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Final Publishable Summary

1.1 Executive Summary

SmartH2O: an ICT Platform to leverage on Social Computing for the efficient management of Water Consumption is an FP7 project which has run from April 2014 until March 2017.

The main objective of the project was to develop an ICT solution to enable water utilities to face the future challenges posed by a growth of urban water demand in face of diminishing or constant availability of water supply. While water utilities profit by selling water, it is their utmost interest to be able to provide water to the customers in an efficient and reliable way, minimizing waste of water and of energy (e.g. pumping and treatment). This explains why even water utilities are interested in saving water.

To this aim, the SmartH2O platform supports water utilities in this aim by: understanding and modeling the consumers' current behavior on the basis of historical and real-time water usage data; predicting how the consumer behavior can be influenced by various water demand management policies, from water savings campaigns, to social awareness campaigns, to dynamic water pricing schemes; and finally raising the awareness of water consumers on their current water usage habits and their lifestyle implications and to stimulate them to reduce water use.

The project has reached its aims by realizing a software platform that was successfully deployed in two real world cases: in Terre di Pedemonte (CH) and in Valencia (ES).

The platform users have achieved, during the experimentation period, an increased awareness of their water consumption habits, as shown by the results of numerous questionnaires, and it was also possible to demonstrate the effect of social norm and awareness of own behavior on water consumption. A sensible water consumption reduction has been observed in both case studies, from approximately 10% in Switzerland to 20% in Spain.

At the same time, the SmartH2O project has made available a set of algorithms and tools to better understand and represent the types of user behavior in water consumption: from disaggregation, classification and clustering algorithms to profile current use, to agent based modelling to extrapolate possible future behaviors, also evaluating the potential impact of social interactions and of innovative pricing schemes and tariffs.

The project has started a number of exploitation and dissemination activities. A new commercial product targeted to water utilities will be offered out of SmartH2O; an innovative hybrid board-digital game for water education has been developed and it will also be commercialized; various commercial opportunities have arisen for the SmartH2O partners. Dissemination has also been successful: social channels and media saw SmartH2O having an active role; scientific publications were produced in the order of 10 journal papers and 30 conference papers, and finally a Summer School has been organized by SmartH2O attracting the interest of the scientific community.

1.2 Description of the project context and objectives

The SmartH2O project aims to provide water utilities, municipalities and citizens, with an ICT-enabled platform to design, develop and implement better water management practices and policies, leading to a reduction in water consumption, without compromising the quality of life, and to an increase in resource security.

Water consumers are people whose behavior depends on a variety of motivations and social and individual drivers and triggers. For this reason, SmartH2O develops a framework able to consider **both the technical and the social sides** of the problem, which **promotes the active engagement of the consumers** with the shared objective of saving water and energy.

The solution proposed by the SmartH2O project is to develop an ICT platform based on the integrated use of **smart meters**, **social computation**, and **dynamic water pricing** that will be able to:

- **Understand and model** the consumers' current behavior on the basis of historical and real-time water usage data;
- **Predict** how the consumer behavior can be influenced by various water demand management policies, from water savings campaigns, to **social awareness campaigns**, to **dynamic water pricing** schemes;
- **Raise the awareness** of water consumers on their current water usage habits and their lifestyle implications and to stimulate them to **reduce** water use;

The SmartH2O platform is a "virtual world" that allows water utilities to experiment various combinations of water demand management policies (e.g. incentives and water pricing, social awareness campaign) and assess their potential impact on water users. The social participation application will also enable obtaining feedback from the users to calibrate and validate users' behavior models. Traditional econometric methods will also be used to model consumer behavior and experimental economics approaches will help calibrate the econometric and agent models. The SmartH2O platform will then produce simulations of the expected impacts of the proposed policies on the users' behavior, thus allowing the water utilities to select the most effective water demand management strategy.

The social participation application is then also used to **deploy policies in the real world.** The consumers will receive signals, such as incentives to save water in specific environmental conditions, or such as dynamic price information. Once the policies are deployed, the SmartH2O platform allows **continuous monitoring** of the users' aggregate behavior, i.e. their water consumption, in order to suggest other actions if the original policy loses effectiveness.

1.2.1 *The project objectives*

The SmartH2O general objectives are to:

1. study, understand and modify consumer behavior in order to …
2. … achieve quantifiable water savings by **raising consumer awareness** and by …
3. … the design and implementation of **dynamic pricing schemes**
4. … thus also improving the efficiency and business operations of water companies.

The general objectives listed above are translated in a set of scientific and technological objectives. The *scientific* objectives of this project are:

- the study of **social awareness incentives** to promote water conservation behaviors;
- the development of an innovative method **to learn and develop models of user behavior** integrating quantitative data, obtained by smart sensors, and qualitative data, collected through an online social participation application;
- the study of the design of **dynamic water pricing** policies;

- the development, implementation and validation of an **agent-based simulation model**, able to reproduce the behavior of whole districts of water users based on selected user profiles;
- to **publish and disseminate** our results, in particular fostering trans-disciplinary works involving both ICT and water resources researchers.

The main *technological* objectives of this project are:

- the development of a **modular and scalable ICT platform** that integrates a series of components, in order to provide water utilities an effective tool for the design and implementation of water demand management policies to promote water usage efficiency;
- to improve the resource efficiency and business operations of water utilities thanks to the use of the SmartH2O platform;
- to promote the adoption of novel ICT solutions in water management companies;

1.3 Description of the main scientific and technological results

We describe in greater detail how we achieved the following scientific and technogical objectives

- How social awareness incentives promote water conservation
- How we can better understand the consumer behaviour by integrating qualitative data, from user psychographic data, and quantitative data from smart meters
- How innovative pricing schemes can affect water consumption
- How agent based simulation is an effective tool to assess the impact of social norms on water consumption
- How the SmartH2O platform offers a series of modular and scalable components able to deliver the above scientific achievements.

1.3.1 *Social awareness as a driver to water conservation*

Incentivizing users to engage in water saving actions has been of crucial importance to the success of the SmartH2O social awareness application. Users need to be motivated to expose themselves to water consumption information, to start thinking actively about their water consumption behaviour, and to engage in water saving actions.

A key contribution of SmartH2O was the in-depth study, design and implementation of incentives for water consumers in different deployment scenarios. The literature about incentives for sustainable water consumption is extremely scarce. There is little guidance on the definition of an appropriate mix of incentive stimuli tailored to a specific customer base and sustainability campaign. Existing efforts rely on (smart metered) consumption feedback only, while doubts have risen about the sustainability of the behavioural change induced by such systems. SmartH2O has invested a large effort in designing and implementing a gamified incentive model paired with appropriate reward schemes, which can be used to deliver a broad set of stimuli, in a technically and communication-wise coherent manner.

The gamified incentive model has been based on a behavioural change process analysis and an in-depth motivational theory inventory, drawing on research from environmental psychology, motivational theory, and research on behavioural change systems. The resulting holistic incentive model aims to motivate users across all phases of the behavioural change process through incentives that appeal to both extrinsic and intrinsic motivations, with the purpose of ultimately build and sustain new water efficient habits.

The SmartH2O social awareness app has been conceptualized iteratively to provide support for all phases in the behavioural change process, and to meet the needs of different users through a process of mock-up development, workshop-based collection of end-user feedback, and formative evaluation (alpha testing). The resulting functionalities can be grouped as follows:

- Interactive exploration of water consumption data
- Incentives through physical, social and gamified virtual rewards
- Setting water consumption goals
- Competing against others
- Rewarding performance with points and badges
- Actionable water saving tips

For all actions that users perform on the SmartH2O portal when using the above-mentioned functionalities, they earn virtual points in four different thematic areas (water saving, water saving insights, participation and profiling). The point scheme has been carefully designed in a balanced way to stimulate water saving as the most important action but also SmartH2O portal participation as a whole, and tested in advance with an agent-based modeling simulation. With points, users can earn virtual rewards (badges) and real rewards. In the small-scale Swiss case, rewards were water saving gadgets such as water saving showerheads or the Amphiro b1 shower meter and could be redeemed on a market place in exchange for a certain number of points.

In the large-scale Spanish case study, a competition-based reward scheme has been implemented, with weekly competitions to win museum tickets and regular overall competitions running for several months, in which the final overall top 3 users can win iPads. To stimulate competitiveness and social comparison, the portal has a public leaderboard where users are ranked according to their score and a neighbourhood map on which users can compare their achievements (points, water saving goals, badges) to friends, family and neighbours in their proximity. Social sharing features enable users to share their achievements and water saving tips with others outside the SmartH2O portal via social networks (Facebook, Twitter) and e-mail, and invite them to join as well.

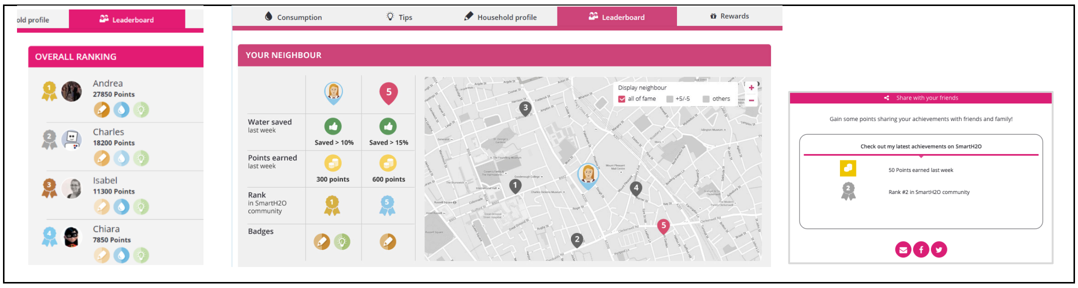

Figure 1. Main SmartH2O incentive model elements.

The objective of the Swiss small-scale pilot was to iteratively develop and test the portal and the measurement infrastructure in a contained setting, before rolling out the SmartH2O system in the large Spanish pilot, which sought to evaluate the impact in a large-scale production setting. For both pilots prior to deployment, usability testing has been conducted on different levels to accommodate the agile and iterative development of the portal. This included continuous heuristic expert-based testing during the continuous development, alpha testing of the mobile app and new web portal features using a feature inspection tool and evaluating ease of use of the web portal and the mobile app.

The Spanish trial has started in April 2016 and lasted for almost a year until mid-February 2017. In total 508 users have signed up, who were invited through various promotion campaigns. Results demonstrate a 21% difference in water consumption between the SmartH2O users and the control group, suggesting that the SmartH2O social awareness applications have been capable of inducing a sustainable change in behavior over the one-year measurement period.

Moreover, questionnaires were administered both at the begin and at the end of the trial to assess the user's awareness about water consumption. For this purpose, instruments were adapted from empirical research in social and environmental psychology. From the 508 users, 452 users have filled out the baseline questionnaire (82%), while 94 users responded to the final questionnaire (18.5%). In the control group, 204 users answered to the baseline survey at the start of the trial, of which 82 respondents also participated in the final evaluation. In spite of the users' already strong concerns about the environment, still beliefs about the need to save water to prevent exhaustion and one's ability to do so have further improved when comparing the measurements at the start and the end of the trial.

For the SmartH2O users, the final evaluation questionnaire also assessed the user's perceptions of the portal. More than 75% of the users responded that the consumption chart and overview, the tips, self-setting goals, and the water consumption alerts increased their motivation to save water and think about water consumption. Moreover, these results were also strongly correlated to the respective awareness measures, suggesting that the incentive model elements have succeeded in inducing a raise in awareness by increasing the motivation of users.

Earlier interim evaluations have already shown that users valued the balance that was sought between usefulness ('pragmatic quality') and fun-of-use ('hedonic quality'), and they proved to use both consumption feedback functionalities and the game elements (e.g. leaderboard, gamification status sidebar). With these final evaluation results we can now conclude that the perceived balanced pragmatic and hedonic quality increases the motivation to engage with water consumption information and the game elements.

We have investigated the potential of SmartH2O to induce a change in water consumption behavior not only by comparing the results before and after the trial, but also by correlating the use of the portal's features to water consumption. Results have shown that the usage of both the water consumption-related features (e.g. water consumption chart and pipe overview, self-set goals) and the use of the leaderboard within the SmartH2O portal is significantly correlated with a decrease in consumption. This further confirms the suitability of the SmartH2O system design and the underlying incentive model to induce a change in behaviour.

The overall level of activity of the users is a good measure for the customer's engagement with water consumption information and with the water utility in general. Analysis of the logs demonstrated that SmartH2O users logged in much more often than users of EMIVASA's pre-existing Virtual Office portal: SmartH2O users log in on average close to five times a month, while 97% of the users of the standard Virtual Office logged in less than once a month. More specifically: 43% of SmartH2O users log in every month or more, while 11% even uses the system on a weekly basis. Other customers who do not use the Virtual Office, only receive a water bill every two months, so the increase of attention trough SmartH2O is even larger compared to this group.

Furthermore, the system logs showed an increase in activity for those users who have installed the mobile app. This applied to both the inspection of consumption feedback and the users keeping track of the gamification status, suggesting that using smartphones to interact with apps is capable of increasing engagement with water consumption information when compared to a web portal.

The small-scale Swiss case study has recruited 22 utility customers to use the advanced gamified portal and 25 users for the basic portal. In spite of the objectives of this pilot which concerned the iterative testing of the application and the water consumption measurement and processing, the pilot has yielded overall positive results, even though the small-scale nature asks for a cautious interpretation. Water consumption measurements have shown that compared to non-SmartH2O households the users have reduced their consumption with 9.9%.

