WPT2: SUSTOURISMO PILOTS

DELIVERABLE T2.1.1. THE SUSTOURISMO APPLICATION ARCHITECTURE

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This report has been produced as part of SUSTOURISMO project (https://sustourismo.adrioninterreg.eu).

SUSTOURISMO project is funded under the Interreg V-B Adriatic-Ionian Programme and the S.O. Promote the sustainable valorisation and preservation of natural and cultural heritage as growth assets in the Adriatic-Ionian area.

This deliverable has been produced with the financial assistance of the European Union. The content of the deliverable is the sole responsibility of SUSTOURISMO Partnership and can under no circumstances be regarded as reflecting the position of the European Union and/or ADRION programme authorities.

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1. Introduction

1.1 SUSTOURISMO project objectives and link with SUSTOURISMO app goals

SUSTOURISMO project aims to upgrade the environment and highlight the natural and cultural heritage elements within the Adriatic region through the reduction of environmental pollutants caused by the increasing use of private vehicles of tourists travelling around the Adriatic countries. The reduction is expected to be achieved through increasing the modal share of active transportation (walking, cycling), Public Transport (PuT) and lower-carbon mobility concepts (car sharing - car pooling, electro mobility).

In this context, attractive 'SUSTOURISMO touristic packages'[1] will be developed to meet the tourists' mobility requirements, while also the SUSTOURISMO application compatible with Android and iOS mobile phones will be designed, developed and pilot tested for a ten months period in the ten SUSTOURISMO pilot cities/areas (Thessaloniki GR, Igoumenitsa GR, Preveza GR, Ravenna IT, Grado & Aquileia IT, Ljubljana SL, Zadar HR, Tivat ME, Berat AL, Belgrade RS).

The main project's objectives are:

1. Identification of crucial tourism & mobility services providers and involved key players
2. Experience exchange for sustainable tourism improvement (through sustainable travel) within the Adriatic - Ionian region
3. Exploring tourists' needs (surveys for identifying interests and needs; sights, areas of historical and cultural value, alternative types of tourism)
4. Building cooperation among identified players for developing a win- win environment; evoke sustainability responsibility to tourists while increasing tourism & mobility sectors profitability
5. Exploiting the power of new technologies for travellers' engagement in 'green' travelling – "SUSTOURISMO" app (for sustainable tourism awareness raising, for crowd-sourcing/crowd-learning and assessing environmental friendly and responsible travel behaviours)
6. Delivering methodologies for transferring and adopting the lessons learned by the pilot cases to other ADRION regions
7. Providing ADRION policy makers with a Sustainable VolunTourism Boost Action Plan (ROADMAP) that concentrates guidelines for reaching sustainable tourism goal

[1] ***In SUSTOURISMO project, with the term 'SUSTOURISMO touristic packages' we refer to the joint promotion of sustainable mobility modes and ways of transport and of other services of touristic interest. The term used has nothing to do with other legal or institutional issues and is used just as such for referring to the pilot tests in SUSTOURISMO case***

The current deliverable describes the architecture of the SUSTOURISMO app, therefore it directly addresses No5 of the above list of objectives. The SUSTOURISMO app's objective (Android and iOS) is twofold. From the one side there is the informative dimension of the app, through which the end users (tourists) are provided with a single point information regarding their staying in each pilot case. From the other side, there is an awareness raising effort towards sustainability; promotion of sustainable 'SUSTOURISMO touristic packages' (joint provision of services that support sustainability, i.e. promotion of active transport) and rewarding schemes for responsible choices (i.e. walking more – winning more / steps calculator). Therefore, it is an app mixing crowdsourcing, informationprovision and awareness raising dimensions with an ultimate goal to change travelers' mind in favor of sustainable and responsive behaviors and to add on the capacity of authorities to plan having in the center of their agenda the travelers' needs. The SUSTOURISMO app supports also the achievement of the objectives No3,4 and 7;

- The tourists are asked via the app to provide special needs regarding the conduction of their trips within the areas of visit and comments that can help the decision-making procedure (No3 objective). The analysis of the above correlated with the profile of the tourists can give targeted information to the decision makers, making planning a 'ground based' activity (No7 objective).
- The app could also potentially present a link to local services. In parallel, information for reaching the points of interest via sustainable modes of transportare adding on the main target of changing travelers' behavior towards sustainable options(No4 objective).

Figure 1: SUSTOURISMO app benefiting effect

Through the use of the SUSTOURISMO app the below target groups will be benefited:

- ✓ **Tourists:** from one side will get provided with useful information regarding touristic points of interest they can visit, organized events they can participate during their staying, attractive 'SUSTOURISMO touristic packages' combining specific offers they can obtain, available transport modes they can use for their trips within and outside the city centre/pilot area,etc. From the other side, they will have the opportunity to state their satisfaction regarding the transport mode used for their trips or propose new ideas for upgrading the provided tourism and transport services of the visited city/area, collecting points as to obtain rewards during their staying.
- ✓ **Transport providers:** such as public transport organizations, interurban bus companies, sea transport companies etc., provide to the app data or information regarding their transport services helping tourists to organize better their trips while in parallel are evaluated by the commuters for their provided services. Therefore, problems and difficulties are defined, giving them the opportunity to upgrade their services taking into account the users recommendations (through the app's service complaints and proposals). The latter helps them also improve both their business models and their market share.
- ✓ **Local Authorities:** beyond tourists and transport providers, Local Authorities are also beneficial of the app as it provides useful data that can be used for the promotion of sustainable tourism via sustainable transport in the city/area. More specifically, the app collects trips related characteristics, complaints and proposals for both tourism and transport provided services, all useful for planning a more sustainable city/area for visitors and residents as well.
- ✓ **Tourism providers:** such as hoteliers, tour operators, travel agencies, etc., can cooperate in order to provide attractive 'SUSTOURISMO touristic packages' , while also can upgrade their services taking into account the tourists ideas, proposals and complaints.

1.2 The scope of Deliverable T2.1.1

The current deliverable describes the principal architectureof the application, the services to be provided by the app, the app's components and the use casesdriven by the user requirements, while it also presents the wireframes' design. The architecture of the SUSTOURISMO application will be the base for the development of the application while it provides the scope and overview of functionalities for any interest reader. Beyond that, the architecture plays the role of the specifications for any future upgrade of the app. It is possible that modifications could take place during the testing phase in order to overcome technical issues and present a well operating app.

The remainder of the report is structured in five sections. The second section describes the functionalities to be provided by the app while the third section provides an overview of the architecture of the application. In the fourth sectionthe main components of the application are described while the fifth section describes the use cases and depicts the relevant wireframes. The

last section includes ideas and proposals for the app's future extension and exploitation.

2. The SUSTOURISMO app functionalities

The two main SUSTOURISMO app functionalities are:

A) Information about the cities/pilot areas (Service 1)

B) Contribute and win (Services 2, 3, 4 and 5 as these are described below).

Information about the city/area functionality

The user, both registered or not visitor, has access to the information for the SUSTOURISMO cities/areas.

Service 1 – Information provision

Through this service the end user will receive information regarding points of interest for each SUSTOURISMO case and will get sustainable transport modes related information – directly or linked to operators' websites. The relevant information will be collected for all pilot areas in order to be incorporated and adjusted in the app and the specific service. An excel file will be created in order to collect input in a specific way, common for all cases. The thematic sections that the service will include are (where applicable):

- Points of interest are clustered in the following:
  - Art and Culture consisted of four sub categories
  - Monuments and Archaeological sites
  - Museums and Art galleries
  - Cultural and Historic Buildings
  - Religious Sites
  - Areas of Touristic Interest
  - Markets (e.g. shopping centers, open markets)

Information will be given according to partners' needs and just where applicable or estimated as necessary.

Available transport modes (e.g. bus, bicycle sharing system, sea transport, etc.) coordinates and features will be collected also in a common way (excel file).

