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MOTIVATE
Promoting citizens' active involvement in the development of Sustainable Travel Plans in Med Cities with Seasonal Demand

Design of the Logical Architecture of MOTIVATE platform

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1 Introduction

1.1 Aims of the MOTIVATE project

The numerous Med areas characterised by seasonal transport demand problems (also known as seasonal traffic peaks) and territorial particularities face the major challenge of developing a sustainable mobility environment. This context creates additional factors that make the development of Sustainable Urban Mobility Plans (SUMP) a quite complicated process.

Unlike the traditional data collection methods, where residents or visitors are "passive" data sources, the innovative approach of MOTIVATE lies on their active involvement in transport data collection/management, problems identification and proposed measures evaluation.

MOTIVATE intends to help decision makers to gain a strong understanding of the main mobility problems that residents and tourists face and to identify the most accepted and sustainable interventions, using innovative and cost-effective ways of data collection and analysis. These will make the development, update and monitoring of SUMP much more targeted, efficient and successful. Thus, the MOTIVATE project promotes a new common model of SUMP development in the entire Med area that is based on the exploitation of social media and crowd-sourcing apps. The new model will be developed and updated after the pilot testing cases, as well as, the transferring protocol that will be created and will include processes, techniques and tools to ensure the efficient and consistent way of transferring the project' results to other cities in the Med area.

1.2 Objectives of the MOTIVATE platform

The core result of the MOTIVATE project is the development of a technological platform, which will be integrated to each Med city after the project implementation, and will be used as a communication channel between relevant authorities and residents/visitors. The platform will be accompanied with a database, where all the collected data will be deposited and the main application server where a library of specific e-tools and e-questionnaires will be stored.

The project will use the platform in order to achieve its main goal, which is to show the large contribution that crowdsourcing and social media could offer to the implementation and monitoring of SUMPs, through specific cases which will test the:

- Data collection that is needed for analyzing the existing mobility situation during high and low season of demand. The use of crowdsourcing and social media will be used for collecting O-D data, travel patterns, road and public transport network problems etc. All cities will use this functionality in order to gain a clear view of the mobility situation.
- Pre- and/or post-assessment of the public acceptance for specific measures that the local Authorities have already or are thinking to include in SUMPs. This activity will help authorities to develop city's common vision on urban mobility and monitor its implementation. More specifically, Larnaka and Ioannina will assess the development of an integrated system for parking management and a relevant application for the users. Rhodes, Siena and Dubrovnik will assess public transport (PT) system and PT

information application. The city of Almada will assess the creation of a mobility centre and will improve the Intermodal Information System.

- Promote sustainable mobility solutions already implemented (social media exploitation) in order to achieve a good level of communication of SUMP to the citizens and visitors.

1.3 Scope of the report

This report describes the detailed design of the MOTIVATE platform. In particular, the report presents the services of the platform, the user requirements, their transformation into core functions and sub-functions, the use cases driven by the user requirements, the communication protocols, the data flows, sets and their storage, as well as the interfaces between the various components of the system and with the external entities etc.

The architecture of the MOTIVATE platform will be used by the developers of the platform for its implementation. Beyond that, the architecture plays the role of the specifications for any future development or extension.

1.4 Intended audience

The following table presents the direct and indirect target groups of the MOTIVATE project and particularly the platform.

Table 1: Target groups of the MOTIVATE platform

Target group	Relevance
General public - Travelers - Residents	The awareness raising for the promotion of sustainable urban mobility policies and measures is among the core objectives of the MOTIVATE project. Increasing the participatory approach in SUMP development and enhancement can only be achieved by a constant communication with this target group. The MOTIVATE platform is mainly addressed to the members of this target group, i.e. travelers and residents.
Local stakeholders and interest groups including NGOs	Members of this target group are hotels, tour operators, travel agencies, mobility providers and other service providers activated in the field of tourism as well as private companies, schools, NGOs and other local associations related to mobility in general. Although they are not direct users of the platform, their knowledge about the needs of travelers and residents, as well as their opinion about the understanding of the local mobility context is important and should be used as input for the specifications of the platform. Moreover, they consist essential target group for the development of SUMPs.

Public authorities	Local authorities that are the competent authorities for SUMP development will benefit from MOTIVATE platform; presenting increased capacities in sustainable mobility interventions adoption that are highly acceptable by citizens and visitors. Based on the transnational character of the MOTIVATE project, not only local authorities, but also regional authorities are among its target groups. Regional in this case has a wide meaning covering the whole MED area.
Other interested cities	Other cities in the Med area will benefit from the results of the project and particularly of the platform. The wide dissemination actions of the project will ensure that the platform and its associated activities are effectively spread to other interested Med cities.

1.5 Structure of the report

Except from the current introductory chapter, the report contains five more chapters:

The second chapter makes an overview of the methodology used for the development of the architecture of the platform. It also presents the diagrammatic techniques used for the various architectural components.

The third is the core chapter of the report as it provides the main components of the platform, its services and the context diagram of the system.

The fourth chapter is devoted to the user requirements and needs of the platform as these were expressed in various meetings, and their transformation into systems functions and sub-functions. It also depicts the use cases and their sequence diagrams.

The fifth chapter describes the communication elements of the platform, both as internal data flows (between functions) and as interfaces with the various users of the platform.

Finally, the sixth chapter provides the data model of the platform, i.e. data requirements and data structures in the form of entity-relationship diagrams.

2 Methodology

The followed methodology is based on the analysis of the system as it was described in the MOTIVATE technical proposal and it was defined during the local workshops and living labs. Within the current deliverable, the system architecture is described by autonomous, operational and independent components and their integration along with respective data structure diagrams, sequence diagrams and use cases.

2.1 Overview of the Methodology adopted

The architecture of a typical IT system, especially Internet based application, consists of the following components:

- **Services**: This describes the services of the system that will be provided to its users. The services consists of a crucial high level architectural element based on which other architectural characteristics are defined. Typically, the services are defined and discussed prior to any design and implementation action, and consists of the guiding principle that should be respected by the development team. The services are defined based on the user requirements and needs.
- **External environment**: This determines the external environment of the system specifying entities such as other systems, equipment, persons, organizations etc. The most effective illustration of this component is through the use of a context diagram.
- **Functional specifications**: This includes the functions and sub-functions of the system. They are defined based on the services (user requirements) and they are presented in a hierarchical fashion following a top-down approach. An important element of the functional specifications is the use cases that illustrate the various actions that the users can perform using the system.
- **Communication architecture**: This presents the characteristivs of all the communications of the system, both between the system and its users (interfaces), as well as between the varions components of the system. It also illustrates the data flows among the various fuctions of the system.
- **Data architecture**: This describes the management of the data needed for the operation of the system. It includes the data requirements and the data storage (databases).

The architecture of the MOTIVATE platform has adopted the above methodology.

2.2 Diagrammatic techniques used

The diagrammatic techniques which have been used for the development of the architecture are the following:

- **Context diagram**: The context diagram defines the boundaries of the system (the MOTIVATE platform in this case). The platform is illustrated as a central pole arround of which there are a number of external entities (which could be other systems, persons, equipment, authorities etc.) with which the platform interacts. The context diagram also includes some basic information flows between the platform and the external entities.
- **Decomposition diagrams**: The decomposition diagrams use a hierarchical structure for the analysis of the functionality of a system. These diagrams apply a top-down method and enable the structural decomposition of the functionality of the system in a series of levels. Another dimension of these diagrams are their direct association with the user needs and requirements as well as with the services of the system.
- **Sequence diagrams**: The sequence diagrams are used for presenting the sequence of actions at the use cases. They allow a simple and ease understanding of the use cases through the ordering of their actions.
- **Entity-relationship diagrams**: The entity-relationship diagrams are one of the most common and well known diagrammatic data modelling technique, which was published by Peter Chen in 1976. These

diagrams describe the structure and content of the data that are used by the functions of the system in one or more databases. An entity-relationship diagram is composed of entities, their attributes and their relationships.

The following table associates the above diagrammatic techniques with the models that compose the architecture of the MOTIVATE platform.

Table 2: Diagrammatic techniques per models used in the MOTIVATE platform

	Logical model	Functional model	Data model
Context diagram	□		
Decomposition diagrams		□	
Sequence diagrams		□	
Entity-relationship diagrams			□

3 Conceptual design of the architecture

3.1 Services of the platform

Overall, the primary purpose of the project is to attract the interest, involvement or motivate the user to perform an action or a series of actions. These actions are related to the collection of a large amount of data about the trips performed by the end users (citizens and visitors) in the cities; to the provision of the opportunity to the end users in order both to assess the existing transport measures and infrastructures, and to express their opinion about the future implementations of the city authorities to expand the local transport system; to the educational character of the platform that will enable the users to get familiar with the sustainable mobility. The later is directly related to the gaming component of the platform. In particular, the platform will offer a gaming environment aiming to:

- inform/teach users about the benefits of sustainable transportation and the dangers originating from unsustainable behavior, and
- facilitate travel diaries collection and measures evaluation & assessment.

The game must offer a limited amount of actions to the user, so that it will not overflow him/her with information and becomes disproportionally difficult, thus unattractive. Additionally, it must not be simply informational; it should offer the possibility to the user to experience the complexity of urban transportation sustainability and arrive to own conclusions. Therefore, the game must have the following characteristics:

- It should transfer to the user the necessary information about transportation sustainability and especially the dilemma between a choice in the present and the effects in the near/distant future.
- It should illustrate the uncertain nature of sustainability problems.
- It should explain in simple terms the complexity and the different dimensions of sustainability.

- It should include a limited number of actions and be slow enough so that users that are traveling to be able to experience it.

Another important element of this service is the reward system. Rewards can take the form of points, challenges to be first in a leaderboard or discovery. For the MOTIVATE system the reward mechanism will be in the form of points. The points that the user will earn from using the application can be later used to perform certain actions in the game. These actions include entering a new mode (for example, exchange points for the ability to enter in the city a new bus or metro system, or upgrade the quality of the existing PT system or skip a questionnaire).

According to the above, the platform will provide to its users (i.e. residents and visitors) the following four main services:

A. Trip Diaries

This service is addressed to transport planners and city authorities and aims to collect information about the mobility patterns and behaviour of the users. It is based on the daily trips of the end users (citizens and visitors). The daily trips are completed either at real time (GPS enabled) or after trip. Although this service is used by the transport authorities, still the beneficiary is the end user, since the mobility patterns will be largely used by the transport planners and city authorities for improving the transport system.

B. Evaluation of existing transport measures

This service is addressed to transport planners and city authorities, and aims to collect information from the end users (citizens and visitors), about existing transport measures. The users are asked to rate the performance of existing mobility measures giving a clear view of their satisfaction from their current operation. Although this service is used by the transport authorities, still the beneficiary is the end user, since it gives them the opportunity to express their opinion and influence the operation of the transport system.

C. Preference on future transport measures

This service is addressed to transport planners and city authorities, and aims to collect information from the end users (citizens and visitors), about future interventions that they intend to implement in the city. The users are asked to provide their perceptions in specific interventions by rating their importance. Although this service is used by the transport authorities, still the beneficiary is the end user, since it gives them the opportunity to influence the future development of the transport system.

D. Game

Through this service, the user will play a spefically designed game that will promote sustainable mobility informing him/her at the same time about the benefits that can be gained both at individual level and city level.

3.2 Context diagram

The context diagram of an IT system defines the context and the external environment of the system. In the case of the MOTIVATE platform, its context diagram is illustrated below.

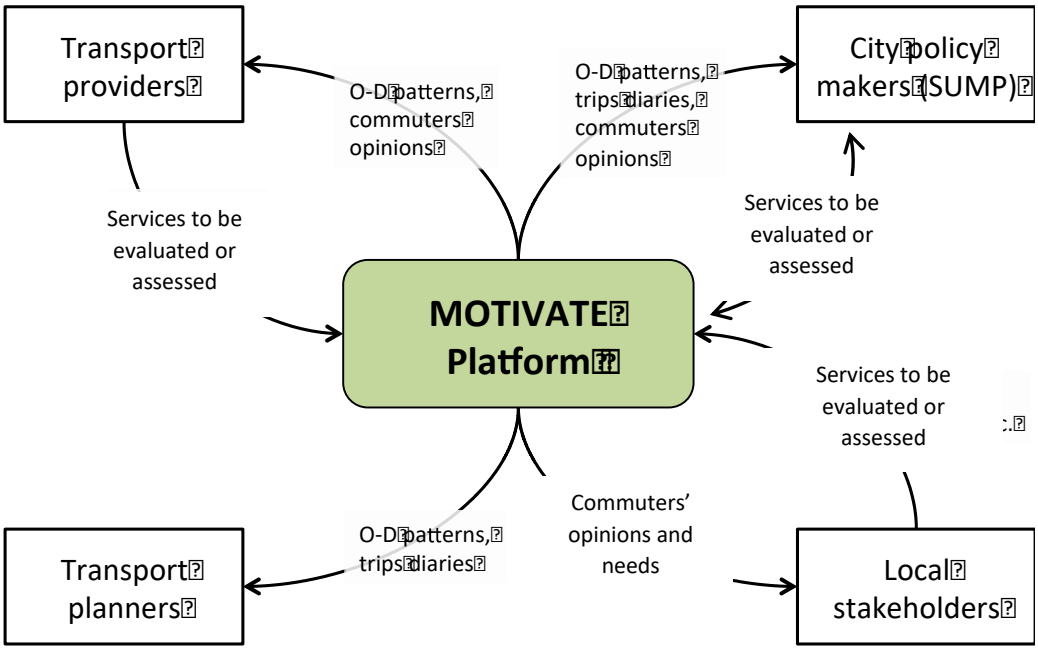


Figure 1: Context diagram of the MOTIVATE platform

The platform and all its comnponents are represented by the shape in the central of the diagram. Arround it, the diagram includes the most important external entities (they could be other systems, persons, equipment, authorities etc.) through which the platform interacts. This interaction is depicted in the form of basic data flows. More particularly:

Transport providers: Transport providers, such as public transport organizations, taxi unions, interurban bus companies and others, provide to the platform data concerning their transport services or operational characteristics that should be evaluated or assessed by the commuters. On the other hand, the platform makes available to these providers, data from the use of the apps, such as residents and visitors O-D patterns as well as the results of their assessment about the transport services and recommendatios.

City policy makers (SUMP): Beyond the end users, the city policy makers are the main beneficial of the platform as the platform will provide very useful data that will be used for the implementation of the city SUMP. In particular, the platform will make important contribution with respect to the use of the local transport system, O-D patterns, trips diaries, and opinions that would make the local mobility system more attractive and sustainable. The city policy makers will also give their opinion about the transport services or operational characteristics that should be evaluated or assessed by the commuters.

Local stakeholders: Local stakeholders, such as commercial associations, chambers, hotels, tour operators, travel agencies, schools, NGOs and other local associations, can provide their knowledge about the needs of travelers and residents, in order to decide the transport services or operational characteristics that should be evaluated or assessed by the commuters. On the other hand, the platform could send to these stakeholders the assesment and opinions of the users about the available mobility services.

Transport planners: Transport planners will also benefits from the plarform, as they can obtain O-D patterns and trips diaries that can help them in their transport studies and planning of the local transport infrastructrure.

3.3 Components of the platform

The MOTIVATE Platform will consist of multiple elements and integration of several components. Below, there is an overview of the overall architecture, which consist of both front end and backend services and functionalities.

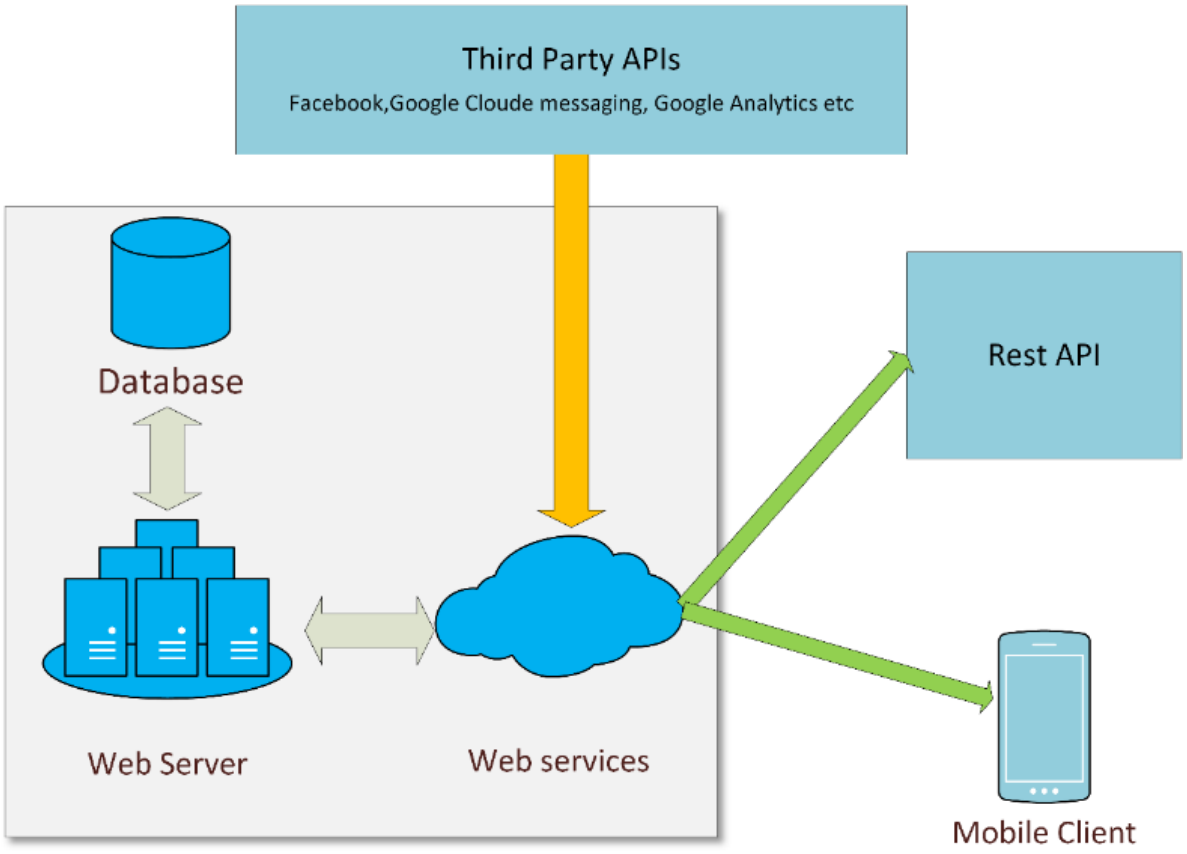


Figure 2: Basic components of the MOTIVATE platform

The platform will consist of:

- Mobile Apps for mobile devices, Smartphones/Tablets for at least Android and iOS devices
- Web Portal 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. The system will be developed with the technical architecture in the following Figure. This n-tiered architecture can be divided into three layers (1) the Presentation layer, (2) the Business layer and (3) the Data layer. The presentation layer is responsible for accepting user input and rendering the user interface that is returned from web services. User Interface using various SDKs such as Android, iOS, .NET, JavaScript, etc depends on the clients platforms (mobile, web). The application layer consists of 2 mobile clients, one for Android and one for iOS with which the user interacts. Also the system has a REST API which can be used to develop a web interface or to communicate with other systems. The business layer implements the core functionality of the system and encapsulates the relevant business logic. The system is structured around the concepts of business processes and business components. Many business processes involve multiple steps that must be performed in the correct order. Business workflow components define and coordinate long running, multistep business processes, and can be implemented using business process management tools.

The data layer provides access to data that is 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 (WSDL). 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.

3.3.1 Web application architecture

Motivate Platform services will be served to the end user over web for any browser that can interpret HTML content. The development of the web application, will be achieved using .NET framework with C# programming language for the backend procedures while for the UI and the client-side HTML, CSS, JavaScript, jQuery and AJAX. The data interoperability between the backend and the web front end application will be achieved with RESTful services over the Parse-Server.

Figure 3: Service Oriented single page web application

The Motivate Web application will be build based on responsive techniques so can be easily accessible and readable by different browsers, window sizes and devices.

The core layout of the web platform 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 be make the relative content and/or service reusable at least within the portal.

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

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 with the usage of a top main menu as well as required link whenever is necessary to provide the user with the relative information.

3.3.2 Mobile application architecture

The provided services by MOTIVATE Platform will be running on the mobile devices running either Android or iOS. The development of the mobile apps, will be achieved with the usage of the Parse-server and other native tools for developing mobile apps depending on the platform.

For iOS development Parse-server API will provide all the necessary functionalities to gather and submit data while Swift programming language will be used for the development of the UI and the internal functionalities of the Motivate client iOS devices.

