



bEhaVioral Insights anD Effective eNergy policy acTions

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Acronyms

Acronym	Explanation
API	Application Programming Interface
CI/CD	Continuous Integration / Continuous Development
DOIs	Digital Object Identifiers
SG	Serious Game
SOA	Service-Oriented Architectures
WebGL	Web Graphics Library

Executive Summary

Reducing household energy consumption is one major step towards a climate-neutral economy since the household sector consumes about 25% of the total energy consumption [1]. EU citizens have a crucial role towards this objective thus it is important to understand the reasoning of their preferences and assess the role of behavioural insights regarding their relevant decisions in the energy efficiency spectrum. Under this main concept, EVIDENT uses a wide range of case studies, experiments, surveys, and RCTs in conjunction with state-of-the-art econometric methods and big-data analytics by considering participants' characteristics to create behavioural models that can interpret consumers' behaviour.

The EVIDENT platform that is developed under the “*WP6 Prototyping and integration*” hosts a series of services, such as serious games and surveys, which collect the related information. The careful design of the platform and the definition of requirements and specifications are crucial to create a system architecture that can achieve all the project's objectives. The project's use cases and requirements are evolved in parallel with the actual development of the platform adopting the continuous integration / continuous development (CI/CD) paradigm to cover any need that might occur from the consortium.

In this deliverable, a detailed roadmap for the continuous integration process of the different software components into the EVIDENT platform is presented, describing the dependencies between the components, and scheduling the integration milestones towards the completion of the platform. The EVIDENT platform will host the sessions from the experts of the consortium during the project's lifetime, but it also aspires to offer an ecosystem for future researchers to host their behavioural studies providing an intuitively and friendly interface.

1. Introduction

1.1 Purpose of the Deliverable

This technical document is the deliverable “*D6.1 Architecture, design, and integration documentation*” of the “*Task 6.1 System Architecture and Design Specifications*”. The goal of this deliverable is to describe and present the use cases, design choices, requirements, and architecture of the EVIDENT platform. The choices for the design of the system play a crucial role in the successful integration of the system incorporating the user and system requirements defined in WP2 while also dictating the deployment and integration of the different sub-components. The deliverable is updated in parallel with the actual development of the EVIDENT platform following the CI/CD paradigm providing a detailed roadmap for the continuous integration of the developed components and the entire platform, describing the integration process and responsibilities of the partners, and setting the objectives of the integrated prototype. An alignment of the development plans of the individual components will be performed resulting in a registry of the dependencies between the components and a schedule of integration milestones with expected maturity for each component.

1.2 Relation with other Deliverables and Tasks

Task 6.1 receives as input the platform requirements resulting from the previous work packages, “*WP1 – Requirements and nature of behavioural biases*”, “*WP2 – Policy interventions and pilots design*”, “*WP3 – Intervention, preparation, and execution*”, and “*WP4 – Econometric analysis and policy evaluation*”. Deliverable 6.1 is used as input in “*Task 6.2 System Development*” where the actual development of the EVIDENT platform takes place. The deliverable also provides the integration and testing plan that will be realised under “*Task 6.3 System Integration, Verification and Validation*” producing the “*Deliverable 6.5 Verification and Validation Report*” for the final version of EVIDENT platform.

1.3 Structure of the Document

This deliverable is structured as follows:

- Section 2 – Elicitation of use cases: offers a survey of similar platforms stressing the shortcomings of existing solutions, and it presents the related use cases.
- Section 3 – Platform requirements and features: describes the requirements that are extracted from the needs of the consortium’s partners and presents the different services of the platform.
- Section 4 – EVIDENT platform architecture: presents the architecture of the system describing its components and the interconnection between them.
- Section 5 – Testing: presents a series of tests to ensure the platform’s readiness and quality.
- Section 6 – Conclusion: concludes the deliverable and stresses the innovative aspects of the platform.

2. EVIDENT platform as a service

The EVIDENT platform aims to provide a unified endpoint (system-as-a-whole) for the resources, services, and tools that will be developed through the project's lifetime. The development of such services requires the development team to examine current solutions, identify the existing needs, and define the different user roles and their behaviour on different use cases.

Subsection 2.1 presents a short literature review on similar platforms, both on research and commercial levels. Additionally, subsection 2.2 presents the different user roles and use cases that are anticipated to be met with the release of the platform.

2.1 Literature review on similar platforms

The EVIDENT platform offers three main components/functionalities included in the platform, namely the crowdsourcing services, the serious game application, and the data hub. Similar services can be found online, however, not under the same integrated system, and they are not focused on the decision-making process of the citizens on energy consumption decisions. Short descriptions of ten related platforms are provided, offering an overview of the EVIDENT platform compared to the existing competition.

Profit project

The platform of the PROFIT project (Grant agreement ID: [687895](#)) aims to promote financial awareness and improve the financial capabilities of its users and market participants. Under this premise, the platform supports various functionalities that build towards the financial literacy and policy agenda awareness goals. In more detail, the PROFIT platform hosts a number of educational courses, tolls and learning material that are available to the wider public and provide information about financial institutions, investment strategies, behavioural biases, and ethics in the financial markets. The platform also supports crowdsourcing tools that process financial data and extract and present knowledge to the end user. Furthermore, PROFIT accommodates a personalized recommendation system to support financial management according to the user's profile and supports financial models that can be utilized to identify market trends, and threats and perform risk assessments in large data sets. By the time this deliverable was completed, the platform of the project was not live.

SurveyMonkey

SurveyMonkey (<https://www.surveymonkey.com/>) is a freemium online platform that focuses on simplifying the survey creation, result analysis, and insight extraction tasks through an easy-to-use interface. To this end, users have access to the following functionalities: a) Creation of surveys, quizzes, and polls for any audience, b) feedback gathering through web links, emails, mobile chat, and social media, c) Data analysis and result visualization, and d) Result exportation capabilities in different file formats. SurveyMonkey also provides templates that can be utilized by users to enhance the visual experience of the audience. Also, the core service provided by the platform is free for each user, but special features such as survey sharing, skip page logic, advanced analysis tools, full data export, and unlimited survey questions are enabled through a paid subscription model.

Google Survey

Google Surveys (<https://surveys.google.com>) is a free online platform where users can create a survey, target respondents and generate statistical results. More specifically the platform provides templates for

survey creation where researchers may ask questions and select from a variety of formats like multiple-choice, open-ended, or star-rating. The researchers may also choose their audience by deciding whom they want to take their survey. In the sequel, the research data are updated and dispatched to the survey creators as the users answer the research questions. Responses are automatically collected in Google Forms, with real-time response info and charts.

Start2act

Start2act (<https://start2act.eu/>) is a European-funded project that focuses on EU start-ups and young SMEs to highlight the potential for energy savings through a set of innovative educational and capacity-building measures. To this end, Start2act platform provides interactive educational material, quizzes, and tools that offer great potential for energy and money savings. Further, the online platform facilitates a large knowledge base in which visitors may obtain information and tips on energy savings, while also a dedicated forum is deployed where experts address questions regarding energy efficiency.

EnerGAware project

The EnerGAware project (Grant agreement ID: [649673](#)) developed and validated a serious game that will be linked with the energy consumption of the player's home and it will be embedded in social media and networking tools. By using this serious game, users can play and learn about the potential energy savings from adopting energy-efficiency measures while modifying their behaviour. Through this gamified approach, users can learn how to balance energy consumption, comfort, and financial costs. Energy savings achieved both virtually, in the game, and at the users' homes will enable progression in the serious game. Finally, the social media features enable users to share their achievements, compete with each other, advice, and form virtual energy communities. By the time this deliverable was completed, the platform of the project was not live.

NUDGE project

The NUDGE project (<https://www.nudgeproject.eu/>) aims to systematically assess and unleash the potential of behavioural interventions towards achieving higher energy efficiency and to pave the way to the generalized use of behavioural interventions as a worthy addition to the policy-making toolbox. Toward this end, the NUDGE platform facilitates a knowledge base that consists of policy recommendations, research findings, and communicational material that fit within the scope of the project. NUDGE consortium has also developed a series of smartphone apps and tools which are designed to teach users about energy efficiency solutions and provide them with energy savings tips. Such tools include a proprietary heating controller for IoT devices, a visualization of individual energy consumption and indoor data, an optimizer for the charging of EVs with self-produced PV power and a visualization and aggregation of energy consumption/ production data.

ENCHANT project

The ENCHANT project (<https://enchant-project.eu/>) aims to support the energy transition by testing the impact of interventions affecting energy consumption behaviour on a large-scale across Europe. ENCHANT's intervention platform will facilitate a knowledge base and it will be implemented into an algorithm-based web application targeting a wide range of stakeholders. The platform will combine the data gathered from implementing various interventions, with a re-analysis of already existing data, in an

empirically informed decision tool for impactful campaign design targeting energy efficiency, relevant for a number of public and private actors.

PENNY project

The PENNY project (<https://www.penny-project.eu/>) applies a behavioural science approach to better understand individual behaviour in the domain of energy efficiency. The project consortium has designed scientific experiments in the domain of consumer behaviour to improve the development of future energy efficiency policies. The project platform houses a research questionnaire in which users answer a series of questions related to household appliances, lights, temperature, and behaviour. Penny collects the user answers and utilizes such data to strengthen the theoretical framework of the project, while users may compare their answers with the answers provided by the rest of the visitors.

Survey sparrow

Survey sparrow (<https://surveysparrow.com/>) is a paid online platform that provides a survey creation system for registered users. Survey sparrow supports a large variety of formats, templates and features, thus, it enables the full customization of each survey. Further, it facilitates survey control functionalities (such as question skipping and control logic) and it provides an API for automatic result management and data visualization. The surveys and questionnaires created with the Survey sparrow platform can be shared via emails, QR codes, web links, SMS, or social media to the target audience.

Sogosurvey

Sogosurvey (<https://www.sogosurvey.com/>) is a freemium online tool that offers an end-to-end solution with advanced functionalities designed to engage participants, increase response rates, and analyse trends. Users utilize pre-existing templates to create and formulate their online research survey and may distribute such questionnaires through multiple channels (website, seminars, planned events and chats) in order to reach a wider audience. Further, survey creators gain access to user responses to understand what the answers really mean and they may share their findings with any of the participants. Finally, Sogosurvey supports a secure data management system and provides data visualization functionalities to the researchers.

