Project co-financed by the European Regional Development Fund

MOTIVATE Portfolio

Common model of using social networks/crowdsourcing techniques for SUMP development/enhancement

MOTIVATE Consortium

Almada Municipality
Portugal

CERTH/HIT
Greece

Rhodes Municipality
Greece

MemEx Srl
Italy

Tiemme S.p.A.
Italy

Larnaca Municipality
Cyprus

Aegean Energy & Environment Agency
Greece

Ioannina Municipality
Greece

Contents

Introduction

The current document represents the output "Common model of using social networks/crowdsourcing techniques for SUMP development/enhancement" which incorporates n° 4 different deliverables released by the MOTIVATE project, and namely:

- Deliverable D3.2.1 "**Development of the MOTIVATE e-platform**", describing the detailed design of the MOTIVATE platform;
- Deliverable D3.9.3 "**Quality monitoring and evaluation of collected pilot data**", reporting the results of the evaluation activities related to the role and the use of a crowdsourcing tool like MOTIVATE in providing data for SUMP development compared to the traditional data collection survey (from the City Planners' point of view);
- Deliverable D4.2.1 "**Transferability methodology, processes, techniques and protocols**", aiming to identify a series of actions for ensuring a successful and efficient implementation of the MOTIVATE services (MOTIVATE e-platform and mobile apps) to other cities.
- Deliverable D3.9.4 "**Final evaluation report**" providing a set of recommendations on how to design, implement and launch crowdsourcing initiatives to collect data for SUMP development/enhancement

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 lied on their active involvement in transport data collection/management, problems identification and proposed measures evaluation.

MOTIVATE intended 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.

The key objective of the MOTIVATE project, was to promote new supporting tools to collect data for SUMP development, based on the exploitation of social media and crowd-sourcing applications (apps) in five selected pilot cities: Almada (PT), Siena (IT), Rhodes and Ioannina (GR), Larnaca (CY). More information about each of the city is reported in the Annex I to this deliverable.

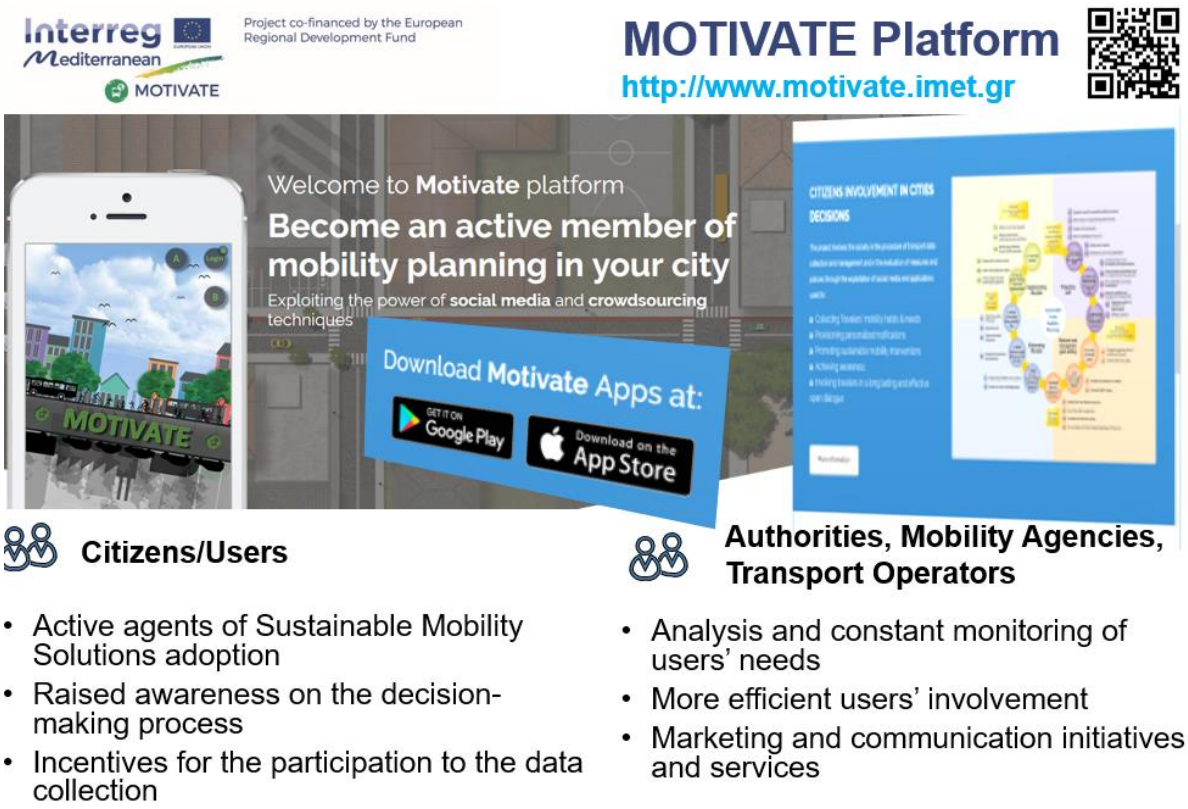

Figure 1 – MOTIVATE PLATFORM

Overall, the primary purpose of the MOTIVATE platform and the relevant apps, was to attract the interest, involvement or motivate users to perform an action or a series of actions. These actions were related to the collection of a large amount of data regarding the trips performed by the end users (citizens and visitors) in the pilot 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. The platform and the relevant apps provided to its users the following three main services:

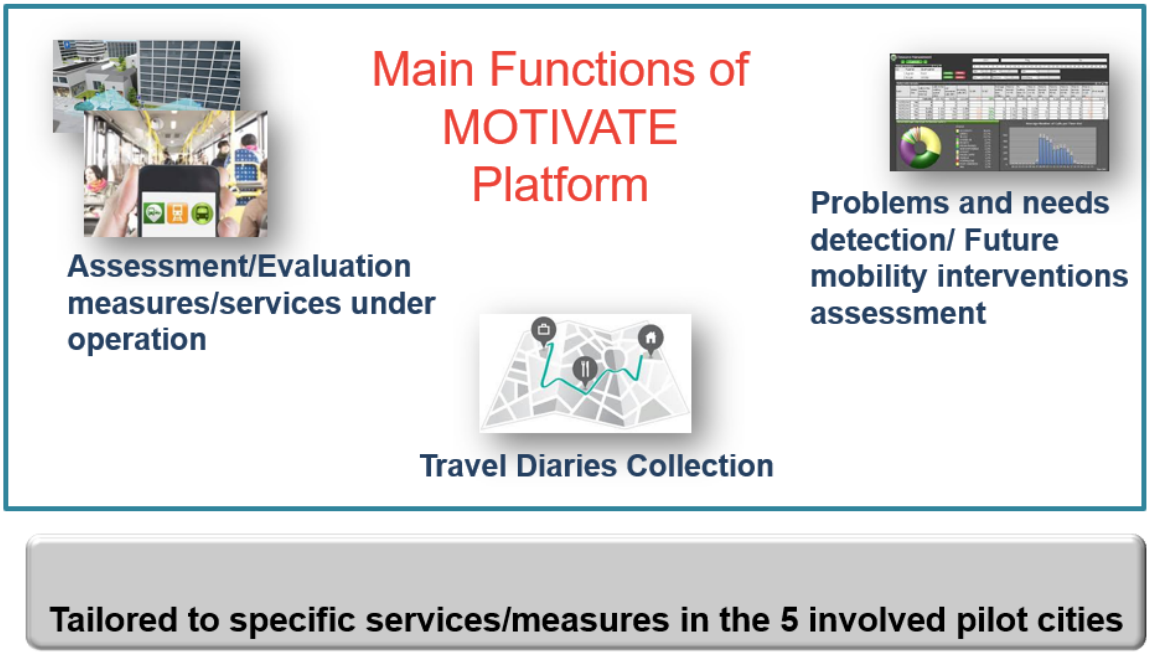

Figure 2 MOTIVATE MAIN SERVICES

A. Trip Diaries

The Trip Diaries service addressed transport planners and city authorities aiming to collect information about the mobility patterns and behavior of the users. Users had to either setup some of their personal information, such as gender, age group, working status, educational level, city etc. or the system filled the appropriate fields based on the registered user profile info. The user, also, should 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 was completed, the system stored 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. The daily trips were completed either at real time (GPS enabled) or after trip.

Although this service was used by the transport authorities, still the beneficiary was the end user, since the mobility patterns would be largely used by the transport planners and city authorities for improving the transport system.

B. Evaluation of existing transport measures

This service addressed transport planners and city authorities, aiming to collect information from the end users, about existing transport measures and services already operating in the city. The users had to select the city and the measure to evaluate and evaluated specific measure-related criteria using a scale from 1 to 7. Once an evaluation was submitted the system stored the relative ratings in relation to the user selected data.

C. Preference on future transport measures

This service addressed transport planners and city authorities, aiming to collect information from the end users about specific future interventions they intended to implement in the city. The users were asked to provide their perceptions regarding the interventions by rating their importance.

The main benefit provided through the MOTIVATE platform and relevant apps was the very close interaction between the travelers (citizens and visitors) inside a city and the transport "decision makers". The travelers became the central source of data and information while the policy makers and the stakeholders could plan upon their needs as graphically presented in the figure below.

The services are accessible in the form of user-friendly web services as well as in a form of a mobile application (APP). The APP form is essential in order to collect travel data in real time. The smartphone APP, available for both Android and iOS, can silently (without user intervention or much effort) collect data from a multitude of the phones' sensors (GPS, WiFi). The data collected is transferred to a central database. Data exports per pilot city is then available to the cities for further analysis. Mobility services evaluation, opinion gathering and sustainable mobility measures promotion are also available via the dedicated webpage and via the app.

The MOTIVATE platform and the relevant apps were developed and adjusted depending on each pilot city's needs.

Interreg Mediterranean MOTIVATE
Project co-financed by the European Regional Development Fund

MOTIVATE 5 Pilot sites

Common feature: Small towns and tourist destinations

- Evaluate mobility services
- Evaluate services provided by Tiemme Mobile App

- Evaluate the public transport system's quality and the real time information system operation
- Assess the utility of a control parking system in the city center as well as the information system
- After PARKING SYSTEM DEVELOPMENT evaluation

- Evaluate the new Tram line
- Assess Mobility Services"

- Evaluate public transport quality and the existing real time information provision system (DIAVLOS)
- After INFO SERVICE DEVELOPMENT provision
- Assess future PuT information system

- Evaluate the quality of the existing PT system, as well as the quality of the existing cycling and walking paths.
- Assess the utility and cost of implementing a parking management system in central axes of the city

For all cases:
Travel Diaries
Strong promotion actions

Design of the Logical Architecture of MOTIVATE platform

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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 have been 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 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.

1.1 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.

1.2 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.

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

Table 1 - Diagrammatic techniques per models used in the MOTIVATE platform

2 Conceptual design of the architecture

2.1 Services of the platform

Overall, the primary purpose of the project was to attract the interest, involvement or motivate the user to perform an action or a series of actions. These actions were 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 latter 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 have offered a limited amount of actions to the user, so that it would not have overflown him/her with information and becomes disproportionally difficult, thus unattractive. Additionally, it must not have been simply informational; it should have offered the possibility to the user to experience the complexity of urban transportation sustainability and arrive to own conclusions. Therefore, the game must have had the following characteristics:

- 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.
- illustrate the uncertain nature of sustainability problems.
- explain in simple terms the complexity and the different dimensions of sustainability.
- 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 was 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 is 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 provides 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 specifically 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.

2.2 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.

