available	
Success End Cond.	The user is able to play a game session involving both the physical card game and the digital extension.	
Failed End Condition	The user is not able to play a game session involving both the physical card game and the digital extension.	
Primary, Secondary Actors	Player user	
Trigger	During a card game session, the user is required to solve a task using the digital game extension.	
DESCRIPTION	Step	Action
	1	The user is playing a card game session.
	2	The current card requires the user to solve a particular task, using the digital game extension.
	3	Using the smartphone, the player completes the task.
	4	The user returns the points obtained playing the digital game into the physical card game context, integrating them with his current score.

Early functional requirements

#	Functional requirement
1	The application should manage game sessions which are an extension of the physical card game, performed by registered or casual players.
2	The application should manage the difficulty of the tasks provided to the players, according to the information provided by them.

10.4 Use case: Gaining power-ups based on the Gamification Engine credits

Use case: Gaining power-ups based on the Gamification Engine credits		
Goal in Context	Stimulating water consumption awareness through gaming activities.	
Preconditions	The player is a customer of the utility, registered to the Gamification Engine.	
Success End Cond.	The player is able to gain power-ups exploiting Gamification Engine credits.	
Failed End Condition	The player is not able to gain power-ups exploiting Gamification Engine credits.	
Primary, Secondary Actors	CustomerPlayer user	
Trigger	Player clicks to "buy" power-ups	
DESCRIPTION	Step	Action
	1	The user clicks to buy power-ups, exploiting the credits collected in the Gamification Engine.
	2	If the user has enough credits, the system takes the required credits off the total ones available in the Gamification Engine.
	3	The user gets the power-ups.

Early functional requirements

#	Functional requirement
1	The application should manage Gamification credits redemption requested in the game context.
2	The application should be able to verify the credits availability in order to suggest the suitable power-ups the user can request.

10.5 Use case: Connecting player profile to the Gamification Engine

Use case: Connecting my player profile to the Gamification Engine		
Goal in Context	Stimulating water consumption awareness through gaming activities.	
Preconditions	The player is a customer of the utility.	
Success End Cond.	The user connects his player profile with his customer profile on the Gamification Engine.	
Failed End Condition	The user does not connect his player profile with his customer profile on the Gamification Engine.	
Primary, Secondary Actors	RegisteredPlayer user	
Trigger	Player clicks to connect the player profile to the utility customer profile.	
DESCRIPTION	Step	Action
	1	The user decides to link his player profile to the gamification engine one, in order to collect points in both platforms.
	2	The user provides the required information to connect his profiles and confirms.

Early functional requirements

#	<i>Functional requirement</i>
1	The application should be able to match the player profile on the Games platform with the one on the Gamification Engine.
2	The application should manage the collection of points performed using both the platforms.
3	The application should display user progress and ranking in both the Games Platform and the Gamification Engine.

10.6 Use case: Setting content of game questions

Use case: Setting content of game questions		
Goal in Context	Stimulating water consumption awareness through gaming activities.	
Preconditions	None.	
Success End Cond.	A new question is inserted into the system.	
Failed End Condition	No question is inserted into the system.	
Primary, Secondary Actors	GamesPlatformCE user	
Trigger	The user accesses the area for managing game questions and provides data	
DESCRIPTION	Step	Action
	1	The user inputs a new question and in case of a closed-ended question the possible answers.
	2	The user can also modify an existing question.

Early functional requirements

#	<i>Functional requirement</i>
1	The application should display the questions already in the system.
2	The application should provide a graphical interface to allow the user to input a new question.
3	The application should allow the user to modify an existing question.

10.7 Use case: Setting content of questions for a given utility game

Use case: Setting content of questions for a given utility game		
Goal in Context	Stimulating water consumption awareness through gaming activities.	
Preconditions	None.	
Success End Cond.	A new question is inserted into the system.	
Failed End Condition	No question is inserted into the system.	
Primary, Secondary Actors	UtilityGamesPlatformContentEditor user	
Trigger	The user accesses the area for managing game questions and provides data	
DESCRIPTION	Step	Action
	1	The user inputs a new question and in case of a closed-ended question the possible answers.
	2	The user can also modify an existing question.

Early functional requirements

#	<i>Functional requirement</i>
1	The application should display the questions already in the system.
2	The application should provide a graphical interface to allow the user to input a new question.
3	The application should allow the user to modify an existing question.

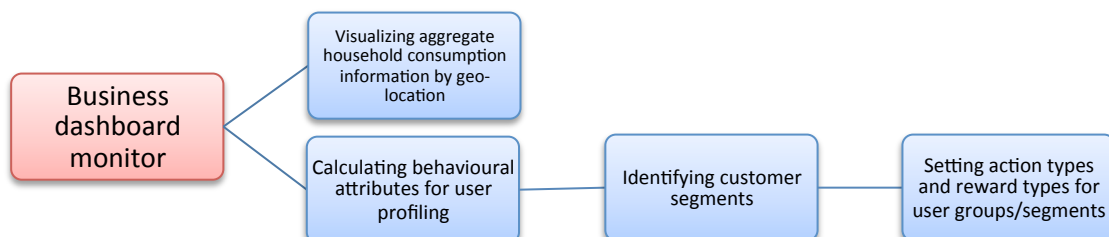
11. Use cases of Business Dashboard: Customer consumption monitor

This set of use cases describes the interaction of utility staff with the customer consumption monitor, one of two Business Dashboard applications. In particular, the following use cases comprise the monitoring of consumption information, the identification and calculation of attributes, the segmentation of customers based on these attributes and the setting and provision of targeted incentives to the different customer groups/segments.

