<table>
<thead>
<tr>
<th>Document Ref.</th>
<th>D3.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document Type</td>
<td>Report</td>
</tr>
<tr>
<td>Work package</td>
<td>WP3</td>
</tr>
<tr>
<td>Lead Contractor</td>
<td>OVER</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Dimitrios Amaxilatis, Andreas Friedl, Joerg Hofstaetter, Jochen Kranzer, Nelly Leligou, Jimm Lerch, Mariano Leva, Georgios Mylonas, Katerina Papadopoulou, Adriano Cerocchi, Massimo Mecella, Giuseppe Bracone, Daniele Buonanno, Fabio Di Sabatino, Mariano Leva, Matteo Zaccagnino, Manos Zacharioudakis, Lidia Pocero</td>
</tr>
<tr>
<td>Contributing Partners</td>
<td>CTI, SK, EDOC, CNIT, SYN OVER, EA, SPARK, OVOS</td>
</tr>
<tr>
<td>Planned Delivery Date</td>
<td>July 31, 2017</td>
</tr>
<tr>
<td>Actual Delivery Date</td>
<td>August 10, 2017</td>
</tr>
<tr>
<td>Dissemination Level</td>
<td>Public</td>
</tr>
<tr>
<td>Status</td>
<td>Final</td>
</tr>
</tbody>
</table>

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement 696029.
Disclaimer

This document contains material, which is the copyright of certain GAIA contractors, and may not be reproduced or copied without permission. All GAIA consortium partners have agreed to the publication of this document. The commercial use of any information contained in this document may require a license from the proprietor of that information. The GAIA Consortium consists of the following partners:

<table>
<thead>
<tr>
<th>Partner No.</th>
<th>Name</th>
<th>Short Name</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Computer Technology Institute and Press “Diophantus”</td>
<td>CTI</td>
<td>Greece</td>
</tr>
<tr>
<td>2</td>
<td>Söderhamns Kommun</td>
<td>SK</td>
<td>Sweden</td>
</tr>
<tr>
<td>3</td>
<td>Eurodocs AB</td>
<td>EDOC</td>
<td>Sweden</td>
</tr>
<tr>
<td>4</td>
<td>National Interuniversity Consortium for Telecommunications</td>
<td>CNIT</td>
<td>Italy</td>
</tr>
<tr>
<td>5</td>
<td>Synelixis Solutions Ltd</td>
<td>SYN</td>
<td>Greece</td>
</tr>
<tr>
<td>6</td>
<td>OVER</td>
<td>OVER</td>
<td>Italy</td>
</tr>
<tr>
<td>7</td>
<td>Ellinogermaniki Agogi</td>
<td>EA</td>
<td>Greece</td>
</tr>
<tr>
<td>8</td>
<td>Spark Works ITC Ltd.</td>
<td>SPARK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>9</td>
<td>Ovos Media Consulting GmbH</td>
<td>OVOS</td>
<td>Austria</td>
</tr>
</tbody>
</table>

The information in this document is provided “as is” and no guarantee or warranty is given that the information is fit for any particular purpose. The user thereof uses the information at its sole risk and liability. This document reflects only the authors’ view and the EC and EASME are not responsible for any use that may be made of the information it contains.
### Document Revision History

<table>
<thead>
<tr>
<th>Date</th>
<th>Issue</th>
<th>Author/editor/contributor</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>30/05/2017</td>
<td>0.1</td>
<td>Adriano Cerocchi, Massimo Mecella, Giuseppe Bracone, Daniele Buonanno, Fabio Di Sabatino, Mariano Leva, Matteo Zaccagnino</td>
<td>Document Structure</td>
</tr>
<tr>
<td>28/06/2017</td>
<td>0.2</td>
<td>Dimitrios Amaxilatis, Andreas Friedl, Joerg Hofstaetter, Jochen Kranzer, Nelly Leligou, Jirm Lerch, Mariano Leva, Georgios Mylonas, Katerina Papadopoulou, Adriano Cerocchi, Massimo Mecella, Giuseppe Bracone, Daniele Buonanno, Fabio Di Sabatino, Mariano Leva, Matteo Zaccagnino</td>
<td>First Draft</td>
</tr>
<tr>
<td>13/07/2017</td>
<td>0.3</td>
<td>Dimitrios Amaxilatis, Andreas Friedl, Joerg Hofstaetter, Jochen Kranzer, Nelly Leligou, Jirm Lerch, Mariano Leva, Georgios Mylonas, Katerina Papadopoulou, Adriano Cerocchi, Massimo Mecella, Giuseppe Bracone, Daniele Buonanno, Fabio Di Sabatino, Mariano Leva, Matteo Zaccagnino</td>
<td>Second Draft</td>
</tr>
<tr>
<td>27/07/2017</td>
<td>0.4</td>
<td>Dimitrios Amaxilatis, Andreas Friedl, Joerg Hofstaetter, Jochen Kranzer, Nelly Leligou, Jirm Lerch, Mariano Leva, Georgios Mylonas, Katerina Papadopoulou, Adriano Cerocchi, Massimo Mecella, Giuseppe Bracone, Daniele Buonanno, Fabio Di Sabatino, Mariano Leva, Matteo Zaccagnino</td>
<td>Third Draft</td>
</tr>
<tr>
<td>03/08/2017</td>
<td>1.0</td>
<td>Dimitrios Amaxilatis, Andreas Friedl, Joerg Hofstaetter, Jochen Kranzer, Nelly Leligou, Jirm Lerch, Mariano Leva, Georgios Mylonas, Katerina Papadopoulou, Adriano Cerocchi, Massimo Mecella, Giuseppe Bracone, Daniele Buonanno, Fabio Di Sabatino, Mariano Leva, Matteo Zaccagnino</td>
<td>Final Version</td>
</tr>
</tbody>
</table>
### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>Authentication &amp; Authorization</td>
</tr>
<tr>
<td>AMQP</td>
<td>Advanced Message Queuing Protocol</td>
</tr>
<tr>
<td>API</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>AS</td>
<td>Authorization Server</td>
</tr>
<tr>
<td>CRUD</td>
<td>Create Read Update Delete</td>
</tr>
<tr>
<td>DB</td>
<td>Database</td>
</tr>
<tr>
<td>GUI</td>
<td>Graphical User Interface</td>
</tr>
<tr>
<td>HTTP</td>
<td>Hypertext Transfer Protocol</td>
</tr>
<tr>
<td>REST</td>
<td>Representational State Transfer</td>
</tr>
<tr>
<td>URI</td>
<td>Uniform Resource Identifier</td>
</tr>
<tr>
<td>WP</td>
<td>Work Package</td>
</tr>
</tbody>
</table>
Executive summary

The aim of GAIA is to raise awareness, educate, motivate, engage and enable measurements of energy and resource efficiency. The applications that can be used as tools to do so in the school communities are developed in WP3 and are presented in this deliverable. These applications include:

- a serious game also known as the GAIA Challenge which aims to raise awareness/educate and prompt the school communities act efficiently,
- a social networking game which aims at engaging people both from the communities and outside them in energy efficiency campaigns prompting them to learn about energy efficiency,
- a web application, called the Building Manager Application, that allows for monitoring the real energy consumption of the schools and correlate it with the school activities, allowing them to define rules and be notified when these are violated; this application is also used by the school communities to experiment with energy efficiency, and,
- a participatory sensing application which allows the member of the communities to enter reading from sensors; this enables better understanding for the involved parameters and also the value of cooperation.

The design for the GAIA application set has been conducted in the first 12 months of the project, as reported in Deliverable D3.1, describing the application prototypes. The developed versions have undergone a degree of testing by GAIA end-users in two forms:

- GAIA workshops: the consortium has organized a series of workshops and meetings with the educators involved
- GAIA mini trials: During these trials, we had the opportunity to collect valuable feedback so as to refine the design of the applications and guided the development of the current version which will be used in the GAIA trials (starting in September).

The GAIA applications allow the school communities’ leaders to decide which, when and how to use each application, so as to shape the behavior of the school members. To ensure that all trial scenarios can be met, the individual scenarios defined in WP4 were examined and content for the GAIA Challenge has been prepared and translated in the pilot target languages apart from English, which mandated close collaboration with teachers and huge effort for transforming educational scenarios to content suitable for the GAIA challenge mechanics as well for translating it. For all of the three applications, the source code and the manuals/tutorials are openly available through the GAIA website and GitHub.

In this document, which is a progression from the initial application design contained in Deliverable D3.1, we briefly discuss the potential combination of applications, which can be exploited to accomplish the GAIA goals. All applications are provided in the languages requested by the partners involved in the trials and the manuals were translated in these languages respectively.

Finally, as the project enters its main phase of trials, there will be additional findings regarding the use of the applications and potential improvements, that will be integrated into the application set by the
time the final version of the GAIA applications will be delivered. We expect that feedback from the end-users will be of great help to the consortium to create an even better and richer final result. Also, there is a number of schools in Greece that are going to participate to a certain degree to the project without having GAIA IoT infrastructure installed. We are going to continue adding features to our applications, in order to accommodate this kind of users as well.
# Table of Contents

1  Introduction  11
2  Community Engagement and Social Networking Game  14
   2.1  Overview  14
      Scavenger Hunt #Hashtag game  14
         Gameplay  14
   2.2  Use Cases  17
      Social Networks Overview  17
         Facebook  18
         Twitter  18
         Instagram  18
         Google+  19
         Snapchat  19
         YouTube  19
         Reddit  19
         Imgur  19
   2.3  Requirements  19
   2.4  Hardware and Software Prerequisites  20
   2.5  Download  21
   2.6  Installation  21
   2.7  Configuration  21
   2.8  User Guide  21
      #ScavengerHunt  25
      GAIA Website  27
      Twitter/Facebook/Instagram  27
      Social Media gameplay  28
         Facebook  28
         Twitter  29
         Instagram  30
   2.9  Tutorial  30
   2.10  Tracking user involvement  30
3  Educational Serious Game  32
3.1 Overview

Unified Terminology
Interface Design Quest Templates, Results & Profile (web & mobile)
Language Versions

3.2 Concept changes according to feedback

Mission Teams
Community Dashboard
Content overview

3.3 Use Cases

3.4 Requirements

3.5 Hardware and Software Prerequisites

Operating System
Browser
JavaScript
Hardware

3.6 Download and Installation

Responsive design

3.7 Configuration

Group configuration
Backend configuration
Technologies in use

3.8 User guide

Navigation
Join Mission Team
My profile
Help
About
Logout
My Quest
Playing a quest
Knowledge Missions
Action Missions
Submitting Snapshots & Portfolios
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snapshots</td>
<td>55</td>
</tr>
<tr>
<td>Portfolios</td>
<td>56</td>
</tr>
<tr>
<td>My Community</td>
<td>57</td>
</tr>
<tr>
<td>Mission Team Management</td>
<td>60</td>
</tr>
<tr>
<td>Group Management</td>
<td>60</td>
</tr>
<tr>
<td>Team List</td>
<td>60</td>
</tr>
<tr>
<td>Starting Action Missions</td>
<td>60</td>
</tr>
<tr>
<td>Submitting a Portfolio</td>
<td>60</td>
</tr>
<tr>
<td>Create Group</td>
<td>60</td>
</tr>
<tr>
<td>Settings</td>
<td>60</td>
</tr>
<tr>
<td>3.9 Tutorials</td>
<td>64</td>
</tr>
<tr>
<td>3.10 Tracking user involvement</td>
<td>64</td>
</tr>
<tr>
<td>4 Building Manager Application</td>
<td>66</td>
</tr>
<tr>
<td>4.1 Overview - Introduction</td>
<td>66</td>
</tr>
<tr>
<td>4.2 Use cases</td>
<td>66</td>
</tr>
<tr>
<td>4.3 Requirements</td>
<td>69</td>
</tr>
<tr>
<td>4.4 Hardware and Software Prerequisites</td>
<td>73</td>
</tr>
<tr>
<td>4.5 Download</td>
<td>74</td>
</tr>
<tr>
<td>4.6 Installation</td>
<td>74</td>
</tr>
<tr>
<td>4.7 Configuration</td>
<td>75</td>
</tr>
<tr>
<td>4.8 User guide</td>
<td>75</td>
</tr>
<tr>
<td>Login</td>
<td>75</td>
</tr>
<tr>
<td>Edit Building</td>
<td>77</td>
</tr>
<tr>
<td>Floorplan</td>
<td>80</td>
</tr>
<tr>
<td>Sensors</td>
<td>81</td>
</tr>
<tr>
<td>Alert Rules</td>
<td>83</td>
</tr>
<tr>
<td>Comparison</td>
<td>84</td>
</tr>
<tr>
<td>Mobile applications</td>
<td>85</td>
</tr>
<tr>
<td>4.9 Tutorials</td>
<td>87</td>
</tr>
<tr>
<td>4.10 Tracking user involvement</td>
<td>87</td>
</tr>
<tr>
<td>5 The GAIA applications grid</td>
<td>89</td>
</tr>
<tr>
<td>6 Conclusions</td>
<td>93</td>
</tr>
<tr>
<td>7 References</td>
<td>94</td>
</tr>
</tbody>
</table>
Annex 1 95
Building Management Application User Feedback 95
User requirements gathering - First Building Management Application Questionnaire 95
Question Summary and Response Presentation 95
Comments on the feedback 98
Pre-trial Evaluation - Second Building Management Application Questionnaire 99
Comments on the feedback 101
Annex 2 102
GAIA Challenge User Feedback 102
Annex 3 105
GAIA #ScavengerHunt User Feedback 105
1 Introduction

This deliverable comprises the first complete version of the GAIA applications, which are developed in the framework of WP3 (all of its three tasks), that will be available to end-users. As it is of demonstrator type, exactly as D3.1, this document is accompanying the open source code of the applications, which are openly available through GitHub. This document also presents the specifications of the prototypes. It essentially summarizes the work of task T3.1, 3.2 and 3.3 until M18 (i.e., July 2017). The main difference with D3.1 is that

- it describes changes to the design that reflect the feedback received from the mini-trials that took place in the first period of the project (i.e., March-May 2017).
- it provides additional details as all WP2 components are ready and fully integrated
- it describes the interconnection and relation between the three different application/channels/means to raise awareness, educate and shape behavior.