Based on the aforementioned descriptions, there are differences among similar existing platforms. EVIDENT's strength lies in the highly vast and heterogeneous dataset derived from both field studies and questionnaires, as well as real-time data from smart metering devices. The combination of these two types of datasets is not taken into account in the available platforms when estimating citizens' energy efficiency decisions, which leads to inadequate policy proposals. EVIDENT also involves the addition of other consumer attributes, such as financial literacy, in the analysis. Combining consumer financial literacy with their energy consumption decisions can yield more insights, which can subsequently be used to propose various policy initiatives.

2.2 EVIDENT platform user roles and terminology

The EVIDENT platform offers a series of functionalities, aiming to create an ecosystem that satisfies different research needs. Three main concepts fall under the umbrella of the EVIDENT platform: surveys, serious game applications, and datahub services. These three services could be combined enabling

researchers to create different lab experiments aimed at different audiences. Lab experiment is a research method by which researchers create controllable environments to test hypotheses.

The first step in the design of the platform is the identification of the users that are anticipated with the release of the platform, and their interactions that are expected to be met. Four different user roles are defined: super-admin, organiser (also referred as “organisation”), participants, and non-registered users.

First, as in every service, there are users with full permission, limited to the specific consortium members that have system administrator knowledge, named *super-admins*. This type of users monitors the operation of the platform, secures access to the platform, and ensures the smooth operation of the services. The number of super-admin users is limited for security reasons.

The organisers are key personnel from an organisation that want to use the EVIDENT platform to design and implement a series of lab experiments. During the development phase of the platform, only the academic partners of the consortium will have this role of exploring the platform and providing their feedback to the development team. After the completion of the platform, the organisations interested in designing and implementing an experiment will communicate with the consortium and after reviewing the request, the access will be granted. The reviewing process is a necessity for the first releases of the platform because the platform needs to maintain its research orientation aiming at high social impact.

The participants are individuals (e.g., students, consumers) who participate in the experiments that have been created and are managed by the organizations. They participate in the platform to gain knowledge in financial literacy and improve their decision-making process on energy consumption issues. Usually, they belong to a specific pool of people (e.g., urban residents).

The development of the system requires the definition of technical requirements which offer differ from the academic (or business) requirements that are collected from discussions with the end-users presented in-depth in the following chapter. Therefore, it is important to provide the basic terms that are used in the process of requirements definition.

Table 1 provides the three basic terms that are used in the document to increase the readability and coherence of the document. These three terms are the foundations for the discussion with the end-uses and they are helpful in the definition of the platform requirements.

Table 1: Terminology used throughout the document

Name	Short description
Survey	A questionnaire that is created by an organization and contains a number of questions.
Serious game	A game designed by an organization aiming to educate the players on specific topics or raise awareness.
Session	A collection of different surveys and serious games created by an organization and synthesized to design and implement a lab experiment. Individual users may participate in an active session. The term session and lab experiment are interconnected.
Page	A tab which appears during the survey creation process and corresponds to a single page of the survey. A page may contain one or more questions.

2.3 EVIDENT platform use cases

The different actors are expected to proceed in specific actions in the platform to achieve their objectives. These actions are called use cases and they are defined as a list of actions or event steps that define the interaction between an actor and a system to achieve a goal. The use cases of the EVIDENT platform are presented in the format of tables providing all the necessary information to be understood, modelled, and eventually implemented. Twenty-four (24) use cases follow, providing the consensus around the use of the platform and assisting in the design and development of the platform.

The use-cases tables that follow present the different characteristics of the use-case (actor, brief description, pre-conditions, basic flow, exceptional flows, and extends. Each field covers a specific need in the development process, and every use case provides a good overview of the functionality of the platform.

Use Case		UC01: Register as an “organisation”
Actor	Organisation	
Brief	An organization can register to the EVIDENT platform and use it to design and implement a controlled lab experiment (e.g., universities, energy companies, policy makers etc.)	
Preconditions	The user has not created a user account for the EVIDENT platform in the past.	
Postconditions	The user has created a new account in the EVIDENT platform, can log in to the platform and use its services.	
Basic flow	<ol style="list-style-type: none"> 1. The user accesses the registration page. 2. The user fills all necessary information into the registration form (e-mail address, password). User also selects if she/he wants to register as an organisation so her/his “position” and a brief “justification” is also needed. 3. The user submits the registration form. 4. The platform owner (“Platform Superadmin”) should offline validate the new organization and grant the new account full access. 5. The platform creates a new user accompanied with the respective default avatar of “new organisation” and respective access rights. 6. The user receives a user account activation link to the e-mail address he/she has previously submitted. 7. The user visits the activation link he/she has received and activates his/her account. 8. The user can now log in to the platform with his/her credentials. 	
Exceptional flow(s)	<ul style="list-style-type: none"> • The user account has already been created using the e-mail address the user submits during registration. Thus, the user is informed about the existence of an older account that uses the same e-mail address and is then pointed to the login page. On the login page, the user can use the “Forgot your password?” option to reset her/his password. • The user cannot be registered because of platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes. • The user won’t register as an organisation. The user can visit her/his account settings and request an organisation account. 	

Dependencies	-
Extends	-

Use Case	UC02: Register as an “participant”
Actor	Participant
Brief	An individual can register to the EVIDENT platform and participate in active lab experiments.
Preconditions	The user has not created a user account for the EVIDENT platform in the past.
Postconditions	The user has created a new account in the EVIDENT platform, can log in to the platform and use its services.
Basic flow	<ol style="list-style-type: none"> 1. The user accesses the registration page. 2. The user fills all necessary information into the registration form (e-mail address, password). 3. The user submits the registration form. 4. The platform creates a new user accompanied with the respective default avatar of “new participant” and respective access rights. 5. User receives a user account activation link to the e-mail address he/she has previously submitted. 6. The user visits the activation link he/she has received and activates his/her account. 7. The user can now log in to the platform with his/her credentials.
Exceptional flow(s)	<ul style="list-style-type: none"> • The user account has already been created using the e-mail address the user submits during registration. Thus, the user is informed about the existence of an older account that uses the same e-mail address and is then pointed to the login page. On the login page, the user can use the “Forgot your password?” option to reset her/his password. • The user cannot be registered because of platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	-
Extends	-

Use Case	UC03: User login
Actor	Superadmin, Organisation, Participant
Brief	The user can log in to the EVIDENT platform and use its services
Preconditions	The user has already registered to the EVIDENT platform.
Postconditions	The user is logged in to the EVIDENT platform and use its services
Basic flow	<ol style="list-style-type: none"> 1. The user accesses the login page. 2. The user fills in her/his e-mail/username and password.

	User is logged in to the platform and redirected to the EVIDENT platform homepage.
Exceptional flow(s)	<ul style="list-style-type: none"> • The user credentials are not correct: The user can either a) try to login again b) reset her/his password via the “Forgot your password?” option. • The user is not registered: The system will prompt the user to register to the platform. • Th user cannot be logged in because of platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01, UC02
Extends	-

Use Case	UC04: User logout
Actor	Superadmin, Organisation, Participant
Brief	The user can logout from the EVIDENT platform
Preconditions	The user has already logged in to the EVIDENT platform.
Postconditions	The user is logged out from the EVIDENT platform.
Basic flow	<ol style="list-style-type: none"> 1. The user has already logged in to the EVIDENT platform and uses its services. 2. The user clicks on her/his profile menu and selects the “Log out” option. 3. The user is logged out from the platform.
Exceptional flow(s)	Not excepted
Dependencies	UC01, UC02, UC03
Extends	UC03

Use Case	UC05: Manage user profile
Actor	Superadmin, Organisation, Participant
Brief	The user can update her/his profile
Preconditions	The user has already registered to the EVIDENT platform. The first time a user will log in to the EVIDENT platform, the platform will prompt her/him to update her/his profile. Any time, the user can update her/his profile.
Postconditions	The user updates her/his profile in the EVIDENT platform
Basic flow	<ol style="list-style-type: none"> 1. The user logs in to the EVIDENT platform. 2. The user visits her/his profile through the user menu, and she/he is prompted with a form prefilled with all available profile information. 3. The user can update any information regarding her/his profile and press the “Update” button. 4. User has updated her/his profile information
Exceptional flow(s)	The user profile is not updated because of platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes

Dependencies	UC01, UC02, UC03
Extends	UC03

Use Case UC06: Delete user account	
Actor	Organisation, Participant
Brief	The user can update delete her/his account in the EVIDENT platform
Preconditions	The user has already registered and logged in to the EVIDENT platform.
Postconditions	The user deletes her/his profile in the EVIDENT platform
Basic flow	<ol style="list-style-type: none"> 1. User logs in to the EVIDENT platform. 2. The user visits her/his account settings and selects the option “Delete your account permanently”. 3. The user confirms his choice and deletes her/his account. 4. The user is redirected to the EVIDENT platform homepage.
Exceptional flow(s)	The user profile is not deleted due to a platform failure. User is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01, UC02, UC03
Extends	UC03

Use Case UC07: Reset password for user	
Actor	Superadmin, Organisation, Participant
Brief	User can reset her/his password through the “Forgot your password?” option on the login page
Preconditions	The user has already registered to the EVIDENT platform.
Postconditions	The user resets her/his password and manages to log in to the EVIDENT platform.
Basic flow	<ol style="list-style-type: none"> 1. The user visits the login page of the EVIDENT platform. 2. The user selects the “Forgot your password?” options and a form asking her/him to fill in her/his email. 3. The user receives an email with a link to reset password. 4. The user clicks on the link and is asked to type (and re-type) his/her new password in the respective form. 5. The user saves his/her new password. 6. The user can now log in to the EVIDENT platform using his/her new password.
Exceptional flow(s)	<ul style="list-style-type: none"> • The user does not exist in the database. The user needs to be a registered user in the EVIDENT platform to reset his password. • The user does not receive the email. The user can either a) repeat the previous steps and request a new email b) wait a couple of minutes to receive the email since there might be a delay on the network or even the email is sent to the “spam” folder.