#	<i>High level requirements</i>
MF1	The application should display aggregated consumption data by geographical region/district or household.
MF2	The application should display the consumption data visualized by different periods of time
MF3	The application should provide to the user some typical location-based consumption metrics, e.g. peak and average of the municipality, to compare to
MF4	The systems should have access to the SmartH2O database
MF5	The system should be able to identify customer behavioural attributes
MF6	The system should be able to identify customer segments

#	<i>High Level non-functional requirements</i>
MNF1	The application shall be accessible and useable for non-technical audiences
MNF2	The application shall be well documented and described
MNF3	The application shall be transparent
MNF4	The application shall be easy to use

Use cases overview



11.1 Use case: Visualizing aggregate household consumption information by geo-location

Use case: Visualizing aggregate household consumption information by geo-location		
Goal in Context	Identifying e.g. leakage or consumption metrics of customers to take appropriate action (e.g. adjust pumping, fix leaks, adapt pricing schemes)	
Preconditions	Customer households are metered; Household consumption data is available	
Success End Cond.	Household consumption data is visualized.	
Failed End Condition	Household consumption data is not visualized.	
Primary, Secondary Actors	ConsumptionSupervisor and system	
Trigger	ConsumptionSupervisor specifies geo-location.	
DESCRIPTION	Step	Action
	1	User selects specific geographic region / district / household
	2	The system visualizes the aggregated metered water consumption data of a specific geographic region / district / household
	3	The user can interact with the visualization by choosing different zoom levels of the information (hourly, daily, monthly)
	4	The user can compare average to a set of available other aggregate averages (e.g. municipality, district)
	5	If data available, the user can compare the consumption with amount of pumped water

Early functional requirements

#	Functional requirement
1	The application should enable to user to select a specific geo-location as the basis for the visualization (e.g. district, street, building, household)
2	The application should display a visualization of the aggregated water consumption of a specified geo-location (e.g. district, street, building, household)
3	The application should provide the option to adjust the view settings of the visualization to different time intervals
4	The application should provide the option to compare the consumption average with the average consumption of other geo-locations / areas.
5	The application should provide a visualized comparison of the current consumption with past

	measurements
6	The application should enable the user to compare the consumption of a specific geo-location with the amount of water pumped into the respective area
7	The application should highlight and visualize unexpected consumption behaviour, e.g. peaks that could relate to leakage

11.2 Use case: Calculating behavioural attributes for user profiling

Use case: Calculating behavioural attributes for user profiling		
Goal in Context	Understanding the most relevant drivers of water consuming at the household level.	
Preconditions	Customer households have provided household and consumption information. Households were metered.	
Success End Cond.	The identified behavioural attributes are validated based on observational data.	
Failed End Condition	The identified behavioural attributes are not confirmed by observational data.	
Primary, Secondary Actors	System	
Trigger	A sufficient rich set of customers provide household and consumption information	
DESCRIPTION	Step	Action
	1	System calculates behavioural attributes from their water consumption and interaction patterns on the gamified water meter system

Early functional requirements

#	<i>Functional requirement</i>
1	The system should automatically calculate behavioural attributes.

11.3 Use case: Identifying customer segments

Use case: Identifying customer segments		
Goal in Context	Identifying specific customer segments to provide targeted incentives and personalized feedback for water saving.	
Preconditions	Customer households have provided household and consumption information. Households were metered.	
Success End Cond.	The identified customer segments are validated based on observational data.	
Failed End Condition	The observational data does not confirm the identified customer segments. The identified customer segments are not fine-grained enough.	
Primary, Secondary Actors	ConsumptionSupervisor user and system	
Trigger	A sufficient rich set of customers provide household and consumption information.	
DESCRIPTION	Step	Action
	1	System displays the behavioural customer and household attributes
	2	Based on this information, the user can identify and save a specific customer segment by selecting a subset of attributes
	3	System identifies customer segments.

Early functional requirements

#	<i>Functional requirement</i>
1	The system should get access to the raw data stored in the Smarth2O database.
2	The system should be able to identify customer segments automatically

11.4 Use case: Setting action and reward types for specific user segments/groups

Use case: Setting action types and reward types for user groups/segments		
Goal in Context	Provide personalized incentives based on specific customer segments.	
Preconditions	User profiles and segments are available in the system.	
Success End Cond.	Different actions and rewards are linked to each user segment.	
Failed End Condition	The system is not able to propose different actions and rewards for each user segment.	
Primary, Secondary Actors	ConsumptionSupervisor user and system	
Trigger	None	
DESCRIPTION	Step	Action
	1	The system is able to propose personalized water saving tips for each customer segment based on identified user model.
	2	Gamified Platform Content Editor user defines reward schemes for a selected customer segment.

Early functional requirements

#	<i>Functional requirement</i>
1	The system should be able to propose water saving tips.
2	The Gamified Platform Content Editor user should be able to specify reward schemes for a selected customer segment.
3	The Gamified Platform Content Editor user should be able to propose a reward for a water saving action performed by the customer.