Even though a reliable assessment of the portal on water consumption awareness requires a substantially larger number of users, the results provide an initial indication that for the advanced portal users the self-reported awareness the household has increased for most of the users, while the error in the estimated water consumption has decreased.

Similar to the Spanish case study, feedback of the users on the SmartH2O application is rather positive, with users demonstrating a very positive attitude towards the application, and, on feature level, expressing the impact of the water consumption chart and pipe overview as well as the self-set goals on the motivation to save water and think about water consumption.

Log analyses have shown that three lead users of the advanced portal continue their high level of activity, whereas the other users remain active on a basic level. In contrast, the activity level in the basic portal has dropped significantly, providing preliminary evidence for the suitability of the SmartH2O gamified incentive model in comparison to a model where only consumption feedback and water saving tips are provided.

1.3.2 *Profiling user behaviour to better understand water consumption*

The development of modelling tools able to construct profiles of water consumers and discriminate among heterogeneous behavior is essential to support the design of customized water consumption feedbacks and demand-side management actions.

In this regards, SmartH2O provided key contributions by developing a set of algorithms to derive mathematical models describing the users' consumption behavior directly from smart metered water consumption data. More in detail, the algorithms are tied together in the following three-step procedure, and contributes to each of its phases:

1) identification of end-use consumption patterns;
2) classification of observed consumption data into users' profiles;
3) simulation of observed and future consumption in response to external stimuli, such as prices, incentives, social norms, etc.

The overall impact of the above modelling framework is two-fold.

First, model building and testing led to the development of the **hierarchical clustering procedure** reported in Figure 2. This procedure has been essential to support the development of the SmartH2O platform and assess its effect on users' behaviour. Indeed, it has been adopted to first identify heterogeneous clusters of water consumption profiles among water users in the two SmartH2O use cases, in Switzerland and Spain, and then evaluate behavioural changes in terms of water consumption profile change as an effect of the usage of the SmartH2O platform. User profiling results after model validation (see deliverable D7.3) show that, in the Spanish case study, SmartH2O users reduced their consumption by 4.05% after the introduction of SmartH2O, slightly shifting their segmentation towards the lowest consumption cluster (see subplots on top of Figure 3). This implied an overall reduction in volume of water used by over 5.6%, and over 4.7% during the Summer peak-period (i.e., as absolute values of water consumption, such percentages correspond to around 14.5 liters/day, which is approximately the volume of, for instance, two toilet flushes). Similarly, in the Swiss case study SmartH2O users reduce their consumption by an average of 9.92% if compared to their consumption before SmartH2O introduction, with a strong prevalence of shifts of user profiles towards lowest-consumption clusters (see subplots on bottom of Figure 3). This implies an overall reduction in volume of water used by over 12%, and over 15 in the Summer period. These results are both relevant in comparison with benchmark experiences in the literature, and compliant with the KPIs of the SmartH2O project.

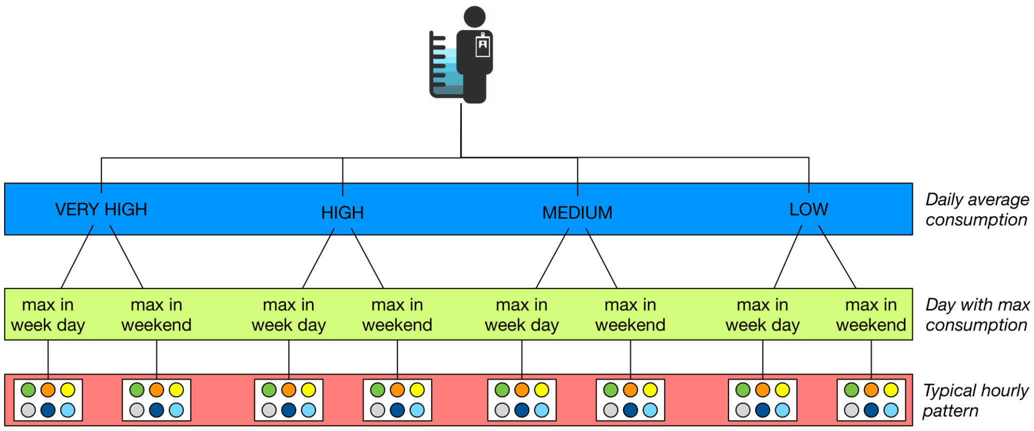

Figure 2: Hierarchical clustering procedure for the identification of consumption profiles.

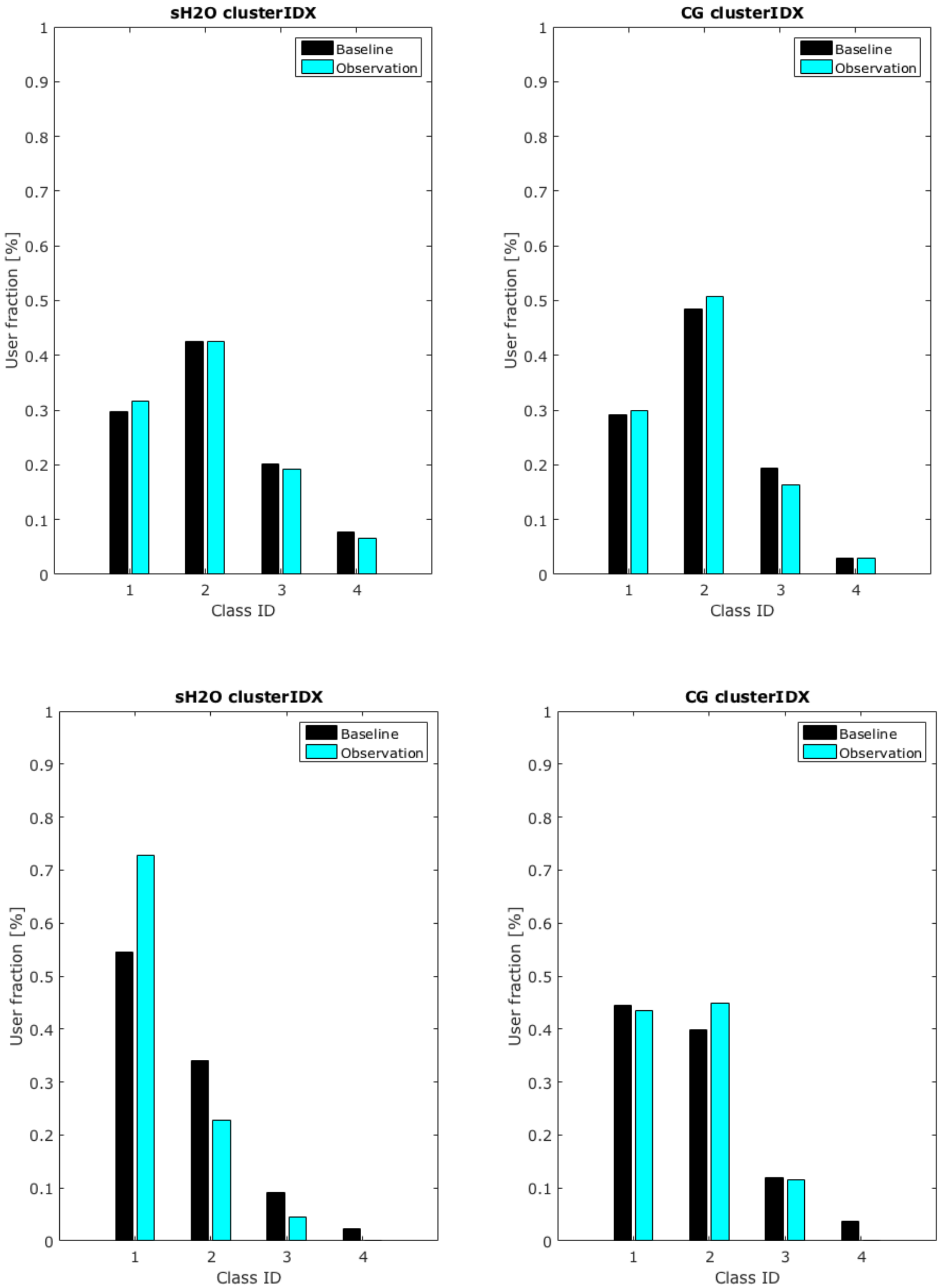

Figure 3. Distribution of users among consumption clusters for EMIVASA users (subplots on top line) and SES users (subplots on bottom line). SmartH2O users (sH2O) on the left, Control Group users (CG) on the right. "Baseline" is the period before the introduction of the SmartH2O platform. "Observation" is the period following it. Consumption increases moving from Class ID 1 to Class ID 4.

Second, model developments for each of the three-step procedure mentioned at the beginning of this section provided important methodological contributions to the state-of-the-art of behavioural modelling, as well as relevant technological recommendations for future developments.

Regarding the first phase of the procedure, i.e., **identification of end-use consumption patterns**, SmartH2O contributed two disaggregation algorithms, the first based on sparse optimization [Piga et al., 2015] and the second one based on a combination of Factorial Hidden Markov Models and iterative Dynamic Time Warping [Cominola et al., 2017]. The problem of decomposing the aggregate household consumption data collected from a single measurement point into device-level consumption data has been largely studied in the energy sector, where also their economic advantages in terms of potentially avoided energy generation and distribution have been demonstrated [Armel et al., 2013]. Rather, in the water research literature, a few studies have been conducted in the last two decades using a variety of single or mixed disaggregation methods, such as household auditing, diaries, high resolution flow meters and pressure sensors (for a complete review see [Cominola et al., 2015a]), selection, unsupervised learning, and cluster evaluation. Yet, the following major limitations of the existing approaches are still unsolved: (i) the requirement of time consuming expert manual processing and intensive human interactions via surveys, audits and water event diaries; (ii) the usually limited accuracy in identifying overlapping events; (iii) the challenges posed by the intrusiveness of calibration data acquisition; (iv) the limited performance in reproducing the timings and frequencies of each device, which would aid the activities of water utilities at different levels, including demand management, network maintenance, and strategic planning. Both the SmartH2O algorithms advanced such disaggregation technologies and have been demonstrated to outperform state-of-the-art disaggregation algorithms on power consumption data and to perform satisfactorily also on high resolution water consumption data (numerical results discussed in deliverables D3.2 and D3.4). Moreover, extensive testing of the above algorithms on multi-resolution disaggregation on water data showed that an end-use disaggregation data sampled at 1-hour resolution and without an intrusively measured end-use groundtruth for calibration, did not appear feasible. Results showed that still, at low resolution, the ranking of most consuming fixtures may be retrieved with an acceptable error. However, this would require a suitable and representative calibration dataset, collected intrusively by directly metering each appliance, or with an extensive campaign of water consumption diaries collection. Despite this result hampered the end-use disaggregation of SmartH2O water data, it constitutes a relevant information supporting technological recommendations to water utilities and agencies regarding the choice of suitable meters (i.e., with suitable data sampling), including data sampling resolution as a criterion for the choice, together with data storage and transmission resources and costs.

Regarding the second phase of the procedure, i.e., the **classification of observed consumption data into users' profiles**, in the literature (for a review, see [Cominola et al., 2015a] and references therein), two distinctive approaches exist: **descriptive models**, which are focused on the analysis of observed water consumption patterns, and **predictive models**, which instead provide estimate of the expected water consumption. SmartH2O developed user profiling algorithms that combine advanced data analytics and machine learning techniques with a double goal: firstly, to describe observed consumption and identify consumption profiles trough a hierarchical clustering procedure; secondly, to identify the most relevant determinants of the observed consumption from a set of candidate variables, including households' characteristics and psychographic features of the users, through feature extraction and feature selection methods [Cominola et al., 2015b]. The general procedure for constructing a single-user behavioural model is composed by three main phases:

- identification of **consumption profiles** from the analysis of observed consumption (as in descriptive models);
- **multivariate analysis** for selecting most relevant drivers associated to the identified consumption profiles;

- **model learning** to describe the average consumption behaviours of single users.

Results demonstrated (see deliverable D3.4) the effectiveness of the SmartH2O algorithms for accurately modelling single-user consumption behaviours. The algorithms have been demonstrated, with application on the *H2ome Smart* project dataset (comprising more than 3000 households in the towns of the Pilbara and Kimberley Regions of Western Australia) to effectively capture the influence of candidate determinants on residential water consumption profiles and in attaining sufficiently accurate predictions of users' consumption behaviours [Cominola et al., 2015b]. The limited number of psychographic data for the SmartH2O case studies have constrained the application of the algorithms on SmartH2O data to the identification of consumption profiles based on smart metered data. Yet, simulation of the single-user water consumption obtained by sampling the pdf characterising the identified consumption profiles in terms of (i) daily average consumption, (ii) day-type with maximum consumption (weekend of week day), and (iii) typical hourly patterns (according to the hierarchical procedure shown in Figure 2) showed high accuracy, when compared with observed data. Indeed, results show that for most of the applications onto SmartH2O data we do not exceed the 20% MSE upper threshold for the KPI on the average error between expected and measured water consumption (see deliverable D7.3). The ability of SmartH2O user profiling models to accurately distinguish among heterogeneous consumption profiles and segment the community of consumers is of high value to inform customized demand management and identify target groups of users for demand management interventions, as well as opportunity for increasing demand efficiency.