For Android development Parse-server API will provide all the necessary functionalities to gather and submit data while Java programming language will be used for the development of the UI and the internal functionalities of the Motivate client Android devices.

In both cases of iOS and Android devices the client Apps will support a variety of different device hardware (ex. Different screen sizes) and software (ex. Lollipop or higher). Mobile device design and development is unique due to the constrained and differing nature of device hardware. Targeting multiple devices with very different hardware parameters. The heterogeneous device environment is something that we will

keep in mind when designing Motivate mobile application. Factors include variations in screen size and orientation, limitations in memory and storage space, and network bandwidth and connectivity.

Consider the following guidelines when determining Mobile application architecture:

- Optimize the application for the device by considering factors such as screen size and orientation, network bandwidth, memory storage space, processor performance, and other hardware capabilities.
- Consider device-specific capabilities that you can use to enhance your application functionality, such as accelerometers, graphics processing units (GPUs), global positioning systems (GPS), haptic (touch, force and vibration) feedback, compass, camera, and fingerprint readers.

3.3.3 Backend architecture

The whole MOTIVATE backend procedure will take place with the usage of Parse-Server.

Parse-server is an open-source API server. It can work as Mobile backend as a service (MBaaS), also known as "backend as a service" (BaaS), is a model for providing web app and mobile app developers with a way to link their applications to backend cloud storage and APIs exposed by back end applications while also providing 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 purposes for use such a service is that web and mobile apps require a similar set of features on the backend, including push notifications, integration with social networks, and cloud storage. Each of these services has its own API that must be individually incorporated into an app, a process that can be time-consuming and complicated for app developers. Parse-server form a bridge between the frontend of an application and various cloud-based backends via a unified API and SDK. Providing a consistent way to manage backend data means that developers do not need to redevelop their own backend for each of the services that their apps need to access.

It have a broad focus, providing SDKs that work for development on multiple platforms, such as iOS, OS X, tvOS, Android, .NET ,Xamarin , PHP ,Javascript , Unity and others. 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.

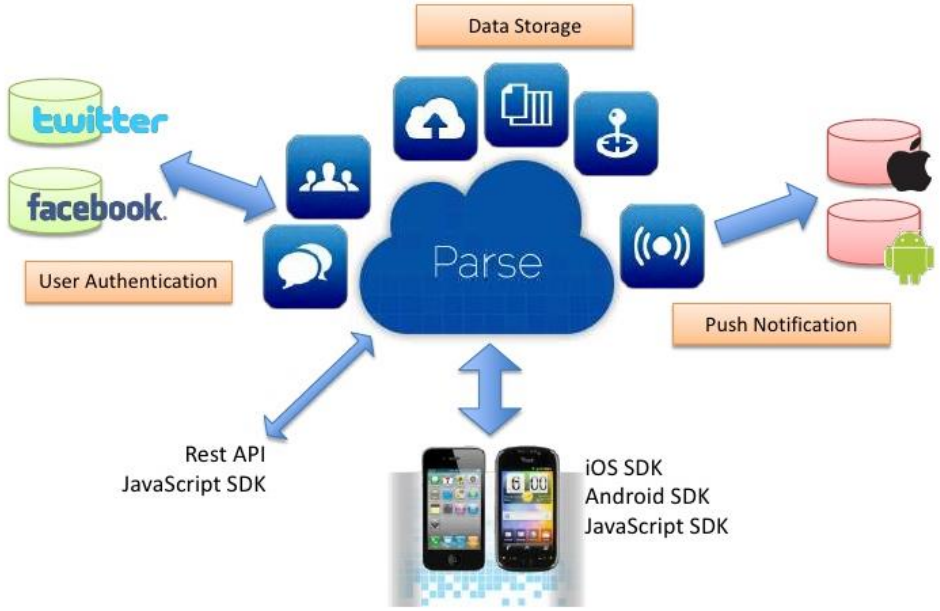


Figure 4:Mobile Apps Conceptual Design

The prerequisites for parse-server are the following:

- Node.js 4.3 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 2.6.X, 3.0.X or 3.2.6. 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.
- Python 2.x or higher. Python is a widely used high-level programming language used for general-purpose programming, created by Guido van Rossum and first released in 1991. An interpreted language, Python has a design philosophy which emphasizes code readability (notably using whitespace indentation to delimit code blocks rather than curly braces or keywords), and a syntax which allows programmers to express concepts in fewer lines of code.

3.3.4 Data Storage

Choosing the correct data access technology is very crucial for the design of data storage and the data management. The choice of an appropriate data technology will depend on the type of data we are dealing with, and how we want to manipulate the data within the hole motivate application. Certain technologies are better suited for specific scenarios. In Motivate's platform scenario the best suited technology is MongoDB.The data storage of the whole platform will be achieved with the usage of MongoDB which is

an open-source cross-platform document-oriented model database storage tool which also support storage and management of spatial data.

MongoDB is classified as NoSQL database program and it does not use tables and rows as in relational databases. Is built on an architecture of collections and documents. The key-value pairs which are contained on the documents are the basic data unit in MongoDB while sets of documents and function 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 usage of Parse-Server.

In the macOS, 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. Although the 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.

3.3.5 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. Other systems interact with the Web service in a manner prescribed by its description using SOAP messages, typically conveyed using HTTP with an XML serialization in conjunction with other Web-related standards.The data stored in the database will be consumed to the application services over Parse-Server with RESTful web services. On the Parse-Server 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.

MongoDB storage is exposed to the applications (web & smartphones) with the usage of Parse-Server. The data storage of MongoDB will be exposed to the application services and the cloud with the usage of Parse-Server.

3.3.6 Conceptual Aspects of the Game

The aim of the application's game is to inform and teach the users about the benefits of sustainable transportation, the dangers originating from unsustainable behaviour and the difficulties associated with achieving the particular goal.

The main issue with sustainability problems is that they have long-term horizons, which makes it hard for people to comprehend how a choice in the present can affect the entire system in the future. At the same time, notions that are not easily quantifiable render the situation more complex. The notions are concerned with aspects of human behavior that are hard to quantify and predict. For example, choice of means of transportation involves variables such as comfort, safety, value of time, accessibility etc. (Beirao & Cabral, 2007); (Odeyale, Alamu, & Odeyale, 2013).

As a result, the game will illustrate the complexity with regards to the use of public transportation and at the same time it sill be simple enough to communicate with ease all those aspects to every user that will use the application. As a result, the game will offer a limited amount of actions to the user, so that it will not overflow him/her with information and become disproportionally difficult and thus unattractive. At the same time, the game will not demand constantly by the user because this will make it unplayable by the users who travel in private cars. Moreover, for the user to be able to perform any of the potential actions of the game, he/she must have the required points (that will be collected from other functionalities/services of the application). Finally, the game will offer the opportunity to the users to arrive to their own conclusions regarding the issues of sustainability and complexity.

Following the above characteristics, the objective of the game is manifold:

- To illustrate in the most intuitive way the complexity of the urban transportation system
- To engage the user in a "dummy" decision-making process, where he/she will have to make trade-offs between the availability of resources and the desired objectives
- To provide insights to the user with regards to the behaviour of the transportation system and the effects (counterintuitive, cumulative and/or delayed) that his/her decision might have to the system

3.3.6.1 Model of the Game

To achieve the objectives of the Game, limited to the aforementioned characteristics, a simulation model is developed with the methodology of System Dynamics. The context will be that of an urban environment with various means of transportation and the simulated population performing movements by choosing means of transportation based on several criteria over a period of simulated time. The purpose for the user of the game will be to achieve a highest score on the main KPIs for each run/turn of the game.

The main causal relationships of the model are illustrated in the Causal Loop Diagram (CLD) below.

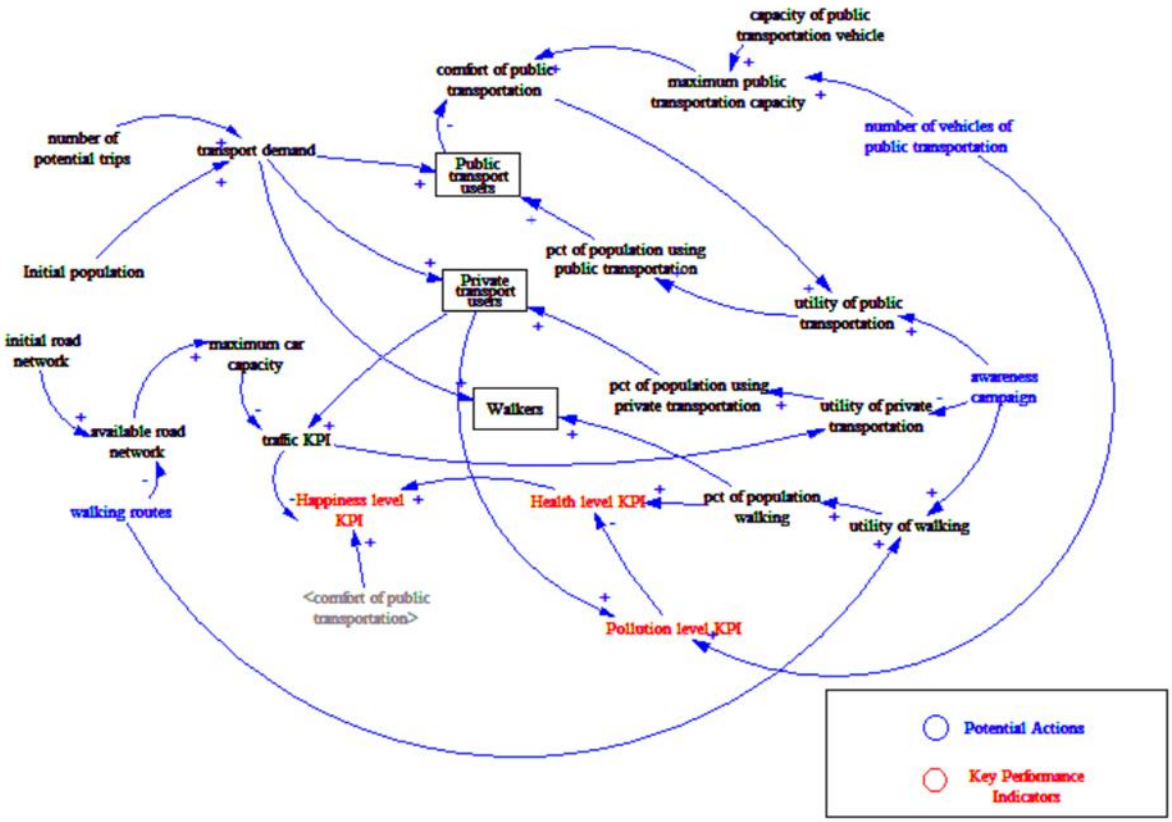


Figure 5 Causal Loop Diagram of the model of the game

The diagram represents the main causal relations among the variables that determine the mechanism of the game and generate its behaviour. The variables in black are the main model variables that are hidden from the user; variables in blue represent the potential actions that the user can perform (assuming that he/she has the required points) and the variables in red represent the KPIs that will be the results of the actions that the user performs.

The arrows demonstrate a causal relation between two variable, while the signs + and - show the direction of that relationship. The + sign illustrates that the direction of the change is similar for both the variables and the - sign that the direction of the change is opposite between the two variables. The table below provides several examples of how the causal relations and the direction of change work.

Causal relation	**Direction of change**	**Meaning**
Traffic KPI is affected positively by private transport users	+ sign (positive direction of change)	The more private transport users there the bigger is the traffic
Traffic KPI is affected negatively by maximum car capacity	- sign (negative direction of change)	The larger is the car capacity in the city's road network the less is the traffic in the streets

Thus, the variable traffic KPI is affected by two variables: Private transport users and maximum car capacity. The direction of change is opposite for the two cause-variables, thus they have a counteracting effect on the traffic KPI. The final behaviour of the traffic KPI will depend on the values of the two variables that in turn depend on the whole state of the model.

These causal relations in the model form several feedback loops. A feedback loop means that a change in one variable will generate changes in several other variables which in turn will result in a new change in the variable that initiated the loop.

For example, a loop is formed among the variables: utility of public transportation →+ pct of population using public transportation →+ Public transport users →- comfort of public transportation →+ utility of public transportation

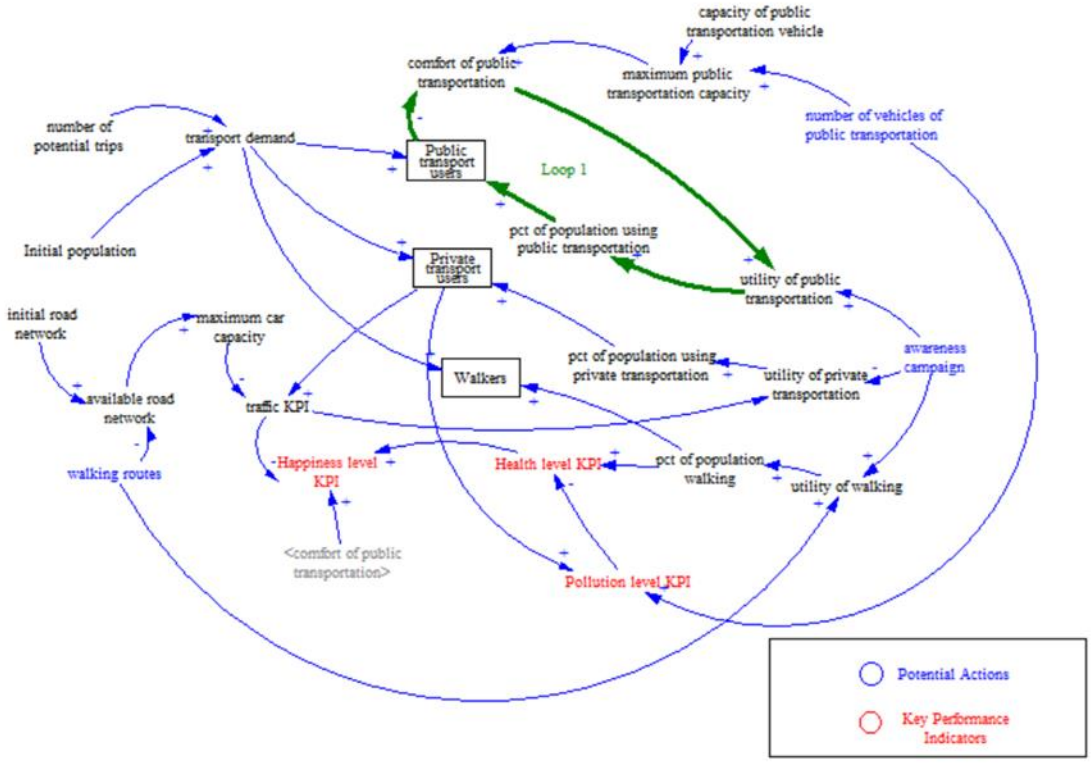


Figure 6 Loop 1 in the Causal Loop Diagram

The explanation of the loop is the following: Let's assume an increase in the utility of public transportation. Then this increase will result in an increase in the percentage of people who use public transportation which will increase the Public transport users. The particular increase will result in a decrease in the comfort of public transportation (- sign) which will ultimately will decrease the utility of public transportation. Depending on the values of the variables, the last decrease may cancel the initial increase in the utility of public transportation, thus generating different behaviour on the whole system that it was originally assumed.

Another loop that is formed is among the variables: utility of private transportation → + pct of population using private transportation → + Private transport users → +traffic KPI → - utility of private transportation

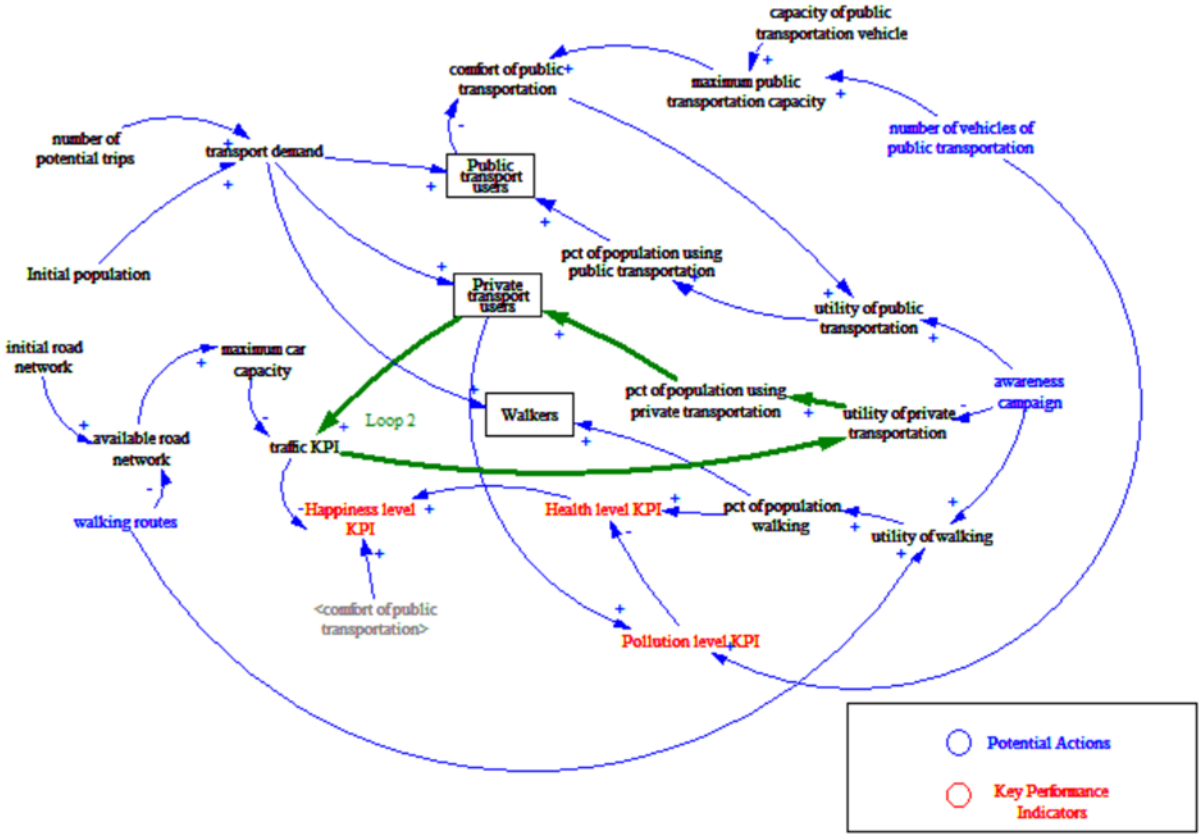


Figure 7 Loop 2 of the Causal Loop Diagram

The explanation of the loop is the following: An increase in the utility of private transportation will result in an increase in the percentage of the population that use private transportation which in turn will result in an increase in the Private transport users. This will increase the traffic KPI which will ultimately decrease the utility of private transportation. Depending on the values of the variables, the last decrease may cancel the initial increase of the utility of the utility of private transportation thus resulting in a different system behaviour than was originally assumed.

Apart from the loops among variables, the loops themselves interact with each other. Following in the previous example, there is an interaction between Loop 1 and 2. A final decrease in the utility of public transportation (Loop 1) will result in an increase of the other utilities (including that of private transportation), thus activating the changes in Loop 2. The interaction between loops is not illustrated in the diagram for economy of space and clarity.

4 Functional specifications

4.1 User requirements

4.1.1 Introduction

The primary users of the MOTIVATE platform, as these have been identified and reported in section 1.4, are the end users (i.e. travelers and residents), as well as the local authorities. The user requirements described below reflect the needs, expectations and mobility requirements of these two user groups.

Their initial requirements were first identified in the MOTIVATE Application Form based on the research performed by the project partners in the participating cities. These initial requirements have been updated after a lot of discussions with the cities' relevant authorities and with the end users, in the workshops that were organized in each city and during specific meetings with the local partners of the pilot cities.

The user requirements are described below according to the two user groups: end users and authorities. It should be stressed that not all of the following needs and requirements have been addressed by the project, since some of them are general mobility needs that are not directly related to the scope of the project. However, it is useful to report them.

4.1.2 Requirements of the end users

- The end users need to participate somehow in the decision making process concerning their mobility choices. They want to feel that the local authorities listen to their mobility needs and problems. The best way to address this need is to give them the possibility to express their satisfaction on existing mobility measures and their preferences on future interventions.
- The sharing of the end users mobility data (diary trips) using crowdsourcing is a major challenge for any transportation agency. The local meetings and workshops demonstrated that the end users must be motivated to share this kind of data. The end users but also the local authorities believe that the best way to do that is by crediting to the end users something like a "gift". However, there is a complicated legal issue for implementing such a form of motivation and it needs further investigation.
- The MOTIVATE platform should have a simple, reliable and user friendly environment that will allow the end users to declare their trips and to give their opinions for future interventions and existing infrastructures. This should be a major task for system developers for both the internet based version of the platform and its mobile versions.
- In some workshops, the users expressed the need to design mobility in the city center with a focus on the bike and pedestrian movement, as top priorities.
- To make the use of the MOTIVATE platform more attractive to the end users it is important to provide more comprehensive content and value added information, such as POIs, maps of cultural interest, historical info, combined transport options, information on closed streets and dangerous paths.