- 'SUSTOURISMO Touristic Packages'

The user will get informed about the 'SUSTOURISMO touristic packages' each city/area offers to visitors. The packages are case-specific (where applicable).

- Events Calendar

A link to events can be shared per case.

- Weather

The user will be able to get informed about the weather conditions in the visiting area, in order to schedule or reschedule all his/her touristic activities.

- Useful links

Useful links to emergency services and other services of potential interest for a tourist will be provided.

Contribute and win functionality

Prerequisite for the use of this 'contribute and win' services is the registration of the user in the application and the acceptance of sharing his/her position (GPS enabled). Rewarding scheme for participating in each of the following services will apply – the'contribute and win' functionality is linked with an e-wallet where virtual coins are collected foreach 'action' of the user within the current functionality. The virtual coins can be translated toreal rewards per case according to the cooperation schemes generated within the SUSTOURISMO cases (partners are responsible per case).

Service 2 – Trip's recording & evaluation / my trips to the area

The service aims to collect data related to tourists' trips in each pilot case, providing to the visitor the possibility to declare a specific trip/route he/she followed (already implemented trip), by filling in relevant information:

- Origin point: the user will insert the origin point of the trip
- Destination point: the user will insert the end point of the trip
- Transport mode used for the trip (a predefined scroll down list will be created for that scope)
- Reason for selecting the specific transport mode (a predefined scroll down list will be created for that scope)
- Trip day (user will select day, month and year from a diary displayed in his/her mobile screen)
- Start and end time of trip (the user will insert the relevant time)

After declaring his/her trip, the user will be asked to rate the transport mode he/she used for the trip's completion, scoring it through a specific scale (i.e. use of a five-point scale 1 - 5, where one corresponds to not at all satisfied and five corresponds to very satisfied).

Following, the user will be asked whether the chosen transport mode was his/her first option and in case the answer is 'No' a scroll down list will be displayed to the user asking him/her to declare the transport mode he/she would prefer to have used and for which reason he/she did not eventually use it (the user will select a specific reason from a predefined list). Therefore, each pilot area will have the opportunity to collect useful information regarding the existing provided transport services which in turn will be taken into consideration by Public Authorities and transport operators in order to upgrade the transportation system of the selected area/city.

Per trip inserted in the app, the user collects virtual coins.

Service 3 – Participation in touristic packages

Under this service, the user can validate its participation in a 'SUSTOURISMO touristic package' (as described under service 1) while for his/her participation, he/she will be rewarded by collecting points in his/her e-wallet. In more detail and in order to ensure both the best possible exploitation of the application, and the promotion of 'SUSTOURISMO touristic packages' a rewarding point system will be developed and integrated within the app as an extra service (points collection and redeeming – responsible for finding out offers per case are the responsible partners). For all the app's services the user will use, he/she will automatically collect points that he/she will be able to redeem through specific rewards/offers (the rewards/offers will be finalized through the creation of cooperation schemesbetween each pilot case and respective public or private bodies directly involved in mobility and tourism activities within the area).

As part of the points' collection system, the app will provide to the user an integrated QR code scanning system which he/she will be able to use during his/her participation in the SUSTOURISMO "tourist packages" that will be developed and tested by each pilot case.

Service 4 – Proposals and complaints

The service aims to encourage tourists to report complaints about tourism and mobility related issues they faced during their visit and to propose suggestions for improving the services.

Service 5 – Counting steps

This service aims to encourage tourists to visit the main points of interest of each pilot case by walking – the current service is a pedometer. T*he more the counted steps, the higher the virtual coins collected for the user. There is no tracking functionality included.*

3. SUSTOURISMO app development stages

The SUSTOURISMO app design and development is divided into 4 (four) stages of implementation.

First stage: Analysis of the project's requirements and specifications

At this stage, the app's development technical team will specify and finalize the additional requirements of app's architecture according to the goals set.

Second stage: Design Phase

Under this stage the app's visual design layout will be shaped. The corresponding graphics and colours will be based on the ones to be agreed upon the first stage. At the end of this stage the final layout of the mobile applications should be chosen in order the next stage of implementation to follow. MVC design pattern will be used for both for iOS and ANDROID.

Third stage: Development Phase

At this stage the technical team will develop the mobile applications based on the final layout selected in the previous step, while also the following projects will be developed:

- Android Mobile Application
- iOS Mobile Application
- Backend
- Administration Panel
- Import of relevant content
- Installation of the backend to the server which will handle the web hosting.

Feature driven development will be used.

Fourth stage: User acceptance testing phase

This stage involves user acceptance testing of the mobile applications, and any modifications might occur.

Throughout the whole process there will be a constant and direct cooperation with the project partners . Special attention to GDPR will be given and guaranteed.

The SUSTOURISMO app architecture will be based on the following subsystems to be developed:

1. Android mobile application "SUSTOURISMO app"
2. iOS mobile application "SUSTOURISMO app"
3. Web administration panel
4. Back end system

All subsystems will be developed considering state-of-the-art technologies that ensure scalability, security, performance and an overall ease to maintain future proof platform resulting in high conversion rates and loyal users.

In more detail the following systems will be developed:

- 1x Native Android Mobile Application and 1x Native iOS Mobile Application
  - Built on Java programming language for Android
  - Built on Swift programming language for iOS
  - Secure Communication between the mobile applications and the backend using RestFul API.
- 1x Back-end system
  - Built on Node JS
  - Restful API that will allow secure communication between mobile applications both Android & iOS, administration panel, and 3rd party systems.
  - The database will be developed on Mongo DB
- 1x Administration panel for your administrators
  - Built on Angular
  - Modern UI Design
  - Fast loading times
  - Provides all the administration tasks like content, users & points of interest management in one place with fine grained permissions.

The above systems will be hosted on any reliable cloud infrastructure like Google Cloud Platform (GCP), Amazon Web Services (AWS), Digital Ocean, or on the projects own infrastructure.

Backend Application, Database and Web administration panel Hosting minimum requirements:

- Virtual Machine or Dedicated Server
- Linux based operating system (Ubuntu is preferred)
- 4GB RAM or more
- 4x CPU or more
- 120GB SSD or more
- Software Installation: Node Js, Mongo DB
- Software or Hardware Firewall in place

Regarding security issues, the technical support team will provide all the upgrades – bug fixes, covering the security flaws which may arise.Some of the security features are described below:

- **Encrypted Communication** - Encrypted communication between the mobile applications and the backend via HTTPs Restful Requests.
- **Secure Login** - Safe user connection via SSL protocol (HTTPS).

- **Access Levels** - Different administration permissions.
- **Disable of unnecessary functionalities** – Functionalities of the platform that do not serve the needs of the project will be removed or disabled to all users.
- **Server firewall security hardening**
- **Database security hardening**

3.1 Components of the system

The SUSTOURISMO mobile application will be developed using all the modern capabilities of mobile devices such as GPS, Pedometer and Camera access with emphasis on user experience and ease of use.

