

DELIVERABLE 7.2

Trial B Report

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Abstract

This report presents an overview of the implementation of DAIAD's Trial B, which took place in St Albans from 1st March 2016 to 28th February 2017, with the participation of 47 households (164 consumers). The purpose of Trial B was to evaluate and validate DAIAD technologies in a bottom-up perspective, with DAIAD being offered directly to the consumers as an actual off-the-shelf personal water monitoring product.

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1.1	09/06/2017	<p>Revised version addressing reviewer's feedback. Summary of changes follows:</p> <ul style="list-style-type: none"> - Included preliminary results in a new Section 4 (<i>Preliminary results</i>). The authors however, <i>strongly urge the readers to ignore</i> the relevant text and instead consider our extensive evaluation in Report Deliverable D7.3, which is devoted in analyzing the project's results. - Added axes descriptions in the captions of all figures <p><i>Clarification on 'common ETL & preprocessing': The complete set of cleaning and pre-processing rules applied in the source data are extensively documented in the D7.3 Deliverable. A discussion on the methodology for the cleaning and analysis of the Trial data is beyond the scope of this report.</i></p> <p><i>Clarification on 'Depended indicators':</i> The KPI presents the total number of shower events received by the system and are distinguished in 'real-time' and 'historical'. These are not dependent indicators, but provide a critical difference in the manner/detail shower events have been received (i.e., synchronously vs. asynchronously). Please consult Section 4.1 for a short discussion, and either of the D1.2, D1.3, or WP2 deliverables regarding the characteristics of the data transmission and collection protocol from b1 devices.</p> <p><i>Clarification on 'comparison with SmarH2O':</i> We would like to stress that the experimental studies of the two projects are dissimilar and hence a comparison cannot be performed. To the best of our</p>	Spiros Athanasiou, Pantelis Chronis, Giorgos Giannopoulos

		<p>knowledge based on the public SmartH2O deliverables, the system became available (web-based only) and users were invited to (a) use it, and (b) complete a few surveys. Consequently, the Trials required much less planned and actual engagement with the users (e.g., no equipment to be distributed and installed), was supported by the local water utility (i.e., similar to our Trial A and not Trial B), had only simple technical requirements (no mobile/Bluetooth 4.0), had a much smaller planned duration (at best 4 months vs. 12), while usage data reveal the system was used at best 5 times during their Trial from each user (i.e., almost once a month).</p> <p><i>Clarification of 'Social innovation'.</i> A further analysis and discussion of insights regarding this issue is out of the scope of this report, as it is extensively covered in the Report Deliverable D7.3, where all Trial data are examined. At this point in time, we cannot elaborate beyond what is already mentioned in this report, as our analysis is ongoing.</p> <p><i>Clarification on high-rate of drop-outs.</i> We have nothing additional to mention or analyze regarding this issue beyond what is already mentioned in the corresponding sections of this report. In summary (please consult Section 4.3), we attribute this issue to the local low-flow water problem affecting households in St Albans, and the limited information participants had (<i>only shower</i>) regarding their water use.</p>	
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Executive Summary

This report presents an overview of the implementation of DAIAD's Trial B, which took place in St Albans from 1st March 2016 to 28th February 2017, with the participation of 47 households (164 consumers). The purpose of this report is to document the implementation and evolution of Trial B across its various phases, present all technical issues raised from DAIAD users, and report all anecdotal and informal information collected from the Consortium. As such, this report serves two goals. First, serve as a basis for the evaluation and validation of the complete DAIAD system which will be provided in Deliverable D7.3 'Trials Evaluation and Social Experiment Results'. Second, assist researchers and water sector practitioners in understanding the scope and context of our experimental study, in order to complete their background knowledge or implement similar large-scale studies.

The purpose of Trial B was to evaluate and validate DAIAD technologies in a *bottom-up perspective*, with DAIAD being offered directly to consumers. Consequently, in Trial B we attempted to replicate for participants the *experience* of DAIAD being offered as an actual *off-the-shelf standalone* personal water monitoring product with them having access *only* one amphiro b1 devices (*i.e., no SWM data available*). Towards this, the system was provided to participants packaged with clear installation, use, and troubleshooting instructions, with support being provided exclusively by *remote electronic means* (email, FAQ). While support provided to consumers was more measured and less hands-on compared to Trial A (*e.g., no visits to households*), local activities to inform and engage participants were much more intense, with numerous gatherings organized in St Albans by Waterwise. In addition, the local water utility (*Affinity Water*) and authorities (*local council*) were engaged in the Trial, after expressing their interest regarding its scope and impact.

The Trial comprised five (5) consecutive treatment phases for the participating population spanning eight (8) months, as well as four (4) months as leeway to account for unforeseen delays. Phase 1 focused on validating the proper installation of the DAIAD system and collecting adequate baseline water consumption data for all participants. Phase 2 compared the effectiveness of analytical vs. real-time feedback. In Phase 3, all participants gained access to the entire DAIAD functionality, with the exception of social comparisons. In Phase 4, we established a control group and provided the remaining consumers with access to social comparisons. Finally, in Phase 5 all consumers gained complete access to the DAIAD system.

The implementation and progress of the Trial was monitored by the Consortium through the DAIAD system itself. All requests for support and reported issues, as well as the subsequent corrective actions were compiled on a daily basis. Further, anecdotal information and informal communications with Trial participants were similarly collected and analyzed. The above information was analyzed and compiled on a monthly basis in the form of an internal Monthly Reports, which were distributed amongst all Consortium members. These reports served as a basis for the current document, and supported executive decisions regarding the implementation of the Trial. A number of adjustments in the timing of the various phases in response to delays and anticipated risks were performed throughout the Trial, validating our decision to budget *a priori* the extra four months.

Overall, we consider Trial B to be successful across all of its aspects, providing us with valuable feedback towards *simplifying, improving, and streamlining* the installation and operation of the DAIAD system, exploring the limits of current technologies, and locating critical key-points for the success of personal water monitoring technologies. The direct comparison with Trial A confirmed our motivation for piloting the system in (a) two

geographical locations with different characteristics in terms consumers and water demand, and (b) in two real-world deployment scenarios. Our early findings, which will be presented in Report Deliverable D7.3, indicate that a *holistic coverage* of total water use in the household *increases* user satisfaction, with consumers treating the provision of only fixture-based information as *incomplete*, making it *less attractive*. As a result, fixture-based water monitoring services enjoy a *lesser degree* of potential commercial success as an autonomous and self-contained product. Following this line of argument, the availability of smart water meter data is critical for the success of real-time water monitoring technologies, and implies either *direct* involvement of the water utility (e.g., *similar to Trial A*), or the *indirect* provision of data under a data sharing agreement (e.g., *similar to the Green button initiative*).

Abbreviations and Acronyms

BT	Bluetooth
ICT	Information and Communication Technologies
KPI	Key Performance Indicator
LCD	Liquid Crystal Display
OS	Operating System
S/N	Serial Number
SWM	Smart Water Meter

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1. Introduction

This report presents an overview of the implementation of DAIAD's Trial B, which took place in St Albans from 1st March 2016 to 28th February 2017, with the participation of 47 households (164 consumers). The purpose of this report is to document the implementation and evolution of Trial B across its various phases, present all technical issues raised from DAIAD users, and report all anecdotal and informal information collected from the Consortium. As such, this report serves two goals. First, serve as a basis for the evaluation and validation of the complete DAIAD system which will be provided in Deliverable D7.3 'Trials Evaluation and Social Experiment Results'. Second, assist researchers and water sector practitioners in understanding the scope and context of our experimental study, in order to complete their background knowledge or implement similar large-scale studies.

The remainder of this document is structured as follows.

In Section 2 we elaborate on the design of our experimental study, providing background information about the scope and goals of the Trial, the recruiting process and demographics of participants, as well as the instruments applied to monitor the pilot, collect issues/feedback and provide support.

In Section 3 we present the progress of the Trial during its 12month duration. Our presentation is organized on a quarterly basis, aiming to convey to the reader the actual evolution of the Trial in response to the challenges we confronted. For each quarter we provide a comprehensive list of all issues reported by the Trial participants, presenting for each one the troubleshooting and corrective steps we took. The diversity of the issues was astounding, yet anticipated, ranging from naïve to challenging, and confirmed the representative nature of our study group. Further, we provide the evolution of select KPIs throughout the duration of the Trial, highlighting select time periods and events of particular interest.

2. Preparation Activities

The preparation activities to ensure the successful implementation of Trial B were performed in the context of Task 7.2 and begun already from M3 of the project, comprising a series of intertwined technical, communication, and organizational activities supported by all partners.

The purpose of Trial B was to evaluate and validate DAIAD technologies in a *bottom-up perspective*. Consequently, in Trial B we attempted to replicate for participants the *experience* of DAIAD being offered as an actual *off-the-shelf standalone* personal water monitoring product with them having access *only* to one amphiro b1 device (*i.e., no SWM data available*). Towards this, the system was provided to participants packaged with clear installation, use, and troubleshooting instructions, with support being provided exclusively by *remote electronic means* (email, FAQ). While support provided to consumers was more measured and less hands-on compared to Trial A (*e.g., no visits to households*), local activities to inform and engage participants were much more intense, with numerous gatherings organized in St Albans by Waterwise. In addition, the local water utility (*Affinity Water*) and authorities (*local council*) were engaged in the Trial, after expressing their interest regarding its scope and impact.

Preparation activities focused on delivering all material and processes required for the recruiting, training, support, and interaction with the pilot participants. In summary, this included: (a) invitations (printed, electronic) explaining in simple terms to scope of the pilot, means of participation, requirements, and process for expressing their interest (see daiad.eu/join), (b) pre-surveys (web-based) based on which the participants were selected (*e.g. demographics, household characteristics*), (c) the process for distributing and initializing the equipment (installation instructions), (d) the discrete phases of the pilot and specific goals for testing DAIAD components against a control group, (e) periodic surveys (web-based) for collecting feedback and insights from the participants, and (f) support instruments for addressing potential technical problems.

In the following sections we present the design of our experimental study, providing background information about the recruiting process and demographics of participants, as well as the instruments applied to monitor the pilot, collect issues/feedback and provide support.

2.1. Participant recruiting

Participation in the Trial was **open** on a voluntary basis for all customers located in the St Albans district and the surrounding area that satisfied the minimum technical requirements of the Trial (see Annex 2 – Trial Guides)

The recruiting process began in M16 with the goal of establishing a *representative* panel of 100 households. Volunteers were invited to join Trial B and express their interest, following an extensive communication campaign with focused dissemination and demonstration actions. Among others, these involved coverage from mass media (radio, newspapers), social media, participation in local events, demonstrations of the DAIAD system, meetings with local stakeholders (local utilities, NGOs/Citizen Associations, local government), preparation and distribution of advertising material as well as specific-purpose sections in our web-site

(daiad.eu/join). After evaluating the expressions of interest from volunteers, our final Trial participants were selected and contacted via email, ensuring the selection of an unbiased and representative population. The DAIAD system was shipped, distributed, and installed by trial participants, confirming its proper deployment by each participant after successfully receiving water consumption data.

In the following section we present the above activities in more detail.

2.1.1. Expression of interest

Applications for pilot participants have been publicly available in a specific section of our web-site: www.daiad.eu/join. This section included links to the web survey where volunteers can register as pilot participants, as well as links to two guides (short, long) in English, in which the DAIAD project, the scope of the Trial and means for participation were presented in detail. The guides are provided in Annex 2 – Trial Guides.

The web survey (Google Forms) aimed to ensure that the basic technical requirements for DAIAD were satisfied from interested volunteers (*e.g. mobile phone, internet access*), as well as facilitate the Consortium into selecting an unbiased and representative sample of the population during the final selection of volunteers. The survey questions are provided in Annex I – Survey for expression of interest.

The open call inviting consumers to express their interest has been extensively disseminated through multiple channels in the context of WP7 (*e.g. social media, media coverage, open events, meetings with local stakeholders*). We have been monitoring the progress of registrations on a daily basis since M20, adjusting our communication actions accordingly. Towards this:

- Waterwise undertook promotion and recruitment events at Affinity Water’s offices, at the Sustainable St Albans event in 2015, attended a Friends of the Earth meeting in January/ February 2015 to promote and discuss the project.
- A press release and media campaign was launched with the Ver Valley Newsletter, Hertfordshire Advertiser, an email to all staff in the St Albans and District Council, the Friends of the Earth newsletter, the Transition St Albans newsletter, an interview on Radio Verulam, and wrap-around sponsored ads in the St Albans Review (local newspaper) for one month.
- An additional social media campaign was undertaken in August 2016 using Twitter, which successful initiated another 5 recruits to the project when some participants dropped out due to low-pressure issues (see Section 2.1.4 for details).
- A Facebook page was also created to support community events linked to the Sustainable St Albans Week 2016.

The bottom-up nature of Trial B, and despite our best efforts to engage participants, made our original recruiting goal extremely hard to achieve, ultimately reaching 92 registrations instead of the planned 100. According to our previous research visits ([Waterwise, 2012](#)), even for *utility-driven* top-down projects in the UK, uptake rate among customers tends to be low if no home visits are involved (*e.g.*, similar to Trial A).

We consider this as one of the most important findings of the Trial, and a critical point for the adoption of personal water monitoring technologies. With these technologies still at a *pre-production/early-production* setting, their market success is driven from *innovators* and *early adopters* rather than the general population.

Specifically, according to the well-known and validated throughout the industry 'Diffusion of Innovations' theory by Everett Rogers, the adopter categories for innovations (such as personal water monitoring technologies) comprise

- Innovators (2.5%), i.e., people willing to take risks, have the highest social status, have financial liquidity, are social and have closest contact to scientific sources and interaction with other innovators. Their risk tolerance allows them to adopt technologies that may ultimately fail.
- Early adopters (13.5%), i.e., individuals have the highest degree of opinion leadership among the adopter categories. Early adopters have a higher social status, financial liquidity, advanced education and are more socially forward than late adopters. They are more discreet in adoption choices than innovators
- Early majority (34%), i.e., individuals that adopt an innovation after a varying degree of time that is significantly longer than the innovators and early adopters. Early Majority have above average social status, contact with early adopters and seldom hold positions of opinion leadership.
- Late majority (34%), i.e., individuals that adopt an innovation after the average participant. These individuals approach an innovation with a high degree of skepticism and after the majority of society has adopted the innovation. Late Majority are typically skeptical about an innovation, have below average social status, little financial liquidity, in contact with others in late majority and early majority and little opinion leadership.
- Laggards (16%), i.e., individuals that are the last to adopt an innovation. Unlike some of the previous categories, individuals in this category show little to no opinion leadership. These individuals typically have an aversion to change-agents. Laggards typically tend to be focused on "traditions", lowest social status, lowest financial liquidity, oldest among adopters, and in contact with only family and close friends.

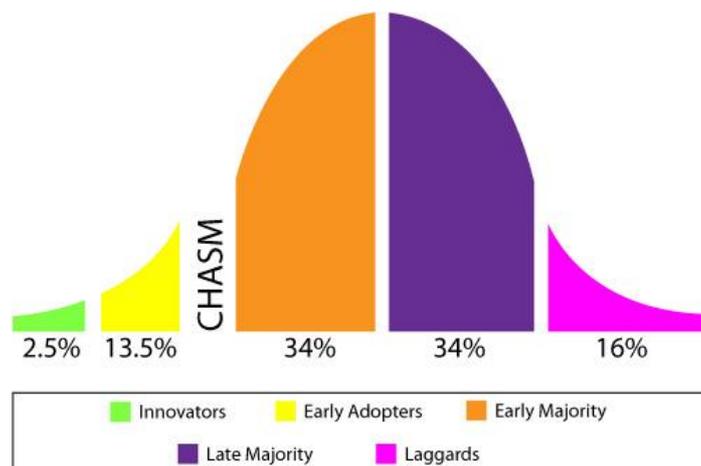


Figure 1: Product adoption curve

As such, engaging consumers for adopting the project's personal water monitoring technologies could realistically reach at most 15% of the total population (*i.e. before the chasm*), and without taking into account any local socio-economic considerations. The direct comparison with Trial A (*top-down, utility-driven*) where we exceeded our recruiting goals by 250%, helps us draw the following important conclusions:

- The early innovation status of personal water monitoring technologies is *strongly alleviated* when water utilities (*i.e., established authority figures, stakeholders and water stewards*) introduce them to their customers in the context of their standard business practices. Consequently, and at least until the critical Chasm is reached in term of adoption (see Figure 1), we consider the direct engagement of water utilities in a top-down manner, *as absolutely necessary*.
- The underlying assumption and research query of Trial B was that *social innovation*, by means of empowered consumers, could become a *strong instrument* for the wider adoption of personal water monitoring technologies, acting as a *catalyst* for the population at large. Unfortunately, throughout the course of Trial B we encountered evidence that social innovation *cannot overcome* the standard theory for ‘Diffusion of Innovations’. While important on a policy and social setting, the *reality* of product innovation is much more constrained in terms of real-world adoption.

2.1.2. Participant selection

Starting from M20, the Consortium began evaluating the expressions of interest and initiated the selection of the participants to be accepted in Trial B. All steps of the process were performed periodically until the Trial positions have been filled. In summary:

- We removed applications which did not cover the minimum technical requirements of the system.
- The participant short-list was distributed amongst the Consortium (*including the survey responses*) for another round of filtering aiming to ensure the representative nature of our panel. Consequently, and depending on the already filled positions, we gave priority to consumers with specific demographic criteria (e.g. large families, low income households).
- Each selected participant was contacted by email and was instructed to complete within 1 week an additional survey available in Annex 3 – Trial Pre-survey. The purpose of the survey was to (a) confirm the contact details of the participant, and (b) collect additional information about the household and its water consumption behavior. Should the participant fail to reply, two follow-up emails were sent, after which the participant was removed from the short-list.
- Upon successful completion of the survey, each participant received an email confirming her official inclusion in the Trial, with instructions regarding the subsequent distribution of the DAIAD system.
- Finally, the participant was added in our white-list (thus allowing them to Sign Up to the DAIAD application).

2.1.3. Equipment distribution

The equipment was distributed via post to all participants in Trial B (*compared with Trial A, where the majority picked them up from the offices of Aguas de Alicante*). Each package included a small leaflet with instructions on how to install the DAIAD hardware and install the DAIAD software (see Annex 4 – Installation instructions). The system’s installation and initialization was monitored remotely through the DAIAD system (see Section 2.3) on a daily basis, with Waterwise contacting consumers by email in case of delays and providing support to any issues the participants experienced.

2.1.4. Drop-outs

Since participation in Trial B is voluntary, participants had the option of opting-out of the Trial at any given time (drop-outs). Participants were requested to simply notify us in such cases, informing them in advance that they only had to return their equipment. We had 9 officially drop out of the trial and return devices. The majority of these participants encountered issues with the low shower flow affecting the area (*see Section 3, Issues for details*), leaks at the connection with the showerhead, or had problems connecting their devices using Bluetooth.

2.1.5. In numbers

The final synthesis of the Trial B panel is presented in the following tables and figures. The following terminology and conventions are used in the presentation that follows:

- **Volunteer.** Each Volunteer is an individual that has expressed her interest to join Trial B (see Section 2.1.1).
- **Participant.** Each Participant is a volunteer that has successfully **joined Trial B and remained in the Trial for its entire duration**. No two Participants are from the same Household (see below), hence each Participant represents a unique household.
- **Drop-out.** Each drop-out is a Participant that has been voluntarily removed from Trial B *at any point* of its duration. All instances and reasons for a drop-out are documented in the Issues sub-sections of Section 3.
- **Consumers.** Includes **all household members of all Participants**. We consider all Consumers as users of the DAIAD system, as they are exposed to the system's interventions. For each household, we have documented its exact number of members, age groups, and sex of its members.

Volunteers	92
Participants	47
Drop-outs	9
Consumers	164

Table 1: Summary of Trial B Panel

2.1.6. Participant statistics

In the following figures we present select statistics for our Participants and Consumers based on the two surveys completed before the start of the Trial (see Annex I – Survey for expression of interest, Annex 3 – Trial Pre-survey).