	<ul style="list-style-type: none"> The user could not reset her/his password due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01, UC02
Extends	-

Use Case	UC08: Export user profile data
Actor	Superadmin, Organisation, Participant
Brief	The user can export all her/his profile data, data stored in the EVIDENT's database.
Preconditions	The user has already registered and logged in to the EVIDENT platform.
Postconditions	The user export all her/his profile data to a JSON file
Basic flow	<ol style="list-style-type: none"> User logs in to the EVIDENT platform. The user visits her/his account settings and selects one of the options "Download my data" or "View my data". The user confirms his choice and download her/his profile data to a JSON file.
Exceptional flow(s)	The user could not export her/his profile data due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01, UC02
Extends	UC03

Use Case	UC09: Update user demographics
Actor	Superadmin, Organisation, Participant
Brief	The user can update essential information about her/his demographics.
Preconditions	The user has already registered and logged in to the EVIDENT platform.
Postconditions	The user is able to participate to the active sessions.
Basic flow	<ol style="list-style-type: none"> The user logs in to the EVIDENT platform. The user visits her/his account settings and selects "Update my demographics". The user confirms her/his choice and saves the changes.
Exceptional flow(s)	The user could not update her/his demographics data due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01, UC02
Extends	UC03

Use Case	UC10: Create a new survey
Actor	Superadmin, Organisation
Brief	Superadmins and Organisations can create and implement a lab experiment. An experiment can contain one or more “survey” and “serious game” applications. The actor creates a “survey”.
Preconditions	The user has already registered to the EVIDENT platform as an Organisation.
Postconditions	The user creates a new survey that can be later used in the context of a lab experiment.
Basic flow	<ol style="list-style-type: none"> 1. The user logs in to the EVIDENT platform. 2. The user visits her/his profile and selects the section “My Surveys”. 3. The user is prompted with all the Surveys she/he has already created and select the button to create a new Survey. 4. The new Survey editor is presented, and the user can create a new survey. <ol style="list-style-type: none"> 1. The user can save as a draft or publish the new survey.
Exceptional flow(s)	<ul style="list-style-type: none"> • The user does not have the rights to create a new survey. The user account has not the rights to create a new survey. Since the user is registered as an organization that might mean that the Superadmin has not granted the platform access yet. <p>The user cannot create the new survey due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.</p>
Dependencies	UC01
Extends	UC03

Use Case	UC11: Update a survey
Actor	Superadmin, Organisation
Brief	The actor updates an existing “survey”.
Preconditions	The user has already registered to the EVIDENT platform as an Organisation. The user has already created a survey.
Postconditions	The user updates an existing survey that can be later used in the context of a lab experiment.
Basic flow	<ol style="list-style-type: none"> 2. The user logs in to the EVIDENT platform. 3. The user visits her/his profile and selects the section “My Surveys”. 4. The user is prompted with all the Surveys she/he has already created and selects the “edit” button of the survey she/he wishes to update. 5. The Survey editor is presented, and the user can edit the selected survey. 6. User can update the survey as a draft or publish it to be available as an individual step in the context of a lab experiment.

Exceptional flow(s)	The user cannot edit an existing survey due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01
Extends	UC03, UC10

Use Case	UC12: Delete a survey
Actor	Superadmin, Organisation
Brief	The actor deletes an existing “survey”.
Preconditions	The user has already registered to the EVIDENT platform as an Organisation. The user has already created a survey.
Postconditions	The user deletes an existed survey.
Basic flow	<ol style="list-style-type: none"> 1. The user logs in to the EVIDENT platform. 2. The user visits her/his profile and selects the section “My Surveys”. 3. The user is prompted with all the Surveys she/he has already created and selects the “delete” button of the survey she/he wishes to delete. 4. A prompt window appears so the user to confirm her/his action. 5. The user deletes the selected survey, and she/he has been redirected to the “My Surveys” page.
Exceptional flow(s)	The user cannot delete an existing survey due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01
Extends	UC03, UC10

Use Case	UC13: Upload a new serious game
Actor	Superadmin, Organisation
Brief	Superadmins and Organisations can create and implement a lab experiment. An experiment can contain one or more “survey” and “serious game” applications. The actor uploads a new “serious game”.
Preconditions	The user has already registered to the EVIDENT platform as an Organisation.
Postconditions	The user attaches the serious game that has previously uploaded in the context of a lab experiment.
Basic flow	<ol style="list-style-type: none"> 1. The user logs in to the EVIDENT platform. 2. The user visits her/his profile and selects the section “My Games”. 3. The user is prompted with all the Games she/he has already created and select the button to upload a new Game. 4. The user is prompt with the Game form. 5. The user adds the configurable fields for the serious game.

	<ol style="list-style-type: none"> 6. The platform will check the credibility of the uploaded file and if successful will move forward with the next steps. In a different case, an error message will appear informing the user about any issue risen. 7. The uploaded Game is listed among the other user's games. 8. User saves as a draft or publishes the new game.
Exceptional flow(s)	<ul style="list-style-type: none"> • The user does not have the rights to upload new serious game. Since the user is registered as an organization that might mean that the Superadmin has not granted the platform access yet. • The user cannot upload a new serious game due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01
Extends	UC03

Use Case	UC14: Update a serious game
Actor	Super-admin, Organisation
Brief	The actor updates an existing “serious game”.
Preconditions	The user has already registered to the EVIDENT platform as an Organisation. The user has already uploaded a serious game.
Postconditions	The user updates an existing serious game that can be later used in the context of a lab experiment.
Basic flow	<ol style="list-style-type: none"> 1. The user logs in to the EVIDENT platform. 2. The user visits her/his profile and selects the section “My Games”. 3. The user is prompted with all the Games she/he has already created and selects the “edit” button of the game she/he wishes to update. 4. The user is prompted with the Game form and completes the serious game data. 5. The user can update the serious game as a draft or publish it to be available as an individual step in the context of a lab experiment.
Exceptional flow(s)	The user cannot update an existing serious game due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01
Extends	UC03, UC13

Use Case	UC15: Create a new lab experiment
Actor	Super-admin, Organisation

Brief	Super-admins and Organisations can create and execute a lab experiment. An experiment can contain one or more “survey” and “serious game” applications. The actor creates a new “lab experiment”.
Preconditions	The user has already registered to the EVIDENT platform as an Organisation. The user has already created at least one “survey” and “serious game”.
Postconditions	The user creates a new lab experiment and assigns the individual steps she/he has previously created (“survey”, “serious game”). User can publish and execute the lab experiment to collect the data.
Basic flow	<ol style="list-style-type: none"> 1. The user logs in to the EVIDENT platform. 2. The user visits her/his profile and selects the section “My experiments”. 3. The user is prompted with all the experiments she/he has already created and select the button to create a new experiment. 4. The new lab experiment editor is presented, and the user can select the individual steps she/he has already created. 5. The user can save as a draft or publish the new lab experiment. If the user selects to publish the experiment in a protected mode, the platform will ask for an extra experiment password, each participant has to fill in in order to participate.
Exceptional flow(s)	<ul style="list-style-type: none"> • The user does not have the rights to create a new lab experiment. The user account does not have the rights to create a new lab experiment. Since the user is registered as an organization that might mean that the Super-admin has not granted the platform access yet. • The user cannot create a new lab experiment due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01, UC09, UC13
Extends	UC03

Use Case	UC16: Edit an existing lab experiment
Actor	Super-admin, Organisation
Brief	Super-admins and Organisations can create and execute a lab experiment. An experiment can consist of one or more “survey”, one or more “serious game”. The actor creates a new “lab experiment”.
Preconditions	The user has already registered to the EVIDENT platform as an Organisation. The user has already created at least one “survey”, “serious game”.
Postconditions	The user creates a new lab experiment and assigns the individual steps she/he has previously created (“survey”, “serious game”). User can publish and execute the lab experiment to collect the data.
Basic flow	<ol style="list-style-type: none"> 1. The user logs in to the EVIDENT platform. 2. The user visits her/his profile and selects the section “My sessions”. 3. The user is prompted with all the experiments she/he has already created and select the button to create a new experiment.

	<p>4. The new lab experiment editor is presented, and the user can select the individual steps she/he has already created.</p> <p>5. The user can save as a draft or publish the new lab experiment.</p>
Exceptional flow(s)	<ul style="list-style-type: none"> The user does not have the rights to create a new lab experiment. The user account has not the rights to create a new lab experiment. Since the user is registered as an organization that might mean that the Super-admin has not granted the platform access yet. The user cannot create a new lab experiment due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01, UC09, UC13, UC14
Extends	UC03, UC15

Use Case	UC17: Delete a lab experiment
Actor	Super-admin, Organisation
Brief	The actor deletes an existing “lab experiment”.
Preconditions	The user has already registered to the EVIDENT platform as an Organisation. The user has already created a lab experiment.
Postconditions	The user deletes an existed lab experiment. However, the linked applications will not be deleted since they might be used in a new/different lab experiment.
Basic flow	<ol style="list-style-type: none"> The user logs in to the EVIDENT platform. The user visits her/his profile and selects the section “My sessions”. The user is prompted with all the Experiments she/he has already created and selects the “delete” button of the experiment she/he wishes to delete. A prompt window appears so the user can confirm her/his action. The user deletes the selected experiment, and she/he has been redirected to the “My sessions” page
Exceptional flow(s)	The user cannot delete an existed experiment due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01, UC09, UC13, UC14
Extends	UC03, UC15

Use Case	UC18: Configure a serious game for a Lab Experiment
Actor	Super-admin, Organisation
Brief	The actor configures an existing “serious game”.
Preconditions	The user has already registered to the EVIDENT platform as an Organisation. The user has already created a serious game template and attached it to the platform.