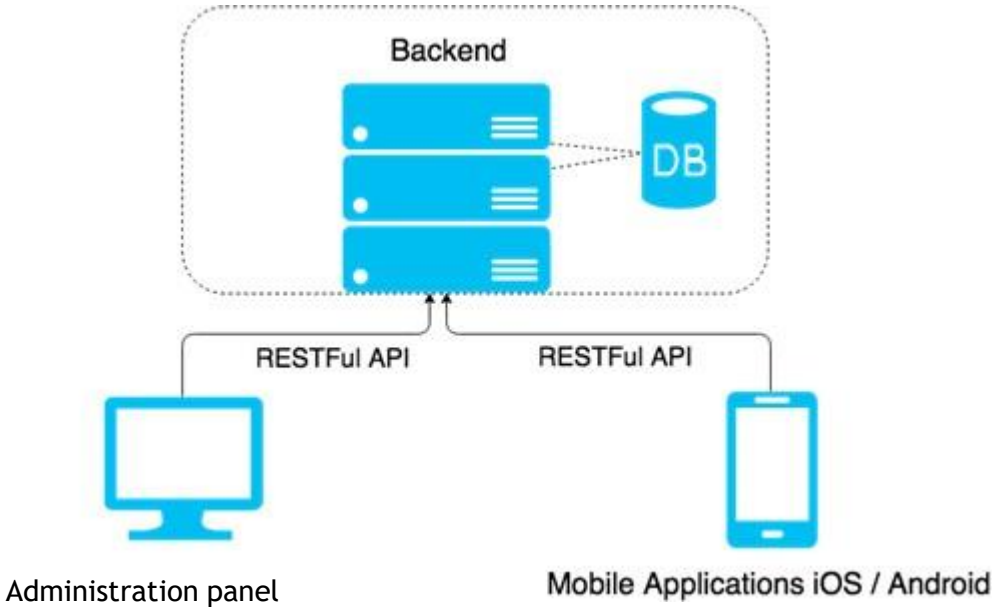


Figure 2: Basic components of the SUSTOURISMO system

The SUSTOURISMO app will consist of multiple elements integrated by several components. Below, there is an overview of the overall architecture, which consists of both front end and backend services and functionalities.

The system will consist of:

- Mobile Apps for mobile devices, Smartphones/Tablets for Android and iOS devices
- Web Administration Panel for access over web browsers
- Web Services for exchanging data

- Data Storage

The system intends to create an open, globally accessible and complete set of information services able to support the needs of the service. It will be developed under the technical architecture as depicted in Figure 2. This n-tiered architecture can be divided into three layers: the Presentation layer, the Business layer and the Data layer.

The presentation layer is responsible for accepting user's input and rendering the user interface that is returned from web services. The user Interface uses various SDKs such as Android, iOS, JavaScript etc depending on the clients platforms.

The application layer consists of two mobile clients, one for Android and one for iOS for the user to interact. Also, the system is supported by a REST API used to develop a web interface for the communication with other systems.

The business layer implements the core functionality of the system and encapsulates the relevant business logic. It is structured under the concept of business processes and business components. Many business processes involve multiple steps that should be performed in the correct order. Business workflow components define and coordinate long running and multistep business processes and can be implemented using business process management tools. The business layer consists of the backend system that will be developed.

The data layer provides access to data hosted within the boundaries of the system. Data access components in this layer are responsible for exposing the data stored in databases to the business layer. The system requires information from external systems to complete a business process. Therefore, business components must access external services or applications. A service gateway is a component that encapsulates the interface, protocol, and code required to use such services. The service is a Web service that uses REST over HTTP for communications and is fully described by means of Web Services Description Language. The service defines a contract that all service consumers must conform in order to access the service. The contract defines such things as the technology, communications protocols, and message definitions needed to communicate with the service.

The prerequisites for the system development are the following:

- Node.js 12.x or higher. Node.js is an open-source, cross-platform JavaScript runtime environment for developing a diverse variety of tools and applications. Although Node.js is not a JavaScript framework, many of its basic modules are written in JavaScript, and developers can write new modules in JavaScript. The runtime environment interprets JavaScript using Google's V8 JavaScript engine.
- MongoDB version 4.x or higher. MongoDB is a free and open-source cross-platform document-oriented database program. Classified as a NoSQL database program, MongoDB uses JSON-like documents with schemas. MongoDB is developed by MongoDB Inc. and is free and open- source, published under a combination of the GNU Affero General Public License and the Apache License.

- Angular 10.x or higher. Angular is an application design framework and development platform for creating efficient and sophisticated single-page apps like the administration panel of this project. is a TypeScript-based open-source web application framework led by the Angular Team at Google and by a community of individuals and corporations. Angular is a complete rewrite from the same team that built AngularJS.

3.2 Web administration panel architecture

The SUSTOURISMO mobile application content management services, will be provided to the admins over web for any browser that can interpret HTML content via an easy to use web administration panel. The development of the web administration panel application, will be achieved using Angular framework with JavaScript, HTML, CSS, and jQuery. The data interoperability between the backend and the web front end application will be achieved with RESTful services over the Backend System.

The web administration panel application will be build based on responsive techniques in order to be easily accessible and readable by different browsers, window sizes and devices.

The core layout of the web administration panel will be based on a master page which will provide a common appearance and behavior to all sections of the platforms while allowing an update to the site with minimum effort. Also, several sections of the platform will be built as user controls, instead of pages, so this will make the relative content and/or service reusable at least within the portal.

The master page and the other pages will be developed using Cascading Style Sheets (CSS) for the layout with HTML while the content will be rendered through the web services from the backend system.

Pages and user controls will be mostly developed using client-side scripts such as JavaScript and jQuery in order to improve the users experience and to provide better responsiveness.

The navigation of the web platform will be achieved through the use of a side main menu as well as a required link whenever is necessary to provide the user with the relative information.

3.3 Mobile application architecture

The SUSTOURISMO app's provided services will be running on the mobile devices either in Android or iOS editions. The development of the mobile apps, will be achieved using the Google's & Apple's native tools for developing mobile apps depending on the platform.

For iOS development, the backend system API will provide all the necessary functionalities to gather and submit data while the Swift programming language will be used for the development of the UI and the internal functionalities of the SUSTOURISMO client iOS devices.

For Android development, the backend system API will provide all the necessary functionalities to

gather and submit data while the Java programming language will be used for the development of the UI and the internal functionalities of the SUSTOURISMO client Android devices.

In both cases (iOS and Android devices) the apps will support a variety of different device hardware (e.g. different screen sizes) and the most popular operating system versions. Mobile device design and development is unique due to the constrained and different nature of device hardware. The heterogeneous device environment will be considered when designing the mobile applications including factors such as variations in screen size and orientation, limitations in memory and storage space, network bandwidth and connectivity.

The following guidelines will be considered during the SUSTOURISMO app architecture development:

- The application will be optimized by considering factors such as screen size and orientation, network bandwidth, memory storage space, processor performance, and other hardware capabilities.
- Device-specific capabilities will be used in order to enhance the application functionality, such as accelerometers, graphics processing units (GPUs), global positioning systems (GPS), haptic (touch, force and vibration) feedback, compass, camera, pedometer.

3.4 Backend architecture

The SUSTOURISMO services will be developed based on the use of a Backend system which will expose a RESTful API and will operate as Mobile backend as a service (MBaaS). It is a model offering to web app (administration panel) and mobile app developers the ability to link specific applications to a backend cloud storage and APIs exposed by backend applications, while it also connects features such as user management, push notifications and integration with social networking services. These services are provided via the use of custom software development kits (SDKs) and application programming interfaces (APIs). The scope of using such a service relies on the fact that web and mobile apps require a similar set of features on the backend, including push notifications and cloud storage. Each of these services is based on its own API which must be individually incorporated into an app.

The backend system basically connects the frontend of an application with various cloud-based backends via a unified API. The provision of a consistent way to manage backend data helps frontend developers to integrate all services into a mobile application ensuring all data.

The backend system, provides software development kits (SDKs) used for the development of multiple platforms, such as iOS, OS X, tvOS, Android, PHP, Javascript, Unity and others, while it also provides several services such as push notifications, file storage and sharing, integration with social networks such as Facebook and Twitter, location services, user management.

3.5 Data Storage

The selection of a correct data access technology is very crucial for the data storage design and the data management and depends on the type of data to be stored and how this data will be handled within the application. Certain technologies are better suited for specific scenarios. In the SUSTOURISMO project scenario the best suited technology is MongoDB. The data storage of the whole platform will be achieved with the use of MongoDB which is an open-source cross-platform document-oriented model database storage tool which also supports storage and management of spatial data.

MongoDB is classified as NoSQL database program and it does not use tables and rows as in relevant databases. It is built on an architecture of documents. The key-value pairs contained on the documents are the basic data unit in MongoDB while sets of documents and functions are the collections which are equivalent to relational database tables.