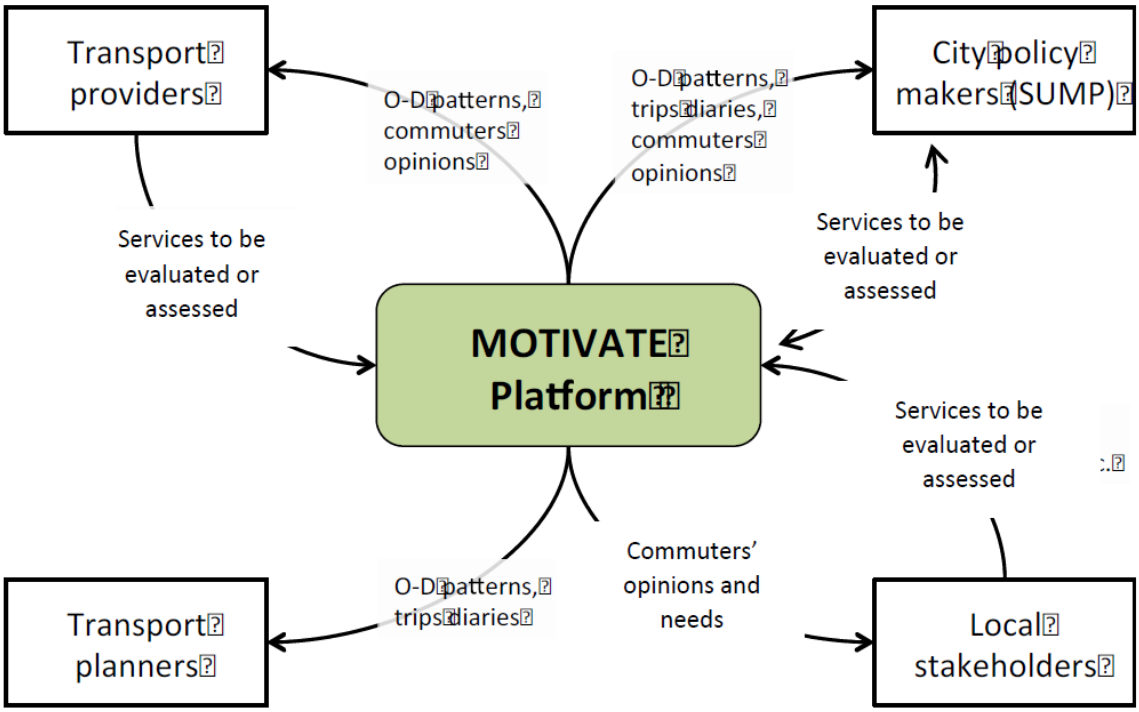

Figure 1 – Context diagram of the MOTIVATE platform

The platform and all its components are represented by the shape in the central of the diagram. Around 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.

2.3 Components of the platform

The MOTIVATE Platform consists 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.

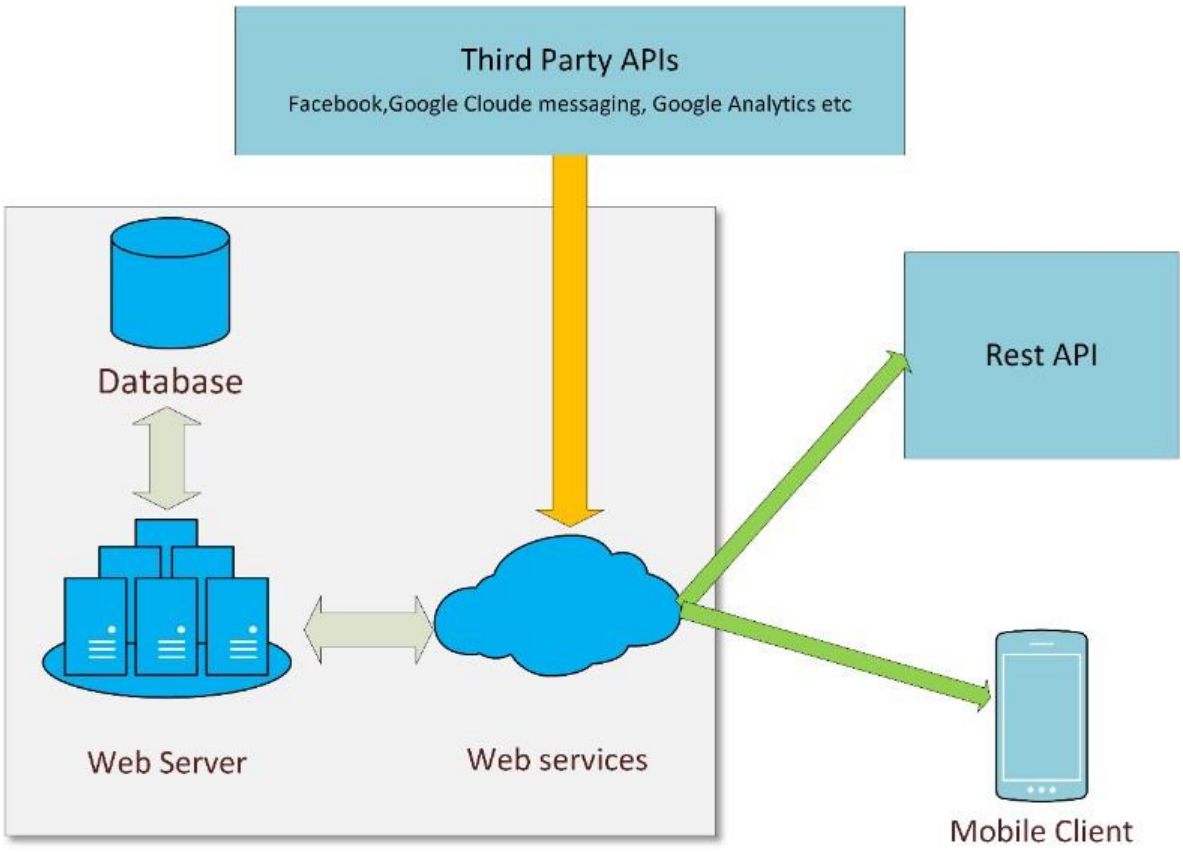

Figure 2 - Basic components of the MOTIVATE platform

The platform consists 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 intended to create an open, globally accessible and complete set of information services able to support the needs of the service. The system was 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.

2.3.1 Web applicationarchitecture

Motivate Platform services are served to the end user over web for any browser that can interpret HTML content. The development of the web application is 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 is built 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 is based on a master page which provides 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 were built as user controls, instead of pages, so this made the relative content and/or service reusable at least within the portal.

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

Pages and user controls were 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 is 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.

2.3.2 Mobile application architecture

The provided services by MOTIVATE Platform run on the mobile devices running either Android or iOS. The development of the mobile apps, was 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.

2.3.3 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.

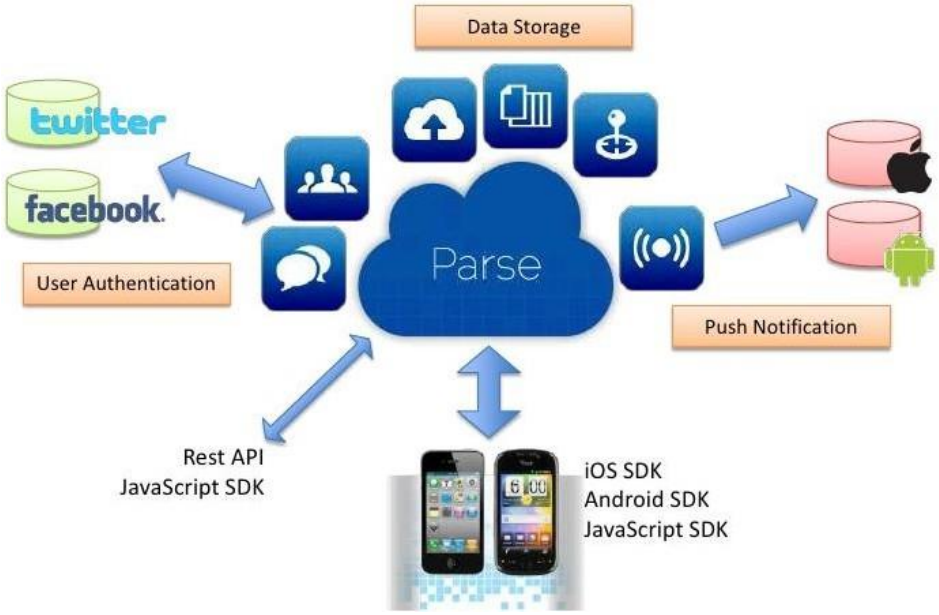

Figure 4: Mobile Apps Conceptual Design

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.

2.3.4 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.

2.3.5 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.

2.3.6 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

2.3.6.1 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.