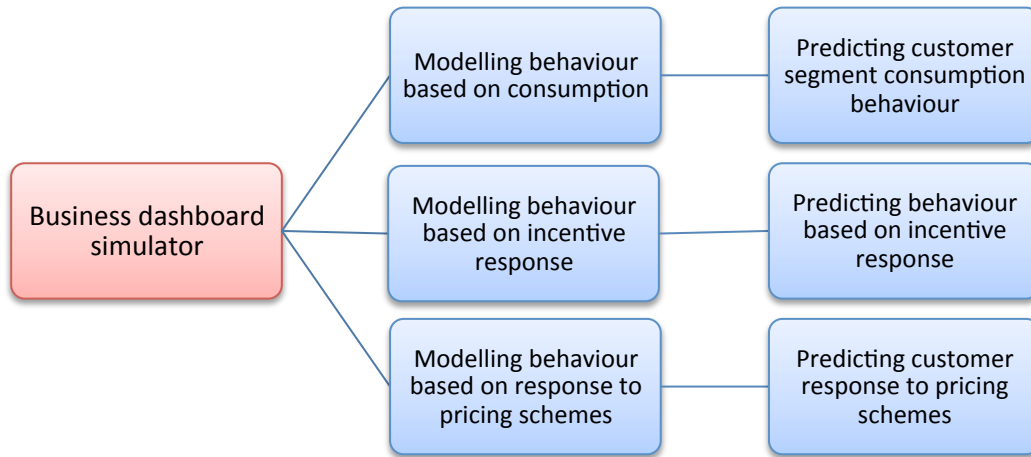
12. Use cases of Business Dashboard: Customer consumption simulator

The use cases of this set describe the modelling and simulation of user behaviour based on different variables (consumption, incentives and pricing schemes) and the corresponding prediction of the reaction of the customers on these variables in terms of water consumption.

#	<i>High level requirements</i>
SF1	The system should have access to the Smarth2O water consumption database.
SF2	The system should be able to produce a behavioural model based on the past consumption data
SF3	The system should update the model periodically
SF4	The system should be able to predict future consumption behaviour based on the behavioural model
SF5	The system should have access to the consumers' water consumption as reaction to applied reward/incentive schemas
SF6	The system should be able to predict customer's water consumption as reaction to a reward/incentive schema
SF7	The system should be able to display the predictions for future water consumption

#	<i>High Level non-functional requirements</i>
SNF1	The application shall be accessible and useable for non-technical audiences
SNF2	The application shall be well documented and described
SNF3	The application shall be transparent
SNF4	The application shall be easy to use

Use cases overview



12.1 Use case: Modelling behaviour based on consumption

Use case: Modeling behaviour based on consumption		
Goal in Context	Understand and model the consumers' current behaviour on the basis of household information and historical and real-time water usage data	
Preconditions	Customer households have provided household and consumption information. Households were metered.	
Success End Cond.	The model is validated against observational data.	
Failed End Condition	Poor matching between the observational data and the output of the model.	
Primary, Secondary Actors	System	
Trigger	Customer provides a sufficient rich set of household and consumption information.	
DESCRIPTION	Step	Action
	1	Based on previous consumption information provided by smart meters and customer input, a behaviour model is estimated.
	2	The estimated behaviour model is periodically updated/tested based on new consumption information.

Early functional requirements

#	Functional requirement
1	The system has access to the water consumption data stored in the SmartH2O database.
2	The system should be able to periodically update the model

12.2 Use case: Predicting customer segment consumption behaviour

Use case: Predicting customer segment consumption behaviour		
Goal in Context	Water consumption prediction by customer segment based on past information and customer segment defined from information available from the app	
Preconditions	Customer households have provided household and consumption information. Households were metered.	
Success End Cond.	The model is able to accurately predict customer segment consumption behaviour.	
Failed End Condition	The model is not able to accurately predict customer segment consumption behaviour.	
Primary, Secondary Actors	System, Customer user, ConsumptionSupervisor user	
Trigger	User requires a water consumption prediction	
DESCRIPTION	Step	Action
	1	Based on behaviour model, system predicts short- and long-term future consumption behaviour
	2	The water demand forecast is displayed.
	3	Customers and water utilities can foresee possible consumption behaviour scenarios and adjust policy or actions accordingly

Early functional requirements

#	Functional requirement
1	The predicted future water consumption should be displayed.

12.3 Use case: Modelling behaviour based on incentive response

Use case: Modelling behaviour based on incentive response		
Goal in Context	Estimation of customer water consumption response to specific reward scheme / incentive based on information collecting by the app.	
Preconditions	Customer households have provided household and consumption information. Households were metered. Relevant and feasible rewards have been identified.	
Success End Cond.	The model is validated against a subset of observational data	
Failed End Condition	Poor matching between model outputs and the validation subsets.	
Primary, Secondary Actors	System	
Trigger	Users are aware of the incentive scheme and react accordingly	
DESCRIPTION	Step	Action
	1	Based on past incentive response a behaviour model is defined and estimated
	2	The estimated behaviour model is periodically updated/tested based on new information.collected from the app

Early functional requirements

#	<i>Functional requirement</i>
1	The application should estimate customer water consumption response to reward/incentive schemes