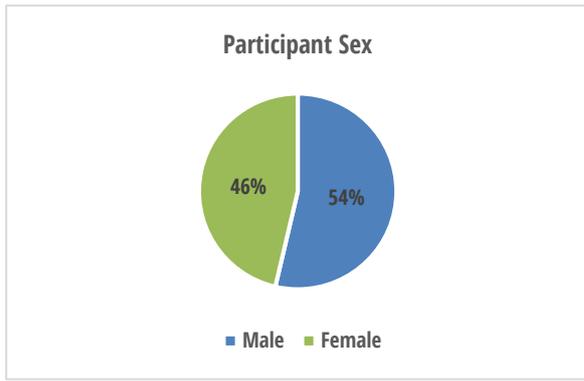


Figure 2: Participant sex

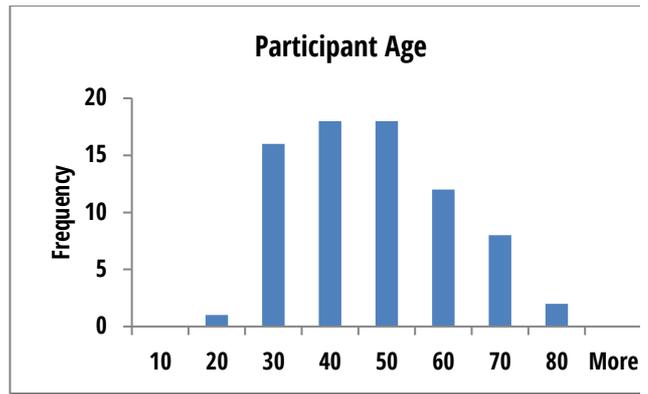


Figure 3: Participant age

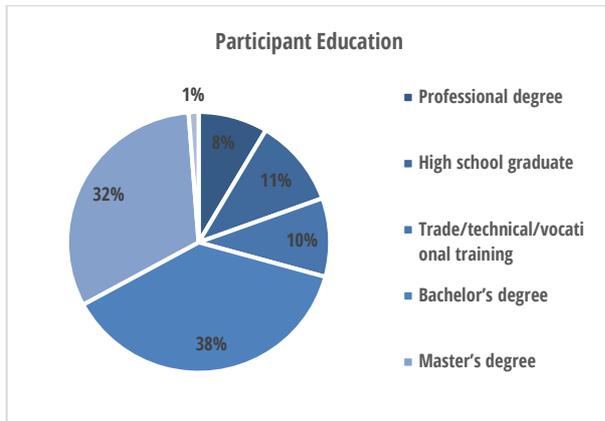


Figure 4: Participant education

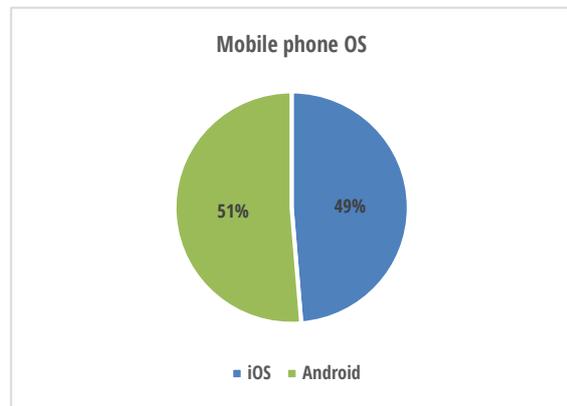


Figure 5: Participant mobile phone OS (main device)

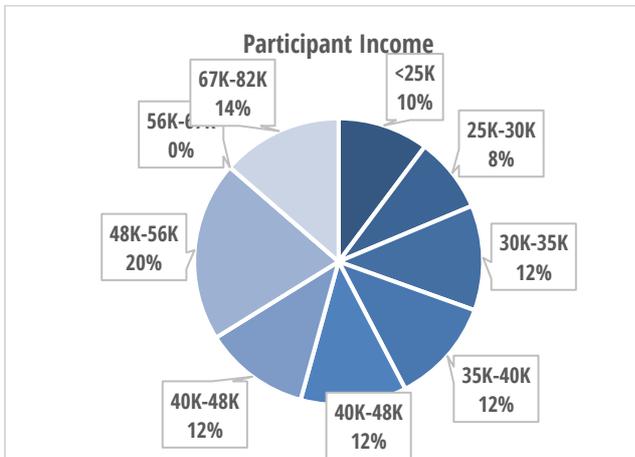


Figure 6: Participant gross income

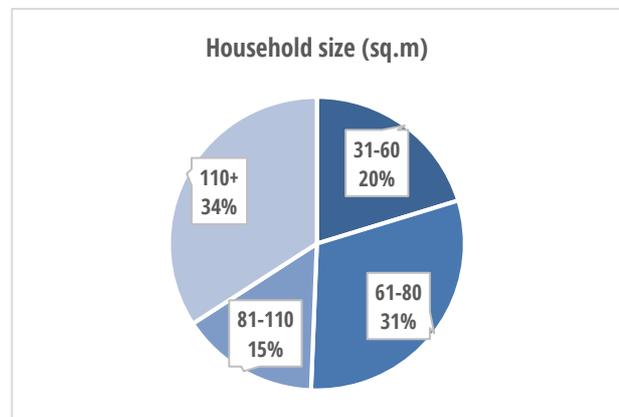


Figure 7: Participant household size (in square meters)

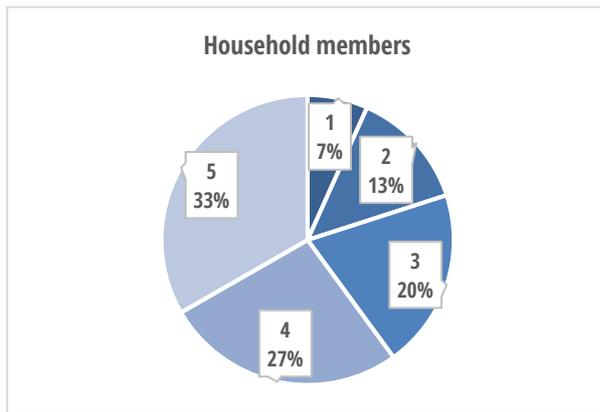


Figure 8: Number of Household members

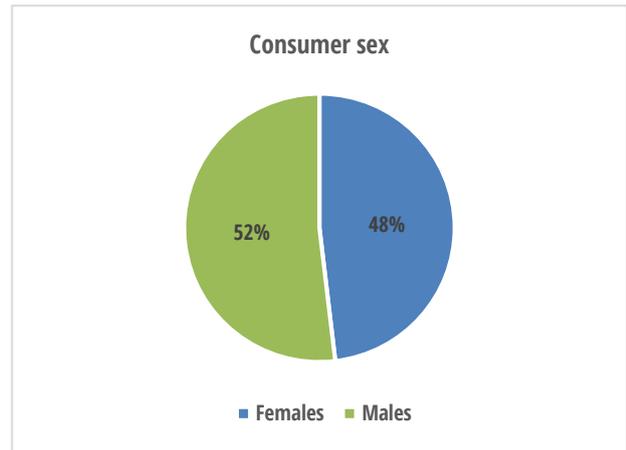


Figure 9: Consumer sex

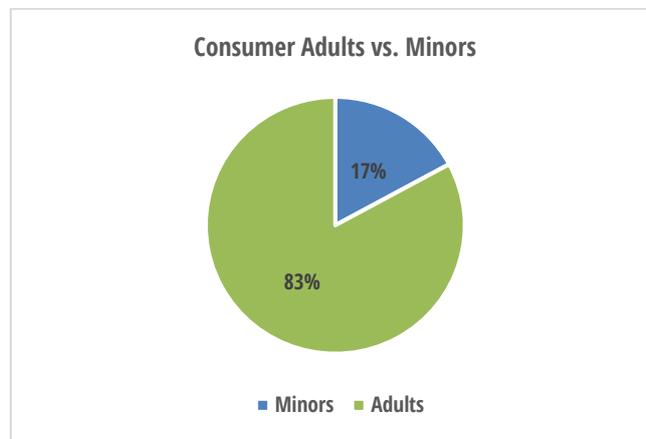


Figure 10: Consumer adults and minors

2.2. Trial Phases

Trial B comprised **five (5) individual *treatment phases***, with each one focusing on collecting **baseline** water consumption data or evaluating a specific subset of the system's **interventions**. The phases and the overall experimental design of the Trial was established in M15, with the aim to maximize the studied interventions and insights, without however *over-taxing* the Trial panel with frequent changes in the DAIAD applications. Overall, the following considerations influenced the design of the treatment phases, as well as their implementation:

- **Real-world operation.** Trial B studies the application of the DAIAD system in a **bottom-up** perspective, with DAIAD being offered **directly** to consumers. As such, these conditions need to be respected at all phases of the Trial. Consequently, in Trial B we attempted to replicate for participants the *experience* of DAIAD being offered as an actual **off-the-shelf standalone personal water monitoring product** with them having access *only* to one amphiro b1 device. Towards this, Waterwise and local stakeholders promoted DAIAD as an eco-innovation product to the local population, without any explicit or implicit engagement of their water utility. Waterwise provided support exclusively by *remote electronic means*,

mediating between the participants and the development team which analyzed issues and problems. At no point was any home visit made, and although Affinity Water promoted the trial, they did not lead on any communications.

- **Streamline participation.** The participation in a 12month Trial can be especially challenging, requiring a small, yet critical level of commitment from its users. Since the participants of Trial B are *volunteers*, but treated as *consumers* in the context of the Trial, it was imperative that we provided *in advance full transparency* over their required involvement, while also keeping their overhead to the absolute *minimum*. Towards this, the treatment phases and the required involvement of each participant were established and communicated to candidates before the recruiting process begun (see Annex 2 – Trial Guides). In addition, during the first and more challenging phases of the Trial (*when participants installed, were acquainted, or did not yet have full access to the applications*) participants were notified via in-app and email notifications (see Annex 5 – Mode management notifications) regarding any substantial changes in the application and its functionality, before it took place.
- **Avoid bias.** The interventions that would be tested at later phases of the Trial, needed to remain *hidden* from participants. This significant detail is unfortunately neglected in other studies and work, contaminating the target/control groups of the study, and thus introducing bias that warrants any validation results void. Towards this, interventions throughout the duration of the Trial were either completely hidden from participants (*appearing only in a hidden debug mode*), or introduced through standard app updates. In addition, the design artifacts for these interventions, relevant source code, and documentation, remained private until the corresponding treatment phase ended. Finally, improvements in the already published interventions and major UI changes were not rolled-out to participants, until after the official end of the Trial.

2.2.1. Phase 1

Phase 1 is focused on validating the proper **installation** of the DAIAD system and collecting **baseline shower usage data**, without providing *any interventions* to participants. Consequently, it allows us to capture the typical shower use behavior of participants and apply this data to discover any changes in water consumption habits at later stages of the Trial. Understandably, it is the most critical phase of the Trial for a number of reasons. First, participants will be completely unfamiliar with the system and its components, thus a learning period is expected. Given the diversity of our panel, this can be very *steep* for certain individuals (e.g. low familiarity with ICT, older members). Second, a number of technical issues are expected to appear in the real-world, as it is the norm for any ICT system when entering a real-world beta evaluation. Finally, potential failure to collect accurate and representative baseline shower usage data (*which is the only type of water use monitored in Trial B*), means that any sort of assessment regarding the effectiveness of the system to induce sustainable changes in consumption behavior will not be possible.

In summary, this is the experience of our participants during this Phase:

- The participant an amphiro b1 devices by post and an email inviting them to install the system using the provided instructions (see Annex 4 – Installation instructions).
- The participant installs the b1 device, downloads the DAIAD application, and follows a wizard (i.e. guide by guide steps) presented during Sign Up.

- After completing the process, the LCD display of the amphiro device remains inactive (i.e. no real-time/in-situ interventions are provided). Further, the mobile application only presents a message informing the participant that the system is in 'Learning mode', thus similarly providing no interventions.
- The participant is requested to just continue with their typical every day activities. In the background, the amphiro b1 device stores any shower events taking place transmitting them via the mobile application when in vicinity, and then back to our monitoring services.

2.2.2. Phase 2

Phase 2 is focused on comparing the effectiveness of **analytical** vs. **real-time** feedback. Our Trial panel is divided into two (2) sub-groups, with each one gaining access to either our analytical or real-time interventions. Real-time interventions are provided by the **amphiro b1** devices, and analytical interventions are provided by DAIAD's **mobile application**. It is important to mention that this is the point in time during which participants actually obtain their *first experience* into the actual interventions of the DAIAD system, seeing it *working for the first time*.

In summary, this is the experience of our participants during this Phase:

- Each participant receives an email (see Annex 5 – Mode management notifications) informing her that the Learning period is complete, and that she now has access to the DAIAD system.
- If the participant is a member of the 'Analytical' group, the next time she opens her mobile application a message informs her the mobile application is now active and that the LCD display of the amphiro b1 will remain inactive.
 - The amphiro b1 device continues to store all shower events taking place transmitting them via the mobile application when in vicinity, and then back to our monitoring services.
 - The mobile application presents analytical interventions using data from the amphiro b1 data received.
- If the participant is a member of the 'Real-time' group, she is requested to have her mobile device near the shower (3-5 meters) next time she takes a shower. The LCD of the amphiro b1 will turn on, while her mobile application will remain inactive.
 - The amphiro b1 device presents in real-time interventions about the current shower. Further, it stores all shower events taking place transmitting them via the mobile application when in vicinity, and then back to our monitoring services.
 - The mobile application presents a message informing her that it will remain inactive for a few weeks.

2.2.3. Phase 3

In this phase **all** participants gain access to **both analytical and real-time interventions**, with the exception of social comparisons. This means that the LCD of the b1 device and the mobile application will become active

for all participants. As such, it allows us to compare study how water consumption habits are affected by the simultaneous delivery of both types of interventions, and evaluate the preferences of users.

In summary, this is the experience of our participants during this Phase:

- Each participant receives an email (see Annex 5 – Mode management notifications) informing her that she now has full access to the DAIAD system.
- If the participant was a member of the ‘Analytical’ group, she is requested to have her mobile device near the shower (3-5 meters) next time she takes a shower. The LCD of the amphiro b1 will turn on.
- If the participant was a member of the ‘Real-time’ group, the next time she opens her mobile application a message informs her the mobile application is now active.
- For all participants:
 - The amphiro b1 device presents in real-time interventions about the current shower. Further, it stores all shower events taking place transmitting them via the mobile application when in vicinity, and then back to our monitoring services.
 - The mobile application presents analytical interventions using data from the amphiro b1 data received.

2.2.4. Phase 4

This phase focuses on studying the effects of **social comparisons** regarding water consumption, and covers all analytical interventions comparing the user’s water use (*actual and ranking*) against similar households, neighboring households, or an entire city. Our Trial panel is divided into two (2) sub-groups, with the first gaining access to these type of analytical interventions through their mobile application, while the second serving as the control group (*i.e. not having access to these interventions*).

In summary, this is the experience of our participants during this Phase:

- The treatment group receives an in-app notification (i.e. ‘Alert’) informing them that a new section of the app has been enabled. From this point on, participants have access to the social comparisons.
- The control group is not contacted, nor gains access to additional functionality.

2.2.5. Phase 5

In this last phase, the control group of Phase 4 also gains access to social comparisons, hence the *entire population* of our study has access to the *entire functionality* of DAIAD. This phase allows us to evaluate the retention of water savings when exposed to interventions in a prolonged time-frame.

2.3. Monitoring

The activity of all Trial participants, from the sign-up process to the actual system operation, was remotely monitored by the Consortium through a proprietary Web-based monitoring environment integrated in the

DAIAD system. These services have been developed with a dual purpose; assist us in monitoring the Trial and facilitate any future custom study by water utilities employing the DAIAD system.

In summary, the DAIAD’s monitoring environment provides the following facilities:

- **Mode Management.** The service provides fine-grained remote control and monitoring services over the *mode* of the system, per *individual user*. As such, it enables the assignment of each participant to a specific *Trial Phase* after examining the status (e.g. *Phase duration, collected data, activity*) of each participant. Additional services include searching and filtering (*user, group, Phase*), accessing system logs for a specific user (e.g. *to troubleshoot or accurately monitor the transition between phases*), as well as links to the detailed User’s Activity (see below).

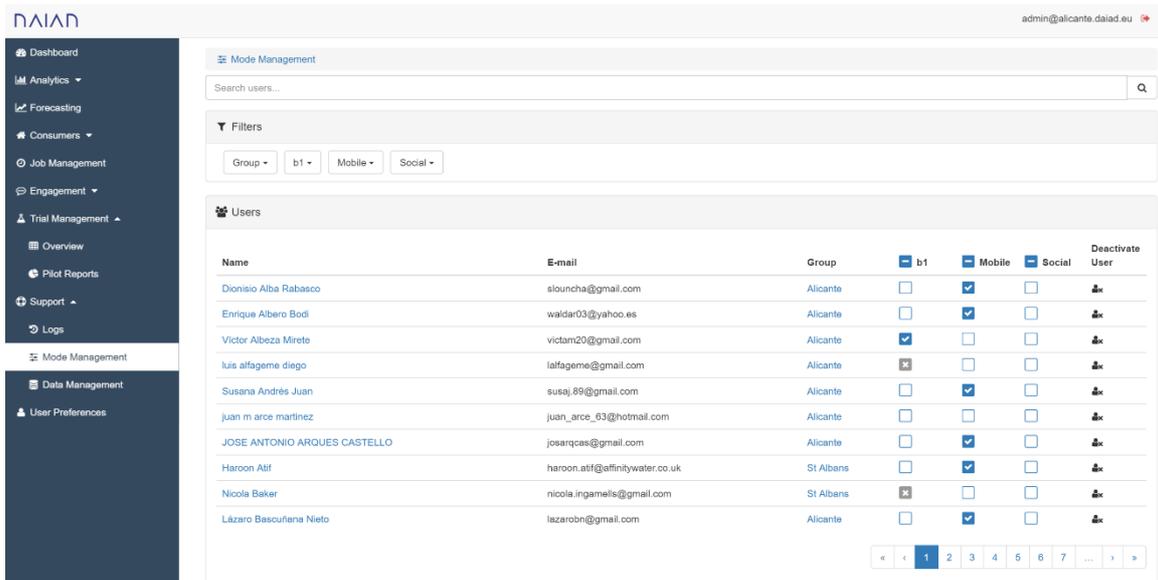


Figure 11: Mode Management

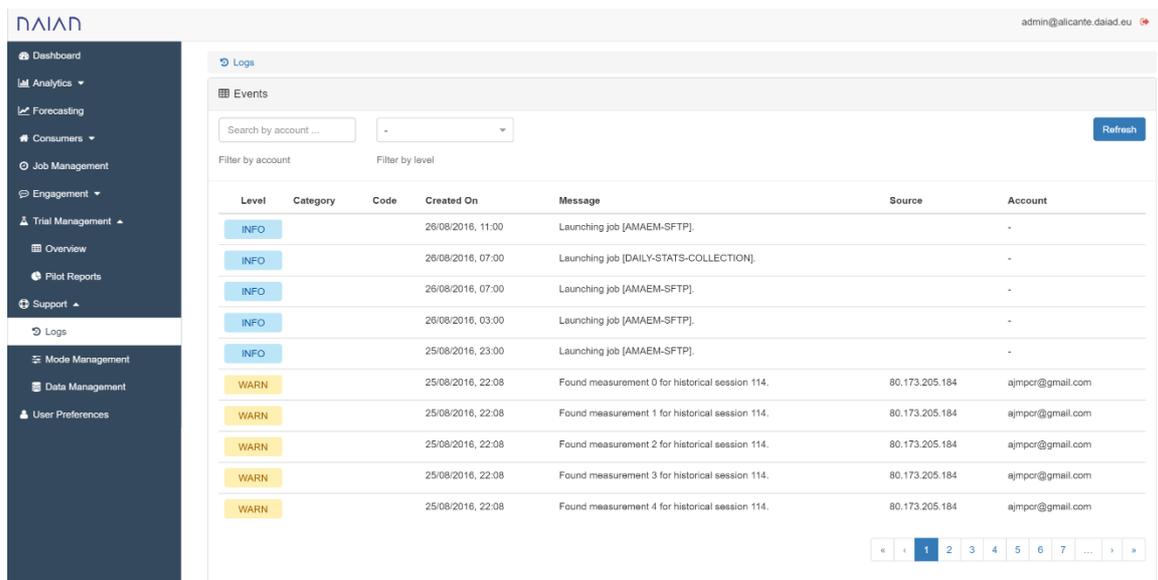


Figure 12: Detailed application logs

- **Trial Activity.** The service provides a high level overview regarding the progress of the entire Trial and its Phases. In summary, it offers a real-time status over the current Phase of all participants, search

facilities for a specific user (*based on name, surname, and email*), visualization services for a user's water consumption (*amphiro b1*), as well as download services for all water consumption data (*amphiro b1*) for a specific user in csv format. The latter is particularly important, as it allows us to easily monitor extractions during the installation steps, ensure the device operates within its working parameters, and identify potential communication or operation issues.

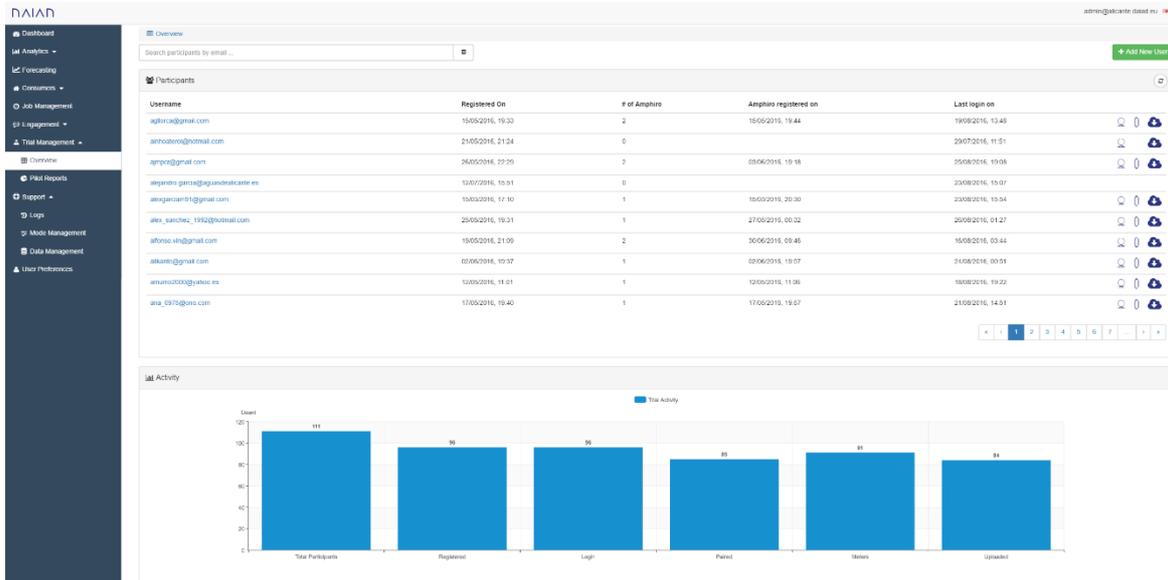


Figure 13: Trial activity

- User Activity. This services provides access to the complete information the system has for an individual user. This includes their profile (e.g. name, surname, email, address, gender, age, mobile phone/table OS), the groups they belong to (e.g. age, household size, number of members), the available data sources (only b1 for Trial B) with additional information for each one (e.g. device ID, last measurement, application mode, last communication), and finally an overview of their water consumption (amphiro b1) for the last 30 days.