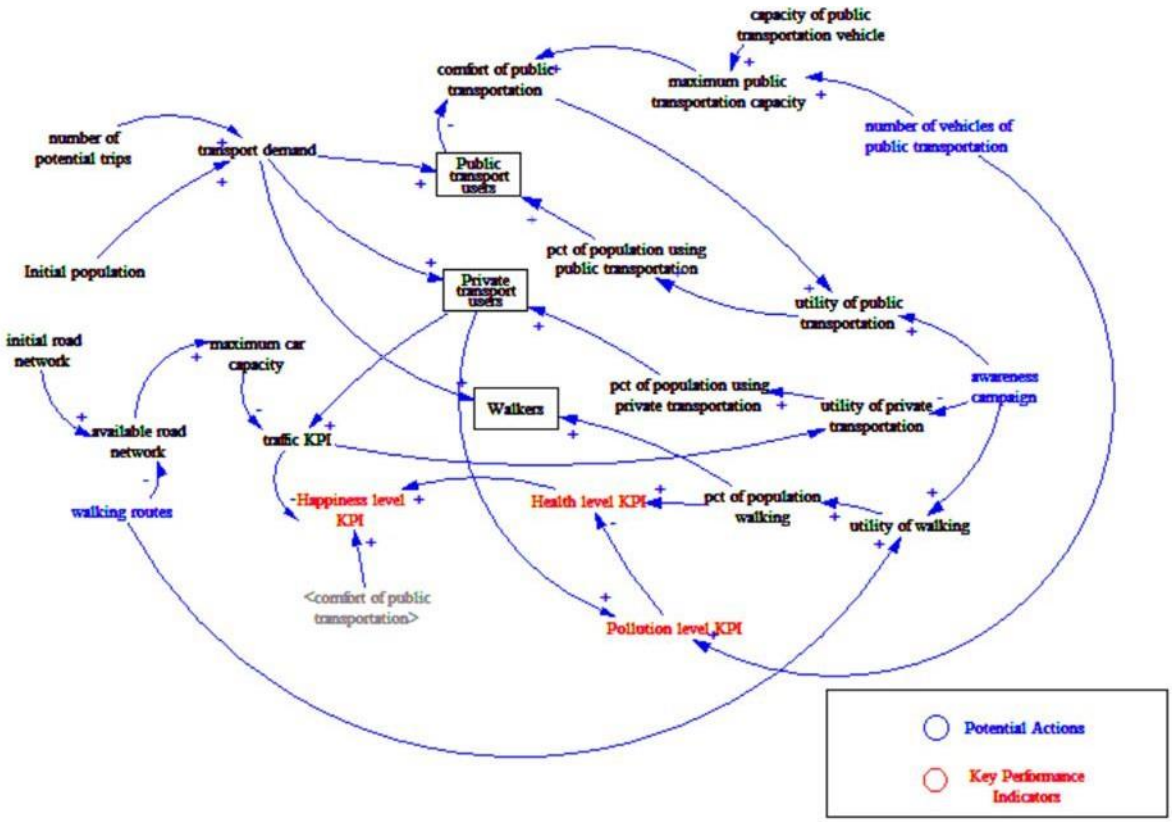

Figure 5 Causal Loop Diagram of the model of the game

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

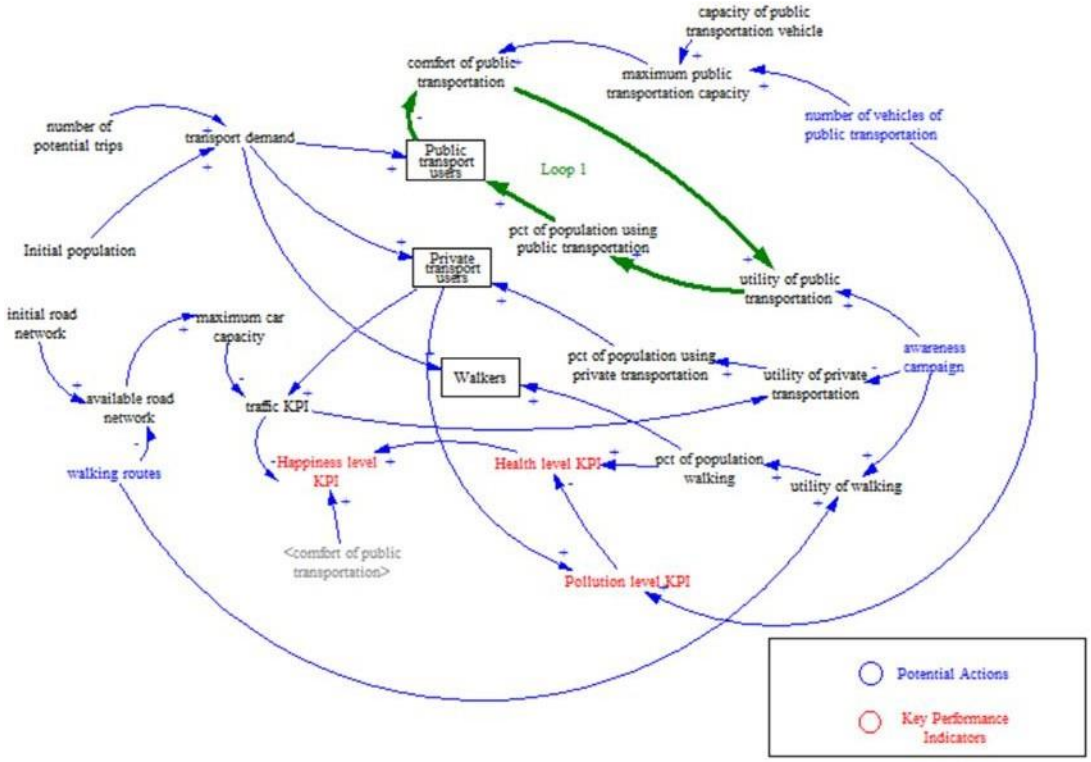

Figure 6 Loop 1 in the Causal Loop Diagram

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

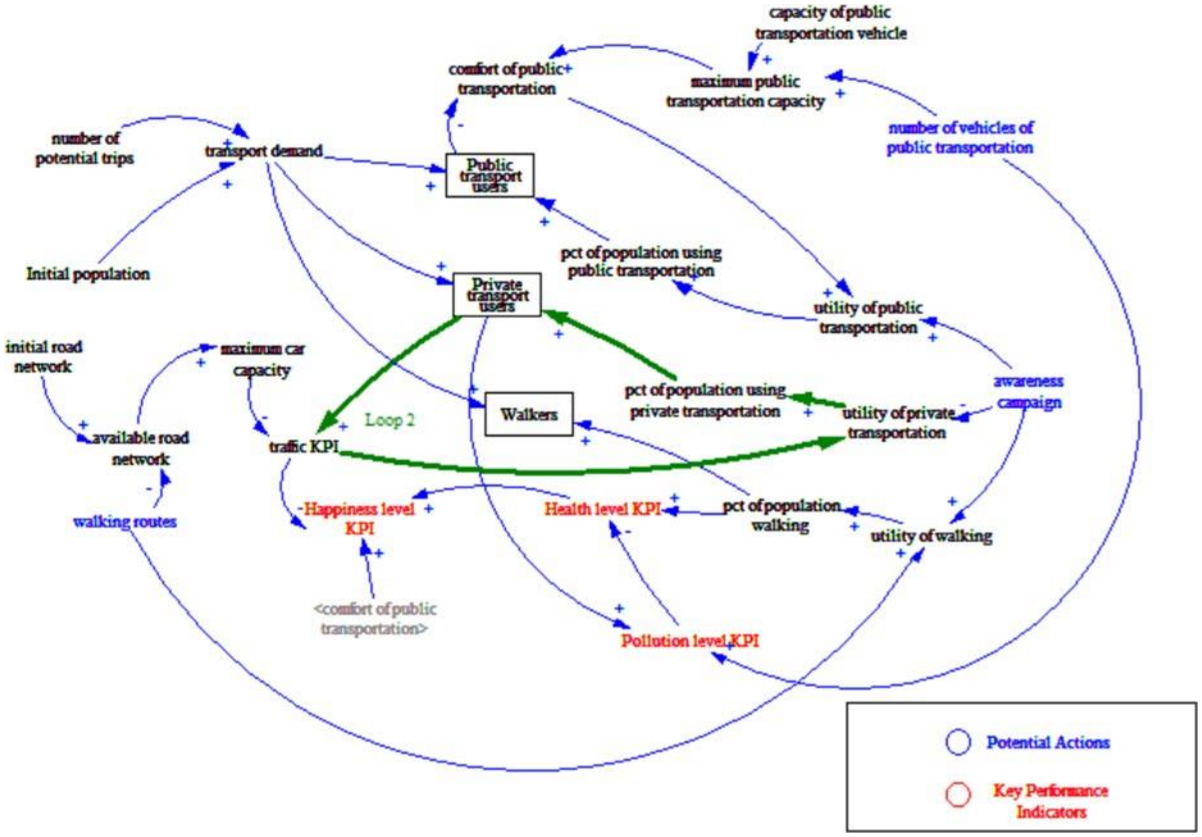

Figure 7 Loop 2 of the Causal Loop Diagram

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.

3 Functional specifications

3.1 User requirements

3.1.1 Introduction

The primary users of the MOTIVATE platform 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.

3.1.2 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.

3.1.3 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.

3.1.4 From the user requirements to the functional specifications

Most of the above user requirements 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 requirements. The following table maps the user requirements with the corresponding functions of the platform. The functions are described in the next section.

Table 2: 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

3.2 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.

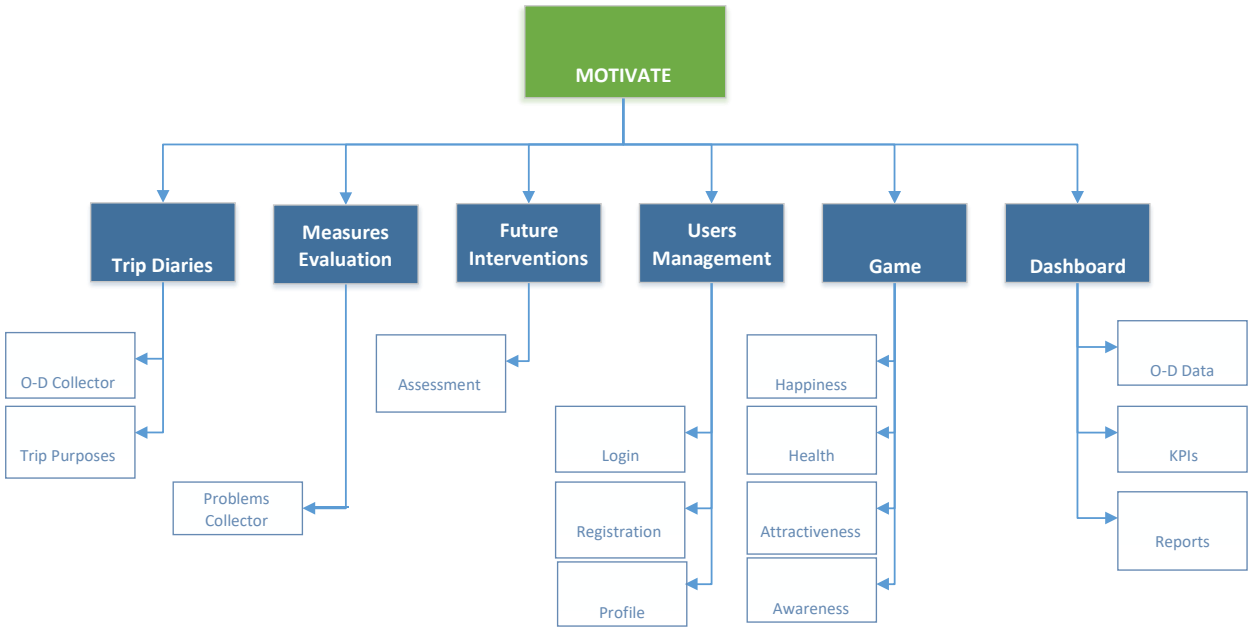

Figure 8 Functional decomposition of the Platform

3.2.1 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 3: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**

User Profile Info	Gender	User Profile Info	Gender		Trip Start Timestamp (Date & Time)
	Age Group		Age Group		Trip End Timestamp (Date & Time)
	Working Status		Working Status	GPS Data	Latitude
	Education Level		Education Level		Longitude
	Car Ownership		Car Ownership		Speed
	City		City		Altitude
	Origin/Destination Address		Origin/Destination Address		Accuracy
	Origin/Destination Postal Code		Origin/Destination Postal Code		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

3.2.2 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.

3.2.3 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.

3.2.4 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.

3.2.5 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.

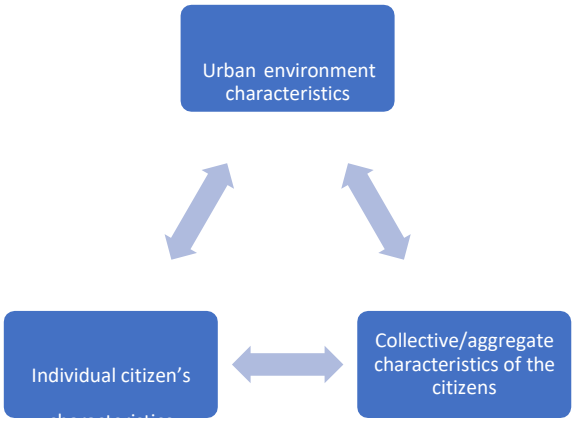

Figure 9 The core loop that explains the relationship between the citizens and the environment

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.

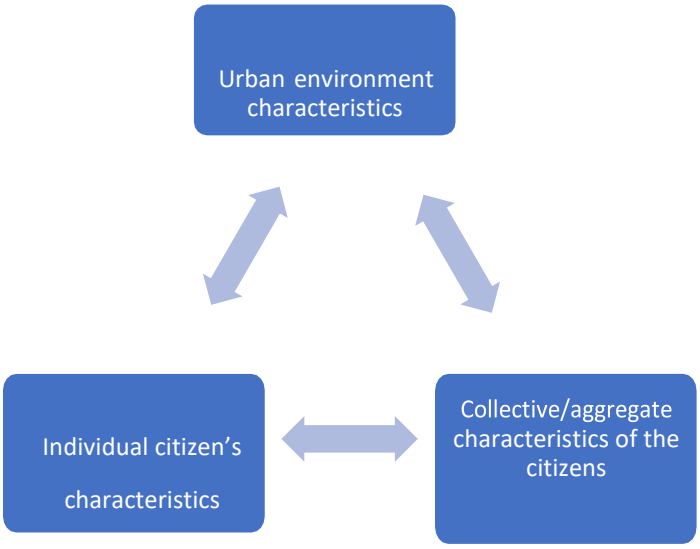

Figure 10 Key actions that can be performed by the player and where they are applied in the context of the game

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.

3.2.6 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.

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.