Finally, the third phase of **simulation of observed and future consumption in response to external stimuli**, such as prices, incentives, social norms, etc. is expanded in the next two sections.

1.3.3 *Innovative pricing schemes for water efficiency*

This section describes the main results from WP5 "Saving water by dynamic water pricing". Dynamic water pricing refers to the possibility offered by smart meters to charge customers at a different volumetric rate at each measurement of consumption – e.g., every hour. For such schemes to promote water efficiency, real-time feedbacks must be conveyed to users on consumed volumes and associated prices. This is made possible by emerging technologies such as the SmartH2O platform that is the main technological asset to result from the project. A dynamic tariff could be used to promote water use efficiency, by reflecting the variations of water demand, availability and delivery costs over time.

In fact, results from WP5 are mainly scientific results, since water utilities have been reluctant to engage with dynamic pricing, even at the trial stage. This is understandable from their standpoint, as water utilities fear the negative public perception, if not the backlash, their brand image may suffer if they are perceived to install smart water meters to change or raise prices. Such perceptions would also negate the possible positive effects of smart metering on residential water consumption. Nevertheless, this obstacle also created the need for finding ways to test the potential of dynamic pricing by engaging with the public, but without being associated with a water utility. This led to the design and execution of innovative ways to reach out to residential water customers, especially via an online experiment. Alternatively, it motivated the creation of a tool to understand the determinants of the price response, through a meta-analysis of 125 published studies of prices elasticity of residential water demand. Besides, a pricing tool was still created to be integrated to the SmartH2O platform.

This section describes the following main results:

- Identification of dynamic pricing schemes (peak pricing and scarcity pricing) and their potential benefits, at the utility scale and at the basin scale.
- Calculation of the potential benefits from peak pricing for London.
- Evaluation of the potential future benefits from scarcity pricing in the Thames River basin where London is situated.
- Elaboration of a potential two-part increasing block tariff (IBT) for the city of Valencia.

- Price response simulation tool to evaluate price elasticity of demand, especially in the case study areas of London (UK), Ticino (Switzerland) and Valencia (Spain).
- SmartH2O pricing tool.
- Exploitation of results from questionnaires described in Section 1.3.1.
- Design of an online experiment to evaluate how effective dynamic pricing could be.
- Analysis of experimental results.

Smart metering enables varying pricing at a wide range of timescales from hourly to weekly or monthly. On one end of the spectrum, sub-daily peak pricing shifts demand away from peak hours in order to lower a utility's operational and capital expenses. On the other end, scarcity pricing factors in the variations of the marginal opportunity cost of water at weekly or longer timescales in the river basin where water is withdrawn. Dynamic pricing schemes that act across timescales can be devised to yield both types of benefits.

Utility-scale benefits of lowering peak demand are lower costs of water distribution network operation, maintenance and expansion. Reducing peak demand may lead to decreasing the size of new mains when a city expands and new areas have to be served, or during the replacement of leaky mains in network maintenance operations; both translate into financial savings. Alternatively, when existing mains need not be replaced immediately because they are leaky, peak pricing can help delay investment in new mains, by 1) postponing the date at which existing mains will no longer be able to handle a rising demand, and 2) lowering the risk of pipe bursts. Besides, reducing peak demand is expected to reduce operational costs. It could lower peak-hour energy consumption because the daily morning and evenings water use peaks often correspond to times of peak-hour electricity tariffs. Therefore, if a utility does not have enough in-network storage, it must incur higher energy costs to deliver water during peak time. Optimal pumping scheduling then becomes a significant source of savings, and reducing peak use can add substantially to these operational savings. Alternatively, if a utility has enough in-network storage, but expects peak demand to grow, reducing peak use delays the investment in new in-network storage.

The potential benefits of lowering peak demand via peak pricing have been computed for the London, an administrative entity of over 8.5 million (M) inhabitants, at the core of a metropolitan area topping 13M inhabitants. Our estimates, robust to a sensitivity analysis of the main factors, reveals that doubling or tripling peak-hour prices could lead to net present value savings of £100 to £200 per property through reduced costs of mains expansion and replacement alone. Real benefits could be much greater, but can only be evaluated with data coming from the improved monitoring of water distribution networks – something that smart metering is bound to bring in the coming years.

Scarcity pricing is concerned with promoting economically efficient water use at the basin level when water becomes scarce. Indeed when that happens, marginal water values increase, and therefore using rising water prices as a signal of this scarcity is an appealing way of increasing economic, social and environmental benefits from allocating a limited supply of water. One example where this approach has been backed by regulation is in Europe with the Water Framework Directive, which promotes the inclusion of environmental and resource costs in the calculation of recovery costs for water services. Evaluating the variations of the water values through space and time in a river basin is one of the objectives of hydro-economic modeling, which is therefore a tool for evaluating dynamic scarcity pricing schemes. The project has identified the marginal resource opportunity cost (MROC) of water as a universal indicator of scarcity, and used it in the two project case-studies where there is either significant documented present (Valencia) or future projected (London) scarcity.

In London, rising population and climate change represent a threat on future supply-demand conditions. This can incur water shortages for residential users, but also for Thames River waters in London, which has environmental and recreational value derived not only from ecosystem services, but also from tourism, property valuation, etc. The scarcity situation, the evaluation of environmental flows, and the Londoners' price response are the three factors that have an influence on the prices that promote the most efficient water allocation. A range of parameters was explored in order to provide a forward-looking outlook of potential benefits.

Analysis found that across all scenarios, residential price increases would be capped at 150% of base levels. Average reduction in environmental flow shortage could be as low as 22% and as high as 63%, with a reduction of 48% in the average (baseline) case. Scarcity pricing is most effective for alleviating less severe shortage, but should be combined with other demand management policies – or preventive investments in new water supply options – in the case of extreme shortage. Then, maximal water prices are not enough of a deterrent to prevent environmental depletion.

A two-part dynamic IBR has been designed for the city of Valencia (Spain). It promotes a more efficient water use by increasing prices when water is scarce, and the value of water is high. It also aims at being the first study to propose a practical way to design dynamic scarcity tariffs in area experiencing water scarcity, while complying with water utility objectives (regulatory or otherwise) such as revenue neutrality or equity among users. Figure 4 shows how the price of the second block increases as the amount of water stored in the reservoirs of the Jucar basin, where Valencia gets its water from, decreases. There are three levels of scarcity, where the charge of the first block remains constant, whilst the charge of the second block is higher when the total storage at the reservoirs is lower.

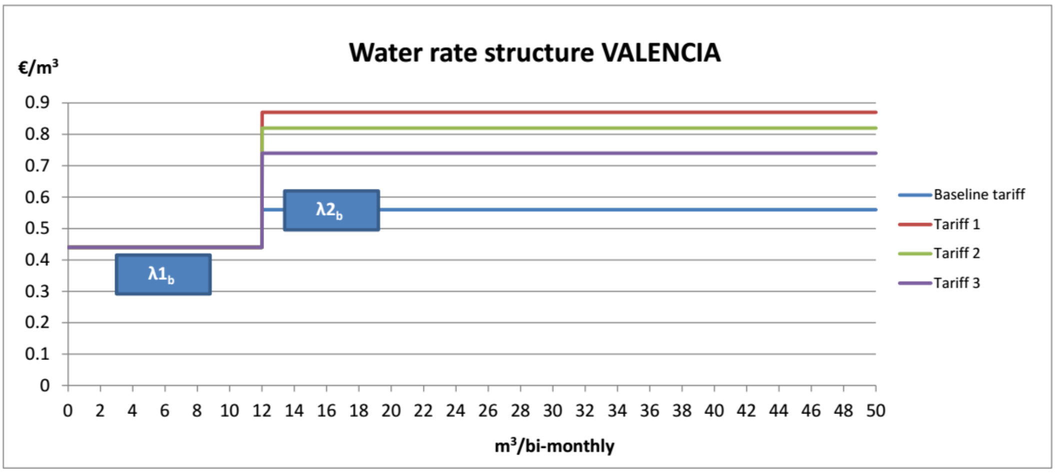

Figure 4. Dynamic water rate for urban water supply to the city of Valencia.

These studies have been made possible by the evaluation of customers' price response to varying prices through a pricing simulation tool based on available price response data from 125 primary studies of the price elasticity of residential water demand. For instance, according to our simulations, an IBR in Valencia would achieve a price elasticity of -0.42. Since the proposed dynamic IBR would entail a price increase in the second block by 30% (Tariff 3), 45% (Tariff 2) and 55% (Tariff 1) with respect to the baseline tariff, we expect a decrease in water consumption - in response to the switch from the baseline to each of the new tariffs - by 13%, 19% and 23%, respectively. Beyond that, the simulations yielded insights on the impact of tariff type and study design on the elasticity estimates.

Yet, the available studies of price elasticity only concern one-time price changes, and not repeated price variations that would likely be the consequence of smart-meter-enabled dynamic pricing. Therefore, both the online surveys of water users from two SmartH2O cases (Valencia and Ticino), and the online experiment, try to bring answers to the two following broad questions:

1) Do water users respond differently to pricing and incentives when they can change over time?
2) What is the impact of the circumstances (e.g., occurrence of a drought) in which a pricing scheme, especially a dynamic one, is implemented?

Exploring these two questions is instrumental in assessing the future potential of dynamic pricing as an effective demand side management policy at the disposal of water utilities and regulators.

On one hand, two online surveys have investigated the potential of pricing policies as DSM instruments in two SmartH2O cases, Ticino (Switzerland) and Valencia (Spain). The survey aims at eliciting the water consumers' response to pricing policies and compare it with other economic incentives (monetary and symbolic rewards). The design of questionnaires capitalizes on literature related to contingent valuation and stated preferences in resource and environmental economics. It allows for investigating incentives for both scarcity pricing (e.g. reducing shower time in time of drought) and peak pricing (e.g. operating the washing machine at night rather than during peak-hour use). These correspond to the two broad types of dynamic tariffs identified in the project. The survey also explores the impact of a price increasing dynamically in a scenario of water shortage. The effects of pricing policies in the survey are then assessed by econometric estimates of the response model. Results converge to show that water consumers do respond to economic incentives, albeit to a limited degree and only for a few uses. As far as the potential of dynamic pricing to manage demand is concerned, the survey results suggest that respondents confronted with a water shortage circumstance react to a greater degree to price increases.

On the other hand, an innovative online experiment was carried out to test the potential for dynamic price increases to help reduce water demand in time of drought. It uses online platforms to quickly find large quantities of respondents, and found the effects of dynamic pricing where greatest when a visual message communicating about drought was inserted in the questionnaire. Beyond dynamic pricing, this way of reaching out to customers is worthy of exploration for utilities interested in potential user response to any demand management scheme. It is also noteworthy that questionnaire results have helped to design the experiment, e.g., by showing that respondents tend to reduce shower length as a result of a price signal, particularly under a water shortage scenario. This is a finding replicated by the online experiment in a different setting – where respondents are motivated by a monetary reward that is the direct consequence of their actions. This makes the methods used complimentary.

All the three above results – from the meta-analysis, questionnaire, and online experiment – have been made necessary by the reluctance of partner utility to engage with pricing aspects of smart metering. Yet, a pricing tool, the virtual bill, has been integrated to enable customers to experiment with a virtual bill, that is, get real-time feedback on how their consumption is ultimately impacting their finances (Figure 5). The tool is also meant to allow customers to simulate different tariff types based on their current consumption (e.g. block rates) in a visual widget. The different functionalities this tool has are meant to enable utilities to gradually engage with their customers on the pricing-related effects of smart metering. Therefore, for now the main purpose of the pricing tool is to be used in controlled lab or workshop settings or longitudinal studies with selected customers.

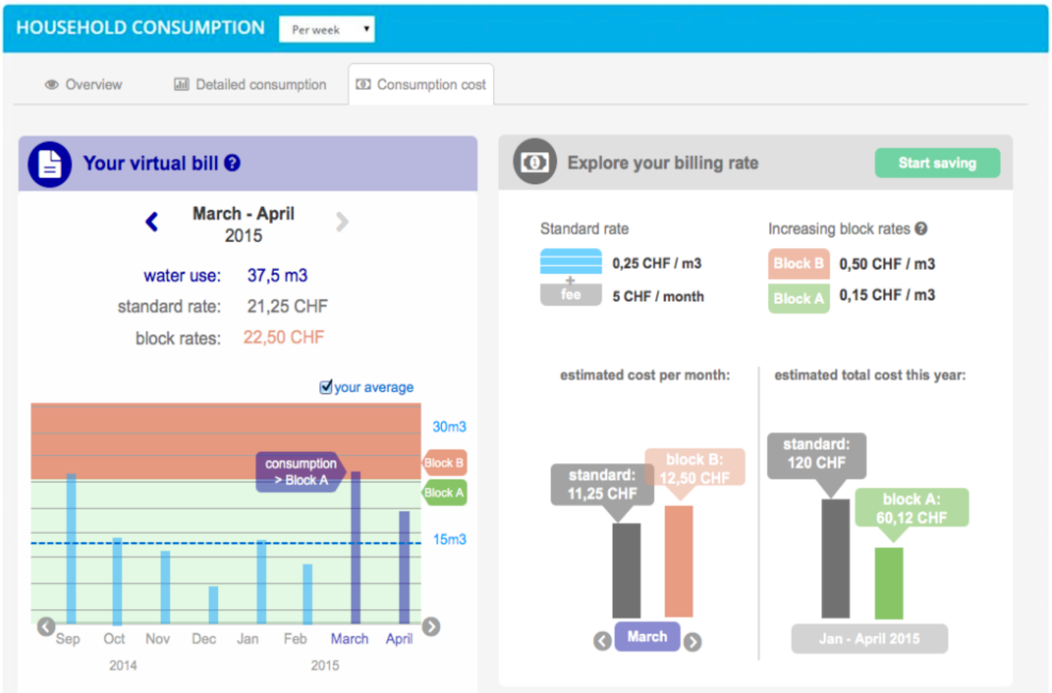

Figure 5. SmartH2O pricing tool.