12.4 Use case: Predicting behaviour based on incentive response

Use case: Predicting behaviour based on incentive response		
Goal in Context	Prediction of customer water consumption response to specific reward / incentive scheme based on the estimated model of customer response to rewards/incentive schemes.	
Preconditions	Customer households have provided household and consumption information. Households were metered. Relevant and feasible rewards have been identified. Customer response model has been estimated.	
Success End Cond.	The model is able to accurately predict customer consumption response to reward/incentive scheme.	
Failed End Condition	The model is not able to accurately predict customer consumption response to reward/incentive scheme.	
Primary, Secondary Actors	GamificationEngineSupervisor user and system	
Trigger	The user requires prediction under given scenarios.	
DESCRIPTION	Step	Action
	1	Based on the behaviour model on incentive response, the system predicts the likely response in terms of consumption and behaviour change for specific customer segments to different kinds of incentives
	2	User can adjust incentives targeted to individual customer segments accordingly, e.g. reward schemes

Early functional requirements

#	Functional requirement
1	The application should enable the utility user to predict the response of customers' water consumption under different rewards and incentive schemes.

12.5 Use case: Modelling behaviour based on response to pricing scheme

Use case: Modelling behaviour based on response to pricing scheme		
Goal in Context	Estimation of customer water consumption response to specific pricing policies	
Preconditions	Customer households have provided household and consumption information. Households were metered. Utilities have experimented pricing policies through the app.	
Success End Cond.	The model is validated against a subset of observational data	
Failed End Condition	Poor matching between model outputs and the validation subsets.	
Primary, Secondary Actors	System	
Trigger	None.	
DESCRIPTION	Step	Action
	1	Based on previous consumption information provided by smart meters and customer input, a behaviour model is defined

Early functional requirements

#	<i>Functional requirement</i>
1	The application should allow users to visualize their past consumption based on current pricing schemes
2	The application should allow users to predict future consumption based on alternative pricing schemes

12.6 Use case: Predicting customer response to pricing schemes

Use case: Predicting customer response to pricing schemes		
Goal in Context	Prediction of customer water consumption response to specific pricing schemes such as blocking rates.	
Preconditions	Customer households have provided household and consumption information. Households were metered.	
Success End Cond.	The model is able to accurately predict customer consumption response to reward/incentive policies.	
Failed End Condition	The model is not able to accurately predict customer consumption response to reward/incentive policies.	
Primary, Secondary Actors	GamificationEngineSupervisor user and System	
Trigger	Utilities user chooses the pricing scheme e.g. blocking rates application	
DESCRIPTION	Step	Action
	1	Based on the pricing model, the system predicts the likely response in terms of consumption and pricing change for specific customer segments to different kinds of pricing schemes

Early functional requirements

#	Functional requirement
1	Allow utilities users to simulate pricing schemes
2	Allow utilities users to see customers' consumption and pricing changes for specific customer segments to different kinds of pricing schemes

13. Early Software Integration Requirements

The early software integration requirements will deal with early requirements on critical issues of the integration/communication of the SmartH2O system with the water companies existing infrastructure (e.g. data integration, services integration etc.)

13.1 Preamble

For providing an effective integration approach, the business and technical requirements are investigated for as a first step.

The following describes issues considered for determining the requirements of the integrated SmartH2O software platform:

- Defining integration solution and business processes
 - Clarify the scope of the integration solution
 - Dividing the scope into a collection of smaller, discrete units of work
 - Identifying the business processes that are candidates for integration
 - Define the activities for each business process
 - Define the characteristics for each business process or component
 - Sequence or order (in relation to other tasks and activities)
 - Frequency of occurrence
 - Urgency and timeliness
 - Duration or elapsed time
 - Volume range, including average volume, peaks, and lulls
- Defining actors and their roles in business processes
 - Identifying the water user types, game players
 - Identifying the geographical distribution of the actors
 - Defining how the data is transported between actors and system
- Defining business events
- Defining the message format for business events
- Defining business data flows
- Defining quality of service
- Defining the integration solution topology

13.2 Data integration

Data are important assets for the SmartH2O platform as data are used to identify and understand user behaviour prior to applying models for inducing changes. Data integration is important for providing a unified view of the SmartH2O platform as data assets. The SmartH2O platform requires integrating data from several distributed sources, which are stored using various technologies and provide a unified view of the data. The main sources of data are:

- Smart Metered consumption periodically provided by the water utility
- Standard Metered consumption provided by the users
- User profiling data provided by the users
- Social data extracted from the Social Media
- External databases and services that send data to SmartH2O platform

Unifying different data sources is an instance of the well-known problem of *heterogeneous data integration*, which addresses the definition of coherent global views on top of multiple data sources, usually heterogeneous. Data integration is an extremely challenging matter, as it requires not only the collection of data from multiple data sources, but also the reconciliation of conflicts and inconsistencies.

The initial data integration necessity regards obtaining Smart Metered consumption provided by the water utility. This objective is implemented after achieving an agreement with the water utilities regarding the protocol for transferring the data files.