The applications, that have been developed during this time period, have already been delivered to the communities, as well as relevant manuals/tutorials both in the form of videos and documents have been prepared and are referenced in this deliverable.

The structure of this deliverable is as follows:

- A separate chapter is devoted to each application including all stages: starting from an overview, mainly reflecting what was initially described in D3.1, proceeding to the use cases which have been updated to reflect users’ feedback and the more mature trial scenarios, the revised requirements, the hardware and software prerequisites, the download chapter, where links to the (open source) code repository are included, installation and configuration guidelines, and finally, user guides and tutorials, primarily providing links to the online resources available.
- Once the applications are described their interconnection and possible uses are discussed in chapter 5 with conclusions drawn in chapter 6.
- With respect to tutorials/presentation and videos, these have been published in the GAIA web site. Namely, under Resources/Presentation\(^1\), multiple presentations exist presenting all GAIA applications and under Gallery/Videos\(^2\), tutorial videos for each GAIA application have been uploaded, as shown in the following figure.

---

The *Annexes* include details about the feedback collected from the users regarding the applications. Namely, Annex 1 contains feedback from the building managers before and after the building manager application has been demonstrated to them in GAIA workshops and GAIA mini trials. More details about the mini trials specifically will be provided in D4.2.
The interrelation between WP3 and the rest of WPs is as follows and as also shown in the following figure:

- The design of the applications was based initially (in D3.1) on the outcomes of WP1 and then (in this document) on work done in WP4 (mini-trials and trial scenarios).
- The applications developed in WP3 were delivered to WP4 for testing and trials.
- The building manager application development consumes services developed in WP2; it is, in essence, the User Interface/front-end of several of the components developed in WP2.
- The social networking game is tightly coupled with WP5 activities; the main difference is that in WP3 the game is used by the communities to compete and the relevant scores can/will be taken into account in the GAIA challenge, while in WP5 the social networking game will be used to engage the large audiences.

![Figure 3. WPs interaction](image-url)
2 Community Engagement and Social Networking Game

2.1 Overview

Scavenger Hunt #Hashtag game

The Community Engagement and Social Networking Game (Connectome game) and the Educational Serious Game share ideas and goals that go hand in hand with each other. They share the concepts of raising awareness, sharing information, expressions of creativity and competition. In an effort to promote the similarities, yet remain separated we will be using a mobile-responsive website that functions like an app on smartphones and tablets and as a website on computers that will host the SocNetComEn game, a type of web scavenger hunt using #hashtags for tracking purposes, and will also have additional GAIA-related resources available as well as a place where we can share the student-created content from the educational serious game.

Through the use of the game and interrelated activities within WP5 (Dissemination and Exploitation), utilizing various social networks and websites, the Community Engagement Social Network Game aims to:

- Make the offerings of GAIA known to a wider audience;
- Raise awareness about energy efficiency among users that, through active participation, promotes behavioral change;
- Create a unique environment to participate with GAIA;
- Attract a wider base of participants beyond the target groups within the trials;
- Provide an additional means to interact with our community;
- Allow for our metrics, methods and results to be shared across more social networks;
- Promote return/continued visits;
- Motivate the community, even trial participants in the Educational Serious Game, to engage and play; and,
- Be fun!

Gameplay

As mentioned above, the SocNetComEn Game is a web-based scavenger hunt, where players will be asked within the game to do one of the following on a weekly basis:

- Look for a specific thing or things,
- Find an answer to a question,
- Complete a certain task,
- Create a unique image/GIF/video, or
- Analyze and share something.
Online players from different countries are asked to answer certain weekly questions, or undertake certain activities via their respective personal social media accounts (primarily targeting Facebook, Instagram and Twitter, but others can be used as well). Their responses to these weekly scavenger hunts will include two types of hashtags. One hashtag will be specifically related to each particular question/activity, while the other hashtag will signify the user’s respective country. The question/activity hashtag will be used to track the question and the country hashtag will be used to track the score for that country which will be shared on our project website as well as through social media in order to provide for some motivation to participate through a type of national competition. The intended goal is that this game will ask the players to do some work finding the answer by conducting deeper exploration of information on not only project-centred information on our website and various social networking accounts, but also other online locations so that they may learn more about issues central to GAIA’s goals in order to effect behavioral change due to increased issue awareness. Examples are shared below and may be directly accessed in the app.

An interesting aspect with the way this game has been developed is that in order to play, one does not necessarily need to use this application, as the questions will be dispersed across our social media accounts and allow for anyone, anywhere to play or even use the concept within the framework of action missions within the GAIA Challenge. We will naturally encourage the use of this application, as it holds a repository of student-created content from the GAIA Challenge, but the #Scavenger Hunt game itself is an all-inclusive activity designed to broaden the reach of not only the message of our consortium, but the larger issues in the promotion of not only energy efficiency, but green awareness in general. Additionally, some of the tasks may involve the use of some data generated from the Building Manager Application to promote and share this to a wider audience.
The #ScavengerHunt game will function as follows:

**How the #ScavengerHunt Works:**

*Figure 4. Scavenger Hunt*

This platform has been tested and used by EDOC for a few years now. Additionally, there are various sections within this application for SocNetComEn game that will be expanded upon, section by section, in this document.

- **GAIA Scavenger Hunt** - This is the SocNetComEn game that is the primary activity of use for this application.
- **GAIA Challenge Weekly Gallery** - This is a collection of some of the student-created content from the Educational Serious Game (T3.2).
- **GAIA Website** - Will directly open the GAIA Website.
- **Twitter** - Will directly open to the GAIA Twitter page to allow for direct posting.
- **Facebook** - Will directly open to the GAIA Facebook page to allow for direct posting.
- **Instagram** – Will directly open to the GAIA Instagram page to allow for direct posting.

Additional sections may be added as needed (such as a polling feature for direct player interaction and feedback, which was used during the mini trials with the students), but this app is not intended to mirror the website, but to be an additional tool/resource to direct players to discover our website and social media presences as well as to persuade the players to explore other website dealing with environmental issues.
the core issues of our project. Also, at this stage we are keeping the app pretty lightweight to prepare for the large amount of images that will be shared throughout the course of the trials during the upcoming year.

With respect to changes since D3.1, two initial placeholder sections, school info and meters, were removed for the sake of both focusing the app more on the games, as well as for load issues. It is possible, however, that these sections may be added again within the app once the trials begin if we find a need for an interesting way to utilize them. Also, the layout was changed to have a more modern feel to it and may also have a different look over the period of the trials.

2.2 Use Cases

The four use cases initially defined in D3.1 still apply. However, we have added an additional use case (5) that is related directly to the Educational Serious Game.

**UC-1: Teacher shares the #ScavengerHunt link with their class**
This is the optimal scenario for the use of this game as it will enhance the educational experience with some online searching and solving scenarios.

**UC-2: Student tells friends, parents, and/or family members about the #ScavengerHunt**
This will increase not only the level of information spread, but also encourage return visits along with the opportunity to raise awareness through discussion.

**UC-3: Random person online sees Tweets or FB/Instagram posts with interesting hashtags and participates**
This scenario is important for the level of information spreading and viral penetration.

**UC-4: GAIA content manager uploads latest hunt**
The interface is easy to use for the addition of the weekly challenges in multiple languages across all platforms.

**UC-5: Teacher starts a #ScavengerHunt as an “Action Mission”**
This instance has a teacher challenge their students, either as a class or as groups within a class, to create their own #ScavengerHunt with a question and a specific hashtag for tracking as a part of the action mission within the GAIA Challenge (more is discussed about this in the respective GAIA Challenge section of this document).

Social Networks Overview

As social networks are the key to this game, it is critical to understand which social networks will be used and how. Social network pages created for information sharing relating to Tasks 3.1 and 3.2 with an explanation of how each will be used follows:
Facebook

- As stated in the DoW, this will be one of our primary outlets for sharing not only Project-wide dissemination information, but also daily posts, the latest Scavenger Hunt challenge and promoting overall GAIA engagement and interaction.
- The hope is that students, parents, teachers, community members will follow our page. Once they have followed, any posts that we make will show up in their respective newsfeeds (the heart and soul of FB), unless they have their notifications turned off.
- The goal will be for them to “like” and/or “comment” on our post(s). Whenever there is an interaction like that, the post may gain further reach and could show up in the newsfeeds of their friends (FB algorithm controls this). If they decide to “share” our post, it will certainly show up in the newsfeeds of their friend and possibly friends of friends.
- Scavenger Hunt participants will receive some monthly “shout outs” on #FollowerFridays.
- Now that FB has live stream capabilities for verified pages, our followers can be notified when we are casting and join in the conversation (similar to Periscope mentioned below).
- The tracking of reach is easily seen through FB analytics and may further be tracked via #hashtags.
- An addition to the general Facebook page will be the addition of a specific “Tab” that will allow us to prominently display some metering information directly to Facebook.

Twitter

- Also mentioned in the DoW, this will serve a similar as FB as this will also be one of our primary outlets for sharing not only Project-wide dissemination information, but also daily posts, and promoting GAIA engagement and interaction.
- The hope is that students, parents, teachers, community members will follow our account so that our tweets will show up in their individual newsfeed.
- The goal will be for the target audience(s) to like and, especially, retweet our posts so that the post would show in the private newsfeeds of their respective followers.
- Scavenger Hunt participants will receive some monthly “shout outs” on #FollowerFridays.
- An interesting feature is that we can make a list of any twitter accounts (individuals, companies, organizations, etc.) that we believe have an interest in what we are undertaking in GAIA. This will begin our digital building of the Network of Stakeholders as well as reach accounts we may not normally reach (everyone like being added to a list and often follows).
- An additional interesting feature is that we can use their add-on, Periscope, for monthly live conversations, if that is desired.
- The tracking of reach is relatively simple with direct info on each post, but also via the #hashtags we will use.

Instagram

- A popular photo-sharing network that has a gallery where we will share our Snapshot messages in .jpg form to a wide audience with the smart usage of specific green awareness related #hashtags.
- Obviously, #hashtag friendly.
Google+
- This network is not actively used by many people, but it is worth using due to the simplicity of sharing information, tracking reach and potentially reaching people in other “circles” that are interested in the issues GAIA is addressing as well as sharing videos from our YouTube channel.
- Easy tracking of reach and also #hashtag friendly

Snapchat
- The majority of children across Europe uses this specific social network. While many have the other social networks mentioned here, studies are continually showing more and more time being spent in this time limited, fun-filtered, photo-sharing network.
- The goal is to have an on-demand geo-filters account where our Snapchat followers will easily be able to share our messages with their friends.
- Not #hashtag friendly, but reach is trackable otherwise and it is important for reaching many in our target group.

YouTube
- Video sharing network where we can create/publish our own videos explaining any number of activities/items within the project.
- Also we can highlight student-created videos and/or create playlists relating to various topics important to GAIA.
- Easy tracking of reach and very #Hashtag friendly

Reddit
- Reddit is a chat forum that is divided into various sections (subedits), where people from around the world discuss, often at length, very issues that is important to them. This is where we will host a subreddit on green awareness under the /r/environment section.

Imgur
- This is a fun network for sharing images and memes. Our main use here would be when we decide to have a meme creation competition for the Scavenger Hunt.

2.3 Requirements

Considering that the Social Networking and Community Engagement game (#ScavengerHunt) has been created for play by not only trial participants to enhance their participatory experience, but for friends, family and the entire online community as a whole, we have created it in such a way that it will be easy to be spread via many forms of social media or even just word of mouth. This makes for the game to have the built-in potential to become far-reaching in order to touch a wider audience than our trial schools alone.

The use of the mobile-responsive web application will be promoted, as there is additional information located within it, but it is not required to be used in order to play the game as it is only the #hashtags that are tracked and counted. Also, there is no requirement for downloading or the need for any type
of registration other than an Internet-connected web browser on an iOS, Android or Windows phone or any computer.

There are no APIs that need to be integrated as the metering information will come directly from the GAIA website. Additionally, the tracking of the hashtags will be done using features already available on the respective social networks and neatly compiled in Hootsuite (widely used by other projects).

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Component Involved</th>
<th>Priority</th>
<th>Relevant Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The GAIA #ScavengerHunt can be accessed through web browsers on desktop computers, laptops (Windows, MacOS and Linux) along with tablets and smartphones (iOS, Android and Windows Phone).</td>
<td>frontend</td>
<td>H</td>
<td>UC-1, UC-2, UC-3</td>
</tr>
<tr>
<td>2</td>
<td>The GAIA #ScavengerHunt has links to the primary social networks (Facebook, Twitter, Instagram) to be used in the game.</td>
<td>frontend</td>
<td>M</td>
<td>UC-1, UC-2, UC-3</td>
</tr>
<tr>
<td>3</td>
<td>General information about the GAIA #ScavengerHunt can be found on the public GAIA website and game landing page.</td>
<td>frontend</td>
<td>M</td>
<td>UC-1, UC-2, UC-3</td>
</tr>
<tr>
<td>4</td>
<td>The GAIA #ScavengerHunt backend has an easy to use interface for editing and adding weekly challenges on the landing page.</td>
<td>backend</td>
<td>M</td>
<td>UC-4</td>
</tr>
</tbody>
</table>

2.4 Hardware and Software Prerequisites

The mobile responsive website is Android, iOS and Windows phone compatible with standard browsers. On mobile devices the GAIA #ScavengerHunt supports:

- Google Android "KitKat" 4.4 or newer
- Apple iOS 9 or newer
- Windows Phone 8.1 and Windows 10 Mobile

Browsers supported are the latest generations of:

- Safari
- Opera Mini

Page 20 of 107
Other mobile browsers should work, but have not been tested at length.