Postconditions	The user configures an existing survey.
Basic flow	<ol style="list-style-type: none"> 1. The user logs in to the EVIDENT platform. 2. The user visits her/his profile and selects the section “My experiments”. 3. The user is prompted with all the experiments she/he has already created and selects the button to create a new experiment. 4. The new lab experiment editor is presented, and the user can select a serious game as an individual step. 5. For each serious game she/he selects, the user can configure the selected game, meaning that for each one of the serious game’s “configurable fields” (see UC12) she/he can select a field from a prior step to be linked with. For example, a serious game might have a configurable field referring to the user’s yearly income, thus the user can select a field from a prior step to be linked with this configurable item. During serious game initiation, the game will consider the value of this field. 6. The user can save as a draft or publish the new lab experiment. If the user selects to publish the experiment in a protected mode, the platform will ask for an extra experiment password, each participant has to fill in in order to participate.
Exceptional flow(s)	The user cannot attach the game to the Lab Experiment and/or configure the game due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01, UC13
Extends	UC03, UC13

Use Case UC19: Participate to a lab experiment	
Actor	Participants
Brief	The participant selects a published or protected lab experiment to participate.
Preconditions	A lab experiment has already been published (either in protected mode or not). The user has registered to the EVIDENT platform as a participant.
Postconditions	The user participates in a lab experiment. After the completion of the experiment, the participant can inspect her/his answers through her/his profile.
Basic flow	<ol style="list-style-type: none"> 1. The user logs in to the EVIDENT platform. 2. The user visits the “Sessions” page where all published (either protected) experiments are listed. 3. The user selects an experiment she/he wants to participate in. 4. The user is prompt with a pop up containing all experiment information (e.g., title, description, aims, time to complete, etc.) 5. The user selects the “start” button to participate in the experiment. If the experiment is protected, the user should also insert the experiment password (set by the organisation who create it). 6. The user is sequentially navigated to each step of the lab experiment.

	7. After the completion of her/his participation the user can inspect her/his answers through her/his profile.
Exceptional flow(s)	The user cannot submit her/his answers due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC02, UC15
Extends	UC03

Use Case	UC20: See scoreboard
Actor	Participants
Brief	The participant checks the collected points for her/his participation in a serious game.
Preconditions	A lab experiment has already been published (either in protected mode or not). The lab experiment includes a serious game. The user has registered to the EVIDENT platform as a participant.
Postconditions	The user participates in a lab experiment that includes at least one serious game. After the completion of the experiment, the participant can inspect her/his points through the scoreboard.
Basic flow	<ol style="list-style-type: none"> 1. The user logs in to the EVIDENT platform. 2. The user visits the “Sessions” page where all published (either protected) experiments are listed. 3. The user selects an experiment she/he wants to participate in. 4. The user is prompt with a pop up containing all experiment information (e.g., title, description, aims, time to complete, etc.) 5. The user selects the “start” button to participate in the experiment. If the experiment is protected, the user should also insert the experiment password (set by the organisation who create it). 6. The user is sequentially navigated to each step of the lab experiment. 7. The user completes the serious game within the lab experiment. 8. After the completion of her/his participation the user can check her/his position on the scoreboard.
Exceptional flow(s)	The user cannot submit her/his answers due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC02, UC19
Extends	UC03

Use Case	UC21: Inspect participation in a lab experiment
Actor	Participants

Brief	The participant participates in a published or protected lab experiment and after her/his participation she/he selects to inspect her/his answers.
Preconditions	The user has participated in a lab experiment (no need to has finished her/his participation though).
Postconditions	The participant inspects the answer to an experiment she/he participated in.
Basic flow	<ol style="list-style-type: none"> 1. The user logs in to the EVIDENT platform. 2. The user participates in a lab experiment by following the step in UC19. 3. The user visits the “My Sessions” page in the user profile where all experiments that the user participated in are listed (published or completed). 4. The user selects the experiment she/he wants to inspect and gets a consolidated view of all her/his answers.
Exceptional flow(s)	The user cannot inspect a lab experiment she/he has participated in due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC02, UC19
Extends	UC03, UC19

Use Case	UC22: Export user answers from a lab experiment
Actor	Participants
Brief	The participant participates in a published or protected lab experiment and after her/his participation she/he exports her/his answers to a supported format file (CSV/xlsx/JSON, etc.).
Preconditions	The user has participated in a lab experiment (no need to has finished her/his participation though).
Postconditions	The participant exports her/his answers from an experiment she/he participated to a file.
Basic flow	<ol style="list-style-type: none"> 1. The user logs in to the EVIDENT platform. 2. The user participates in a lab experiment by following the step in UC19. 3. The user visits the “My Sessions” page in the user profile where all experiments that the user participated in are listed (published or completed). 4. The user select to export her/his answers from a particular experiment. 5. The user receives her/his answers to a file.
Exceptional flow(s)	The user cannot export her/his answers to a lab experiment she/he has participated in due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC02, UC20
Extends	UC03, UC20

Use Case	UC23: Collect answers from a lab experiment
Actor	Super-admin, Organisation
Brief	The actor can collect/export all participants' answers from a lab experiment that she/he has created.
Preconditions	The user has created a lab experiment and there is at least one participation.
Postconditions	The user collects the results of the lab experiment she/he created.
Basic flow	<ol style="list-style-type: none"> 1. The user logs in to the EVIDENT platform. 2. The user creates a lab experiment by following the step in UC19.. 3. The user publishes and runs the lab experiment. 4. The user visits the “My Sessions” page in the user profile where all user’s experiments are listed and selects the experiment, she/he wishes to collect the data for. 5. Data are de-associated to protect the anonymity of the participants. 6. The user receives her/his answers to a file.
Exceptional flow(s)	The user cannot collect/export the answers from a selected lab experiment she/he has created due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC01, UC16, UC21
Extends	UC03

Use Case	UC24: Share a lab experiment
Actor	Super-admin, Organisation, Participant, Non-registered users
Brief	Actors can share a lab experiment on social media or via email.
Preconditions	A lab experiment has already been created by an Organisation and it is listed on the “Sessions” page.
Postconditions	The actor shares a lab experiment either on social media or via email.
Basic flow	<ol style="list-style-type: none"> 1. Actor visits the “Sessions” page in the EVIDENT platform, where all published and protected experiments are listed. 2. Actor selects an experiment she/he wants to share and select the “Share” option from the available actions. 3. Actor selects one of the available options and gives authorization to the platform to post on his/her account. 4. A lab experiment is now shared on social media or sent by email
Exceptional flow(s)	The user cannot share a lab experiment due to a platform failure. The user is informed about platform failure and is kindly asked to try again in a couple of minutes.
Dependencies	UC15
Extends	-

3. Platform requirements

The definition of the different user roles and use cases in the platform provides an overview of its objectives. The configurations that ensure the smooth and efficient execution of the platform’s functionalities are collected and presented in this section. The requirements that are listed in the next two subsections are crucial for determining the success of the EVIDENT platform. Failure to meet these requirements can result in installation problems or performance issues. They can be broken into two types: Functional and Non-functional requirements. They are usually conveyed in everyday language without in-depth details of technical implementations. The requirements specification outlines the needs of the platform under development and represents the results of the requirements analysis.

3.1 Functional requirements

In this subsection, the functional requirements which are the basic features that the system should provide are reported. These are depicted or stated in the form of input to the system, operation executed, and intended output. They are the user’s expressed requirements that, unlike non-functional criteria that are presented in the following sub-section, can be seen immediately in the completed platform.

During the analysis of the platform, thirty (30) functional requirements were collected and presented in the format of tables. The tables include the unique id of the requirement, title, short description, the module that targets (crowdsource component, serious game subcomponent, data collection component), priority, coverage of the users’ actions, and related UCs.

Req. ID:	Func_01
Req. title	User Authentication
Description	The EVIDENT platform must include an authentication mechanism
Target module	Platform-level
Priority	High
Coverage	The EVIDENT platform provides a secure registration/login page.
Related UCs	UC01, UC02, UC03

Req. ID:	Func_02
Req. title	User Authorization
Description	The EVIDENT platform must include an authorization mechanism
Target module	Platform-level
Priority	High
Coverage	After the completion of the user authentication, the user authorization will follow to provide the appropriate user rights.
Related UCs	UC01, UC02, UC03

Req. ID:	Func_03
Req. title	Organization Validation
Description	The EVIDENT platform must include a validation mechanism for the users registered
Target module	Platform-level
Priority	High
Coverage	The super-admins of the platform will validate the request for the registration of a user as an organization (offline process)
Related UCs	UC01

Req. ID:	Func_04
Req. title	Organization grant access
Description	The EVIDENT platform must grant access to validated users as organizers.
Target module	Platform-level
Priority	High
Coverage	After the validation process, an email will be sent to the users registered as organization confirming the rights of the user as organization.
Related UCs	UC01

Req. ID:	Func_05
Req. title	User login
Description	The users of the EVIDENT platform should be able to log-in
Target module	Platform-level
Priority	High
Coverage	After the completion of the user authentication and the user authorization, the user will access the EVIDENT platform.
Related UCs	UC03, UC04, UC06, UC07, UC08

Req. ID:	Func_06
Req. title	User roles
Description	The EVIDENT platform should support different user roles
Target module	Platform-level
Priority	High
Coverage	The EVIDENT platform supports the creation of multiple user roles (super-admin, organizer, participant) while non-registered users can also browse specific pages of the platform.