Figure 40 is a representation of the flow of transferring, receiving, storing and processing of the smart counter files:

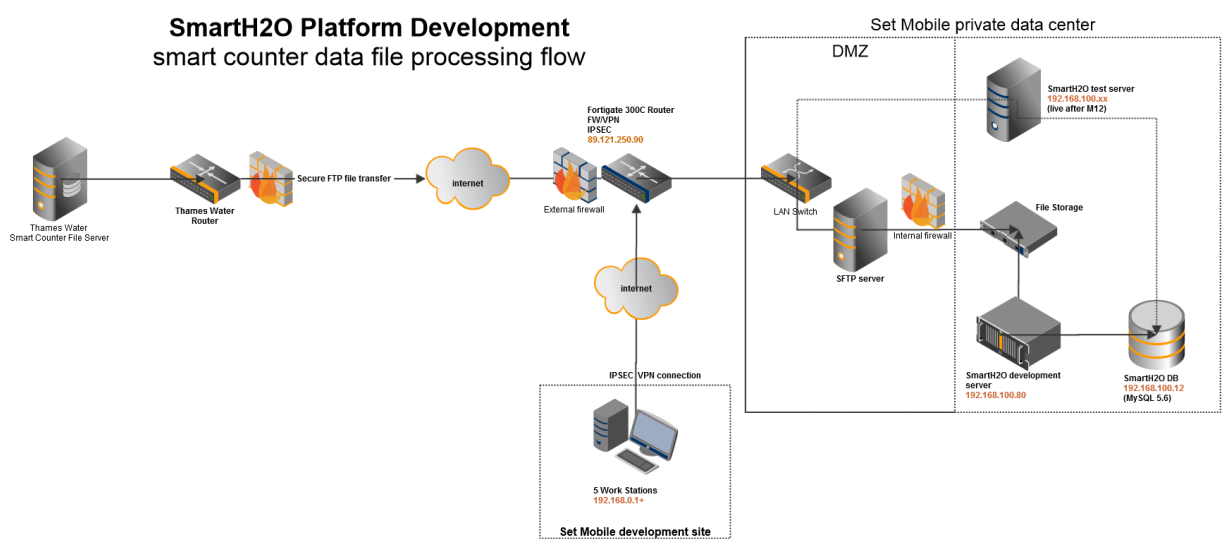


Figure 40. Smarth2O platform development: smart counter data file processing flow.

The data governance policy implemented at the premises of SETMOB - as the partner in charge with the Smarth2O platform development and integration - defines the technical solutions to protect the data files received from the partners during the work flows of the development phase.

It regards:

- a. Data in transit (data that is transferred between the Smarth2O development server and other network nodes)
 - Firewall FortiGate 300C. No external non-authorized access;
 - IPSEC VPN access for listed IPs. The partners will send their authorized IP addresses. They will receive a ready configured VPN client. The partners will connect through VPN in order to access the platform applications and services;
 - *Secured FTP* to upload data files to the Smarth2O development server. The FTP server uses a custom configuration;
 - Secured HTTP for application access over the internet;
 - User / password authentication for application access over the internet;
- b. Data in use (active data under constant change, stored in RAM)
 - Processing data on unique physical server with unique external IP;
 - Setting access rights for data manipulation at application level;
 - Implementing encryption protocols for accessing data via web-services;
 - Application *whitelisting*;

- c. Data at rest (inactive data)
 - Private datacenter with limited access (4 IT staff) card based;
 - Unique IT admin for the SmartH2O development server;
 - Policy of No Off-site data backup allowed;

13.3 Example of smart counter data file processing flow

The following describes an example flow of transferring, receiving, storing and processing of the smart counter files:

- Step 1: The receiving partner (SETMOB) transmits to the providing partner (TWUL, SES) the parameters and credentials for accessing the Secured FTP (SFTP) server. The SFTP server resides in the DMZ of a data center protected by a FortiGate 300C router firewall.
- Step 2: The providing partner connects, authenticates and uploads the archive with files containing smart water counter readings to the SFTP server. After successfully receiving the archive, the SFTP server then moves the archive to the File Storage which resides in the non-DMZ LAN of the data center.
- Step 3: The providing partner will upload the MD5 signature of the uploaded archive. This will be used by the receiving partner for successfully validating the file transfer.
- Step 4: The *Smart Meter Data Management* Component running on the SmartH2O development server process the archive and stores the data from the data files in a local data base protected by a build-in security layer.
- Step 5: After processing, the archive received from the providing partner is automatically encrypted and moved in a dedicated zone on File Storage. A log will be available for the providing partner to acknowledge the outcome of the process.
- Step 6: The data saved in the database is accessed, processed and displayed by user/password authenticated applications according to the business logic.

13.4 Service integration

Web services play a major role in function/method-oriented integration within SmartH2O platform. Web services are one of the most commonly used patterns for enterprise and business-to-business application integration.

Function or method integration involves the direct component-to-platform integration. It can range from custom code (Java, Python or C/C++) to application programming interfaces (APIs), to remote procedure calls (RPCs), Java remote method invocation (RMI), message oriented middleware (MOM), and DCOM or to XML Web services using Simple Object Access Protocol (SOAP).

Function or method-oriented integration is primarily synchronous in nature—it is based on request/response interactions between the client (requesting program) and the server (responding program). Generally, it will support the following:

- Full SOAP/WSDL/UDDI support
- Middleware integration (J2EE, CORBA)
- Language integration (Java, Python, C/C++)
- Packaged application integration
- Transformation
- Transaction support
- Scripting
- Logging and auditing
- Performance and scaling

- Asynchronous message delivery and message correlation
- Message signatures and trusted intermediaries
- Complementary development tools

Integration Services are usually divided into two major use cases: behind the firewall and on the Internet. In the SmarH2O platform perspective, both of the use cases are applied. The “behind the firewall” services type are used for integrating platform components developed by partners while the “on the Internet ” services type are used for collecting data from external portals as well as from social media networks.