2.5 Download

The prospective player will be directed to scan the QR code for our app or may directly type the website into the browser of either their mobile phone or their computer. The #ScavengerHunt game is located by typing the following address into any web browser on a smartphone: http://gaia.eurodocs.net or by scanning the QR code below with your mobile.

![QR Code]

2.6 Installation

Considering this is built as a flexible mobile responsive website, this will function like an app that is Android, iOS and Windows phone compatible and also works on tablets. It also functions on desktop computers, but it is not built specifically for that.

2.7 Configuration

Once the App opens, the player will be asked to choose their language. Also, the app itself may identify the player’s preferred language from their mobile and make the language choice for them, but they will always have the option of switching languages at will.

After the language has been chosen the main screen will appear. The CSS is completely customizable, so we will probably move to a more modern feel that can have some similarities with the layout of the Educational Serious Game to provide a sense of cohesion, but to not be confused with it. This platform has been tested and used by EDOC for a few years now without any major technological flaws that hampered its usability.

2.8 User Guide

Taking a look at the images below, you will see the icon on the landing page once the site has been
visited. After clicking on the Icon the splash-screen for the Community Engagement and Social Networking game will appear for about 2-5 second and then the front page will appear. Now the front page has loaded (see below). The image on the left is the initial landing page, while the image on the right is a scrolled view of the rest of the front page.

Figure 5. Community Engagement and Social Networking game splash screen

Figure 6. Community Engagement and Social Networking game icon
Figure 7. Community Engagement and Social Networking game front page

The image below demonstrates what will happen when you press the menu button on the top left of the navigation bar. The menu button is locked in that position throughout the app for ease of navigation. The menu may be closed by pressing the button again or swiping left on the screen.
As you can see, there are a few buttons to guide you deeper into the app. We will briefly state what they are for and will go into more detail, section by section.

- **#ScavengerHunt** - This is the SocNetComEn game, the primary function of this app.
- **GAIA Challenge Weekly Gallery** - This is a collection of some of the student-created content from the Educational Serious Game (T3.2).
- **GAIA Website** - Will directly open the GAIA Website.
- **Twitter** - Will directly open to the GAIA Twitter page to allow for direct posting.
- **Facebook** - Will directly open to the GAIA Facebook page to allow for direct posting.
- **Instagram** - Will directly open to the GAIA Instagram page to allow for direct posting.

Additional sections may be added later (such as a polling feature for direct player interaction and feedback), but this app is not intended to mirror our website, but to be an additional tool/resource to direct players to discover our website and social media presences as well as to persuade the players to explore other websites and social media accounts dealing with the core issues of our project. Also, at this stage we are trying to keep the app pretty lightweight to prepare for the large amount of images that will be shared here. Let’s look more in depth at each section.
#ScavengerHunt

Once the button has been pressed, the instruction screen for the Scavenger will appear and the initial sample hunts may be swiped up. Below the instructions on how to play the game, will be the list of Scavenger Hunts. The instructions for the game, as written within the app are:

We're very excited about our new GAIA Scavenger Hunt game pitting country versus country in a web/social media scavenger hunt.

**How does it work?**

Every week a new challenge will be issued for you to find and share back with us. These challenges may consist of something as simple as finding an answer within a post that we have shared on our website, Twitter, Instagram, Facebook or other social media network to something more complex like finding or calculating a specific measurement that one of our school-based metering devices/sensors have recorded during the week.

After you have tracked down what you think is the correct answer, you will post that answer to us on Twitter [@EU_GAIA], Instagram (EU_GAIA_Project) or Facebook (@EUGAIAProject) with that week's specific #Hashtag along with the hashtag of your country, like: #Greece, #Italy, #Sweden, etc.

Sounds easy, but we will be making this increasingly more challenging throughout the school year and make you dig!

If you're ready to have some fun and even learn something along the way...play the GAIA Scavenger Hunt!

We will add an additional objective to hunt every week, but that may be increased depending on subject matter and popularity. Each hunt will attempt to coincide with the topic in the Educational Serious game and/or teacher curriculum (e.g., heat usage and related energy costs, electricity usage for lighting versus natural light, etc.), but that may not always be the case. Occasionally, there will be holiday or theme weeks that will receive attention, like energy consumption over Christmas or awareness raising regarding Earth Day or bike to school weeks.
Figure 9. Community Engagement and Social Networking game instructions
GAIA Challenge Weekly Gallery

This section will handle the Social Network sharing activities within Task 3.2. It involves the modification, editing and sharing of student created Snapshots to various forms of social media without any identifying aspect of the student(s) involved in the creations. To be more precise (and as mentioned within the DoW), along with obvious sharing on the GAIA website and through the larger channels of Facebook and Twitter, the edited/modified snapshots will also be shared to Snapchat and Instagram along with a periodic (weekly or monthly) montage on YouTube. Below are examples of what the gallery will look like (on the left) and a sample image with caption on the right.

![Community Engagement and Social Networking gallery](image)

**Figure 10. Community Engagement and Social Networking game gallery**

GAIA Website
Jump-off link to our project website.

Twitter/Facebook/Instagram
Jump-off link to our Primary Social Networks.
Social Media gameplay

As mentioned previously, we will make use of a wide variety of social networks for a couple of reasons. We want to increase our scope of reach (casting a wide net) beyond our trial participants to include not only the local community where the schools are located, but also the wider community of potentially interested stakeholders on the web that may not otherwise be aware of our project. Also, as outlined above, different social networks have different abilities regarding the use of #hashtags and we will cover the big three of Facebook, Twitter and Instagram. Below we have an example of how the #ScavengerHunt will work for anyone, without the use of this app, as we are concerned with tracking the hashtags across the various networks.

Figure 11. Community Engagement and Social Networking game Facebook page
Figure 12. Community Engagement and Social Networking game Twitter profile
2.9 Tutorial

The tutorial video is available on the project website under gallery/videos, and on YouTube as well: http://youtu.be/WlodC6avUVI?hd=1

2.10 Tracking user involvement

While a detailed list of the respective GAIA components used to reach the KPIs is available in Deliverable D3.1, we will share those directly related to the social network and community engagement game. Such as:

The KPIs in scope of the GAIA Challenge are listed below.

- GB.1 (time spent using the web portal)
- GB.2 (persons using web portal)
- GB.3 (sessions per user)
- GB.4 (session duration)
- GB.5 (cohort analysis - hashtags)
- ED.7 (#parents/relatives or friends indirectly involved - hashtags)
The following user data can be tracked from the application (beyond the tracking of hashtags across social media networks):

- Date/Time of launch
- Page(s) visited
- Operating system used for app launch
3 Educational Serious Game

3.1 Overview

The Educational Serious Game - the GAIA Challenge - provides a gamified learning environment for both individual users such as students, teachers, family members and friends, as well as for user groups such as school classes. It is an online platform and can be accessed via desktop computers, laptops and tablets. The concept behind the GAIA Challenge is to create awareness on the ubiquity of energy consumption and on our responsibilities in regards to environmental habits. The game aims to reinforce the message that behavioral change can have an influence on energy consumption and to teach concrete measures on how energy consumption can be optimized.

The core concept of the educational serious game including specifications on individual mechanics were already described in more detail at D3.1. This document focusses on pointing out the changes and adaptations since then. The feedback from students and teachers during the mini trials as well as from the GAIA partners and internal feedback loops resulted in some changes in the concept following an iterative process. While complexity was significantly reduced the core gameplay mechanics which received exclusively positive feedback were maintained. Overall, it can be said that the GAIA Challenge was received well. Details on the user feedback can be found in Annex 2.

It is stressed that while in this chapter the focus is on the design /structure and on the technological development of the GAIA challenge, an equally important (and effort consuming) task was the development of pedagogically valuable content, which had to cover target groups of different age, different cultures and languages. This required very close collaboration with the teachers, transformation of their ideas to content suitable to the GAIA challenge structure and finally translation in multiple languages.

Unified Terminology

In order to optimize communication and feedback loops we agreed on a unified terminology:

Page 32 of 107
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAIA Challenge</td>
<td>the Educational Serious Game</td>
</tr>
<tr>
<td>mission</td>
<td>the action-and- content units in the Challenge, a mission contains a set of tasks</td>
</tr>
<tr>
<td>knowledge mission</td>
<td>available for all users at all times</td>
</tr>
<tr>
<td>action mission (previously referred to as class activity)</td>
<td>activated by a teacher for a mission team, at the time chosen by the teacher</td>
</tr>
<tr>
<td>task</td>
<td>a set of subtasks (always part of a mission)</td>
</tr>
<tr>
<td>subtask</td>
<td>a single atomic question (always part of a task)</td>
</tr>
<tr>
<td>&quot;mission team&quot; (previously referred to as group or class)</td>
<td>social unit in the Challenge, a group of players led by a teacher</td>
</tr>
<tr>
<td>teacher</td>
<td>a teacher in a participating schools, also: the user role with access rights to manage mission teams</td>
</tr>
<tr>
<td>starting a task</td>
<td>starting to play the whole sequence of subtasks in this task</td>
</tr>
<tr>
<td>completing a task</td>
<td>having answered every subtask of the task</td>
</tr>
</tbody>
</table>

Interface Design Quest Templates, Results & Profile (web & mobile)

Figure 15. Educational Serious Game Quest templates
Language Versions

The GAIA Challenge has been fully translated into English, Greek and Italian. (For our mini-trials in Sweden, the English version was used as the official course language taught in these school is English.)
I tre pilastri della GAIA Challenge

**Conoscenza**
Metti alla prova la tua conoscenza nel tabellone interattivo. Ti attendono numerose sfide su diversi argomenti.

**Azione**
Documenta le attività della tua squadra per ridurre il consumo energetico della tua scuola e condividi i risultati come snapshot o aggiungili al tuo portfolio.

**Comunità**
Gioca con la tua squadra e confronta i tuoi risultati con quelli delle altre scuole.

---

**Figure 18. Educational Serious Game Italian (1)**

**Figure 19. Educational Serious Game Italian (2)**

**Figure 20. Educational Serious Game Greek (1)**
3.2 Concept changes according to feedback

The following mechanics have changed/been updated, since the documentation made available in Deliverable D3.1.

Mission Teams

- Instead of selecting a mission team during registration process, new users can join a mission team via an invitation code provided by a teacher. This way the teacher can either send the invitation code to students via email (e.g. in universities) or simply write it on the blackboard / projector directly in class (e.g. in primary schools). The code is a unique six-digit character string consisting of numbers and lowercase letters.
- Teachers have the exclusive right to create new mission teams. They can also lock (prevent new users from joining) and delete their mission teams at their convenience.
- There is a new Mission Team Dashboard for teachers. This overview allows teachers to inspect the progress of every student of every Mission Team created owned by the teacher. Teachers can also start Action Missions for the Mission Team from there.
- The above mentioned configuration dialogues are pictured and described in detail in 3.7 Configuration and 3.8 User guide.

Community Dashboard

- The school ranking in the community dashboard as defined in D3.1 is replaced by a mission team ranking. The comparison of mission teams (aggregated scores of a mission team's users) turned out to be both more motivational and meaningful than comparing whole schools (aggregated scores of a school’s mission teams). The new ranking system reduces noise caused by different geographical characteristics and allows comparison of mission teams from the same school.
- The scoring system initially featured three individual sub scores (knowledge, action and community points). It was reduced to a single score as it is hardly reasonable to expect GAIA’s
young target group to understand a quite complex algorithm that would compute the former
action score out of sensor data. This was also reflected in the feedback received on the initial
high concept document. Therefore, every action a user performs contributes now to a
transparent and easy to understand single score for this user.

- In D3.1 Community Challenges were described as a way to reward user groups for
  engagement and progression within the challenge. In D3.2 Community Challenges are
  replaced entirely by Group Achievements. Group Achievements simplify both the visual
  representation as well as the complexity of the algorithm required. A Group Achievement is a
  Badge awarded to a Mission Team for achieving certain results in the Challenge. In comparison
to the former Community Challenges Group Achievements have a single threshold as a unlock
condition which makes them easier to understand.

<table>
<thead>
<tr>
<th>Achievement Name</th>
<th>Unlock condition</th>
<th>Badge design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolios Master Team</td>
<td>A Mission Team has submitted two portfolios.</td>
<td></td>
</tr>
<tr>
<td>Audience Award</td>
<td>The portfolios submitted by the Mission Team have received 50 or more votes.</td>
<td></td>
</tr>
<tr>
<td>Snapshot Master Team</td>
<td>The Mission Team has submitted 20 or more snapshots.</td>
<td></td>
</tr>
<tr>
<td>Hands-On Energy Agents</td>
<td>The Mission Team has started both Activity Missions.</td>
<td></td>
</tr>
<tr>
<td>Collective Mega Brain</td>
<td>The Mission Team has completed 50 or more Knowledge Missions.</td>
<td></td>
</tr>
</tbody>
</table>
The Mission Team has 10 or more users who have completed all missions.

- Sensor data is a valuable addition for snapshots and portfolios. Teachers and students have the option to add images of sensor data charts (e.g. extracted from the building manager application) to their submissions.