Related UCs	UC01, UC02, UC03
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Req. ID:	Func_07
Req. title	User logs out
Description	The EVIDENT platform should allow users to log out
Target module	Platform-level
Priority	High
Coverage	When the users are logged-in, the EVIDENT platform offers the log-out functionality to its users independently from their role
Related UCs	UC04

Req. ID:	Func_08
Req. title	Complete profile information
Description	The users of the platform have a profile and they can fill it with related information.
Target module	Platform-level
Priority	Medium
Coverage	With the users are logged-in, the EVIDENT platform offers a dedicated page with a form for related profile information.
Related UCs	UC03, UC05

Req. ID:	Func_09
Req. title	Update profile information
Description	The users of the platform have a profile which can be updated.
Target module	Platform-level
Priority	Medium
Coverage	With the users are logged-in, the EVIDENT platform offers a dedicated page with the profile form pre-completed which can be updated at will.
Related UCs	UC03, UC05

Req. ID:	Func_10
Req. title	Update user demographics
Description	The users of the platform have demographics which can be updated.
Target module	Platform-level
Priority	Medium

Coverage	With the users are logged-in, the EVIDENT platform offers a dedicated page with the demographics to be updated at will.
Related UCs	UC03, UC05

Req. ID:	Func_11
Req. title	Delete account
Description	The users of the platform can delete their accounts.
Target module	Platform-level
Priority	Medium
Coverage	With the users are logged-in, the EVIDENT platform in the profile page offers the choice to delete their accounts.
Related UCs	UC03, UC06

Req. ID:	Func_12
Req. title	Forgot password
Description	The EVIDENT platform should cover the users if they forget their passwords.
Target module	Platform-level
Priority	Medium
Coverage	The platform in the login page offers the option forgot password. By selecting this option, an email containing a unique URL to reset the user password is sent to user's email.
Related UCs	UC01, UC02, UC07

Req. ID:	Func_13
Req. title	Update password
Description	The EVIDENT platform should provide the capability to users to update their passwords.
Target module	Platform-level
Priority	Medium
Coverage	The platform in the profile page offers the option for the logged-in users to update their passwords at will. The user should provide the current password and confirm the new one twice.
Related UCs	UC03, UC07

Req. ID:	Func_14
Req. title	Export user profile data

Description	The logged-in users have the capabilities to download data related to their profiles.
Target module	Platform-level
Priority	Low
Coverage	The platform in the profile page offers the option to the logged-in users to download the collected data related to their actions in the platform.
Related UCs	UC03, UC08

Req. ID:	Func_15
Req. title	Create survey
Description	The logged-in users with organizer rights should be capable to create a survey.
Target module	Crowdsourcing component
Priority	High
Coverage	The EVIDENT platform supports the creation of survey for the users registered as organizers in the survey editor. The survey is stored in the internal survey library, and it can also be used in future lab experiments.
Related UCs	UC03, UC10

Req. ID:	Func_16
Req. title	Update survey
Description	The logged-in users with organizer rights should be capable to update an existing survey from their survey library.
Target module	Crowdsourcing component
Priority	High
Coverage	The EVIDENT platform supports the update of survey for the users registered as organizers in the survey editor. The survey is stored in the internal survey library, and if selected it can be edited/updated.
Related UCs	UC03, UC11

Req. ID:	Func_17
Req. title	Delete survey
Description	The logged-in users with organizer rights should be capable to delete an existing survey from their survey library.
Target module	Crowdsourcing component
Priority	High

Coverage	The EVIDENT platform supports the creation of survey for the users registered as organizers in the survey editor. The survey is stored in the internal survey library, and it can also be used in future lab experiments.
Related UCs	UC03, UC10, UC12

Req. ID:	Func_18
Req. title	Overview existing serious games
Description	The logged-in users with organizer rights should be capable to browse serious games that are archived in the serious game library.
Target module	Crowdsourcing component
Priority	High
Coverage	The EVIDENT platform supports the overview of existing serious games for the users registered as organizers.
Related UCs	UC03, UC13

Req. ID:	Func_19
Req. title	Upload a new serious game
Description	The logged-in users with organizer rights should be capable to upload a serious game.
Target module	Crowdsourcing component
Priority	High
Coverage	The EVIDENT platform supports the attachment of a new instance of a serious game for the users registered as organizers. The user visits her/his profile and selects the section 'My Games', the option 'Add game', and a form is appeared prompted to upload the game file.
Related UCs	UC03, UC13

Req. ID:	Func_20
Req. title	Update a serious game
Description	The logged-in users with organizer rights should be capable to edit an existing serious game.
Target module	Crowdsourcing component
Priority	Medium
Coverage	The EVIDENT platform supports the update of an existing a serious game for the users registered as organizers. The user visits her/his profile selects the section 'My Games', selects the game she/he wants to edit, and a form is appeared prompted to update the game files.
Related UCs	UC03, UC13

Req. ID:	Func_21
Req. title	Overview existing lab experiments
Description	The users registered as organizers should be capable to browse existing lab experiments.
Target module	Crowdsourcing component
Priority	Medium
Coverage	The logged-in users with organizer rights can visit their profiles, select “My experiments” and overview the lab experiments that they have previously created.
Related UCs	UC03, UC17

Req. ID:	Func_22
Req. title	Create a lab experiment
Description	The users registered as organizers should be capable to create a lab experiment.
Target module	Crowdsourcing component
Priority	Medium
Coverage	The logged-in users with organizer rights can visit their profiles, select “My experiments” and create a new experiment.
Related UCs	UC03, UC18

Req. ID:	Func_23
Req. title	Setup lab experiment wizard
Description	The users registered as organizers when selecting to create an experiment, a setup wizard will appear.
Target module	Crowdsourcing component
Priority	Medium
Coverage	The logged-in users with organizer rights can visit their profiles, select “My experiments” and when selecting the option “Create a new experiment” the setup lab experiment wizard will guide them into the process.
Related UCs	UC03, UC18

Req. ID:	Func_24
Req. title	Edit an existing lab experiment
Description	The users registered as organizers can edit a lab experiment archived in their library.

Target module	Crowdsource component
Priority	Medium
Coverage	The logged-in users with organizer rights can visit their profiles, select “My experiments”, browse over existing lab experiments, select the experiment they desire to edit, and proceed in the changes they prefer.
Related UCs	UC03, UC18

Req. ID:	Func_25
Req. title	Delete an existing lab experiment
Description	The users registered as organizers can delete a lab experiment archived in their library.
Target module	Crowdsource component
Priority	Medium
Coverage	The logged-in users with organizer rights can visit their profiles, select “My experiments”, browse over existing lab experiments, select the experiment they desire to delete, and delete it.
Related UCs	UC03, UC19

Req. ID:	Func_26
Req. title	Serious game manager
Description	A setup wizard for serious games that assists in the creation and edit serious games.
Target module	Serious game subcomponent
Priority	Medium
Coverage	The user (superadmin or organization) has logged-in to the platform, visits her/his profile, selects the “My Games” option, and then, selects the option “Launch serious game manager” which provides the necessary services for the different management of the serious games.
Related UCs	UC03, UC13

Req. ID:	Func_27
Req. title	Configure a serious game
Description	The available serious game should have some fields that are configurable.
Target module	Serious game subcomponent
Priority	Medium
Coverage	The user (superadmin or organization) has logged-in to the platform, visits her/his profile, selects the “My Games” option, and then, selects the option

	“Launch serious game manager and inside this module there are the configurable fields of the serious game
Related UCs	UC03, UC20

Req. ID:	Func_28
Req. title	Attach a serious game to lab experiment
Description	The logged-in attaches a lab experiment and attaches a serious game.
Target module	Serious game subcomponent
Priority	Medium
Coverage	The user (superadmin or organization) has logged-in to the platform, visits her/his profile, visits the running lab experiments, selects the choice ‘Attach a serious game’
Related UCs	UC03, UC20

Req. ID:	Func_29
Req. title	Participate in a lab experiment
Description	The logged-in participant participates in an experiment that has been set up from an organization.
Target module	Crowdsource component
Priority	High
Coverage	The user logs-in the platform, visits the page “Sessions”, browses existing experiments, selects the experiment she/he wants to participate and the platform navigates her/him to each step of the lab experiment.
Related UCs	UC03, UC21

Req. ID:	Func_30
Req. title	Inspect participation in a lab experiment
Description	The user after its participation in a lab experiment, reviews her/his answers.
Target module	Crowdsource component
Priority	Low
Coverage	The user has logged-in the platform and has already participated in a lab experiment. Then, selects the option “My Sessions” under the user profile, overviews the sessions she/he has participated, selects a specific session, and inspects her/his answers.
Related UCs	UC03, UC22

Req. ID:	Func_31
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Req. title	Export answers from a lab experiment
Description	The organization that has set up an experiment exports the relevant answers.
Target module	Data collection component
Priority	High
Coverage	The user has logged in (as organization) and created an experiment. After the completion of the experiment, she/he can select the option 'My sessions', browse the session she/he has created, and then select the option "Export answers".
Related UCs	UC03, UC24

Req. ID:	Func_29
Req. title	Share a lab experiment
Description	The user has completed a lab experiment and then shares the link via email or social media.
Target module	Crowdsource component
Priority	Low
Coverage	The user has logged-in the platform and when she/he completes the experiment, the option to share the experiment via email or social media appears.
Related UCs	UC03, UC21, UC24

Req. ID:	Func_30
Req. title	User scoreboard
Description	The user has completed a lab experiment, gained points for its participation, and compares her/his performance with other users in the same experiment.
Target module	Crowdsource component
Priority	Low
Coverage	The user has logged-in the platform and when she/he completes the experiment, the points gained for her/his participation is appeared on the scoreboard.
Related UCs	UC03, UC21, UC24

3.2 Non-functional requirements

Following the functional requirements of the EVIDENT platform, in this subsection, the non-functional requirements are documented. They are the quality requirements that the system must meet to fulfil the needs of the platform. The main topics they address are security, reliability, scalability, reusability of performance, and flexibility. The non-functional requirements are also used as evaluation metrics for the performance of the platform.

During the analysis of the platform, nine (9) non-functional requirements were collected and presented in the format of tables. The tables include the unique id of the requirement, title, short description, priority, and coverage of the users' actions. The non-functional requirements focused on the system's behaviour in contrast to the functional requirements that are closely related to the users' behaviour.

Req. ID:	Non_Func_01
Req. title	Password encryption
Description	The users' password should be stored encrypted.
Priority	High
Coverage	The platform uses encoding mechanism to store the passwords as hash (PBKDF2 algorithm with a SHA256 hash).

Req. ID:	Non_Func_02
Req. title	Data anonymization
Description	The data stored in the platform should not lead to a specific user.
Priority	High
Coverage	The EVIDENT platform supports data anonymization by exporting the results of the experiments as group results.

Req. ID:	Non_Func_03
Req. title	Availability
Description	The EVIDENT platform should be available 24/7.
Priority	Medium
Coverage	The platform will be hosted in virtual server that supports automatic migration in case of failure.

Req. ID:	Non_Func_04
Req. title	Scalability
Description	The platform's architecture should support additional features if requested.
Priority	Medium

Coverage	The EVIDENT platform is designed to be component-based hence the addition of components can take place without requiring re-design of the architecture.
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Req. ID:	Non_Func_05
Req. title	Reliability
Description	The EVIDENT platform should perform according to its design.
Priority	High
Coverage	The developing cycle includes numerous iterations covering any unexpected events that might occur.

Req. ID:	Non_Func_06
Req. title	Recoverability
Description	The system should address rapidly any damage sustained as a result of system failure.
Priority	Medium
Coverage	Related scripts will be developed supporting automated processes in case of a failure.