After performing the initial integration analysis with the water utility companies the common decision was that the method for acquiring data containing water consumption is exposing an SFTP service on the SmarH2O platform side.

Water utility system uploads the files containing the consumption data for a reference interval of time to the SFTP server. Then the data integration process downloads the data from the SFTP server and import the data into the SmarH2O database by performing an ETL transformation.

14. Conclusions and Next Steps

In this deliverable we have provided the foundation for the requirements guiding the development of the SmartH2O applications. We have outlined a number of different user stories, which are relevant for and have been evaluated with end-users. For this, we considered both application scenarios:

- Saving water by raising social awareness.
- Saving water by innovative pricing schemes.

This document has specified the early requirements and use cases for the SmartH2O applications applying a human-centred development process and considering a combined *User pull – Technology push* requirements analysis cycle. Section 2 has described the development and evaluation of preliminary user stories. Evaluation of these preliminary user stories has taken place with end-users in each case study area, i.e. both water consumers and suppliers with a strong emphasis on water utilities, and with the project's technical partners. Based on this feedback, we have defined a first set of early user stories and mockups, which have been described in sections 3 and 4, identifying four main applications:

- The basic Customer Portal “Visual Water Meter”.
- The advanced Customer Portal “Gamified Water Meter”.
- The Games Platform consisting of the Card Game “Drop!” and its digital mobile game app extension.
- The Business Dashboard with a “Customer Consumption Monitor” and “Customer Consumption Simulator”.

On the one hand, the envisioned applications aim to engage customers and stimulate water saving by raising social awareness. Means to implement this include the provision of easy meter data access, basic water saving tips and alerts, while engaging customers in a gamified environment where they can earn points through their water saving actions, compare themselves to others and positively influence their environment. Utilities will have means to monitor the consumption behaviour of their customers closely, to stimulate them with targeted reward schemes and to simulate their strategies in advance of implementation.

On the other hand, the applications will also enable the customers and utilities to gain knowledge on current and new pricing schemes and to predict future water consumption based on new pricing schemes in order to maximize water savings.

From the conceptualized user stories and mockups, we have derived a preliminary user model, early high level functional and non-functional requirements, as well as use cases with early functional requirements.

Finally, early software integration requirements have been specified to align the implementation process with integration with the water utilities' system infrastructure from the start. These will be finalized in D2.3 Functional specification of the SmartH2O platform.

We have stressed that the specification of the requirements is an on-going, iterative process. As a next step, we therefore need to obtain feedback on and further refine the now defined user stories and mockups.

This will also help us become more comprehensive with regard to the use cases and requirements. Therefore, the presented use cases and early requirements will also be revised, refined und completed (e.g. with success criteria and sequence diagrams) in the subsequent deliverable D2.2, scheduled for M12, that will contain the complete inventory of the final use cases and requirements informing the functional specification and implementation of the SmartH2O platform.

15. References

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16. Appendix A: User groups specification

Name	User
Description	The user of the SmartH2O system, who can be either a consumer using the services provided or an admin who manages the content or monitors the system.
Profile Data	Username, Password, Email
Super-group	-
Sub-group	Consumer, Admin
Use cases	-
Objects accessed in read mode	-
Objects accessed in content management mode	-

Name	Consumer
Description	Generic consumer user who may want to exploit the services provided by the SmartH2O system (Consumer Portal, Gamification Engine or Games Platform). A Consumer is not yet registered to any service of the system.
Profile Data	No profile required, they are not yet registered.
Super-group	User
Sub-group	Player, Customer
Use cases	Costumer Portal Signup (8.1) Games Platform Signup (10.1)
Objects accessed in read mode	-
Objects accessed in content management mode	-

Name	Player
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Description	User who plays the Games provided by the Smarth2O system.
Profile Data	No profile required, they are not yet registered.
Super-group	Consumer
Sub-group	CasualPlayer, RegisteredPlayer
Use cases	Playing a standard mobile game (10.2) Playing the card game and its digital game extension (10.3) Inherited Uses Cases: 8.1, 10.1 from Consumer
Objects accessed in read mode	-
Objects accessed in content management mode	-

Name	CasualPlayer
Description	Not registered visitor interested in playing a game.
Profile Data	No profile required, they are not yet registered.
Super-group	Player
Sub-group	-
Use cases	Inherited Uses Cases: <ul style="list-style-type: none"> • 10.2, 10.3 from Player • 8.1, 10.1 from Consumer
Objects accessed in read mode	-
Objects accessed in content management mode	-

Name	RegisteredPlayer
Description	Player registered to the Games platform.
Profile Data	Username, Password, Email.
Super-group	Player

Sub-group	CustomerPlayer
Use cases	Connecting player profile to the Gamification Engine (10.5) Inherited Uses Cases: <ul style="list-style-type: none"> • 10.2, 10.3 from Player • 8.1, 10.1 from Consumer
Objects accessed in read mode	-
Objects accessed in content management mode	-