4.1.3 Requirements of the authorities

- The local authorities need an effective means in order to gain a sound understanding of the main mobility problems and needs of the end users. Moreover, usually, residents have different needs than the travelers. Therefore, the authorities should be able to obtain their different needs.
- The same applies to the mobility measures, existing or future. The authorities need an effective way to collect the preferences of the end users, especially on future interventions. This will allow them to design and implement mobility measures with high use rates.
- The local authorities and especially the transportation planners need a means to collect the daily trips of the end users and their particular characteristics. This way they will be able to shape the profile and the patterns of the end users, and ultimately plan the appropriate measures to address their needs and problems, as for example, tailor-made routes and schedules for the major poles of attraction.
- A lot of information is needed from the residents in order to form a clear view of the city transportation needs. However, the local authorities have limited financial sources for frequent collection and updating of such data. Therefore, a simple tool that will allow the collection of vast trip data could be of major help.
- The local authorities agree that they want the residents and the travelers to participate in the establishment of a real sustainable mobility environment in their cities. This is a major challenge that requires the direct and constant communication with the end users, and to give them incentives that will encourage them to change their behavior in favor of sustainable transport. The first step in doing that is to give them the floor to provide their needs and expectations. Then, it is up to the authorities to prove that they listen to the end users needs.
- Some local authorities also reported the traditional needs of their cities, such as traffic congestion and accessibility. These authorities stated that investments in the areas of IT, such as the platform and smart parking technology, will make it easier for citizens and visitors to drive around the city and to engage with local businesses, public administration and recreational activities, but also reduce traffic congestion.
- Many city authorities have their own IT systems and platforms, and they want the MOTIVATE platform to cooperate with these local systems. For example, in the city of Ioannina, the MOTIVATE platform and the e-parking application should work along with the local urban bus platform.
- Some other authorities expressed the necessity that the MOTIVATE platform should be developed taking into account disabled people and people with reduced eye capability.

4.1.4 From the user requirements to the functional specifications

Most of the above user requiremnts have been translated into functional specifications for the MOTIVATE platform. This actually means that the functionality of the platform addresses the majority of the above requiremnts. The following table maps the user requiremnts with the corresponding functions of the platform. The functions are described in the next section.

Table 3: Mapping of user requirements against the functions of the Platform

User Requirements		**Functional Specifications**
User group	Requirement	

End users	To participate in the decision making process	Measures evaluation, Future inteventions
	To sharing mobility data	Trip diaries
	To develop a user friendly system (platform)	Users management
	To place priority on bike and pedestrian modes	Partly addressed by the Game
	To develop a system (platform) with comprehensive content	The objective of the platform is not to provide content
Authorities	Tp gain a sound understanding of the mobility problems and needs of the end users	Measures evaluation
	To collect the preferences of the end users, especially on future interventions	Future inteventions
	To collect the daily trips of the end users	Trip diaries
	To form a clear view of the city transportation needs	Measures evaluation, Trip diaries, Game, Dashboard
	The end users to participate in the establishment of a sustainable mobility environment	Measures evaluation, Future inteventions
	To overcome traffic congestion and accessibility	Partly addressed by Trip diaries and Dashboard
	To couple the MOTIVATE platform with their existing IT systems and platforms	To be investigated
	To allow the MOTIVATE platform to assist disabled people and people with reduced eye capability	Not applicable

4.2 Core functionalities of the platform

The MOTIVATE platform will consist of the following functional areas. Each functional area represents either a different service to the end users or a functionality to support the services.

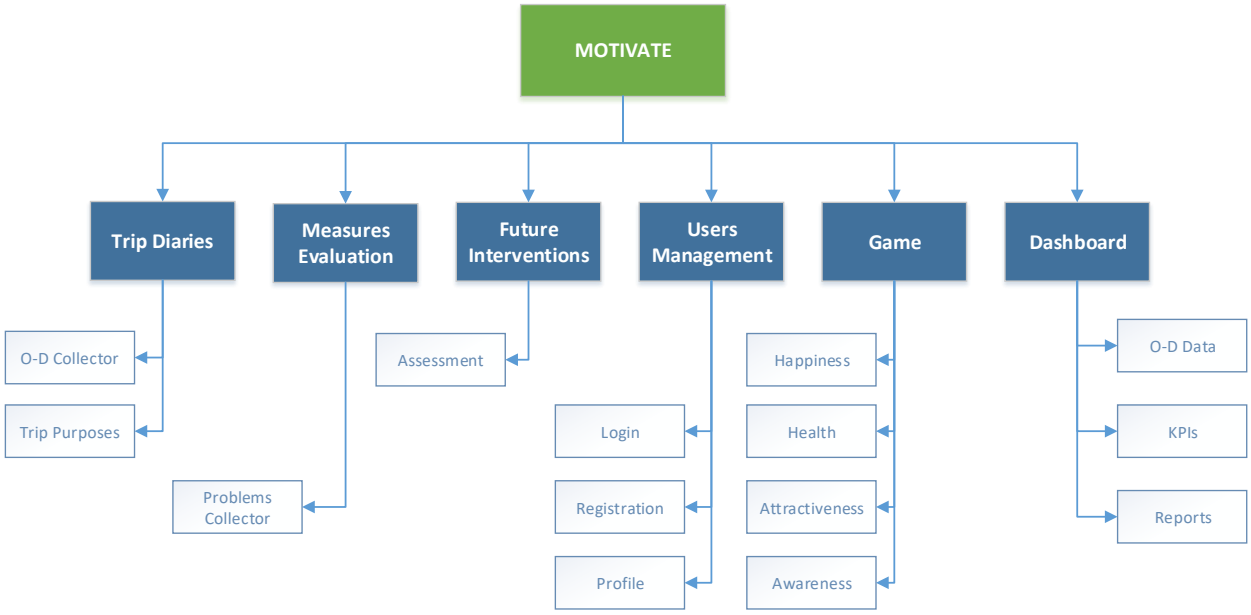


Figure 8 Functional decomposition of the Platform

4.2.1 Trip Diaries

The Trip Diaries section will collect the user's daily trip. The users will have either to setup some of their personal information, such as gender, age group, working status, educational level, city etc. or the system will fill the appropriate fields based on the registered user profile info. The user, also, must set up his/her origin and destination, the transport mode and the trip purpose as well as the reason for choosing the desire transport mode.

Once a trip is completed, the system will store the relative trip data, such as trip start and end time (and date) stamp, the GPS data like latitude, longitude, speed etc. the overall travel time and the average trip speed and all this in relation to the user selected data.

At the end of each trip recording, the system will also calculate the relative awarded points based on the user's selected input and it will add them to the Motivate game for the user to expand his/her game city and make it further sustainable.

The following table presents the relative inputs and outputs of the Trip Diaries service based on the actors of the Motivate platform and the devices that the service will be available.

Table 4:Trip Diaries potential I/O

Trip Diaries					
Possible Actors:	Services user, Anonymous user, Registered user				
Device(s)	Smart devices, Web				
	Potential Inputs		**System input data**		**Service output data**

	Gender		Gender		Trip Start Timestamp (Date & Time)
	Age Group		Age Group		Trip End Timestamp (Date & Time)
	Working Status		Working Status		Latitude
	Education Level		Education Level		Longitude
User Profile Info	Car Ownership	User Profile Info	Car Ownership		Speed
	City		City		Altitude
	Origin/Destination Address		Origin/Destination Address		Accuracy
	Origin/Destination Postal Code		Origin/Destination Postal Code	GPS Data	Direction
	Origin/Destination Coordinates		Origin/Destination Coordinates		User Id
	Transport Mode		Trip Start Timestamp (Date & Time)		Device Id
	Reason choosing Transport Mode		Trip End Timestamp (Date & Time)		Trip Interim Stop Coordinates
	Trip Purpose				Travel Time
					Average Speed
					Points award for the game

4.2.2 Measures Evaluation

The Measures Evaluation service will provide the end users (citizens & tourists) the opportunity to evaluate existing city status and conditions.

First of all, each pilot city in MOTIVATE project consortium, must provide the platform with its measures and relative questions to be evaluated by the users. The web part of the platform will provide the city authorities the appropriate service to manage their measures and questions with the ability to either add a new one or to amend an existing one.

A measure evaluation will be assessed by the users by either setting up some of their personal information such as gender, age group, working status, educational level, city etc. or the system will fill the appropriate fields based on the registered user profile info. Then, the users must select the desire measure for evaluation and assess each of the relative question by their satisfaction using a scale from 1 to 5, where 1 is very poor or not acceptable or not existing while 5 is very good or very acceptable.

Once an evaluation is submitted the system will store the relative ratings in relation to the user selected data. At the end of each measure evaluation the system will also calculate the relative awarded points

based on the user's selected input and it will add them to the Motivate game for the user to expand their game city and make it further sustainable.

The following table presents the relative inputs and outputs of the Measure Evaluation service based on the actors of the Motivate platform and the devices that the service will be available.

Table 5: Measures Evaluation potential I/O

Mobility Measures Evaluation					
Possible Actors:	Services user, Anonymous user, Registered user				
Device(s)	Smart devices, Web				
	Potential Inputs		**System input data**		**Service output data**
User Profile Info	Gender	User Profile Info	Gender		Measure
	Age Group		Age Group		Questions
	Working Status		Working Status		Rate
	Education Level		Education Level		User Id
	Car Ownership		Car Ownership		Points award for the game
	City		City		
	Desire Measure		Measures		
	Question Rate		Measures Questions		

4.2.3 Future Interventions Assessment

The Future Interventions Assessment service will provide the end users (citizens & tourists) the ability to participate (in a way) to the city's future policies, expansion and measures by assessing possible interventions that may apply to their city.

First of all, each pilot city in MOTIVATE project consortium, must provide the platform with their desired possible future interventions and relative questions to be assessed by the users. The web part of the platform will provide the city authorities the appropriate service to manage their possible interventions and questions with the ability to either add a new one or to amend an existing one.

A future intervention will be assessed by the users by either setting up some of their personal information, such as gender, age group, working status, educational level, city etc. or the system will fill the appropriate fields based on the registered user profile info. Then, the users must select the desired future intervention for assessment and answer each of the relative questions by their satisfaction using a scale from 1 to 5, where 1 is very poor or not acceptable or not existing while 5 is very good or very acceptable.

Once an assessment is submitted the system will store the relative ratings in relation to the user selected data. At the end of each future intervention assessment, the system will also calculate the relative awarded points based on the user's selected input and it will add them to the Motivate game for the user to expand their game city and make it further sustainable.

The following table presents the relative inputs and outputs of the Future Interventions Assessment service based on the actors of the Motivate platform and the devices that the service will be available.

Table 6: Future Interventions Assessment potential I/O

Mobility Future Interventions Assessment					
Possible Actors:	Services user, Anonymous user, Registered user				
Device(s)	Smart devices, Web				
	Potential Inputs		**System input data**		**Service output data**
User Profile Info	Gender	User Profile Info	Gender		Intervention
	Age Group		Age Group		Questions
	Working Status		Working Status		Rate
	Education Level		Education Level		User Id
	Car Ownership		Car Ownership		Points award for the game
	City		City		
	Desired Intervention		Interventions		
	Question Rate		Interventions Questions		

4.2.4 Users Management

The Users Management functionality is an optional section for the end users. This functionality consists of the registration and login process, as well as the user profile management.

The user's registration to the MOTIVATE platform will be an optional process for the end users as possible optional inputs to the services will be asked again in case of an unregistered user.

However, by registering to the platform and filling up the relative user profile a user will not be bothered to enter/select again and again some of the same fields such as gender, age group, education level, city etc. as those will be filled up automatically by their profile. Also, by registering to the platform the user will also become a member to a community that will be easily informed about the status and condition of their city.

The following table presents the relative inputs and outputs of the user registration and user profile process based on the actors of the Motivate platform and the devices that the service will be available.

Table 7: Users Management potential I/O

Users Management	
Possible Actors:	Registered user
Device(s)	Smart devices, Web

	Potential/Required Inputs		System input data		Service output data
	Username (required)		City		User Profile
	Password (required)		Country		
	Display Name (required)				
	Social Media IDs (facebook, G+ e.t.c)				
	Mail				
	Gender				
	Age group				
	Working Status				
	Country				
	City				
	Education level				
	Car ownership				

4.2.5 Game

The purpose of the game is to make the users familiar to sustainability, how it can be achieved and how everyday decisions that they make can affect the entire urban environment both in the short- and medium-term.

To make the game even more closer to real life, it will be a simulation of an urban environment reflecting the citizens mobility in the city. In more detail, the environment into residential and commercial, where people live and work respectively. Furthermore, in the environment there are three available means of transportation:

- Walking/cycling through the city's pedestrians' network (or walking routes) or bicycling network
- Public transportation in the form of buses or trams
- And the use of private cars

Each citizen must make the following decisions:

- If his/her movement goal is to get at home or at work
- If the appropriate amount of time has passed, in which the citizen must stay at work or at home
- The means that will use for transportation
- Perform the movement

Each citizen's decision changes several characteristics of the environment: for example how many private cars circulate, how many means of public transportation are necessary (or if the current ones are adequate) and the pollution level in the form of CO2 emissions. Moreover, the urban environment has

two other characteristics that are affected by individual choices; however they are not easy to quantify. These are the aggregate "happiness level" and the health level of the city.

These two characteristics are Key Performance Indicators that summarize in a meaningful way the "happiness" and health level of each citizen. The change of these environment characteristics in turn affects the individual characteristics and actions of each citizen ("happiness" and health levels, and the choice of transportation). Thus, a loop is formed where the characteristics and actions of each individual citizen affects the characteristics of the entire group of citizens, which in turn affects the characteristics of the environment, which finally affects back both the individual and collective characteristics, and actions of the citizens. The figure below illustrates this loop that the game scenario is based upon.

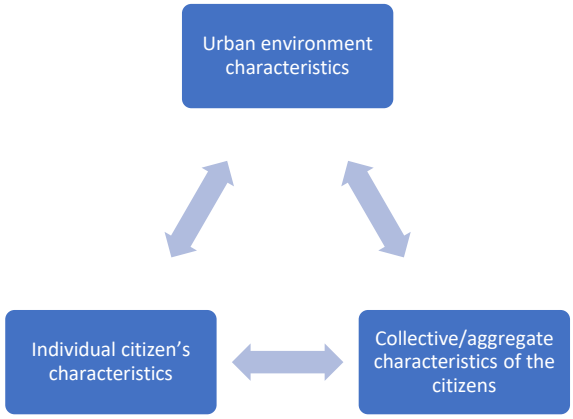


Figure 9: The core loop that explains the relationship between the citizens and the environment

Thus, for the concept of the game does not involve the user/player; all the interactions, the updates and the movements are performed automatically. However, for it to be a game it must involve the user. As a result, the user can act on the game on a top-down approach as an entity with power over several characteristics of the game. These interventions/game actions are:

- On the urban environment, where the player can act upon the availability of public means of transportation and the routes for walking/cycling
- On the aggregate citizens' characteristics, where the player can act/manipulate their choice of transportation (it can be thought as campaigns that urge citizens to avoid the use of private cars)

These two game actions have a dual purpose which describe the objective of the game:

Each player must try to achieve the highest possible levels of "happiness" and health levels before the end of the game cycle.

Each player must avoid the aggregate "happiness" and health levels to become zero.

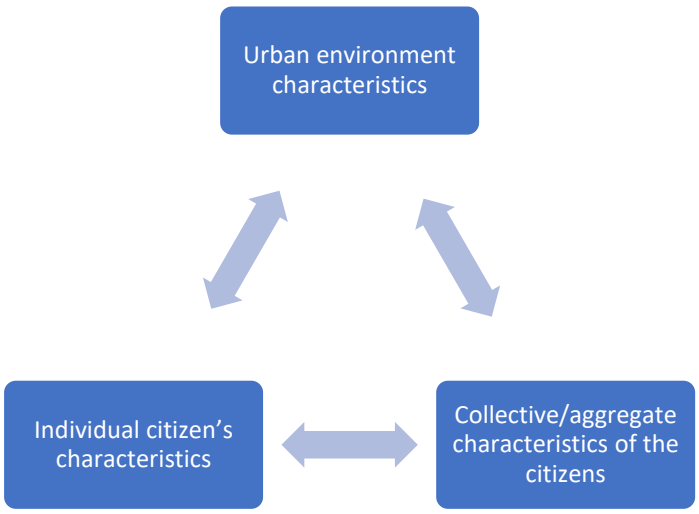


Figure 10: Key actions that can be performed by the player and where they are applied in the context of the game

As it was mentioned earlier, the above are the objectives of the game player, however, the game itself has one more objective, which is to inform the players about the complexity of the transportation systems in the context of an urban environment and how an individual choice can affect the entire urban system.

4.2.6 Dashboard

The Dashboard acts both as a service and as a functionality. The service part of the Dashboard presents to the users the relative Key Performance Indicators (KPIs) and provides the ability to Cities Authorities to download/export the desired data either in full or by filtering them for a specific period. The functionality part of the Dashboard actually does all the processes, calculations and aggregations, and prepares all desired data either for export or to present the relative statistics and indices.

The Dashboard as a service will ask the users to select the desired city, the possible data period and the section of the dashboard. By making the appropriate selection the system feeds the Dashboard functionality with the required data and produces the relative data sets, statistics and KPIs.

The Dashboard on its turn presents the results to the users in tabular, textual and graphical forms based on the user's selections.

If the user of the Dashboard is a register user and has the appropriate credentials as a MOTIVATE City Authority user then the user will have the ability to download/export the relative data sets for further analysis.

The following table presents the relative inputs and outputs of the Future Interventions Assessment service based on the actors of the Motivate platform and the devices that the service will be available.

Table 8: Dashboard potential I/O

Dashboard					
Possible Actors:	Cities Authorities				
Device(s)	Web				
	Potential Inputs		**System input data**		**Service output data**
	City		Trip Diaries Info	KPIs	Number of Users per measure question
	Data Period		Measures Evaluation Ratings		Gender Percentage per measure question
	Trip Diaries		Interventions Assessment Ratings		Average satisfaction of measure question
	Measures Evaluation				…
	Future Interventions Assessment				…
					…
					Export Data to Excel/CSV
					Export Data to SHP

Through the use of the MOTIVATE platform, some well known and useful Key Performance Indicators (KPIs) can be extracted. The role of these KPIs is to provide an overview of the end users (i.e. residents and visitors) mobility patterns and habits, and το measure their sustainability behavior. The KPIs that will be calculated by the platform using the data provided by the users are:

1. **Modal split**: This is perhaps the most well known indicator that presents the share (in %) of the transport modes used by the users in their movements. It is calculated by the transport modes indicated by the users in their trip diaries.
2. **Degree of use of sustainable modes**: The indicator attempts to measure the degree of use of the three sustainable modes (i.e. walking, cycling and public transport) in relation to the entire transport system. It will be calculated based on the trip diaries and be expressed as a percentage (%).
3. **Average trip length**: This indicator measures the average length of the users' trips in terms of time (in hours) and distance (in km). The trip diaries are the source of data for the calculation of the indicator. The indicator can be calculated and presented on daily, weekly, monthly and annually basis.
4. **Measures preference**: The indicator makes an hierarchy of the existing measures, which are preferred most by the users. It is calculated through the Measures Evaluation function and the ratings provided by the users.

5. **Desired Interventions**: The indicator makes an hierarchy of the future interventions, which are preferred most by the users. It is calculated through the Future Interventions Assessment and the ratings provided by the users.

Market segmentation analysis: The above indicators can be further analyzed according to additional information provided by the users, such as gender, age, education Level and working status. This analysis will provide further insight on the behavior of specific population segments.