3.3 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

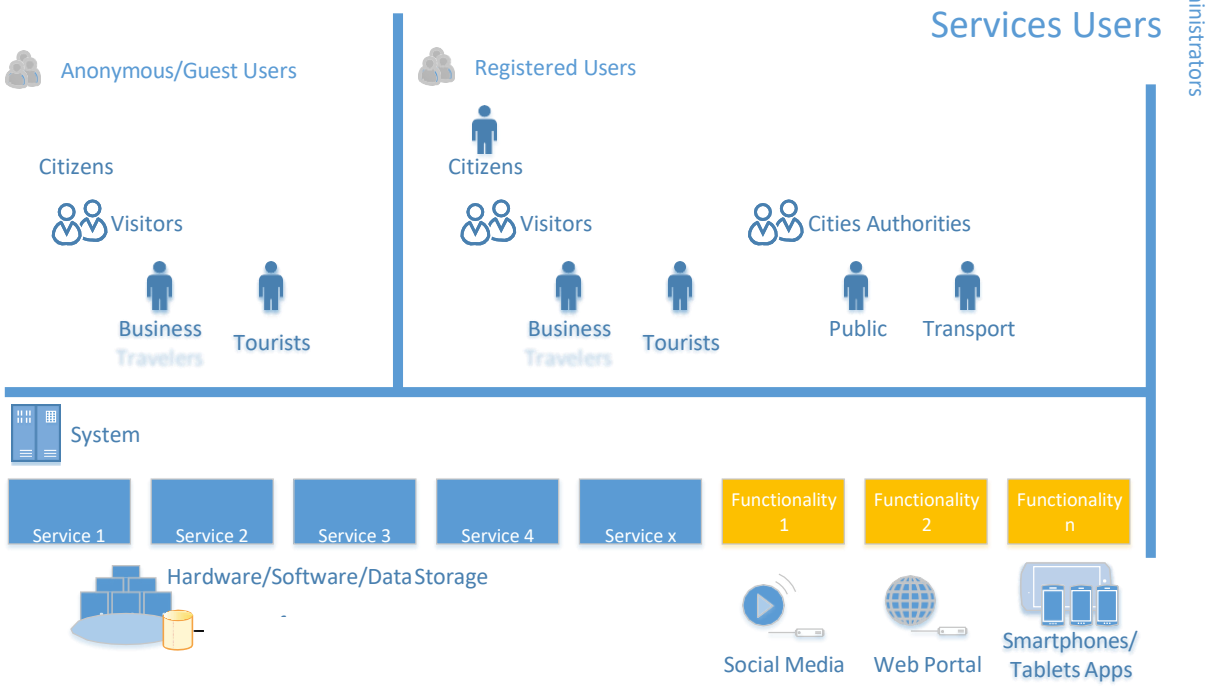

Figure 11 Users Overview

4 Communication architecture

4.1 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.

4.1.1 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 12 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 reached 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.

4.1.2 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:

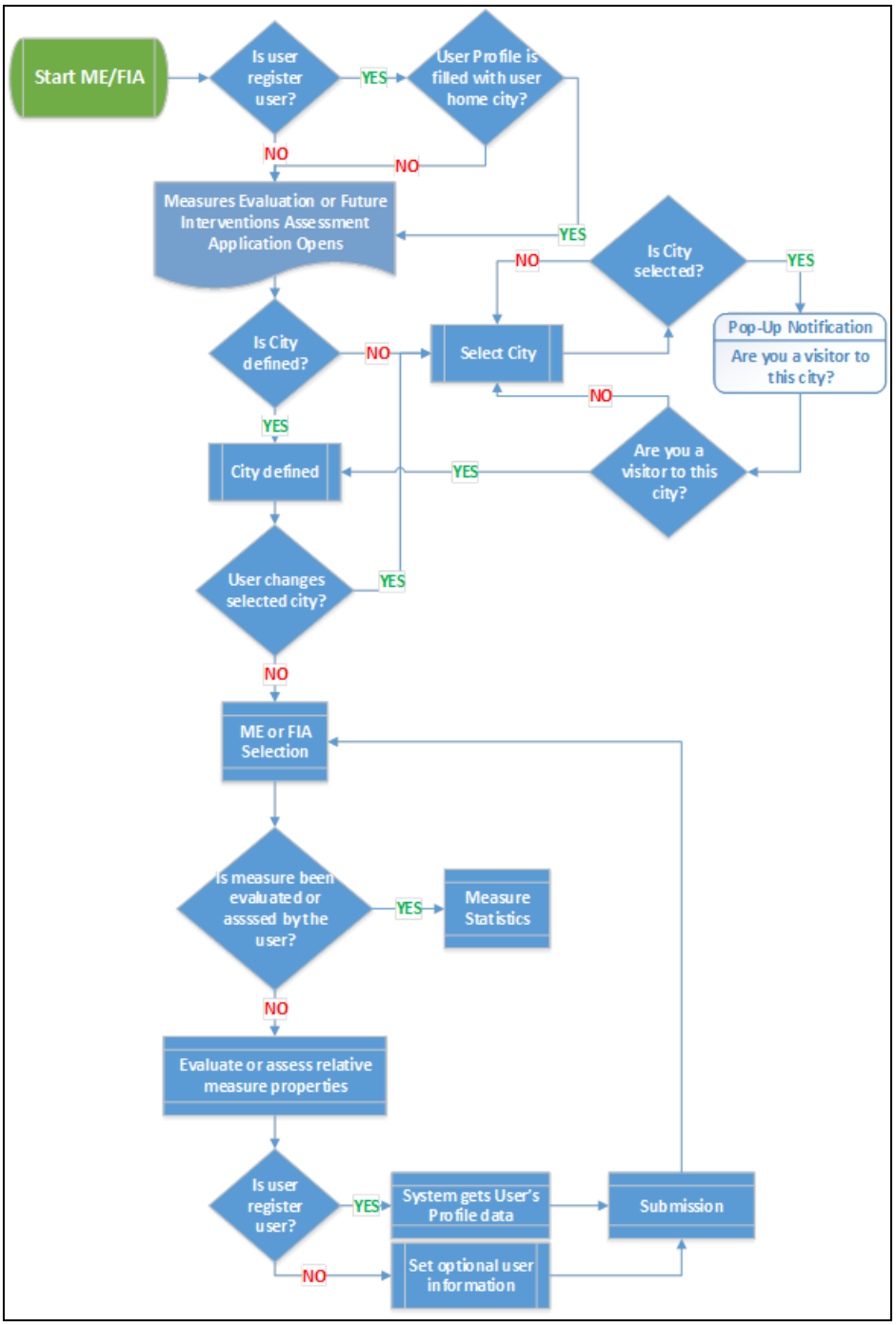

Figure 13 Measures' evaluation/assessment Service Data Flow

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.

4.2 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.

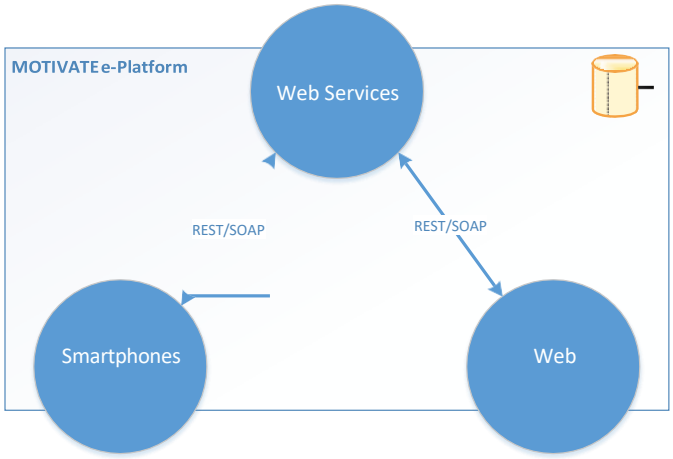

Figure 14 Platform Interfaces

4.2.1 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.

4.2.2 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 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.

4.2.2.1 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.

5 Data structure and Stream analysis

5.1 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

5.2 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.

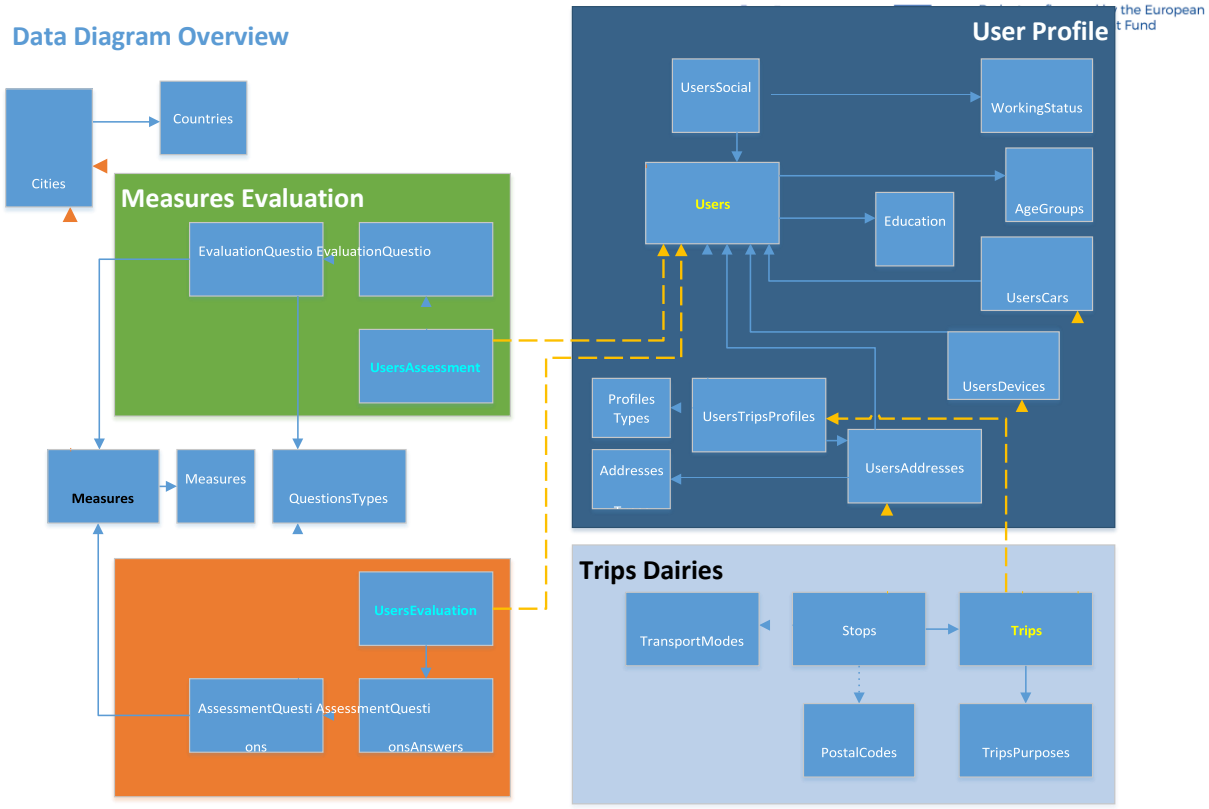

Figure 15 Data Overview

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.