Name	CustomerPlayer
Description	User who is registered both to the Gamification Engine and the Games Platform. He has the possibility to collect points either by performing actions provided in the Gamification Engine or by playing the available games.
Profile Data	
Super-group	RegisteredPlayer, HouseHolder, Competitor
Sub-group	-
Use cases	Making actions and earning digital points with the Games Platform (9.15) Gaining power-ups based on the Gamification Engine credits (10.4) Inherited Uses Cases: <ul style="list-style-type: none"> • 8.10, 9.6, 9.19, 9.21, 9.22, 9.23, 9.24 from Householder • 9.3, 9.4, 9.7, 9.8, 9.10, 9.11, 9.12, 9.13, 9.14, 9.17, 9.18, 9.20 from Competitor • 8.3, 8.4 from StandardMetered • 8.2, 8.5 from SmartMetered • 8.6, 8.8, 8.11, 8.12, 9.1, 9.5, 9.25, 12.2 from Customer • 10.5 from RegisteredPlayer • 10.2, 10.3 from Player • 8.1, 10.1 from Consumer
Objects accessed in read mode	-
Objects accessed in content management mode	-

Name	Customer
Description	User registered to the Consumer Portal, who accesses in order to monitor his water consumption and water bill.
Profile Data	Username, Password, Email, First Name, Last Name, Birth Date, Registration Date, Educational Level, Income Rate, Currency.
Super-group	Consumer
Sub-group	StandardMetered, SmartMetered
Use cases	Providing water consumption alerts (8.6) Providing water consumption tips (8.8) Modifying user settings (8.11) Customer Portal Unsubscription (8.12) Gamification Engine Signup (9.1) Learning interactively about dynamic pricing models (9.25) Predicting customer segment consumption behaviour (12.2) Inherited Uses Cases: 8.1, 10.1 from Consumer
Objects accessed in read mode	House, Meter Reading, Bill, Weather Condition, Tip, MediaAsset.
Objects accessed in content management mode	House.

Name	StandardMetered
Description	Customer not having smart meters system installed in his house. The user needs to manually input consumption data into the system.
Profile Data	Username, Password, Email, First Name, Last Name, Birth Date, Registration Date, Educational Level, Income Rate, Currency.
Super-group	Customer
Sub-group	Competitor
Use cases	Manually collecting consumption data (8.3) Visual exploration of water consumption information (8.4) Inherited Uses Cases: <ul style="list-style-type: none"> • 8.6, 8.8, 8.11, 8.12, 9.1, 9.25, 12.2 from Customer

	<ul style="list-style-type: none"> • 8.1, 10.1 from Consumer
Objects accessed in read mode	House, Meter Reading, Bill, Weather Condition, Tip, MediaAsset.
Objects accessed in content management mode	House, Meter Reading.

Name	SmartMetered
Description	Customer having smart meters system installed in his house. The water meter measures the customer's water consumption automatically.
Profile Data	Username, Password, Email, First Name, Last Name, Birth Date, Registration Date, Educational Level, Income Rate, Currency.
Super-group	Customer
Sub-group	Competitor
Use cases	<p>Collecting consumption data (8.2)</p> <p>Visual exploration of water consumption at fixture/appliance level (8.5)</p> <p>Inherited Uses Cases:</p> <ul style="list-style-type: none"> • 8.6, 8.8, 8.11, 8.12, 9.1, 9.25, 12.2 from Customer • 8.1, 10.1 from Consumer
Objects accessed in read mode	House, Meter Reading, Bill, Weather Condition, Tip, MediaAsset.
Objects accessed in content management mode	House.

Name	Competitor
Description	Customer who accepted to participate to the gamification mechanisms, including execution of actions, acquisition of badges and redemption of rewards.
Profile Data	Username, Password, Email, First Name, Last Name, Birth Date, Registration Date, Educational Level, Income Rate, Currency, Photo, Bio, Total Credits, Participation Points, Participation 7 days.
Super-group	StandardMetered, SmartMetered.

Sub-group	HouseHolder
Use cases	<p>Self setting consumption goals (9.3)</p> <p>Fulfilling consumption goals (9.4)</p> <p>Implementing water saving actions (9.5)</p> <p>Declaring water consumption and action information (9.7)</p> <p>Exploring gamification actions (9.8)</p> <p>Comparing achievements with family, friends and neighbours (9.10)</p> <p>Inviting another user to join a collaboration (9.11)</p> <p>Collecting achievements collaboratively with other family members (9.12)</p> <p>Collecting achievements collaboratively with neighbours (9.13)</p> <p>Achieving goals collaboratively with other users (9.14)</p> <p>Leaderboard self opt-in (9.17)</p> <p>Leaderboard self opt-out (9.18)</p> <p>Leaderboard family opt-out (9.20)</p> <p>Inherited Uses Cases:</p> <ul style="list-style-type: none"> • 8.3, 8.4 from StandardMetered • 8.2, 8.5 from SmartMetered • 8.6, 8.8, 8.11, 8.12, 9.1, 9.25, 12.2 from Customer • 8.1, 10.1 from Consumer
Objects accessed in read mode	House, Meter Reading, Device, Device Consumption, Bill, Weather Condition, District, Thematic Area, Action Type, Action Instance, Badge Type, Badge Instance, Reward Type, Reward Instance, Tip, Goal.
Objects accessed in content management mode	House, Device Consumption, Action Instance, Badge Instance, Goal.