MongoDB supports dynamic schema design, allowing the documents in a collection to have different fields and structures. The database uses a document storage and data interchange format called BSON, which provides a binary representation of JSON-like documents. Automatic sharding enables data in a collection to be distributed across multiple systems for horizontal scalability as data volumes increase. MongoDB storage is exposed to the applications (web & smartphones) with the use of the backend system.

In the iOS, programming frameworks, property list files are files that store serialized objects. Property list files use the filename extension. plist, and thus are often referred to as p-list files. Property list files are often used to store a user's settings and other data locally on the iOS client. They are also used to store information about bundles and applications, a task served by the resource fork in the old Mac OS.

In Android, resource files are used to store user's settings, preferences and other data locally. Resource files are XML files. XML is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. The W3C's XML 1.0 specification and several other related specifications, all of them free open standards, define XML. The design goals of XML emphasize simplicity, generality, and usability across the Internet. It is a textual data format with strong support via Unicode for different human languages. Althoughthe design of XML focuses on documents, the language is widely used for the representation of arbitrary data structures such as those used in web services.

3.6 Web Services

A Web service is a software system designed to support interoperable machine-to-machine interaction over a network. It has an interface described in a machine-processable format. The data stored in the database will be consumed to the application services over the backend system with RESTful web services. On the backend system several functions will be implemented as web services and more specifically as cloud functions to store and provide the relative data. The web services as cloud functions will provide the ability to the project to easily extend its services to other means as an additional functionality or different device hardware and software.

3.7 Communication architecture

Technically, the mobile applications will communicate with modern and secure data exchange technologies (via Restful API) with the backend system created in Node JS and all the data will be saved in a mongo db database instance which will be located on the same server. In addition, an administration system will be implemented, fully interconnected with the backend system via Restful API, which will allow administrators to update/add/delete application data, search for data using filters and export the data that they want in .csv format. The main use of the administration panel is the content management and the reporting tool of the project.

3.8 Interoperability

The data interchange between the different interfaces will take place through relative web services using REST. By using Backend System web services data can be exposed to multiple UIs and can be further extended or integrated into existing services outside of the project. Depending on the function, each function could be called with the appropriate input in order to return the relative object or objects. For example, a function called getCountries has as input the desire locale of the user and returns all Countries objects.

3.9 Design & UI Interfaces

All services' user Interfaces (UI) follow a minimalistic approach in order to be user friendly. Colours and fonts are applied in an attractive way so as to be readable by the user. Controls are used in the most usable way and whenever is necessary.

The administration panel uses HTML, CSS, JavaScript and jQuery in conjunction with Bootstrap front-end framework to render and display the relevant information, thus, making the web application fully responsive and available for different screen sizes and devices.

User interface components provide to users the ability to interact with the mobile applications rendering and formatting data for users, while also acquire and validate data input by the user. User process components synchronize user interactions. Separate user process components may

be useful in case of a complicated UI. Implementing common user interaction patterns as separate user process components allows to reuse them in multiple UIs. The design principle for the UI "One Screen, One Task" will be used in this case. Every screen designed for the mobile applications will support a single action of real value to the user. Each screen will be designed for one task with no more than 1 call-to-action. This makes it easier to learn, easier to use and easier to add to or build on when necessary.

The user interface will be designed according to project specific guidelines (colours, logos etc.)

The wireframes and graphic designs of all the separate screens will be prepared for the mobile application, indicating the flow of the user for each of the provided services. The mobile applications design will be compliant with the latest design guidelines of Google and Apple for mobile applications.

4. Core functionalities of the app

4.1 Web administration panel content management system

A web administration panel environment will be created for data processing and content management by the administrators of the project. An administrator can use the administration content management panel in order to perform the basic actions of creating, updating, deleting and viewing a record stored in the database of the backend. It securely communicates through a Restful API with the backend system to perform the below actions. An administrator can create or update multiple text fields of an article like the title, a short description, a main description, the category it belongs, the GPS coordinates, the specific characteristics of the article like phone numbers, websites, e-mails, working hours, bus stops numbers, images, videos and other multimedia content in an easy to use and without any specific technical knowledge.

- Administrator Login / Registration functionality.
  - Ability to create a new administrator.
  - Ability to delete.
  - Ability to update / change e-mail & password.
  - Ability to view.
- User management functionality.
  - Ability to view the user.
- Points of Interest (POIs) content management functionality (museums, monuments, archeological sites, tourist routes, etc.).

- Ability to create a POI.
- Ability to delete a POI.
- Ability to update a POI
- Ability to view a POI.

• Alternative transport modes content management (e.g. use of bicycle, use of Public Transport system, walking, etc.).

- Ability to create.
- Ability to delete.
- Ability to update.
- Ability to view.

• Trips content management functionality.

- Ability to view a trip.

• Evaluation data content management functionality (e.g. of an excursion, of a transport mode).

- Ability to view.

• Complaints content management functionality.

- Ability to view.

• Trip management functionality.

- Ability to view.

• Ability to manage reward points.

- Ability to view.

4.2 General features of the mobile applications

Native Android & Native iOS applications.

Compatibility with Android and iOS operating systems.

- iOS mobile application compatibility with iOS 11 up to the latest iOS version.
- Android mobile application compatibility with Android 7 operating system up to the latest Android version.

- No restrictions on the amount of content.
- Listing preparation and upload of the applications to their respective application stores (App Store for iOS & Google Play for Android).
- Download applications at no extra cost from the client's corporate account in the App Store and Google Play.

4.3 Basic functionalities of the mobile applications

Multilingual functionality - Two (2) languages (Greek & English).

- Central content management of mobile content from the administration panel.
- Ability to hide/restrict specific content from the administration panel environment.
- Ability to view photos & photo galleries.
- File download functionality.
- Location of the project support offices on Google maps and access instructions via GPS and interactive maps.
- Information functionality to all users of the application for news, updates, cultural events, new points of interest, events, etc. via mobile push notifications
- Direct Communication with the offices / services of the company (touch to call & touch to email).
- mobile application sharing functionality to social media and to third parties, e.g. by e-mail.
- System of usage statistics of the application.
- Special system for recording any crash reports of the application so that application updates are planned correctly.

4.4 Special functionalities of the mobile applications

The following functions for each city/area participating in the program will be implemented.

- User Registration / Login functionality.

  Ability for a user to Register by filling out a form with the following fields.

  - City of residence

- Gender
- Age

Service 1: Information about the pilot area/city

- Ability to display Points of Interest (e.g. museums, monuments, archaeological sites, tourist routes, thematic routes, etc.).
- Ability to view the classification of points of interest based on the nearest GPS.
- Ability to display points of interest accompanied by photos and text.
- Ability to display points of interest on the map and be guided via GPS. A prerequisite is the GPS activation.
- Ability to display alternative sustainable transport modes features (e.g. bicycle, pedestrian movement, etc.) based on the user's location.
- Ability to display the provided SUSTOURISMO touristic packages.
- Ability to display events.
- Weather functionality of the area (this is a service of a third party provider,like yahoo weather).
- Useful links display.

Service 2: Trip's recording & evaluation / my trips to the area

- Ability to select the origin point of a tourist trip.
- Ability to select the destination point of a tourist trip.
- Ability to select the start and end time of the trip.
- Ability to declare the transport mode used for the trip through a predefined scroll down list.
- Ability to select the reason for selecting the specific transport mode through a predefined scroll down list.
- Ability to evaluate the selected transport mode through a drop down menu of a specific scale (e.g. 1-5, 1-not satisfied at all, 5- very satisfied).

- Ability to define whether the selected transport mode was the user's first choice.
- Ability to define the reason for not selecting the preferable transport mode (first choice) through a predefined scroll down list.
- Ability to redeem points.