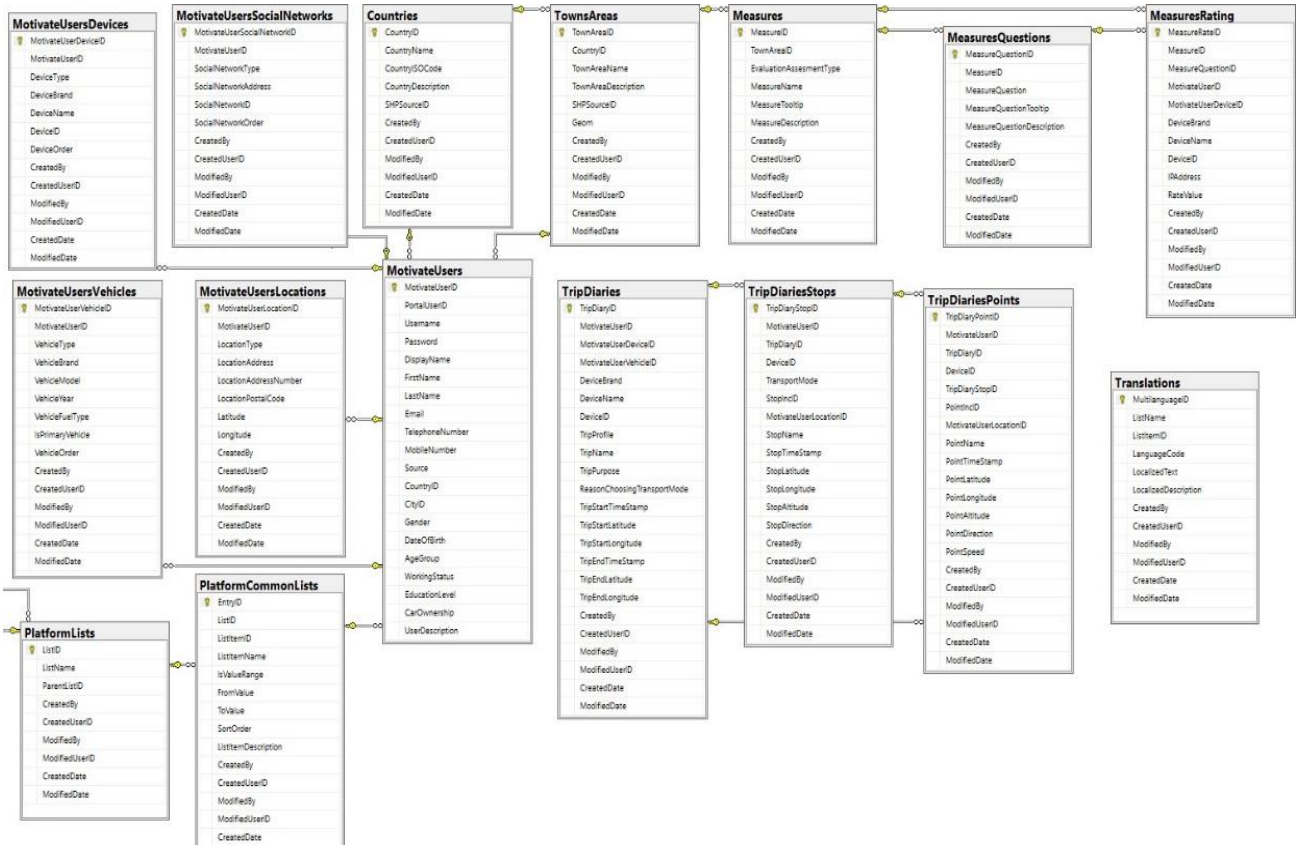

Figure 16 Overall E-R Diagram

Quality monitoring and evaluation of pilot data

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1 Evaluation framework

The conceptual approach used to set the MOTIVATE evaluation is here briefly summarized (*Table 1*) in order to give consistency and self- readiness to the document.

Table 1: The three-levels approach adopted for MOTIVATE evaluation

Level ID	Level of evaluation process
L1)	Validation of the compliance of MOTIVATE functionalities with the functional/technical requirements and performance levels required for an effective operation of the platform
L2)	Assessment of the base requirements and conditions for using the MOTIVATE platform by the residents and tourists and Administration
L3)	Evaluation of the contribution of the MOTIVATE platform to enhance the SUMP base actions (data collection, base line assessment, suitable ideas/solutions definition) and to assess potential impacts on the SUMP development process

The conceptual approach to MOTIVATE evaluation is also represented in *Figure 1:*

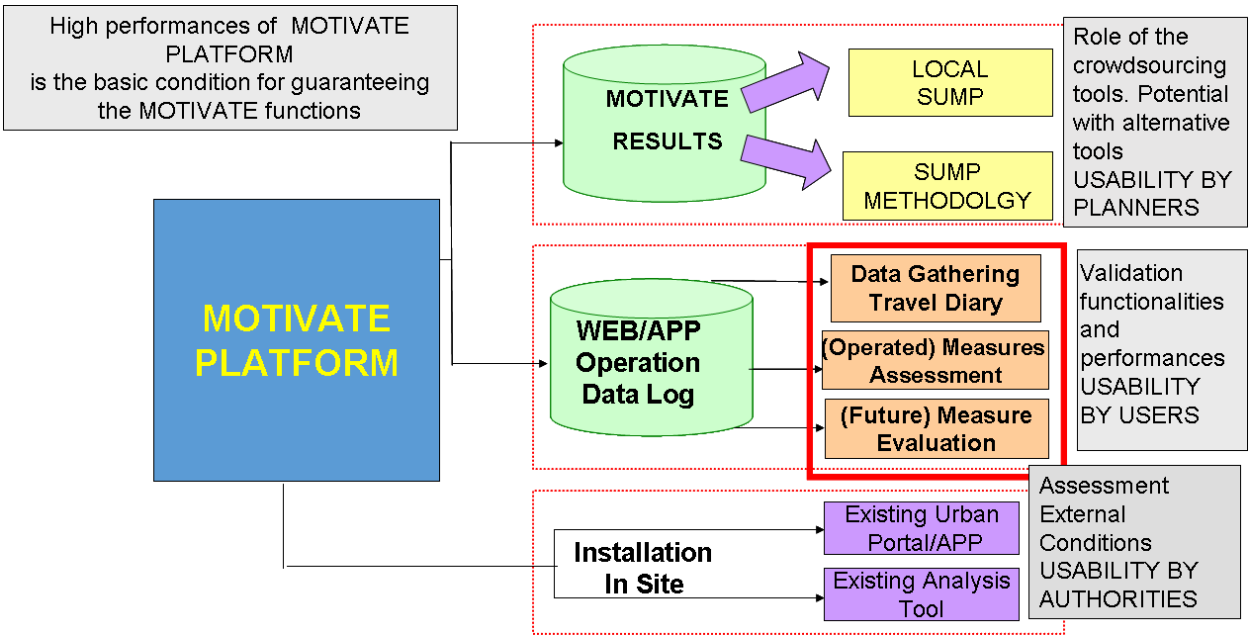

Figure 1: Conceptual approach to MOTIVATE evaluation

In a nutshell, the three levels of the evaluation conceptual approach can be described as follows:

- **L1) End users' point of view** – this level assesses the MOTIVATE platform in terms of technical performance (i.e. reliability) and end-user's usability
- **L2) City Authorities' point of view** - this level assesses the actions/efforts required by a new city to be aggregated in the platform, to launch and to operate it as a supportive tool in a crowdsourcing initiative
- **L3) City Planners' point of view** – this level assesses the role and the use of a crowdsourcing tool in providing data for SUMP development compared to the traditional data collection survey.

1.1 Crowdsourcing tools to which the evaluation approach is applied

The conceptual approach to the evaluation summarized in section 1 is applied through two different crowdsourcing tools developed within the MOTIVATE project:

- The MOTIVATE platform which has been adopted as "stand-alone" system by Almada andLarnaka as any former web application was already operated in these sites. The MOTIVATE platform was developed by CERTH/HIT and provides both mobile (Android/iOs APP) and desktop (web portal) interfaces.
- The integration of MOTIVATE platform functionalities into the user information system upgraded during the project in Rhodes and Ioannina
- The Tiemme Mobile APP (already operated by Tiemme, Public Transport Operator in Siena as commercial company APP) which has been upgraded with a replication of the MOTIVATE functionalities (trip diary submission and questionnaires' provision) adapted to the needs of a Public Transport Operator and targeted to the provision of data deriving from the Public Transport ecosystem which could be useful to the SUMP development process. In Siena the web portal interface for data collection was guaranteed by linking the MOTIVATE platform to the Tiemme company website. Data integration in a common repository (collecting data from all the pilot cities involved in the project) was realized implementing data exchange webservices (based on the cloud functionalities provided by the MOTIVATE platform). A Basically, the technological scenarios implemented in the project relate to three operational scenarios identified also for transferability
- Adoption of the MOTIVATE platform by a (new) city when any web application is already operated (Almada and Larnaka)
- Integration of MOTIVATE functionalities (through the cloud functions) into a web application already operated when these are added or built on available solutions (city web portal, mobility company's APP, application for providing info to citizens or visitors such as tourism info services) (Rhodes and Ioannina)
- Replication of MOTIVATE functionalities into a web application already operated (Siena)

1.2 Progress status of SUMP development in the MOTIVATE cities

The progress status of of SUMP development in the MOTIVATE cities is summarized in *Table 2* below.

Table 2: Summary of SUMP progress state

CITY	SUMP status at the beginning of the MOTIVATE project	SUMP evolution during the MOTIVATE project
Almada	First SUMP already approved Almada's second generation SUMP (named Strategic Plan for Urban Mobility - PUMA) under development	SUMP defined and is currently under approval

CITY	SUMP status at the beginning of the MOTIVATE project	SUMP evolution during the MOTIVATE project
Siena	Urban Traffic Plan and environment plan PAC (Municipal Action Plan) already developed Preliminary report on SUMP guidelines and principles in November 2015 City Council decision to develop a SUMP approved in February 2016 Tender for contracting the elaboration of SUMP published in February 2017	First release of SUMP by the awarding contractor to the Municipality in December 2017. Consultation activities and SUMP refinement by December 2018 Approval of SUMP by City Council in February 2019
Rhodes	SUMP not available	Preparatory activities took place
Larnaka	SUMP not available	SUMP definition during the project
Ioannina	SUMP available	Approval of SUMP by the City Council in June 2019

Based on the summary provided in *Table 2*, three different situations are identified among MOTIVATE pilot cities:

- First level: cities without a SUMP which entered in the SUMP elaboration during the project (Rhodes)
- Second level: cities without a SUMP which have defined the SUMP during the project (Siena, and Larnaka)
- Third level: cities with a SUMP already adopted which has been enhanced/updated during the project or cities which finalized the SUMP within the project's duration (Almada and Ioannina respectively).

The above-indicated conditions are well representative of all the cities scenarios where crowdsourcing tools for data collection (such as those demonstrated during the MOTIVATE project) can be introduced.

1.3 Role and objectives of the deliverable

This Deliverable reports the results of the evaluation activities implementing the L3 approach. Then the validation described in this Deliverable aims at assessing the potential, relevance and usefulness of the adoption of crowdsourcing tools (such as those demonstrated in MOTIVATE project) for data collection supporting the SUMP development/enhancement/update and thus at assessing the impacts produced by the pilot activities (and innovative data collection tools) regarding the sustainable urban mobility planning process.

1.4 Structure of the document

The structure of the report is presented below:

- Section 2 provides an outlook to L3 evaluation methodology summarizing the targets, indicators and procedures adopted for measuring them
- Section 3 describes the actions carried out for the implementation of the L3 evaluation methodology

- Section 4 introduces the SUMP process, the steps followed for its elaboration and the relevant data need to be collected
- Section 5 details the data typology which are strictly related to the SUMP elaboration steps where the crowdsourcing tools demonstrated in MOTIVATE can be applied. The quantity of the data required to carry out these steps is also detailed in order to identify the role of the crowdsourcing tools demonstrated in the MOTIVATE project for the data collection.
- Section 6 provides some relevant conclusions, based on the findings reported in section 5.

1.5 Target audience

Table 3 identifies the target groups of this Deliverable.

Table 3: Target audience of this Deliverable

Target group	Relevance
Mobility/PT stakeholder and Public Authorities of MOTIVATE pilot cities	Assessment of the potential/relevance/usability of innovative crowdsourcing tools as resulting from the evaluation of pilot results in order to decide on long-term the maintenance of tools operation and future scale up in case of SUMP development/enhancement/update
Mobility/PT stakeholder and Public Authorities of Other interested cities	Understanding the potential/relevance/usability of innovative crowdsourcing tools in order to transfer these tools in their operational practice and technological background
	Guidelines to tune the role of these tools in the data collection process for SUMP development/enhancement/update

2 Outlook to the evaluation methodology (L3)

Based on the overview of the MOTIVATE evaluation approach provided in section 1, this section resumes the methodology defined for L3 approach, which is the core element of this Deliverable.