## Content overview

In cooperation with the responsible partners for didactics and teachers there has been a decision on the Challenge mission contents. The topics of the five knowledge missions are:

<table>
<thead>
<tr>
<th>Knowledge mission id</th>
<th>Knowledge mission name</th>
<th>content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>So, what's the challenge? (Introduction)</td>
<td>● Let's stay on this planet! (The need for energy efficiency)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Let’s GAIA! (Play GAIA to learn energy efficiency)</td>
</tr>
<tr>
<td>2</td>
<td>Turn me off unless you need me! - I</td>
<td>● Light in the dark (The lights)</td>
</tr>
<tr>
<td>3</td>
<td>Turn me off unless you need me! - II</td>
<td>● Sleeping daemons (The devices)</td>
</tr>
<tr>
<td>4</td>
<td>What a school atmosphere! - I</td>
<td>● Hot or cold? (Heating and cooling)</td>
</tr>
<tr>
<td>5</td>
<td>What a school atmosphere! - II</td>
<td>● Building smartness (e.g. building orientation, insulation, local climate)</td>
</tr>
</tbody>
</table>

The topics of the two action missions are:

<table>
<thead>
<tr>
<th>Action mission id</th>
<th>Action mission name</th>
<th>content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Let’s act for energy efficiency!</td>
<td>● Observe, experiment, act! (Action for behavior change in school)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>● Let’s ‘wake up’ the locals! (Synergies with the local climate)</td>
</tr>
</tbody>
</table>
## 3.3 Use Cases

The GAIA Challenge engages its users to

- interact with energy saving topics in the context of their school,
- work on online quests at their own pace,
- participate in on-site activities organized by the teachers,
- experience their impact on the facilities energy consumption over the course of the challenge,
- compete and compare against other facilities in other countries
- and share their experiences with their peer group.

During the mini trials the application was already tested in multiple public schools in Greek as well as in Staffangymnasiet in Söderhamn, Sweden. The final version of the platform is available in English, Greek and Italian and will be used mainly but not exclusively contributed in schools all over Greece, Italy and Sweden.

From the initial documentation in D3.1, **some of the five defined use cases have been slightly adjusted to align with the final version of the concept**. Previous and some new use cases are described here:

**UC-0: Get general information about the GAIA Challenge**

Visitors and users want to get general information about the GAIA Challenge:

- What is the GAIA Challenge and how does it work?
- Which schools are participating?

Visitors also want to see the submitted portfolios and snapshots.

**UC-1: Register and login as a student**

Users/Students need to be able to register for the GAIA Challenge and thereby create a user account.

**UC-2: Login as a content manager**

Content managers need to be able to register and login to the GAIA Challenge Backend in order to access the backend.
UC-3: Author content as a content manager

Content managers need to be able to author the mission contents. They need to be able to edit:

- knowledge and action missions
  - assign tasks to missions
- tasks
  - assign subtasks to tasks
  - rename tasks
- subtasks
  - set subtask-type
  - set subtask-description
  - set solution
  - set images/texts
  - set points

UC-4: Edit user profile

Users want to be able to manage (set and delete) their user avatar.

UC-5: Interact with knowledge missions

Users need to be able to play knowledge missions. Users want to be able to replay already solved quests.

UC-6: Join a mission team.

A student must be able to join a mission team via an invitation code provided by a group leader (teacher).

UC-7: Register and login as a teacher.

Teachers must be able to register for the GAIA Challenge in order to create and manage mission teams.

UC-8: Create and submit snapshots

Users want to submit snapshots of their experiences and learning after completing a knowledge mission.

UC-9: Interact with action missions

Teachers need to be able to activate action missions for their mission teams so that the users of these mission teams can play interact with that content.

UC-10: Create and submit portfolios

Teachers need to be able to submit portfolios in the names of their mission teams for each activated
UC-11: Use the GAIA Challenge as a supporting tool in class as a teacher

The GAIA Challenge is built in a way that is easy to use for teachers and offers an overview for teachers on their students' individual progress.

UC-12: Get details on the current status of the Challenge

Visitors want to see the current status of the GAIA Challenge. This includes:

- How many registered users are there?
- What is the current mission team ranking?
- What school does a mission team belong to?
- What are the mission teams' scores?
- What is the current user ranking within a mission team?
- Browsing through the submitted snapshots and portfolios of each mission team

3.4 Requirements

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Current status/Component Involved</th>
<th>Priority</th>
<th>Relevant Use case</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The landing page provides useful information about the GAIA Challenge and its relation to the GAIA project</td>
<td>Implemented / frontend</td>
<td>H</td>
<td>UC-0</td>
</tr>
<tr>
<td>2</td>
<td>The landing page provides a registration and a login form for students and teachers. E-Mail address is optional and only used when the user forgets the password to send out a new one. After six months registration data of inactive users are deleted automatically.</td>
<td>Implemented / OVOS authentication system (connects to Spark Works API for association between user and school building)</td>
<td>H</td>
<td>UC-1, UC-7</td>
</tr>
<tr>
<td>3</td>
<td>The landing page features a Dashboard which provides information about the current state of the challenge and game stats about the participating mission teams.</td>
<td>Implemented / frontend</td>
<td>H</td>
<td>UC-0, UC-12</td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Implemented / Backend</td>
<td>Access</td>
<td>UCs</td>
</tr>
<tr>
<td>-----</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------</td>
<td>--------</td>
<td>-------------------</td>
</tr>
<tr>
<td>4</td>
<td>The GAIA Challenge has a backend login for administrators and content managers in order to setup and maintain and adapt the challenge content such as missions, tasks and subtasks.</td>
<td>Implemented / backend</td>
<td>H</td>
<td>UC-2, UC-3</td>
</tr>
<tr>
<td>5</td>
<td>Logged in users can interact with the contents of the quest map (knowledge missions) in order to improve their personal score.</td>
<td>Implemented / frontend</td>
<td>H</td>
<td>UC-5</td>
</tr>
<tr>
<td>6</td>
<td>Logged in users can interact with the contents of the optional action missions in order to improve their personal score.</td>
<td>Implemented / frontend</td>
<td>H</td>
<td>UC-9</td>
</tr>
<tr>
<td>7</td>
<td>Teachers can create, edit and delete user groups (mission teams). Teachers also can invite students to these groups.</td>
<td>Implemented / frontend</td>
<td>H</td>
<td>UC-6, UC-9, UC-11</td>
</tr>
<tr>
<td>8</td>
<td>Teachers can decide if and when they want to enable optional content for group collaboration (action missions) for their mission teams individually.</td>
<td>Implemented / frontend</td>
<td>H</td>
<td>UC-9</td>
</tr>
<tr>
<td>9</td>
<td>Logged in users can capture and share their experiences and learnings in an easy and fun way.</td>
<td>Implemented / frontend</td>
<td>H</td>
<td>UC-8</td>
</tr>
<tr>
<td>10</td>
<td>User groups feature a portfolio space to collaborate on tasks and share their experiences as Text, images/or Videos. Teachers can help in these collaborative tasks but is not required to be involved at all times.</td>
<td>Implemented / frontend</td>
<td>H</td>
<td>UC-9, UC-10</td>
</tr>
<tr>
<td>11</td>
<td>Teachers have insight in mission progress of each individual user of each of their groups.</td>
<td>Implemented / frontend</td>
<td>M</td>
<td>UC-11</td>
</tr>
<tr>
<td>12</td>
<td>The backend allows an easy/intuitive way to modify, tweak and translate content.</td>
<td>Implemented / backend</td>
<td>M</td>
<td>UC-3</td>
</tr>
<tr>
<td>12</td>
<td>Logged in users can change the appearance of their user profile in the form of a custom avatar image. The use of an avatar image is optional for the user.</td>
<td>Implemented / frontend</td>
<td>L</td>
<td>UC-4</td>
</tr>
</tbody>
</table>
3.5 Hardware and Software Prerequisites

In the following the software and hardware requirements for the GAIA Challenge are listed:

Operating System

On desktop computers the following operating systems are supported:

- Microsoft Windows 7 or newer
- Apple OS X Yosemite or newer
- Ubuntu Linux 16 or newer

Other desktop operating systems and older versions of the above mentioned systems are not supported but may work as well.

On mobile devices the GAIA challenge supports:

- Google Android "KitKat" 4.4 or newer
- Apple iOS 9

Older versions or derivatives of the above mentioned systems (such as watchOS and Android Wear) are not supported.

Browser

For the best user experience, we recommend the usage of modern web browsers such as

- Microsoft Internet Explorer 10-11
- Microsoft Edge 13-15
- Mozilla Firefox 51-53
- Google Chrome 57-59 (including Chrome for Android)
- Apple Safari 9-10.1 (including Safari for iOS)

Other browsers such as Opera, Vivaldi or the Android Browser (modern Android smartphones are getting already shipped with Google Chrome instead of the old stock Android Browser) are not explicitly supported but it is most likely that the majority of the game's features work just fine.

JavaScript

The execution of JavaScript is required and must be enabled in the browser.

Hardware

The GAIA Challenge was initially designed with desktop and mobile tablet displays in mind. During the development a responsive design solution was achieved which allows proper scaling of the application even on smaller screen sizes. Due to how the game is set up and presented a minimum display resolution of 1024 x 786 pixels and a minimum display size of 7.9 inch is still recommended for an optimal user experience.

3.6 Download and Installation

The GAIA challenge can be reached online via [http://gaia-challenge.com](http://gaia-challenge.com). The game runs in the browser, there is thus no need for additional downloads. Internet access is required at all times.
Responsive design

The responsive design of the application scales fluently according to the display size. This allows users to play the GAIA Challenge on devices with medium to small screens (such as tablets and even smartphones) without the need to install additional software.

3.7 Configuration

Group configuration

Teachers have access to a special configuration where they can create user groups for their classes. The teacher can specify a name (i.e., class name), school name and country for the group. Regular users are then able to join a group with an invitation-code provided by the teacher. The group configuration is accessible from the frontend (when logged in) only for teachers. More information about the group configuration can be found in the GAIA Challenge user guide.

![Figure 22. Educational Serious Game group settings](image)

Backend configuration

The GAIA Challenge has a convenient content management system (CMS). The CMS is used to author all texts and translations that appear in the Challenge. Additionally, the CMS backend allows creating and managing of missions and tasks. There are several tools that allow the author to define unlock-conditions and rewards (points) for individual missions, tasks and group achievements. Also players and player groups (Mission Teams) can be inspected and managed from the backend.
The table below shows the various Challenge backend management tools:

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Task Slots</th>
<th>Ch. Points</th>
<th>Created At</th>
<th>Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>So, what's the challenge?</td>
<td>7</td>
<td>0</td>
<td>11/06/2016 13:36</td>
<td>✓</td>
</tr>
<tr>
<td>2</td>
<td>Turn me off unless you need me! I</td>
<td>2</td>
<td>600</td>
<td>04/05/2016 15:53</td>
<td>✓</td>
</tr>
<tr>
<td>3</td>
<td>Let's act for energy efficiency! II</td>
<td>2</td>
<td>0</td>
<td>14/11/2018 15:19</td>
<td>✓</td>
</tr>
<tr>
<td>4</td>
<td>Turn me off unless you need me! II</td>
<td>2</td>
<td>0</td>
<td>14/11/2018 15:19</td>
<td>✓</td>
</tr>
<tr>
<td>5</td>
<td>Die-it: Yourself energy efficiency II</td>
<td>2</td>
<td>0</td>
<td>14/11/2018 15:19</td>
<td>✓</td>
</tr>
<tr>
<td>6</td>
<td>What a school atmosphere! I</td>
<td>0</td>
<td>0</td>
<td>25/08/2016 16:31</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Mission list**

In the mission list the author can create, edit and delete missions. The type of the mission (Knowledge Mission/Action mission) can also be set here. The list also gives an overview of how many tasks (Task Slots) are assigned to each mission and shows an accumulation of all points of the missions' tasks. A mission can be toggled active/inactive via a checkbox.

---

**Figure 23. Educational Serious Game CMS**

The table below shows the various Challenge backend management tools:
Task list
Similar to the mission list, tasks can be created, duplicated, edited and deleted in the task list view. The list shows how many subtasks are assigned to each task and which mission the task belongs to. Also the sum of all subtasks' points is shown. A task can be toggled active/inactive via a checkbox.

Task editor
In the task editor the details (name and assigned mission) can be edited. Also subtasks can be created, edited and assigned to the task.

Subtask editor
Each subtask type has its own editor form. As an example the images on the left show the editor for the image picker subtask. The editor has two tabs. In the first tab the author can edit the subtask's name, content, points and solution. Content and solution are rich text editor fields featuring a WYSIWYG (What you see is what you get) editor for formatting the text and adding images or HTML snippets (e.g. video players). In the second tab the images for the image picker subtask can be edited.
Achievement list
The achievement list allows the authoring of group achievements. Each achievement has a name, a programmatically predefined unlock-condition (type), a badge image, and points when unlocked.

Group list
The groups list shows all mission teams, the respective player count, the invitation code, the assigned language version, the assigned teacher (owner), country city, school name and group name. From the list each mission team can be set active/inactive and closed for new members.
Technologies in use

The technologies used for the implementation of the GAIA Challenge has been described in Deliverable D3.1. A summary is provided here:

- The CMS backend uses a combination of PHP and JavaScript. The underlying backend architecture is based on the Zend PHP framework. For mapping the data to the MySQL relational database the Doctrine framework is in use. The backend interface uses ExtJS for the rendering of windows, forms, buttons etc.
- The GAIA challenge frontend is rendered via the dynamic and flexible Javascript frameworks Backbone, Backbone Relational and React. Animations in the quest map are programmed with GSAP (GreenSock Animation Platform), a suite of JavaScript tools for high-performance HTML5 animations.
- For data storage the GAIA Challenge uses a relational database architecture. The CMS is connected to a MySQL database where all data is stored including the individual progress for each user. As the GAIA Challenge is available in multiple languages the missions and tasks are stored individually for each language version. A user group is assigned to a language version and thus the points scored by the team’s users only accounts for the respective Challenge of
the language version.

3.8 User guide

The full version of the user manual in English, Greek and Italian can be found on the internal google drive (under WP3) as well as in the GAIA web site under “resources”. Extracts from the English version are provided here:

Navigation

When logged in in the top bar there is the main navigation menu [1] with two options:

- **My Quest**: This section features the Quest Map overview where the user can play quests and score points.
- **My Community**: This section features the community widgets.

In the top right corner there is another menu [2] with several options.

Join Mission Team

If your teacher already has created a Mission Team, you can join the team by clicking here and entering the invitation code provided by your teacher [3].