Req. ID:	Non_Func_07
Req. title	Maintainability
Description	The platform should be easily maintained from the supporting team.
Priority	High
Coverage	The platform will be developed using known best-practises while the deliverables of the project will provide the necessary details on the platform's architecture. Additionally, the code will be documented with comments to support its legibility.

Req. ID:	Non_Func_08
Req. title	Serviceability
Description	The EVIDENT platform should be supported by a mechanism that ensures its operation on a stable status.
Priority	Medium
Coverage	A series of system tests are designed supporting the ease and speed of the corrective maintenance and preventive maintenance of the system.

Req. ID:	Non_Func_09
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Req. title	Usability
Description	The EVIDENT platform should support the condition for the users to perform any actions (e.g. creation of experiments, data export, etc.) safely, effectively, and efficiently while enjoying the experience.
Priority	High
Coverage	The design process of the EVIDENT platform includes constant feedback from the project's end-users ensuring that the interface of the platform follows the best practices in the market while the experience of the users is an enjoyable act.

4. EVIDENT platform architecture and development

Following the definition of the user roles, the description of the anticipated actions through the presentation of the use cases, the definition of the platform requirements, the EVIDENT platform architecture, and the development strategy are presented in this section. The different components, modules, and interfaces are presented providing an overview of the overall system.

Sub-section 4.1 provides details on the platform architecture including a visual representation of the architecture, sub-section 4.2 presents details on the development paradigm that has been followed, while sub-section 4.3 presents the integrations and testing plan that will be followed to evaluate the operation and the credibility of the EVIDENT platform.

4.1 Platform Architecture

Based on the previous sections, the EVIDENT platform should cover a plethora of different functionalities, thus a well-defined, easily expandable component-based architecture is needed. The components that perform more complicated functions could include sub-components specifying features and objectives. More specifically, the EVIDENT platform has five (5) components:

- **Crowdsource component** includes the survey subcomponent and the serious game subcomponent. It aims to collect valuable information from the users of the platform.
- **Data collection component** compiles the information given from the users, proceeds in their anonymization, and provides the interfaces for the external use of the collected data.
- **Data extraction component** processes the collected data and produces useful insights that are used for both commercial and research purposes.
- **User component** covers all the functionalities that are provided to the platform's users to interact with its services.
- **Datahub services** provide a repository for all the datasets that are used in the context of the EVIDENT project and for future projects in the field of financial literacy.

Figure 1 provides a graphical interpretation of the platform's architecture, demonstrating the relations between the different components of the platform. The session element manages the smooth operation of the platform's main functionality, allowing users to join and interact with the lab experiments, and the user profile element acts as the link between the main functionalities of the EVIDENT platform (create an account, participate in sessions, attach serious game, etc.) and the datahub services tool.

Delving deeper into the architecture, the aim of the crowdsource component is to extract users' opinions on the current behavioural biases that lead their energy consumption habits. This information is extracted from the subcomponents of survey and serious game, providing insights into consumers' opinions and behaviours. Through the survey subcomponent, the users registered as organization can create and edit surveys that can be used within the lab experiments. If published, the new survey can be selected as a distinct step in the context of a lab experiment. For the survey subcomponent, the SurveyJS, a well-known JavaScript survey builder will be incorporated to provide an integrated survey creator for in-house data

storage. The organisation users will be able to leverage the full functionalities of the SurveyJS library creating dynamic surveys and using them in their lab experiments.

Similarly, the organizations can use the serious games subcomponent to upload and edit serious games as a web app in the context of a lab experiment both as a website and a mobile application. The new serious game can be selected as a distinct step in the context of a lab experiment. The crowdsourcing component will undertake to deploy the chosen game scenario, present the survey that has been prepared, and collect the outcome of the two applications for further evaluation. CERTH’s serious game framework is a gamification engine based on the Unity game engine that will be used to create the EVIDENT serious games. The games are designed offline, and the EVIDENT platform will be used as a runtime environment. The serious games will be developed offline and will be uploaded to the EVIDENT platform through the corresponding subcomponent. The subcomponent will provide a mechanism to evaluate the uploaded file to easily deploy it to the platform.

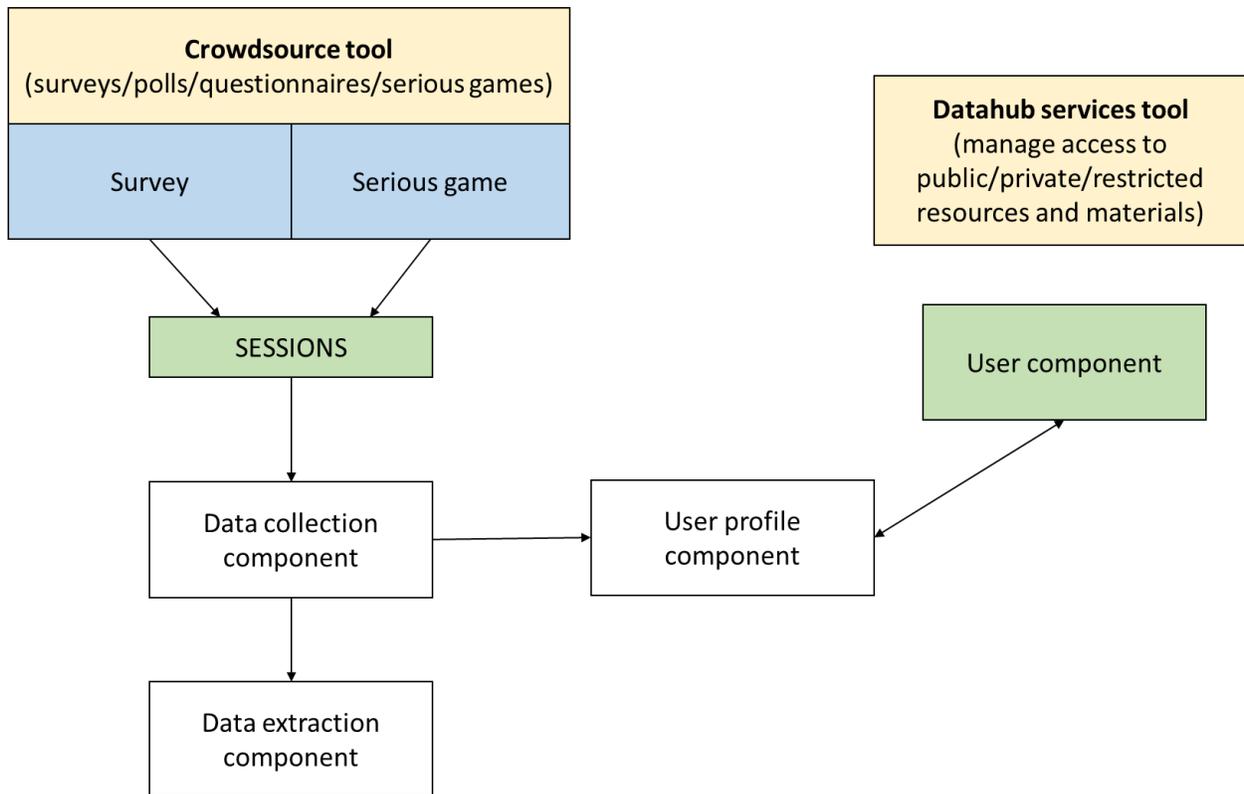


Figure 1: EVIDENT platform component architecture

The EVIDENT platform provides a complete ecosystem for managing lab experiments under the “SESSIONS” component which refers to the functionality given to the users to participate in a lab experiment. Since the phrase “lab experiment” might create wrong impressions to the user, we decided to use the term “sessions” when referring to sections visible to the participants. In the EVIDENT platform, we plan to replace the word “lab experiment”, which is the research term, with the word “session”, which is the software component, in order not to create wrong impressions to the participants. This subcomponent will provide the tools to the organisation users to create and update a lab experiment including a lab experiment editor where the user can select the individual steps for her/his lab experiment. A lab experiment is an experiment conducted under highly controlled conditions (not necessarily a

laboratory), where accurate measurements are possible. The researcher decides where the experiment will take place, at what time, with which participants, in what circumstances and using a standardized procedure. In the context of the EVIDENT platform, a lab experiment may consist of one or more applications/steps such as surveys and serious games.

Each user can register to the EVIDENT platform and participate in several lab experiments regarding energy efficiency. The users registered as organizations can create/edit/run a session, as well as collect the corresponding data. The participants should be able to participate in an active session, and when finished, they should be able to see their progress (through their profile).

The creation of a session is split into statuses, enabling a more user-friendly environment for the organizations that want to execute their lab experiments. The different statuses in the creation of session/survey/serious game follow:

- Draft (for survey/serious game/session) created but it is saved as a draft. The user can continue editing the application or delete it. The application is not visible to others yet.
- Published (for survey/serious game/lab experiment), a survey/serious game is published and available to be used as an individual step in the context of a new session. A published session is visible to other users and is open for participation.
- Protected (for session), a session is published but it is password protected. To participate, the participant should enter the session password given from the organization.
- Completed (for session), a session that has been completed and/or the organisation has deactivated it.
- Deleted (for survey/serious game/session), the material is deleted and not available to the organisation/participants.

The data collection component is closely related to the session since it includes the mechanism of organising and storing the collected data coming from the users' participation in a lab experiment.

The data extraction component can be used both by organisations or participating users to extract the collected data from a session or their participation, respectively. Since the functionality is quite similar, there is only one data extraction component for both user roles.

The user component refers to actions a user can perform regarding her/his account. Based on use cases, a user might want to extract all her/his data the EVIDENT platform has collected for her/him, update her/his personal data processing consent, etc. The component implements the user dashboard and extends the user profile subcomponent and the data extraction component.

The user profile subcomponent provides the mechanism for the user to edit her/his profile such as personal information, platform password, etc. and moreover to leverage the functionalities of the data extraction component to extract the data collected during her/his participation in a session.

The datahub services tool will be used as a hub that will host all the data used for the intervention trials (in anonymized form, without exposing any private user information), the econometric analytical tools that will be developed during the project lifetime, and the reports and insights derived from results. This component will provide access (openly available or protected) to materials relevant to the scope of the EVIDENT project. The datahub services tool is not directly connected with the previous components since it can be used to store/save and manage resources with public, private, or restricted access. A service like

Zenodo should be available for all registered users. The admin should be able to add/edit/delete/inspect the materials and resources.