The methodological approach adopted for the L3 evaluation in MOTIVATE is described in this section in terms of objectives, means of verification, data sources and evaluation indicators.

2.1 Objectives and means of verification

The objective of this level of the evaluation is to assess the potential, role and impacts of adoption of the crowdsourcing tools (as the MOTIVATE platform) in providing data supporting the SUMP development/enhancement/update.

In particular, two evaluation analysis are considered:

- Quantitative analysis:
    - (Data typology): Identification of the typologies of data collected by the crowdsourcing tools demonstrated in the MOTIVATE project compared to the whole set of data required for SUMP development/enhancement/update and evaluation of the potential/role of the crowdsourcing tools in terms of data typology covered/assured
    - (Data quantity): Identification of the number (quantity) of data to be collected in a medium-small city for SUMP development/enhancement/update regarding the typologies covered/assured by the crowdsourcing tools demonstrated in the MOTIVATE project in comparison with the number (quantity) required. Evaluation of the potential/role of the

crowdsourcing tools in terms of number (quantity) of data collected through crowdsourcing campaign (as demonstrated in MOTIVATE) for each of the data typology covered/assured

- Qualitative analysis:
    - Evaluation of the potential/role/impacts of crowdsourcing tools demonstrated in the MOTIVATE project from the point of view of SUMP expertise (consultancy companies, mobility experts, etc.). This evaluation is carried out based on criteria which go beyond the strict quantitative approach: for example, potential for future scalability (in terms of typologies of data collected, functionalities provided, etc.) and correspondence with evolving trend and needs of Public Authorities, etc.
    - Evaluation of the success and failure stories playing a role in MOTIVATE sites, for example:
        - Strategies for engagement of the stakeholders and creation of local consensus
        - Strategies and implementation of the promotion, identification of target groups, etc.

2.2 Data collection procedures

The info and data used for the L3 evaluation derive from the following sources:

- Quantitative estimation of the data typologies required for SUMP development/enhancement/update and their quantity:
    - Contribution from MOTIVATE cities well experienced in SUMP (Almada) updating it during the project
    - Contribution from MOTIVATE cities which are developing the SUMP during the MOTIVATE project, Larnaka andSiena) or have just developed it (Ioannina)
    - Professional knowledge of MOTIVATE partners which provide consultancy or supporting activities for SUMP development (MemEx, CERTH/HIT)
    - Expert opinion of organizations/companies working on SUMP development which are in network contacts of MOTIVATE consortium (TRT, ISINNOVA, LuxMobility)
    - Results of literature review (specifications of SUMP tenders, past projects, etc.)
- Quantitative assessment of the data collected by the MOTIVATE crowdsourcing tools during their demo operation in the project:
    - MOTIVATE platform repository
- Qualitative assessment of the potential/role/impacts of the crowdsourcing tools demonstrated during the MOTIVATE project:
    - Contribution from all the MOTIVATE cities as outcome of their participation to the project and operation of crowdsourcing tools for demonstration
    - Professional knowledge of MOTIVATE partners which provide consultancy or supporting activities for SUMP development (MemEx, CERTH/HIT)
    - Expert opinion of organizations/companies working on SUMP development which are in network contacts of MOTIVATE consortium (TRT, ISINNOVA, LuxMobility)

- Evaluation of the impacts of other innovative tools for data collection supporting SUMP developed and based on a crowdsourcing approach (carried out by MemEx, CERTH/HIT and AEGEA)

2.3 Evaluation indicators

In the following the evaluation indicators are detailed.

Quantitative analysis:

- $Q_T = \frac{TD_R}{TD_C}$

TD_R = Number of trip diaries required for SUMP (to be collected through traditional/alternative tools from the MOTIVATE platform) – estimation for medium sized cities

TD_C = Number of the trip diaries collected by the MOTIVATE platform

- $Q_Q = \frac{UQ_R}{UQ_C}$

UQ_R = Number of questionnaires required to evaluate/assess a mobility measure for SUMP (to be collected through traditional/alternative tools from the MOTIVATE platform) – estimation for medium sized cities

UQ_C = Number of questionnaires (aiming to evaluate/assess a mobility measure for SUMP) collected by the MOTIVATE platform

A qualitative approach is used for the other evaluations taking place in L3 Level: the evaluation is based on the outcomes of all the MOTIVATE demonstration pilot cities, real experience coming from Almada, Rhodes, Ioannina and Larnaka in SUMP development and expert assessment.

3 Actions carried out for the L3 evaluation

This section details the actions carried out to finalize the L3 evaluation approach summarized in section 2.

Table 4 lists the actions carried out during the MOTIVATE project for the L3 evaluation methodology finalization.

Table 4: Actions carried out for the L3 evaluation approach

ACTION	RESPONSIBILITIES	TIMING
Identification of innovative tools for data collection similar to MOTIVATE	CERTH, AEGEA, MemEx	February – March 2019
Contribution on typology and estimated number of trip diaries/questionnaires required	From pilot cities to MemEx From experts to MemEx	March 2019
Identification of data typology and estimated quantity of data required for SUMP	MemEx supported by CERTH	April 2019
Monitoring of the number of trip diaries/questionnaires collected	CERTH, MemEx	January – July 2019
Collection of expert opinions on qualitative evaluation of data collected by the MOTIVATE platform	From pilot cities to MemEx From experts to MemEx	May 2019
First draft of D3.9.4	MemEx	July 2018

4 Insight to SUMP and supporting data collection

Before assessing the potential, role and impacts of the innovative crowdsourcing tools such as those demonstrated in the MOTIVATE project, it is useful to give an insight to the SUMP concept, its objectives, implementation phases and required activities in order to introduce the results of the evaluation of crowdsourcing tools demonstrated within the MOTIVATE project (as detailed in section 5). The contents of this section partially come from the EC guidelines for SUMP development (available at Eltis website: https://ec.europa.eu/transport/themes/urban/urban_mobility/urban_mobility_actions/sump_en) and partially from the know-how of the MOTIVATE consortium.

4.1 SUMP definition and scope

A SUMP (Sustainable Urban Mobility Plan) is a strategic plan designed to satisfy the mobility needs of people and businesses in cities and their surroundings for a better quality of life.

The policies and measures defined in a Sustainable Urban Mobility Plan cover all modes and forms of transport in the entire urban agglomeration, including public and private, passenger and freight, motorized and non-motorized, moving and parking.

4.2 SUMP lifecyle

The SUMP is the result of a structured process that comprises status analysis, vision building, objective and target setting, policy and measure selection, active communication, monitoring and evaluation and the identification of lessons learnt.

The guidelines describe the process of how to prepare a SUMP. This process consists of 11 main steps made up of 32 activities. They should be taken as part of a regular planning cycle in the sense of a continuous improvement process (as detailed in *Figure 2*).

Each step and the associated activities are presented into details in the EC guidance document.

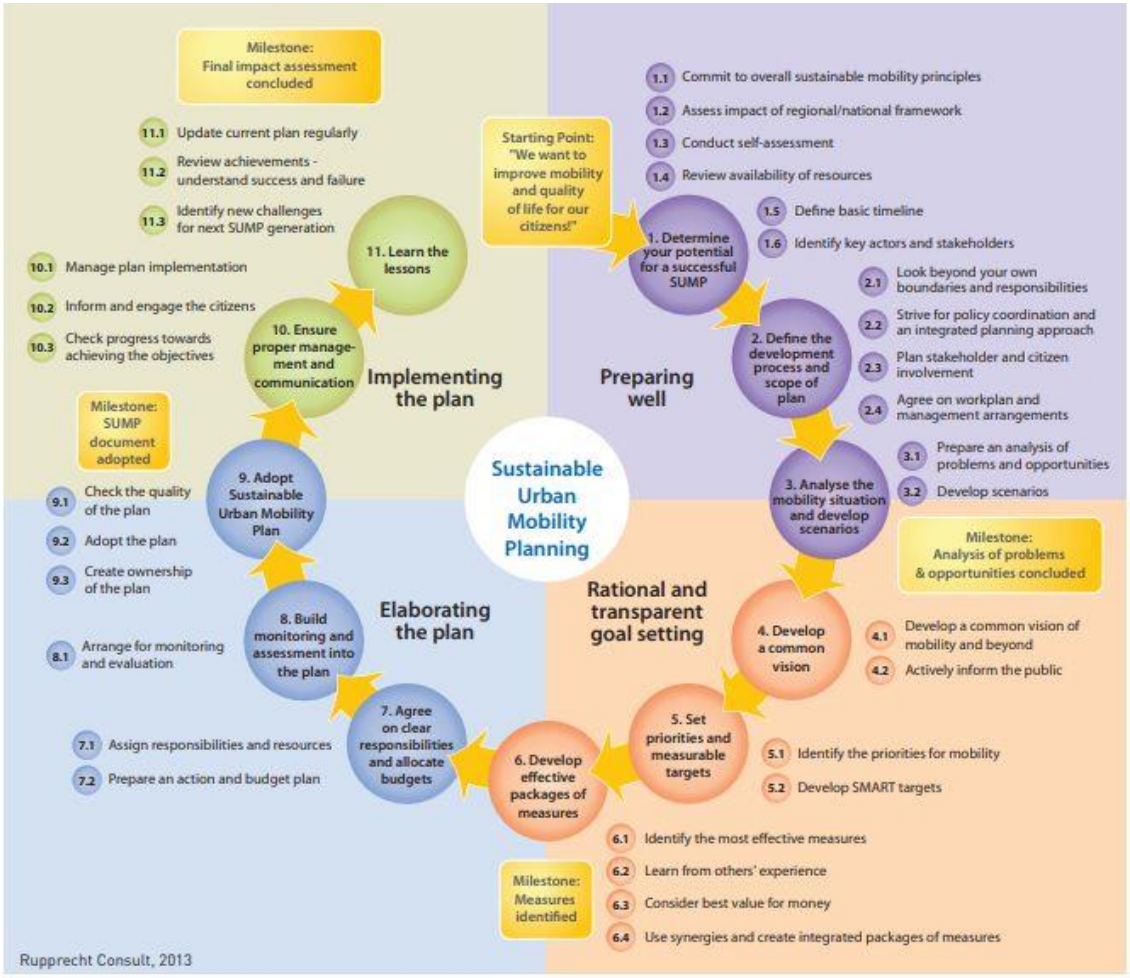

Figure 2: SUMP lifecycle

The SUMP lifecycle consists of 4 main steps:

- *Preparation of the plan*
- *Setting of the plan objectives*
- *Elaboration of the plan*
- *Implementation, monitoring and review of the plan.*

The crowdsourcing tools demonstrated in the MOTIVATE project are related to the following steps of the SUMP elaboration:

- *Preparation of the plan (Step 3)*
- *Development of mobility measures (Step 6)*
- *Build monitoring and assessment indicators and procedures (Step 8).*

In the following section 4.3 the actions (which are included in these steps and are specifically addressed by the crowdsourcing tools demonstrated in MOTIVATE) are detailed.

4.3 Role of the crowdsourcing tools into the SUMP lifecycle

Going into details, each step of the SUMP lifecycle, indicated in section 4.2, includes a set of actions: some of them are specifically addressed by the crowdsourcing tool demonstrated in the MOTIVATE project, highlighted in bold within the text):

- Preparation of the plan:
  - Definition of the reference area that means the geographical area into the impacts of the mobility interventions are supposed to be restricted
  - Analysis of the territorial context
  - Analysis of the demographic and social trends and forecasts
  - Analysis of the economic data
  - Analysis of the current **mobility conditions (demand, offer, trends and gaps)**
- Development of mobility measures:
  - Definition of service scenario
  - Definition of the mobility interventions
  - Prioritization of the mobility interventions
- Build monitoring and assessment indicators and procedures:
  - Definition of the performance indicators and target values
  - Definition of monitoring procedures
  - Ex-ante (before the intervention) analysis
  - Ex-post analysis (after the intervention) analysis

In particular, the primary role of crowdsourcing tools demonstrated in the MOTIVATE project is to be applied for defining the mobility demand, trends and needs.