Service 3: Participation in SUSTOURISMO touristic packages

- Ability to validate participation in a specific SUSTOURISMO touristic package.
- Functionality of a Reward System.
- Ability to collect points when using the app's services (e.g. in case of trip recording, trip evaluation, etc.).
- Ability to redeem points.
- QR Code Scan functionality for collecting and redeeming points (e.g. bicycle rental, etc.).

Service 4: Proposals and complaints

- Ability to fill in a complaint using free text and submitting it to the administration panel, through the selection of a specific category of complaints.
- Ability to submit proposals using free text for the upgrade and enhancement of tourism and mobility services of the city/area.
- Ability to redeem points.

Service 5: Counting steps

- Functionality I walk in the city/area I visit - I count my steps.
- Ability to redeem points.

5. SUSTOURISMO MOBILE APPLICATIONS USE CASES

In the case of the SUSTOURISMO app, any user can download the relevant app either from the Google Play App store in case of using an Android mobile device or the Apple App store in case of

using an iOS mobile device. Through these stores the user automatically ensures stability or security updates might be needed for the users to be provided with. Both the use cases and the design layouts depicted below, refer to Android as well as to iOS mobile applications.

5.1 User Login / User Registration Use Case

The user can register to the SUSTOURISMO (Figure 3) mobile app by creating an account filling in the following personal details:

- E-mail address
- City of residence
- Gender
- Age
- Password

This ends the user registration process. In case the user already owns an account, he/she might use the login option to the SUSTOURISMO app by writing down the e-mail and password he/she previously selected during the registration procedure.

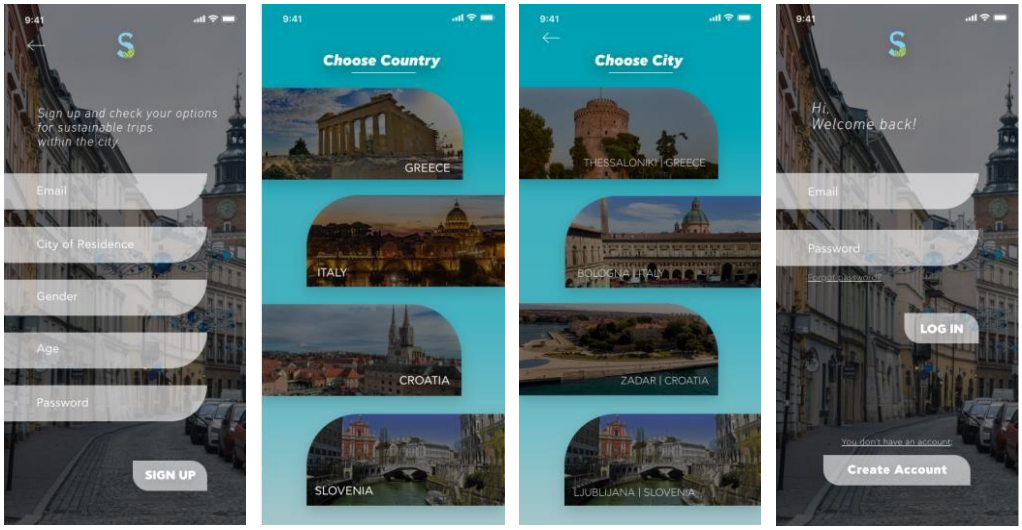


Figure 3: User login/User registration wireframes

5.2 User Navigation Use Case

The user navigates through the app's sections tapping the relevant buttons. Two options are displayed:

- **Information about the city/area:** Under this section, the app's service 1 is provided to the userwho can navigate through points of interest and get information for specific points and howhe/she can reach them by using the nearest available sustainable transport modes according to (bicycle., public transport system, e-scooter, etc.). User registration is not mandatory.
- **Contribute & Win:** Under this section the user can participate in services 2,3,4 and 5 as these were described in section 2 of the current Deliverable and collect points in his/her e-wallet which in turn can redeem them selecting from a list of predefined rewards (registration necessary, GPS enabled requirement).

There is also a side menu open by the burger menu icon on the top left of the screen where the user can update his/her personal profile, change any available settings of the app, and check his/her wallet where all reward points are stored and saved.

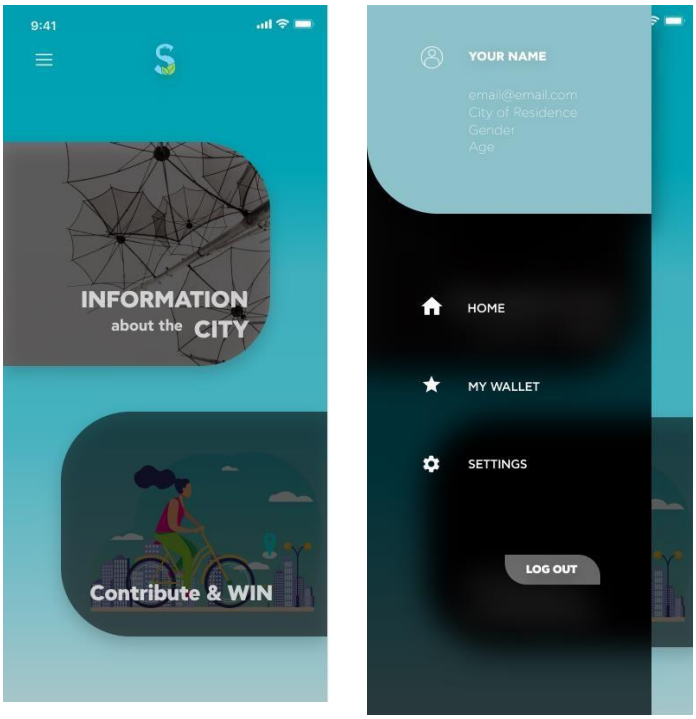


Figure 4: User navigation wireframes

5.3 Information about the city/area Use Case

The user selects the Information about the city/area menu option and a secondary menu is displayed providing the below informative categories:

- **Points of Interest**

The user is informed about points of interest of the city/area he visits and how he/she can reach a specific point by using the nearest to his location sustainable transport mode.

Points of interest include four sub-categories:

- Art and culture
  - Monuments and archaeological sites
  - Museums & Art Galleries
  - Cultural Sites / Historic Buildings
  - Religious Sites
- Areas of Touristic Interest
- Markets (shopping centres, flea markets, etc) – where applicable
- Available Transport modes (terminals / stops and lines)

- **SUSTOURISMO Tourist Packages**

The user navigates through the available SUSTOURISMO Tourist Packages and gets information.

- **Events**

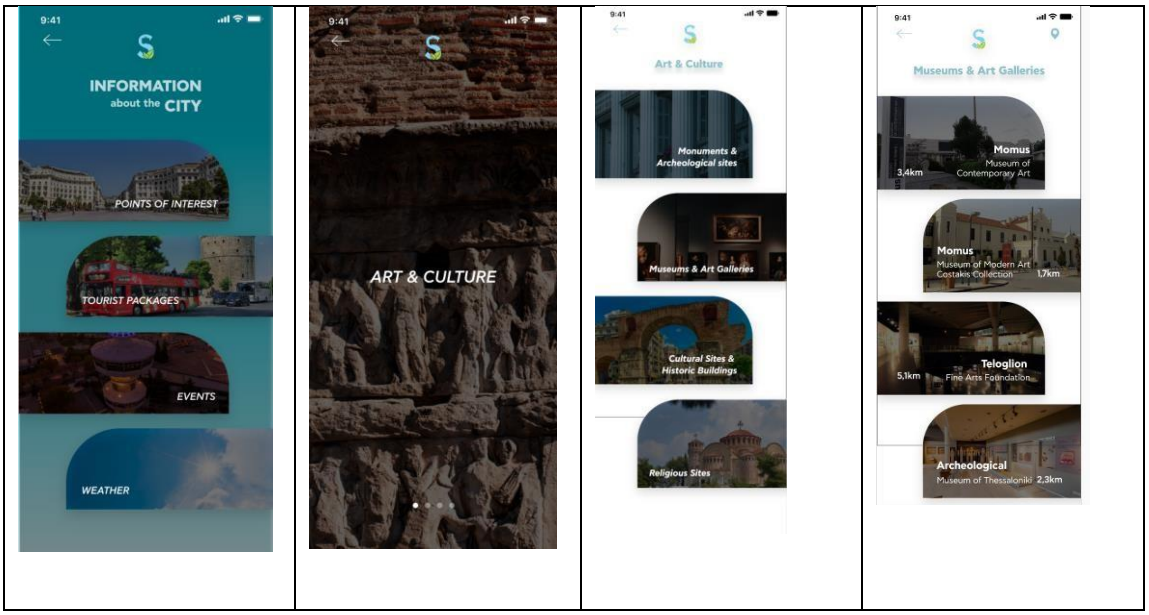
The user navigates through the available city/area events and gets informed.