1.3.4 *Agent based simulation as a tool to evaluate the impact of water awareness policies*

Water conservation constitutes a natural playground for conflict between private and public interests. From the point of view of a water utility or a public authority, two possible approaches can be tackled in the aim of solving this social dilemma: a structural one and a social-psychological one. The former means to apply strategies that intervene directly on the outcome of the dilemma, like installing water meters and use price policies by charging based on usage. The latter means to intervene to alter the way citizens value and think about the resource.

Since it defines agents as autonomous entities interacting with each other and with an environment, agent based modelling provides a powerful framework where to study and analyse the emergence of shared behaviours from local, decentralised interactions, and thus constitutes a formidable support for policy makers to attack the aforementioned dilemma of water conservation by simulating the water management cycle and therefore designing and estimating the impact of the adoption of a certain policy.

The overall goal of a simulator is therefore not to forecast the exact state of the modelled system, but to explore how the system will evolve because of a specific policy.

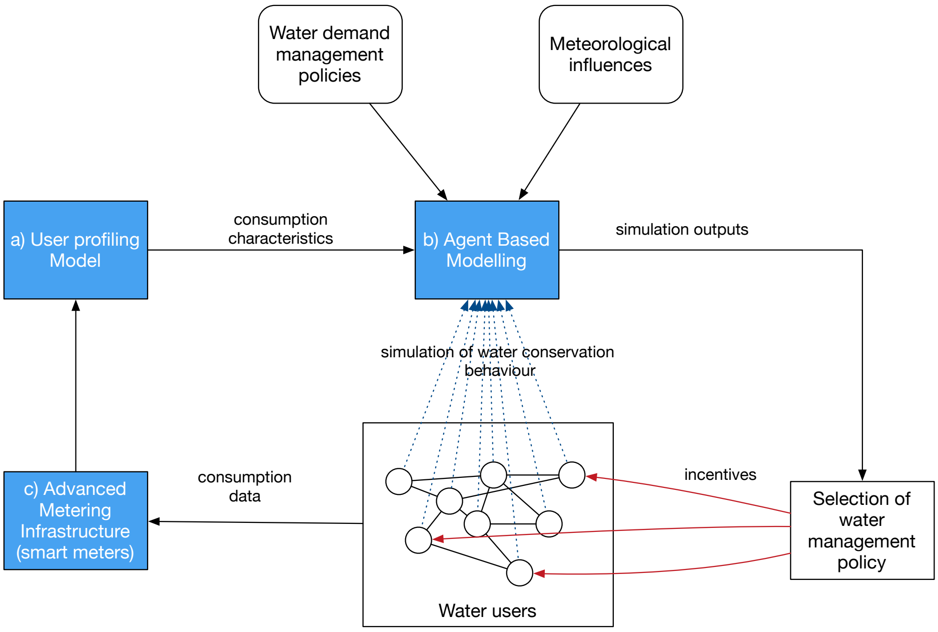

Figure 6. The agent based policy design loop.

A contribution of the SmartH2O project has been the development of an agent based model for simulating the aggregate water consumption behaviour of a community of users within a district based on their current level of water usage - and possibly other exogenous factors, like e.g. seasonality and a price policy, - and focusing on the diffusion of:

- The adoption of the SmartH2O platform, and
- A water saving attitude within active platform users due to social pressure.

The structure of the ABM is depicted in Figure 7.

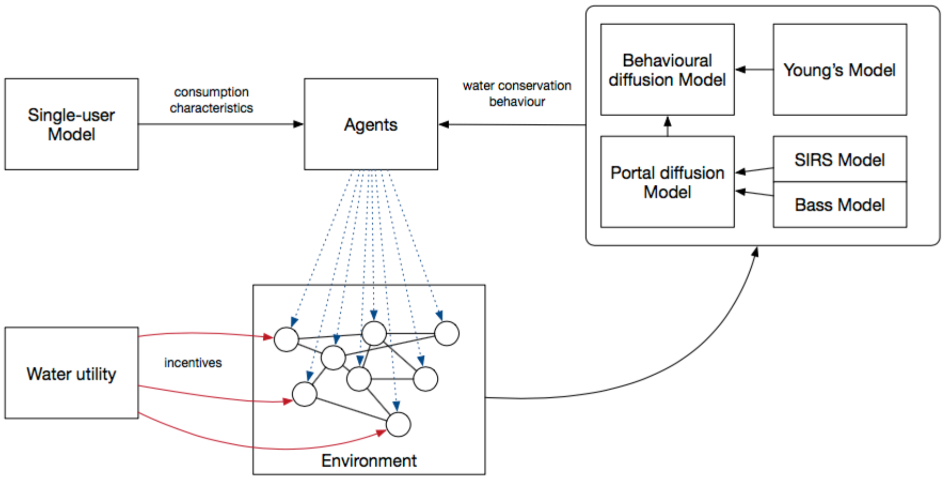

Figure 7. General SmartH2O agent-based model structure.

The first component is an implementation of the single-user consumption behaviour model at the household level. Recall that the latter is structured as a two-step procedure. Firstly, the most relevant determinants of users' consumption profiles are identified, and secondly a model learning procedure relates the extracted subset of determinants to the water consumption level. In the ABM, the consumption level classifications obtained thorough the model learning procedure is implemented within the Household agents as an explicit attribute and determine the characteristics of the water consumption function.

Several variables can affect users' water consumption. A key factor is the role of technology and, in our specific context, the role of the SmartH2O portal. To incorporate its role and thence assess its influence, we have defined two sub-models. Firstly, since the adoption and diffusion of technology, i.e. the portal in our case, is not an immediate process, but depends on the interaction among users, as well as on adoption campaigns initiated by authorities, we have incorporated a technology (portal) diffusion model diffusion as a Bass model coupled with features of an epidemic SIRS to capture the fact that adopters can decide to stop using the adopted technology (for a while), in our case the SmartH2O portal. Secondly, we wanted to take into account the role of the SmartH2O portal with respect to the social attitude of the population towards the water resource. To this aim we use a behavioural diffusion model to capture the spread of social awareness and thus of a sustainable water consumption behaviour thorough the usage of the SmartH2O portal. The adopted behavioural model is the so called Young diffusion model: it is a reversible stochastic diffusion model that has been already successfully employed in the study of the domestic water management in Valladolid metropolitan area and of the Orb river. The model assumes that a household, while it is a portal adopter, can choose over time between an environmentalist (E) behaviour and a non-environmentalist (NE) behaviour, and considers a decrease in water consumption as consequence of E behaviour. In turn, the choice of a behaviour is determined by the agent current behaviour, the behaviour of its social network and the social pressure towards a behaviour E.

Another direct key factor is seasonality. To capture this factor, an estimation of the seasonality parameters discussed in the scientific literature has been integrated homogeneously into the water consumption function of households as a monthly multiplicative factor.

Lastly, price can act as an incentive towards users' water conservation behaviour. Based on the results of the pricing survey (conducted in Ticino among SES customers), we have also incorporated a mechanism to capture the impact on consumption of a price policy.

The performance of the model without the diffusion sub-modules has been validated against the observed data for the two SmartH2O pilot case studies of Terre di Pedemonte and Valencia. In the former case we have obtained an aggregate monthly over-estimation between 8% and 10 %, whereas in the latter case the over-estimation was always under the 2%.

For both case studies, we have then modelled future behaviour under social norms. In doing so, we aimed at understanding the influence of the usage of the portal on consumption. From the simulations, it turned out that in scenarios where the adoption of the portal concerned at least a quarter of the users, the reduction on water usage became measurable (around 1% or more), and reflected the strength of the environmentalist behaviour as a norm among the concerned population (the higher the social pressure, the higher is the reduction in the consumption). When the fraction of users who adopted the portal was low, the reduction on consumption was on the contrary below 1%, and the impact of the strength of environmentalist behaviour as a norm on consumption was not visible.

Finally, we modelled a scenario in which a price shock was applied to the Swiss district of Terre di Pedemonte. More precisely, we considered the case in which there is an increase in the semester bill of 40 CHF. To model such scenario, we rely on the results of the pricing survey (conducted in Ticino among SES customers). The results of the simulations have shown that that the if-then rule we introduced in the model allowed capturing an expected reduction in water consumption between 2.5% and 3% due to showertime reduction as reaction to a bill increase of 40 [CHF/(semester per household)].

1.3.5 *The SmartH2O software platform*

A critical achievement of the project is the SmartH2O platform that embodies the main objective of leveraging on social computing for the efficient management of water consumption.

SmartH2O platform consists of a backend for data acquisition, storage, processing and the behavioural modelling of users, coupled to a set of graphical user interfaces, ranging from gaming interfaces to business portals to data analytics dashboards, offered to a variety of stakeholders. The platform was built up by integrating in a whole a series of specialized, independent and interdependent software components providing synergic functionality:

- **Smart Meter Data Management** dealing with the acquisition of data streams from smart meter and their consolidation within the SmartH2O database.
- **Customer portal** providing detailed consumption to the water consumers.
- **Water utility administrative portal** providing a set of controlling tools to water utility administrators.
- **Gamification engine** embodying the rules for transforming users' actions into gamification scores and achievements.
- **Social data exchange** which ensures communication between the SmartH2O platform and social network communities where the utility company has a presence or consumers are already enrolled.
- **Agent Based Model (ABM) component** implementing the user model that simulates the user's behaviour in given input scenarios.
- **Games platform** supporting the computation of consumers' achievements and scores, also providing an educational approach regarding sustainable water consumption behaviour through DROP! the question online and offline game.
- **REST API** whose main function is to expose communication services from behalf of the SmartH2O platform to third parties.
- **Enterprise Service BUS** a service oriented middleware layer supporting the loose coupling of the SmartH2O components; it fulfills the main integration objectives of the components into the SmartH2O platform decoupling the heterogeneous components as much as possible, and providing support to platform extension with new services and functions for a quick adaptation of the platform to new contexts.
- **Authetication Gateway** providing a Single Sign-On service for incoming users and centralizing the user registration data within the SmartH2O platform database.

As a whole, the **SmartH2O platform** gathers the behaviour of a water user by collecting data on its water consumption by means of smart meters (**Smart Meter Data Management** component) and, at the same time, by an online social participation application supporting the computation of consumers' achievements, scores, badges (**Gamification Engine** component shown in Figure 8).

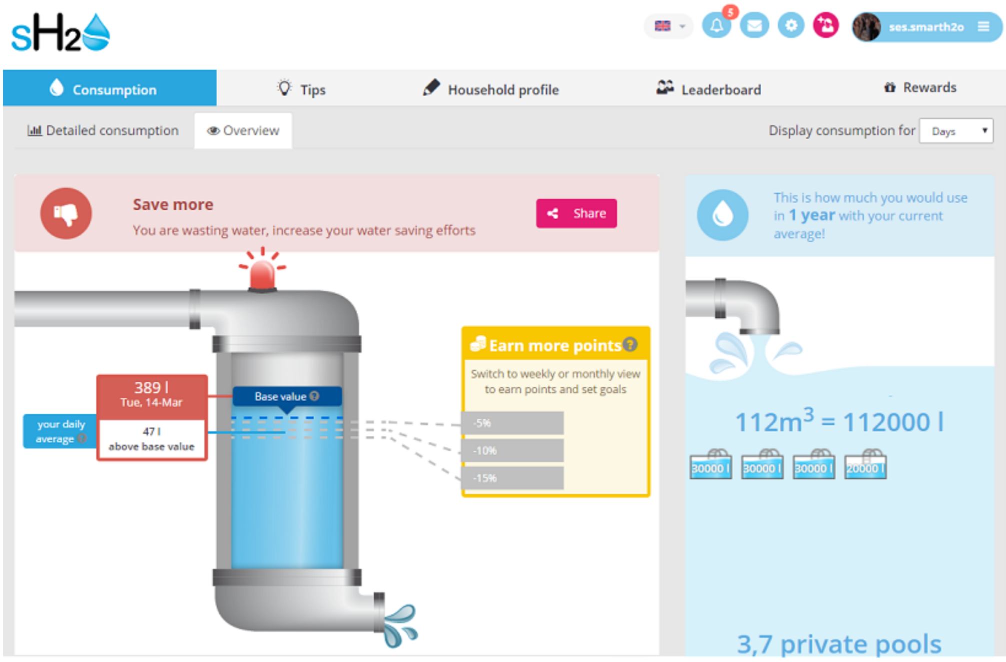

Figure 8. Computation of consumers' achievements

while providing an educational approach regarding sustainable water consumption behaviour through DROP! the question online and offline game (**Games platform** component depicted in Figure 9).