Overall, the EVIDENT platform is based on mature technological solutions and tools to provide a holistic approach for designing and implementing online lab experiments. The crowdsourcing component should orchestrate the main interactions in the platform acting as a consolidated tool for the organisations, while the interconnections between the different subcomponents guarantee the consistency of the collected data. All created applications (surveys/serious games/sessions) and their collected data should be organised and safely stored in the central EVIDENT database so each platform actor could easily export the desired data. For example, if we assume the session contains two different applications, a survey, and a serious game, each participant's activity/answers should be characterized by her/his unique ID among the lab experiment unique ID. The challenge that accompanies the crowdsourcing component is the design of an effective development and integration plan enabling the fast and smooth materialisation of the platform.

4.2 Development using the agile paradigm

The development team follows the agile paradigm working in an iterative manner delivering work in small, but consumable, increments instead of a single finished product. Scrum is the most used agile technique where we concentrate on the team and collaboration [2] [3]. According to the scrum methodology, the Scrum master and the product owner are the two major roles in the team. The Scrum master leads the agile development team and supports the product owner to gain a good overview of the development process. The product owner manages the product backlogs and interacts with external stakeholders to maximise the value of the product. The iterative meetings between the scrum master and the scrum team are called team sprints and last up to 4 weeks. Then, there is an analytical process for design - code - test followed by the integration team's work. The team's meetings (Scrum team) often happen and focus on what will be implemented in the following days. These meetings are called "sprints".

Figure 2 provides a visual representation of the Scrum lifecycle that is followed for the development of the EVIDENT platform. First, the product backlog is defined, containing a list of the new features, changes to existing features, bug fixes, design changes, infrastructure updated requirements, and any other activities that the Scrum team needs to deliver to produce a specific outcome. Then, the list of the features is prioritised with the definition of the Sprint, and the specific goals of each Sprint are recorded in the Sprint backlog. The development Sprint includes four steps: meeting of the Sprint team, design of the new features, development of these features, and testing. At the end of the Sprint, the Sprint test takes place ensuring that the new features can be integrated into the existing system without conflicts, and the newest release of the software becomes available. Testing in the Scrum lifecycle is realised at two stages: the unit level and the integration level of the small release at the end of each sprint. The iterative testing takes place after the implementation of each feature that serves a specific requirement.

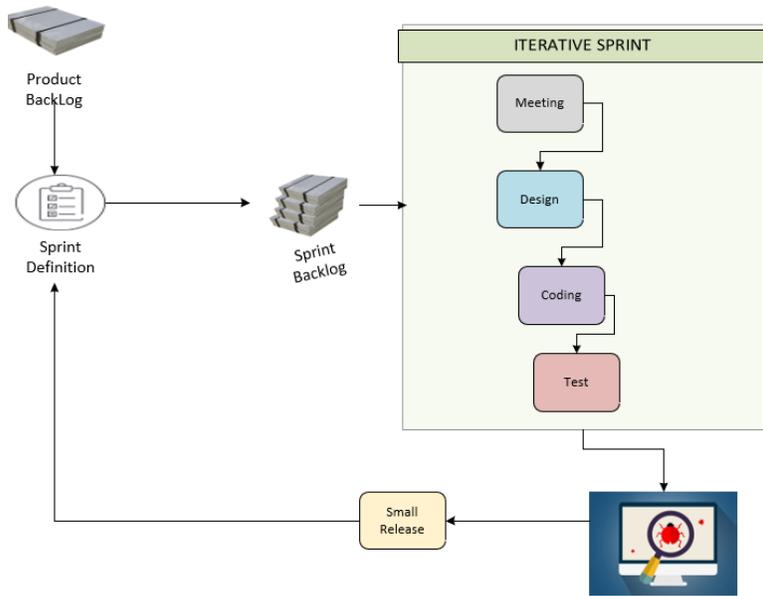


Figure 2: The Scrum lifecycle inspired from [7]

For the reporting of the various problems, bugs and requests that may appear, the development team uses a version control system. This aids in the management of all the components over time. Changes that are made are logged and documented for future reference. If there is a problem in the system, call-back to previous operational versions is feasible. With the tracking of changes by the contributors, possible conflicts are avoided and the version control system aids at the incompatibilities that may occur without interfering with contributors working on another aspect of the platform. The monitoring of the development process is realised using the semantic versioning X/Y/Z:

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- X – Major Version: increment when there are API breaking changes.
- Y – Minor Version: increment when making backward-compatible changes
- Z – Patch Version: increment when correcting bugs

Figure 3 presents the milestones for the design and development of the EVIDENT platform. Nine (9) major milestones have been set throughout the project’s duration. The first milestone is the conceptualization of the EVIDENT platform based on the description provided in the project’s GA, followed by the second milestone the 1st round of discussions with the consortium’s stakeholders. The stakeholders are engaged throughout the design and development of the platform, but the first round of discussion is marked as a milestone because it provides the foundation for the software’s features that are developed. Then, the architecture of the platform is finalised based on the discussions with the consortium covering all the potential needs that may appear. The basic functionalities of the platform (user/session/survey model)

were prepared by M12, and the advanced features (serious game model, UI/UX optimization) were completed by M16. The current deliverable that compiles and records the development process is the sixth milestone. The second SCRUM sprint is focused on the integration of the serious game and, according to the plan, will be completed on M20. The last SCRUM spring will integrate the datahub services into the EVIDENT platform, and the final version of the EVIDENT platform will be delivered in M32.

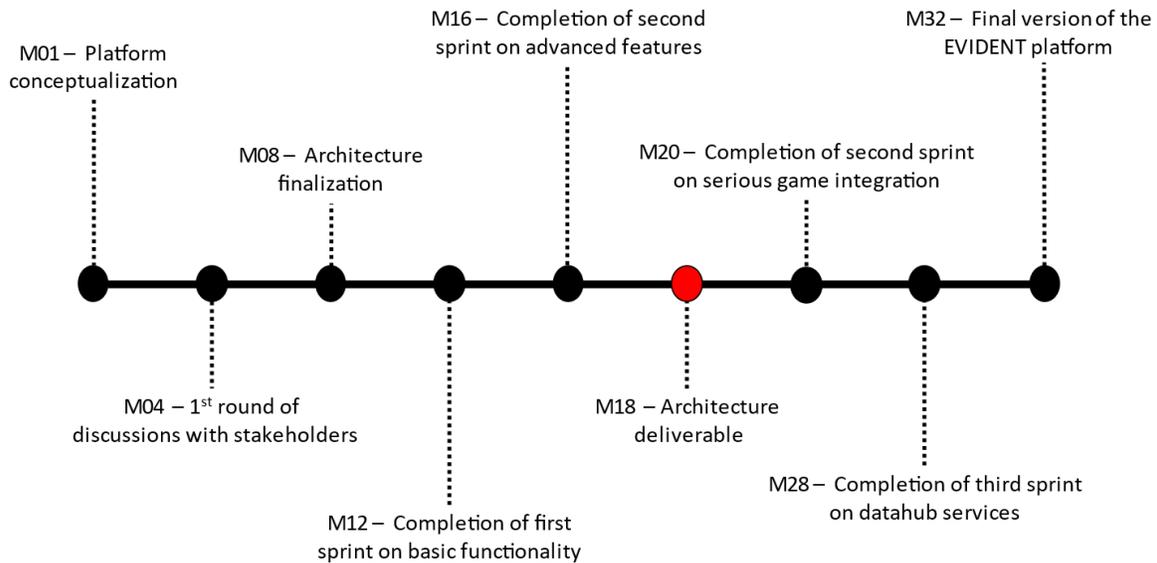


Figure 3: Platform development milestones

The different versions of the EVIDENT platform are verified via the system integration procedures including unit, platform, and acceptance testing, evaluating whether it satisfies all the projects. There are three main types of testing: white box, black box, and grey box. Each type of testing covers different aspects of the development process and all of them are used to test different functionalities and detect different bugs. The white-box (or clean box) testing is code-based tests that are designed by the Scrum team and automatically assess specific functionalities. On the other hand, black-box testing only uses the information that exists in the software’s specification. The grey-box testing combines aspects of the two aforementioned testing types through an iterative process; whenever a problem is encountered (e.g., orphan links), the developers proceed with changes in real-time in the code, and then, confirm the successful execution of the features. During the initial stages of the development, grey testing is mostly used because an important factor of the platform is the ease of use from the users, which can be tested only while browsing the platform.

Figure 4 provides a graphical interpretation of the interactions between specification, program, and test cases. Testing validates the program’s behaviour bridging the gap between the code-based view (expected response) and the behavioural view (observed response). More specifically, given a program and specifications, let us consider a set S of specified behaviours or specifications and a set of P of programmed behaviours that implement the software. Suppose some specification behaviour from set S has not been implemented. In that case, this behaviour will not exist in set P . Furthermore, some implementations might have been created without being in specified behaviours. In general, what is outside the intersection of S and P (identified with the numbers 1 and 2), are omissions or errors. Instead, the intersection is the correct portion, both specified and implemented behaviours. The test cases are

provided in the set T and whatever is in the intersection between P , S , and T (identified with the number 1) are features that are specified, developed, and tested. The intersection between P and T (identified with the number 3) reveals functionalities that have been developed and tested, but not specified, and the intersection between S and T (identified with the number 4) indicates specifications that are tested but not observed during the execution of the program. Finally, the areas that are identified with the numbers 5, 6, and 7 indicate defined specifications, functioning capabilities, and test cases, respectively, which do not interact with each other. The goal of every testing plan is maximising the intersection between the three sets, minimising unexpected behaviours.