My profile

Here the user can edit the user profile, change the email address and the password

Help

This option will open a help overlay [4] with useful information on how to use the GAIA Challenge.

About

More information about the GAIA Challenge and the GAIA project.

Logout

Log the current user out from the GAIA Challenge and redirects to the landing page.

If you are logged in as a teacher, the menu [5] will have additional options.

<table>
<thead>
<tr>
<th>Navigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1]</td>
</tr>
<tr>
<td><img src="image" alt="GAIA" /></td>
</tr>
</tbody>
</table>

Page 49 of 107
Join a Mission Team!

Please enter the group code you received from your teacher.

[Group code]

CONFIRM

Help

Welcome to the GAIA Challenge!

In the top bar you can find the main navigation:

In My Quest you find the map overview where you can play quests. By playing quests you score points for your Mission Team. Play all the quests to help your Team earn Achievements and reach the top of the leader board!

In My Community you can explore your Mission Team’s score and compare your results with others. You will also find the submitted Snapshots and Portfolios of all Mission Teams there.
My Quest
In My Quest you find the map overview where you can play quests. By playing quests you score points for your Mission Team.

At the top of the “My Quest” view there is the user scoreboard [1]. It shows your user avatar, your scored points, your progress in all Knowledge Missions and your progress in all Action Missions.

Below the scoreboard is the Quest Map [2]. The map itself is a visual representation of your progress in the challenge. It is divided into five chapters. In the beginning the Quest Map is completely covered by clouds, but the more quests you play, the more of the map will be revealed.

Below the map there is the activity log [3]. It shows the user’s recent activities and achievements in the GAIA Challenge.
Playing a quest

By clicking on a quest container [1] in the map, the respective quest will be started.

Each quest consists of multiple short tasks. A task [2] can appear in various forms:

---

Page 52 of 107
All task layouts are very similar. There is always a title teasing the content of the task. Then there is short description/introductory text followed by a question. Below the question there are the actual quests elements to interact with e.g. answers to pick from or a visual scenery in which the user has to search for something specific. Once the user has picked an answer he/she can click on “Check” in the bottom right [3]. A text explaining the solution will show up below the task after the user submitted an answer. The dots in the bottom left [3] indicate how many tasks there are left in the current quest.

Once the user has completed all tasks in a quest the result view is shown [4] and the user can go back to the Quest Map by clicking on “Continue” or play the same quest again by clicking on “Try Again”.

<table>
<thead>
<tr>
<th>Playing a quest</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="Image of quest interface" /></td>
</tr>
</tbody>
</table>

0 of 600 points

0 of 0 points

Snapshot

Light in the dark - II

START
Room layout

The building's orientation can be used for passive heating and cooling. It also affects when the room is illuminated by the natural light of the sun. However, because of the changing rotation and movement of the earth relative to the sun, the incidence of sunlight changes with the seasons.

Which orientation is best for a classroom in winter?

- to the north
- to the east
- to the south
- to the west

Windows on the south side guarantee you a lot of sunshine in winter. Therefore, south-oriented rooms benefit from a better warming during the winter months.
There are two types of missions:

Knowledge Missions
Knowledge Missions are available for all users at all times. Points scored in missions’ quests are added to your Mission Team’s score. When you have completed all quests of a Knowledge Mission you can submit a Snapshot for this mission.

Action Missions
Action Missions are hidden by default on the Quest Map. These missions are activated by a teacher for a Mission Team, at the time chosen by the teacher. When an Action Mission has been activated by a teacher new quests will show up on the map for the next 14 days and only for users of that Mission Team. During that period users of this team can play the mission. After the 14-day period the mission closes automatically and cannot be opened again for this team. While the Action Mission you should work together with your Mission Team on a collaborative Portfolio. Eventually your teacher can submit the portfolio for the Mission Team.

Submitting Snapshots & Portfolios

Snapshots
You can submit a Snapshot for each Knowledge Mission after all quest of the mission have been
completed. You can open the submission editor by clicking on the respective Snapshot container in the map [1].

The submission editor [2] allows you to add text blocks, images and videos (from YouTube and Vimeo) to your submission. You can move blocks around by dragging them on their striped handles on the left hand side. When you are done editing your submission click on “save & go back” to submit your submission. The Snapshot will now appear in the public gallery.

Portfolios

Submitting Portfolios works the same way as submitting Snapshots except that only teachers can submit Portfolios for their Mission Teams. The submission editor looks and works the same way though.

---

**Submitting Snapshots & Portfolios**

<table>
<thead>
<tr>
<th>[1]</th>
<th>Turn me off unless you need me! - I</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="Image of a game interface" /></td>
<td></td>
</tr>
<tr>
<td>500 of 600 points</td>
<td>0 of 0 points</td>
</tr>
<tr>
<td>Light in the dark - I</td>
<td>Light in the dark - II</td>
</tr>
</tbody>
</table>
My Community

The My Community section shows a Mission Team leader board [1]. You can click on the entries to reveal more information about each Mission Team. In the purple area the Achievements of the Mission Team are shown [2]. Below that, in the yellow area the Mission Team’s users are listed with their personal score. At the bottom there is a gallery [3] of all submissions (Snapshots and Portfolios) of the Mission Team. By clicking on a Snapshot or Portfolio in the gallery you can read the complete

Page 57 of 107
submission with all its texts, images and videos [4].

My Community

[1]

Mission team ranking

<table>
<thead>
<tr>
<th>Rank</th>
<th>School Name</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Model Experimental Junior High School Patras</td>
<td>254045</td>
</tr>
<tr>
<td>2</td>
<td>NO CLASS</td>
<td>153535</td>
</tr>
<tr>
<td>3</td>
<td>1st Junior High School of N. Philadelphi</td>
<td>144151</td>
</tr>
<tr>
<td>4</td>
<td>Primary School of Lygia (Leukada)</td>
<td>5400</td>
</tr>
<tr>
<td>5</td>
<td>Gramsci-Keynes, Prato</td>
<td>5000</td>
</tr>
<tr>
<td>6</td>
<td>1st Laboratory Centre of Patras</td>
<td>4500</td>
</tr>
<tr>
<td>7</td>
<td>46th Primary School of Patras</td>
<td>3425</td>
</tr>
<tr>
<td>8</td>
<td>Primary School of Megisti (Kostolono)</td>
<td>2975</td>
</tr>
<tr>
<td>9</td>
<td>Test Mission Team Hogwarts, Vienna</td>
<td>500</td>
</tr>
<tr>
<td>10</td>
<td>1st Technical High School of Patras</td>
<td>300</td>
</tr>
</tbody>
</table>

[2]

Model Experimental Junior High School
Patras, Italy

Achievements

Highscore

<table>
<thead>
<tr>
<th>Rank</th>
<th>Username</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>morganitis</td>
<td>5250</td>
</tr>
<tr>
<td>1</td>
<td>fotis_tr_34</td>
<td>5250</td>
</tr>
<tr>
<td>1</td>
<td>tzefanos</td>
<td>5250</td>
</tr>
<tr>
<td>2</td>
<td>andrewtolzas</td>
<td>4325</td>
</tr>
<tr>
<td>3</td>
<td>zoe</td>
<td>4775</td>
</tr>
<tr>
<td>4</td>
<td>proectskotias22</td>
<td>4925</td>
</tr>
<tr>
<td>5</td>
<td>mariaaa</td>
<td>4975</td>
</tr>
<tr>
<td>6</td>
<td>panos456</td>
<td>4925</td>
</tr>
<tr>
<td>7</td>
<td>bithikotisis</td>
<td>3950</td>
</tr>
<tr>
<td>8</td>
<td>nick the greek</td>
<td>3800</td>
</tr>
</tbody>
</table>
Lights in the ovos office
by af
Jun 28, 2017

Test Portfolio
by Hans
Jun 28, 2017

My Snapshot
by Dummy User
Jun 28, 2017

Lorem ipsum dolor
by Julia Schwan
Jun 28, 2017

My epic story
by af
Jun 28, 2017

Dum di du
by af
Jun 28, 2017

---

portfolio submitted by:
af

date
Jun 28, 2017

Lights in the ovos office

Pleasant lighting in the ovos office

These are the lights in the ovos office. They have a warm color and ensure a pleasant lighting. Luckily, it is usually very bright in our office because we have many windows. So we do not have to turn on the light so often.
Mission Team Management

The teacher menu [1] holds several additional options in order to manage Mission Teams.

Group Management

Click here to toggle the teacher menu.

Team List

Every Mission Team you have created will appear here. Click on a team name to open its overview [2]. The Mission Team Overview shows a list of all users in the team and their individual quest progress. At the top of the overview the teacher can start Action Missions for this Mission Team.

Starting Action Missions

An Action Mission can only be started once for every group. When an Action Mission has been activated new quests will show up on the map for the next 14 days and only for users of that Mission Team. During that period users of this team can play the mission. After the 14 day period the mission closes automatically and cannot be opened again for this team [3].

Submitting a Portfolio

The teacher of a Mission Team can write and submit a portfolio for each active Action Mission [4].

Create Group

Click here to create a new Mission Team [5]. After a new Mission Team has been created the teacher receives an invitation code for students to join the team [6].

Settings

Click here to open the Mission Team settings dialogue [7]. In this dialogue the teacher can edit the name of each of his/her Mission Teams, allow/disallow joining the Mission Teams and delete the Mission Teams. As a security measure, every change made in this dialogue requires the teacher to enter his personal password.
Mission Team Management

[1]

My team: Test Mission Team
- Group management
  - Test Mission Team
  - 21st of Athens
  - Junior High School
  - Create Group
  - Settings

My profile
Help
About
Logout

[2]

Test Mission Team
Hogwarts, Vienna
4 members

Action Mission 1: Let's act for energy efficiency!
Action Mission 2: Do-It- Yourself energy efficiency

START THIS MISSION
START THIS MISSION
Are you sure you want to start this Action Mission?

An Action Mission can only be started once for every group.
The mission will be available for the next 14 days. During that period users of this group can play this mission. After the 14 day period the mission closes automatically and cannot be opened again for this group.

Yes, start the Mission now

NO, CANCEL

Test Mission Team
Hogwarts, Vienna
1 member

Action Mission 1: Let's act for energy efficiency!
MISSION IS ACTIVE
visit at 00:00 2023-04-08

START THIS MISSION

WRITE PORTFOLIO

Create Group

Group name

Group name

School name

School name

City

City

Country

Select a country

CREATE GROUP NOW
Group Created

Your group has been created successfully.
Your students can join the group now with the following code:

Group Code

dvuus4

Group Settings

5th Primary School of N. Smirni

Group code: sqxt00
☐ Registration closed
☐ Delete group

Ellinogermaniki Agogi

Group code: 7g9g9dh
☐ Registration closed
☐ Delete group

Watch out! If you delete a group, all data is lost!

In case of changes, please enter your password:

Password

SAVE
3.9 Tutorials

Three videos were produced showcasing and explaining the functionality of the GAIA Challenge. The videos are available on the GAIA website under gallery/videos and on GAIA’s YouTube channel.

- **Video #1** provides an introduction and explains the core concepts: https://www.youtube.com/watch?v=ssZM6yLK3xs
- **Video #2** showcases the GAIA Challenge from a student’s perspective and explains how to register, play quests and contribute content: https://www.youtube.com/watch?v=jyB5yxEclkE
- **Video #3** explains the advanced features available for teachers to manage and inspect user groups and how to publish team portfolios: https://www.youtube.com/watch?v=sa5gLAgMlYo

3.10 Tracking user involvement

In order to measure the impact towards the KPIs (as described in Deliverable D3.1) the PIWIK tracking suite was integrated into the GAIA Challenge. The KPIs in scope of the GAIA Challenge are listed below.

- GB.1 (time spent using the web portal)
- GB.2 (persons using web portal)
- GB.3 (sessions per user)
- GB.4 (session duration)
- GB.5 (cohort analysis)
- GB.6 (#quests completed)
- GB.8 (#quest finishing rate)
- ED.1 (#students directly involved)
- ED.3 (#teaching staff involved)
- ED.6 (#European languages translated)
- ED.7 (#parents/relatives or friends indirectly involved)

A detailed list of the involved GAIA components in order to reach the KPIs is available in Deliverable D3.1. In the following all tracked data within the GAIA Challenge are listed below.

The following data can be read directly from the **GAIA Challenge CMS**:

- Number of users registered in total
- Number of users registered in each mission team
- Users’ high score

The following data will be exported directly from the **Challenge MySQL database**:

- How many times was a user logged in with his/her account?
- How many individual tasks have been started by each user?
- How many individual tasks have been completed by each user?

The following data is tracked via **PIWIK**:

- Which pages of the GAIA Challenge did he/she visit?
- What time of the day the user was logged in (morning, afternoon, night)?
- Visitor geo data (Browser Language, Country, City)
- Visitor engagement (Visits by days since last visit, visits by local time, visits per visit duration)
- Registration rate (How many of all individual users who visit the landing page did register for the Challenge)
- Completion rate (How many of all individual users who visit the landing page did register and complete all tasks in the Challenge)

Overall, regarding PIWIK, the data tracked can be accessed online via the PIWIK dashboard and exported as reports similar to Google Analytics reports. Also, with respect to visitor engagement, it needs to be stressed that the tracking of visitor engagement (per-user interaction time) is an estimation. It is to possible to measure an exact interaction time / session time from a technical point of view. For example, a user does not necessarily have to re-login when he/she keeps the browser open for a long time. Also there is no clear indication when user’s session ends (there is no way to guarantee that users explicitly log-out every time, they may just close their browser window). Also the session time is not necessarily the same as the user’s actual interaction time: E.g., a user can be logged in to the Challenge and walk away from the computer.