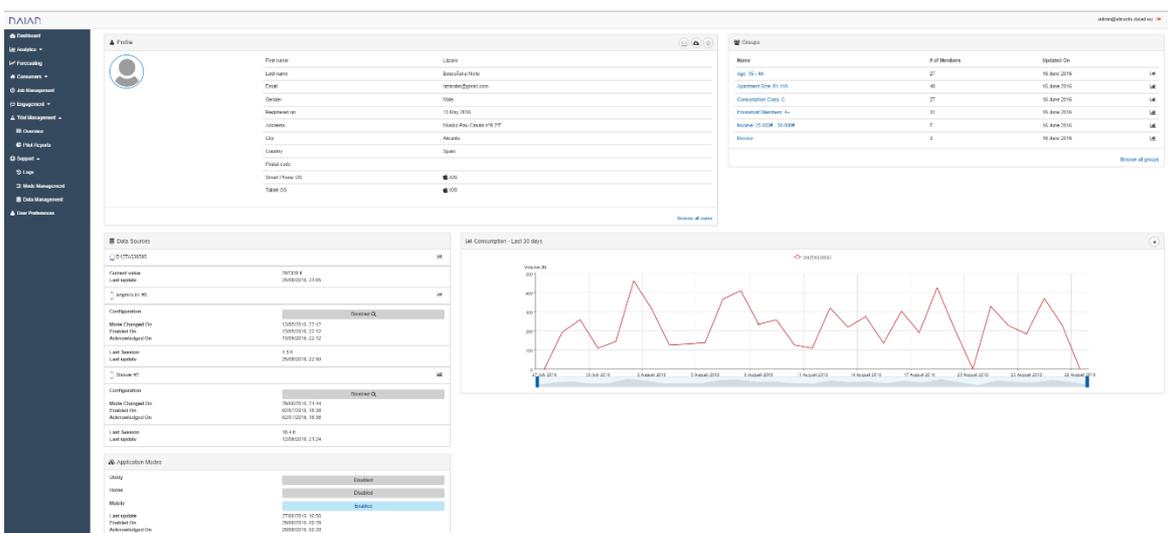


Figure 14: User activity

- Trial Reports. This service generates automatically all KPIs regarding the progress of the Trial on a monthly basis, facilitating the preparation of our internal Monthly Reports.

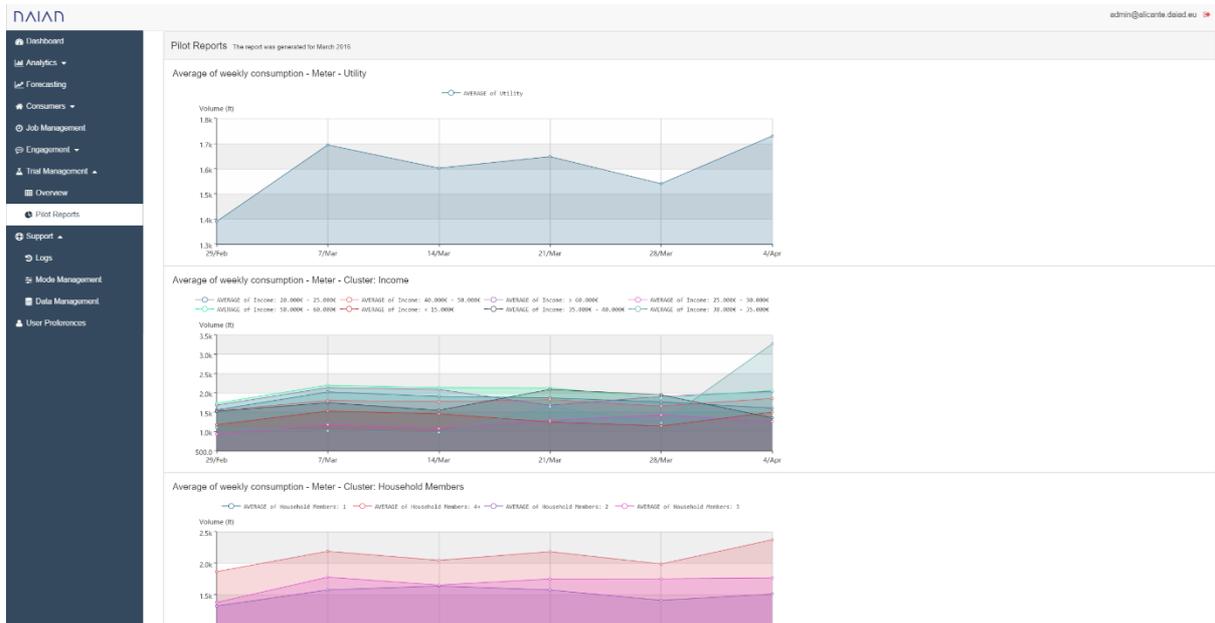


Figure 15: Trial reports

3. Trial Implementation and Evolution

Trial B officially started on 1st March 2016 (M25), after a one-year period of preparation and participant recruiting. In the following sections we present the evolution of the Trial on a *quarterly basis*, based on the internal Monthly Reports prepared by the Consortium during the actual implementation of the Trial. First, we briefly present our original planning for the timeline of the Trial established in M15. In the following subsections, we present for each quarter a summary of the Trial’s progress, the targeting of the reference period, all technical issues reported and the corresponding corrective actions, as well as any anticipated risks for the following month.

3.1. Original Planning

The Trial comprised **five (5)** treatment phases for the participating population spanning **nine (9) months**, as well as **three (3) months** as leeway to account for unforeseen delays. The planning of the Trial was established on M15 and served as our guideline for all relevant technical, organizational, and communication tasks.



Figure 16: Trial Original Timeline

Our original decision for a 12-month duration of the Trial was necessitated by the strong *seasonal* nature of water consumption. As extensively documented in the literature, domestic water use is affected by a number of factors, such as temperature, precipitation, holidays, etc. This critical detail is all too often neglected in similar studies, leading to *wrong* results which cannot be reproduced and thus applied in practice. In addition, it is important to emphasize that the timing and duration of the Phases correspond to the **minimum time a single participant** must spend in each Phase. Consequently, at any given point in time during the Trial’s duration, we may have consumers in more than one Phase. As explained in Section 2.3, DAIAD offers integrated facilities for *remotely* altering the mode of the system, for each individual consumer (i.e. ‘Mode Management’). This provided us with a very fine-grained control over the Phase each participant is in, and negates the need for synchronizing the treatment phases of the entire population. Our approach is another novelty in the study of water efficiency, as well as a major of advantage of DAIAD over other systems. The decision to follow this route was taken during M13 of the project and for the following reasons:

- The DAIAD Trials comprised multiple treatment phases, instead of just *one*, which is the norm for similar studies and projects. Instead of simply providing the system to all participants at the *same time* and studying its effects over a specific period (e.g., 3 months), our goal since the *inception* of the project was to study and compare *multiple* intervention types and approaches. This decision certainly perplexed the design, monitoring, and analysis of the Trial, but also significantly *increased its value*.

- Objectively studying and analyzing the effects of various water monitoring systems regarding water efficiency is a point of concern for the water sector, making reasoning about the effectiveness and real world adoption of ICT challenging. As mentioned previously, the vast majority of relevant studies cannot be objectively validated and reproduced. Consequently, we decided to integrate facilities for performing arbitrary treatment studies within DAIAD itself, enabling stakeholders to perform their own water efficiency studies in terms of interventions, participants, duration, etc. At a later stage, our business monitoring activities in the context of WP8 revealed that the few ICT systems competing with DAIAD offer similar, yet narrower functionality, thus affirming our original decision.
- Our partners Amphiro and UNI BA have performed numerous similar studies in the past, comparing the effectiveness of various interventions types (*A-B, multi-variate testing*). A critical observation and knowhow from these studies concerned the extreme difficulty for ensuring all participants were synchronized across the various treatment phases. The real-world challenges in coordinating *volunteers* into performing simple, yet time-critical steps (*e.g. download a new app, take a shower*) while simultaneously managing technical issues (*e.g. sensor malfunction*), leads to significant delays, constant timeline adjustments, user frustration (*also leading to drop-outs*), and hinders data post-processing. With the DAIAD system being much more complex, we anticipated these problems to significantly increase.

The planned Phases of the Trial and their duration are as follows:

- **Phase 1 (1.5 months).** This phase is focused on validating the proper installation of the DAIAD system (*hardware and software*) from consumers, providing any assistance if needed. Further, during this phase we collect baseline shower use data for all participants. As analyzed in Section 2.2.1, as soon as a consumer successfully initializes the DAIAD system, she enters the system's 'Learning mode'. On average, this selected duration would allow us to establish a baseline of at least 40 showers per household, which is in line with similar studies we have performed in the past.
- **Phase 2 (2 months).** During this phase we compare the effectiveness of analytical vs. real-time feedback. The extended duration of this phase is required for two reasons. First, it would be the first actual experience consumers would have using the DAIAD system. Second, it studies a critical issue for water efficiency. Real-time interventions for water use have been shown from other studies to be more effective than analytical interventions. However, real-time interventions are significantly more expensive to provide and challenging to roll-out in the entire population. In contrast, analytical interventions are easier and less expensive to offer, but less effective.
- **Phase 3 (1 month).** During this phase all participants gained access to the entire DAIAD functionality, with the exception of social comparisons. The one month duration was considered adequate, as participating consumers would already be familiar with the DAIAD system, and simply be exposed to one additional type of intervention.
- **Phase 4 (2 months).** During this phase we established a control group and provided the remaining consumers access to social comparisons. The expanded duration of the phase was required by its particular focus. Interventions tapping into social norms and gamification have been validated in other domains as strong influences of personal behavior. However, ample time is required for the

'social effect' to take place; competing against others, setting collective goals, and allowing a sense of *community* to form, cannot be rushed.

- **Phase 5 (1.5 months).** During this phase all consumers gained complete access to the DAIAD system.

An extra 3 months were budgeted as leeway to address any unforeseen delays or issues affecting the implementation of the Trial. These months were to be used to expand particular Trial Phases or test additional interventions.

3.2. Quarter 1

3.2.1. Period summary

The DAIAD Trials officially started on 1st March 2016, after a year-long period of preparation and participant recruiting. During this period, our efforts have been focused on the distribution of DAIAD's hardware (amphiro b1), the provision of support to participants for downloading, installing and initializing the DAIAD mobile application, as well as on the management of any organizational and technical issues related to the initialization of the DAIAD system.

The distribution and initialization of the DAIAD system has been completed at the end of this period, with all participants successfully entering the Phase 1 of the Trial. However, we have experienced a number of delays and issues regarding the installation and initialization of the DAIAD system, mostly attributed to the participant's availability and schedule considerations. In summary, DAIAD hardware was distributed to St Albans participants either in an 'equipment pick-up' event at the Civic Centre of the St Albans City and District Council, or by post service. For many participants the deliveries were rescheduled multiple times after their own request, introducing a delay of 2-4 weeks per case. Further, a number of participants (~20%) did not respond to our communications for receiving their equipment or installing it at their residences. After waiting at least 2 weeks after our last communication, we successfully replaced these participants with others from our pool.

In terms of technical issues, their majority concerned the low flow of water in the area of St Albans (see Issues for details), which resulted into affected users (5) requesting to be removed from the Trial. In summary:

- *Low local water flow.* This issue was gradually analyzed, with its cause determined, in a gradual manner following a series of communications with users. Specifically, the first user contacted us by email informing us that the major problem she is facing concerns the *reduction of water flow when attaching the amphiro b1* at the showerhead. We informed the user that a *slight drop* in water pressure is expected, since the energy powering the amphiro b1 is harvested by water flow. To determine the exact cause (*malfunctioning b1, low water pressure in the area*) we provided the user with simple instructions in order to measure the water flow in her shower (*with and without the amphiro b1*).

In subsequent communications, and as more users reported similar problems, we reached the conclusion the issue is not caused by a potential b1 malfunction. After examining all reported cases, we have concluded that the problems were *localized* to consumers with an already *very low water flow*

in their households (<6 lt/min). For example, one user reported that the amphiro b1 device: “*reduced water pressure in the shower by about 50%, meaning that it the shower became effectively unusable*”, while another mentioned that “*our water pressure is not that great, so that might be the course of the problem*”.

Unfortunately, addressing these low-flow scenarios is not practically feasible with current technologies (*mechanical-based*), but an open research topic for new types of microelectronic sensors. To account for the increased number of drop-outs we organized a number of communication activities to recruit additional participants. In addition, these findings were forwarded to Amphiro, initiating a new round of line of work for the final version of the micro-generator employing static bypasses to cope with exceptionally low flow-rates

- *Amphiro b1 malfunction*. For 4 b1 devices, the integrated BT radio of the b1 would not work, or operate intermittently. The result was failure to complete the pairing process, dirty data, or complete failure to transmit real-time water consumption data.

In terms of anecdotal information, the increased communication and interaction with Trial participants during this period was a source of great informal feedback. Although Phase 1 (i.e., Learning mode) is *essential* for baseline data collection, and the Trial’s timeline was clearly communicated to participants (see Annex 2 – Trial Guides), their feedback suggested they were *very impatient* and expected to start using their newly installed devices and mobile app *immediately*. While a similar feeling of *anticipation* was observed in Trial A, the local population in St Albans was even more *vocal* in its critique. In the context of our local events and gatherings we even received unjustified *negative comments* (e.g., ‘Why not start with the full functionality available?’) with little room for understanding, despite our best efforts to remind the planned phases and timeline of the Trial, for which the users provided their explicit consent during the recruiting process. We can only attribute this behavior in local attitudes and accept them as an important insight for organizing similar large-scale studies in the future. In addition, this led us to consider an expansion of Trial A or Trial B with users having *immediate access* to the entire DAIAD functionality (i.e., a production roll-out), without involving the interim phases of our experimental protocol.

Finally, the end of Q1 finds the Trial *delayed by 2 months* compared to our original schedule. It is important to highlight such delays were anticipated already by the planning phase of Trial, by budgeting 4 months as a leeway in case of technical and/or organizational difficulties. Consequently, the overall picture regarding the progress of the Trial in the course of this period remains positive.

3.2.2. KPIs

In this section we provide the evolution of select KPIs presenting the progress of the Trial B in Q1, highlighting specific periods and/or events of particular interest.

3.2.2.1. Participants per Phase

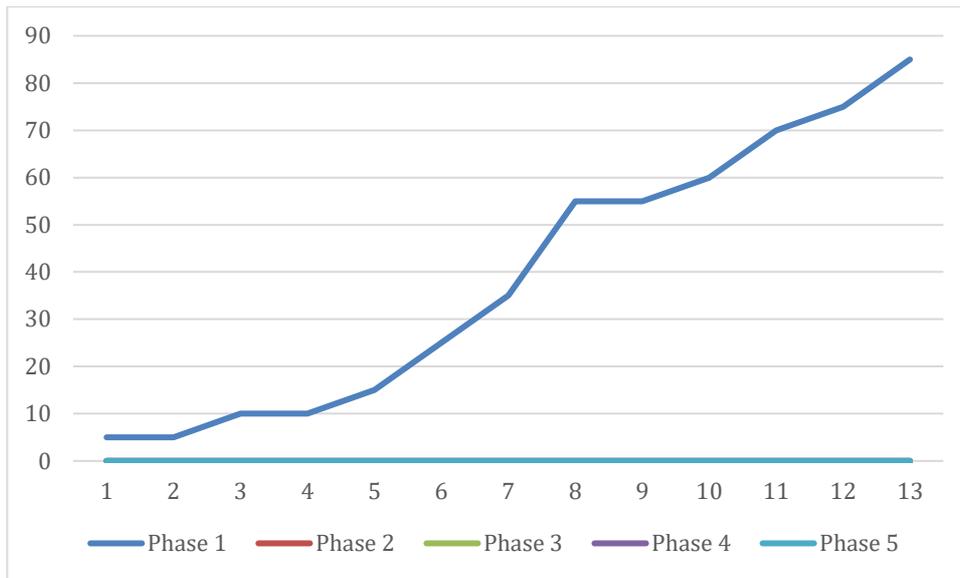


Figure 17: Distribution of participants per phase during Q1 (Y axes: % of panel population; X axes: week in Quarter 1)

The installation and initialization of the system (Phase 1) progressed at a lower rate than anticipated due to the issues encountered by participants, which are elaborated on the next section, as well as their high latency in replying to our support inquiries. However, by the end of Q1 all participants had successfully entered Phase 1 of the Trial.

3.2.2.2. Water Consumption (shower)

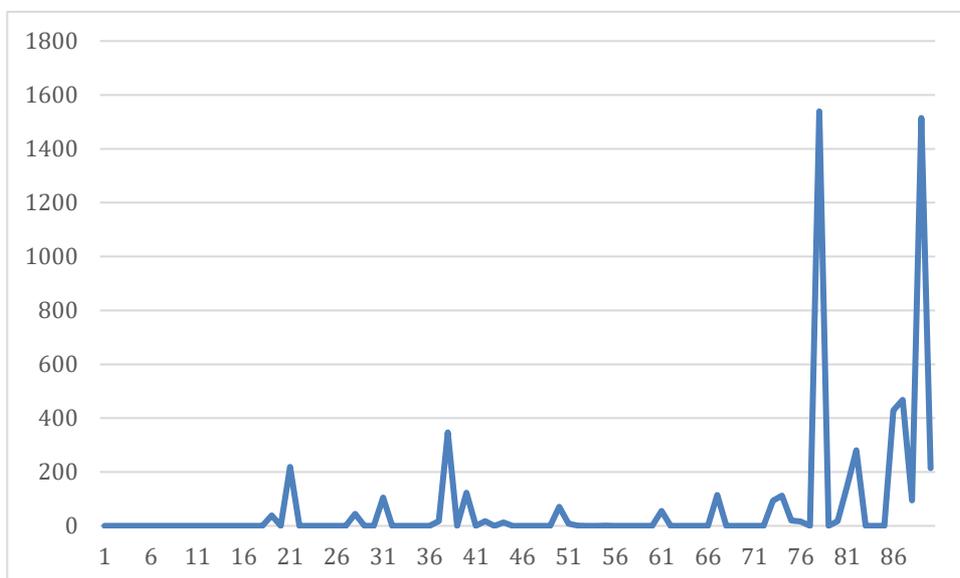


Figure 18: Total daily shower consumption for Q1 (liters) (Y axes: total water consumption in liters; X axes: day in Quarter 1)

With all consumers in Phase 1, the transmitted shower use from the amphiro b1 devices is expectedly very low (also see next KPI). As analyzed in Deliverable D1.2, shower events are transmitted from the b1 devices in an opportunistic manner. When the user's mobile device is within working BT range of the b1 during a

shower, then we receive the real-time shower information (*i.e.*, a full time-series of water, temperature and flow) along with historical shower data stored within the b1 (*i.e.*, shower events not captured in real-time). Specifically, in Phase 1 the system provides no interventions (*mobile and b1 displays are off*) so the users due to lack of familiarity and incentive, largely do not have their mobile devices in proximity of the b1 during a shower.

3.2.2.3. Shower events

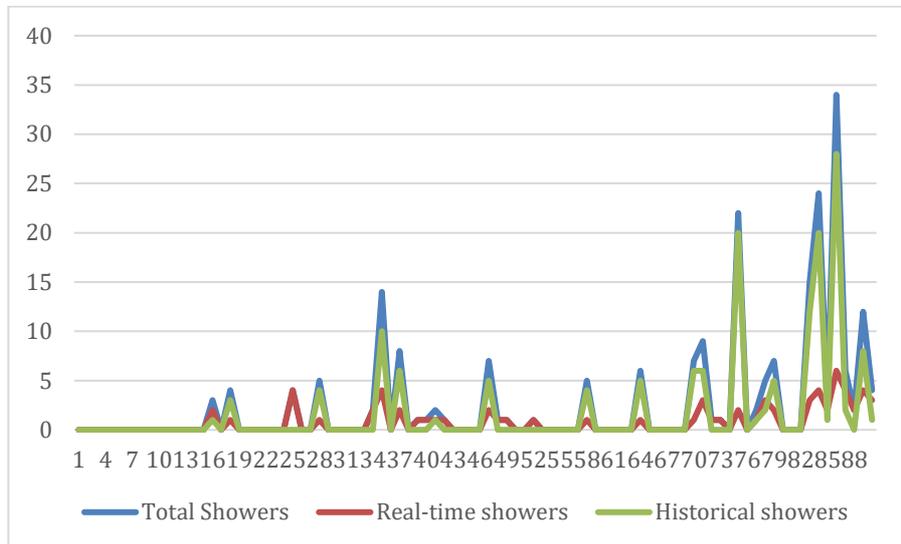


Figure 19: Shower events (total, real-time, historical) for Q1 (Y axes: number of shower events; X axes: day in Quarter 1)

During this period, we captured in total 202 shower events, of which 60 are real-time shower events and 142 historical shower events. For the reasons explained in the previous sub-section, we can observe the low number of transmitted shower events during Phase 1.