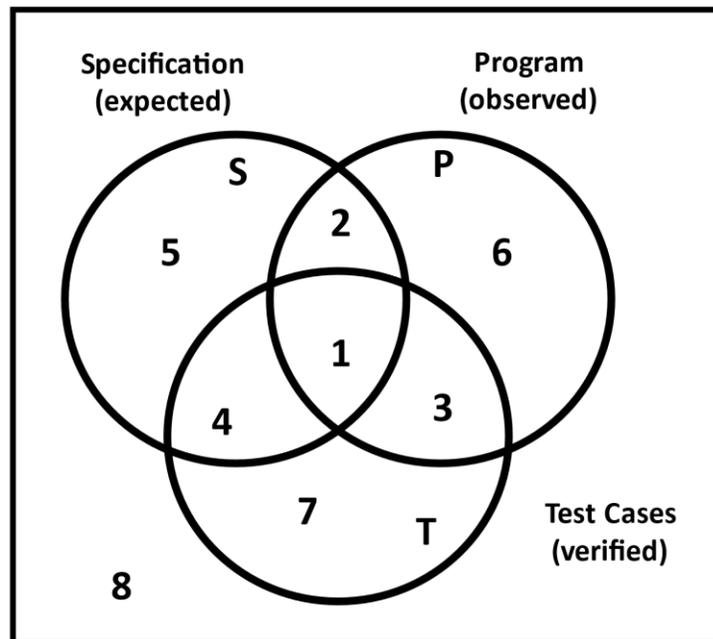


Figure 4: Graphical illustration of the interactions between specification, program, and test

4.3 Integration and testing plan

The integration of the EVIDENT components is based on the architecture and the requirements defined in this deliverable. The EVIDENT development plan, presented in the previous subsection, follows the agile methodology where the platform is split into several phases for more efficient monitoring allowing constant feedback from the end-users. The core value of the agile methodology is the constant collaboration with stakeholders and continuous improvement at every stage of development. Every development phase includes a process of planning, executing, testing, and integrating into the existing system.

The development of the crowdsourcing component is the main component of the EVIDENT platform dictating the use of a specific paradigm and programming framework. The different features within the crowdsourcing component were integrated into the platform without any major issues. However, the datahub and the serious game components are not designed with the same principles as the main platform.

The serious game is a 3D game, designed using Unity, which will help with the research in a more intractable way. The form of the game will be a WebGL (Web Graphics Library) export using Unity and/or an android application. WebGL is a JavaScript API used for rendering interactive 2D and 3D graphics within any compatible web browser without the use of plug-ins. The WebGL application will run through the EVIDENT platform on the user's browser. The information exchange between the game and the platform come true through JSON files. The communication with the platform is running through HTTP requests and handling HTTP responses. The JSON file's information will initialize the settings of the game, personalizing the game to every user based on his previous answers. Moreover, the user's answers will be saved on a database that will be used for further research.

The EVIDENT team is considering using the Zenodo repository as the primary repository for the data created on the EVIDENT Platform [3]. Moreover, Zenodo provides safe archiving and referability, including digital object identifiers (DOIs). The EVIDENT platform will integrate Zenodo to offer the capability to users to develop a set of DOIs corresponding to the Datahub. Likewise, Zenodo has an application programming interface (API) and will enable its connection with the EVIDENT Platform [4]. It should also be mentioned that there is a sandbox environment where testing is allowed, and integration tests can be performed during development, where the sandbox environment can be cleaned at any time.

Special focus is given to software testing as a necessary step in software development, and it is defined as the process of evaluating and verifying that a software product or application does what it is supposed to do [4]. Software testing has a twofold aim, first, evaluates the quality and the acceptability of the produced software, and second, discovers problems in the error-prone process of software development. The benefits of designing and implementing a testing plan include the early recognition of bugs, the reduction of development costs, and the improvements in the system's performance.

Each component will be thoroughly unit tested with tools to be defined by the development team. Each subsystem is responsible for updating other subsystems, so after each change, a unit test is developed to ensure the existing system is not affected. The EVIDENT development plan aims to evaluate the functionalities that are developed in each Sprint, minimising the threat of cumulative bugs. The testing process is split into four categories: unit testing, integration testing, system testing, and acceptance testing.

The unit tests allow us to isolate a part of a software application and validate it with no dependencies. Additionally, they don't need access to databases, APIs, or other external information references. They are often executed via code, and they only cover limited aspects of the system. However, giving unit tests isn't always enough to confirm that our program operates successfully. To indicate that all the components of our program work appropriately, communicating and transferring data between them rightly, we use integration tests.

Integration testing validates two or more components of an application at once, including the exchanges between the elements, to specify if they operate as planned. This type of testing expresses weaknesses in the interfaces between disparate components of a part as they gather each other and provide data between themselves. Integration tests are extremely important in service-oriented architectures (SOA) where different components must communicate for the final service to be provided.

The evaluation of the system as a whole takes place under system testing aiming to identify the desired behaviour of the software. Evaluating a system is closer to our everyday life, for example, evaluating a

product or system against our expectations that derive from the description of the product. The tests under the umbrella of system testing cover business scenarios validating the proper integration and cooperation with all software components.

Finally, user acceptance testing takes place on the software in order to verify its smooth operation based on the user’s needs. User acceptance tests follow the black-box paradigm validating the execution of the system’s different features without any interruptions or crashes, ensuring that the user takes the solution; and software sellers often refer to this as 'beta testing', preceding the production release [5].

The EVIDENT development plan includes a grey testing process for every feature having an identifier ID, the purpose of the test, a description of the test conditions, the values of the input data that the test had, and the outcomes of the test. It is important to keep the same format throughout all the different tests that take place for readability and accessibility reasons. However, black-box testing often takes place from non-expert users browsing the platform, thus it is not realistic or beneficial to ask them to complete formal testing forms.

Table 2 presents the issues that appeared from the black box testing. The first column presents the ID of the issue, and the second column provides a short description of the issue.

Table 2: Black-box testing, issues found

Issue ID	Description
Pass_req_01	Session password is never requested by the user during the session participation process. This happens even if a password is set (by an organization) when creating a session.
Surv_pop_01	When creating a session and the organization chooses a survey to include, an alert appears on the top of the screen which indicates the number of surveys already included in the session. This should be removed.
Surv_pop_02	After the user finishes the participation in a survey, a pop-up message appears that says “you can see all your answers by visiting your profile here”. The word “here” is a hyperlink that does not lead anywhere.
Upd_sess_01	If a user has already participated in a session and then, the creator of that session updates/changes it with a new/updated survey, the user can’t participate on the newly updated session.
Dead_link_01	The “home” hyperlink in sessions page leads to dead link. Instead, it should link to the home page. The same behaviour is observed when a user is participating in a session and clicks on the “home” hyperlink. Steps to replicate: <ul style="list-style-type: none"> 1. Go to sessions page or start participating in a session 2. Click on the home hyperlink. The home is located on the upper left corner of the screen. 3. Note that there are 2 home hyperlinks: One located on the header, and one located just below the header. This bug is replicated only if you click on the second one.
Surv_read_01	Choosing the “read-only” option on a single survey page (when creating a survey), causes the whole survey to malfunction.

	<p>Steps to replicate:</p> <ol style="list-style-type: none"> 1. Create a survey. 2. Add a new page to the survey. 3. Go to the page-specific options of the corresponding page 4. Check the “read-only” field 5. Save the survey 6. Create a session and include the survey to this session 7. Log in with a user account and try to participate in the sessions created during the step 6.
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Throughout the black box testing process, the testers also acknowledge the functionalities that operated as expected. This documentation allows the product owner to receive feedback from the users and direct the development process towards key objectives of the software. Table 3 presents some preliminary successful findings of the black box testing. The first column has the ID of the tests, and the second column presents a short description of each test.

Table 3: Black-box testing, successful tests

Test ID	Description
Sur_toolbox_01	Every toolbox option in a survey (Question types). Drop-down, text-based answers, checkboxes, image selection. Every one of them is properly working.
Sur_shuffle_01	Shuffling survey pages and questions i.e., when a survey creator shuffles the pages on an existing survey. This can be achieved by dragging and dropping survey pages so that to change their order.
Sur_create_01	Adding titles, logos, description, and name to a survey. More than 10 logos tested.
Sur_add_01	Adding locally stored images to a survey (either as logo, or as part of a question)
Sur_display_01	The properties of each individual survey page (Name, title, description, visibility etc.). Except from the “read-only” option as depicted in table 2. All properties were tested.
Quest_add_01	The “add logic” option which enables/disables questions of sets pre-defined answers according to a set of rules. More than 15 logic combinations tests.
Surv_settings_01	Survey settings. The general setting of the survey. Every setting was tested.
Surv_time_01	Time settings (per survey or per page) i.e., options related with time thresholds (how many seconds does the user have to answer a question, how many seconds for a survey etc.). All time options were tested.
Surv_upd_01	Updating a survey (e.g., Adding more questions or changing existing pages) automatically update active sessions that use this survey.
Surv_participate_01	Users can’t participate in a survey twice.
Surv_question_01	Multiple questionnaires in a single session. Up to 4 surveys per session were tested.
Surv_add_pages_01	Adding new pages. Surveys with up to 20 pages were tested.

Surv_rename_01	Changing the title of a survey causes the active sessions to properly adapt to the new title.
Surv_page_dupl_01	Page duplication (during the creation of a survey) works.
Suv_page_del_01	Pages deletion (during the creation of a survey) works.
Undo_redo_01	Undo/Redo function as expected.

The tests that are provided in this deliverable are only the preliminary ones and took place under the agile development paradigm that has been followed. The detailed tests following both black and grey box techniques will be provided in Deliverable 6.4, “Verification and Validation Report for the final version of the EVIDENT platform.”

For every component of EVIDENT, we will examine how they connect to each other and problems that will be encountered during the integration will be reported in deliverable 6.4 “Verification and Validation Report for the final version of EVIDENT platform “.

5. Conclusion

This document describes the activities performed in the context of “Task 6.1 *System Architecture and Design Specification*” of the EVIDENT project while also defining a thorough roadmap for the continuous development and integration of the platform’s components. The deliverable includes a roadmap with the major milestones of the development process and the definition of the testing methodology that will be executed in “Task 6.3 *System Integration, Verification and Validation*”.

The potential of the EVIDENT platform as a service has been evaluated by reviewing the existing market and research platforms, and then, specific user roles and use cases have been defined. Step-by-step integration documentation along with the design and the architecture of the EVIDENT platform are presented in this document. All the requirements (functional and non-functional) are well described to keep track of the expected outputs of the EVIDENT platform. Development, integration, and testing plans are part of this deliverable which are aligned with the ongoing work for the integrated prototype.

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