- **Weather**

The user is informed about the weather conditions of the visited city/area.

- **Useful Information & Links**

The user is informed about useful information like links and emergency phone numbers of the local police station, ambulance service etc of the visited city/area.



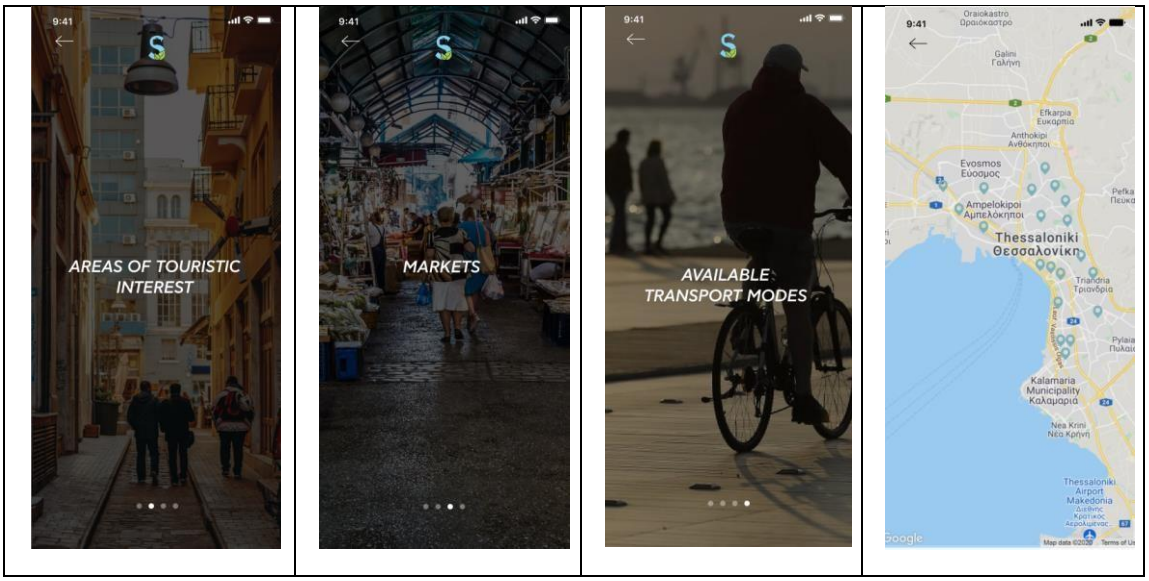


Figure 5: Information about the city/area wireframes

5.4 Contribute & Win Use Cases

Under the Contribute & Win section, a menu is displayed in the user including the provided by the app services 2, 3, 4 and 5 (as described in section 2 above). In all cases, user registration is required as well as GPS should be enabled.Through his/her participation in the provided services of this section the user has the opportunity to collect points and win specific prices. Below, the use cases are described in more detail.

- **Trips Recording and Evaluation use case / My trips in the area**

The user can submit a trip he/she completed earlier. For that, the user selects the trip's start and end date as well as the origin and destination location by using an interactive map. Following, the user selects the trip's purpose using a predefined scroll down list, the sustainable transport mode he/she used and the overall satisfaction he/she experienced while travelling with the specific transport mode (the user evaluates the transport mode used using a 5 level scale, whereas 1 corresponds to not satisfied at all and 5 corresponds to very satisfied).

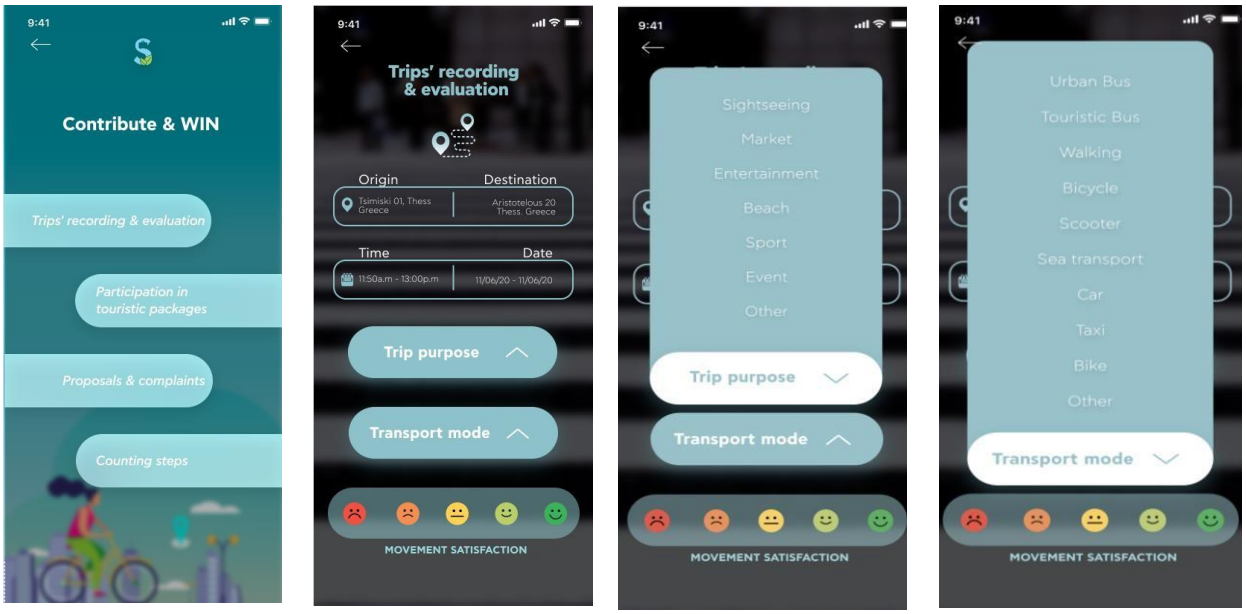


Figure 6: Trips recording frameworks

For each trip submitted the user is rewarded with a specific amount of points. When the user submits the completed trip he/she is asked whether this transport mode was the first choice. If the answer is YES, no more questions are asked, in case the answer is NO, the user is asked to declare the transport mode he/she would prefer to have used from a scroll drop down list and the reason for not using it by using also a predefined list - indicatively:

- Increased/High cost
- Increased travel time
- Access difficulties
- Incomplete information
- Overcrowded public transport
- Long distance from the nearest bicycle
- Participation in SUSTOURISMO Tourist Packages

- Other (with open answer/short text)?