4.3 Actors

As top level, the system recognizes four different users types (Actors) that will be able to use, manage and view the MOTIVATE Platform. The Actors are:

i. **Services user** which is the travelers (citizen or tourist) that will provide data regarding daily travels, evaluate/assess measures, get informed on mobility solutions and benefit from various rewards given as an incentive boosting their participation. This Actors "group" could be divided to two different types based on their credentials.

ii. **Anonymous user**, the user that visits the platform without proper credentials. While working with anonymous users (guests) is inherently limiting in some ways (few things are known for sure about them) e.g. they cannot receive personalized tips and notifications, they have to insert every time they visit the platform data that for registered users are automatically used e.g. their home as an origin point etc.. However, travel data can be collected (FS1 – Travel Diaries), their opinions can be stated (FS2 & FS3) and promotion actions (FS4) can reach them.

iii. **Registered user**, a user of the platform who has proper credential to access the MOTIVATE Services. Registered users are asked to follow a logging in procedure; provide some sort of credentials (such as a username or e-mail address, and a password) to the system in order to prove their identity. Registered users personal data () added in the favorites lists that facilitate the use of the services, will be used for personalized notifications and easy access to the services and are also essential for Authorities in transportation planning.

iv. **Cities Authorities**, of the participating cities of the project, which will provide appropriate input for the services and analyze their status based on users input. The participating Cities Authorities will provide to the system, and thus services, the following content for example:

   a. Public Transport services and network for analysis and personalized notifications
   b. Advertisements for the promotion of sustainable measures
   c. Possible measures and future interventions for evaluator and assessor services

v. **Platform Administrator(s)** which are the responsible for the provision, monitoring and maintenance of the system (HIT)

vi. **System** which contains all the sub-functionalities and processes of all services

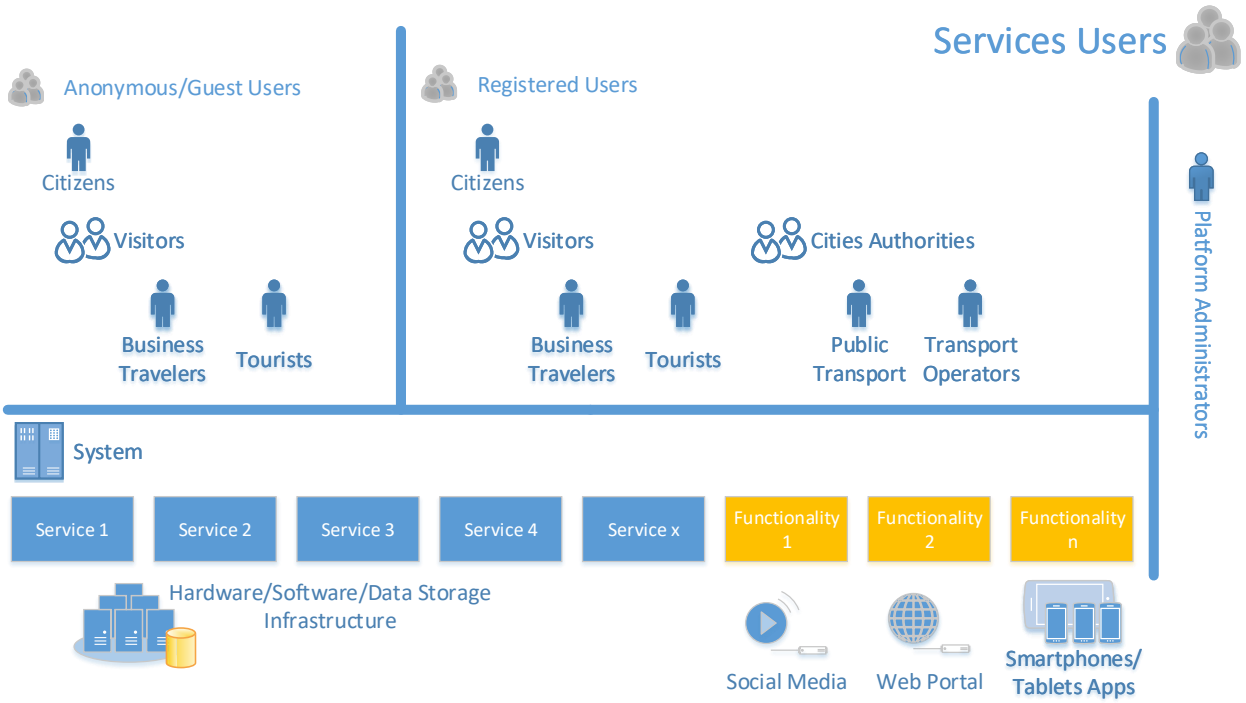


Figure 11: Users Overview

4.4 Use cases and sequence diagrams

4.4.1 UC1: Users' Access

4.4.1.1 UC1.1: User Registration

The user can create an account where personal data are entered. By the time a new user account is created, automatically the user is logged in the system and user's status changes from "anonymous" to "registered".

Use Case 4.4.1-1: User Registration

Use Case: User Registration
ID: 1.1
Brief description:
The user can create an account where personal data is entered
Primary actors:
Anonymous User
Secondary actors:
Web Portal, Wi-Fi network, 3G/4G network
Pre-conditions:
internet access
Main flow:
1. The user selects ***User Registration*** from the main screen of the application 2. The system displays a form to be filled with personal details of the anonymous user: ➢ Username (required)

- Password (required)
- Email (required)
- Display Name (required)
- First Name
- Last Name
- Gender
- Age group/Date of Birth
- Working Status
- Home City
- Education level
- Car ownership

3. The anonymous user inserts the data
4. The system validates the inserted information
5. The system ask confirmation from user
6. The user confirms registration
7. The system connects in background to portal and sends the data
8. The portal creates the user account
9. The portal adds X points to user account
10. The system informs the user for the successful registration and the amount of earned points with a welcome message
11. Use case ends

Post-conditions:

The use account has been created

Alternative flows:

1. (A) 1. The user selects ***Registration via Facebook***
   2. The user inserts credentials
   3. The flow control goes to step 4 of the main flow

1. (B) 1. 1. The user selects ***Registration via other social media***
   2. The user inserts credentials
   3. The flow control goes to step 4 of the main flow

2. (A) 1. The system retrieves personal data from Facebook or other social media
   2. The flow control goes to step 4 of the main flow

4. (A) 1. Missing or wrong data to required fields
   2. The portal informs the user for the error and asks for re-entering the correct information
   3. The flow control goes to step 5 of the main flow

6. (A) 1. The user declines registration
   2. The flow control goes to step 11 of the main flow

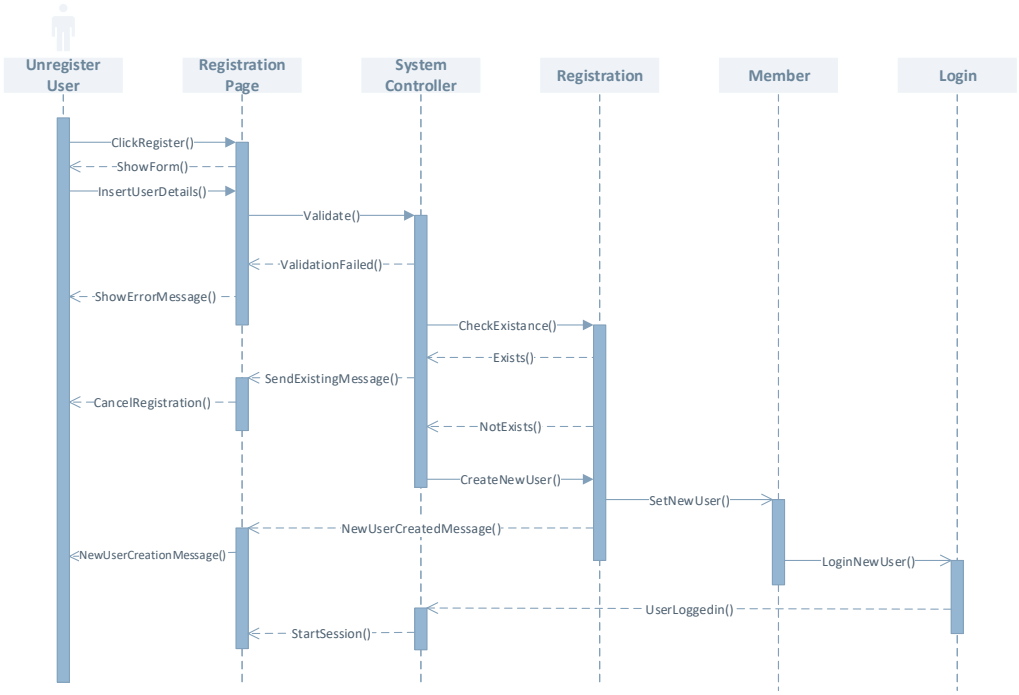


Figure 12: Sequence diagram: 'User Registration'

4.4.1.2 UC1.2: User Login

The user is identified and receives access as a registered user to the entire set of functionalities.

Use Case 4.4.1-2: User Login

Use Case: User Login
ID: 1.2
Brief description: The user is identified as registered and receives access to the entire set of functionalities
Primary actors: Registered User
Secondary actors: Web portal, Wi-Fi network, 3G/4G network
Pre-conditions: internet access
Main flow: 1. The user selects ***Login*** from the main screen of the application 2. The system asks the user to enter **username** and **password** 3. The user enters his/her credentials (Username and Password) 5. The system connects in background to portal and validates the user 6. The user receives access to the services

7. A welcome message is displayed 8. Use case ends
Post-conditions: User has logged in
Alternative flows: 1. (A) 1. The user selects ***Login via Facebook*** from the main screen of the application 2. The flow control goes to step 2 of the main flow 1. (B) 1. The user selects ***Login via other social media*** from the main screen of the application 2. The flow control goes to step 2 of the main flow 5. (A) 1. The system authenticates user via Facebook or other social media 2 .The flow control goes to step 5 of the main flow 5. (B) 1. Authentication error 2. Repeat for 2 times 2.1. The system displays an authentication failure message 2.2. The flow control goes to step 3 of the main flow 3. The flow control goes to step 8 of the main flow

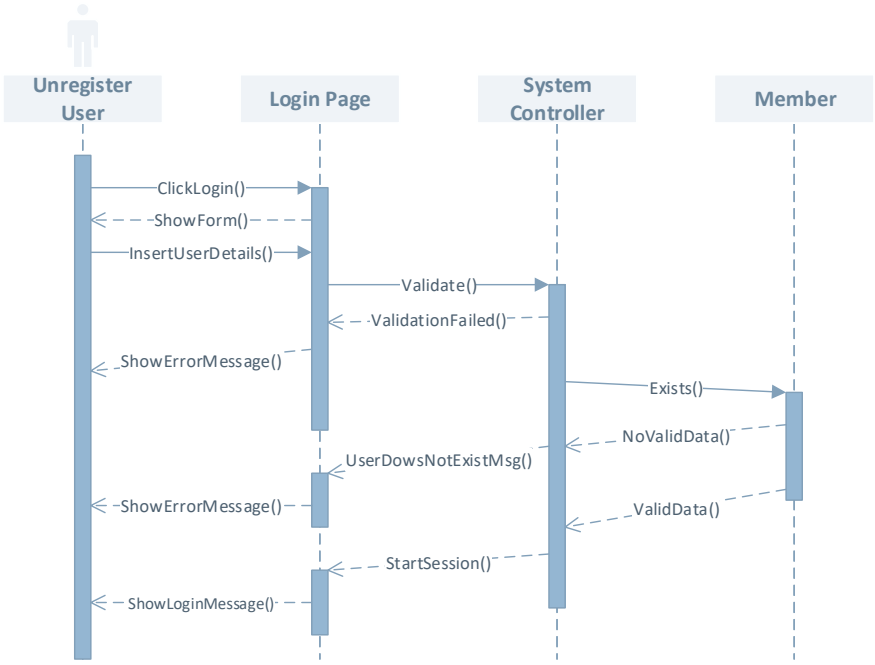


Figure 13:Sequence diagram: 'User Login'

4.4.2 UC2: Users Management

4.4.2.1 UC2.1: Users Profile

Through the use case “User Profile”, the registered user can see its personal details.

Use Case 4.4.2-1: Users Profile

Use Case: Users Profile
ID: 2.1
Brief description:
The user is identified as registered and can view his/her personal information
Primary actors:
Registered User
Secondary actors:
Web portal, Wi-Fi network, 3G/4G network
Pre-conditions:
internet access
Main flow:
1. Registered information displayed in different tabs; ➢ Personal data ➢ Points earned 2. The user chooses the tab that is of interest at the current time 3. All respective information under the specific tab is displayed
Post-conditions:
User profile presentation
Alternative flows:
User Profile Data Modification - In case User wishes to update his profile, the System provides it with the “UC2.2: Update Personal Data” option.

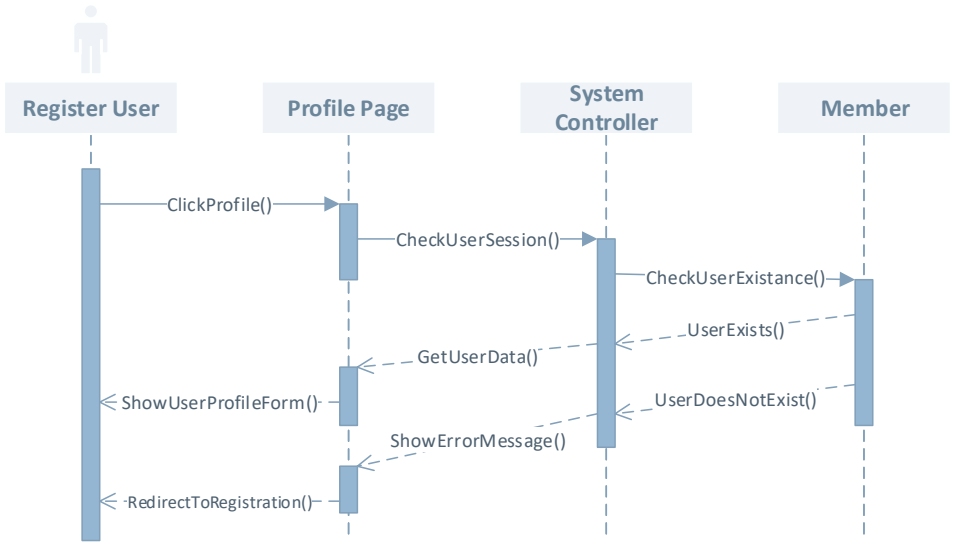


Figure 14: Sequence diagram: 'User Profile'

4.4.2.2 UC2.2: Profile Management

The use case "Profile Management" allows the registered user to update/modify its personal data.

Use Case 4.4.2-2: Profile Management

Use Case: Profile Management
ID: 2.2
Brief description: The registered user can see, insert, and modify personal data
Primary actors: Registered user
Secondary actors: Web portal, Wi-Fi network, 3G/4G network
Pre-conditions: internet access
Main flow: 1. The user selects ***Profile Management*** from the main screen of the application 2. The system executes the use case ***1.2. User Login*** (include) 3. The system connects in background to portal and retrieves user's profile data 4. The system displays user's profile data on screen 5. The user inserts or modifies profile data: ➢ Display Name ➢ First Name ➢ Last Name ➢ Gender ➢ Age group/Date of Birth ➢ Working Status ➢ Home City ➢ Education level ➢ Car ownership 6. The user when has finished selects ***Save*** 7. The system sends user's profile data to the portal to be saved 8. The use case ends
Post-conditions: User's profile is update
Alternative flows: 2. (A) 1. User already logged in

2. The flow control goes to step 3 of the main flow

6. (A) 1. The user selects ***Exit*** any time

2. The flow control goes to step 8 of the main flow

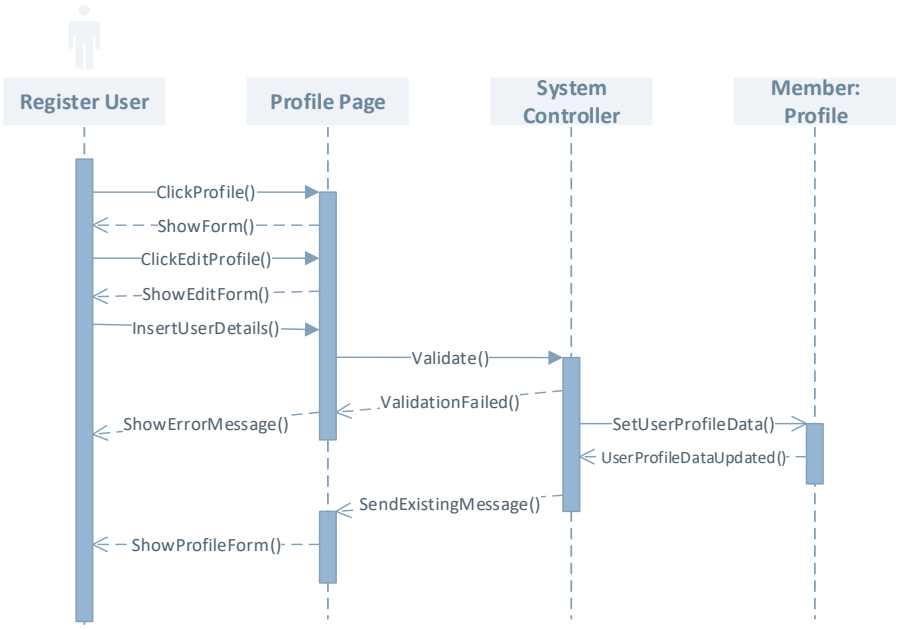


Figure 15: Sequence diagram: 'Profile Management'

4.4.3 UC3: Travel diaries collection

4.4.3.1 UC3.1: Travel Diaries Collector

The use case "Travel Diaries Collector" allows the user to record its daily trips, view statistics for these trips, earn points for every trip entered, become member of a forum and receive personalized notifications.

User Input	Service Output
Mode of Transport	Points earned
Reason for choosing the indicated Mode of Transport (asked)	Travel time and average speed information
Trip Purpose (asked)	
Trip Origin point	
Trip Destination point	
Stops detection point(s) (User/Automatically)	
Route (silently captured)	
Trip End/Destination point	

Use Case 4.4.3-1: Travel Diaries Collector

Use Case: Travel Diaries Collector
ID: 3.1
Brief description: It allows the user to record its daily trips and view statistics for this trips
Primary actors: Anonymous/Registered User
Secondary actors: Web Portal, GPS, Wi-Fi network, 3G/4G network
Pre-conditions:
Main flow: 1. The use case starts when the user selects ***Travel Diary*** from the main screen of the application 2. The user sets the **Origin Point** based on use case **3.2. Trip Origin**. 2.1. The flow control goes to step 3 3. The user sets the **Destination Point** based on use case **3.3. Trip Destination** 3.1. The flow control goes to step 4 4. The user optionaly sets the purpose of the trip, the mode of transportation and the 4.1. reason for choosing this mode 4. The system checks whether the user is a registered user 4.1 If the user is registered 4.1.1 Optional census fields are filled automatically by the user profile 4.2 Else the user sets the optional census fields 5 if origin location has been automatically set by the GPS 5.1 The user selects **Start Trip** 5.2 The route is recorded as described at use case **3.4. Trip Recording** 5.3 The user selects to stop the trip recording 5.4 The system **Submits** as described at use case **3.5. Travel Diaries Submission** 6 Else if origin location has been by the user 6.1 The user selects to **Submit** as described at use case **3.5. Travel Diaries Submission** 7 The system provides information tips about sustainability 8 Use case ends
Post-conditions: The trip diary is saved

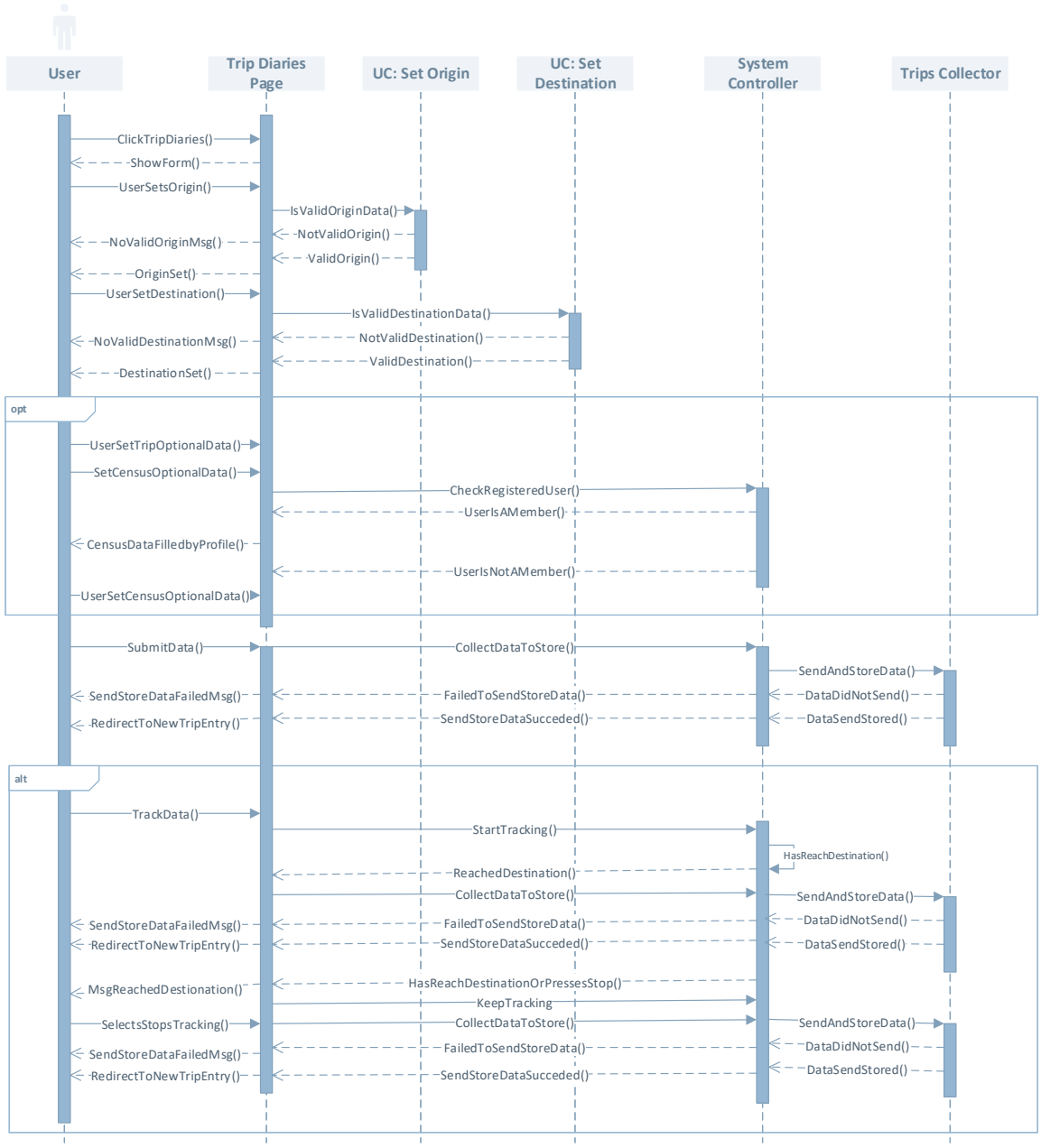


Figure 16: Sequence diagram: 'Travel Diaries Collector'

4.4.3.2 UC3.2: Trip Origin

The use case "Trip Origin" allows the user to set the desire origin location either automatically based on the GPS receiver or by selecting a point on a map or by entering an address.