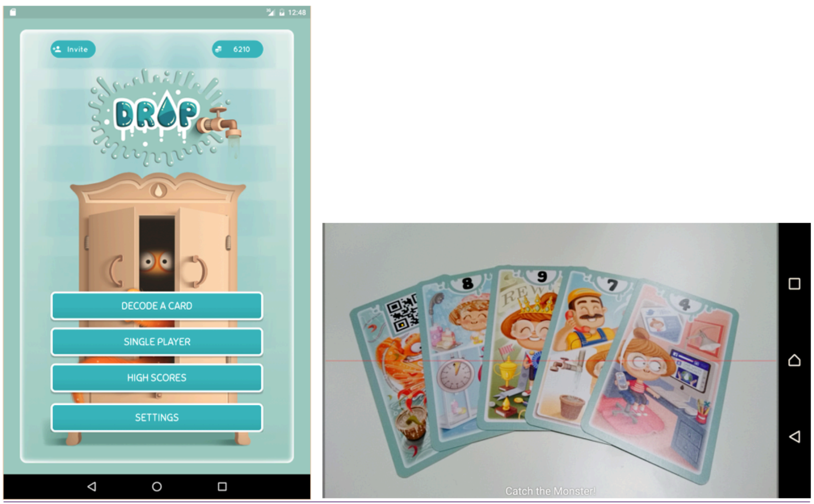

Figure 9. Water sustainability education through DROP! the question online game.

Qualitative information about the user preferences and attitudes are collected (**Customer portal** component, presented in Figure 10).

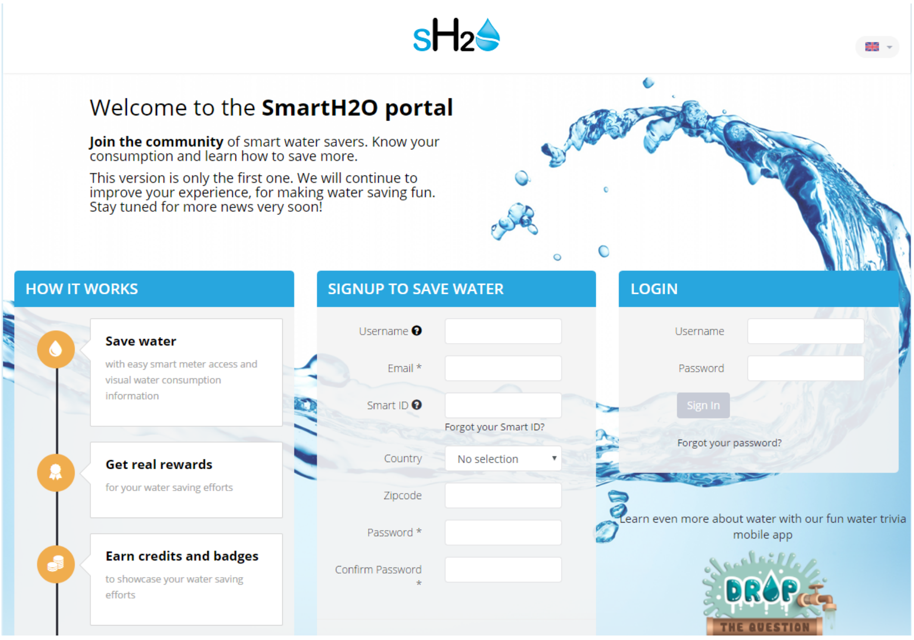

Figure 10. Customer portal login screen.

This information is processed and the user is "profiled" in order to produce a synthetic user behaviour model (**Agent Based Model** component), which is fed in an agent-based simulation model.

The social participation applications (**Social Data Exchange** component) are then used to deploy policies in the real world (**Water utility administrative portal** component, presented in Figure 11).

Figure 11. Deploying policies in the real world.

The consumers receive signals, such as incentives to save water in specific environmental conditions, or such as dynamic price information. Once the policies are deployed, the SmartH2O platform allows continuous monitoring of the users' aggregate behaviour, i.e. their water consumption, in order to suggest other actions if the original policy loses effectiveness.

The SmartH2O platform has been deployed in two production software environments hosted by SES in Locarno, for the Swiss case study respectively by EMIVASA in Valencia, for the Spanish case study.

Figure 12 depicts the SmartH2O customer portal integration within EMIVASA Virtual Office portal.

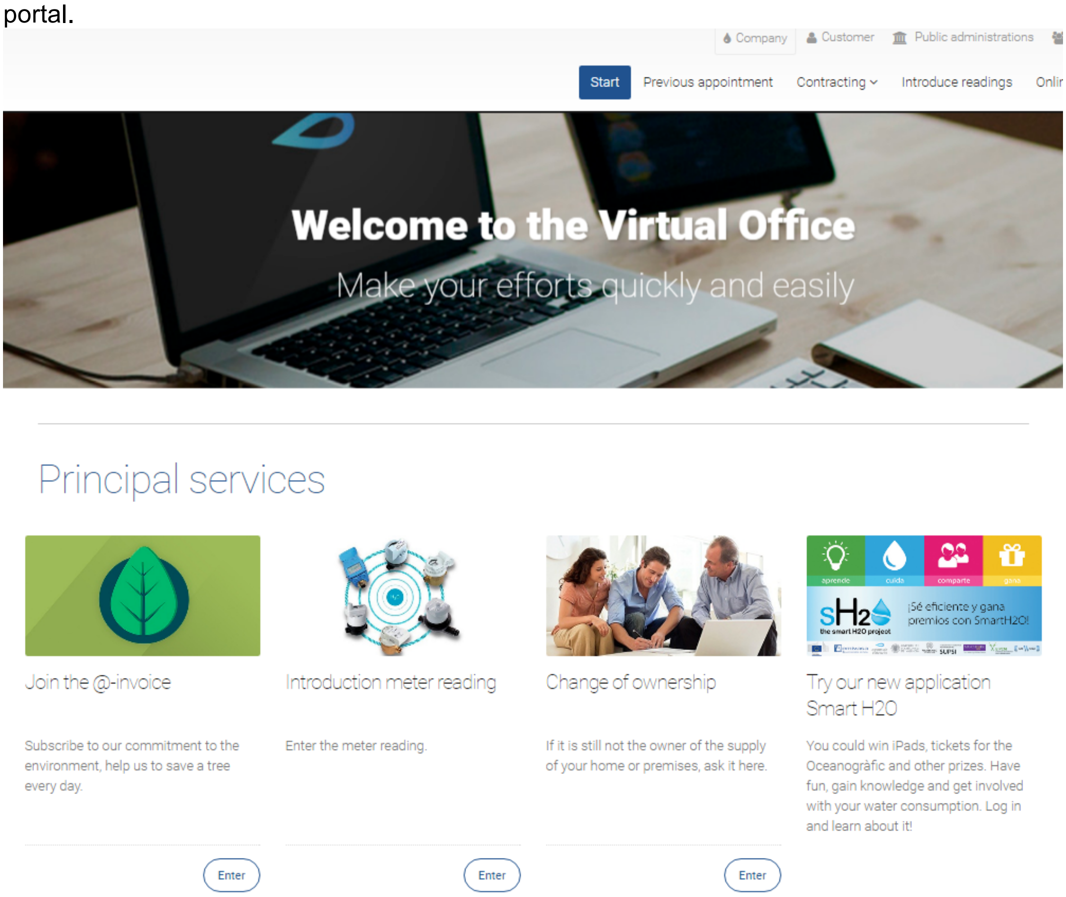

Figure 12. SmartH2O customer portal integration within EMIVASA Virtual Office portal.

Also, the SmartH2O platform has been deployed on a cloud infrastructure hosted by Amazon Web Services in order to accommodate testing and production accounts for the next water utilities that will assess and implement the SmartH2O platform.

1.4 The potential impact and main dissemination activities

The expected final result of the SmartH2O project is an **ICT platform** able to:

- **Understand** and model the consumers' current behavior, based on historical and real-time water usage data
- **Predict** how the consumer behavior can be influenced by various water demand management policies: water savings campaigns, social awareness campaigns, to dynamic water pricing schemes
- **Raise the awareness** of water consumers on their current water usage habits and their lifestyle implications and to stimulate them to reduce water use

The SmartH2O ICT infrastructure will enable water managers to close the loop between actual water consumption levels and desired targets, using information about how the consumers adapt their behavior to new situations: new regulations, new water prices, appeals to water savings. This feedback will allow to aptly revise the water demand management policies, enabling to maximise the water and energy saving goals.

1.4.1 *The socio-economical impact and the wider societal implications*

Water demand is growing worldwide, especially in densely populated areas, as a consequence of population growth and urbanization. The increase in water consumption should be, in principle, positive for the business model of a typical water utility. Yet, the spatial concentration of water demand in urban areas is impacting demand magnitude, peak intensity, share between use sectors, and indoor and outdoor usage. This, coupled with climate change and land use change, is intensifying the stress on finite water resources, creating both operational and environmental challenges to water utilities, which still need to satisfy the demand of their customers.

To cope with this evolving context, traditional supply and management schemes need to be adapted to meet future demand whilst preventing unsustainable resources exploitation. In this context, keeping into account geographical constraints and increasing marginal cost often limiting capacity expansion through infrastructural, demand-side management strategies are key to complement supply-side interventions for securing reliable water supply as well as reducing shortages and overall utilities' costs.

Within the broad portfolio of demand-side management interventions that can be implemented (i.e., technological, financial, legislative, maintenance, and educational), there is a growing attention to exploring the effect of behavioural change programs aiming at promoting water saving practices and increasing water awareness among users Smart meters provide essential data to characterize the behavior of individual users and support the development of customized demand-side management interventions targeted on specific groups of users, and tailored to act on the drivers of their water consumption behavior. Indeed, a major role in forming the water demand is played by the behavior of water consumers, each potentially driven by diverse social and individual motivations and triggers.

The solutions offered by the SmartH2O project enable an efficient water demand management based on the aggregate effect of actions undertaken by several, diverse, individuals. SmartH2O creates a communication channel and a continuous feedback-loop between water users and utility companies, providing consumers with information on their consumption in near real-time while enabling water utilities to plan and implement strategies to reduce or reallocate water consumption. This can be achieved by exploiting collected information about how the consumers adapt their behavior as a reaction to different stimuli, such as awareness campaigns and changes in regulations or prices. To this aim, smart water meters are leveraged for collecting high frequency consumption data, which are used to provide high granularity information to water utilities on the state of the distribution network. At the same time, the collected information can be employed to stimulate a change in water consumption behavior. Accordingly, the SmartH2O system has been designed as a behavioural change support system (BCSS): "a socio-technical information system [...] designed to form, alter or reinforce attitudes, behaviours or an act of complying without using coercion or deception" (Oinas-Kukkonen, 2013).

The SmartH2O approach considers that a change in water consumption behaviour can occur when underlying psychological determinants change through a combination of different incentive and persuasion strategies, acknowledging that both in the energy domain and in the water domain consumption data alone are not sufficient to induce a sustainable behavioural change. Rather than relying on smart metered consumption feedback alone, the systematic approach followed by SmartH2O is grounded in motivational theory and research on incentive models, employing different mechanisms to incentivize users to save water. This has resulted in an ICT platform for improving consumer awareness, available on web and on mobile devices via a downloadable app. It incorporates smart metering, social computation, data visualization, big data analytics to model user behavior, and gamification to engage consumers in the process.

The SmartH2O approach has the potential to promote a more sustainable use of water through a non-normative approach which has some concrete advantages in terms of societal impact:

It requires extremely low installation and deployment and operational costs, if compared to infrastructural interventions aimed at increasing water supply;

It promotes a water saving approach based on awareness and information, instead of a simple economical approach aimed at “hitting the pocket”. The combination of the motivational approach proposed by SmartH2O with innovative tariff schemes can obtain sensible water savings without angering the customers. Water is seen as a resource to be shared, not as a resource to be exploited by the water utility at the disadvantage of the customers.

While it has been demonstrated that SmartH2O users can achieve sensible water savings, the main obstacle to the widespread diffusion of this type of approach is the low adoption rate that has been observed. Future studies and real world application will need to study in depth the marketing strategy to maximize the engagement of the users. We expect that the transition towards a digital society will make the use of tools such as SmartH2O more and more common, but the road is still long and windy.

1.4.2 *Main dissemination activities*

SmartH2O made a large use of social media, complementing the standard website communications with Twitter, LinkedIn, and Slideshare in order to reach the general public. As a result, all the targets defined in D9.1 – Dissemination Tools and Materials have been met: the SmartH2O twitter account has more than 700 followers and produced more than 1500 tweets; the SmartH2O Innovation Community involves 279 members; the SmartH2O Slideshare account counts 21 presentations and almost 48,000 views. Moreover, numerous public events with the SmartH2O users were organized. Several contacts with parallel projects and water companies have also been established for showcasing the SmartH2O results and collecting feedbacks from experts in the field.

At the same time, SmartH2O produced top-level scientific results, as demonstrated by the 10 journal papers published during the project lifetime, along with more than 30 contributions to international conferences and workshops.