Figure 24. Educational Serious Game PIWIK
4 Building Manager Application

4.1 Overview - Introduction

The “building manager application” was initially outlined in D3.1 (which was submitted at M12) according to the DoA and the first interactions with the potential users. Here, in D3.2, we present the revised and more elaborate design together with the supporting material (manual, tutorial, etc.). The revisions were driven primarily from the feedback received from the building managers involved in the project as well as from teachers involved in the mini trials. This feedback was captured in three different ways:

- Questionnaire (using google forms) distributed to the building managers regarding their needs
- Interviews with members from the school communities during the mini trials.
- Questionnaire distributed to the building managers after the mini trials with respect to their satisfaction and improvement proposals from the use of the developed application as well as during the summer school.

While the mini-trial process and its results will be detailed in WP4 deliverables, in the following sections we will refer to the valuable insights provided by the school communities through all the above mentioned ways.

While this section as well as the relevant task in WP3 is titled “building manager application”, what we call “building manager application” in GAIA consists of:

- A web-based application that can be run/executed in a mobile device (smartphone or tablet) or in a desktop/laptop computer not only from the building managers but from any member of the school community with different access and action permissions
- A native mobile app application enabling participatory sensing and luminosity sensing (the latter exploiting mobile device sensors).

As already stated in D3.1, the application for building managers is designed and developed in task 3.3 and aims to fulfil the following WP objectives:

- Development of a web-application for building managers.
- Development of a participatory sensing application specialized for the needs of GAIA. Participatory sensing was extended from what was initially included in the DoW from energy metering to environmental conditions and comfort level sensing.
- Development of a direct visualization application depicting in various forms and various aggregation and analysis levels energy consumption information

4.2 Use cases

The five use cases initially defined in D3.1 still apply, however with some modifications to better match the feedback received from the users. In each use case section, we stress the modifications to avoid just pasting the description. For completeness reasons, we list the five considered use cases and in their descriptions we highlight the modifications from D3.1. The building manager will be able to
perform the following high level actions:

1. Insert building specific information (this enable buildings profiling and profile comparisons)
2. Insert data regarding building status (e.g. sensor readings or energy consumption information) realizing participatory sensing
3. Inspect building status and monitor building performance (building analytics)
4. Receive valuable suggestions for energy savings.
5. Communicate through social networks with other building managers and/or experts to get advice on energy savings.

Next, we elaborate on the information communicated between the application and all types of users of the application (not only the building manager).

**UC-0: Registering a user**

The interesting thing to stress here is that we have defined five different roles:

- **GAIA Administrator**: full rights for all schools in GAIA
- **Global BMS Manager**: same rights as Local BMS Manager only for multiple schools
- **Local BMS Manager**: rights to insert all building details and to insert energy and other sensor readings; rights to view all analytics and tag anomalies; receives alerts and notifications.
- **Teacher**: can view all analytics and perform participatory sensing; the values entered by the member are stored separately from the values entered by the building managers.
- **Student**: can view all analytics and perform participatory sensing; the values entered by the member are stored separately from the values entered by the building managers.

The users enter the GAIA BMS web application typing [http://bms.gaia-project.eu](http://bms.gaia-project.eu) and is redirected to SPARKS’ platform for user registration/authentication and authorization. There the users provide their full name, desired username, desired password and e-mail address. It is worth stressing that for students who do not wish to enter their e-mail address, a community address can be entered. Then the administrator of the platform assigns a role according to the predefined agreements with the schools. (This agreement defines the users of the schools and the role they play in the community.) This process has been decided to hold at least for the project lifetime, to ensure appropriate access to the platform.

After the administrator activates the role of a user, the user enters the GAIA portal (through either a laptop or a mobile device) using their credentials. (We assume here that each actor belongs to the community of one school and not multiple. If this assumption does not hold, a limited number of role/school pairs will be available to select.)

**UC-1: Registering a building**

The global or local building manager is able to insert information relevant to the building as detailed in the Building Manager Application manual sub-section 3. It is only the building manager that is capable of defining the number and names of classrooms and spaces of the schools as well as the number and names of metering devices.
UC-2: Participatory sensing

The building manager will be able to:

- insert readings from sensors including a) power meters not connected to the GAIA cloud, b) fuel/heating system consumption, c) luminosity, d) indoor and outdoor temperature, e) comfort level for luminosity and indoor temperature.
- the dashboard will allow uploads of energy consumption in typical formats (manual entered monthly readings, file upload of hourly or 15-minute values)

Before entering any values, the building managers or the teacher can define a new “virtual” sensor (e.g. temperature, classroom B2), so that the students can then fill in values for this “virtual sensor”. The relevant functionality is presented in Annex 1 - section 8. It is worth stressing that the teachers and students will also be eligible for entering sensor readings or environmental and situational information in the platform fostering the role of crowdsourcing in GAIA. However, this information will be stored separately.

Readings from real or virtual sensor can be inserted either through the web application or through the mobile app. Additionally, through the mobile app, the user can select to read the luminosity exploiting the sensors available in the mobile device and upload the value automatically.

UC-3: Building inspection and monitoring

The building manager will be able to:

- Inspect real-time energy usage where respective (energy, temperature, etc.) meters are available in various timescales (daily, weekly, monthly, yearly) - see BMS manual, section 2. According to building managers answers, monthly are the most interesting graphs to monitor. Additionally, while the power meters gave very high accuracy, for the measurements and graphs to be of value to the users, KWh should/are currently used.
- Inspect results from comparison with similar buildings or with the same building in other time spans (e.g. previous years) along with comments - see BMS manual, section 7 “comparison”. The comparison has been extended from energy (originally planned) to all sensors; the user is able to select the (school, sensor, timespan) triplets to compare. The building manager will be able to select from a drop down menu the measurement object and the source type (e.g. electricity consumption from smart power meter 2). He/she also be able to change the timescale and to add/remove curves on the same analytics window. With respect to similarity this is decided based on geographical and climate information. (For the GAIA trials, this is hard-coded in the GAIA back-end.)

UC-4: Receive energy efficiency recommendations and alerts

Apart from the recommendations provided automatically by the system thanks to the optimizer component residing at the GAIA back-end and designed in WP2, the user is able to set rules upon which he/she is notified /alerted, (exploiting the rule engine component implemented in the GAIA back-end as detailed in D2.1 chapter titled recommendation engine).

Based on the feedback collected from the building managers, they are mostly interested in (unusual)
peaks, abnormal situations and they are also interested in inspecting and indicating whether a peak was justified or not, so as to optimize the anomaly detection pattern.

Additionally, the majority of building managers want to receive notifications through the application alone with a small percentage (lower than 20%) interested in receiving notification through e-mails.

**UC-5: Communication with other building managers and/or experts**

It is important to allow the building managers communicate because this can enhance their knowledge on actions that can lead to energy savings. Currently, in the BMS web application there is a direct link to the social network group created for GAIA buildings managers. In this social network, a contest can be established based on the likes of the achievements and/or suggestions each building manager posts. We plan to update the specs of this social networking activity based on the feedback we will receive during the first pilot trials.

### 4.3 Requirements

The requirements of the application for the building manager (slightly adjusted to match the above revised use cases are listed in the following table, along with the current status (Satisfied-S or Unsatisfied-U)) and the component responsible for this.

The requirements of the application for the building manager (slightly adjusted to match the above revised use cases are listed in the following table, along with the current status (Satisfied-S or Unsatisfied-U)) and the component responsible for this.
<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
<th>Current status/Component Involved</th>
<th>Priority</th>
<th>Relevant UC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The user is registered in the SparkWorks platform through either a mobile device or a laptop/desktop PC.</td>
<td>Implemented (communication between WP3 and WP2)</td>
<td>H</td>
<td>UC-0</td>
</tr>
<tr>
<td>2</td>
<td>GAIA should be able to discriminate the following four roles: Administrator, building manager, teacher, students. An additional discrimination between local and global BMS manager has been defined as demanded in the mini-trials.</td>
<td>Implemented (communication between WP3 and WP2)</td>
<td>H</td>
<td>UC-0</td>
</tr>
</tbody>
</table>
| 3  | GAIA should be able to associate:  
  - a building manager per school or building.  
  - multiple teachers per building.  
  - groups of students using the same building.  
  - groups of students using the same classroom.  
  - groups of students associated with a teacher. | Implemented (in WP2) | H | UC-0 |
| 4  | The information that has to be maintained per building is described in use case 1. | Status: Implemented  
Components involved: GAIA building database, GAIA API between mobile apps and backend, GAIA mobile and desktop app UI | H | UC-1 |
<table>
<thead>
<tr>
<th>#</th>
<th>Summary</th>
<th>Status</th>
<th>Component Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>The building manager will be allowed to enter the building specific information either from a mobile device or from a web application.</td>
<td>STATUS: Completed</td>
<td>GAIA building database, GAIA mobile and desktop application UI</td>
</tr>
<tr>
<td>6</td>
<td>The UI of the GAIA app will be as user friendly as possible and will support multilingual operation. (For the first prototype only two languages will be supported; for the final, it will be four.)</td>
<td>STATUS: Completed. It can support unlimited languages via a translation file. Currently it supports English, Greek, Italian. GAIA mobile and desktop application UI</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>The participatory sensing application is available for students and teachers as well.</td>
<td>STATUS: Completed by 20/7/2017. Components involved: GAIA mobile application GAIA mobile and desktop application UI GAIA backend (Sparks)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Each user is capable of storing data regarding inside and outside temperature and luminosity declaring the room he is in.</td>
<td>STATUS: Completed by 20/7/2017. Components involved: GAIA mobile and desktop application UI GAIA backend</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>The building manager is responsible for defining and registering - the number and names of classroom and - the number and names of spaces of the building campus - the number and names of the metering devices available in each school</td>
<td>Status: Ready Components involved: GAIA app (with respect to UI) GAIA database (for storing the information) API between the app and the back-end GAIA mobile and desktop application UI</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>The building manager has access to analytics from both the mobile device and a laptop/desktop.</td>
<td>Status: Ready</td>
<td>H</td>
</tr>
<tr>
<td>11</td>
<td>The building manager has access to analytics from all measurement sources (smart meters, sensors, etc.) from both smart metering devices and results from participatory sensing, in various timescales. The users should be able to see visualized for their building/school: All the measured values (power consumption, temperature (from sensor and from participatory sensing), humidity, luminosity, weather, motion) in different time scales Comparisons with the historic data of these values Comparisons with other schools a) in the first year release, selecting from a drop-down menu among the GAIA schools and b) selecting between similar and dissimilar buildings/schools in the 2nd year.</td>
<td>STATUS: Completed. GAIA app, GAIA database structure, GAIA back-end API, GAIA UI Status: 1. Analytics in different timescales 2. Comparisons with the historic data: a) For energy consumption ready b) For other measured values 3. Comparisons with other schools</td>
<td>H</td>
</tr>
<tr>
<td>12</td>
<td>The building manager can select from a limited set of only “similar” buildings to perform comparisons. “Similarity” will be decided either hard-coded in the lifetime of the project or automatically by components residing in the back-end</td>
<td>Status: Completed</td>
<td>H</td>
</tr>
</tbody>
</table>
The building manager will be able to receive recommendation notification and alerts through either the mobile app or the web-based portal.

Status: DONE
- Optimizer (generates the alerts)
- API (for communicating the alerts)
- Back-end database for storing recommendation
- GAIA application mobile and desktop

The building managers will be able to communicate through social networks

Status: DONE

The building manager should be able to upload values in a CSV file format and define at the same time the metric this file contains values about. The building manager should be able to upload values about heating costs and overall electricity bills through a dedicated form.

Status: Completed
- GAIA desktop or mobile app, back-end database and API.

The building manager will be able to forward recommendation notifications to the teachers of the school.

Although initially this seemed as a means to enforce “efficiency campaigns” at schools, it is currently under reconsideration in the pedagogical scenario design.

4.4 Hardware and Software Prerequisites

The web based application is accessed through any browser from desktop, laptop, mobile device or tablet. The mobile app for participatory sensing runs in any Android 5+ device.

The architecture adopted for the implementation of the Building Manager System is shown in the following figure.
The Building Manager applications exploits the services developed in WP2. In more detail, as shown in the figure,

- User authentication/authorization is performed exploiting the service described in D2.1 chapter 3
- The building profile (i.e. the static information of the building) is kept in the building DB described in chapter 6 of D2.1
- The real-time data required to present the graphs to the users are obtained through the real-time Data API described in chapter 5
- The data required to present comparisons are obtained by communicating with the analytics modules described in D2.1
- Reading from the participatory sensing

4.5 Download

The code is uploaded to the GitHub in our public repository:  
https://github.com/GAIA-project/bma

4.6 Installation

As the building manager application is a web-based application, for the installation of the open source, a web server is required (e.g. Apache) running also PHP version 5 or higher and supporting MySQL. The folder with the Building Manager System code is then uploaded (transferred) from the GitHub to the public folder of the server and the BMS is up and running. (It automatically connects to the GAIA service infrastructure and all necessary components). The code is developed in the Angular.js framework.

With respect to the participatory sensing application, the user downloads it from the GitHub in APK format (the relevant Android app format) and can be run in any mobile device running the Android 5.x operating system and newer.
4.7 Configuration

There is no need for configuration. The user registration and roles settings happen through the user authentication and authorization APIs developed under WP2.

It is worth stressing that we deliver a url (dedicated page) which is independent of the BMS platform and can be embedded in any third party application e.g. GAIA challenge or other, so as to retrieve school data.

4.8 User guide

The user guide has been developed in English, Greek and Italian. All user guides are available both in the internal google drive (e.g. under WP3) as well as in the GAIA web site under “resources”. Extracts from the English version are provided here.

The Building Energy Management Application provides a variety of functions such as real-time monitoring of energy consumption of your building, the diagrammatic illustration of this, automatic and manual entry of sensor and meters placed in the building etc. An important advantage of the application is the ability to track from any mobile device such as mobile phones and tablets, provided that there is internet connection. In the following sections, the features offered by the application are presented in detail.