Use Case 4.4.3-2: Trip Origin

Use Case: Trip Origin
ID: 3.2
Brief description:

It allows the user to set the desire origin of his trip
Primary actors: Anonymous/Registered User
Secondary actors: Web Portal, GPS, Wi-Fi network, 3G/4G network
Pre-conditions: Travel Diary service started
Main flow: 1. The use case starts when the ***Travel Diary*** service starts 2. The system checks whether GPS is enabled 3. If the GPS receiver is disabled 3.1. The user is notified that the GPS is disabled and whether he wants to enable it 3.2 if he choose to enable it 3.2.1 The device settings appears in order to enable it and then goes to step 2 3.3 if he choose to NOT enable it 3.3.1 The system provides the ability to the user to select an origin either by: 3.3.1.1 Select point on map 3.3.1.2 Entering desire address or point of interest location 3.4 The user selects the desire origin location 4 If GPS Receiver is enabled 4.1 The system aquires the current coordinates of the GPS 4.2 Set it as origin location 5 Use case ends
Post-conditions: Origin location is set

4.4.3.3 UC3.3: Trip Destination

The use case “Trip Destination” allows the user to set the desire destination location by selecting a point on a map or by entering an address.

Use Case 4.4.3-3: Trip Destination

Use Case: Trip Destination
ID: 3.3
Brief description: It allows the user to set the desire destination of his trip
Primary actors: Anonymous/Registered User
Secondary actors: Web Portal, GPS, Wi-Fi network, 3G/4G network

Pre-conditions: Travel Diary service started
Main flow: 1. The use case starts when the ***Travel Diary*** service starts 2.1 The system provides the ability to the user to select an destination either by: 2.1.1 Select point on map 2.1.2 Entering desire address or point of interest location 2.2 The user selects the desire destination location 3 Use case ends
Post-conditions: Destination location is set

4.4.3.4 UC3.4: Trip Recording

The use case "Trip Recording" allows the user to track all the movement along his trip.

Use Case 4.4.3-4: Trip Recording

Use Case: Trip Recording
ID: 3.4
Brief description: It allows the user to record movement along the trip
Primary actors: Anonymous/Registered User
Secondary actors: Web Portal, GPS, Wi-Fi network, 3G/4G network
Pre-conditions: GPS Enabled, Set Start Tracking
Main flow: 1. The use case starts when the ***Travel Diary Tracking*** service starts 2. The system keeps collecting coordinates from GPS 3. The system checks whether the last coordinates are within destination buffer 4. If the last coordinates are within destination buffer 4.1. The system notifies the user whether he has reach his destination 4.1.1. If user selects yes 4.1.1.1. The tracking stops 4.1.2. Else the system keeps collecting coordinates 4.2. Else the system keeps collecting coordinates 4.2.1. Stop is pressed 3 Use case ends
Post-conditions:

GPS coordinates collected

4.4.3.5 UC3.5: Travel Diaries Submission

The use case “Travel Diaries Submission” sends the recorded data to the back end server for further analysis and use by the Cities Authorities.

Use Case 4.4.3-5: Travel Diaries Submission

Use Case: Travel Diaries Submission
ID: 3.5
Brief description: Sends the recorded data of Travel Diaries to the back end server for further analysis and use
Primary actors: Anonymous/Registered User
Secondary actors: Web Portal, Wi-Fi network, 3G/4G network
Segment 1
Pre-conditions: 1. Wi-Fi enabled and/or 3G/4G enabled
Main flow: 1. The system starts transmitting the trip data to the back end server 2. Trip diary transmitted successfully 3. The user informed for the successful transmission
Post-conditions: The trip diary has been transmitted
Alternative flows: 2. (A) 1. Trip diary transmission error 2. Repeat for 2 times 2.1. The flow control goes to step 1 of main flow 2.2. If trip diary transmitted successfully 2.2.1. The flow control goes to step 3 of main flow end the alternative flow 2.(A) ends 2.3. Else the flow control goes to step 1 of main flow 3. Trip diary is not transmitted 4. The user informed for the transmission error

4.4.3.6 UC3.8: Trip Statistics

The use case “Travel Statistics” provides to the users, basic statistics as trip duration, average speed and displays them on screen after a trip completion.

Use Case 4.4.3-6: Trip Statistics

Use Case: Travel Statistics
ID: 3.12
Brief description: It calculates basic statistics as trip duration, average speed and displays them on screen
Primary actors: Anonymous/Registered User
Secondary actors: none
Pre-conditions: A trip diary is saved
Main flow: 1. The system calculates the average speed during the trip 2. The system displays the calculated statistics on screen
Post-conditions: none
Alternative flows: none

4.4.4 UC4: Existing mobility measures evaluation

4.4.4.1 UC4.1: Measures Evaluation

The user can evaluate using either Motivate portal or Apps City based measures that are already implemented and used.

User Input	Service Output
City Selection (selection among MOTIVATE cities)	Points earned
Measure(s) performance evaluation (evaluation of measures – e.g. outstanding, very good, satisfactory, marginal, unsatisfactory)	Statistics

Use Case 4.4.4-1: Measures Evaluation

Use Case: Existing Mobility Measures Evaluation
ID: 4.1
Brief description: The user can evaluate the already implemented measures
Primary actors: Anonymous/Registered User
Secondary actors: none
Pre-conditions: none
Main flow: 1. The user selects ***Existing Measures Evaluation*** from the main screen of the application

2. The system ask from user to choose ***Registration***, ***Login*** or ***Continue as anonymous***
3. If the user chooses ***Registration t***he use case ***1.1. User Registration*** is executed
   2.1. The flow control goes to step 4.1
4. Else if the user chooses ***Login***
   4.1. The use case ***1.2. User Login*** is executed
   4.2. The flow control goes to step 6
5. Else if the user chooses ***Continuous as anonymous*** the flow goes to step 6
6. The user is asked to select a city from a displayed drop down menu
7. The user selects a city
8. The system displays the implemented measures in regard to selected city
9. The system asks the user to select and evaluate the measures using a 7-level scale such as outstanding, very good, satisfactory, marginal, unsatisfactory
10. The system calculates X points for each evaluated measure
11. The system saves evaluations and earned points to the local Data Base
12. The system executes the use case ***7.5. Data Transmission*** (include)
13. Use case ends

Post-conditions:
Evaluations and earned points have been saved to the local Data Base

Alternative flows:
14. (A) 1. The user selects ***Display Statistics***
        2. The system executes the use case ***9. Data Statistics***
        3. The flow control goes to step 14 of the main flow

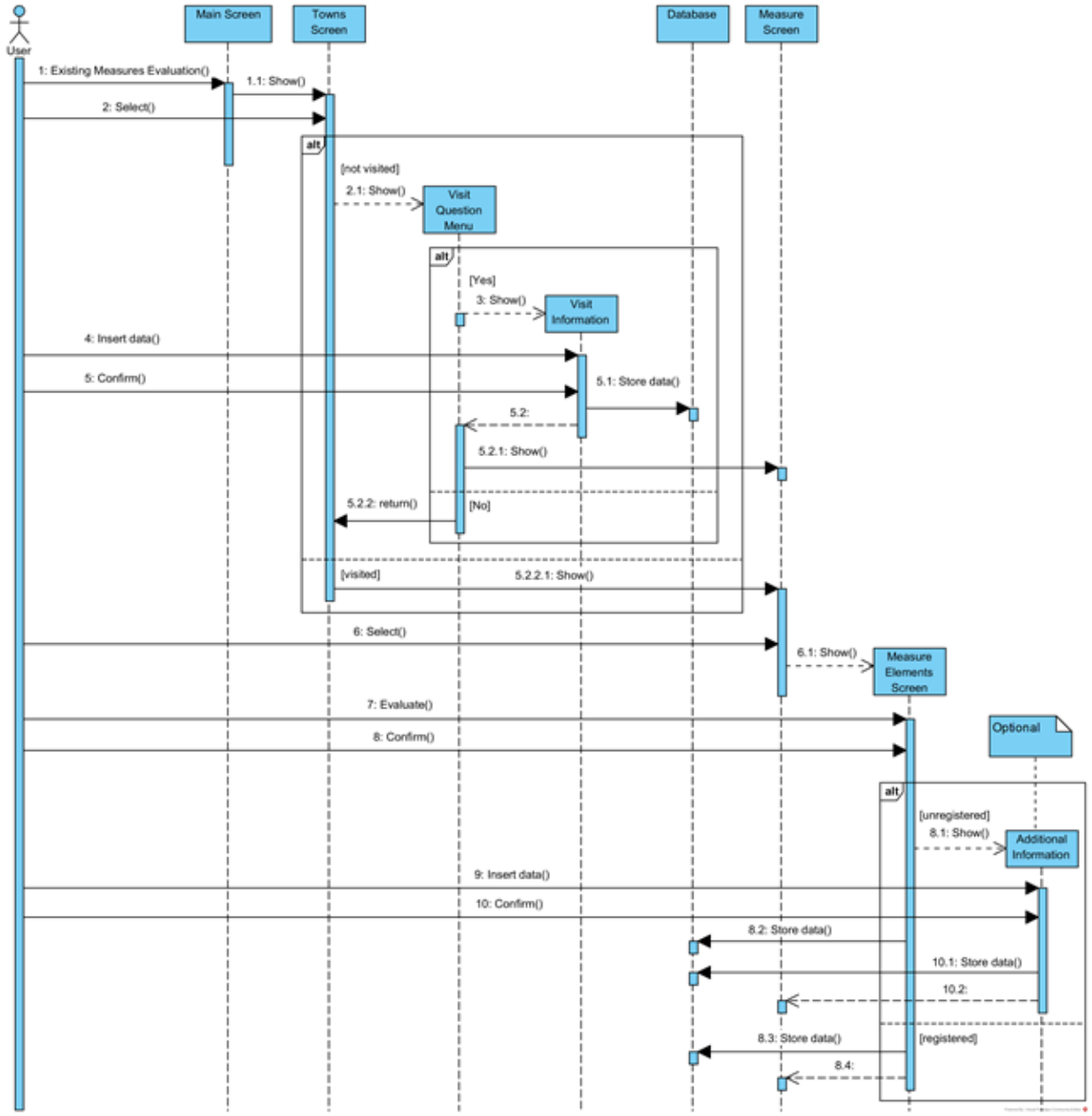


Figure 17: Sequence diagram: 'Measures Evaluation'

4.4.5 UC5: Future mobility interventions assessment

4.4.5.1 UC5.1: Future Interventions Assessment

The user can assess using either Motivate portal or Apps, City based future Interventions that may arise on each city.

User Input	Service Output
City Selection (selection among MOTIVATE cities)	Points earned

Proposed measure(s) importance (e.g. outstanding, very good, satisfactory, marginal, unsatisfactory)	Users of similar profile???
	Statistics

Use Case 4.4.5-1: Future Interventions Assessment

Use Case: Future Mobility Interventions Assessment
ID: 5.1
Brief description: The user can assess future interventions that may arise on a city
Primary actors: Anonymous/Registered User
Secondary actors: none
Pre-conditions: none
Main flow: 1. The user selects ***Future interventions assessment*** from the main screen of the application 2. The system ask from user to choose ***Registration***, ***Login*** or ***Continue as anonymous*** 3. If the user chooses ***Registration t***he use case ***1.1. User Registration*** is executed 2.1. The flow control goes to step 4.1 4. Else if the user chooses ***Login*** 4.1. The use case ***1.2. User Login*** is executed 4.2. The flow control goes to step 6 5. Else if the user chooses ***Continuous as anonymous*** the flow goes to step 6 6. The user is asked to select a city from a displayed drop down menu 7. The user selects a city 8. The portal displays the future interventions planned in regard to selected city 9. The portal asks the user to select and assess the interventions using a 7-level scale such as outstanding, very good, satisfactory, marginal, unsatisfactory 10. The system calculates X points for each intervention assessment 11. The system saves assessments and earned points to the local Data Base 12. The system executes the use case ***7.5. Data Transmission*** (include) 13. Use case ends
Post-conditions: none
Alternative flows: 14. (A) 1. The user selects ***Future interventions assessment Statistics*** 2. The system executes the use case ***9. Data Statistics*** 3. The flow control goes to step 14 of the main flow

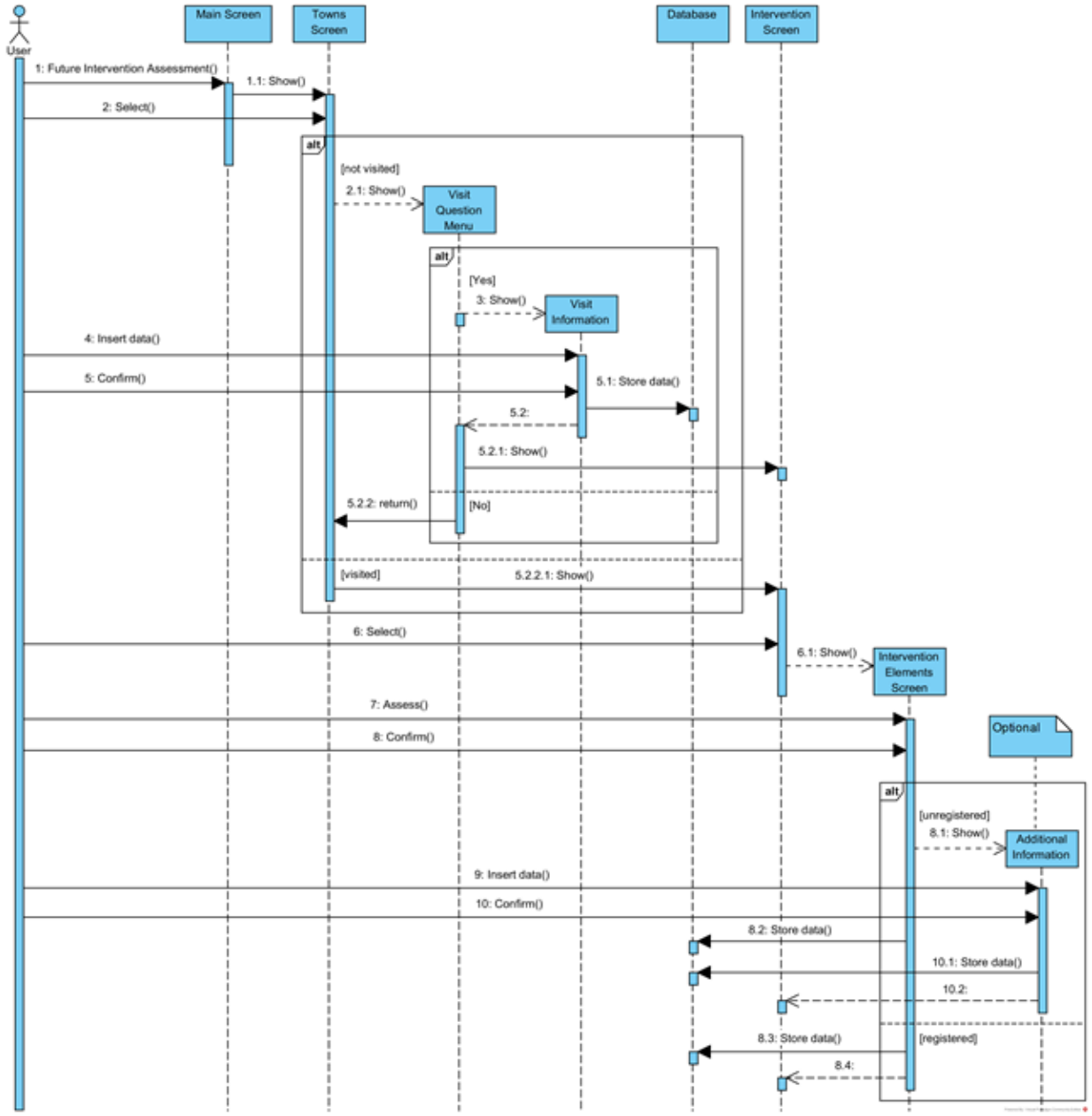


Figure 18: Sequence diagram: View 'Future Interventions Assessment'

4.4.6 UC7: Reporting Services - Dashboard

4.4.6.1 UC7.1: Raw Data Provisioning

The use case "Raw Data Provisioning" provides the user with the desire records of the trip dairies, the measures evaluation data or the interventions assessment data.