3.2.2.4. Amphiro b1 malfunctions

During this period, there were four (4) reported malfunctions out of the 47 deployed b1 devices.

3.2.2.5. System availability (uptime)

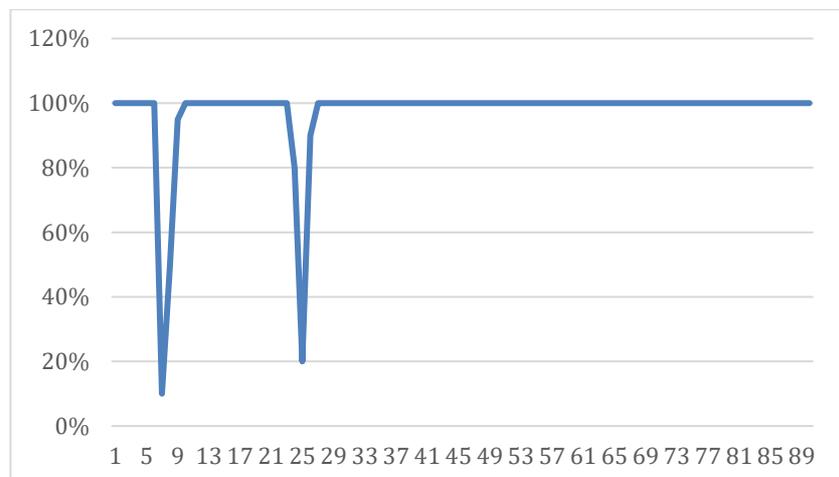


Figure 20: Daily system availability (% of time within a day system was available) (% of time within a day system was available) (Y Axes: % of system availability; X axes: day in Quarter 1)

All interruptions in the system’s availability during Q1 were *scheduled* down-times (maintenance/upgrades).

3.2.3. Issues

The following table presents the issues we addressed during Q1 of Trial B, and the corrective steps we took in in order to explore, analyze, and address them.

ID	Date	Problem Description	Corrective Steps
1	23/03/2016	<ul style="list-style-type: none"> • Sign-up problem. <p>A user contacted us by email reporting that she could not sign up in DAIAD’s mobile application.</p>	<p>The issue was caused by a delayed transfer of the participant’s details in the Trial’s Whitelist. This process is manual in order to ensure that all participants have responded in both required surveys, have responded to email communication, and that they fully satisfy the minimum requirements (technical, demographics, etc.) for our study. As a result, delays of 1-2 working days in manually importing a participant in the DAIAD Whitelist are expected. The participant was imported in our Whitelist and notified to proceed with the Sign Up process.</p>
2	24/03/2016	<ul style="list-style-type: none"> • Malfunctioning amphiro b1. <p>A user contacted us by email reporting a problem connecting the b1 with the DAIAD mobile app during the initialization steps. The user also informed us that the amphiro b1 sometimes does not register temperature correctly and shows 0 degrees throughout the duration of a shower.</p>	<p>We provided the user with suggestions to address the most common technical issues. However, the user responded that the problems persisted, even after trying it in two separate devices (Moto G 2013 smartphone, Nexus 7 2013 tablet). In the following, we tested the pairing process in two mobile devices <i>identical</i> to the ones used by the participant, but the problem could not be reproduced. As such, we reached the conclusion that the b1 is malfunctioning, informed the user that the b1 will be replaced, and arranged the shipping of the device to examine the cause of the problem. The original b1 device has been returned to the Consortium and carefully studied, confirming our suspicions for a hardware problem caused during assembly.</p>
3	02/04/2016	<ul style="list-style-type: none"> • Malfunctioning amphiro b1. <p>A user contacted us by email reporting a problem connecting</p>	<p>We provided the user with suggestions to address the most common technical issues. However, the user responded that the problems persisted, even after testing it with</p>

		the b1 with the DAIAD mobile app during the initialization steps.	other devices. We informed the user that the b1 will be replaced and arranged the shipping of the malfunctioning device to examine the cause of the problem. The user finally reported that the new b1 successfully connected with the mobile device.
4	05/04/2016	<ul style="list-style-type: none"> • Unsupported Android device. <p>A user contacted us by email reporting a problem connecting the b1 with the DAIAD mobile app during the initialization steps.</p>	After providing the user with suggestions to address the most common technical issues, the user responded that none of the available mobile devices satisfy the minimum requirements for the DAIAD mobile application (i.e. Android 5.0, Bluetooth 4.0). We decided to allow the participant to remain in the pilot and informed her that periodically a Consortium member will arrange visits to collect her historical water consumption data.
5	05/04/2016	<ul style="list-style-type: none"> • Sign-in problem. <p>A user contacted as by email reporting a problem signing-in the DAIAD app after uninstalling and installing it.</p>	This was not caused by a technical issue, but from the user selecting 'Sign Up' (i.e. create an account) rather than correctly proceeding with 'Sign-in'. We gave the user detailed instructions on how to correctly 'Sign-in' the DAIAD app.
6	08/04/2016	<ul style="list-style-type: none"> • Bluetooth connection problem / Low water pressure. <p>A user contacted us by email reporting a problem connecting the b1 with the DAIAD mobile app during the initialization steps.</p>	<p>We provided the user with suggestions to address the most common technical issues. The user did not provide us with any feedback. Further, no user activity was captured from our monitoring services, indicating that the user has not successfully paired the b1.</p> <p>We contacted the user again by email and she responded that the major problem she is facing is the reduction of water flow when attaching the amphiro b1 at the showerhead. We informed the user that a slight drop in water pressure is expected, since the energy powering the amphiro b1 is harvested by water flow. The perceived great reduction in water flow could be caused by the b1, from an already low water pressure in the area. Towards this, we provided the user with simple instructions in order to measure the water flow in her shower (with and without the amphiro b1). The user responded that she will follow up</p>

			with her findings and acknowledged that <i>'our water pressure is not that great, so that might be the course of the problem'</i> .
7	08/04/2016	<ul style="list-style-type: none"> Malfunctioning amphiro b1. <p>A user contacted us by email and reported a problem connecting the b1 with the DAIAD mobile app during the initialization steps.</p>	<p>We provided the user with suggestions to address the most common technical issues. However, the user responded that the problems persisted, even after trying on a different smartphone.</p> <p>We informed the user that the b1 will be replaced and arranged the shipping of the malfunctioning device to examine the cause of the problem. After a few weeks, no user activity has been captured from our monitoring services, indicating that the user has not successfully paired the new b1 (i.e. the replacement).</p> <p>We contacted the user by email and she responded that she had not yet received the new amphiro b1. We re-scheduled the post service delivery of the b1. In the following days we observed from our monitoring UI that the user has successfully completed the pairing process.</p>
8	08/04/2016	<ul style="list-style-type: none"> Forgotten password. <p>A user contacted us by email and reported that she has forgotten her password and could not sign in the DAIAD app.</p>	<p>We reset the user status to 'Unregistered' in the DAIAD system. After providing the user with instructions to proceed with the 'Sign Up' process, create a new password and note it down, we confirmed from our monitoring services that she has successfully signed up the DAIAD system.</p>
9	11/04/2016	<ul style="list-style-type: none"> DAIAD app problem. <p>A user contacted us by email reporting a problem using the DAIAD app and the website FAQs.</p>	<p>This was caused by a scheduled maintenance of the DAIAD cloud infrastructure during non-working hours (6h total downtime). We contacted the user the following day explaining the cause of the issue and inviting her to use the DAIAD app.</p>
10	12/04/2016	<ul style="list-style-type: none"> Pilot drop-out. <p>A user contacted us by email informing about her intention not to participate in the pre-pilot survey.</p>	<p>We reminded the user that the completion of the pre-pilot survey was a requirement for her participation in the pilot, explaining once again (a) the critical nature of this data for our study, (b) the strictly confidential management of her data from the Consortium. However, the user</p>

11			continued to object to these terms and opted to be removed from the Trial. The equipment was returned and allocated to another participant within 3 weeks.
	15/04/2016	<ul style="list-style-type: none"> Unsupported iOS device. <p>A user contacted us by email reporting a problem connecting the amphiro b1 with her mobile device (iPhone 6s).</p>	We provided the user with suggestions to address the most common technical issues. The participant reported that the problem persisted after having followed all the given instructions. We have addressed this issue in a new version of the iOS mobile app, and expanded on the device-specific prototype and testing regime to include high-end iOS devices (<i>up to iPhone 5s previously</i>).
12	18/04/2016	<ul style="list-style-type: none"> Usage of Amphiro app. <p>A participant contacted us by email reporting that her amphiro app has recorded only a few showers.</p>	We informed the user that she is required to install the DAIAD mobile application, rather than Amphiro's application (available since 2014). After a few weeks, no user activity has been captured from our monitoring services, indicating that the user has not successfully paired the amphiro b1 with her mobile device. A follow-up email was sent to the user. In the following days we observed from our monitoring UI that the user has successfully completed the pairing process.
13	18/04/2016	<ul style="list-style-type: none"> Bluetooth connection problem. <p>A participant contacted us by email reporting a problem connecting the amphiro b1 with the mobile device.</p>	We provided the user with suggestions to address the most common technical issues. Further, no user activity has been captured from our monitoring services, indicating that the user has not successfully paired the b1. A follow-up email was sent to the user. In the following days we observed from our monitoring UI that the user has successfully completed the pairing process.
14	18/04/2016	<ul style="list-style-type: none"> Low water pressure / Pilot drop-out. <p>A user contacted us by email informing us about her intention not to use the amphiro b1 due to a perceived reduction in water flow in her shower.</p>	<p>The user reported that the amphiro b1 device: <i>"reduced water pressure in the shower by about 50%, meaning that it the shower became effectively unusable. I am therefore unable to use the device (most unfortunately)"</i>.</p> <p>We thanked the user for her participation and instructed her to return the amphiro b1 device for examination. Further, we replaced her with another participant from our pool. However,</p>

			should the device prove malfunctioning, we will send her a new device and re-include her in the pilot.
15	19/04/2016	<ul style="list-style-type: none"> Data transmission problem. <p>A user contacted us by email reporting that her mobile device cannot be connected with the amphiro b1.</p>	We provided the user with suggestions to address the most common technical issues. In the following days we observed from our monitoring UI that the user has successfully completed the pairing process.
16	19/04/2016	<ul style="list-style-type: none"> Wi-Fi connectivity issues. <p>A user contacted us by email reporting that during initialization, the DAIAD app disconnects the mobile device from the Wi-Fi and prevents Wi-Fi access until the app is being terminated.</p>	We provided the user with suggestions to address the most common technical issues. The participant uninstalled/reinstalled the DAIAD app and reported that the problem was solved. Upon further analysis, we located the issue at the non-standard BT API implementation of the particular version of the Android kernel, which caused intermittent Wi-Fi connectivity problems when the BT was in specific modes of operation. This particular problem was addressed at a later version of the Android OS.
17	04/05/2016	<ul style="list-style-type: none"> Water leaks / low water pressure / participant drop-out. <p>A user contacted us by email reporting that she observed water leaks in the plastic casing of the amphiro b1; these caused condensation inside the LCD, ultimately leading to its malfunction.</p>	We instructed the user to install additional O-rings (included in the package) to minimize water leaks in both water connections of the device. The user reported that the problem persisted and we informed her that we will replace the malfunctioning device in order to examine the cause of the problem. After a few days, the user informed us that the replacement amphiro b1 reduced water flow in her shower considerably, to the point of her not being able to use the device. As such, she requested to be removed from the Trial and return the device. The equipment was returned and allocated to another participant within 3 weeks.
18	05/05/2016	<ul style="list-style-type: none"> Low water pressure. <p>A user contacted us by email informing us that the water flow in her shower has reduced significantly after installing the amphiro b1, thus making difficult the use of shower head.</p>	We informed the user that a slight drop in water pressure is expected, since the energy powering the amphiro b1 is harvested by water flow. The perceived great reduction in water flow could be caused by the b1, from an already low water pressure in the area. Towards this, we provided the user with simple

19			instructions in order to measure the water flow in her shower (with and without the amphiro b1). After a few days, she responded us that she will try the suggestions and inform us be email.
	10/05/2016	<ul style="list-style-type: none"> Usage of Amphiro app. <p>A participant contacted us by email reporting that her mobile app has recorded only a few showers.</p>	We informed the user that she is required to install the DAIAD mobile application, rather than Amphiro's application (available since 2014). After a few weeks, no user activity has been captured from our monitoring services, indicating that the user has not successfully paired the amphiro b1 with her mobile device. A follow-up email was sent to the user. In the following days we observed from our monitoring UI that the user had successfully completed the pairing process using DAIAD's mobile app.
	12/05/2016	<ul style="list-style-type: none"> Water leak / unsupported device. <p>A user contacted us by email reporting that she observed leakage from the top bit of the amphiro b1 attached to the shower head.</p>	<p>We informed the user that the b1 will be replaced and arranged the shipping of the malfunctioning device to examine the cause of the problem. She reported us that she received the replacement. However, after a few weeks, no user activity had been captured from our monitoring services, indicating that she had not successfully paired the replacement amphiro b1 with her mobile device.</p> <p>We contacted her by email and she responded that her mobile device could not be connected with the amphiro b1. We provided the user with suggestions to address the most common technical issues, which revealed that the user has installed the app in an unsupported device (Samsung S2). We reminded the user the minimum requirements for the DAIAD mobile application (i.e. Android 5.0, Bluetooth 4.0). The participant reported that she used a compatible mobile device which was successfully paired with the amphiro b1.</p>
21	12/05/2016	<ul style="list-style-type: none"> Low water pressure / drop-out. <p>A user contacted us by email informing about her intention</p>	We informed the user that a slight drop in water pressure is expected, since the energy powering the amphiro b1 is harvested by water flow. The perceived great reduction in water flow could

		not to use the amphiro b1 due to a perceived reduction in water flow in her shower.	be caused by the b1, from an already low water pressure in the area. The user reported us that in their residence there is no sufficient water pressure to cope with the resistance introduced by amphiro b1. Consequently, she requested to be removed from the Trial and return the device. The equipment was returned and allocated to another participant within 3 weeks.
22	12/05/2016	<ul style="list-style-type: none"> Pairing problem. A user contacted us by email reporting that her mobile device cannot be paired with the amphiro b1.	We provided the user with suggestions to address the most common technical issues. The user reported us that she uses the amphiro b1 in the household and showers have become competitive among household members but she still faces problems with the pairing. In the following days we observed from our monitoring UI that the user has successfully completed the pairing process.
23	20/05/2016	<ul style="list-style-type: none"> Pairing problem. A user contacted us by email informing us that she faced problems entering the amphiro b1 codes.	We provided the user with detailed instructions to successfully enter the pairing codes into the respective fields. She replied that the problem was resolved and that she had successfully paired the device.
24	24/05/2016	<ul style="list-style-type: none"> Unsupported device. A user contacted us by email reporting a problem connecting the amphiro b1 with her mobile device.	We provided the user with suggestions to address the most common technical issues, which revealed that the user has installed the app in an unsupported device (iPad2). We reminded the user the minimum requirements for the DAIAD mobile application (i.e. Android 5.0, Bluetooth 4.0). The participant reported that she used a compatible mobile device which was successfully paired with the amphiro b1.
25	25/05/2016	<ul style="list-style-type: none"> Pairing problem. A user contacted us by email and reported that she could not pair her mobile device with amphiro b1.	We provided the user with suggestions to address the most common technical issues. She responded that she had successfully paired her mobile device and the problem was resolved.
26	26/05/2016	<ul style="list-style-type: none"> Unsupported iOS device. A user contacted us by email reporting a problem connecting the amphiro b1 with her mobile device.	We provided the user with suggestions to address the most common technical issues, which revealed that the user has installed the app in an unsupported device (iPad2). We reminded the user the minimum requirements for the DAIAD mobile application (i.e. Android

27			5.0, Bluetooth 4.0). The participant reported that she used a compatible mobile device which was successfully paired with the amphiro b1.
	26/05/2016	<ul style="list-style-type: none"> • Low water pressure / drop-out. <p>A user contacted us by email informing us about her intention not to participate in the pilot due to the reduction in water flow.</p>	We informed the user that a slight drop in water pressure is expected, since the energy powering the amphiro b1 is harvested by water flow. The perceived great reduction in water flow could be caused by the b1, from an already low water pressure in the area. The user reported us that in their residence there is no sufficient water pressure to cope with the resistance introduced by amphiro b1. Consequently, she requested to be removed from the Trial and return the device. The equipment was returned and allocated to another participant within 3 weeks.

Table 2: Issue Tracking Q1

3.2.4. Risks

We anticipate the following risks for the next period of the Trial.

ID	Risk	Contingency Plan
1	Low participation in the St Albans trial	<p>The risk is important, due to the <i>volunteer and bottom-up nature</i> of the St Albans trial. The Consortium has limited means to ensure participants actually install and use the DAIAD system, as it depends on their own schedule and preferences.</p> <p>We will be using the remote administration and monitoring facilities of DAIAD to daily evaluate progress, communicate by email with users to remind them of their responsibilities for the pilot, and in parallel, continue with our recruiting activities. Should a participant fail to respond after repeated communication after 2 weeks, we will replace her with another participant from our pool of candidates.</p> <p>This type of delays and replacements have been anticipated and addressed from our pilot methodology and the DAIAD system itself. The management of the pilot phases (<i>e.g. learning</i></p>

		<i>mode, b1 active, all system active</i>) can be managed on <i>an individual user basis</i> , ensuring data and results and be reconciled at a later stage.
2	Malfunctioning b1 devices	The risk is small, as currently more than 94% of the distributed devices operate trouble-free. We will be monitoring the pilot for any technical issues, replace the devices when needed, and study them to identify any systematic technical problems.
3	Delays in the Whitelist update process	The risk is small as it relates only to the next period, and may affect at most 3-5 users. We have accelerated the manual approval process, but we will not automate it completely (<i>although it is technically feasible</i>).
4	Reduction in water flow caused by the Amphiro b1	<p>The risk is high, with 10% of the participants observing a considerable water flow reduction (as much as 50%) after having attached the amphiro b1 device. More importantly, this has led to participants requesting to be removed from the Trial, as the low flow makes showering, and thus the use of amphiro b1, practically impossible.</p> <p>We have carefully examined these cases to identify the causes and used the remote monitoring facilities of DAIAD to assess the average water flow of our participants compared to the literature, as well as through in-situ measurements. In laboratory testing the current version of b1 leads to a reduction in water flow by 20-30%, which is within acceptable operational parameters.</p> <p>After examining all reported cases, we have concluded that the problems were <i>localized</i> to consumers with an already <i>very low water flow</i> in their households (<6 lt/min). This means that the use of the b1 reduced water flow to <i>less than 4lt/min</i>, which had two effects: (a) reduce water flow, making showering uncomfortable, and (b) reduce the energy harvested from the b1, making its operation impossible.</p>

Unfortunately, addressing these low-flow scenarios is not practically feasible with current technologies (*mechanical-based*), but an open research topic for new types of microelectronic sensors. To account for the increased number of drop-outs we organized a number of communication activities to recruit additional participants. In addition, these findings were forwarded to Amphiro, initiating a new round of line of work for the final version of the micro-generator employing static bypasses to cope with exceptionally low flow-rates.

Table 3: Risks Q1

3.3. Quarter 2

3.3.1. Period summary

During this period, our efforts were focused on providing technical support to participants and collecting their feedback. It has been a considerably *less intense* period compared to Q1 in terms of reported technical issues, but quite demanding to ensure the continued engagement of our participants and the recruiting of additional members to replace drop-outs.

As already observed in Q1, participants were vocally *impatient* and wanted to *gain full access* to DAIAD. This meant that we had to keep reminding our panel the specific purpose and scope of the experimental study (*as established already from their recruiting and communicated via email*), advising them to be patient, and keeping them engaged. The few technical issues reported were again largely caused by users expecting the complete functionality of DAIAD to be available, regardless of the specific Phase they were in. Again, we had to *nudge* the users towards respecting the experimental protocol and reassure that they would have full access to the DAIAD system according to the original schedule.

Overall, the continued mix of anticipation and lack of cooperation regarding the timeline of the Trial was particularly interesting, confirming our initial evaluation of the local population in terms of its ‘innovation potential’ (see section 2.1.1), as well as the potential impact of *bottom-up* innovation for personal water monitoring technologies. The direct comparison with Trial A reveals a large difference in consumer attitudes and expectations when the introduction of this innovation is managed by a water utility. We expect these findings to hold true in the remaining periods, confirming our early insights regarding the need for engaging water utilities in the introduction of personal water monitoring technologies at this stage of their lifecycle.

Finally, the end of Q2 finds the Trial *delayed by 2 months* compared to our original schedule. As explained, such delays were anticipated already by the planning phase of Trial, by budgeting 4 months as a leeway in

case of technical and/or organizational difficulties. Consequently, the overall picture regarding the progress of the Trial in the course of this period remains positive.

3.3.2. KPIs

In this section we provide the evolution of select KPIs presenting the progress of the Trial B in Q2, highlighting specific periods and/or events of particular interest.