Login

In order to log in to the online energy management application, type http://bms.gaia-project.eu/#/page/signin on your browser, add your username and password and click “Sign In”, Fig. 26.

![Figure 26. BMA Login]

Dashboard

Page 75 of 107
As soon as you are successfully logged in you will land on the application Dashboard.

In the upper right corner, you can change the application language. From the “Profile” icon you can log out from the application by clicking “Log out”. The button in the upper left corner expands or hides the application main menu which appears on the left part of the screen. From this page, the user is able to access all buildings registered in their account. From the “Details” button the user is transferred to the management page of the corresponding building, Figure 28.
In this page the user can view in detail all the recorded data of the particular building in the form of diagrams, if they have already assigned the sensors placed in the building with their corresponding metric. The assignment is carried out in the Edit building page (Section 3). In any diagram the application allows to alter the granularity through the buttons “Per 5 minutes”, “Per Hour”, “Per Day”, “Per Month”. The user may also refresh the illustrated data to the latest recorded values through the button, to save the illustration locally on their computer in the form of an image through the button, to zoom in a diagram area and return it to its original form through the buttons, to see the recorded data, to turn the diagram in bar form through and return it to linear form through. In the main menu the “View” button allows the user to return to this page from any other page in the application.

Edit Building

The “Edit Building” page, accessed from the corresponding button in the main menu, allows the user to view and alter the building’s characteristics. In the General Characteristics tab, the manager may declare the name of the school (1), choose the available energy sources (2), select if there is a thermostat or not (3) as well as the threshold value for the heating system (4). They may also declare whether the heating and cooling systems are regularly maintained (5), and if they are insulated (6). They can also input the consumption meter’s serial number (7). The manager may select the energy type for the heating (8) and cooling (9) system, if there is a cooling system (10) and if it has a thermostat (11), as well as its threshold value (12).
Pressing the “Save” button, all the data is saved in the system. In the Construction Characteristics tab, the manager inputs the year the building was built (1), its average user number (2) and its orientation (3) and then presses “Save”, Figure 30.
Areas

In the Areas page the user accesses the information of the separate areas within the building, as shown in the following figure. The user clicks the “Details” button on the right of the name of an area of interest and on the window on which appears all the information is at hand. The building managers are able to edit the description of an area.
Floorplan

In the Floorplan page the user has access to the floorplan of all the areas of the building as they have been set in the Areas page. The depiction of each area is in the form of a parallelogram which dimensions correspond to the actual dimensions as they have been declared by the user. Inside the parallelogram the name of the room, the sensors placed and their corresponding measurements are depicted. The user is able by holding the left mouse button to drag each room depiction and leave it in its correct place in the building scheme; then they click “Save”. In this way the manager may, at any given time, have a summarized view of the building’s energy status, on a realistic depiction.
Sensors

In the Sensors page the user may view the current values of all the real sensors placed in a building as well as of all the virtual sensors, Figure 33.
The user, by clicking on a sensor of interest may view its history, Figure 34. The diagram which appears presents the last recorded values (the absence of value from the meters is presented as “zero” value in the diagram).

![Figure 34. BMA Sensor history](image)

Furthermore, the user is able to declare the specific time frame for which they would like to view the sensor’s values as well as the diagram pitch, from the corresponding fields, “From”, “To” and “Granularity”.

From the Sensor’s main page, the “Add a virtual Sensor” button allows a Group A user (building managers) and a Teacher to create a virtual sensor. As such GAIA defines metrics of Energy and Temperature to be uploaded manually in the system, User Comfort Level, any other measurement they wish to keep track of and metrics uploaded from the Participatory Sensing Application.
Alert Rules

An important characteristic of the Building Energy Management Platform is the ability to create customizable rules. The role of a rule is to alert the user when all the set criteria apply. If a criterion does not apply, then the rule is not activated. Clicking the “Rules” button on the right of an area the user views all the rules which have been set for this area. Clicking the “New Rule” button the user adds a new rule under that area, (following figure). The user defines the characteristic name of the rule, a short description, a suggestion of action to be taken in case of triggering. Finally they select the appropriate sensor, e.g. a virtual sensor, the operator (<,>,=,>=,<=) and the threshold value.
Comparison

In the Comparison page the user may compare values of measurements in their own building or with another similar building. In the “Your School” tab the user chooses 2 time frames, the measurement and the granularity and receives a combinational chart of the building’s chosen measurement for these time frames, Figure 37.

Figure 36. BMA Adding a new rule

Figure 37. BMA Two different time frames energy consumption comparison
Mobile applications

Although the complete building management system is accessed through any mobile device through a browser, here we focus on the participatory sensing features of the mobile app. Through the Participatory Sensing Application, the user is able to manually upload measurements in the system, under the Virtual Sensors as they have already been defined by the teachers. Upon login the user is presented with the buildings to which they have access, Figure 38.

![Participatory Sensing Application landing page](image)

Figure 38. Participatory Sensing Application landing page

Upon selecting a school, they are presented with all the pre-installed virtual sensors, Figure 39. Selecting one they are able to associate the measurement they desire with their selected sensor by typing in the field provided and clicking “Save”. If they prefer their device’s sensor to provide values, e.g. for light measurements, they may turn Auto Gathering on by clicking on the button at the bottom right corner of their screen.
Figure 39. Virtual Sensor list

Figure 40. Adding measurements through auto-gathering exploiting devices' sensors
4.9 Tutorials

We have developed two types of tutorials:

1. Presentations that were used to familiarizing the users (focusing on building managers for the mini-trials) in English, Greek and Italian (published through GAIA web site under “resources/presentations” and also available in google drive (access was provided to the building managers participating in GAIA trials).
2. Videos demonstrating the functionality of the application. Multiple videos were developed focusing on basic functionality and added features. All the materials are uploaded in the GAIA site http://gaia-project.eu/index.php/en/gallery/videos/ and in GAIA’s and Synelixis’ YouTube channel:
   a. https://www.youtube.com/watch?v=JCLn9B5Gilo
   b. https://www.youtube.com/watch?v=uHPuGXDMb2Q
   c. https://www.youtube.com/watch?v=EN6bwsxWdpM

4.10 Tracking user involvement

As discussed in D3.1, chapter 5, each application is associated with a set of KPIs. The Building Manager System developed in GAIA contributes in the achievement of the following KPIs:

- GB.1 (time spent using the web portal)
- GB.2 (Persons using web portal)
- GB.3 (Sessions per user)
- GB.4 (Session duration)
- GB.5 (cohort analysis)

To enable the quantification of these KPIs, we integrated PIWIK, which is a site analytics tool similar to Google Analytics. The reason we preferred PIWIK is that it has repeatedly emphasized ownership of data when compared to Google Analytics. Their probable unique selling point is that it is self-hosted (PHP, MySQL) vs. Google Analytics is a remotely hosted service. So with any of the community’s data, GAIA remains in control with PIWIK.

Using Piwik, we will monitor:
- the number of users the access the building manager system,
- The number of users that perform participatory sensing,
- The number of session each user established,
- The duration of each session,
- The number of users per role would also be an interesting metric.
5 The GAIA applications grid

GAIA has developed in the three different tasks of this WP a set of applications each of which offers a different pathway to behavior shaping:

- the social networking game aims at prompting the user (all types, member of the school community of even relatives, friends) to obtain bites of knowledge about energy efficiency and be informed about energy efficiency actions,
- the GAIA challenge aims at raising the knowledge of students about energy efficiency in a playful way and support school missions
- the building manager system aims at advising the building manager behaves efficiently and at the same time allows the rest of the school community to experiment in real life; e.g. they can turn off the lights of the gym and check what the different in real-time energy consumption is
- The participatory sensing application can be used by any user and user group to collect measurements and more realistically to make user observe the evolution of effects, e.g. temperature, energy consumption, or any other.

In each school, these applications can be used in any combination, all of them or any subset of them depending on the peculiarities of the target group (age, habits, curricula), available timeframe and resources (both time and sensing infrastructure). This way, during the project, GAIA application set can cover a variety of different cases and after the project trials, the collected feedback can be exploited to improve them and to put emphasis on those most efficient.

In this perspective, **GAIA applications have been designed having flexibility and diversity of the target communities in mind.** Apart from the support of **multiple languages**, the flexibilities foreseen are tabulated as follows:

<table>
<thead>
<tr>
<th>Application</th>
<th>Flexibility</th>
</tr>
</thead>
</table>
| Social networking game      | - Multiple established social networking platforms to ensure penetration in all three target countries which have different statistics with respect to social network platform preference  
- The item hunted can be piece of information relevant to events, or knowledge or other depending on the target outcome of the mission  
- The users/user group can post snapshots of the achieved outcomes from the building manager system |
| GAIA challenge              | - The web-based GAIA Challenge can be used without the need to install additional software. The Quests templates are responsive meaning that the Challenge can be played on Laptops, Tablets and Smartphones with an internet connection.  
- the teachers can set and unlock appropriate content to match the different curricula, countries and ages. (Even though during the project lifetime, limited content is developed as the target groups are multiple, the structure is solid) |
The GAIA Challenge features a backend meaning quests can be added or adapted by admins to facilitate sustainable usage and adaptability.

| Building Manager Application | Can be used by building managers of school with installed infrastructure to monitor the evolution of energy consumption.  
|                             | Can be used by building managers who operate a school with no infrastructure but they exploit participatory sensing features to check the progress of their operations; for example, they enter the energy consumption evolution from the utilities' bills and monitor every day how they are doing.  
|                             | They exploit the rule-engine to be notified if a certain threshold (in temperature or daily consumption or else) has been violated to limit waste.  
|                             | Can be used by any member of the school community to experiment with the impact of switching on and off a certain device so that calculations over longer time periods are feasible; for example, the students can observe the saving on energy consumption caused by switching off the lights at the gym and then calculate the yearly energy consumption if the lights were used 10% less.  

| Participatory sensing mobile app | Can be used by all member of the community to inject values for any “virtual sensor”. (Depending on the user role, the values are stored differently to avoid mixing the values inserted by building managers with the values inserted by pupils.  
|                                | The participatory sensing mobile app can be used to automatically upload luminosity reading to the GAIA ecosystem and see this plotted.

GAIA applications can be used in combination and can interlink among each other as follows:

- **Social Networking game and GAIA challenge** can be combined so that:
  - The competition in reaching as many locals as possible can be an integral activity of the GAIA challenge; this can maximize the reach of our efforts and create a sustainable effect on energy efficiency.
  - The results of the #ScavengerHunt game can be used in the game mechanics of the GAIA challenge.
  - The GAIA challenge user-created content (snapshots and mission team portfolios) can be featured in the weekly gallery of the social networking game and this way distributed among GAIA’s various social media channels.

- **Social network game and building manager application**:  
  - The students/teachers can use the building manager application to take snapshots of the results they have achieved (showing for example the graph of energy power or any other graph from the building manager application) and share it with the social networks of GAIA for further distribution to promote their recognition (primarily as teams).
  - Ideas exchanged in the social network group of the building managers can be taken into account in the design and definition of additional recommendations towards the building managers. Although this requires intervention in the optimization components in the backend, this is still an improvement which would have not been possible if GAIA had not triggered them to communicate energy management issues.

- **GAIA challenge and building manager application**:
○ The building manager application will deliver to the GAIA challenge for presentation the graph regarding the power consumption of the school the user is associated with. This way the school communities can have a direct view on the impact of their actions on energy consumption.

○ GAIA challenge users have the option to add images of sensor data charts extracted from the building manager application to their snapshot and portfolio submissions.

- **All applications together:** The teachers can use the social networking game to push initial thinking about energy efficiency and in parallel start using the GAIA challenge to raise awareness and concretize what energy efficiency is about. Then they can use the building manager application to provide tangible result of their actions and prompt them modify them towards energy efficiency.

In any case, the combinations can be tailored to the target audience. Additionally, we have examined in collaboration with WP1 and WP4 how these applications support the execution of educational scenarios.
<table>
<thead>
<tr>
<th>GAIA applications</th>
<th>Social networking Game</th>
<th>GAIA challenge</th>
<th>BMA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deliver</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social networking game</td>
<td></td>
<td>Let’s wake up locals</td>
<td>Novel recommendations exchanged between BMs</td>
</tr>
<tr>
<td>GAIA challenge</td>
<td>User generated content for weekly gallery</td>
<td>Action Missions in the GAIA Challenge are used for scenario-based exploration tasks in combination with the BMA.</td>
<td></td>
</tr>
<tr>
<td>BMA</td>
<td>Snapshots of activities results to disseminate to locals</td>
<td>Graphs on energy consumption to a) evaluate efficiency and b) check results of activities</td>
<td></td>
</tr>
</tbody>
</table>
6 Conclusions

WP3 has successfully developed a set of applications that will be used in the GAIA trials during the school/academic year starting in autumn 2017. The GAIA DoW outlined a social networking game, a serious on-line game, the building manager application and a participatory sensing application. These applications were specified first in D3.1 which gave the opportunity to start the development. Placing emphasis on the target user groups, the consortium refined the applications specification as detailed in this document (D3.2) based on interviews/questionnaires and on feedback collected from mini-trials executed in a subset of the involved schools in the three countries.

The end result is that now (M18) we have ready:

a) The #scavengerhunt game, a social networking game which fosters engagements and raises awareness of the members of the communities.

b) The GAIA Challenge, a web-based game that support school/university activities, delivering quests (with multiple types of questions) and supporting “mission” establishment.

c) The building manager application which allows all member of the communities to monitor the energy spending in their schools and provides suggestions to the building managers.

d) The participatory sensing functionality which is delivered either through a mobile app or embedded in the building manager application.

All applications come:

a) As open source (through the GitHub).

b) With rich documentation (manuals, presentation, videos).

c) With concrete innovations (as will be further described in WP5 deliverables).

d) With tracking mechanisms to enable quantification of user engagement and of the achievement of GAIA KPIs (which are outlined in D1.2).