Use Case 4.4.6-1: Raw Data Provisioning

Use Case: Raw Data Provisioning
ID: 6

Brief description: Provides the city authorities with the desire records of the trip dairies, the measures evaluation data and the interventions assessment data.
Primary actors: Registered user (City Authorities)
Secondary actors: Web portal, Wi-Fi network, 3G/4G network
Pre-conditions: Wi-Fi enabled and/or 3G/4G enabled
Main flow: 1. The user selects ***Reporting Services*** from the main screen of the application 2. The system executes the use case ***1.2. User Login*** (include) 3. The user logs in 4. The user is asked to select a city from a displayed drop down menu 5. The user selects a city 6. The user selects the type of desired raw data from a displayed drop down menu (Trip Dairies, Measures Evaluations, Interventions Assessments) 7. The user apply the desired selection filters from the provided (From Date/Time To Date/Time, Type of file for export, etc.) 8. The user selects ***Prepare report*** 9. The system retrieves data from the Data Base of the web portal 10. The system displays the prepared report on screen with download functionality 11. Use case ends
Post-conditions: A report has been prepared
Alternative flows: 2. (A) 1. User already logged in 2. The flow control goes to step 4 of the main flow 9. (A) 1. There is no data for the selected city or/and filters 2. The system informs user with message 3. The flow control goes to step 5 of the main flow 10. (A) 1. User selects download 2. The system downloads the report 3. The flow control goes to step 11 of the main flow

4.4.6.2 UC7.2: Trip Diaries KPIs

Use Case 4.4.6-2: Trip Diaries KPIs

Use Case: Trip Diaries KPIs
ID: 7.2
Brief description: The user is informed about City Mobility Trips
Primary actors: Users
Secondary actors:

Web portal, Wi-Fi network, 3G/4G network
Pre-conditions: internet access
Main flow: 1. The user selects ***Trip Diaries***from the Dashboard Page 2. The system asks the user to select the desire City 3. The system returns by default all relative statistics (KPIs) 5. based on last 7 days 6. The user changes the from and/or to date 7. The system returns by default all relative statistics (KPIs) based on user selection 8. Use case ends
Post-conditions: User view City Statistics
Alternative flows: 1. (A) 1. The user selects to download the relative data 2. The system provides the relative data as described at use case **7.1. Raw Data Provisioning** 3. The flow control goes to step 8 of the main flow

4.4.6.3 UC7.3: Mobility Measures KPIs

Use Case 4.4.6-3: Future Mobility Interventions Statistics

Use Case: Mobility Measures KPIs
ID: 7.3
Brief description: The user is informed about City Mobility Existing measures satisfication
Primary actors: Users
Secondary actors: Web portal, Wi-Fi network, 3G/4G network
Pre-conditions: internet access
Main flow: 1. The user selects ***Measures Evaluation***from the Dashboard Page 2. The system asks the user to select the desire City 3. The system returns by default all relative statistics (KPIs) 5. based on last 6 months 6. The user changes the from and/or to date 7. The system returns by default all relative statistics (KPIs) based on user selection 8. Use case ends

Post-conditions: User view City Statistics
Alternative flows: 1. (A) 1. The user selects to download the relative data 2. The system provides the relative data as described at use case **7.1. Raw Data Provisioning** 3. The flow control goes to step 8 of the main flow

4.4.6.4 UC7.4: Future Mobility Interventions KPIs

Use Case 4.4.6-4*: Future Mobility Interventions KPIs*

Use Case: Future Mobility Interventions KPIs
ID: 7.4
Brief description: The user is informed about City Mobility Future measures Interventions
Primary actors: Users
Secondary actors: Web portal, Wi-Fi network, 3G/4G network
Pre-conditions: internet access
Main flow: 1. The user selects ***Future Interventions***from the Dashboard Page 2. The system asks the user to select the desire City 3. The system returns by default all relative statistics (KPIs) 5. based on last 6 months 6. The user changes the from and/or to date 7. The system returns by default all relative statistics (KPIs) based on user selection 8. Use case ends
Post-conditions: User view City Statistics
Alternative flows: 1. (A) 1. The user selects to download the relative data 2. The system provides the relative data as described at use case **7.1. Raw Data Provisioning** 3. The flow control goes to step 8 of the main flow

4.4.6.5 UC7.5: Data Transmission

Use Case 4.4.6-5: Data Transmission

Use Case: Data Transmission
ID: 7.5

Brief description: The system transmits stored data for trip diaries, existing mobility measures evaluations and future mobility interventions assessment to web portal
Primary actors: Anonymous/Registered User
Secondary actors: Web portal, Wi-Fi network, 3G/4G network
Segment 1
Pre-conditions: Wi-Fi enabled and/or 3G/4G enabled
Main flow: 1. The system connects in background to the portal 2. The system retrieves trip diary/evaluation/assessment data from the local Data Base 3. The system starts transmitting trip diary/evaluation/assessment data 4. The trip diary/evaluation/assessment data transmitted successfully 5. The user is informed for the successful transmission
Post-conditions: The trip diary evaluation/assessment data has been transmitted
Alternative flows: 4. (A) 1. Trip diary/evaluation/assessment data transmission error 2. Repeat for 2 times 2.1. The flow control goes to step 3 of main flow 2.2. If trip diary evaluation/assessment data transmitted successfully 2.2.1. The flow control goes to step 5 of main flow end the alternative flow 4.(A) ends 2.3. Else the flow control goes to step 3 of main flow 3. Trip diary/evaluation/assessment data is not transmitted 4. The user is informed for the transmission error
Segment 2
Pre-conditions: 1. Wi-Fi enabled and/or 3G/4G enabled 2. The user launches the application
Main flow: 1. The system connects in background to the portal 2. The system retrieves trip diary/evaluation/assessment data from the local Data Base 3. The system starts transmitting trip diary/evaluation/assessment data 4. The trip diary/evaluation/assessment data transmitted successfully 5. The use case ends
Post-conditions: The trip diary evaluation/assessment data has been transmitted
Alternative flows: 4. (A) 1. Trip diary/evaluation/assessment data transmission error 2. Repeat for 2 times 2.1. The flow control goes to step 3 of main flow 2.2. If trip diary evaluation/assessment data transmitted successfully 2.2.1. The flow control goes to step 5 of main flow 2.3. Else the flow control goes to step 3 of main flow 3. Trip diary/evaluation/assessment data is not transmitted

4. The flow control goes to step 5 of the main flow

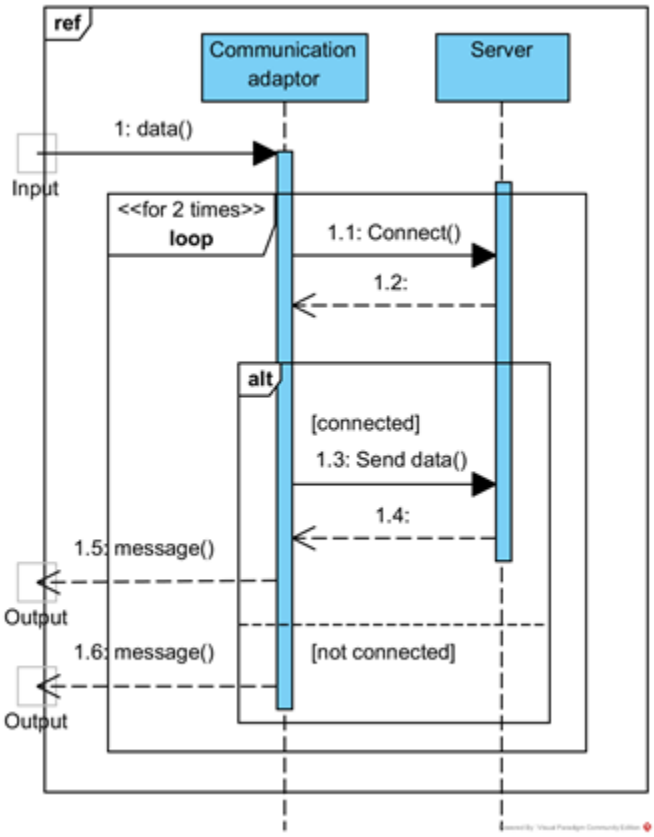


Figure 19: Sequence diagram: 'Data Transmission'

4.4.7 UC8: Game

4.4.7.1 UC8.1: Points earning

Use Case 4.4.7-1: Points earning

Use Case: Game with no action by the user
ID: 8.1
Brief description: The user opens the game
Primary actors: Registered User, Unregistered user
Secondary actors: none
Pre-conditions: none
Main flow: 1. The user taps the button "Play the game" 2. The system opens the environment of the game

3. The systems starts running the game 5. The game ends 6. The values of the KPIs are saved at the end of the game are saved in the User's profile 7. Use case ends
Post-conditions:
Alternative flows: 2. (A) 1. The user exits the game 2. The system pauses the simulation/running of the model 3. The system saves the simulation time of the pause 4. The user re-enters the game 5. The system starts running the game from the point it stopped
Use Case: Game with action by the user
ID:
Brief description: The user opens the game
Primary actors: Registered User, Unregistered user
Secondary actors: none
Pre-conditions: none
Main flow: 1. The user taps the button "Play the game" 2. The system opens the environment of the game 3. The systems starts running the game 4. The user increases the slider of "walking routes" by 5 km. 5. The total points of the user are decreased by 4 6. The system runs the game with the new value 7.The game ends 8. The values of the KPIs are compared with the last saved. 1. If the values of all the new KPIs are larger than the ones saved, they the new ones are saved and the last ones are deleted 2. If the values of all the new KPIs are smaller than the ones saved, then the old ones are kept saved 9. Use case ends
Post-conditions:
Alternative flows: 4. 1. The user tries to increase slider of "walking routes" by 5 km 2. The system pauses the simulation/running of the model 3. The user does not have the required points to perform the action 4. The message "Not enough points for this action" is displayed 5. The system starts running the game from the point it stopped

5 Communication architecture

5.1 Basic data flows (relationships)

Motivate platform consist of the following three services:

- Trip Diaries
- Mobility Measures Evaluation
- Future Mobility Interventions Assessment

The following sections describes the main flows of each main service.

5.1.1 Trip Diaries

Trip Diaries service in simple words records the daily travels of the citizens by recording the origin and the destination. The main flow of Trip Diaries service is presented below:

Figure 20: Trip Diaries Service Data Flow

One of the main key characteristics of Trip Diaries process is whether the user has and hasn't enabled the GPS receiver on his smartphone. With the GPS receiver, the whole process is simplified and the data are more accurate.

Once a user starts Trip Diary service checks whether GPS is enabled on the device. If the GPS is disabled a notification appears stating that GPS is disabled and whether you want to enable it. If the user selects to enable it, it redirects to the appropriate settings to enable it.

At any case, even if the user selects not to enable the GPS receiver, the Trip Diary service form appears. With enabled GPS, the origin location is already set based on “My Location” (current coordinates based on GPS receiver data). With disabled GPS, the user must set the origin location by selecting a location on the map and set the relative start date and time of the trip on the appropriate fields.

Following the origin setup, the user must set the desire destination location by selecting a location on the map in similar way as the origin. Then the user sets the relative date and time reaching the destination location.

Additionally, to the above fields, optionally the user could provide some extra information about his trip like the trip purpose, transport mode and the reason for choosing it. Also, could provide some more information like whether he was or is a visitor to this area, the year of visiting this area and the season.

Finally, if the user is an unregistered user, he is asked to provide some more information like his gender, his age group, his working and education status and whether he is a car owner. If the user is a registered user then previous mentioned fields are already filled based on the user’s profile.

Once all the above, at least the mandatory fields, are set, the user must select start to either submit the trip or start tracking his trip. Once the user selects start, a notification appears asking the user for his consent to either submit or track his trip. If the user does not provide his consent then the service ends and returns to the main screen. If the user provides his consent then if the GPS receiver is disabled the data are either submitted if there is internet access available or are stored locally until an internet connection is available.

In case where the user provides his consent and the GPS receiver is enabled then the device starts tracking the user’s trip. While the trip is tracking the system checks whether the current location is within a decent radius of the destination location. If that’s so then a notification appears asking the user whether he has reach his destination. If the user selects no then tracking continuous. If the user selects yes then destination date and time fields are update based on the current date and time and the data are either submitted if there is internet access available or are stored locally until an internet connection is available.

In case the user selects to stop the tracking process prior of reaching his destination then the last known GPS location updates the destination location and the date and time fields and then the data are either submitted if there is internet access available or are stored locally until an internet connection is available.

Alternative, on the web portal, the user can set either the origin location and destination location by entering the desire address or point of interest and search for the relative location through a geocoding process which will translate the address or point of interest to coordinates.

In both situations, either with GPS enabled or disabled, and for origin and destination, the relative location can be refined by dragging the relative marker to the desire location.

5.1.2 Mobility Measures Evaluation & Future Mobility Interventions Assessment

The Mobility Measures Evaluation and Future Interventions Assessment services as flow process are very similar and they share a common flow process. The relative flow of the evaluation and assessment services is presented below:

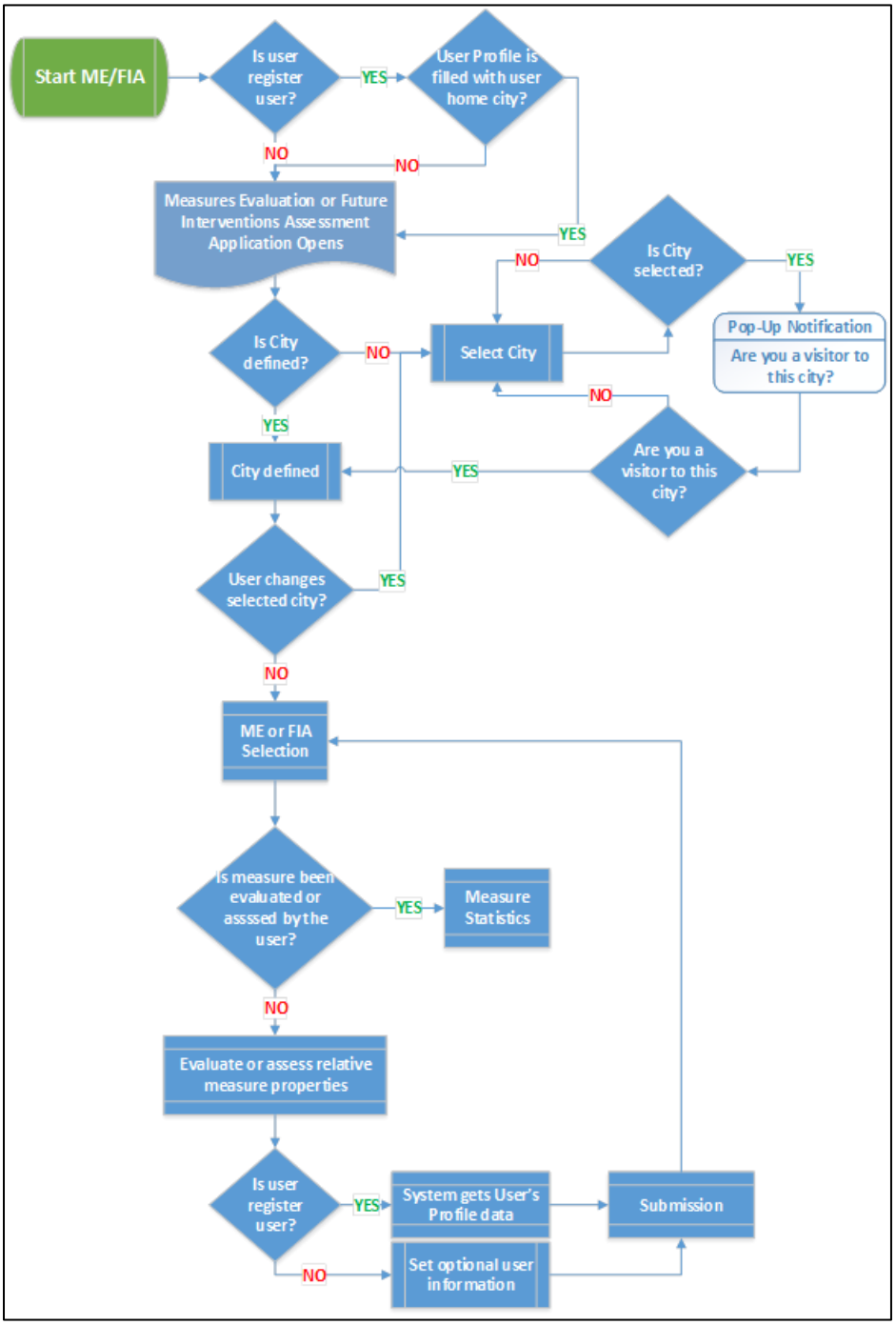


Figure 21:Measures' evaluation/assessment Service Data Flow

In both cases, of measures evaluation and interventions assessment, the key characteristic is the area location which will provide the user with the relative properties to assess or evaluate.

Once a user starts any of the two services, the system checks whether he is a registered user or not and if he is a registered user then the relative service starts with the selected city from the user's profile.

If the user is an unregistered user then the user must select a city from the relative list. In both cases of register and unregister user if the user desires to change the city then he is asked whether he is a visitor to this (selected) city. If he selects no then the system asks to select a city.

Once the desired city is selected then the relative list of measures either for evaluation or assessment appears and the user must select the desire measure.

If the user selects a measure which has already evaluated or assessed then general statistics about this measure are displayed. Otherwise, a list of the relative measure properties appears and the user should evaluate or assess based on a range from 1 to 7 stars where 1 is very bad and 7 is very good.

Once the user completes his assessment or evaluation of the measure properties the user is asked for some additional optional information such as the year of visiting this area and the season, his gender, his age group, his working and education status and whether he is a car owner. If the user is a registered user then previous mentioned fields are already filled based on the user's profile.

Once all the above, at least the mandatory fields, are set, the user selects to submit the data and the data are either submitted if there is internet access available or are stored locally until an internet connection is available.

5.2 Interfaces

MOTIVATE e-Platform consist of three different interfaces levels, which each one aims different purpose. First two levels, smartphone apps and web platform, actually contain the UI part of the platform while the third one consists of the storage, communication and interoperability part of the platform.

The following figure presents the platform interfaces.

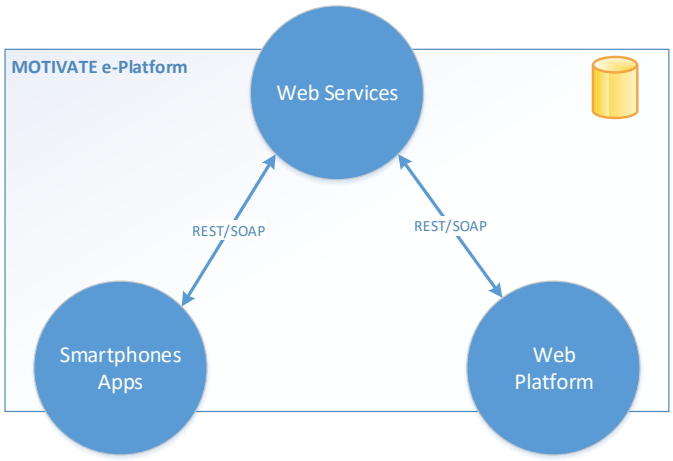


Figure 22: Platform Interfaces

5.2.1 UI Interfaces

All services User Interfaces (UI) follows a minimalistic approach so they will be user friendly and easy to use by the users. Colors and fonts are applied in a way so they will be readable by the user. Controls used in the most usable way and whenever is necessary.

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

User interface components provide a way for users to interact with the mobile applications. They render and format data for users. They also acquire and validate data input by the user. Also, user process components synchronize and orchestrate user interactions. Separate user process components may be useful if you have a complicated UI. Implementing common user interaction patterns as separate user process components allows you to reuse them in multiple UIs. We try to follow the design principle for the UI "One Screen, One Task" . Every screen we design for the mobiles applications trying to support a single action of real value to the person using it. Design each screen for one thing and one thing only, 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.

5.2.2 Interoperability

The data interchange between the different interfaces will take place by using the relative web services using REST/SOAP. With the usage of Parse-server, web services are exposed to the different UI and are ready for further future extensions or integration into existing services

Such scenario is the city of Siena where as a partner and pilot city of the project will integrate MOTIVATE e-Platform services into their existing TIMME's App services.

Depending on the function, each function could be called with the appropriate input in order to return the relative object or objects. For example, the function getCountries has as input the desire locale of the user and returns all Countries objects.

The following table presents all the functions that has been produced in order to cover all the necessities of the services and the different platforms.

Table 9: Cloud Functions

Function	Input	Output
getCountries	locale	object(s)
getTownAreas	locale	object(s)
getMeasures	locale, townID, typeID	object(s)
getMeasures2	locale, townID, typeID	object(s)
getMeasuresQuestions	locale, measureID	object(s)
createProfile	FirstName, LastName, Email, Gender, UserID, DisplayName, DateOfBirth, CityID, OwnsCar, Points	object(s)
saveMesureRatings	DateOfBirth, Gender, VisitedSeason, WorkingStatus, RateValue, MeasureQuestionID, MeasureID, TownAreaID,	object(s)

	CarOwnership, EducationLevel, VisitedYear, IsCityVisitor, MotivateUserID, TripPurpose	
saveMesureRatings2	DateOfBirth, Gender, VisitedSeason, WorkingStatus, RateValue, MeasureQuestionID, MeasureID, TownAreaID, CarOwnership, EducationLevel, VisitedYear, IsCityVisitor, MotivateUserID, TripPurpose	object(s)
getProfile	objectID	object(s)
saveTripDiary	DateOfBirth, Gender, WorkingStatus, CarOwnership, EducationLevel, VisitedSeason, VisitedYear, IsCityVisitor, TripPurpose, TripDestinationDateTime, TripDestinationLongitude, TripDestinationLatitude, TripOriginLatitude, TripOriginLongitude, TripOriginDateTime, MotivateUserID, TransportMode, RCTransportMode, ODTripPurpose, PTLineID, TripName, PTOriginStopID, TripOriginName, PTDestinationStopID, TripDestinationName	object(s)
updateTripDiary	TripDestinationDateTime, TripDestinationLongitude, TripDestinationLatitude, TripDiaryID, TripDiaryCords	object(s)
updateUsersPoints	Userprofileid, Points_flag, Points	object(s)
getMessageForUser	locale	object(s)
saveUserVoting	userID, typeID, townID, measureID	object(s)
getPlatformLists	locale, platformListID	object(s)
getPlatformListItems	locale, PlatformListID	object(s)

The case of Siena within the project period will allow to demonstrate the reliability of MOTIVATE functions (and definition methodology), the level of transferability of the MOTIVATE approach and functions in other “already equipped” City/situation.

5.2.2.1 SIENA Pilot Site as Services Integration

Siena as a pilot city within the MOTIVATE project period, provides a case study and testing environment for the reliability of integrating MOTIVATE Platform functions with either new or existing infoservices of other cities.

The integration between TIEMME’s Mobile App and MOTIVATE Platform will achieved with the usage of the cloud function which supports MOTIVATE’s Platform services.