3.3.2.1. Participants per Phase

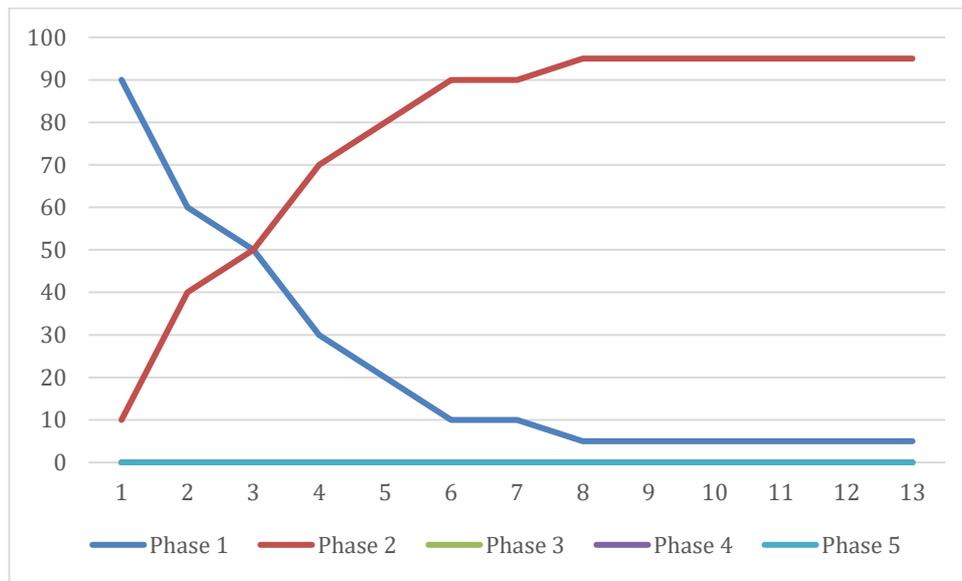


Figure 21: Distribution of participants per phase during Q2 (Y axes: % of panel population; X axes: week in Quarter 2)

The progression of all Trial participants towards Phase 2 continued during the first weeks of Trial A and was completed by week 9. As explained in the previous sections, in Phase 2 our participants were split into two groups, with the first gaining access only to real-time interventions (i.e., b1 display ON) and with the second gaining access only to diagnostic interventions (i.e., mobile app ON).

3.3.2.2. Water Consumption (shower)

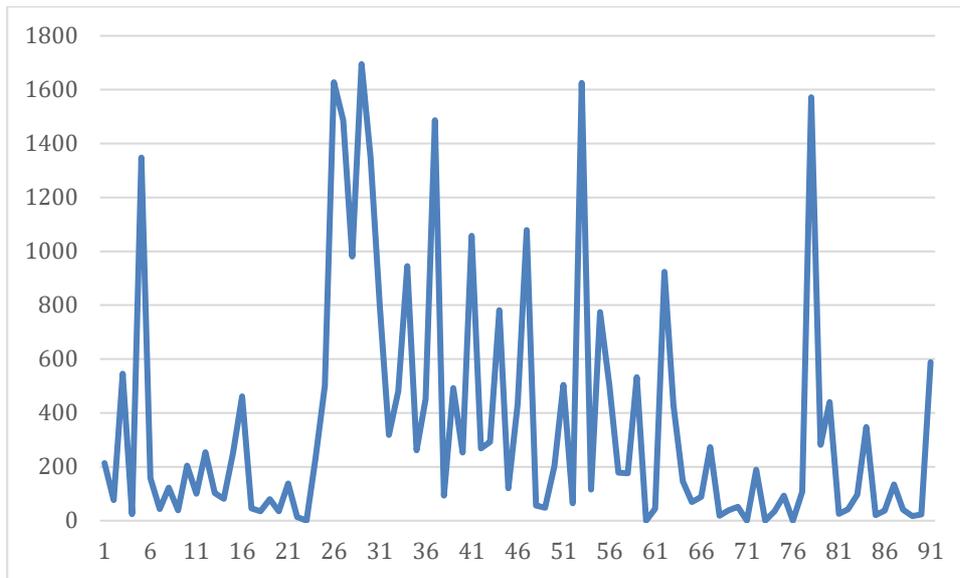


Figure 22: Total daily shower consumption for Q2 (liters) (Y axes: total shower consumption in liters; X axes: day in Quarter 2)

The daily volume of transmitted showers from our Trial participants rapidly increased as expected, with visible peaks following 26-32, during which a new app update increased the throughput for receiving historical showers (*hence a high number of historical showers were retrieved these days*). Upon further inspection, the time-series also provides insight into the delayed update of the mobile app from our participants (*up to 8 weeks*) compared to Trial A, with peaks (i.e., use of the updated version of the app) apparent practically till the end of the period.

3.3.2.3. Shower events

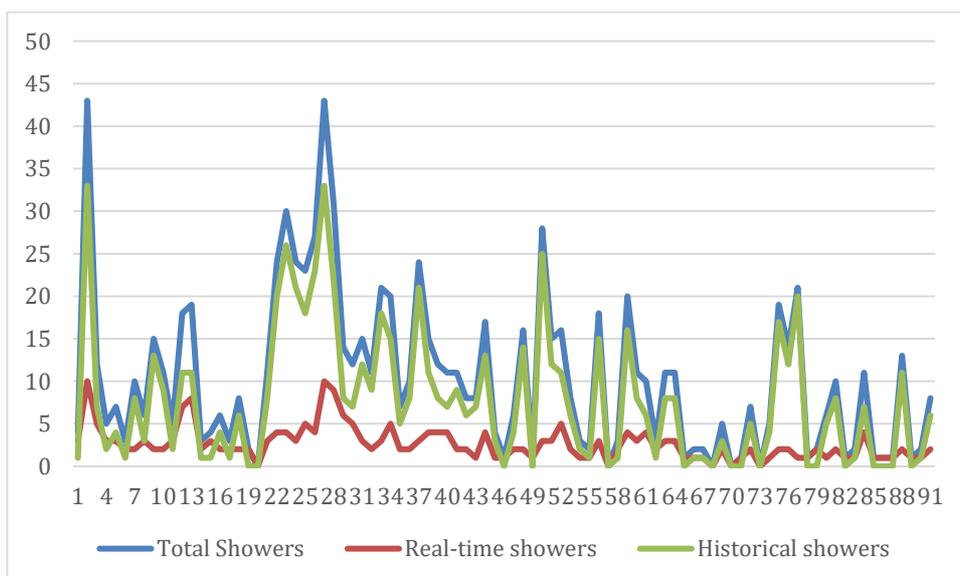


Figure 23: Shower events (total, real-time, historical) for Q2 (Y axes: number of shower events; X axes: day in Quarter 2)

During this period, we captured in total 940 shower events, of which 243 are real-time shower events and 697 historical shower events. As we can observe, the number of historical showers increased after the introduced mobile app update mentioned in the previous section, and is directly responsible for the increase in total shower events (*real-time showers remained practically stable throughout the period*). In addition, we observe the very low ratio of real-time showers vs. historical showers, implying that the participants of Trial B only seldom had their mobile devices in the vicinity of the b1 during a shower.

3.3.2.4. Amphiro b1 malfunctions

During this period, no problems were reported with the 47 deployed b1 devices.

3.3.2.5. System availability (uptime)

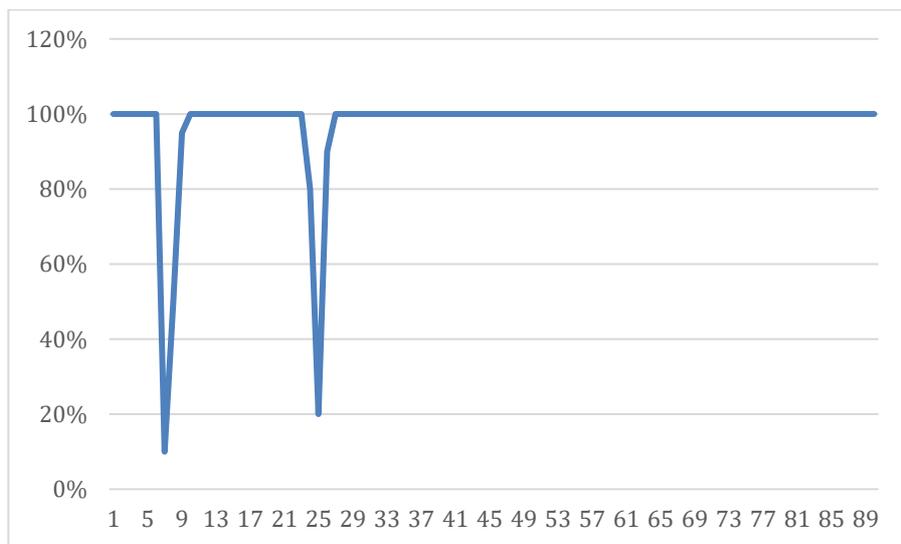


Figure 24: Daily system availability (% of time within a day system was available) (% of time within a day system was available) (Y Axes: % of system availability; X axes: day in Quarter 2)

All interruptions in the system’s availability during Q2 were *scheduled* down-times (maintenance/upgrades).

3.3.3. Issues

The following table presents the issues we addressed during Q2 of Trial B, and the corrective steps we took in in order to explore, analyze, and address them.

ID	Date	Problem Description	Corrective Steps
28	29/06/16	<ul style="list-style-type: none"> Unsupported Android device. <p>A user contacted us by email reporting a problem connecting the b1 with the DAIAD mobile app during the initialization steps.</p>	<p>We provided the user with suggestions to address the most common technical issues and advised her to use an alternative device. The user responded that there is an available mobile device in the household which satisfies the minimum requirements for DAIAD mobile</p>

29			application (i.e. Bluetooth 4.0). He then reported that she faced sign in problems. After providing her with the necessary steps to 'Sign In' by using her credentials, we observed by the monitoring service that she had successfully paired her mobile device with the amphiro b1.
	29/06/16	<ul style="list-style-type: none"> Installation of DAIAD app in another device. <p>A user contacted by email informing us about her intention to install DAIAD app in another device.</p>	<p>We informed the user about the necessary steps to successfully install DAIAD app in the other device and then proceed with 'Sign In' by using her credentials.</p> <p>In addition, after moving her to Phase 2 (b1 ON, mobile OFF) she reported her preference for using universal units in the app instead of imperial units. This localization feature has been integrated in the next DAIAD app update, allowing users to set their preferred unit system both the b1 and the mobile app.</p>
	30/06/16	<ul style="list-style-type: none"> Mode change - Bluetooth synchronization delay. <p>A user contacted us by email reporting that although she has joined Phase 2 (b1 ON, mobile OFF), the display of the b1 device remained inactive.</p>	<p>We reminded the user that the changes will take effect after her next shower, and only if her mobile device is in the vicinity of the b1.</p> <p>In the following days we observed from our monitoring UI that the display of the amphiro b1 had been successfully enabled.</p>
31	02/07/16	<ul style="list-style-type: none"> Mode change delay. <p>A user contacted us by email reporting that although she has joined Phase 2 (b1 OFF, mobile ON) the mobile app remained disabled.</p>	<p>We provided the user with suggestions to address the most common technical issues.</p> <p>After a few days the participant reported us that DAIAD app was successfully enabled and the amphiro b1 was disabled. We explained to the user that this is normal as her DAIAD system functions in 'Normal mode'.</p> <p>In a following communication, the user reported her preference for using universal units in the app instead of imperial units. This localization feature has been integrated in the next DAIAD app update, allowing users to set their preferred unit system both the b1 and the mobile app.</p>

32	11/07/16	<ul style="list-style-type: none"> • Sign-in problem. <p>A user contacted us by email reporting a problem signing-in the DAIAD app.</p>	<p>This was not caused by a technical issue, but from the user selecting 'Sign Up' (i.e. create an account) rather than correctly proceeding with 'Sign-in'. We gave the user detailed instructions on how to correctly 'Sign-in' the DAIAD app.</p>
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Table 4: Issue Tracking Q2

3.3.4. Risks

We anticipate the following risks for the next period of the Trial.

ID	Risk	Contingency Plan
5	Low participation in the St Albans Trial	<p>We will be using the remote administration and monitoring facilities of DAIAD to daily evaluate progress, communicate by email with users to remind them of their responsibilities for the pilot, and in parallel, continue with our recruiting activities. Should a participant fail to respond after repeated communication after 2 weeks, we will replace her with another participant from our pool of candidates.</p> <p>This type of delays and replacements have been anticipated and addressed from our pilot methodology and the DAIAD system itself. The management of the pilot phases (<i>e.g. learning mode, b1 active, all system active</i>) can be managed on an individual user basis, ensuring data and results and be reconciled at a later stage.</p>
6	Compatibility problems with low-cost Android devices	<p>The risk is small, with less than 5% of the participants having problems due to the proprietary and/or obsolete version of the Android OS installed in their devices.</p> <p>Despite the low penetration of low-cost Android devices in the UK and the eventual update of the underlying OS for these devices (<i>standard Android practice for these manufacturers</i>) we will expand our in situ development and testing regime to include low-cost manufacturers. This decision aims solely to address any problems encountered by our users. With the final DAIAD system expected in a year from now, the majority of these devices will no longer officially be supported by their manufacturers, while our emphasis</p>

is on ensuring DAIAD's compatibility with devices available *up to and beyond* Q4 2017.

Table 5: Risks Q2

3.4. Quarter 3

3.4.1. Period summary

During this period, our efforts were focused on providing technical support to participants, collecting their feedback, and maintaining active communication with the system's administrators in order to rapidly identify and address all issues encountered by users.

The number of issues and support inquiries very small, as expected, with users progressing to the next planned Phases of the Trial with minimal problems. We opted to proactively communicate with users when moving to a new Phase, confirming the system was operating as intended. A satisfaction survey was distributed to Trial participants (see Annex 6 – Satisfaction survey), which will be repeated during the next final period, with their results presented in the Deliverable D7.3 'Trial Evaluation'.

In terms of technical issues, we only observed two malfunctioning b1 devices, which were returned for further inspection and were replaced with new devices. Further, a user reported a discrepancy in the displayed shower use between the b1 and the mobile app, which was caused by the new data transmission protocol available in the latest mobile app version. The analysis of the shower extractions received during this period confirmed an observation we had from the previous period; Trial B participants neglect to periodically have their mobile device near the shower in order for historical shower data to be extracted from the internal memory of the b1 device. Consequently, there is a small risk of not receiving all shower data by the end of the Trial on a timely manner. There is no risk of lost data as they are stored within the b1 device and the internal memory capacity is adequate for the majority of user exhibiting this behavior. We have contacted the users, reminding them the importance of periodically bringing their mobile device with them. If the participants do not respond, we will instruct them after the end of the Trial to turn on the shower and spend 10-15 minutes with the mobile device in vicinity in order to retrieve all missing historical data.

Finally, the end of Q3 finds the Trial *delayed by 1 month* compared to our original schedule. Consequently, the overall picture regarding the progress of the Trial in the course of this period remains positive, and we expect it to be successfully completed within the next period.

3.4.2. KPIs

In this section we provide the evolution of select KPIs presenting the progress of the Trial B in Q3, highlighting specific periods and/or events of particular interest.

3.4.2.1. Participants per Phase

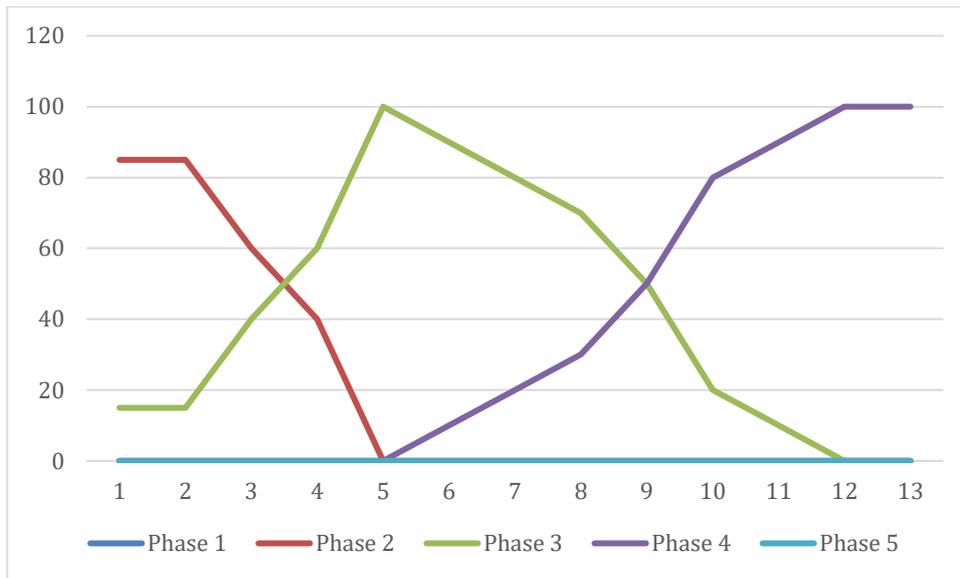


Figure 25: Distribution of participants per phase during Q3 (Y axes: % of panel population; X axes: week in Quarter 3)

During this period, all participants gradually obtained full access to the DAIAD system (Phase 3), at which point they gained access to the hidden interventions of Phase 2. This marked an important milestone for the Trial, as participants were exposed both to diagnostic and real-time interventions, and for the first time received a complete impression of the normal operation of the system. As the period progressed, our participants moved to Phase 4, during which only half of them were exposed to social-based comparisons.

3.4.2.2. Water Consumption (shower)

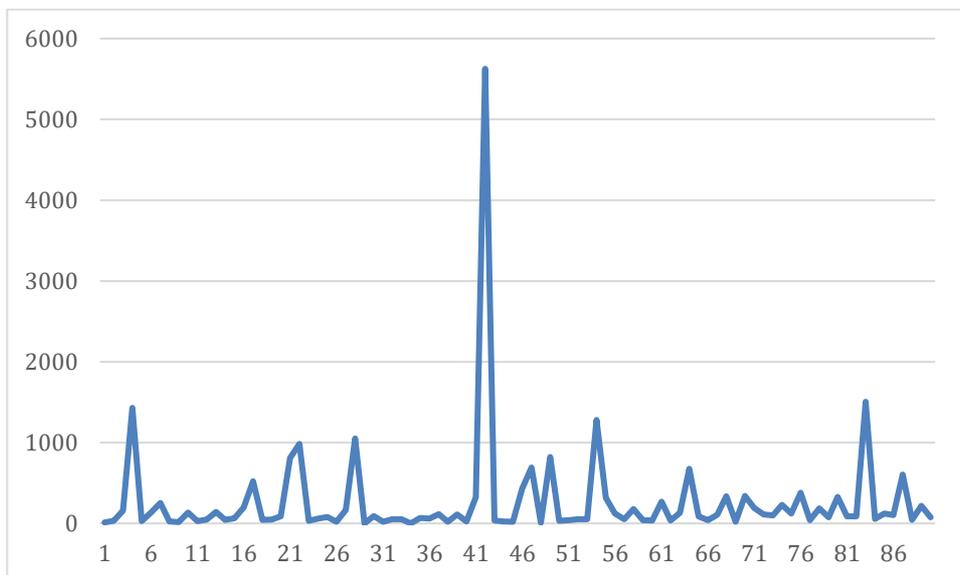


Figure 26: Total daily shower consumption for Q3 (liters) (Y axes: total shower consumption in liters; X axes: day in Quarter 3)

The daily volume of transmitted showers from our Trial participants remained stable and practically the same with the previous period, with a visible peak around days 41-44, following a communication effort instructing

our users to bring their mobile devices in the vicinity of the b1 during a shower. This increased the number of showers received in the following days, as a large number of historical shower events stored in the internal memory of the b1 devices were successfully retrieved and submitted to the server from the mobile app.

3.4.2.3. Shower events

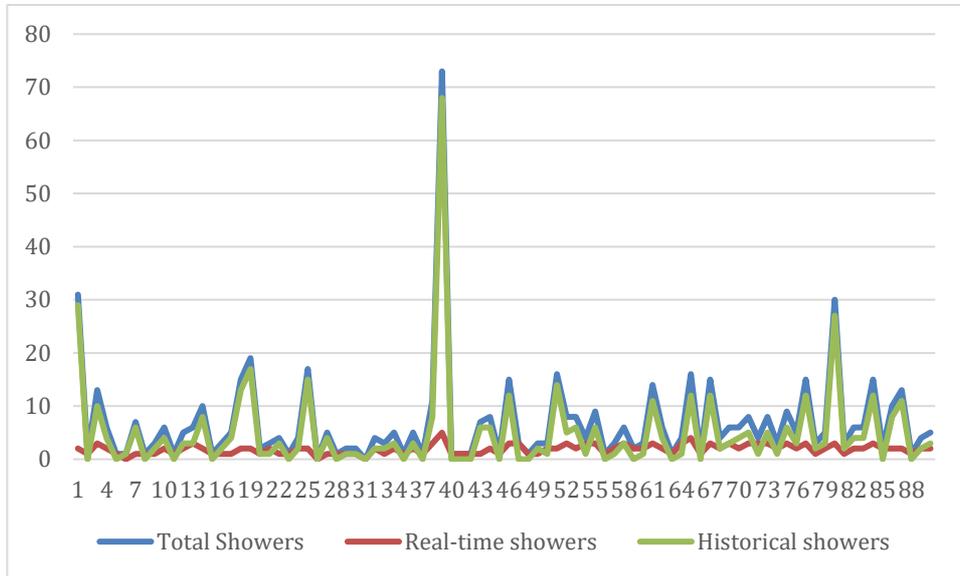


Figure 27: Shower events (total, real-time, historical) for Q3 (Y axes: number of shower events; X axes: day in Quarter 3)

During this period, we captured in total 612 shower events, of which 166 are real-time shower events and 446 historical shower events. As we can observe, the number of historical showers increased following the days of our communication campaign, as explained in the previous section. In addition, we can observe the extremely low ration of real-time vs. historical showers, a joint insight from Trial A as well. This necessitated a further improvement in the throughput of the data transmission for historical showers (*at least 100%*) to ensure that *more* historical showers are transmitted in the fewer opportunities available (*i.e., the real-time events*), and thus *all shower data* eventually reach the server.