During the third year of activity, SmartH2O organized a summer school on “Smart Systems for Water Management – Modelling, Simulation, Analytics and ICT for Behavioral Change”. The school, held on August 22-25, 2016 at Monte Verità (Switzerland), involved several international speakers and participants. The topics discussed during the school are expected to contribute to the associated Thematic Issue on Urban Water Demand Management hosted by Environmental Modelling & Software journal. In addition, the final dissemination event of the SmartH2O project took place in March 2017 during the WaterWise Annual Water Efficiency, the premier event for showcasing water efficiency in the UK where all the major players in the UK water sector are present, including the private water utilities but also regulatory agencies tackling with water and environmental issues.

Finally, SmartH2O has also planned to support the ongoing and future activities related to the exploitation of the final project results beyond the project lifetime by means of a series of press releases that will be distributed in the months of April and May 2017 to showcase the validation of the SmartH2O platform in the two case study applications.

1.4.3 *Exploitation of results*

The SmartH2O project has already achieved substantial objectives with respect to the exploitation goals, even before its conclusion:

- It has been deployed in a **real-world case in Valencia**, and it is now being offered by EMIVASA as a value-added proposition for new customers of their water distribution services.

- SETMOB and WEBRATIO **teamed in the creation and distribution of a new product** named “SmarterWater”, which is currently being offered to prospective customers.
- The Drop! Game and its digital extension Drop!The Question **are planned for commercialization by KALEIDOS GAMES** under licence from MOONSUB.
- POLIMI is deploying an instance of SmartH2O in the **city of Magenta** (Italy) in collaboration with CAP GROUP.
- SETMOB and POLIMI made available a testing account of SmartH2O platform for **ANGLIAN WATER the second water utility from UK in terms of number of served citizens**. Next, WEBRATIO will deliver a number of copies of DROP! the card game for internal assessment within ANGLIAN WATER. SETMOB presented the SmartH2O platform to **Compania Regionala de Apa** Bacau (CRAB), a regional water utility from Romania interested in implementing the software platform and applying the outcome of the research project. Following his interest for observing the project outcome, the General Manager of Compania Regionala de Apa Bacau has been invited to attend the SmartH2O Gala Event, where the winners of the SmartH2O community competition held in the Spanish case study will be awarded.
- SUPSI, POLIMI, SETMOB and EIPCM are now collaborating on a **new EU funded research project** (H2020 enCOMPASS) which draws many ideas and inspiration from SmartH2O.

1.5 Project public website

The project public website is available at http://www.smarth2o-fp7.eu

1.6 Contact details of the project consortium

The SmartH2O project consortium is composed by:

Research and Academia

Name	Country	Principal investigator	Website
SUPSI (coordinator)	CH	Prof Andrea Rizzoli *andrea@idsia.ch*	http://www.supsi.ch
Politecnico di Milano	IT	Prof Piero Fraternali, Prof Andrea Castelletti, Prof Paola Maria Garrone *{piero.fraternali, andrea.castelletti, paola.garrone}@polimi.it*	http://www.polimi.it
University of Manchester	UK	Prof Julien Harou *julien.harou@uom.ac.uk*	http://www.uom.ac.uk
Universitat Politecnica de Valencia	ES	Prof Manuel Pulido Velàzquez *mapuve@upv.es*	http://www.upv.es

Utilities

Name	Country	Contact person	Website
Thames Water	UK	Mr Martin Holt *martin.holt@thameswater.co.uk*	http://thameswater.co.uk
SES	CH	Ing Marco Bertocchi *marco.bertocchi@ses.ch*	http://www.ses.ch
EMIVASA (now GlobalOmnium)	ES	Mr Joan Carles Guardiola Herrera. *jguardiola@globalomnium.com*	Mr Joan Carles Guardiola Herrera.

Organisations representing users:

Name	Country	Contact person	Website
EIPCM	DE	Prof Jasminko Novak *j.novak@eipcm.de*	http://www.eipcm.de

SMEs dedicated to innovation:

Name	Country	Contact person	Website
SetMobile	RO	Mr Luigi Caldararu *luigi@setmobile.ro*	http://www.setmob.ro
MoonSubmarine	UK	Mr Fausto Dassenno *fdassenno@moonsubmarine.com*	http://www.moonsubmarine.co.uk

Moreover two associated third parties joined the project in the second year

Name	Country	Contact person	Website
WebRatio (associated with POLIMI)	IT	Mr Stefano Butti *stefano.butti@webratio.com*	http://www.webratio.com
Aguas de Velancie (associated with EMIVASA)	ES	Mr Jaime Barba Sevillano *jbarba@aguasdevalencia.es*	http://www.aguasdevalencia.es

2. Use and dissemination of foreground

2.1 Section A – dissemination measures

This section describes the dissemination measures, and all scientific publications relating to foreground.

In Template A1 we report that the SmartH2O project has issued a total of 40 scientific publications: 9 peer-reviewed journal papers (6 are currently under review); 25 peer-reviewed conference papers; and 6 workshop papers.

In Template A2 we report the list of all dissemination activities (publications, conferences, workshops, web sites/applications, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters). The SmartH2O project has performed a total of 46 dissemination activities among which we explicitly mention 19 international and national conferences, 9 presentations to the general public of the project progresses and results, 4 exhibitions where the project was displayed, and 5 workshops where we interacted with other researchers and groups.

These tables are cumulative, which means that they should always show all publications and activities from the beginning until after the end of the project. Updates are possible at any time.

TEMPLATE A1: LIST OF SCIENTIFIC (PEER REVIEWED) PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
NO.	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Year of publication	Relevant pages	Permanent identifiers[1] (if available)	Is/Will open access[2] provided to this publication?
1	Integrating behavioural change and gamified incentive modelling for stimulating water saving	Novak et al.	Environmental Modelling & Software		*Elsevier*		*Under review*			no
2	Gamified approaches for Water Management	Castelletti et al.	Book Chapter in Water Smart Grids – A Cyber-				*Under review*			

1 A permanent identifier should be a persistent link to the published version full text if open access or abstract if article is pay per view) or to the final manuscript accepted for publication (link to article in repository).

2 Open Access is defined as free of charge access for anyone via Internet. Please answer "yes" if the open access to the publication is already established and also if the embargo period for open access is not yet over but you intend to establish open access afterwards.

	Systems: an Overview.		Physical Approach							
3	Economic-engineering utility-scale assessment of smart-meter-enabled dynamic pricing	Rougé et al.	Journal of Water Resources Planning and Management				*Under review*			
4	Understanding the impacts of tariff structure and study design on the price elasticity of residential water demand: a meta-analysis	Marzano et al.	Water Resources Research				*Under review*			
5	Incentives to water conservation: comparing price and reward effects through stated preferences	Garrone et al.	Journal of Environmental Economics and Management				*Under review*			
6	Price elasticity of residential water demand and water scarcity.	Garrone et al.	Land Economics				*Under review*			
7	A Hybrid	Cominola et	Applied	185	Elsevier		2017	pp. 331-	DOI:	no

	Signature-based Iterative Disaggregation algorithm for Non-Intrusive Load Monitoring	al.	Energy					344	10.1016/j.apenergy.2016.10.040	
8	Sparse Optimization for Automated Energy End Use Disaggregation	Piga et al.	IEEE Transactions on Control Systems Technology,	24 (3)	IEEE		2016	pp. 1044-1051	DOI: 10.1109/TCST.2015.2476777	no
9	Benefits and challenges of using smart meters for advancing residential water demand modeling and management: A review	Cominola et al.	Environmental Modelling & Software	72	Elsevier		2015	pp. 198-214	DOI: 10.1016/j.envsoft.2015.07.012	no
10	SmartH2O: Plataforma TIC basada en la computación social que promueve la gestión eficiente del consumo de agua (SmartH2O: ICT	Guardiola	Revista Técnica de Medio Ambiente (RETEMA)	186			2015	pp. 42-48	ISSN: 1130-9881	

	platform based on social computing that promotes sustainable water consumption)									
11	ICT solutions for highly-customized water demand management strategies	Giuliani et al.	2016 AGU Fall Meeting	December, 12-16			2016			
12	Behaviour change and incentive modelling for water saving: first experiences from the SmartH2O project	Novak et al.	Proceedings of the 8th International Congress on Environmental Modelling and Software – iEMSs 2016	11-14 July			2016			
13	Profiling residential water users' routines by eigenbehavior modelling.	Cominola et al.	Proceedings of the 8th International Congress on Environmental Modelling and Software –	11-14 July			2016			

			iEMSs 2016								
14	Developing a stochastic simulation model for the generation of residential water end-use demand time series	Cominola et al.	Proceedings of the 8th International Congress on Environmental Modelling and Software – iEMSs 2016	11-14 July			2016				
15	An agent based model for water consumption forecasting under socio-economical stimuli	Rottondi et al.	Proceedings of the 8th International Congress on Environmental Modelling and Software – iEMSs 2016	11-14 July			2016				
16	Targeting rebates in the water-energy nexus	Escriva-Bou et al.	Proceedings of the 8th International Congress on Environmental Modelling and Software – iEMSs 2016	11-14 July			2016				

17	Smart meter enabled dynamic pricing of water	Rougé et al.	Proceedings of the 8th International Congress on Environmental Modelling and Software – iEMSs 2016	11-14 July			2016			
18	Behavioural role analysis for multi-faceted communication campaigns in Twitter	Lazaridou et al.	Proceedings of ACM WebSci 2016	May, 22-25			2016			
19	Data-driven behavioural modelling of residential water consumption to inform water demand management strategies	Giuliani et al.	EGU General Assembly	April, 17-22			2016			
20	Reducing the Intrusiveness of Energy and Water End-Use Disaggregation via Social Media and Users	Giuliani and Mossina	Proceedings of the workshops of the Tenth International AAAI Conference on	May, 17			2016			

	Interactions		Web and Social Media Social Web for Environmental and Ecological Monitoring								
21	Advancing residential water management by smart metering and data intensive modelling of consumers' behaviors	Cominola et al.	California Water and Environmental Modeling Forum (CWEMF) 2016 Annual Meeting Session Abstracts	April, 11			2016				
22	On the role of task design in crowdsourcing campaigns.	Bernaschina et al.	Third AAAI Conference on Human Computation and Crowdsourcing				2015				
23	Champagne: a web tool for the execution of crowdsourcing campaigns	Bernaschina et al.	Proceedings of the 24th International Conference on World Wide Web Companion				2015				

24	Modeling and managing urban water demand through smart meters: Benefits and challenges from current research and emerging trends	Cominola et al.	2015 AGU Fall Meeting	14-18 December			2015				
25	Integrating real and digital games with data analytics for water consumption behavioral change: a demo	Fraternali et al.	Proceedings of IEEE Utility and Cloud Computing 2015 (UCC 2015)	December			2015				
26	SmartH2O: an integrated platform coupling smart water meters with ICT and data intensive modeling to support residential water management.	Cominola	Proceedings of the 2nd Int. Electron. Conf. Sens. Appl., 15–30 November 2015; Sciforum Electronic Conference Series, Vol. 2				2015		DOI: 10.3390/ecsa-2-P001		
27	A gamification framework for	Galli et al.	Proceedings of IAHR World	28 June-3			2015				

	customer engagement and sustainable water usage promotion		Congress	July						
28	Modeling residential water consumers' behaviors by feature selection and feature weighting	Cominola et al.	Proceedings of IAHR World Congress	28 June-3 July			2015			
29	A convex optimization approach for automated water and energy end use disaggregation	Piga et al.	Proceedings of IAHR World Congress	28 June-3 July			2015			
30	Management of water supply services through integral operation based on advanced Smart Metering schemes	Guardiola et al.	Proceedings of the 13th IWA Leading Edge Conference on Water and Wastewater Technologies	13-16 June			2015			

31	The SmartH2O platform: advancing residential water management by smart metering and data intensive modeling of consumers' behaviors	Cominola et al.	EWRI World Congress	17-21 May			2015			
32	Enabling Privacy in a Gaming Framework for Smart Electricity and Water Grids.	Rottondi and Verticale	2nd International Workshop on Cyber-Physical Systems for Smart Water Networks (CySWater 2016)	11 April			2015			
33	When food matters: identifying food-related events on twitter.	Ciceri et al.	1st International Workshop on Knowledge Discovery on the WEB (KDWeb 2015)				2015			

28	Visualizing & Gamifying Water & Energy Consumption for Behavior Change	Micheel et al.	Workshop on Fostering Smart Energy Applications (FSEA) 2015 at Interact 2015				2015			
34	Could smart-meter enabled dynamic pricing schemes lower water demands?	Padula et al.	Workshop on Managing Water Demand at University College London				2015			
35	The SmartH2O project: a platform supporting residential water management through smart meters and data intensive modeling.	Cominola et al.	2014 AGU Fall Meeting	15-19 December			2014			
36	Smart metering, water pricing	Harou et al.	Proceedings of 16th	July			2014			

	and social media to stimulate residential water efficiency: opportunities for the SmartH2O project		Conference on Water Distribution System Analysis							
37	The SmartH2O project and the role of social computing in promoting efficient residential water use: a first analysis	Rizzoli et al.	Proceedings of the 7th International Congress on Environmental Modelling and Software – iEMSs 2014	15-19 June			2014		ISBN: 978-88-9035-744-2	

TEMPLATE A2: LIST OF DISSEMINATION ACTIVITIES									
NO.	Type of activities[3]	Main leader	Title	Date/Period	Place	Type of audience[4]	Size of audience	Countries addressed
1	*Conference*	*Castelletti*	*IAHR World Congress*	*28 June – 3 July, 2015* *0*	*Delft (NL)*	*Scientific Community*	*300*	World
2	*Conference*	*Castelletti*	*EWRI Congress 2015*	*May 17-21, 2015*	*Austin (TX)*	*Scientific community*	*250*	*World*
3	*Conference*	*Castelletti*	*AGU Fall Meeting 2014*	*December 15-19, 2014*	*San Francisco (CA)*	*Scientific community*	*1500*	*World*
4	*Conference*	*Rizzoli*	*Gamifying Water*	*September 14- 15,*	*Oxford (UK)*	*Industry*	*80*	*Europe*

3 A drop down list allows choosing the dissemination activity: publications, conferences, workshops, web, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters, Other.