For this reason, Trip Diaries, Measures Evaluation and Future Interventions Assessment MOTIVATE’s service will be integrated into TIEMME’s Mobile App by providing to them all the necessary lists over the specific cloud function and with the cloud functions TIEMME will push the data to MOTIVATE Platform.

6 Data structure and Stream analysis

6.1 Data requirements

The following table provides an overview of the data requirements for each of the Platform Services. The main source for each data type is described in the relevant column.

Data Requirements	Description	Source
Trip Diaries		
Transport Modes	The transport modes that exist on each City	City Authorities
Cities Georeferences	The geographical Cities boundaries	City Authorities
Trip Purpose		HIT
Measures Evaluation		
Existing Measures	Existing measures for sustainable mobility modes and infrastructures	City Authorities
Measures Questions	Questionnaire for each measure	City Authorities
Measures Future Interventions		
Future Measures	Possible future measures for sustainable mobility modes and infrastructures	City Authorities
Measures Questions	Questionnaire for each measure	City Authorities
Dashboard		
KPIs	Possible indicators for each service	HIT

6.2 Data structures

The data storage of the MOTIVATE e-Platform is separated into two different parts. One is the data storage of the web portal core and the other one is the data storage on the smartphones devices. The web part data storage contains all the data both collected from web and the different apps. This will refer as Core data storage. The smartphones devices data storage refers to the app local database that handles the required data.

Following section presents the overall data structure of the MOTIVATE Platform and additionally for each major service.

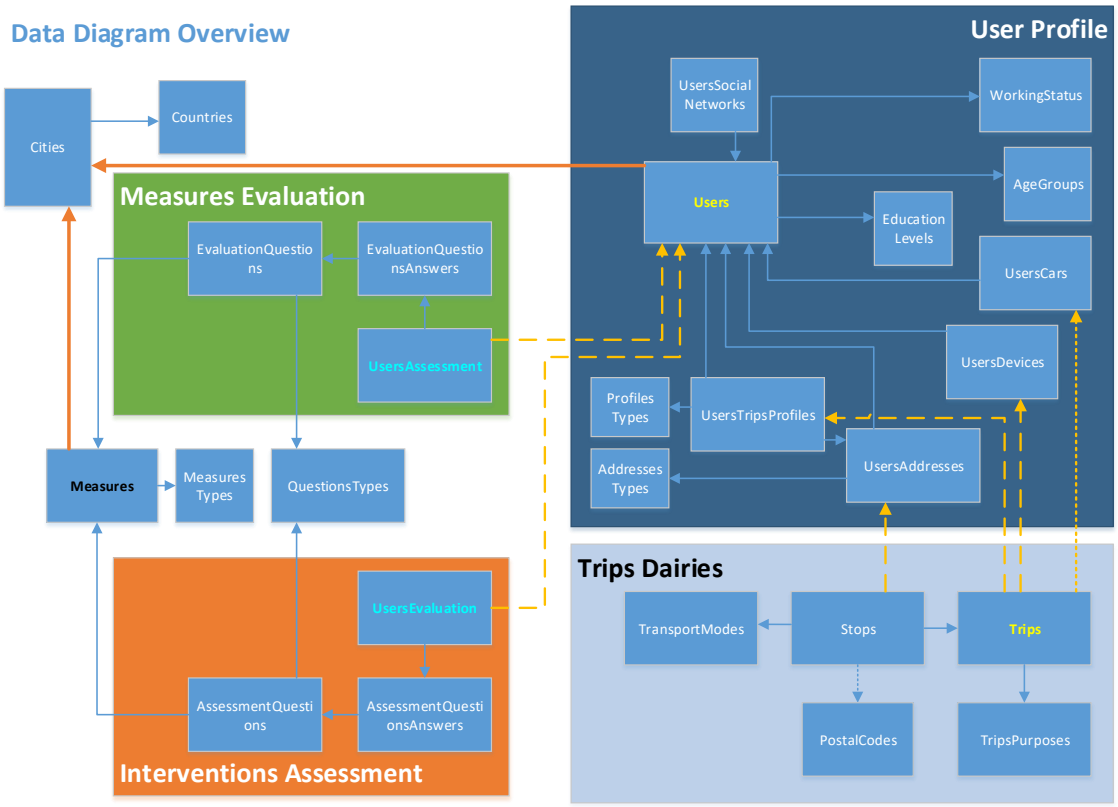


Figure 23: Data Overview

The Entity-Relation (E-R) diagram below presents the core database structure on the back-end server that stores and manage all required and collected data.

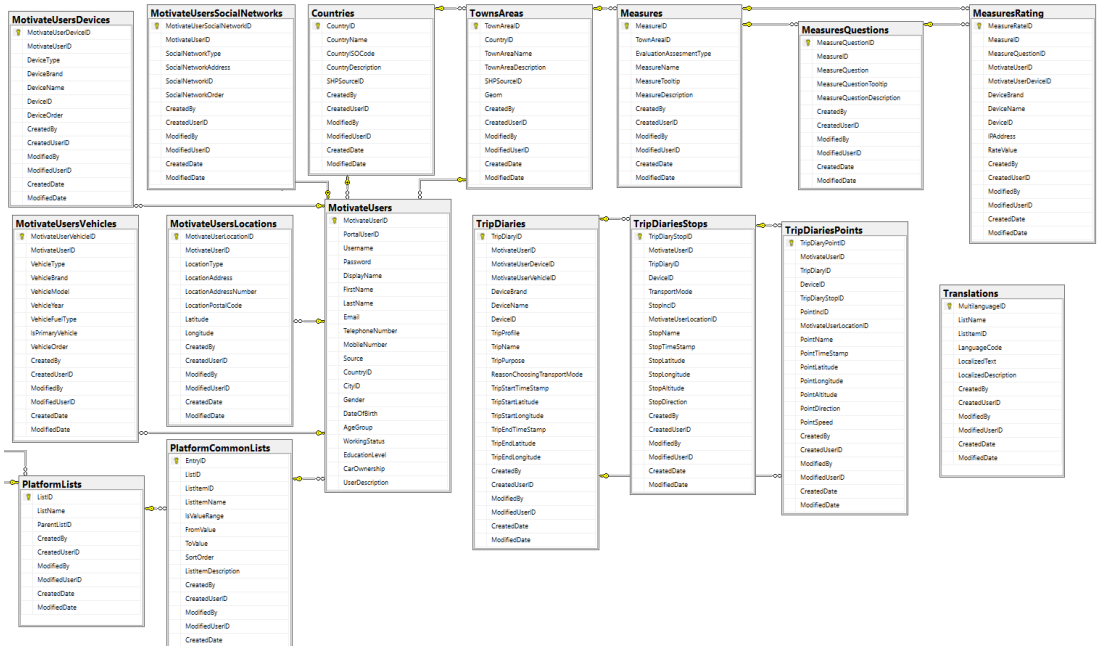


Figure 24:Overall E-R Diagram

6.3 Common Tables

The horizontal section of the database structure consists of the following tables:

- Countries
- TownAreas
- PlatformLists
- PlatformCommonLists
- Translations

The structure of each table is presented below. The following abbreviations are used to represent the columns on the table data structure

- **Null**: Data record could be null
- **ID**: Identity column
- **PK**: Primary Key
- **FK**: Foreign Key
- **OPK**: Optional Foreign Key

6.3.1 Countries

The Countries table stores all the required data to represent the countries.

Table:	**Countries**							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
CountryID	int	X	**V**	**V**	X	X		The unique id that represent a record
CountryName	nvarchar(MAX)	X	X	X	X	X		
CountryISOCode	nvarchar(MAX)	X	X	X	X	X		
CountryDescription	nvarchar(MAX)	**V**	X	X	X	X		
SHPSourceID	int	**V**	X	X	X	X		
CreatedBy	nvarchar(MAX)	X	X	X	X	X		
CreatedUserID	int	X	X	X	**V**	X	PlatformUsers	
ModifiedBy	nvarchar(MAX)	X	X	X	X	X		
ModifiedUserID	int	X	X	X	**V**	X	PlatformUsers	
CreatedDate	datetime	X	X	X	X	X		
ModifiedDate	datetime	X	X	X	X	X		

6.3.2 TownAreas

The TownAreas table stores all the required data to represent the cities or an area as geographical reference.

Table:	**TownsAreas**							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
TownAreaID	int	X	**V**	**V**	X	X		The unique id that represent a record

CountryID	int	X	X	X	**V**	X	Countries	The reference to the Countries table
TownAreaName	nvarchar(MAX)	X	X	X	X	X		
TownAreaDescription	nvarchar(MAX)	**V**	X	X	X	X		
SHPSourceID	int	**V**	X	X	X	X		
Geom	geometry	**V**	X	X	X	X		
CreatedBy	nvarchar(MAX)	X	X	X	X	X		
CreatedUserID	int	X	X	X	**V**	X	PlatformUsers	
ModifiedBy	nvarchar(MAX)	X	X	X	X	X		
ModifiedUserID	int	X	X	X	**V**	X	PlatformUsers	
CreatedDate	datetime	X	X	X	X	X		
ModifiedDate	datetime	X	X	X	X	X		

TownAreas table may contain one or more geographical areas that belongs to a country. This is stated by the relative foreign key on the above table.

6.3.3 PlatformLists

The PlatformLists table stores several required lists and possible sub lists such as working status, age groups, measures evaluation/assessment types etc.

Table:	**PlatformLists**							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
ListID	int	X	**V**	**V**	X	X		The unique id that represent a record
ListName	nvarchar(MAX)	X	X	X	X	X		
ParentListID	int	**V**	X	X	**V**	X	PlatformLists	The reference to the PlatformLists table
CreatedBy	nvarchar(MAX)	X	X	X	X	X		
CreatedUserID	int	X	X	X	**V**	X	PlatformUsers	
ModifiedBy	nvarchar(MAX)	X	X	X	X	X		
ModifiedUserID	int	X	X	X	**V**	X	PlatformUsers	
CreatedDate	datetime	X	X	X	X	X		
ModifiedDate	datetime	X	X	X	X	X		

PlatformLists table may contain one or more lists that belongs to another list. This is stated by the relative foreign key on the above table.

6.3.4 PlatformCommonLists

The PlatformCommonLists table stores the content of the several required lists and possible sub lists such as working status, age groups, measures evaluation/assessment types etc.

Table:	PlatformCommonLists							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
EntryID	int	X	**V**	**V**	X	X		The unique id that represent a record
ListID	int	X	X	X	**V**	X	PlatformLists	The reference to the PlatformLists table
ListItemID	nvarchar(MAX)	X	X	X	X	X		
ListItemName	nvarchar(MAX)	X	X	X	X	X		
IsValueRange	bit	**V**	X	X	X	X		
FromValue	float	**V**	X	X	X	X		
ToValue	float	**V**	X	X	X	X		
SortOrder	int	X	X	X	X	X		
ListItemDescription	nvarchar(MAX)	**V**	X	X	X	X		
CreatedBy	nvarchar(MAX)	X	X	X	X	X		
CreatedUserID	int	X	X	X	**V**	X	PlatformUsers	
ModifiedBy	nvarchar(MAX)	X	X	X	X	X		
ModifiedUserID	int	X	X	X	**V**	X	PlatformUsers	
CreatedDate	datetime	X	X	X	X	X		
ModifiedDate	datetime	X	X	X	X	X		

PlatformCommonLists table may contain one or more list items (records) that belongs to a list. This is stated by the relative foreign key on the above table.

6.4 Trip Diaries

The trip diaries section of the database structure consists of the following tables:

- TripDiaries
- TripDiariesStops
- TripDiariesPoints

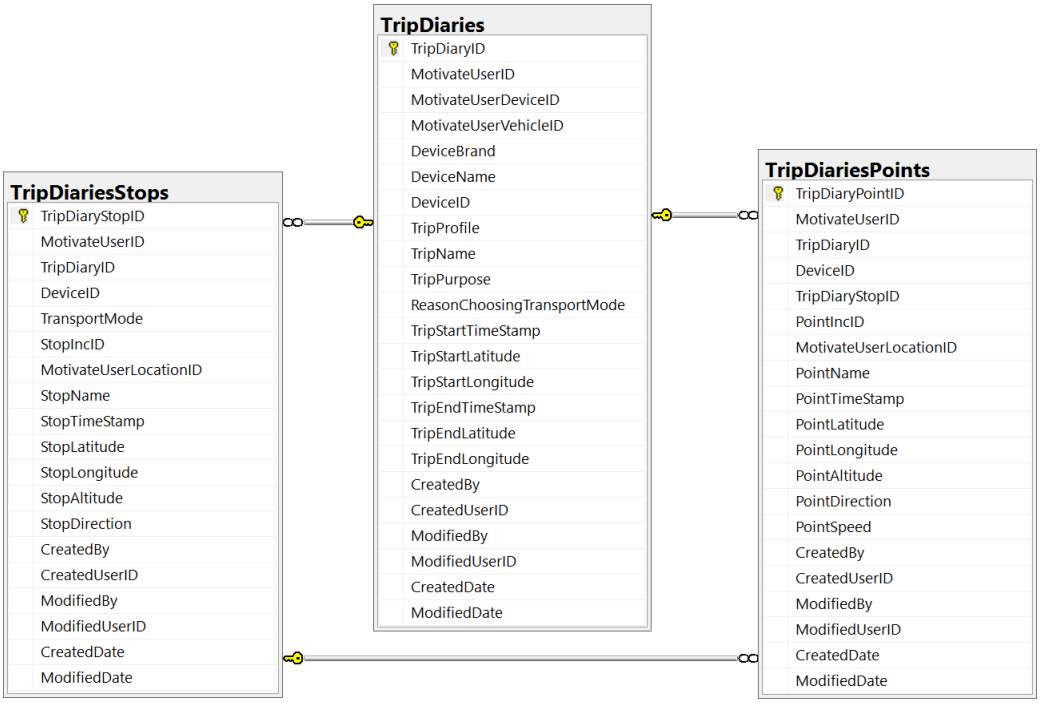


Figure 25:Trip Diaries Data Diagram

The structure of each table is presented below. The following abbreviations are used to represent the columns on the table data structure

- **Null**: Data record could be null
- **ID**: Identity column
- **PK**: Primary Key
- **FK**: Foreign Key
- **OPK**: Optional Foreign Key

6.4.1 TripDiaries

The TripDiaries table stores the content of a recorded trip.

Table:	TripDiaries							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
TripDiaryID	int	X	**V**	**V**	X	X		The unique id that represent a record
TownAreaID	int	X	X	X	**V**	X	TownsAreas	The reference to the TownsAreas table
MotivateUserID	int	**V**	X	X	X	**V**	MotivateUsers	The reference to the MotivateUsers table
MotivateUserDeviceID	int	**V**	X	X	X	**V**	MotivateUsersDevices	The reference to the MotivateUsersDevices table
MotivateUserVehicleID	int	**V**	X	X	X	**V**	MotivateUsersVehicles	The reference to the MotivateUsersVehicles table
DeviceBrand	nvarchar(MAX)	**V**	X	X	X	X		

DeviceName	nvarchar(MAX)	X	X	X	X	X		
DeviceID	nvarchar(MAX)	X	X	X	X	X		
TripProfile	int	**V**	X	X	X	X		
TripName	nvarchar(MAX)	**V**	X	X	X	X		
TripPurpose	int	X	X	X	X	X	PlatformCommonLists (TripsPurposes)	The reference to the PlatformCommonLists table at TripsPurposes list
ReasonChoosingTransportMode	int	X	X	X	X	X	PlatformCommonLists (ReasonChosingTransportMode)	The reference to the PlatformCommonLists table at ReasonChoosingTransportMode list
TripStartTimeStamp	datetime	X	X	X	X	X		
TripStartLatitude	float	X	X	X	X	X		
TripStartLongitude	float	X	X	X	X	X		
TripEndTimeStamp	datetime	**V**	X	X	X	X		
TripEndLatitude	float	**V**	X	X	X	X		
TripEndLongitude	float	**V**	X	X	X	X		
CreatedBy	nvarchar(MAX)	X	X	X	X	X		
CreatedUserID	int	X	X	X	**V**	X	PlatformUsers	
ModifiedBy	nvarchar(MAX)	X	X	X	X	X		
ModifiedUserID	int	X	X	X	**V**	X	PlatformUsers	
CreatedDate	datetime	X	X	X	X	X		
ModifiedDate	datetime	X	X	X	X	X		

TripDiaries table contain several optional foreign keys. The term optional foreign key means that a record could point as reference to another table without this been mandatory.

6.4.2 TripDiariesStops

The TripDiariesStops table stores the possible interim stops of a recorded trip.

Table:	**TripDiariesStops**							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
TripDiaryStopID	int	X	**V**	**V**	X	X		The unique id that represent a record
MotivateUserID	int	**V**	X	X	X	**V**	MotivateUsers	The reference to the MotivateUsers table

TripDiaryID	int	X	X	X	**V**	X	TripDiaries	The reference to the TripDiaries table
DeviceID	nvarchar(MAX)	X	X	X	X	X		
TransportMode	int	X	X	X	X	**V**	PlatformCommonLists (TransportModes)	The reference to the PlatformCommonLists table at TransportModes list
StopIncID	int	X	X	X	X	X		
MotivateUserLocationID	int	**V**	X	X	X	**V**	MotivateUsersLocations	The reference to the MotivateUsersLocations table
StopName	nvarchar(MAX)	**V**	X	X	X	X		
StopTimeStamp	datetime	X	X	X	X	X		
StopLatitude	float	X	X	X	X	X		
StopLongitude	float	X	X	X	X	X		
StopAltitude	float	**V**	X	X	X	X		
StopDirection	float	**V**	X	X	X	X		
CreatedBy	nvarchar(MAX)	X	X	X	X	X		
CreatedUserID	int	X	X	X	**V**	X	PlatformUsers	
ModifiedBy	nvarchar(MAX)	X	X	X	X	X		
ModifiedUserID	int	X	X	X	**V**	X	PlatformUsers	
CreatedDate	datetime	X	X	X	X	X		
ModifiedDate	datetime	X	X	X	X	X		

TripDiariesStops table may contain one or more stops that belongs to a recorded trip. This is stated by the relative foreign key on the above table.

6.4.3 TripDiariesPoints

The TripDiariesPoints table stores the all GPS points of a recorded trip.

Table:	**TripDiariesPoints**							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
TripDiaryPointID	int	X		**V**	X	X		The unique id that represent a record
MotivateUserID	int	**V**	X	X	X	**V**	MotivateUsers	The reference to the MotivateUsers table
TripDiaryID	int	X	X	X	**V**	X	TripDiaries	The reference to the TripDiaries table
DeviceID	nvarchar(MAX)	X	X	X	X	X		

TripDiaryStopID	int	**V**	X	X	X	X	TripDiariesStops	The reference to the TripDiariesStops table
PointIncID	geometry	**V**	X	X	X	X		
MotivateUserLocationID	int	**V**	X	X	X	**V**	MotivateUsersLocations	The reference to the MotivateUsersLocations table
PointName	nvarchar(MAX)	**V**	X	X	X	X		
PointTimeStamp	datetime	X	X	X	X	X		
PointLatitude	float	X	X	X	X	X		
PointLongitude	float	X	X	X	X	X		
PointAltitude	float	**V**	X	X	X	X		
PointDirection	float	**V**	X	X	X	X		
PointSpeed	float	X	X	X	X	X		
CreatedBy	nvarchar(MAX)	X	X	X	X	X		
CreatedUserID	int	X	X	X	**V**	X	PlatformUsers	
ModifiedBy	nvarchar(MAX)	X	X	X	X	X		
ModifiedUserID	int	X	X	X	**V**	X	PlatformUsers	
CreatedDate	datetime	X	X	X	X	X		
ModifiedDate	datetime	X	X	X	X	X		

TripDiariesPoints table may contain one or more points that belongs to a recorded trip. Also, a recorded point may belong to a stop. This is stated by the relative foreign key on the above table.

6.5 Measures Evaluation & Future Intervention Assessment

Measures Evaluation & Future Interventions Assessment services shares common database structure as the main difference between the two services is conceptual.