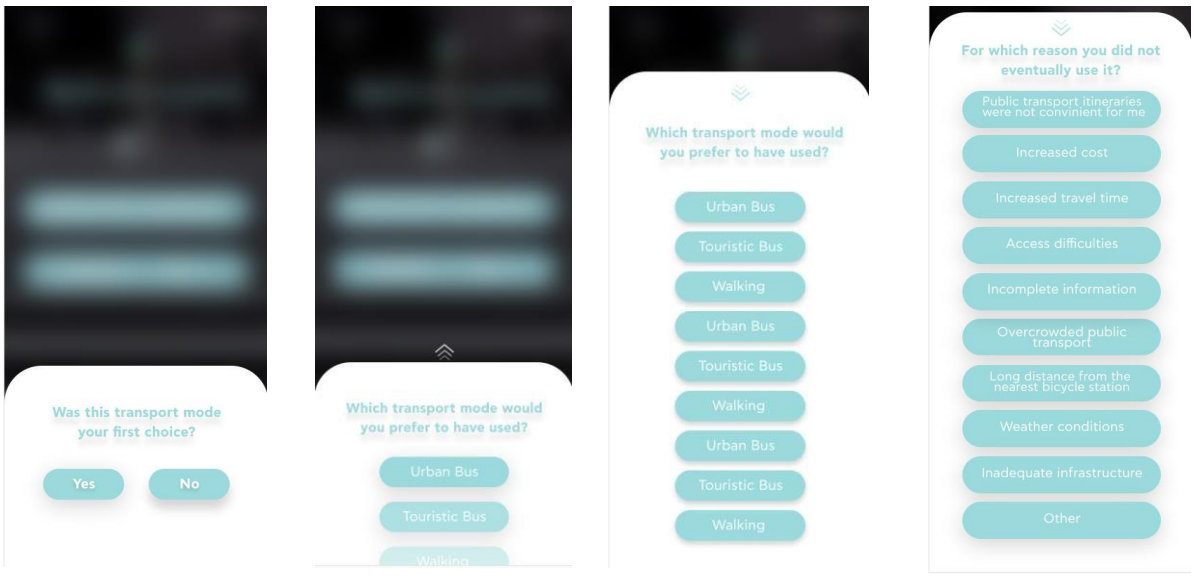


Figure 7: Trips evaluation frameworks

- **Participation in 'SUSTOURISMO Tourist Packages' use case**

The user can select to participate in the available 'SUSTOURISMO touristic packages' and scan a relevant QR codethat will be created for certificating his/her participation. Thus, the user can collect a specific amount of points in his/her e-wallet.

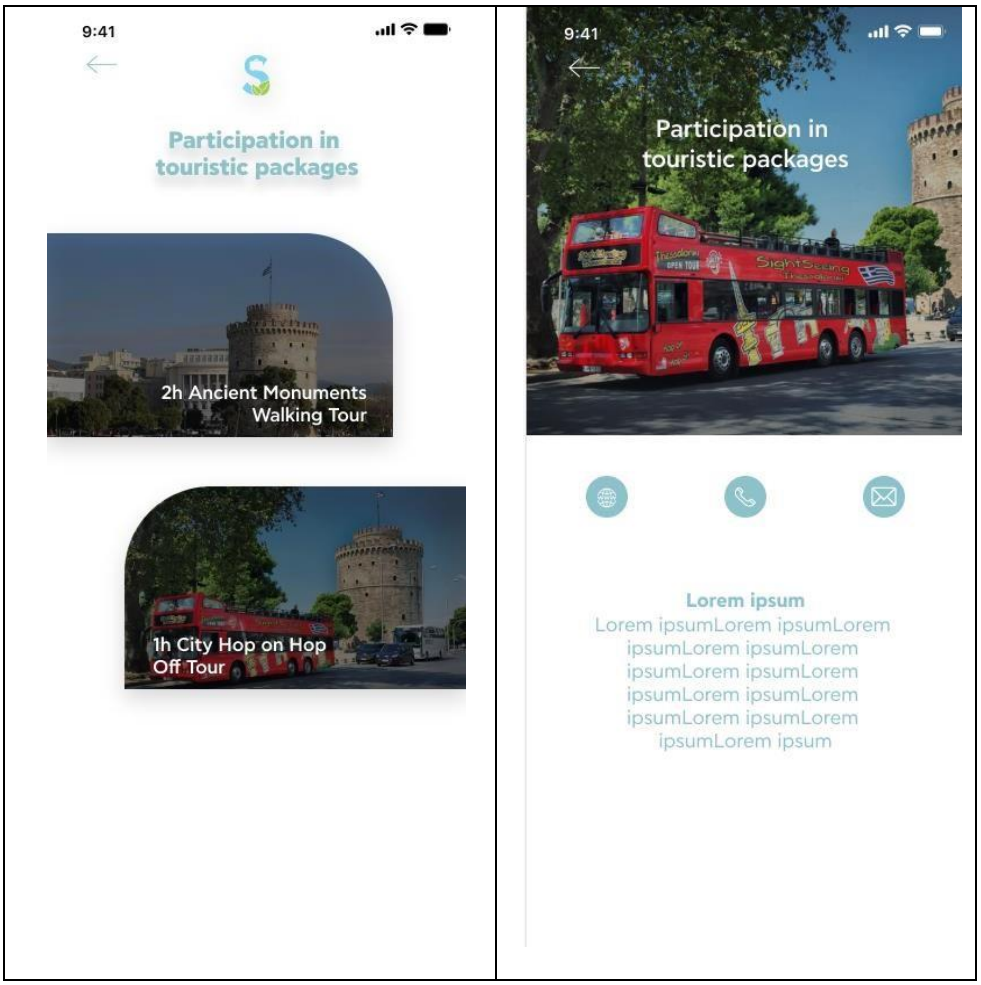


Figure 8: Participation in SUSTOURISMO Tourist Packages frameworks

- **Proposals & Complaints use case**

The user can submit his/her proposals and /or complaints for touristic and transport services experienced through his/her staying in the visited city/area. Specific categories have been created forthis purpose as listed below:

- Travel within the city/area
- 'SUSTOURISMO touristic packages'
- Touristic Services
- Other

The user navigates to the proposal or complaints main menu, selects a category, and submits a free text describing the relevant proposal or complaint.

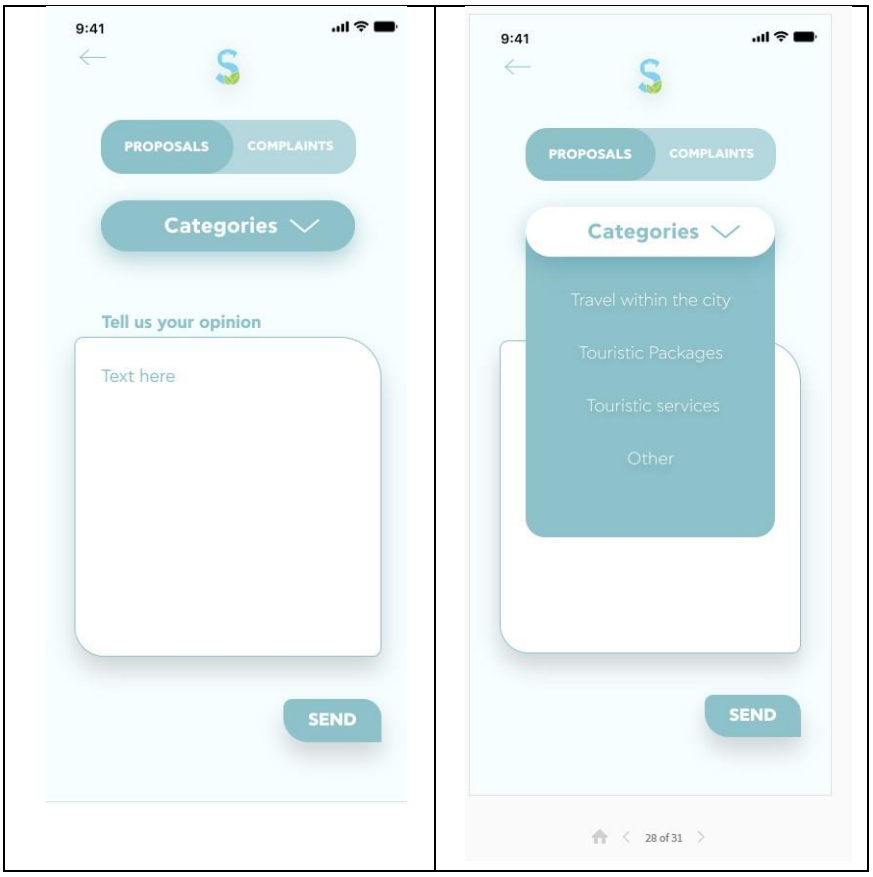


Figure 9: Proposals & Complaints frameworks (similar format of the two sections)

- **Counting Steps use case**

The user can count his/her steps while visiting a point of interest on foot (Figure 10). The SUSTOURISMO app counts a daily threshold of steps that the user should complete in order to win the available reward points.