3.4.2.4. Amphiro b1 malfunctions

During this period, there were three (3) reported malfunctions out of the 47 deployed b1 devices.

3.4.2.5. System availability (uptime)

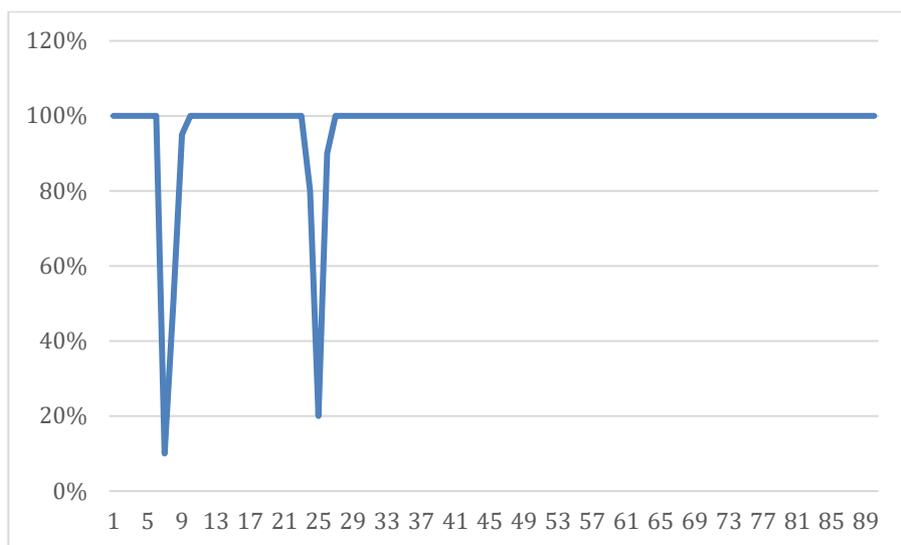


Figure 28: Daily system availability (% of time within a day system was available) (% of time within a day system was available) (Y Axes: % of system availability; X axes: day in Quarter 3)

All interruptions in the system’s availability during Q3 were *scheduled* down-times (maintenance/upgrades).

3.4.3. Issues

The following table presents the issues we addressed during Q3 of Trial B, and the corrective steps we took in in order to explore, analyze, and address them.

ID	Date	Problem Description	Corrective Steps
33	15/09/2016	<ul style="list-style-type: none"> Malfunctioning amphiro b1 <p>A user contacted us by email and reported a problem connecting the b1 with the DAIAD mobile app using iPhone 5s and an iPad Mini 4.</p>	<p>We provided the user with suggestions to address the most common technical issues. However, the user responded that the problems persisted. As such, we reached the conclusion that the b1 is malfunctioning, informed the user that the device will be replaced, and arranged the shipping of the device to examine the cause of the problem. The original b1 device has been returned to the Consortium for analysis (<i>hardware problem of the integrated BT radio</i>)</p>
34	19/09/2016	<ul style="list-style-type: none"> Malfunctioning amphiro b1 <p>A user contacted us by email and reported a problem connecting the b1 with the DAIAD mobile app.</p>	<p>We provided the user with suggestions to address the most common technical issues. However, the user responded that the problems persisted. As such, we reached the conclusion that the b1 is malfunctioning, informed the user that the device will be replaced, and arranged the shipping of the device to examine the cause</p>

			of the problem. The original b1 device has been returned to the Consortium for analysis (<i>assembly problem</i>)
35		<ul style="list-style-type: none"> Discrepancies in last shower consumption <p>A user contacted us by email informing us about discrepancy in the last shower consumption between the mobile app and the b1</p>	<p>This discrepancy is caused by the new data transmission protocol available in the latest mobile app and affects only low-cost Android devices (<i>proprietary/older BT implementation, slow CPU</i>). It had been a known issue identified already during development, and a necessary compromise to ensure all historical shower data during the Trial are successfully retrieved.</p> <p>Specifically, during a shower event the b1 transmits via its BT radio to the connected mobile device a series of data packets which include: the current (i.e. in real-time) shower event, and (b) historical shower data stored in the b1's internal memory. The low bandwidth of BT means that a compromise must be reached in terms of prioritizing the allocation of the available bandwidth. Through DAIAD's integrated monitoring services (<i>see KPI subsections of this report</i>) we had observed that the average ratio of real-time vs. historical showers was around ~10% (i.e., <i>within an expected range</i>), but for certain users fell below 5%, meaning that during a typical shower more than 20 historical showers needed to be transmitted.</p> <p>This posed a potential problem, as the limited amount of internal memory available in the b1 (~200 showers), combined with the lower comparable BT bandwidth of low-cost Android devices, introduced a potential risk of not receiving all captured historical showers. Consequently, we intentionally and temporarily re-allocated the available BT bandwidth to prioritize historical shower extractions. This was manifested to users as a lag of the mobile app vs. the b1 (e.g., the app displays 8lit, while the b1 displays 8.5lt) due to the lower frequency packets for real-time showers are transmitted. As explained, this was an intentional and necessary compromise, which will not be</p>

			present at the final version of the mobile app and b1 prototype after the end of the Trials. A completely new version of the BT API and new BT radio have already been implemented and are undergoing internal testing, addressing all bandwidth problems.
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Table 6: Issue Tracking Q3

3.4.4. Risks

We anticipate the following risks for the next period of the Trial.

ID	Risk	Contingency Plan
6	'White-screen' reported issue from Trial A	<p>A small number of users in Trial A have reported a problem with their mobile app, with the screen simply displaying a white background with no other information. The white screen affected only specific type/version of Android mobile devices due to a non-standard API implementation. We developed a bug-fix and uploaded a new version of the app within a few days, which solved this problem.</p> <p>This problem had not been raised in Trial B, but with a number of Trial B participants potentially being affected, we proactively reminded users to ensure the mobile app is always updated (<i>either manually, or automatically from their OS</i>)</p>
	Delays in receiving historical data	<p>The analysis of the shower extractions received during this period revealed that Trial B participants neglect to periodically (<i>i.e., once every 2-3 weeks</i>) have their mobile device near the shower in order for historical shower data to be extracted from the internal memory of the b1 device. Consequently, there is a small risk of not receiving all shower data by the end of the Trial on a timely manner. There is no risk of lost data as they are stored within the b1 device and the internal memory capacity is adequate for the majority of user exhibiting this behavior. We have contacted the users, reminding them the importance of periodically bringing their mobile device with them. If the participants do not respond, we will instruct them after the end of the</p>

	Trial to turn on the shower and spend 10-15 minutes with the mobile device in vicinity in order to retrieve all missing historical data.
--	--

Table 7: Risks Q3

3.5. Quarter 4

3.5.1. Period summary

This period marked the successful end of the Trial and the availability of its results to the entire Consortium for analysis and evaluation in the context of T7.5. We received very few support requests from our Panel, signaling both the increased technical maturity of the app, as well as their increased familiarity with its use.

Overall, our efforts have been focused on *maximizing* the data generated from the Trial, ensuring excellent coverage and quality. Towards this, we have taken the following measures:

- *Historical b1 data.* We introduced a new harvesting scheme for our opportunistic data transmission protocol from the b1, placing emphasis on retrieving *all historical data* stored within the device that were not transmitted during past real-time events. This change was rolled-out in an app update and allowed us to massively collect all shower events performed by our Panel, thus completing our knowledge concerning shower usage for all participants during the Trial.
- *Coherent data export.* A new facility was integrated in DAIAD, allowing all Consortium members to retrieve the data produced during the Trial in a uniform manner. Users can download the original data (*b1, phases, users*), and the cleaned data (*applying common rules for data cleaning and sanitization*).
- *Post-experimental surveys.* A new survey was prepared and sent to Trial A participants in order to assess their final impressions from the system, with its results analyzed and presented in D7.3.
- *Evaluate retention.* Following the official end of our Trial, we decided to *maintain* the operation of the DAIAD system till the end of the project, allowing our users to continue using the system, and allowing us to monitor the retention of the achieved changes in their consumption behavior. In this period, we will not provide any support to consumers, and only continue the monitoring and analysis of their behavior, which we consider as an important aspect for our work in T7.5.

3.5.2. KPIs

In this section we provide the evolution of select KPIs presenting the progress of the Trial B in Q4, highlighting specific periods and/or events of particular interest.

3.5.2.1. Participants per Phase

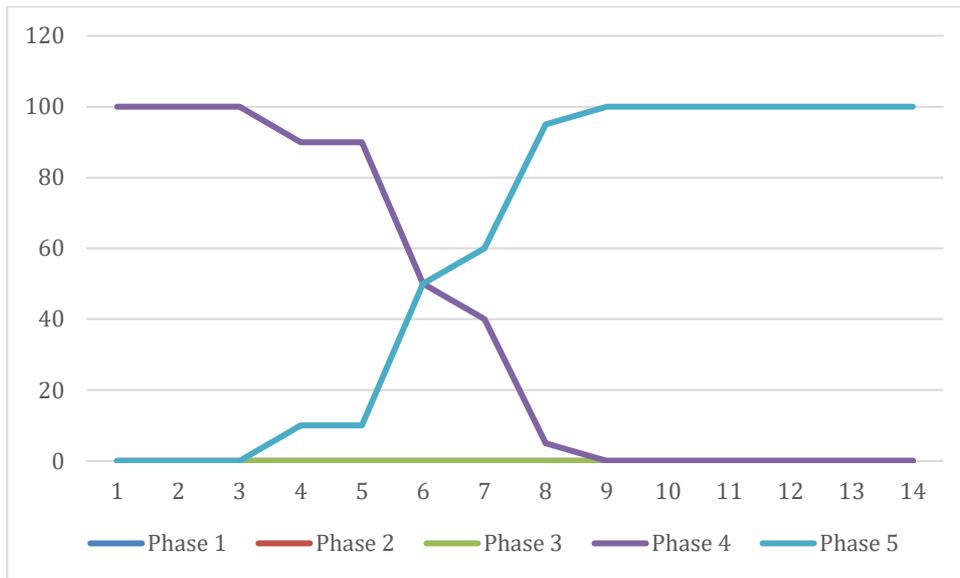


Figure 29: Distribution of participants per phase during Q4 (Y axes: % of panel population; X axes: week in Quarter 4)

During this period, all participants were successfully moved to Phase 5, at which point the complete functionality of the system became available to all users with no exceptions.

3.5.2.2. Water Consumption (shower)

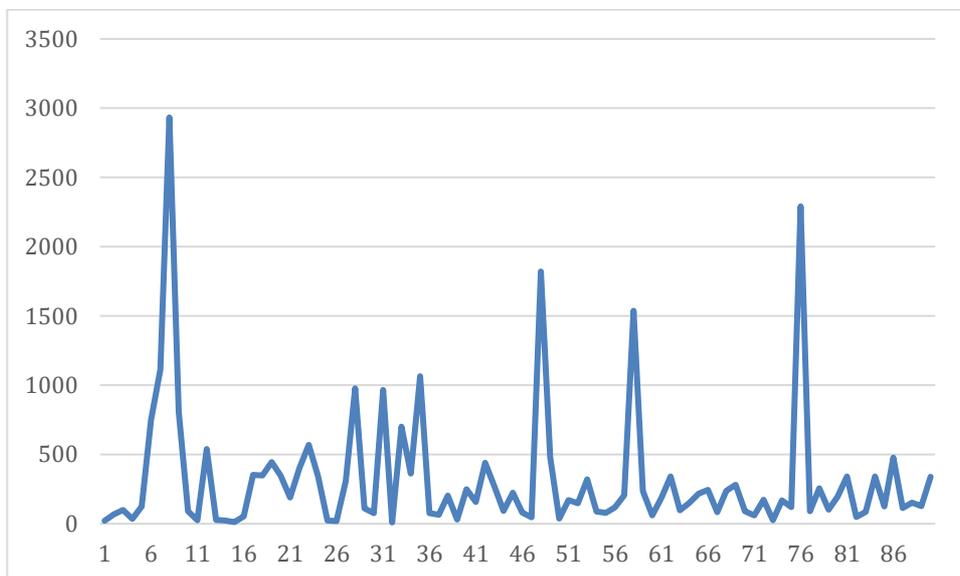


Figure 30: Total daily shower consumption for Q4 (liters) (Y axes: total shower consumption in liters; X axes: day in Quarter 4)

The daily volume of transmitted showers from our Trial participants remained stable and practically the same with the previous period, with a number of visible peaks, during which a new app update *tripled* the throughput for receiving historical showers (*hence a high number of historical showers were retrieved these days*). This improvement was planned during the previous period (see 3.4.4) and ensured that *all shower events* captured and stored in the b1 were successfully transmitted to the server.

3.5.2.3. Shower events

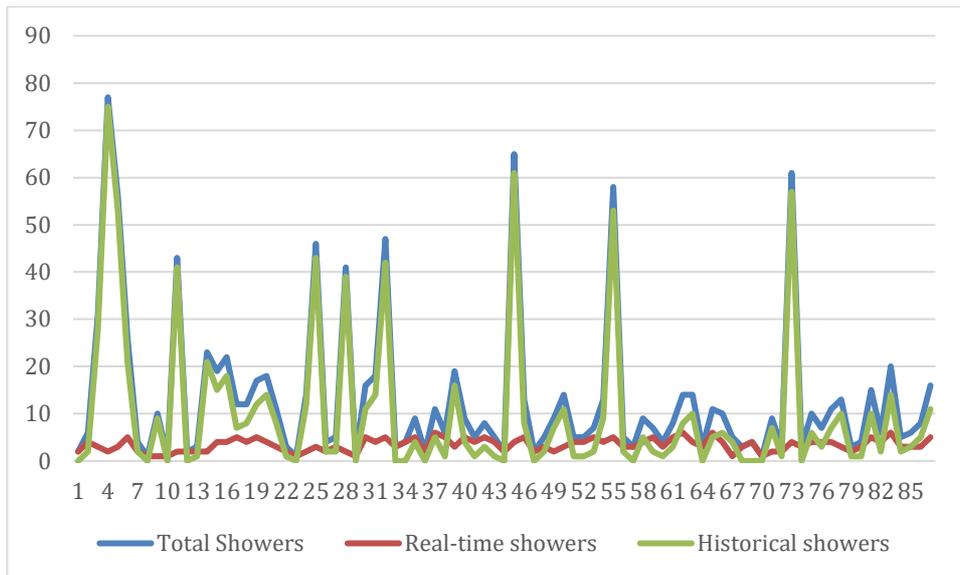


Figure 31: Shower events (total, real-time, historical) for Q4 (Y axes: number of shower events; X axes: day in Quarter 4)

During this period, we captured in total 1,182 shower events, of which 300 are real-time shower events and 882 historical shower events. As we can observe, the number of historical showers increased after the introduced mobile app update mentioned in the previous section, and is directly responsible for the increase in total shower events (*real-time showers remained practically stable throughout the period*).

For the entire duration of the Trial, we captured in total 2,936 shower events, of which 769 are real-time shower events and 2,167 historical shower events.

3.5.2.4. Amphiro b1 malfunctions

During this period, no b1 devices were reported as malfunctioning.

3.5.2.5. System availability (uptime)

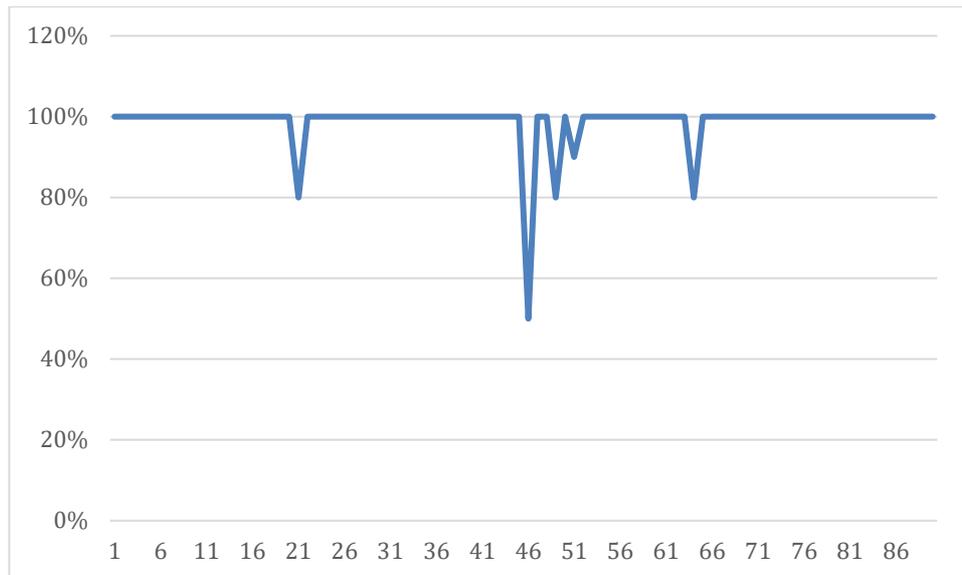


Figure 32: Daily system availability (% of time within a day system was available) (Y Axes: % of system availability; X axes: day in Quarter 4)

All interruptions in the system’s availability during Q4 were *scheduled* down-times (maintenance/upgrades).

3.5.3. Issues

The following table presents the issues we addressed during Q4 of Trial B, and the corrective steps we took in in order to explore, analyze, and address them.

ID	Date	Problem Description	Corrective Steps
36	05/12/2016	<ul style="list-style-type: none"> BT connection problem A user contacted us by email informing us about intermittent problems in BT connectivity.	We advised the user to either update the mobile app, or attempt to uninstall and re-install it, since neither the system’s logs, nor the described issues had been reported by other users.
37	06/12/2016	<ul style="list-style-type: none"> General improvements A user contacted us by email suggesting to negate the need for having a mobile device in the vicinity of the b1 and to provide an API for downloading her own water use data	We thanked the user for her suggestions and reminded her the hardware constraints of the BT radio, which does not allow for a greater data transmission range (<i>at least until the upcoming new version of BT</i>).
38	08/12/2016	<ul style="list-style-type: none"> Discrepancies in last shower consumption A user contacted us by email informing us about a discrepancy in the last shower	This discrepancy is caused by the new data transmission protocol available in the latest mobile app and affects only low-cost Android devices (<i>please see Issue #35 for details</i>). We

		consumption between the mobile app and the b1	advised the user to update the app in its latest version, in which this issue has been resolved.
--	--	---	--

Table 8: Issue Tracking Q4

4. Preliminary results

4.1. Introduction

In the following, we provide some preliminary results regarding the effect of the DAIAD system in terms of water savings for our Trial population. The reader is strongly urged however, to ignore the following text and instead study our Report Deliverable D7.3, which is dedicated on presenting a thorough analysis of the user Trials across multiple dimensions.

At the time of this writing, the analysis of the Trial data *has not been completed* for reasons that are apparent from studying this report and of course relate to the real-world focus of our experimental evaluation. In summary:

- Shower extraction events from our Trial panel are transmitted in the system in an *opportunistic* manner, as explained in this report and the corresponding project deliverables. In summary, during a shower event, if a mobile device is near the b1 device (5-6 meters) and with Bluetooth turned on, then we receive the shower time-series in real-time. In parallel, we also retrieve shower extraction events stored within the device’s internal memory. In case of a shower event where data retrieval from the b1 device is not possible (e.g., turned off Bluetooth, out of range), the shower extraction event is stored in the device’s memory. This is the reason in this report we distinguish received shower events in real-time (*i.e., received synchronously*) and historical (*i.e., received asynchronously*). At a non-extreme scenario, it possible for a user to have taken 200 showers (*~3 months for a 2-person households*) without any data transmitted (the user simply did not take her mobile device near the shower). During shower #201 the user has her mobile device with her, so we retrieve *one* real-time shower (#201) as well as all the internally stored *200 historical showers*. As it is obvious, and even at the time of this writing, there are still shower extraction events stored in the b1 devices of our panel, that have not been received (*ranging from gaps of a few showers, to hundreds*). At all cases, at this point in time we cannot guarantee that the retrieved shower extraction data, and hence the savings mentioned in the following, are complete and will not change.

4.2. Water savings

Table 9 presents the savings, averaged over all Trial users for all phases of Trial B.

Phases	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
% Savings in shower consumption (b1)	N/A	0.7%	-19.2%	15.75%	N/A

Table 9: Water consumption savings in all Phases

4.3. Insights

In the following, we provide select early insights from the Trial. Overall, we consider the implementation of Trial B to be successful, providing the Consortium with critical insights, which allowed us to significantly improve the DAIAD system, explore the limits of current technologies, and locate critical key-points for the success of smart water monitoring technologies. The direct comparison with Trial A confirmed our motivation for piloting the system in (a) two geographical locations with different characteristics in terms consumers and water demand, and (b) in two real-world deployment scenarios. Our findings indicate that a *holistic coverage* of total water use in the household *increases* user satisfaction, even if it has a *minimal effect* in savings. Consumers treat the provision of only fixture-based information as *incomplete*, making it *less attractive*. As a result, fixture-based water monitoring services enjoy a *lesser degree* of potential commercial success as an autonomous and self-contained product. Following this line of argument, the availability of smart water meter data is critical for the success of real-time water monitoring technologies, and implies either *direct* involvement of the water utility (e.g., similar to Trial A), or the *indirect* provision of data under a data sharing agreement (e.g., similar to the *Green button initiative*).