The Measures section of the database structure consists of the following tables:

- Measures
- MeasuresQuestions
- MeasuresRating

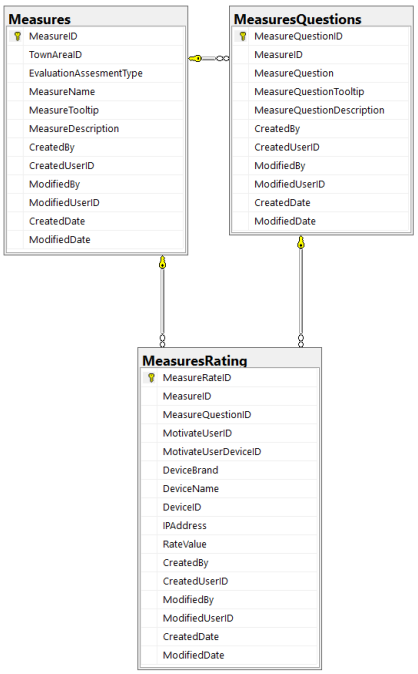


Figure 26: Measures Data Diagram

The structure of each table is presented below. The following abbreviations are used to represent the columns on the table data structure

- **Null**: Data record could be null
- **ID**: Identity column
- **PK**: Primary Key
- **FK**: Foreign Key
- **OPK**: Optional Foreign Key

6.5.1 Measures

The Measures table stores cities existing and possible future intervention.

Table:	Measures							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
MeasureID	int	X	**V**	**V**	X	X		The unique id that represent a record
TownAreaID	int	X	X	X	**V**	X	TownsAreas	The reference to the TownsAreas table
EvaluationAssesmentType	int	X	X	X	**V**	X	PlatformCommonLists (EvaluationAssesmentType)	The reference to the PlatformCommonLists table at EvaluationAssesmentType list
MeasureName	nvarchar(MAX)	X	X	X	X	X		
MeasureTooltip	nvarchar(MAX)	X	X	X	X	X		
MeasureDescription	nvarchar(MAX)	**V**	X	X	X	X		

CreatedBy	nvarchar(MAX)	X	X	X	X	X		
CreatedUserID	int	X	X	X	**V**	X	PlatformUsers	
ModifiedBy	nvarchar(MAX)	X	X	X	X	X		
ModifiedUserID	int	X	X	X	**V**	X	PlatformUsers	
CreatedDate	datetime	X	X	X	X	X		
ModifiedDate	datetime	X	X	X	X	X		

Measures table may contain one or more existing measures or future interventions that belongs to a city. This is stated by the relative foreign key on the above table. The difference between the existing measures and the future interventions is provided on the table on the *EvaluationAssesmentType* foreign key.

6.5.2 MeasuresQuestions

The MeasuresQuestions table stores questions of any existing and possible future intervention measure.

Table:	**MeasuresQuestions**							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
MeasureQuestionID	int	X	**V**	**V**	X	X		The unique id that represent a record
MeasureID	int	X	X	X	**V**	X	Measures	The reference to the Measures table
MeasureQuestion	nvarchar(MAX)	X	X	X	**V**	X		
MeasureQuestionTooltip	nvarchar(MAX)	X	X	X	X	X		
MeasureQuestionDescription	nvarchar(MAX)	X	X	X	X	**V**		
CreatedBy	nvarchar(MAX)	X	X	X	X	X		
CreatedUserID	int	X	X	X	**V**	X	PlatformUsers	
ModifiedBy	nvarchar(MAX)	X	X	X	X	X		
ModifiedUserID	int	X	X	X	**V**	X	PlatformUsers	
CreatedDate	datetime	X	X	X	X	X		
ModifiedDate	datetime	X	X	X	X	X		

MeasuresQuestions table may contain one or more existing measures or future interventions questions that belongs to a measure. This is stated by the relative foreign key on the above table.

6.5.3 MeasuresRating

The MeasuresRating table stores the users ratings of any existing and possible future intervention measure question.

Table:	**MeasuresRating**

Field Name	Data Type	Null	ID	PK	FK	OPK	Foreign Key Table	Comments
MeasureRateID	int	X	**V**	**V**	X	X		The unique id that represent a record
TownAreaID	int	X	X	X	**V**	X	TownsAreas	The reference to the TownsAreas table
MeasureID	int	X	X	X	**V**	X	Measures	The reference to the Measures table
MeasureQuestionID	int	X	X	X	**V**	X	MeasuresQuestions	The reference to the MeasuresQuestions table
MotivateUserID	int	**V**	X	X	X	**V**	MotivateUsers	The reference to the MotivateUsers table
Gender	int	**V**	X	X	X	**V**	PlatformCommonLists (Gender)	The reference to the PlatformCommonLists table at Gender list
AgeGroup	int	**V**	X	X	X	**V**	PlatformCommonLists (AgeGroups)	The reference to the PlatformCommonLists table at AgeGroups list
WorkingStatus	int	**V**	X	X	X	**V**	PlatformCommonLists (WorkingStatus)	The reference to the PlatformCommonLists table at WorkingStatus list
EducationLevel	int	**V**	X	X	X	**V**	PlatformCommonLists (EducationLevels)	The reference to the PlatformCommonLists table at EducationLevels list
CarOwnership	bit	**V**	X	X	X	X		
MotivateUserDeviceID	int	**V**	X	X	X	X		
DeviceBrand	nvarchar(MAX)	**V**	X	X	X	X		
DeviceName	nvarchar(MAX)	**V**	X	X	X	X		
DeviceID	nvarchar(MAX)	**V**	X	X	X	X		
IPAddress	nvarchar(MAX)	**V**	X	X	X	X		
RateValue	int	X	X	X	X	X		

6.6 Users Profiling

The Users Profiling section of the database structure consists of the following tables:

- MotivateUsers
- MotivateUsersLocations
- MotivateUsersDevices
- MotivateUsersSocialNetworks
- MotivateUsersVehicles

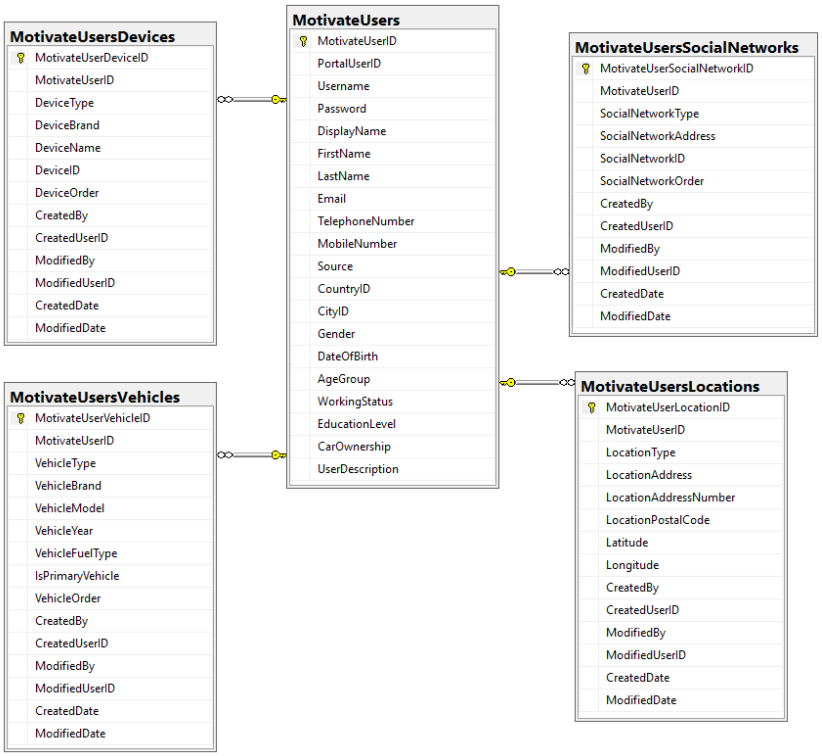


Figure 27: Users Profiling Data Diagram

The structure of each table is presented below. The following abbreviations are used to represent the columns on the table data structure

- **Null**: Data record could be null
- **ID**: Identity column
- **PK**: Primary Key
- **FK**: Foreign Key
- **OPK**: Optional Foreign Key

6.6.1 MotivateUsers

The MotivateUsers table stores the main user profile data.

Table:	MotivateUsers							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
MotivateUserID	int	X	**V**	**V**	X	X		The unique id that represent a record
PortalUserID	int	X	X	X	**V**	X	PlatformUsers	
Username	nvarchar(MAX)	X	X	X	X	X		
Password	nvarchar(MAX)	X	X	X	X	X		
DisplayName	nvarchar(MAX)	X	X	X	X	X		
FirstName	nvarchar(MAX)	X	X	X	X	X		
LastName	nvarchar(MAX)	X	X	X	X	X		
Email	nvarchar(MAX)	X	X	X	X	X		

TelephoneNumber	nvarchar(MAX)	**V**	X	X	X	X		
MobileNumber	nvarchar(MAX)	**V**	X	X	X	X		
Source	nvarchar(MAX)	**V**	X	X	X	X		
CountryID	int	X	X	X	**V**	X	Countries	The reference to the Countries table
CityID	int	X	X	X	**V**	X	TownsAreas	The reference to the TownsAreas table
Gender	int	**V**	X	X	X	**V**	PlatformCommonLists (Gender)	The reference to the PlatformCommonLists table at Gender list
DateOfBirth	datetime	X	X	X	X	X		
AgeGroup	int	**V**	X	X	X	**V**	PlatformCommonLists (AgeGroups)	The reference to the PlatformCommonLists table at AgeGroups list
WorkingStatus	int	**V**	X	X	X	**V**	PlatformCommonLists (WorkingStatus)	The reference to the PlatformCommonLists table at WorkingStatus list
EducationLevel	int	**V**	X	X	X	**V**	PlatformCommonLists (EducationLevels)	The reference to the PlatformCommonLists table at EducationLevels list
CarOwnership	bit	**V**	X	X	X	X		
UserDescription	nvarchar(MAX)	**V**	X	X	X	X		

MotivateUsers table may contain one or more users that belongs to a city and thus country. This is stated by the relative foreign key on the above table.

6.6.2 MotivateUsersLocations

The MotivateUsersLocations table stores the possible user location like home, work etc.

Table:	**MotivateUsersLocations**							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
MotivateUserLocationID	int	X	**V**	**V**	X	X		The unique id that represent a record
MotivateUserID	int	X	X	X	**V**	X	MotivateUsers	The reference to the MotivateUsers table
LocationType	int	X	X	X	X	**V**	PlatformCommonLists (LocationsTypes)	The reference to the PlatformCommonLists table at LocationsTypes list
LocationAddress	nvarchar(MAX)	**V**	X	X	X	X		

LocationAddressNumber	nvarchar(MAX)	**V**	X	X	X	X		
LocationPostalCode	nvarchar(MAX)	**V**	X	X	X	X		
Latitude	float	X	X	X	X	X		
Longitude	float	X	X	X	X	X		
CreatedBy	nvarchar(MAX)	X	X	X	X	X		
CreatedUserID	int	X	X	X	**V**	X	PlatformUsers	
ModifiedBy	nvarchar(MAX)	X	X	X	X	X		
ModifiedUserID	int	X	X	X	**V**	X	PlatformUsers	
CreatedDate	datetime	X	X	X	X	X		
ModifiedDate	datetime	X	X	X	X	X		

MotivateUsersLocations table may contain one or more location that belongs to a user. This is stated by the relative foreign key on the above table.

6.6.3 MotivateUsersDevices

The MotivateUsersDevices table stores the possible user devices like smartphones, tablets etc.

Table:	**MotivateUsersDevices**							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
MotivateUserDeviceID	int	X	**V**	**V**	X	X		The unique id that represent a record
MotivateUserID	int	X	X	X	**V**	X	MotivateUsers	The reference to the MotivateUsers table
DeviceType	int	X	X	X	**V**	X	PlatformCommonLists (DevicesTypes)	The reference to the PlatformCommonLists table at DevicesTypes list
DeviceBrand	nvarchar(MAX)	X	X	X	X	X		
DeviceName	nvarchar(MAX)	X	X	X	X	X		
DeviceID	nvarchar(MAX)	**V**	X	X	X	X		
DeviceOrder	int	X	X	X	X	X		
CreatedBy	nvarchar(MAX)	X	X	X	X	X		
CreatedUserID	int	X	X	X	**V**	X	PlatformUsers	
ModifiedBy	nvarchar(MAX)	X	X	X	X	X		
ModifiedUserID	int	X	X	X	**V**	X	PlatformUsers	

CreatedDate	datetime	X	X	X	X	X		
ModifiedDate	datetime	X	X	X	X	X		

MotivateUsersDevices table may contain one or more device that belongs to a user. This is stated by the relative foreign key on the above table.

6.6.4 MotivateUsersSocialNetworks

The MotivateUsersSocialNetworks table stores the user's possible social networks references.

Table:	MotivateUsersSocialNetworks							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
MotivateUserSocialNetworkID	int	X	**V**	**V**	X	X		The unique id that represent a record
MotivateUserID	int	X	X	X	**V**	X	MotivateUsers	The reference to the MotivateUsers table
SocialNetworkType	int	X	X	X	**V**	X	PlatformCommonLists (SocialNetworkTypes)	The reference to the PlatformCommonLists table at SocialNetworkTypes list
SocialNetworkAddress	nvarchar(MAX)	X	X	X	X	X		
SocialNetworkID	nvarchar(MAX)	X	X	X	X	X		
SocialNetworkOrder	int	X	X	X	X	X		
CreatedBy	nvarchar(MAX)	X	X	X	X	X		
CreatedUserID	int	X	X	X	**V**	X	PlatformUsers	
ModifiedBy	nvarchar(MAX)	X	X	X	X	X		
ModifiedUserID	int	X	X	X	**V**	X	PlatformUsers	
CreatedDate	datetime	X	X	X	X	X		
ModifiedDate	datetime	X	X	X	X	X		

MotivateUsersSocialNetworks table may contain one or more social network links that belongs to a user. This is stated by the relative foreign key on the above table.

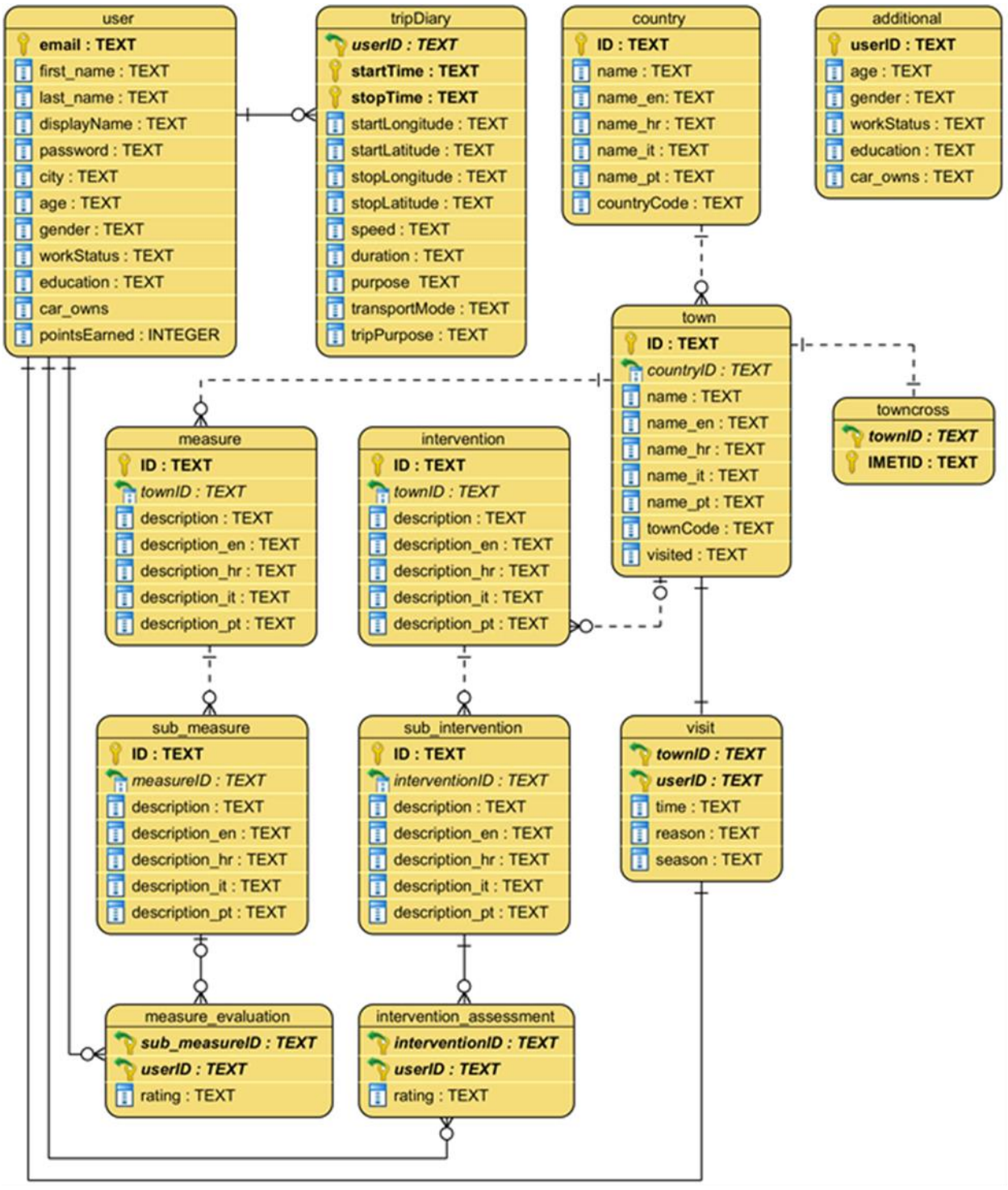
6.6.5 MotivateUsersVehicles

The MotivateUsersVehicles table stores the user's vehicles.

Table:	MotivateUsersVehicles							
Field Name	**Data Type**	**Null**	**ID**	**PK**	**FK**	**OPK**	**Foreign Key Table**	**Comments**
MotivateUserVehicleID	int	X	**V**	**V**	X	X		The unique id that represent a record
MotivateUserID	int	X	X	X	**V**	X	MotivateUsers	The reference to the MotivateUsers table
VehicleType	int	**V**	X	X	X	**V**	PlatformCommonLists (VehicleTypes)	The reference to the PlatformCommonLists table at VehicleTypes list
VehicleBrand	nvarchar(MAX)	X	X	X	X	X		
VehicleModel	nvarchar(MAX)	X	X	X	X	X		
VehicleYear	int	**V**	X	X	X	X		
VehicleFuelType	int	**V**	X	X	X	**V**	PlatformCommonLists (FuelTypes)	The reference to the PlatformCommonLists table at FuelTypes list
IsPrimaryVehicle	bit	**V**	X	X	X	X		
VehicleOrder	int	X	X	X	X	X		
CreatedBy	nvarchar(MAX)	X	X	X	X	X		
CreatedUserID	int	X	X	X	**V**	X	PlatformUsers	
ModifiedBy	nvarchar(MAX)	X	X	X	X	X		
ModifiedUserID	int	X	X	X	**V**	X	PlatformUsers	
CreatedDate	datetime	X	X	X	X	X		
ModifiedDate	datetime	X	X	X	X	X		

MotivateUsersVehicles table may contain one or more vehicle that belongs to a user. This is stated by the relative foreign key on the above table.

6.6.6 Apps Local Data Structure


user
email : TEXT
first_name : TEXT
last_name : TEXT
displayName : TEXT
password : TEXT
city : TEXT
age : TEXT
gender : TEXT
workStatus : TEXT
education : TEXT
car_owns
pointsEarned : INTEGER
tripDiary
userID : TEXT
startTime : TEXT
stopTime : TEXT
startLongitude : TEXT
startLatitude : TEXT
stopLongitude : TEXT
stopLatitude : TEXT
speed : TEXT
duration : TEXT
purpose TEXT
transportMode : TEXT
tripPurpose : TEXT
country
ID : TEXT
name : TEXT
name_en: TEXT
name_hr : TEXT
name_it : TEXT
name_pt : TEXT
countryCode : TEXT
additional
userID : TEXT
age : TEXT
gender : TEXT
workStatus : TEXT
education : TEXT
car_owns : TEXT
town
ID : TEXT
countryID : TEXT
name : TEXT
name_en : TEXT
name_hr : TEXT
name_it : TEXT
name_pt : TEXT
townCode : TEXT
visited : TEXT
towncross
townID : TEXT
IMETID : TEXT
measure
ID : TEXT
townID : TEXT
description : TEXT
description_en : TEXT
description_hr : TEXT
description_it : TEXT
description_pt : TEXT
intervention
ID : TEXT
townID : TEXT
description : TEXT
description_en : TEXT
description_hr : TEXT
description_it : TEXT
description_pt : TEXT
sub_measure
ID : TEXT
measureID : TEXT
description : TEXT
description_en : TEXT
description_hr : TEXT
description_it : TEXT
description_pt : TEXT
sub_intervention
ID : TEXT
interventionID : TEXT
description : TEXT
description_en : TEXT
description_hr : TEXT
description_it : TEXT
description_pt : TEXT
visit
townID : TEXT
userID : TEXT
time : TEXT
reason : TEXT
season : TEXT
measure_evaluation
sub_measureID : TEXT
userID : TEXT
rating : TEXT
intervention_assessment
interventionID : TEXT
userID : TEXT
rating : TEXT