In section 4.4, the analysis of the mobility demand is then specified detailing the data typology required[1].

4.4 Specifications of data typology for the analysis of mobility demand

Table 5 specifies the data typology required for the analysis of the mobility demand.

Table 5: Data typology for the analysis of the mobility demand

Transport Mode	Data typology involved in the definition of the mobility demand
Private Traffic	• Traffic flows (estimation) on roads and intersections (per transport mode) • O/D matrix estimation on main intersections and cross-sections of the area and selected internal routes

[1] In the following we assume the development of a SUMP as the general case to be considered for the MOTIVATE evaluation as this situation includes (from the perspective of data to be collected) the updating/enhancement of a former version of the plan already defined in the past.

	• Parking lots occupancy and identification of the average time of parking occupancy • Level of satisfaction/expectations of the users • Mobility gaps and critical points
Public Transport	• (estimated) Number of on-board passengers (per transport mode) • Drop-on/off passengers at bus stops • O/D matrix estimation on selected-lines • Level of satisfaction/expectations of the users • Public Transport gaps and critical points

4.5 Data collection procedures: focusing on O/D matrix estimation

The data specified in the previous section 4.4 can be collected through the following procedures:

- Data available from former surveys and data collection campaign (including Census data)
- Automatic vehicles counting (or occupancy detection)
- On-field data collection surveys
    - Random interviews on main entry/exit points to the selected area and internal screen lines
    - Random on-board interviews
    - Interviews at bus stops and terminals
    - Random phone interviews

In general, the previous data collection procedures are usually combined to carry out the analysis of the current mobility demand in the preparatory phase of SUMP development.

From a methodological point of view, the estimation of O/D matrix is the key (and most demanding too) data collection survey among those required to analyse the mobility demand. O/D matrix enables to map the points where trips start and end, to associate the start/end time and the transport mode, to understand how many times the trip is carried out, how the trip affects the parking demand, etc.

The data collection for the estimation of the O/D matrix is carried out by on-field and remote (phone) interviews carried out at selected points of private and Public Transport network.

Theoretically the Census data can be used to estimate the O/D matrix. Its use could avoid to carry out the interviews campaign as we know where the people live, work and how may times during the week they travel for work/education and which time. Nevertheless, in the real practice, the Census data are affected by relevant weakness/constraints which prevent them to be used as “stand-alone” base of data for O/D estimation. Census data are collected every (about) 10 years then they are not updated when they are needed for the purpose of mobility demand analysis. Moreover, the Census data mostly refers to systematic trips (commuters for work and education) and does not reflect the impacts of the irregular demand.

For these reasons the Census data needs at least to be integrated with a number of on-field survey (interviews). In general, the interviews carried out for the estimation of O/D matrix are integrated with

general questions about the status of the traffic and public transport, their main critical points, the level of satisfaction of the users related to the initiatives/measures already implemented and the level of acceptance of new mobility initiatives and measures.

The result of the on-field interviews is integrated with the data collected automatically through vehicles counting and/or PT passengers counting.

Focusing on the data collected for the estimation of O/D matrix, the following info are gathered by the on-field interviews (an example related to road interview is provided in the following):

- Date
- Number of people travelling on the vehicle
- Start point of the trip
- Destination of the trip
- Travelling time (start/end time)
- Time of return trip (only for commuters)
- How many times the same trip is carried out on that way (purpose of the trip)
- Place of parking (on-road, off-road, private premises, etc.) and time.

The on-field interviews are carried out during the peak hours of a weekday (from Monday to Friday) and during the weekend (Saturday and Sunday). In cases where a day of the week is associated with a specific event (i.e. fair, sport event, etc.) which will affect the mobility inside the reference area, on-field interviews are carried out specifically for that day.

4.6 From SUMP to the feasibility of new mobility scenarios

The data coming from the analysis of the mobility demand are used for the definition of the transport model of the reference area.

The definition of the transport model is based on the following activities:

- Network building including the classification of the roads (arterial, major, local, secondary roads), main attributes (i.e. one-way, two-way, etc.) of supporting elements
- Identification of the intersections (i.e. nodes, junctions, etc.) and definition of their attributes (i.e. allowed turns, etc.)
- Definition of the traffic zones inside the reference area: each zone represents a homogeneous portion of the reference area in terms of geographical, demographic and socio-economic attributes. The objective of each zone is to represent in a single point all the trips carried out inside the zone itself
- Classification of PT offer
- Classification of the mobility offer
- Classification of the parking offer

Once the road graph is defined and the zones are established, the model is fed with the data coming from the analysis of the mobility demand (O/D matrix building).

Once calibrated, the model is used for a first evaluation of the impacts of the new mobility scenarios.

5 Evaluation of the potential of crowdsourcing tools to support data collection for SUMP

As indicated in section 2.1, the evaluation of the potential of crowdsourcing tools for SUMP data collection can be faced from different perspectives:

- Data typology required for SUMP which can be collected through crowdsourcing tools
- Data quantity assured by crowdsourcing tools compared to what is required for the estimation of mobility demand
- Identification of the supporting action required to implement crowdsourcing tools for SUMP data collection

5.1 Typology of data collected

The typology of data required for the definition of the mobility demand in SUMP baseline are specified in section 4.4.

The crowdsourcing tools developed in the MOTIVATE project (MOTIVATE platform + Tiemme Mobile APP enhanced with MOTIVATE functionalities) support the collection of data typology detailed in *Table 6*.

Table 6: Data typology collected by MOTIVATE crowdsourcing tools

Data typology involved in the definition of the mobility demand	**Data typology collected by MOTIVATE crowdsourcing tool**
Private traffic	
Traffic flows (estimation) on roads and intersections	NO
O/D matrix estimation on main intersections and cross-sections of the area and selected internal routes	YES
Parking lots occupancy and identification of the average time of parking occupancy	NO
Level of satisfaction/expectations of the users	YES
Mobility gaps and critical points	YES
Public Transport	
(estimated) Number of on-board passengers	NO
Drop-on/off passengers at bus stops	NO
O/D matrix estimation on selected-lines	YES
Level of satisfaction/expectations of the users	YES

Public Transport gaps and critical points	YES

As concluded by the Table above, the crowdsourcing tools developed in the MOTIVATE project can collect **some of the data typology** required for the analysis of mobility demand in SUMP **but not all**.

5.2 Quantity of data collected

This analysis focuses on the data typology collected by the MOTIVATE crowdsourcing tools (detailed in *Table 6*).

Table 7 specifies the quantity of data required for the estimation of O/D matrix for SUMP elaboration when this analysis takes place through traditional data collection procedures (see section 4.5).

Table 7: Quantity of data required to estimate mobility demand (traditional data collection procedures)

Data typology involved in the definition of the mobility demand	Data quantity required to estimate mobility demand
O/D matrix estimation	Depending on the traffic flow level (the sample needs to be statistically relevant then the data collection is carried out with the approach "more as better"), on the expected response distribution, on the range of acceptable error and on the confidence interval value. The sample of data required for O/D matrix estimation is an average of 10% (at least) of the actual trips number. For a medium sized city with an average of 20.000 trips per day, this means an estimation of about 2.000 data. Usually this data comes from the traffic flow counting (carried out in a number of locations designing a surrounding cordon in the city at peak time hours – i.e. from 7:00 to 9:00 divided into various time windows – repeated for defined day typology (weekday, Sunday, day with particular event such as market, etc.) integrated with on-site/phone surveys. The surveys are needed to assign the flows to O/D relations. The number of surveys carried out is very low compared to the flow counting. The estimation provided relates to the flow counting which is the main one from the quantitative point of view.
Level of satisfaction/expectations of the users	More difficult to be estimated from a quantitative point of view. This analysis is carried out with the approach "as more as better". We are talking about several hundred of interviews
Mobility gaps and critical points	Usually this analysis does not require high number of data. Within traditional data collection procedures, this analysis is carried out through stakeholder's focus group and expert (consultancy contracted to define the SUMP) opinion.

The data collected through MOTIVATE crowdsourcing tools are indicated in *Table 8*. This data refers to the period from the launch of demonstration activities in the 5 pilot cities (beginning 2018) up to date.

Table 8: Quantity of data collected by MOTIVATE crowdsourcing tools

	Almada	Larnaka	Ioannina	Rhodes	Siena
Total number of trip diaries collected during the demo	58	131	47	1494	4305
Evaluation questionnaires collected during the demo	120	54	45	73	492

Table 9 summarizes the assessment of data collected by MOTIVATE in the pilot cities compared to the quantity required for the demand estimation for SUMP definition. The assessment is carried out on an average daily basis.

Table 9: Quantitative assessment of the data collected by MOTIVATE compared to what is required for demand analysis

Data quantity required for demand analysis	**Data collected by MOTIVATE**	
	MIN	**MAX**
O/D matrix estimation	1 every 10 days	10 every day
Evaluation questionnaires	1 every 10 days	1 every day

On the basis of Table 9, the following considerations can be highlighted:

- The number of data collected by the MOTIVATE crowdsourcing tools (normalized to a daily average) is, in general, very low compared to the data required to estimate O/D matrix; then they are not enough by their own to do that estimation
- In the case the number is higher (Siena case[2]), it must be considered that:
    - The daily average is not well representative of the actual number of data available as the data collected per day is extremely variable during the demonstration period. This does not comply with the requirement to assure the minimum data quantity for each day typology (weekday, Sunday, etc.)
    - The (average) daily data are spread out over different O/D relations. In MOTIVATE these relations are geographically considered from any map "point" to any "point" and not between network's "main" cordon points as it would had been for the demand estimation. As the "main" cordon points are a few number (in general less than one hundred in a medium sized city) this means that the information provided by MOTIVATE are extremely less concentrate than what is required
- For the evaluation of the questionnaires, the situation is similar
- Focusing again on the evaluation questionnaires, due to the actual number of data collected by the MOTIVATE crowdsourcing tools, the information available for each mobility service is quite poor. For example, various pilot cities (Almada, Rhodes, Larnaka) use the MOTIVATE platform to evaluate the quality of Public Transport services: the evaluation collected refers to a number of Public Transport

[2] In Siena trips are related only to bus transport mode

lines then the data available for each line is a few one. Vice versa traditional data collection procedures are more suitable to be targeted to a specific service (for example: one bus line, etc.) and can produce high number of data in a reduced time period (i.e. interviews with passengers/customers on-board or at the bus stop/on the road).

- Even in the case of the questionnaires, the daily number collected is extremely variable. The daily number is quite low at the beginning and then slightly increase so a period of time must be allocated to achieve the final targets. Traditional data collection procedures can be restricted in a shorter time period

5.3 Potential role of crowdsourcing tools in data collection for SUMP

Taking into account the results of the qualitative and quantitative assessment (data typology and data quantity achieved in MOTIVATE), the demonstration of innovative crowdsourcing tools which took place within the MOTIVATE project leads to the following conclusions about their role compared to traditional procedures:

- Crowdsourcing tools such as those experienced within MOTIVATE can be hardly used on their own for the estimation of O/D matrix (quantitative analysis), therefore they can't replace the traditional data collection for this purpose. On the other hand, they can be adopted to identify the main origin-destination relations at a preliminary stage of mobility demand analysis and definition of mobility interventions. Crowdsourcing tools seem not able to generate high amount of data to reach statistical relevance but enough for a preliminary analysis. They are "low cost" not demanding system suitable to be adopted in the preliminary analysis

- Crowdsourcing tools can be more effectively adopted for the ex-ante (or ex-post) evaluation of mobility measures already operated, the assessment of the level of satisfaction of new proposed ones and for the identification of gasps, uncovered needs and critical points of the current mobility services. In this case they can replace the traditional data collection procedures at a large scale: traditional data collection procedures (such as focus groups with stakeholder or selected users' categories, interviews, etc.) can be used to make a preliminary assessment contributing to identify the main topics and select those really interesting for the citizens. Once a first group of topics has been selected, a wider public consultation can be managed with the support of crowdsourcing tools.