4 A drop down list allows choosing the type of public: Scientific Community (higher education, Research), Industry, Civil Society, Policy makers, Medias, Other ('multiple choices' is possible).

			2014	*2014*				
5	*Exhibition*	*Rizzoli*	*Water IDEAS 2014*	*October 22- 24, 2014*	*Bologna (IT)*	*Industry*	*1000*	*Europe*
6	*Conference*	*Rizzoli*	*International Conference on Water Distribution Systems Analysis*	*July 14-17, 2014*	*Bari (IT)*	*Scientific community*	*250*	*World*
7	*Conference*	*Rizzoli*	*International Conference on Environmental Modeling and Software (iEMSs 2014)*	*June 15-19, 2014*	*San Diego (CA),*	*Scientific community*	*350*	*World*
8	*Conference*	*Novak*	*SocInfo 2014 – International Conference on Social Informatics*	*November 10-13, 2014*	*Barcelona (ES)*	*Scientific community*	*150*	*World*
9	*Workshop*	*Rizzoli*	*SmartH2O user workshop*	*September 15, 2014*	*Terre di Pedemonte (CH)*	*Civil society*	*20*	*Local*
10	*Workshop*	*Harou*	*SmartH2O user*	*October 15, 2014*	*Manchester*	*Civil society*	*15*	*Local*

			workshop		*(UK)*			
11	*Newsletter*	*Giuliani*	*First SmartH2O newsletter*	*February 2015*	*Internet*	*Scientific community, civil society, industry, policy makers*	*400*	*World*
12	*Newsletter*	*Giuliani*	*Second SmartH2O newsletter*	*December 2015*	*Internet*	*Scientific community, civil society, industry, policy makers*	*400*	*World*
13	*Press release*	*Rizzoli*	*Articles n SmartH2O appeared on various newspapers in Canton Ticino (La Regione, Azione)*	*May-June 2014*	*Canton Ticino (CH)*	*Civil society*	*140'000*	*Local*
14	*Radio interviews*	*Rizzoli*	*Radio interviews announcing the launch of SmarthH2O in Terre di Pedemonte*	*June-December 2014*	*Canton Ticino*	*Civil society*	*80'000*	*Local*
15	*Press releases*	*Guardiola*	*Press releases announcing the launch of SmartH2O in Valencia*	*April-June 2015*	*Valencia (ES)*	*Civil society*	*1'500'000*	*Local*

16	*Conference*	*Cominola*	*AGU Fall meeting 2015*	*December 12-16, 2015*	*San Francisco (CA)*	*Scientific community*	*1'500*	*World*
17	*Conference*	*Fraternali*	*UCC 2015*	*7-10 December 2015*	*Cyprus*	*Scientific community*	*120*	*World*
18	*Conference*	*Cominola*	*SWM2015*	*29 November – 3 December 2015*	*Perth (AUS)*	*Scientific community*	*200*	*World*
19	*Conference*	*Cominola*	*ECSA 2 Onlione conference*	*15-30 November 2015*	*Internet*	*Scientific community*	*500*	*World*
20	*Workshop*	*Micheel*	*Interact 2015 workshop*	*15-18 December 2015*	*Bamberg (DE)*	*Scientific community*	*50*	*Europe*
21	*Conference*	*Cominola*	*IAHR World congress*	*28 June – 3 July 2016*	*Delft (NL)*	*Scientific community*	*250*	*World*
22	*Exhibition*	*Caldararu*	*ExpoApa 2015 conference*	*17 June 2015*	*Bucharest (RO)*	*Industry, policy makers*	*500*	*National*
23	*Conference*	*Cominola*	*EWRI Congress 2015*	*May 17-21 2015*	*Austin (TX)*	*Scientific community*	*200*	*World*
24	*Exhibition*	*Rizzoli*	*EXPO 2015*	*September 26 2015*	*Milan (IT)*	*Civil society*	*2000*	*World*
25	*Presentation*	*Rizzoli*	*TreTerre d'Autunno*	*October 11 2015*	*Terre di Pedemonte (CH)*	*Civil society*	*200*	*Local*
26	*Presentation*	*Fraternali*	*ICT 2015 Lisbon*	*18-22 October 2015*	*Lisbon (PT)*	*Civil society, industry, policy makers*	*1000*	*Europe*
27	*Presentation*	*Fraternali*	*European Utility Wek*	*3-5 November 2015*	*Wien (AT)*	*Industry, policy makers*	*800*	*Europe*

28	*Video*	*Fraternali*	*Meetme tonight*	*October 2016*	*Milan (IT)*	*Civil society*	*300*	*National*
29	*Article in the popular press*	*Rizzoli*	*Rivista Elettricità*	*May 2016*	*Canton Ticino (CH)*	*Civil society*	*140'000*	*Local*
30	*Article in the popular press*	*Rizzoli*	*HiTest*	*May 2016*	*Italy*	*Civil Society*	*250'000*	*National*
31	*Article in the popular press*	*Rizzoli*	*La Regione Tiicno*	*October 2016*	*Canton Ticino (CH)*	*Civil society*	*40'000*	*Local*
31	*Article in the popular press*	*Rizzoli*	*Rivista TreTerre*	*Summer 2016*	*Terre di Pedemonte (CH)*	*Civil society*	*4000*	*Local*
32	*Conference*	*Giuliani*	*AGU Fall Meeting 2016*	*December 12-16, 2015*	*San Francisco (CA)*	*Scientific community*	*2500*	*World*
33	*Conference*	*Garrone*	*AiIG Annual Meeting 2016*	*13-14 October 2016*	*Bergamo (IT)*	*Scientific community*	*100*	*National*
34	*Conference*	*Rizzoli*	*International Congress on Environmenal Modelling & Software – iEMSs2016*	*10-14 July 2016*	*Toulouse (FR)*	*Scientific community*	*350*	*World*
35	*Conference*	*Novak*	*ACM WebSci 2016*	*22-25 May 2016*	*Hannover (DE)*	*Scientific community*	*400*	*World*
36	*Conference*	*Castelletti*	*EGU General Assembly*	*17-22 April 2016*	*Wien (AT)*	*Scientific community*	*800*	*Europe*
37	*Workshop*	*Giuliani*	*International Workshop on the Social Web for*	*17 May 2016*	*Köln (DE)*	*Scientific community*	*80*	*Europe*

			Environmental and Ecological Monitoring, SWEEM 2016					
38	*Workshop*	*Rottondi*	*International Workshop on Cyber-Physical Systems for Smart Water Networks (CySWater 2016)*	*11 April 2016*	*Wien (AT)*	*Scientific community*	*70*	*Europe*
39	*Conference*	*Cominola*	*California Water and Environmental Modeling Forum (CWEMF) 2016 Annual Meeting*	*11 April 2016*	*Folsom Lake (CA)*	*Policy makers, scientific community*	*100*	*National*
40	*Exhibition*	*Fraternali*	*Ecomonodo 2016*	*November 2016*	*Rimini (IT)*	*Civil society, policy makers*	*300*	*National*
41	*Presentation*	*Fraternali*	*Climathon 2016*	*November 2016*	*Como (IT)*	*Civil society*	*500*	*National*
42	*Presentation*	*Rizzoli*	*German association of water and energy industry (BDEW)*	*February 2017*	*Berlin (DE)*	*Policy makers, industry*	*20*	*National*
43	*Presentation*	*Fraternali*	*Lombardy Energy Cleantech Cluster*	*February 2017*	*Monza (IT)*	*Industry*	*50*	*National*

44	*Presentation*	*Fraternali*	*Secondary Scholl of Albavilla*	*March 2017*	*Como (IT)*	*Civil society*	*25*	*National*
45	*Presentation*	*Rizzoli*	*Waterwise 2017*	*8 March 2017*	*London (UK)*	*Policy makers, industry*	*100*	*European*
46	*Presentation*	*Rizzoli*	*L'acqua una risorsa sotto stress*	*27 March 2017*	*Ascona (CH)*	*Civil society*	*25*	*Local*

2.2 Section B – exploitable foreground

This section should specify the exploitable foreground and provide the plans for exploitation. All these data can be public or confidential; the report must clearly mark non-publishable (confidential) parts that will be treated as such by the Commission. Information under Section B that is not marked as confidential will be made available in the public domain thus demonstrating the added-value and positive impact of the project on the European Union.

Part B1

The applications for patents, trademarks, registered designs, etc. shall be listed according to the template B1 provided hereafter.

The list should, specify at least one unique identifier e.g. European Patent application reference. For patent applications, only if applicable, contributions to standards should be specified. This table is cumulative, which means that it should always show all applications from the beginning until after the end of the project.

No patent applications, trademarks and registered designs have arisen from the SmartH2O project. This was also expected because of the open source nature of the project.

Part B2

Please complete the table hereafter:

Type of Exploitable Foreground[5]	Description of exploitable foreground	Confidential Click on YES/NO	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application[6]	Timetable, commercial or any other use	Patents or other IPR exploitation (licences)	Owner & Other Beneficiary(s) involved
Commercial exploitation of R&D results	*SmarterWater: the 2.0 digital solution for water utilities*	*Yes*	*31/03/2018*	*User engagement platform*	*E. Water Supply*	*2017*	*No patents are foreseen*	*SETMOB, WebRatio*
Commercial exploitation of R&D results	*Drop!*	*Yes*	*31/03/2018*	*a hybrid digital game for water awareness*	*E. Water Supply*	*2017*	*No patents are foreseen. A trademark will be sought.*	*KALEIDOS GAMES under license from MOONSUB*

19 A drop down list allows choosing the type of foreground: General advancement of knowledge, Commercial exploitation of R&D results, Exploitation of R&D results via standards, exploitation of results through EU policies, exploitation of results through (social) innovation.

6 A drop down list allows choosing the type sector (NACE nomenclature) : http://ec.europa.eu/competition/mergers/cases/index/nace_all.html

2.2.1 *Exploitable foreground: SmarterWater*

Purpose

The main goal of SETMOB in exploiting the results of SmartH2O project is commercial. As a SME, it is critical that the effort that was invested in the platform development will pay off in terms of better revenues, increased company value and economic growth.

How the foreground might be exploited and by whom

From commercial prospective, SETMOB will form a joint venture with Webratio for selling SmartH2O platform and Smart Meter Data Manager software component rebranded as SmarterWater.

The objective of the SmarterWater - Smart Meter Data Manager (**SMDM**) software component is the acquisition and processing of data streams from smart meters and consolidation within the SmartH2O platform database.

SMDM collects and processes meter data and drive cost savings and operational efficiencies in different areas, including meter-to-cash, diversion and theft, customer service, and distribution optimization planning. In certain circumstances, **SMDM** can become an extension of the water utility data analytics and therefore it can evolve into a dedicated software solution by itself.

Exploitation plan

We intent to sell **SMDM** to water utilities from EU, with the first business operations starting in Romania, both as an independent software component and as a component of the **SmartH2O platform**.

Table 1. Three years sales assumption by SETMOB regarding SMDM component.

Assumptions after two years	
No.of water utilities to sold at the SmartH2O platform after three years	12
Total no.of end-users of water utilities after three years	50000
Average monthly **SmartH2O platform** charge per end-user (€)	2.00
SMDM revenue share from SmartH2O platform	25%
Average monthly **SMDM** charge per end-user (€)	0.50
Average monthly **SMDM** revenue after three years (€)	**25000**

Financial plan

We will follow a Software as a Service sales model. **SMDM** will be sold to water companies on a pay-per-user subscription model, at a price based on the total number of registered user.

Table 2. SETMOB sales target for SMDM component.

Interval of time	No. of water utilities	No. of users	Yearly revenue
Year 1 (2017)	2	5.000	25.000 €
Year 2 (2018)	7	20.000	120.000 €
Year 3 (2019)	12	50.000	300.000 €

In Romania, the water utility market is fragmented, with around 450 water utilities all over the country, the most of them serving communities from small towns and the nearby villages with an average of less than 5.000 served citizens.

Also, there are a number of bigger water utilities serving cities, such as:

ApaNova Bucuresti, 1,9 M served citizens, around 250.000 accounts; Compania de Apa Somes Cluj-Napoca, 0.75 M served citizens, around 150.000 accounts; Aquatim Timis, 0.7 M served citizens, around 120.000 accounts; RAJA Constanta, 0.5 M served citizens, around 100.000 accounts; Compania de Apa Bacau, 0.35 M served citizens, around 75.000 accounts

We will introduce and sell SMDM starting with the biggest water utilities from Romania, then gradually moving to middle size water utilities while approaching water utilities from the countries around.

Planned activities

In Table 3 we list the planned activities to sell and deliver **SMDM**.