Name	HouseHolder
Description	Responsible of a specific house, he/she can add other family members to the Gamification Engine and create collaborations with neighbours.
Profile Data	Username, Password, Email, First Name, Last Name, Birth Date, Registration Date, Educational Level, Income Rate, Currency, Photo, Bio, Total Credits, Participation Points, Participation 7 days.
Super-group	Competitor

Sub-group	CustomerPlayer
Use cases	<p>Providing feedback on consumption disaggregated data (8.10)</p> <p>Contributing household and user profiling information (9.6)</p> <p>Leaderboard family opt-in (9.19)</p> <p>Geolocation opt-in (9.21)</p> <p>Geolocation opt-out (9.22)</p> <p>Defining family composition (9.23)</p> <p>Defining water consumption distribution rule among family members (9.24)</p> <p>Inherited Uses Cases:</p> <ul style="list-style-type: none"> • 9.3, 9.4, 9.5, 9.7, 9.8, 9.10, 9.11, 9.12, 9.13, 9.14, 9.17, 9.18, 9.20 from Competitor • 8.3, 8.4 from StandardMetered • 8.2, 8.5 from SmartMetered • 8.6, 8.8, 8.11, 8.12, 9.1, 9.25, 12.2 from Customer • 8.1, 10.1 from Consumer
Objects accessed in read mode	House, Meter Reading, Device Consumption, Bill, Weather Condition, District, Thematic Area, Action Type, Action Instance, Badge Type, Badge Instance, Reward Type, Reward Instance, Tip, Goal.
Objects accessed in content management mode	House, Device, Action Instance, Badge Instance, Reward Instance, Goal.

Name	Admin
Description	Generic administrator of the Smarth2O services.
Profile Data	Username, Password, Email.
Super-group	User
Sub-group	ContentEditor, Supervisor
Use cases	-
Objects accessed in read mode	-
Objects accessed in content management mode	-

Name	ContentEditor
Description	Administrator in charge of creating the content of the applications composing the SmarH2O system.
Profile Data	Username, Password, Email.
Super-group	Admin
Sub-group	GamificationEngineContentAndRulesEditor, GamesPlatformCE, ConsumerPortalCE.
Use cases	-
Objects accessed in read mode	-
Objects accessed in content management mode	-

Name	GamificationEngineContentAndRulesEditor
Description	Editor in charge of creating the content related to the Gamification Engine (the one used by Competitor users) such as actions, rewards and goals. The user is also in charge of defining the rules to assign the suitable amount of points to each action.
Profile Data	Username, Password, Email.
Super-group	ContentEditor
Sub-group	-
Use cases	Setting consumption goals (9.2) Setting action types and reward types (9.9) Converting game actions into rewards (9.16)
Objects accessed in read mode	Goal, Action Type, Badge Type, Reward Type.
Objects accessed in content management mode	Goal, Action Type, Badge Type, Reward Type.

Name	GamesPlatformCE
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Description	Editor in charge of creating the content related to the games, such as the questions provided in a quiz game related to generic water consumption topics.
Profile Data	Username, Password, Email.
Super-group	ContentEditor
Sub-group	UtilityGamesPortalCE
Use cases	Setting content of game questions (10.6)
Objects accessed in read mode	Question, Answer
Objects accessed in content management mode	Question, Answer

Name	UtilityGamesPlatformCE
Description	Editor in charge of creating the content related to a specific utility game. For example they manage the specific questions provided in a quiz game.
Profile Data	Username, Password, Email.
Super-group	GamesPlatformCE
Sub-group	-
Use cases	Setting content of questions for a given utility game (10.7) Inherited Uses Cases: 10.6 from GamesPlatformCE
Objects accessed in read mode	UtilityQuestion, UtilityAnswer
Objects accessed in content management mode	UtilityQuestion, UtilityAnswer

Name	ConsumerPortalCE
Description	Editor in charge of creating the content related to the platform used by Customer users, such as tips to improve water saving, teaching videos.
Profile Data	Username, Password, Email.

Super-group	ContentEditor
Sub-group	-
Use cases	Setting water consumption tips (8.7)
Objects accessed in read mode	Tip, MediaAsset
Objects accessed in content management mode	Tip, MediaAsset

Name	Supervisor
Description	Administrator in charge of monitoring and managing system data.
Profile Data	Username, Password, Email.
Super-group	Admin
Sub-group	ConsumptionSupervisor, GamificationEngineSupervisor
Use cases	-
Objects accessed in read mode	-
Objects accessed in content management mode	-

Name	ConsumptionSupervisor
Description	Administrator in charge of modelling users consumption.
Profile Data	Username, Password, Email.
Super-group	Supervisor
Sub-group	-
Use cases	Visualizing aggregate household consumption information by geo-location (11.1) Identifying customer segments (11.3) Setting action and reward types for specific user segments/groups (11.4)

	Predicting customer segment consumption behaviour (12.2)
Objects accessed in read mode	
Objects accessed in content management mode	

Name	GamificationEngineSupervisor
Description	Administrator in charge of profiling users , making available users clusters that can be used to suggest the most suitable actions to perform.
Profile Data	Username, Password, Email.
Super-group	Supervisor
Sub-group	-
Use cases	Predicting behaviour based on incentive response (12.4) Predicting customer response to pricing schemes (12.6)
Objects accessed in read mode	
Objects accessed in content management mode	