- A number of participants have dropped-out from the Trial due to a perceived reduction in water-flow at their shower after having attached the amphiro b1 device. Users reported a considerable water flow reduction (as much as 50%), which in some specific cases makes showering, and thus the use of b1, practically impossible. In laboratory testing the current version of b1 leads to a reduction in water flow by 20-30%, which is within acceptable operational parameters. Further, we have had no similar complaints from Trial A participants. After examining all reported cases we have concluded that the problems were localized to consumers with an already *very low water flow* in their households (<6 lt/min). This means that the use of the b1 reduced water flow to *less than 4lt/min*, which had two effects: (a) reduce water flow, making showering uncomfortable, and (b) reduce the energy harvested from the b1, making its operation impossible. Unfortunately, addressing these low-flow scenarios is not practically feasible with current technologies (*mechanical-based*), but an open research topic for new types of microelectronic sensors. To account for the increased number of drop-outs we organized a number of communication activities to recruit additional participants.
- User satisfaction from the DAIAD system, as documented from our periodic satisfaction surveys was *moderate* (~50% *Very satisfied or satisfied*, ~30% *somewhat dissatisfied or dissatisfied*). In addition, participation in the Trial was less active compared to Trial A, with a number of participants ultimately dropping out (~35%). As analyzed above, we attribute these problems to the *low water flow* issues hindering the households of multiple participants. This was an unforeseen and highly localized issue (within the UK also), which however provided us with critical feedback towards further optimizing energy harvesting and fine-tuning the accuracy of the amphiro b1. In addition, we consider the narrower focus of the Trial B (*only shower analytics available*) to be another important reason for the comparatively lower user satisfaction. Without access to smart water meter data (*and thus their total water use*), participants only received *piecemeal* information about their water demand that covered *part* of their water use. While sustained water savings in the shower were practically the same in both Trials, the narrower focus in terms of information and stimuli introduces an *upper limit* in *user engagement* and thus potential market success as *autonomous* products.

5. Annex I – Survey for expression of interest

In this Annex we provide the Welcome screen of the web survey as well the complete list of questions and answers (exported via printing the form, styling omitted).

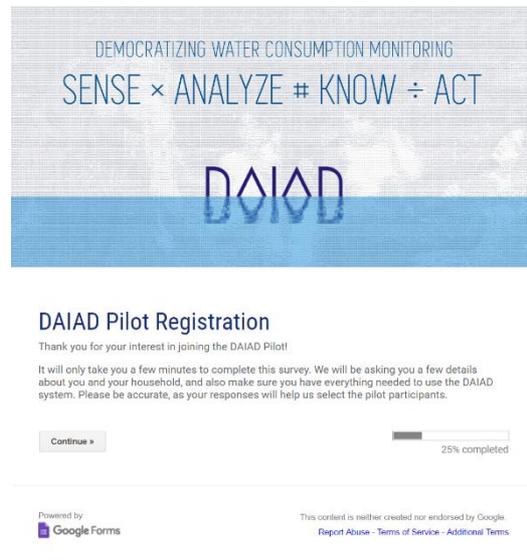


Figure 33: Survey for expression of interest - Welcome screen

DAIAD Pilot Registration

Thank you for your interest in joining the DAIAD Pilot!

It will only take you a few minutes to complete this survey. We will be asking you a few details about you and your household, and also make sure you have everything needed to use the DAIAD system. Please be accurate, as your responses will help us select the pilot participants.

*Required

Tell us a bit about yourself

Please give us a few details about yourself. It will allow us to contact you in case you are selected to join the pilot!

1. Name *

2. Surname *

3. Address *
Street address (Avenue/Street/Square); House number (Name/Number/Letter)

4. City *
(WV, St. Albans, otherwise please choose other)
Mark only one oval:
 St. Albans
 Other

5. Email *

6. What is your age? *

Mark only one oval.

- less than 18 years old
- 18-24 years old
- 25-34 years old
- 35-44 years old
- 45-54 years old
- 55-64 years old
- 65-74 years old
- 75 years or older

7. What is the highest degree or level of school you have completed? If currently enrolled, highest degree received *

Mark only one oval.

- No schooling completed
- High school graduate
- Trade/technical/vocational training
- Bachelor's degree
- Master's degree
- Professional degree
- Doctorate degree

8. What is your gender? *

Mark only one oval.

- Female
- Male

Eligibility

In the following we want to make sure that you are eligible to participate in the pilot, and also agree to help us in our research work.

9. How many hand showers are there in your home? *

Mark only one oval.

- 1
- 2
- 3
- more than 3
- I do not have one

10. My smartphone is with *

Mark only one oval.

- the iOS operating system (e.g. Apple iPhone 4, iPhone 5 or newer)
- the Android operating system (e.g. Samsung, LG, Sony, Motorola)
- the Windows operating system (e.g. Windows Phone or Windows 10 on Nokia, Samsung, HTC, Huawei)
- a different operating system (e.g. Blackberry, Firefox, Salfish, Ubuntu, Tizen)
- I do not know which operating system my smartphone uses
- I do not have a smartphone

11. My tablet is with *

Mark only one oval.

- the iOS operating system (e.g. Apple iPad(iPad mini))
- the Android operating system
- the Windows operating system
- I do not have one

12. On either your mobile or tablet device, how often is your Bluetooth switched on? *

Mark only one oval.

- Always, or almost always
- Mostly
- About half of the time
- Occasionally
- Never, or almost never
- Bluetooth is turned on when I need it
- My mobile or tablet device does not have Bluetooth

13. Do you have wireless internet (Wi-Fi) in your home? *

Mark only one oval.

- Yes
- No
- I am not sure

14. Do you have data plan for your mobile phone? *

Data plan provides internet access through you mobile phone.

Mark only one oval.

- Yes
- No
- I am not sure

15. Do you plan to be away from home for 3 months or more (e.g. holidays or business trip)? *

Mark only one oval.

- Yes
- No

16. Do you give us your consent for analyzing your information about you and your household during the pilot? *

Your personal data will be made anonymous and treated strictly confidentially for the data analysis, and will not be shared with third parties.

Mark only one oval.

- Yes
- No

17. Are you willing to provide us with your feedback during the pilot? *

Mark only one oval.

- Yes
- No

Your household

Please provide us with some information about your household. It will greatly help us understand how DAAD will be used by you and your household members.

18. How many members are there in your household? *

Mark only one oval.

- 1
- 2
- 3-5
- 6-10
- 11 or more

19. How many minors live in your household (i.e. of age less than 18 years old)? *

Mark only one oval.

- None
- 1
- 2
- 3
- 4
- 5 or more

20. What is the size of your apartment/house in square meters/feet? *

Mark only one oval.

- 30 sq. meters or less/322 sq. feet or less
- 31-60 sq. meters/323-645 sq. feet
- 61-80 sq. meters/646-861 sq. feet
- 81-110 sq. meters/862-1184 sq. feet
- 111 sq. meters or more/1185 sq. feet or more

Powered by
Google Forms

6. Annex 2 — Trial Guides

6.1. Short guide

Hello St Albans!

Do you want to join us?
www.daiad.eu/join

Welcome to DAIAD!

Introduction
Waterwise is proud to announce that 100 residents of St Albans will be able to participate in a 12 month pilot of novel water monitoring technologies developed by DAIAD, an EU research project. DAIAD has created a new way for you to monitor and understand how much water you use, helping you make informed decisions and reduce your water use. A new smart water sensor for your shower, will enable you to understand how much water you use. You will have access to this information from your mobile phone, the web, even in your shower!

Waterwise has managed to secure that 100 residents of St Albans can participate in the pilot for free!

Who we are
The DAIAD team

DAIAD is a research project tackling a significant challenge for sustainability and the well-being of our society. We want to improve the way we use and reuse water, and increase individual and collective awareness for water efficiency. Towards this, we develop novel water sensors, mobile applications, and intelligent systems to help consumers understand and improve their water use.



What will I be testing?

The DAIAD system

All participants will receive for free the DAIAD system, which they can keep using after the pilot has ended. The DAIAD system includes a smart water sensor, an application for your mobile phone or tablet, and a dedicated web site. All these work together to monitor and analyze your water use, and provide you with insights on how you can improve your water consumption.



Water Sensor



Mobile app



Web site

Are you eligible?

Requirements for participants

Handheld shower

You need a handheld shower in your house



Mobile Device

You need a smartphone or a tablet



A few hours of your time

We need your feedback! Only a few hours in 12 months



Your consent

We will be analyzing information about you and your household



What will I be doing in the pilot?

Just use the system!

It's actually quite simple! After you install the smart water sensor and the mobile application, just carry on! We don't want you to try and change your behavior, or do anything similar. Take a shower, wash the dishes, drink water (it's good for you) and nothing out of the ordinary.

- We will notify you by email if you are selected to participate in the pilot (Hooray!). You can expect this email in the last months of 2014.
- You will be invited to complete a survey providing us information regarding you and your household. Remember about giving us your consent? Well this is it! We need you to be thorough, precise and candid.
- After a few weeks you will receive the smart water sensor in a nice box. It will look like just any other ordinary device you purchase from a store.
- You will follow the included instructions to install the sensor in your shower, download the mobile application and test that everything works. It shouldn't take longer than 10 minutes of your time.
- Congratulations, you are now a member of DAIAD!
- After 12 months, we will invite you to complete a final survey, providing us with your views and experiences from the system.
- And this is end of the pilot! The DAIAD system is yours and you can keep using it for as long as you like.



I want to join the pilot

Thank you!

We are really happy you want to help us!

Please visit the following address and complete the survey to express you interest. It will only take 2 minutes.

We will email you in a few months to let you know if you will join the pilot

www.daiad.eu/join

¡Gracias!, Thank you, Ευχαριστώ, Vielen Dank!

 @DAIAD_EU



 www.daiad.eu





DAIAD is a research project funded by European Commission's 7th Framework Programme

6.2. Long guide

DAIAD

@DAIAD_EU www.daiad.eu

DEMOCRATIZING WATER CONSUMPTION MONITORING
SENSE × ANALYZE ≠ KNOW ÷ ACT

DAIAD is research project funded by European Commission's 7th Framework Programme

Who we are
The DAIAD team

DAIAD is a research project funded by the European Union tackling a significant challenge for sustainability and the well being of our society. We want to improve the way we use and reuse water, and increase individual and collective awareness for water efficiency. Towards this, we develop novel water sensors, mobile applications, and intelligent systems to help consumers understand and improve their water use.

DAIAD is a collective effort bringing together researchers and innovators across Europe.

<p>IHEM Research Center Athens, Greece</p> <p>"We create algorithms that analyze your water consumption, extract knowledge, and provide you with intelligent recommendations"</p>	<p>University of Bamberg Bamberg, Germany</p> <p>"We devise new means to visualize your water consumption that inform and motivate you to save water"</p>	<p>Fraunhofer ISI Karlsruhe, Germany</p> <p>"We study the factors that influence your water use, like the weather, your age, or even water price. This knowledge helps us manage water more efficiently"</p>
<p>Amphiro AG Zürich, Switzerland</p> <p>"We develop a miniaturized sensor that monitors how much water and energy you use. It doesn't need a battery and works with your mobile phone"</p>	<p>AGUAS DE ALICANTE Alicante, Spain</p> <p>"We strive to make water safer and affordable for everyone, ensuring it is not wasted. We safeguard our water resources for the generation and the ones that follow"</p>	<p>Waterwise London, UK</p> <p>"We inform and mobilize consumers, the public sector, and companies on how to use water more efficiently. Everyone can save water, its very simple"</p>

Welcome to DAIAD!
Introduction

Waterwise is the leading authority on water efficiency and as part of our strategic work is to research and promote new water saving technologies. This includes working on European research projects, such as DAIAD.

We are proud to announce that in a few months residents of St Albans will be able to participate in a 12 month pilot of novel water monitoring technologies developed by DAIAD, an EU-funded research project.

DAIAD has created a new way for you to monitor and understand how much water you use, helping you make informed decisions and reduce your water use. A new smart water sensor for your shower, will enable you to understand how much water you use. You will have access to this information from your mobile phone, the web, even in your shower!

Waterwise has managed to secure that 100 residents of St Albans residents can participate in the pilot for free!

You have the opportunity to become one of the first water consumers worldwide to have access to DAIAD technologies, give us feedback and help us improve our work. In the following pages you can find more information about DAIAD, the pilot, and how you can join.

What will I be testing?
The DAIAD system

All participants in the pilot will receive for free the complete DAIAD system, which they can keep using after the pilot has ended. The DAIAD system includes a smart water sensor, an application for your mobile phone or tablet, as well as a dedicated web site. All these components work together to monitor and analyze your water use, and provide you with insights on how you can improve your water consumption.

The DAIAD system is for all family members, regardless of age, or technical expertise.

The DAIAD smart water sensor measures how much water you use in the shower! You simply install in a handhold shower and take your showers as you would normally do. The moment you start your shower, it automatically turns on and monitors your water use. In its display you can see your water consumption, temperature and shower efficiency! And it doesn't need a battery. The device transmits your water consumption to your mobile device.

The DAIAD mobile application receives your water consumption information from the smart water sensor. It logs and analyzes every shower you take, enabling you to explore your water behavior over time. The application also analyzes your water use and provides you with insights and recommendations on how to improve your water consumption. If you want, you can also see how much water you use compared to other members of your family, or your city.

The DAIAD web site provides you with even more tools to explore and understand your water consumption. The data you see are transmitted from your mobile phone, so that you can have a complete overview of your water use from your computer. Just login, explore your consumption in detail, and even share your achievements with others! Have you reduced your water consumption by 20%? Why not share it through social media and motivate your friends to join you?

Are you eligible?

Requirements for participants

Participation in the pilot is open to all residents of St Albans, regardless of family size, location, age, or income! However, in order for DAIAD to operate, we need to ensure a minimum set of requirements are covered by all participants.

Handheld shower

You need to have a handheld shower in your house



Mobile Device

You need a smartphone or a tablet



A few hours of your time!

We need to give you your feedback and impressions for the DAIAD system. Did you like it? Feel something is missing? Have an idea on how make it better? Your views are important as it is the only way for us to improve the system! Don't worry, it's only going to be a few hours in 12 months.



Your consent

During the pilot we will be analyzing your water consumption data in an effort to extract knowledge and insights that will help you improve your water use. This means that we will ask you to give us information about you and your household.

Having your consent to collect and analyze this data is extremely important for us. Quite simply, if we don't have your consent, we will not be able to improve the DAIAD system.



What will I be doing in the pilot?

Just use the system!

It's actually quite simple! After you install the smart water sensor and the mobile application, just carry on! We don't want you to try and change your behavior, or do anything similar. Take a shower, wash the dishes, drink water (it's good for you) and nothing out of the ordinary.

Now, this is just an overview of how your involvement in the pilot will be.

- We will notify you by email if you are selected to participate in the pilot (hooray!). You can expect this email in the last months of 2014.
- You will be invited to complete a survey providing us information regarding you and your household. Remember about giving us your consent? Well this is it! We need you to be thorough, precise and candid.
- After a few weeks you will receive the smart water sensor in a nice box. It will look like just any other ordinary device you purchase from a store.
- You will follow the included instructions to install the sensor in your shower, download the mobile application and test that everything works. It shouldn't take longer than 10 minutes of your time.
- Congratulations, you are now a member of DAIAD!
- After 12 months, we will invite you to complete a final survey, providing us with your views and experiences from the system.
- And this is the end of the pilot! The DAIAD system is yours and you can keep using it for as long as you like.



I want to join the pilot

Thank you!

We are really happy you want to help us!

Please visit the following address and complete the survey to express your interest. It will only take 2 minutes.

We will email you in a few months to let you know if you will join the pilot

www.daiad.eu/join

¡Gracias!, Thank you, Ευχαριστώ, Vielen Dank!



Frequent Questions

For more, reach us at contact@daiad.eu

Handheld shower

Why is the handheld shower necessary? The DAIAD sensor is simply connected to your handheld shower, so if you don't have one, you will not be able to fully use the system.

I have more than one handheld showers. That's fine! We will be giving you one sensor for each handheld shower in your residence.

The handheld shower is mostly used by my children. Again, no problem! DAIAD has been designed to be simple to use even for very young children

Mobile device

Why do I need a mobile device? The water sensor wirelessly transmits your water consumption to your mobile device. If you don't have a mobile device, you will not be able to see your past water use and gain access to insights.

Do I need to have Bluetooth turned on? Yes, please! There is no reason to worry about your battery. Bluetooth 4.0 (also known as Bluetooth Low Energy) is extremely energy efficient. I don't know if my phone has Bluetooth 4.0 in this case you probably have an Android phone. Assuming you purchased it in the past 2 years, you probably do have Bluetooth 4.0.

Will I be using the data plan of my mobile device? As long as you have Wi-Fi in your residence there is no need to do so.

I only have a tablet. No problem! DAIAD can work fine with a tablet available.

I have a smartphone and a tablet. That's great! You can install the DAIAD mobile application in both devices and use whatever device you want.

Can I use more than mobile phones? Certainly! Actually every member of your household can install the application in his/her own mobile device

Frequent Questions

For more, reach us at contact@daiad.eu

Your feedback

What feedback do we expect from you during the 12 months of the pilot?

- Complete at most 5 web surveys, which shouldn't take more than 3 hours in total! We will be notifying you by email, and we expect you to complete the survey within 2 weeks.
- Send us feedback by email or through the DAIAD applications for any issues, suggestions, or ideas you may have. Whatever it is, we want it to hear it!
- Participate in one informal discussion panel with DAIAD researchers and other pilot participants. We would like to meet you and hear your views about our work.

Your consent

During the pilot we will be analyzing your water consumption in an effort to extract knowledge and insights that will help you improve your water use. This means that we will ask you to give us information about you and your household.

Having your consent to collect and analyze this data is extremely important for us. Quite simply, if we don't have your consent, we will not be able to improve the DAIAD system.

Let us give you an example of what we mean. By analyzing your water use with weather data, we might discover that your consumption is influenced by precipitation. Perhaps we might discover an association with your family size as well! Who knows? It is what we call an open research topic. From our side we guarantee that your information will be used only for the purpose of our own scientific research and will not be shared with anyone else.

Actually, you may have already provided similar information to an application, without knowing it! It could be a fitness tracker, a diet application, or something even less apparent. Not us! We are scientists and our code of ethics prohibits us from using your information without your consent. If you have any objections to providing us your consent please do not participate in the trial. We thank you for your understanding.



7. Annex 3 — Trial Pre-survey

In this Annex we provide the Welcome screen of the web survey as well the complete list of questions and answers (exported via printing the form, styling omitted).

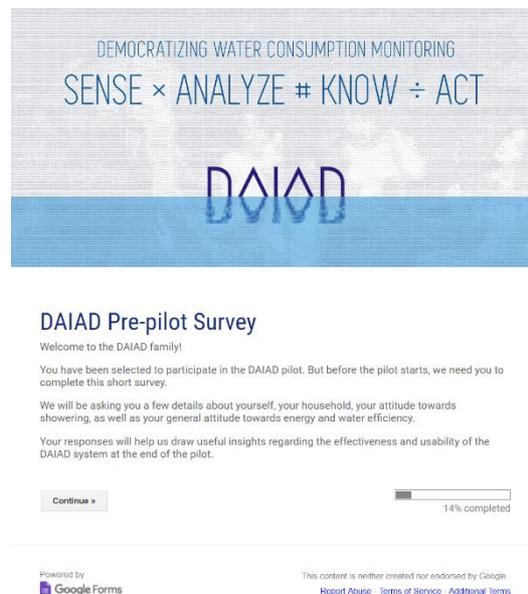


Figure 34: Expression of interest survey - Welcome screen

DAIAD Pre-pilot Survey
Welcome to the DAIAD family!
You have been selected to participate in the DAIAD pilot. But before the pilot starts, we need you to complete this short survey.
We will be asking you a few details about yourself, your household, your attitude towards showering, as well as your general attitude towards energy and water efficiency.
Your responses will help us draw useful insights regarding the effectiveness and usability of the DAIAD system at the end of the pilot.
**Required*

Your contact details
Your responses will be used to create your personal DAIAD user account!

1. **Name ***
.....

2. **Surname ***
.....

3. **Email ***
Please provide the email you used in the DAIAD Pilot Registration.
.....

4. **What is your age? ***
.....

Your household details
Your responses will help us relate water consumption with your household characteristics.

5. **How many members are there in your household? ***
Please specify the total number of your household members, including yourself. If you live alone, just select 1.
Mark only one oval.

1
 2
 3
 4
 5
 6
 7
 8
 9 or more

6. **How many of your household members are females? ***
Please specify the total number of adult females in household, including yourself (if you are a female).
Mark only one oval.

0
 1
 2
 3
 4
 5
 6
 7
 8
 9 or more

7. **How many of your household members are males? ***
Please specify the total number of adult males in household, including yourself (if you are a male).
Mark only one oval.

0
 1
 2
 3
 4
 5
 6
 7
 8
 9 or more

8. How many of your household members are minors? *

Hint: Minors are of age less than 18 years old.
Mark only one oval.

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9 or more

9. What is approximately your yearly household income before tax? *

Mark only one oval.