Table 3. Activities planned by SETMOB for SMDM commercial exploitation

Marketing	Marketing strategy elaboration: - positioning - campaign plan
	Campaigns elaboration: - key messages - creative assets
	Campaigns execution: - campaign material production costs - media costs: online / offline - events attendance - monitoring
Sales	Presales - environment preparation - demo session Travel and Sales meetings Sales partnerships (partners, referrals, sales agents)
Product development	Development of new features Bug fixing
Infrastructure	Computing, storage and network costs
Platform operations	Platform administration - monitoring - resource allocation / deallocation - provisioning / unprovisioning customer accounts - administration optimization
On-demand activities	Training Consultancy Customization and integration

Potential impact

In Table 4 we report a forecast of expected revenues and costs.

Table 4. Revenues and costs forecasted by SETMOB for SMDM

	Year1 (2017)	Year2 (2018)	Year3 (2019)
Revenues (projected)			
No of new water utilities starting a PoC	4	6	8
revenues from PoC (€)	5000	10000	15000
No of water utilities in production	2	7	12
No of subscriptions	5000	20000	50000
revenues from subscriptions (€)	20000	110000	285000
Total revenues (€)	25000	120000	300000
Costs (projected)			
Sales and Marketing			
Marketing spend	15000	30000	50000
Personnel costs	12000	16000	18000
General&Administrative	3000	3000	3000
Technical Support			
Personnel costs	12000	24000	24000
Research and Development (R&D)			
Personnel costs	40000	70000	80000
Other Costs			
Travel	3000	5000	10000
Staff related **(**office supplies, subscriptions, phones, etc.**)**	1000	1000	1000
Onboarding **(**computer, software, desk, etc.**)**	0	500	1000
Various (Server infrastructure, rent, service providers, etc.**)**	1000	1500	2000
Total costs (€)	87000	151000	189000
Gross margin (€)	-62000	-31000	111000

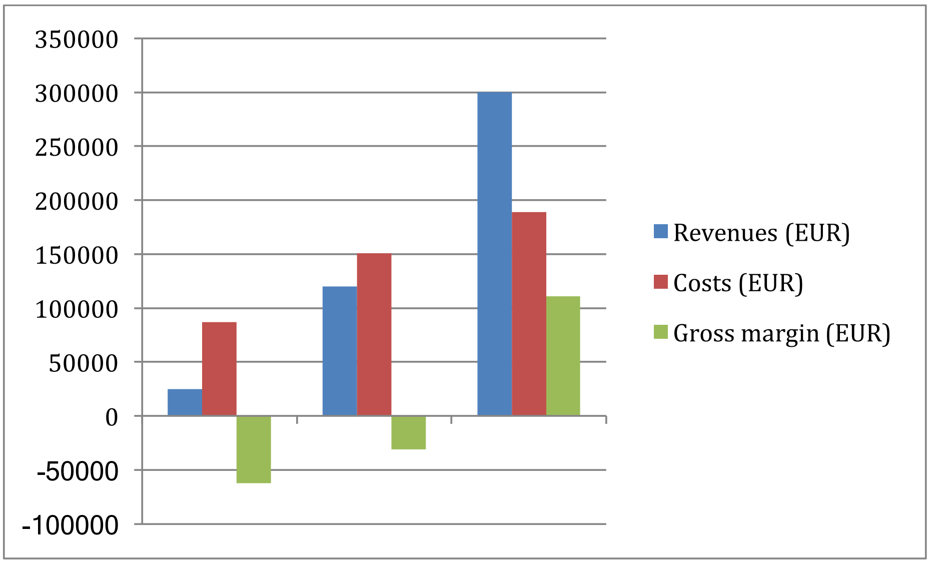

Figure 1. Revenues and costs chart forecasted for SMDM exploitation by SETMOB.

2.2.2 *Exploitable foreground: Drop!*

Purpose

MOONSUB will exploit the results of SmartH2O in two different directions: by designing a new line of B2B products for SME and Corporations and by licensing the card game to become a retail product.

How the foreground might be exploited and by whom

With the experience from the SmartH2O project we will launch a new line of B2B products for SMEs and Corporations providing them with a product to promote their client fidelity.

MOONSUB will leverage its experience in gamification to design the following B2B products:

- "Off the shelf" customized product
- Fully customized product

The **"off the shelf" version** of Drop! The Card game is the standard version of the game with just a customized app. The core of the game is the interaction between the card game and the extended version accessible via the proprietary app.

The card game will be exactly like the one produced for the SmartH2O project and no customization on the graphic material or on the game rules will be applied. The customized part of the product will be the mobile app that will be designed around the specific needs of the user.

The mobile app is a natural compendium of the card game and is composed of two main elements:

- Questions (connected to the main topic of the game which is water saving)
- Graphic assets

This latter element will be personalized reflecting the client logo and visual identity.

The standard package is composed by:

- Standard game set
- Customized mobile app

The client will be free to distribute the game as part of his commercial/communication and create vibrancy around it.

The **fully customized product** will allow a complete redesign of the game and the mobile app. The actual concept of Drop! The Game revolves around raising the awareness around saving water. Aiming to extend our Total Addressable Market we will allow clients to request a fully customized version of the platform (game + app) to be designed around their value proposition. We will be able to design customized version of the game for gas companies, transportation and logistic companies, e-commerce and any other industry.

Our internal design team will provide a new concepts and a new design that will completely fit our clients business model.

The items that will be customized in this option are:

- Graphic of the cards and packaging
- Rules (they need to be in line with our clients' business model)
- App (including questions and graphical assets);

Exploitation plan

The exploitation plan will first focus on "Drop! the game" retail product

Leveraging on the product validation from the SmartH2O initiative we may be in the position of producing a retail version of the game for the consumer market.

Moonsubmarine will work in partnership with Kaleidos Publishing from Milan to bring to market this version.

Kaleidos Publishing has years of experience in this type of products and Moonsubmarine ltd will license the full product.

The business model underlying will be based on a revenue share.

Moonsubmarine ltd and Kaleidos Publishing will agree on a publishing and marketing plan also leveraging on the actual Kaleidos Publishing network of European distributors. This will allow a thorough go to market unlocking new revenue streams.

The actual version of Drop! is leveraging the mobile app to complete the experience. This part of the product will be dropped in the first version of the retail product in order to minimize the localization effort and re-integrated as soon as the first wave will be on sold from the distributor.

Given the potential market and the total addressable market great attention will be dedicated to the optimisation of the procurement.

Kaleidos Publishing already has a network of manufacturers that can provide very competitive costs for the production keeping the COGS at a profitable level.

Potential impact

In the following table we report the economies of scale of the production line.

# items produced	Cost per Item	Sell price point	Gross Margin per copy
#1 5000	€ 3,50	€ 5.50	€ 2,00
#2 10000	€ 3,10	€ 5.50	€ 2,40
#3 15000	€ 2,90	€ 5,50	€ 2,60

Based on the above production lotsizes we may be able to generate the following revenues:

- Hypothesis #1: Sell price * Rev. Share 10% 2.750
- Hypothesis #2: Sell price * Rev. Share 10% 5.500
- Hypothesis #3: Sell price * Rev. Share 10% 8.250

3. Report on societal implications

Replies to the following questions will assist the Commission to obtain statistics and indicators on societal and socio-economic issues addressed by projects. The questions are arranged in a number of key themes. As well as producing certain statistics, the replies will also help identify those projects that have shown a real engagement with wider societal issues, and thereby identify interesting approaches to these issues and best practices. The replies for individual projects will not be made public.

A General Information *(completed automatically when **Grant Agreement number** is entered.*	
Grant Agreement Number:	FP7-ICT-619172
Title of Project:	SmartH2O: an ICT Platform to leverage on Social […]
Name and Title of Coordinator:	Prof Dr Andrea Emilio Rizzoli

B Ethics	
1. Did your project undergo an Ethics Review (and/or Screening)? • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 '*Work Progress and Achievements*'	No
2. Please indicate whether your project involved any of the following issues (tick box) :	
RESEARCH ON HUMANS	
• Did the project involve children?	No
• Did the project involve patients?	No
• Did the project involve persons not able to give consent?	No
• Did the project involve adult healthy volunteers?	Yes
• Did the project involve Human genetic material?	No
• Did the project involve Human biological samples?	No
• Did the project involve Human data collection?	No
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	No
• Did the project involve Human Foetal Tissue / Cells?	No
• Did the project involve Human Embryonic Stem Cells (hESCs)?	No
• Did the project on human Embryonic Stem Cells involve cells in culture?	No
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	No
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	No
• Did the project involve tracking the location or observation of people?	Partly
RESEARCH ON ANIMALS	
• Did the project involve research on animals?	No
• Were those animals transgenic small laboratory animals?	No
• Were those animals transgenic farm animals?	No

• Were those animals cloned farm animals?	No
• Were those animals non-human primates?	No
RESEARCH INVOLVING DEVELOPING COUNTRIES	
• Did the project involve the use of local resources (genetic, animal, plant etc)?	n.a.
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	n.a.
DUAL USE	
• Research having direct military use	No
• Research having the potential for terrorist abuse	No

C Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator	0	1
Work package leaders	0	9
Experienced researchers (i.e. PhD holders)	8	29
PhD Students	1	2
Other	5	20

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	20
Of which, indicate the number of men:	15

D Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project? ● Yes ○ No

6. Which of the following actions did you carry out and how effective were they?

		Not at all effective				Very effective
❑	Design and implement an equal opportunity policy	○	○	○	○	○
☒	Set targets to achieve a gender balance in the workforce	○	●	○	○	○
❑	Organise conferences and workshops on gender	○	○	○	○	○
☒	Actions to improve work-life balance	○	○	○	○	●
○	Other:					

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

○ Yes- please specify

● No

E Synergies with Science Education

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

● Yes- please specify `Demo of platform and game`

○ No

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

○ Yes- please specify

● No

F Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?

○ Main discipline[21]: **2.2**

○ Associated discipline[21]: **2.1** ○ Associated discipline[21]: **5.4**

G Engaging with Civil society and policy makers

11a Did your project engage with societal actors beyond the research community? *(if 'No', go to Question 14)* ● Yes ○ No

11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?

○ No
○ Yes- in determining what research should be performed
● Yes - in implementing the research
● Yes, in communicating /disseminating / using the results of the project

[21] Insert number from list below (Frascati Manual).

11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	○ ●	Yes No

12. Did you engage with government / public bodies or policy makers (including international organisations)

- ● No
- ○ Yes- in framing the research agenda
- ○ Yes - in implementing the research agenda
- ○ Yes, in communicating /disseminating / using the results of the project

13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?

- ○ Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
- ● Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
- ○ No

13b If Yes, in which fields?

Agriculture Audiovisual and Media Budget Competition Consumers Culture Customs Development Economic and Monetary Affairs Education, Training, Youth Employment and Social Affairs		Energy Enlargement Enterprise Environment External Relations External Trade Fisheries and Maritime Affairs Food Safety Foreign and Security Policy Fraud Humanitarian aid		Human rights Information Society Institutional affairs Internal Market Justice, freedom and security Public Health Regional Policy Research and Innovation Space Taxation Transport	

13c If Yes, at which level?

- ◉ Local / regional levels
- ◉ National level
- ○ European level
- ○ International level

H Use and dissemination

14. How many Articles were published/accepted for publication in peer-reviewed journals?	3
To how many of these is open access[22] provided?	3
How many of these are published in open access journals?	0
How many of these are published in open repositories?	3
To how many of these is open access not provided?	0
Please check all applicable reasons for not providing open access:	
■ publisher's licensing agreement would not permit publishing in a repository ❑ no suitable repository available ❑ no suitable open access journal available ❑ no funds available to publish in an open access journal ❑ lack of time and resources ❑ lack of information on open access ❑ other[23]: ……………	

15. How many new patent applications ('priority filings') have been made? *("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).*	0

16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	0
	Registered design	0
	Other	0

17. How many spin-off companies were created / are planned as a direct result of the project?	0
Indicate the approximate number of additional jobs in these companies:	

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:

❑ Increase in employment, or	❑ In small & medium-sized enterprises
❑ Safeguard employment, or	❑ In large companies
❑ Decrease in employment,	❑ None of the above / not relevant to the project
■ Difficult to estimate / not possible to quantify	

[22] Open Access is defined as free of charge access for anyone via Internet.
[23] For instance: classification for security project.

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (*FTE = one person working fulltime for a year*) jobs: Difficult to estimate / not possible to quantify	*Indicate figure:* ☒

I Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?

○ Yes ● No

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?

○ Yes ● No

22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?

■	Press Release	■	Coverage in specialist press
☐	Media briefing	■	Coverage in general (non-specialist) press
■	TV coverage / report	■	Coverage in national press
■	Radio coverage / report	☐	Coverage in international press
■	Brochures /posters / flyers	■	Website for the general public / internet
☐	DVD /Film /Multimedia	■	Event targeting general public (festival, conference, exhibition, science café)

23 In which languages are the information products for the general public produced?

■	Language of the coordinator	■	English
■	Other language(s)		

***Question F-10*:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES
1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]
1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)
1.3 Chemical sciences (chemistry, other allied subjects)
1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)
1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2 ENGINEERING AND TECHNOLOGY
2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)

2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)

3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)

3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)

4.2 Veterinary medicine

5. SOCIAL SCIENCES

5.1 Psychology

5.2 Economics

5.3 Educational sciences (education and training and other allied subjects)

5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)

6.2 Languages and literature (ancient and modern)

6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]