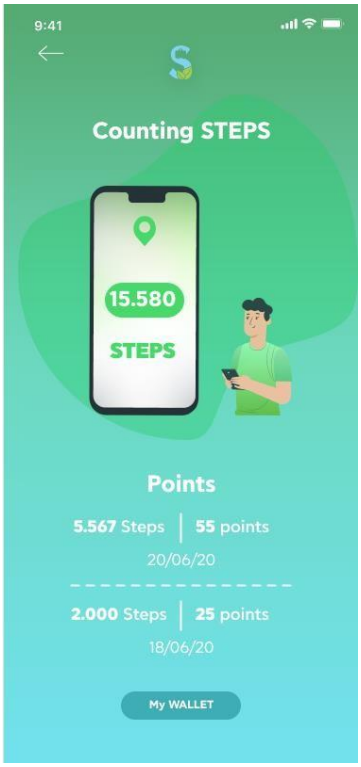


Figure 10: Counting steps wireframe

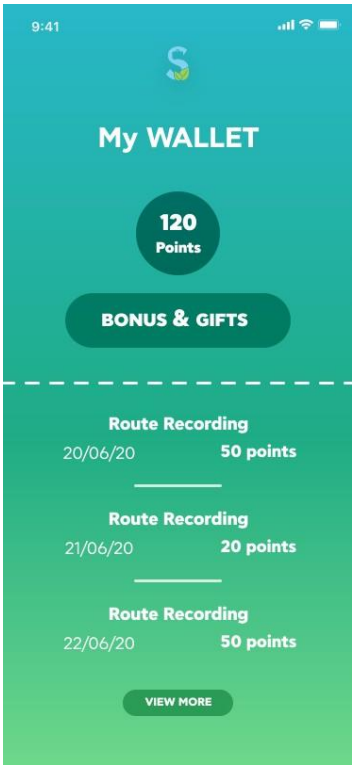


Figure 11: My wallet wireframe

5.5 My e-wallet Use Case

The user can check all the points collected and stored from his/her activities in his/her wallet from the side menu (Figure 11). It represents the user's contribution and participation in the SUSTOURISMO app for a specific area that he/she visited (GPS verified).

5.6 Administration panel

The administrators of the developed system will be able to login into an administration panel developed specifically for the content management of the SUSTOURISMO application (Figure 12). The administrators will manage (check, update, create, delete) the content, the photos, the maps of all points of interest, all the registered users' information and all the users' generated content (submitted trips, complaints/proposals, rewards etc.).

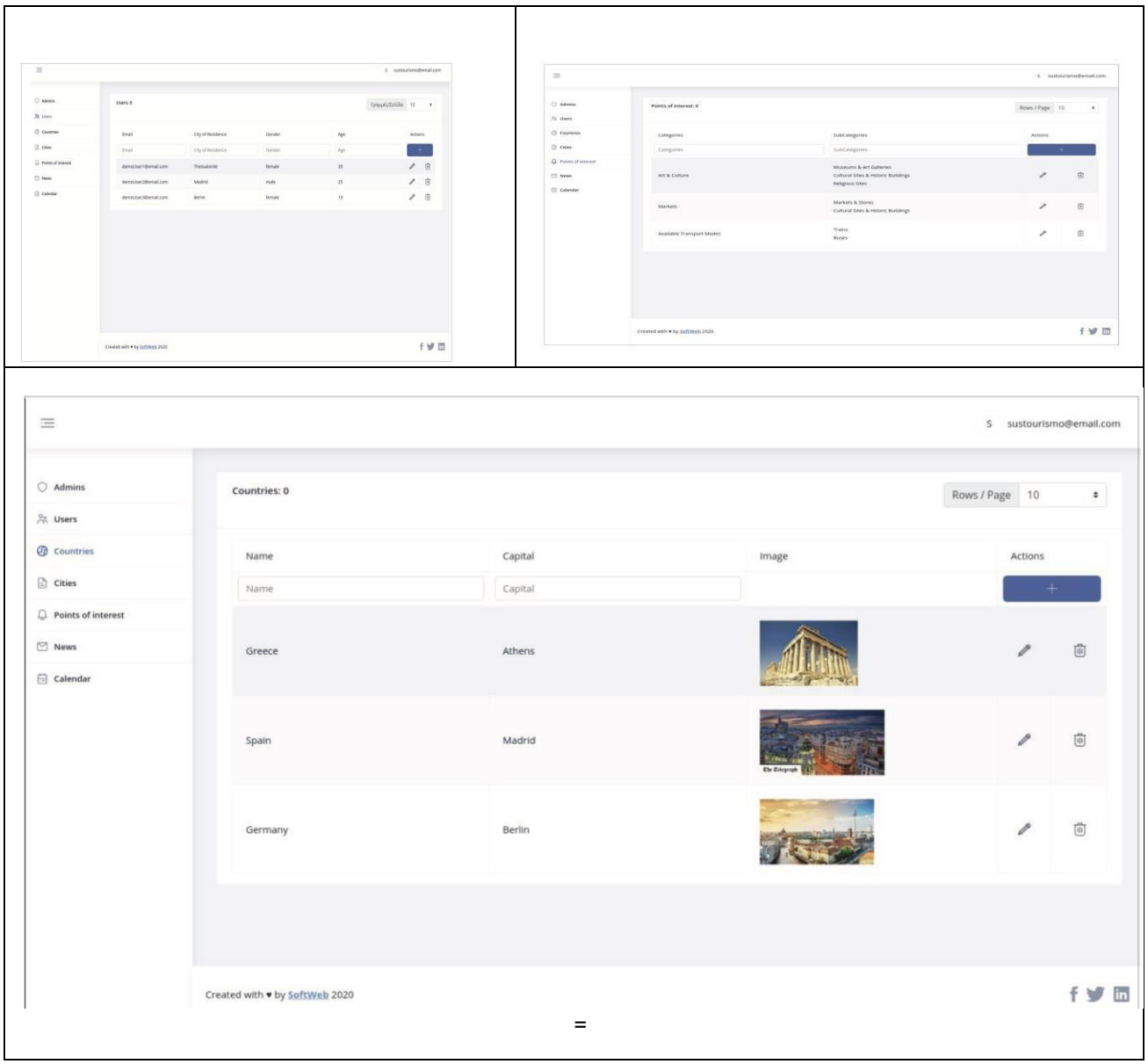


Figure 12: Administrator panel

6. Concluding remarks

The SUSTOURISMO app is designed in an easy to be extended way; within the project pilot phase, it would include information and other case-specific services for the 10 SUSTOURISMO cases. However, and given the interest of other ADRION cities (to be achieved through intense capitalization actions activated by partners' networks) the app can include new areas. The content

(new points of interest, new descriptions, updated accessibility information etc) can also be updated and enhanced based on the common format asked (excel file).

Ideas for additional new services in the future include (not contracted for the initial tender, therefore not currently designed and included);

- The language of the app at the project phase will be the English one. However and given the provision by the areas of the translations, local languages can also be added.
- Link to social media is estimated to enhance the visibility of the app.
- Interaction among travelers is a desired future enhancement - Integrated social feed so the user can interact with friends or share points collected on social media sites.
- Personalized push notifications according to the data collected; i.e. travel choices of people with similar profile, CO2 reduction based on steps calculation
- Alternative rewarding schemes can be designed; i.e. ranking the users assigning a specific status when a specific n. of total points is reached (after first 100 points, then at 500, ….) A 'beginner – expert – ambassador' scheme can be added.