- Less than 25,000€
- 25,000€ - 30,000€
- 30,000€ - 35,000€
- 35,000€ - 40,000€
- 40,000€ - 48,000€
- 48,000€ - 56,000€
- 56,000€ - 62,000€
- 62,000€ - 108,000€
- More than 108,000€

10. Do you own or lease your residence? *

Mark only one oval.

- Own
- Lease
- Other

11. I consider my household's water consumption to be: *

Mark only one oval.

- Extremely high
- High
- Average
- Low
- Extremely low

19. How many minutes is water running for washing the dishes by hand per day? *

If you don't wash your dishes by hand just enter 0.

20. How many minutes is water running for outdoor activities per week (e.g. yard/garden watering system, car washing, etc.)? *

If you don't spend water for outdoor activities just enter 0.

Your attitude towards showering

Showers account for a large part of water consumption in a typical household.

Your responses will help us establish what you consider as a typical shower, as well as your overall attitude towards showering.

21. How many liters of water do you think you use in a typical shower during which you do not wash your hair? *

Hint: One typical bucket of water holds around 10 liters.

22. How many liters of water do you think you use in a typical shower during which you wash your hair? *

Hint: One typical bucket of water holds around 10 liters.

23. Assuming we compare your shower water consumption with 100 people who are similar with regard to sex and hair length, how many people do you think would use more water per shower than you? *

12. How often are you informed about the water consumption of your household? *

Mark only one oval.

- Whenever I want to
- At least every week
- At least every month
- At least every few months
- At least once a year
- I don't know, I don't really notice how much water I consume

Your typical household water use

Your responses will help us establish a baseline for the typical water consumption in your household.

When answering these questions, please consider the total number of your household members. Also, there is no need to be precise. Just give us your best estimate.

13. Number of showers taken in your household per week? *

Please include all showers from members of your household.

14. On average, how many minutes is the water running per shower? *

No need to be precise! Just give us your best estimate.

15. Number of baths taken in your household per month? *

Please include all baths from members of your household.

16. Toilet flushes in your household per day? *

Please include all flushes from members of your household.

17. How many times is the washing machine used per week? *

If you don't use a washing machine just enter 0.

18. How many times is the dishwasher used per week? *

If you don't use a dishwasher just enter 0.

24. How much do you agree with the following statements? *

Mark only one oval per row.

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
To me, showering means enjoyment, relaxation and well-being.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Showering is a necessary routine. Not cleaning my teeth is a must rather than a pleasure.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I look forward to my daily shower.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In general, I aim to reduce my energy and water consumption.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I expect to reduce my energy or water consumption while showering with the Smart Shower Meter.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Your attitude towards water and energy efficiency

Please provide us with some information about your personal attitude towards water and energy efficiency.

Your feedback will help us understand how DAAD can assist households to improve their energy and water consumption.

25. What is your opinion of environmental issues? *

Mark only one oval.

- It's just a trend, there is nothing really to worry about.
- There is some reason for concern, but I am not really interested.
- There is a need for policy measures from the government, which I fully support.
- I actively participate in actions to raise awareness in environmental challenges.
- I have no opinion.

26. Do you have eco-efficient washing appliances in your household? *

Hint: Consider the Energy Star or Water Factor Rating of your appliance.
Mark only one oval.

- Yes
- No
- I do not know

27. Do you have an eco-efficient shower head in your household? *

Hint: Consider either the case of electric shower or seated shower or the BMA label.
Mark only one oval.

- Yes
- No
- I do not know

28. Do you have a dual-flush in your household? *

Hint: Consider a High Efficiency Toilet (HET). Mark only one oval.

- Yes
- No
- I do not know

possible

No matter what other people do, I feel that I should reduce my water consumption as much as possible

I would have a bad conscience if I showered for too long

I would have a bad conscience if the shower was too hot

You and technology

Your responses will help us establish a baseline regarding your familiarity with new technologies, as well as your individual personality characteristics.

30. Please rate how well the following statements describe you. *

Mark only one oval per row.

	Not at all like me	Probably not like me	Somewhat like me	Exactly like me
I enjoy learning new computer programs and exploring new technologies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I am given an assignment requiring that I learn to use a new program or how to use a machine, I usually succeed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Solving technological problems seems like a fun challenge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Technology is my friend	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find most technology easy to learn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People expect me to know about technology and I don't want to let them down	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I relate well to technology and machines	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am comfortable learning new technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I know how to deal with technological malfunctions or problems	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel as up-to-date on technology as my peers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

29. How much do you agree with the following statements? *

Mark only one oval per row.

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
I often talk with others about saving energy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often talk with others about saving water	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have energy efficient devices and appliances in order to reduce my energy consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have water efficient devices and appliances in order to reduce my water consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am doing a lot to reduce my energy consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am doing a lot to reduce my water consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Changing my showering behavior could help reduce my energy consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Changing my showering behavior could help reduce my water consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I reduce water consumption while showering it will have an impact on my overall energy consumption	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I reduce water consumption while showering it will have an impact on the environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If I reduce water consumption while showering it will have an impact on my household budget	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People who are important to me think that I should save energy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People who are important to me think that I should save water	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People who are important to me do a lot to save energy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People who are important to me do a lot to save water	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In my current living status, it is difficult for me to pay attention on saving energy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In my current living status, it is difficult for me to pay attention on saving water	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
No matter what other people do, I feel that I should reduce my energy consumption as much as possible	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

31. How well do the following statements describe your personality? I see myself as someone who:

Mark only one oval per row.

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
is reserved	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
is generally trusting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
tends to be lazy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
is relaxed, handles stress well	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
has a few artistic interests	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
is outgoing and sociable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
tends to find fault with others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
does a thorough job	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
gets nervous easily	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
has an active imagination	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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8. Annex 4 – Installation instructions

Installing DAIAD

What you will need

-  10 minutes
-  Access to your hand shower
-  amphiro b1
-  Your mobile device

Ready? Let's go!

- Download and install DAIAD for your mobile device:
 - Search for DAIAD at the App Store or Play StoreOR
 - Scan this QR code
- Open the DAIAD application
- Sign up with your email
- Follow the on screen instructions!

That's it, you have successfully installed DAIAD!

Problems? Check daiad.eu/faq-en or reach us at contact@daiad.eu



[@DAIAD_EU](https://twitter.com/DAIAD_EU)  www.daiad.eu

  DAIAD is a research project funded by European Commission's 7th Framework Programme

9. Annex 5 — Mode management notifications

9.1. Phase 1 — Reminder

Hi DAIADers,

We are nearly there, hang in tight!

Please remember to take your mobile device with you whenever you take a shower! Each time open the DAIAD app, make sure Wi-Fi and Bluetooth are turned on, and just take your shower. Your mobile device should be near the shower (3-5 meters) and in a dry place.

Why this important?

Well, DAIAD is in 'learning mode' and appears to be inactive. However, in the background we collect your typical shower usage, or what we call your 'baseline'. This will allow us to understand how DAIAD affects your water use in the long-run.

And the only way to establish your baseline is if you take your mobile device in the shower!

If you already do that, you will soon exit the 'learning mode' and be able to start using DAIAD! Those who do not, will simply spend much more time in 'learning mode'.

Please remember that we would like to know about your experience. Tell us a bit at Twitter with the hashtag #water adding @Daiad_EU and @Waterwise.

Best,

The DAIAD Team

9.2. Phase 2 (b1 ON/mobile OFF)

Thank you for your patience, you can now start using DAIAD!

DAIAD has been in 'Learning mode' since you first installed it, collecting crucial information about your water consumption habits. This is why the mobile application and amphiro b1 were inactive!

Well, the learning period is now complete!

And we are moving to a new phase of the pilot:

- Your amphiro b1 will now activate itself, presenting you your water use, temperature, and shower efficiency.
- Your mobile application will remain inactive for a few more weeks.

DAIAD

Just follow these steps:

- Next time you plan on taking a shower, bring your mobile device with you.
- Open the DAIAD mobile app and make sure Bluetooth and WiFi are turned on.
- Leave your mobile device near the shower (within 3-5 meters) and just take your shower!
- If everything goes according to plan, the display of the amphiro b1 will start working after a few minutes!

That's it! From now on you can shower and learn in real-time how much water you use.

Just remember to bring your mobile device with you in the shower whenever possible, ideally in every shower. Make sure each time you open DAIAD's mobile application with Bluetooth and WiFi turned on. The mobile app will be inactive, but still wirelessly collect your shower data in the background!

Please remember that we would like to know about your experience. Tell us a bit at Twitter with the hashtag #water adding @Daiad_EU and @Waterwise.

Thank you for your support in testing and improving DAIAD! For any help you might need, just reach us at contact@daiad.eu.

Hope you enjoy using DAIAD!

Best,

The DAIAD Team

9.3. Phase 2 (b1 OFF/mobile ON)

Thank you for your patience, you can now start using DAIAD!

DAIAD has been in 'Learning mode' since you first installed it, collecting crucial information about your water consumption habits. This is why the mobile application and amphiro b1 were inactive!

Well, the learning period is now complete!

And we are moving to a new phase of the pilot:

- Your mobile application will now activate itself, presenting you with information about your water use!
- Your amphiro b1 will remain inactive for a few more weeks.

Just follow these steps:

- Next time you plan on taking a shower, bring your mobile device with you.
- Open the DAIAD mobile app and make sure Bluetooth and WiFi are turned on.
- Leave your mobile device near the shower (within 3-5 meters) and just take your shower!

That's it! From now on you can monitor your water use through DAIAD's mobile application.

You will find all sort of novel functionalities and features you can use. Feel free to explore them! We would like to give you detailed instructions on how to use them, but letting you discover the application is part of our experiment! :)

Just remember to bring your mobile device with you in the shower whenever possible, ideally in every shower. Make sure each time you open DAIAD's mobile application with Bluetooth and WiFi turned on. This way your shower data will be wirelessly collected from DAIAD's mobile application!

Please remember that we would like to know about your experience. Tell us a bit at Twitter with the hashtag #water adding @Daiad_EU and @Waterwise.

Thank you for your support in testing and improving DAIAD! For any help you might need, just reach us at contact@daiad.eu.

Hope you enjoy using DAIAD!

Best,

The DAIAD Team

9.4. Phase 3

We are very happy to announce that you now have full access to the complete DAIAD system!

The amphiro b1 and DAIAD mobile application will both be active, enabling you to monitor your water use wherever and whenever you want!

Just follow these steps:

- Next time you plan on taking a shower, bring your mobile device with you.
- Open the DAIAD mobile app and make sure Bluetooth and WiFi are turned on.
- Leave your mobile device near the shower (within 3-5 meters) and just take your shower!

That's it!

Just remember to bring your mobile device with you in the shower whenever possible, ideally in every shower. Make sure each time you open DAIAD's mobile application with Bluetooth and WiFi turned on.

Please remember that we would like to know about your experience. Tell us a bit at Twitter with the hashtag #water adding @Daiad_EU and @Waterwise.

You will be hearing from us again soon! We have lots of great new features in the pipeline, which will help you improve your water use.

Hope you enjoy using DAIAD!

Best,

The DAIAD Team

10. Annex 6 – Satisfaction survey

In this Annex we provide the complete list of questions and answers (*exported via printing the form, styling omitted*).

312017 Satisfaction Survey

Satisfaction Survey
**Required*

1. Your email address *

2. How would you rate your experience using the DAMAD system so far? *

Mark only one oval

Very satisfied
 Somewhat satisfied
 Neither satisfied nor dissatisfied
 Somewhat dissatisfied
 Very dissatisfied

3. Which of the following words would you use to describe the DAMAD system? You can select multiple words! *

Tick all that apply

Innovative
 Reliable
 Useful
 Unique
 Intuitive
 Poor quality
 Unreliable

4. How well does the DAMAD system meet your needs? *

Mark only one oval

Very well
 Rather well
 Neither well nor poor
 Rather poor
 Very poor

312017 Satisfaction Survey

6. According to your experience so far, how would you rate amphiro b1, DAMAD's intelligent shower monitor? *



Mark only one oval per row

	Very good	Rather good	Neither good nor poor	Rather poor	Very poor
Ease of installation	<input type="radio"/>				
Bluetooth connectivity	<input type="radio"/>				
Ease of use	<input type="radio"/>				
Practicality	<input type="radio"/>				
Usefulness	<input type="radio"/>				
Quality	<input type="radio"/>				

7. The smart shower meter shows different information. How easy was it to understand them? *

Mark only one oval per row

	Very easy	Easy	Neither easy nor difficult	Difficult	Very difficult
Temperature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water used	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Energy used	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Poller Bear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

8. Not all users are interested in the display elements in the same way. How much were you interested in the different elements on your smart shower meter? *

Mark only one oval per row

	Very interested	Interested	Neither interested nor uninterested	Uninterested	Very uninterested
Temperature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water used	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Energy used	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Poller Bear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Your final impressions

9. How likely is it that you would recommend the DAMAD system to a friend or a colleague? *

Mark only one oval

Very likely
 Somewhat likely
 Not sure
 Somewhat unlikely
 Very unlikely

312017 Satisfaction Survey

5. According to your experience so far, how would you rate DAMAD's mobile application? *



Mark only one oval per row

	Very Good	Rather good	Neither good nor poor	Rather Poor	Very Poor
Ease of installation	<input type="radio"/>				
Bluetooth connectivity	<input type="radio"/>				
Ease of use	<input type="radio"/>				
Practicality	<input type="radio"/>				
Usefulness	<input type="radio"/>				
Quality	<input type="radio"/>				

Skip to question 6.

Your amphiro b1
The following questions refer to your experience with the amphiro b1 device installed in your shower

312017 Satisfaction Survey

10. If you have any comments or ideas to improve DAMAD, please let us know!

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11. Annex 7: Annual evolution of KPIs

For completeness and to assist the reader, in the following sub-sections we have assembled the evolution of our KPIs in throughout the 12-month duration of the Trial.

11.1. Participants per Phase

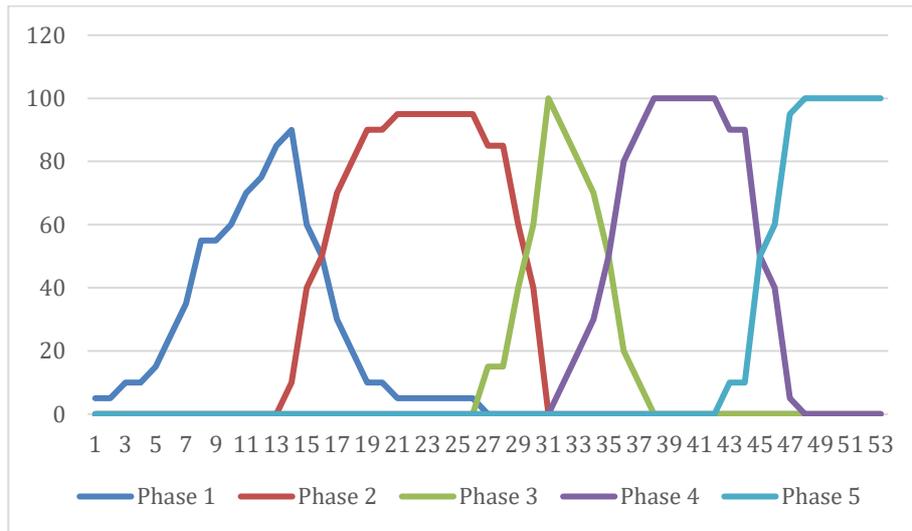


Figure 35: Distribution of participants per phase during Trial B (Y axes: % of panel population; X axes: week in M1-M12 of the Trial)

11.2. Water Consumption (shower)

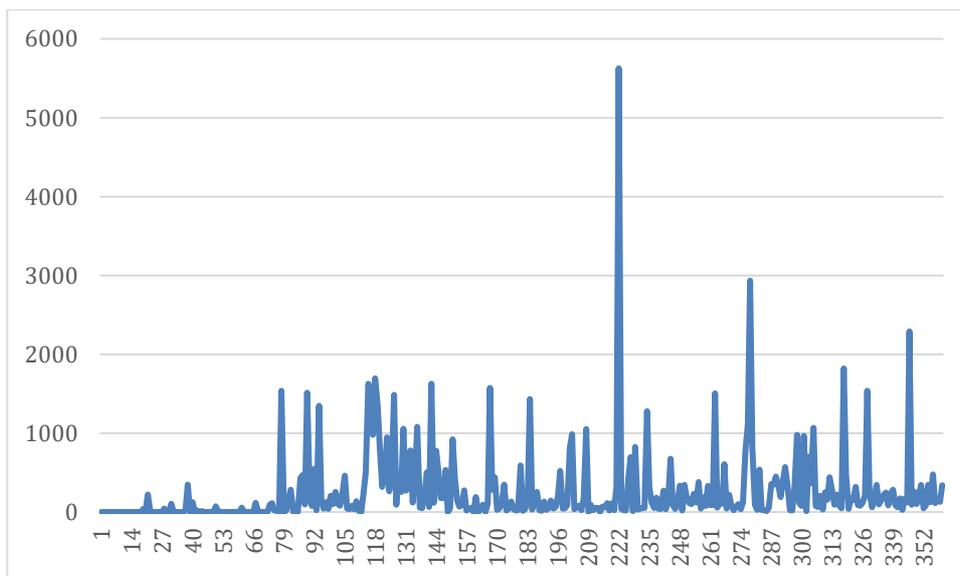


Figure 36: Total daily shower consumption for Trial B (liters) (Y axes: total shower consumption in liters; X axes: day in M1-M2 of the Trial)

11.3. Shower events

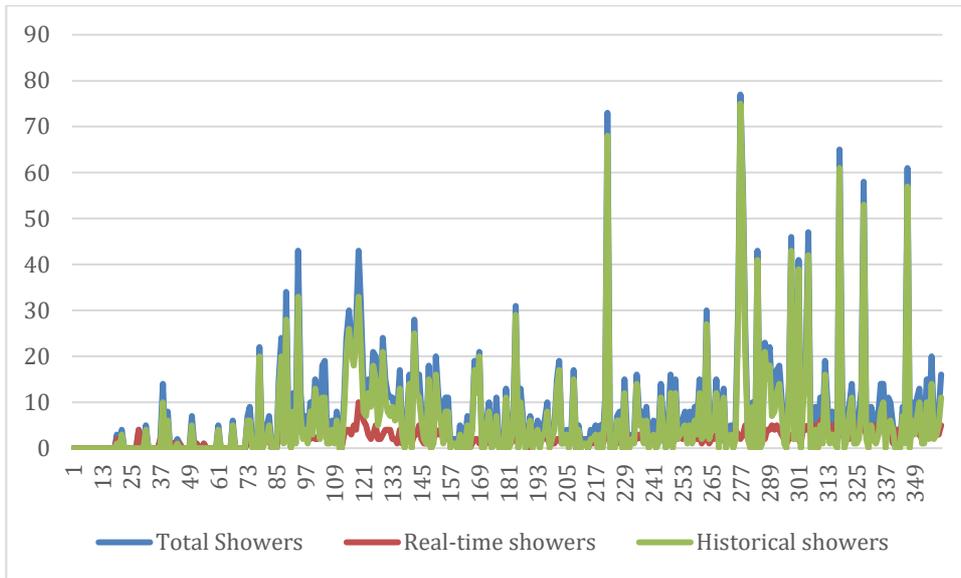


Figure 37: Shower events (total, real-time, historical) for Trial B (Y axes: number of shower events; X axes: day in M1-M12 of the Trial)

11.4. System availability (uptime)

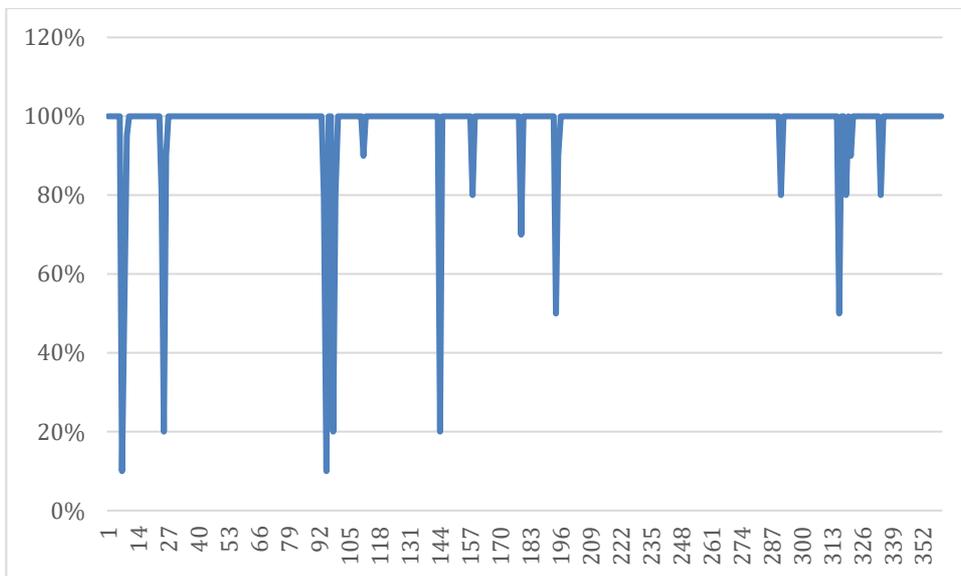


Figure 38: Daily system availability for Trial B(% of time within a day system was available) (% of time within a day system was available) (Y Axes: % of system availability; X axes: day in M1-M12 of the Trial)