They comprise a toolbox for teachers which can be tailored to each community to raise awareness and drive behavioral change in school communities and outside them. The results of the trials will give us further feedback and insights so as to improve our applications and deliver a high quality set in M21.
7 References

1. GAIA, Description of Work
2. GAIA, D3.1- Applications Prototypes, delivered February 2017
3. GAIA, D2.1- Initial Infrastructure Software
4. GAIA, D1.1 - GAIA Design
Annex 1

Building Management Application User Feedback

In order to align the Building Management application features with the needs of its target groups, we have kept close contact with the schools and utilized various methods in order to gather feedback from the users throughout the development and trial periods. A series of Questionnaires has been designed to be distributed to the users at specific time periods, each with a different scope in mind.

User requirements gathering - First Building Management Application Questionnaire

In the text which follows we present the results of the first questionnaire distributed – in early 2017 – to the managers of the schools participating in the GAIA trials, concentrating on the features they would expect and would find most useful from an Energy Management platform.

Question Summary and Response Presentation

We present each question separately along with the summary and the analysis of its responses:

Question 1

Please select the role that best describes your job position.

70% of the responders are the headmasters of their corresponding schools, also holding building managerial rights and responsibilities (the rest are: 10% faculty, 10% technical staff and 10% building managers).

Question 2

Please select the areas in which you would be most interested in managing your facility’s energy consumption.

Choosing from a predefined list, 70% of the responders were most interested in managing the energy allocated to heating, closely followed by indoor lighting (60%) and outdoor lighting (50%).

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor Lighting</td>
<td>60%</td>
</tr>
<tr>
<td>Outdoor Lighting</td>
<td>50%</td>
</tr>
<tr>
<td>Heating</td>
<td>70%</td>
</tr>
<tr>
<td>Ventilation</td>
<td>10%</td>
</tr>
<tr>
<td>Air Conditioning</td>
<td>40%</td>
</tr>
<tr>
<td>IT Equipment</td>
<td>20%</td>
</tr>
<tr>
<td>Security/Video surveillance systems</td>
<td>20%</td>
</tr>
<tr>
<td>Electrical Appliances</td>
<td>30%</td>
</tr>
<tr>
<td>Water Consumption</td>
<td>40%</td>
</tr>
<tr>
<td>Gas Consumption</td>
<td>20%</td>
</tr>
<tr>
<td>Oil Consumption</td>
<td>40%</td>
</tr>
</tbody>
</table>

Question 3

Please describe briefly the type(s) of energy used in the building, the type of information you receive from your provider and the type of extra information you would be interested in receiving.
All the responders naturally use electrical energy, 50% of them use oil and 45% natural gas for heating. The users are interested in monitoring their energy consumption, preferably per building in the facility and in ways of possible energy savings.

**Question 4**

*Please choose the most helpful for you way of interacting with the application.*

90% of the responders prefer using the application from a desktop computer rather than a mobile device.

**Question 5**

*Please select the areas in which you would be most interested in being alerted.*

All responders find it crucial to be alerted in the case of abnormal energy spikes, while 50% of them would like to be notified in the case of considerable progress in their energy consumption.

---

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal energy spikes</td>
<td>100%</td>
</tr>
<tr>
<td>Abnormal energy lows</td>
<td>40%</td>
</tr>
<tr>
<td>Significant progress in energy consumption</td>
<td>50%</td>
</tr>
<tr>
<td>Identification of trends</td>
<td>40%</td>
</tr>
<tr>
<td>Manual override of preset settings in heating, air conditioning etc.</td>
<td>60%</td>
</tr>
</tbody>
</table>

---

**Question 6**

*Please select possible areas of recommendations provided by the system you would like to receive.*

The responders are equally interested in receiving recommendations on making the most of natural resources - e.g. natural light, on shutting down electronic equipment on standby and on turning off lights, cooling etc. in unoccupied building sectors.

**Question 7**

*Please select the means of real time notification you would most prefer.*

Most of the users would like to be notified through the application alone, while a few would prefer an e-mail notification as well.

**Question 8**

*Please select the visualizations on energy consumption you would be most interested in receiving.*

The users are most interested in receiving weekly and monthly charts on energy consumption. Furthermore, comparison charts and detailed reports seem to be useful features as well.
Question 9

*Please select the notifications/updates on energy demand you would be most interested in receiving.*

Responders were mostly interested in receiving weekly and monthly updates.

Question 10

*Would you find it useful for all users of the facility to have access to the application and submit opinions or data on energy usage, such as their level of comfort?*

The affirmative and negative responses were equally divided.

Question 11

*Would you find it useful for participatory sensing users receive notifications from the application?*

70% of the responders preferred this feature to apply for the users according to their organization position (e.g. students, teachers).

Question 12

*In case special conditions apply would you prefer for the manager to manually control and manage the situation or for the system to react based on pre-set rules?*

80% of the responders would rather for this feature to be customized depending on the situation in question.

Question 13

*Would you find it useful if the application send automated orders to the system according to participatory sensing users’ imported data?*
80% of the responses were affirmative.

**Question 14**

*Please choose the possible automation methods you would find useful.*

70% of the responders would prefer for the manager to be notified and then choose if the system will act while only 30% for the system to act by itself (turn of the lights, change room temperature etc.).

**Question 15**

*Are you currently using a Building or Energy Management System?*

Only 20% of the responders currently use a BMS/EMS. -The rest of the Questions apply only for those who answered Question 15 affirmatively-

**Question 16**

*Are your EMS and BMS integrated?*

In all the cases the energy management system is integrated to the building system.

**Question 17**

*Is your EMS fully automated?*

In half the cases the system is automated.

**Question 18**

*Can the system you are currently using be accessed by a mobile device?*

100% affirmative responses.

**Question 19**

*Was training required on the use of your system?*

Training was required in all cases.

**Question 20**

*How would you rate your satisfaction with the system you are currently using?*

The satisfaction of the users currently hosting a management system in their premises is quite high with their current systems.

Comments on the feedback

Since the majority of the responders hold building managerial positions at their schools they are able to provide constructive feedback and valuable insight. From the responses gathered, we have concluded that the areas most in need of monitoring in educational facilities are those of heating and lighting. The users need to be readily informed in the case of abnormal use of energy and to receive customized advice on how to achieve energy savings. The visualization of energy consumption through weekly and monthly charts would be most useful, while to be able to create customized comparison charts is welcome as well. For a building manager it seems the feature of participatory sensing is not essential. What we have gathered from the schools with an existing management system is that we
need to develop a high level energy management platform that is especially easy to use and that delivers real time monitoring with customized notifications.

Pre-trial Evaluation - Second Building Management Application Questionnaire

During the development process we kept in mind the user feedback, as has been presented, in order to satisfy their requirements. A first introductory version of the platform was released prior to the official trial period and made available to the schools. Close communication with the representatives of the schools was achieved even through the summer break. This communication yielded valuable information which was incorporated in the version to be released for trials. Apart from written and spoken communication, a second questionnaire was distributed covering the users’ first impression of the application. The results of this are presented next, in the same fashion as with the first questionnaire.

**Question 1**

*Please select the role that best describes your post.*

80% of the responders are teachers at their corresponding schools (the rest are: 10% headmasters and 10% building managers).

**Question 2**

*Please evaluate your total satisfaction from using the application.*

Choosing from a linear scale from 1 to 5 where 5 is the maximum satisfaction, 60% of the responders were very satisfied with using the application, 30% were quite satisfied and 10% extremely satisfied.

![Pie chart showing satisfaction levels]

**Question 3**

*Please evaluate your satisfaction on accessing the features of the application.*

Similarly, 60% of the responders were very satisfied with the application features, 20% were quite satisfied and 20% extremely satisfied.

Page 99 of 107
Question 4

Please evaluate your satisfaction on the visualization of the measurements (diagrams).

Again in a similar scale, 50% of the responders were quite satisfied with the diagrams, 20% were very satisfied and 30% extremely satisfied.

Question 5

Is the information you need adequately presented in the diagrams?

90% of the responses were “YES”.

Question 6

Please present shortly which feature(s) was in your opinion most useful or interesting.

The users found most useful the visualization through the diagrams, the building sensor view and the comparison tool.

Question 7

Did you need to look at the User Manual while using the application?

50% of the responders did not need to look at the manual at all. 40% had to refer to it several times and 10% only once or twice.

Question 8

Which parts did you find difficult to handle while using the application.

The tools for which some of the users encountered some minor difficulties were the Floorplan and the Rule Engine.

Question 9

Are you currently using another Building or Energy Management System?

Only 20% of the responders currently use another management system at their building.

Question 10
Please mark how much GAIA’s Building Energy Management application is more satisfactory form your current system.

Out of those, 100% replied that GAIA’s BMS is quite more satisfactory than their current system.

Question 11

Please present the changes or upgrades you would like to see in the next version of the application.

In the next version of the application the users would like to see energy measurements per class/area not just the entire building (40% of the responders commented on that). One responder would like the ability to add measurements from raspberry or Arduino type PCs.

Comments on the feedback

Mostly teachers participated in the mini trials as were organized by the project and replied in the questionnaire. This gave valuable feedback from the people who will be running the project within the classrooms. Most of the teachers of the schools which have an existing management system seem to have little access to it and are glad of the opportunity to participate in a more active way to their school’s sustainability practices. The application seems at the most part able to satisfy user requirements, as well as quite accessible and easy to use. GAIA has incorporated all the suggestions and those of the responders’ comments that are in line with the project, to deliver a stable and satisfactory to all application for the trials.
Annex 2

GAIA Challenge User Feedback

The GAIA Challenge was tested by several hundreds of students of primary and secondary education. The game was played by groups of students in most cases. Students replied to an evaluation questionnaire regarding the GAIA Challenge (content, interface, etc.). It can be said that the overall feedback was positive.

Question 1

*Device for login*

![Device for login chart]

Question 2

*How easy was the access to the GAIA Challenge?*

![How easy was the access to the GAIA Challenge chart]
When users were asked about the most common problem with respect to logging in, they stated that their Internet connection was too slow/bad.

**Question 3**

*The interface of the GAIA Challenge was user friendly?*

```
<table>
<thead>
<tr>
<th>Rating</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely</td>
<td>80</td>
</tr>
<tr>
<td>Very</td>
<td>60</td>
</tr>
<tr>
<td>Moderately</td>
<td>40</td>
</tr>
<tr>
<td>Slightly</td>
<td>10</td>
</tr>
<tr>
<td>Not at all</td>
<td>5</td>
</tr>
</tbody>
</table>
```

**Question 4**

*Did you find the content interesting?*

```
<table>
<thead>
<tr>
<th>Rating</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely</td>
<td>50</td>
</tr>
<tr>
<td>Very</td>
<td>40</td>
</tr>
<tr>
<td>Moderately</td>
<td>10</td>
</tr>
<tr>
<td>Slightly</td>
<td>5</td>
</tr>
<tr>
<td>Not at all</td>
<td>3</td>
</tr>
</tbody>
</table>
```

Popular comments about the content were: Interesting / Boring / Not clear questions / More missions
General comments from the experience of the GAIA Challenge

It was a great experience and we learned a lot.

I liked that after each mission we could see our percentages.

I like that we have score but I didn't like that it was only questions and nothing interactive.

The game was interesting and awesome. The first time I had very low score. Then I try again and I improved my personal score. I liked the noise of the wrong choose.

I would like to see a mission with activity for energy saving.

I like the interface and it was very nice that the corrected answers were given below the false ones. Some questions were difficult for our age. I would like the game to have music.

My experience from the game is too positive. The game was too rich from educational material and funny tasks. I found it interesting, well designed, educational and entertaining game. I liked it a lot.

I like the multiple questions and less the guess questions. I would like to have more explanations in such questions.
Annex 3

GAIA #ScavengerHunt User Feedback

The GAIA #ScavengerHunt was tested by two groups of students in secondary school in Söderhamn, Sweden. The App was tested, by seventeen students and then they replied to an evaluation questionnaire. Following that we had a bit of a discussion related to the concept and the responses were largely positive for both the ease of use as well as the general concept of the game.

Following are the questions, the type and responses.

**Question 1**
*How did you log in? (Selection)*

<table>
<thead>
<tr>
<th>(Possible answers)</th>
<th>(Respondent #)</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ Scanned QR code</td>
<td>9</td>
</tr>
<tr>
<td>○ Web link</td>
<td>8</td>
</tr>
</tbody>
</table>

**Question 2**
*The navigation within the app was... (Scale)*

<table>
<thead>
<tr>
<th>(Possible answers)</th>
<th>(Respondent #)</th>
</tr>
</thead>
<tbody>
<tr>
<td>○ 0 (Difficult)</td>
<td>0</td>
</tr>
<tr>
<td>○ 1</td>
<td>0</td>
</tr>
<tr>
<td>○ 2</td>
<td>0</td>
</tr>
<tr>
<td>○ 3</td>
<td>4</td>
</tr>
<tr>
<td>○ 4</td>
<td>9</td>
</tr>
<tr>
<td>○ 5 (Easy)</td>
<td>(Easy)</td>
</tr>
</tbody>
</table>

4
The navigation within the app was...

Question 3
Do you think the content will be informative during the trials? (Selection)

(Possible answers)                          (Respondent #)
○ Yes                                      8
○ Maybe                                    8
○ No                                       1

Do you think the content will be informative during the trials?

Question 4
Which types of social media accounts do you have? (Multiple selection)

(Possible answers)                          (Respondent #)
○ Facebook                                  4
○ Twitter                                   4
○ Instagram                                 4
○ Snapchat                                  5
○ None of the above                         0

Page 106 of 107
Question 5
How likely do you think it would be that you may participate and share your findings on social media?

(Scale)

(Possible answers) (Respondent #)
○ 0 (Not at all) 2
○ 1 5
○ 2 3
○ 3 5
○ 4 2
○ 5 (Very likely) 0

How likely do you think it would be that you may participate and share your findings on social media?