In both cases, the crowdsourcing tools and the traditional data collection procedures need to be combined. Table 10 summarizes the role of crowdsourcing and traditional data collection tools for the elaboration of the SUMP.

Table 10: The role of crowdsourcing and traditional data collection tools for the elaboration of the SUMP

Data typology required for mobility demand analysis targeted by MOTIVATE	Role of innovative crowdsourcing tools	Role of traditional data collection procedures
O/D matrix	To be used in the preliminary phase for the identification of main origin-destination relations at low costs	Estimation of the matrix with statistical relevance. To be used for the setup (configuration + calibration) of the model
Evaluation questionnaires	Large-scale validation of preliminary analysis through a public consultation	To be used in the preliminary phase for the identification of services/topics to be evaluated.

		Definition of the short-list of topics to be evaluated.

5.4 Supporting actions for the adoption of the crowdsourcing tools for data collection

Section 5.3 identifies the potential of crowdsourcing tools for the data collection for SUMP definition and specifies the role these tools can play in relation with the traditional data collection procedures.

Once defined how these tools can be usedin the SUMP development process, some indications on how to implement them are provided below

These lessons learnt derive from the experience gained throughthe demonstration of MOTIVATE crowdsourcing tools in the 5 participating cities:

- In order to reach a higher number of users (and collect a larger amount of data) the crowdsourcing tool must not be operated as a “stand alone” tool: with this kind of approach, it would become very hard to engage users. On the contrary, the crowdsourcing functionalities must be developed on the top of already running applications. The users should provide their data without be explicitly asked to do that but rather when they use some info service (Siena case)
- Promotional campaigns are key actions for the success of the initiative. For this purpose, it is mandatory to engage as many stakeholders as it is possible in order to produce a “multiplier” effect. Each stakeholder should target a different group/segment of potential users and define the most appropriate way to disseminate the use of the tool. Stakeholder should encompass tourism, mobility and public sector
- The promotion should avoid the adoption of traditional dissemination channels (brochure, advertise, etc.). The use of on-line marketing techniques (i.e. social media) needs to be fully exploited as they are more likely to influence the citizens which are prone to use the tools. Face-to-face meetings are good opportunity to disseminate the tools and they need to be scheduled with key responsible of the stakeholder which can support the promotion
- The application of gamification schemes and the role of incentives (in order to promote the use of the tools) have not been duly exploited in the demonstration of the MOTIVATE cities. This could be considered as an option supporting the tool implementation in the replicability of the initiative.

6 Conclusions

This deliverable summarizes the main findings of the evaluation of the role/potential of crowdsourcing tools demonstrated in the MOTIVATE project for the collection of selected data required by the SUMP elaboration/enhancement.

The evaluation is carried out on the basis of two criteria: the first is quantitative based (this supposes to consider which kind of data can be collected through the crowdsourcing tools compared to the entire set of data required for mobility demand analysis and to compare the number of data required for SUMP with the number of data collected during the MOTIVATE demonstration) whereas the second is qualitative (taking advantage of the opinion provided by experts working on SUMP development and considering the future potential beyond the effective results of MOTIVATE demonstration).

The crowdsourcing tools can play a role in the following steps of the SUMP elaboration: the preparation of the plan, the definition of mobility measures and the monitoring and assessment phase. In particular the

main action where such crowdsourcing tools can be introduced is the analysis of the mobility demand and the ex-ante/ex-post evaluation of the mobility measures to be implemented. The crowdsourcing tools cope with the collection of this kind of data providing functionalities for the collection of trip diaries and the users' level of satisfaction/acceptance (on-line questionnaires). The data collected by MOTIVATE crowdsourcing tools do not include all the data required for the SUMP elaboration/enhancement even they can be applied for some among the most relevant such as the O/D matrix (quantitative evaluation).

From the qualitative point of view, crowdsourcing tools such as those experienced within the MOTIVATE project can't be used on their own for the estimation of O/D matrix or users' perception regarding the mobility service and therefore can't replace the traditional data collection for this purpose. On the other hand, they can be adopted in the preliminary stage of mobility demand analysis and definition of mobility interventions in order to guide/target the mobility demand analysis. In particular they can be more successfully adopted when the data to be collected requires a low sample (i.e. the ex-ante/ex-post evaluation rather than the O/D matrix).

Nevertheless, it must be highlighted that the MOTIVATE tool was pilot tested and crowdsourcing tools need to be further explored and their use well know. Innovative crowdsourcing tools always need some time to be widely known, accepted and used by the public.

TRANSFERABILITY METHODOLOGY, PROCESSES, TECHNIQUES AND PROTOCOLS

Contents

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Terminology

These are terms that are used in the transferability process.

Adopter city A city which wishes to implement the MOTIVATE e-platform that has been successfully implemented in a pioneer city

Components Main factors that can contribute to the success (or failure) of MOTIVATE e-platform when implementing in a city

Pioneer city A city where MOTIVATE e-platform has been implemented successfully

Scaling (up/down) Increasing or decreasing the covered area of an action/intervention (i.e. for MOTIVATE e-platform the area where data are collected

Transferability A process of verifying the chances of a successful implementation of MOTIVATE e-platform guided by a city (pioneer city) where has been already implemented to another city (adopting city) at an operational or implementation level

1 INTRODUCTION

1.1 Aims of the report

The Transferability methodology aims to identify a series of actions for ensuring a successful and efficient implementation of the MOTIVATE services (MOTIVATE e-platform and mobile apps) to other cities.

The key objective of the MOTIVATE project, is to promote new supporting tools to collect data for SUMP development, based on the exploitation of social media and crowd-sourcing apps. To support this, the transferability methodology as developed and presented below, aims to determine the principles and the conditions needed or the specifications ensuring the successful deployment of the MOTIVATE e-platform and the relevant applications (apps) in other cities. The developed methodology will enable the systematization of the transferring process, i.e. organize how tools, methods and processes tested in the project will be transferred while it will also analytically describe their role and the need they respond to.

1.2 Structure of the report

In addition to this introductory chapter, the report contains 4 Chapters

Chapter 2 presents the MOTIVATE platform developed and tested in the project's pilot cities (pioneer cities) and its correlation to specific steps of the SUMP cycle. The experience gained from the platform's use will be the basis for a successful transfer of the MOTIVATE platform to other regions and cities (adopter cities)

Chapter 3 provides the transferability methodology to be followed for a successful transfer of the MOTIVATE platform.

Chapter 4 includes some final remarks and recommendations for the cities to adopt the MOTIVATE platform in the near future

2 MOTIVATE PLATFORM –AN INNOVATIVE TOOL FOR SUSTAINABLE URBAN MOBILITY PLAN DEVELOPMENT

2.1 The MOTIVATE project

The **MOTIVATE** project promotes new supporting tools to collect data for SUMP development in the entire MED area, based on the exploitation of social media and crowd-sourcing applications. The project intends to help decision makers to gain a strong understanding of the main mobility problems that residents and tourists face. Based on that, sustainable interventions have been designed and tested, using cost effective ways of data collection and analysis (MOTIVATE platform and mobile apps). This makes the development, update and monitoring of SUMP much more targeted and efficient.

For the project's needs a technological platform, the "MOTIVATE e-platform" has been developed and tested in five Mediterranean cities that present high seasonality in transport demand. The experience gained throughout the project's duration showed that this can act as a useful tool on the hands of city planners and transport engineers via which, the daunting task of data collection and idea/views/opinions capturing is facilitated.

2.2 Overview of the MOTIVATE platform

The MOTIVATE e-platform as developed and integrated in each one of the five pilot cities participating in the project is used as a communication channel between relevant authorities and residents/visitors. The platform is accompanied with a database, where all the collected data is deposited. The platform provides to each user three services which are designed to cover specific needs of a city, as described below:

Service 1: Trip Diaries/Frequent trips

This service is addressed to transport planners and city authorities and aims to collect information about the mobility patterns and behavior 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 (frequent trips). 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 city's transportation system. The specific service covers the following needs of the city.

A) Need for data collection regarding Origin–Destination trips (creation of origin-destination (O-D) matrix)

The creation of O-D matrix is essential as a baseline to identify the main actions to be carried out to improve the mobility services and to assess the impacts of related interventions

The data collected through this service, will be used in order to identify, analyze and cover the mobility needs of citizens and visitors of a city. More specifically:

- The monitoring of visitors' trips will reveal their mobility patterns and will form specific touristic routes, providing the authorities and transport planners a good (database) starting point to analyze, define and plan interventions for offering to the city's visitors upgraded mobility services.
- The monitoring of citizens' everyday mobility habits will reveal the congested and problematic areas of the city, providing the authorities and transport planners all the data needed for the organization and optimization of the city's transport system.

B) Need for data collection regarding travel times and travel distances

The declaration of both the departure and arrival date and time by the end users offers the opportunity for travel time estimation, while it also provides useful data regarding the peak hours in specific axes of the city's network. All the data collected will allow transport planners and local authorities to apply specific policies, strategies or measures in order to alleviate the traffic conditions of the city and upgrade the life quality of both citizens and visitors.

C) Need for data collection regarding the trip purpose

The end users through the *"trip diaries"* service declare their travel trends (trip purpose) providing data that can be used for land use planning, while it can also form a common understanding regarding the range of services typically offered in specific areas of the city.

D) Need for data collection regarding the selection of transport mode and the reason for choosing the specific transport mode

The declaration of the transport mode used as well as the reason for this choice, provides useful data for the factors taken into account by the end users regarding their trips. These factors are related to: transport costs; reliability and regularity of the provided mobility services; safety; accessibility; comfort; time spent; etc. Based on the above factors, useful conclusions can be derived, as an indirect quantitative estimation of the use of the existing transport modes of the adopter city takes place.

Overall, the data collected via Service 1 for covering the abovementioned needs can be used in the transport model development process, which will provide relevant and accurate information into planning and decision making.

E) Need for real time data collection

The provision of real time information through this service allows the collection of the right information efficiently and cost-effectively. A frequently updated, comprehensive and accurate data helps transportation planners to get a clear picture of their city and its mobility needs, in contrast with data from surveys that are five to ten years old, which force planners to guess what the city needs or to respond to the city's loudest constituents instead of its greatest challenges. Moreover, a more powerful forecasting is informed by real-time data, which allows transportation planners to address any potential issues before they become massive problems. With this knowledge, they can also present more realistic budget requests and get the funding they need easily instead of making multiple requests, which possibly are denied.

F) Need for estimation of indicative performance indicators

The trip diaries collected allow the estimation of indicative performance indicators regarding the main actions that the city authorities must take in order to enhance sustainable urban mobility and solve specific traffic problems of the area. Moreover, the indicators can be used for the assessment of the city's SUMP development and its progress.

G) Provision of data regarding the SUMP development

The data collected will allow cities which have already developed their SUMP or are in the final complementary stages to update the relevant information and re-assess its progress. In case the city has not yet developed its SUMP, the data collected by this service will facilitate the first steps towards the SUMP elaboration. What needs to be mentioned is that the data required in the first phase of SUMP (analysis of the city's mobility situation) will be gathered under a crowdsourcing dimension, a solution that is more economic and less time consuming than the traditional origin-destination surveys.

Service 2: 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 mobility 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 city's transportation system. The specific service covers the following needs of the city.

A) Need for better understanding of the city's mobility requirements

The data collected will reveal

- The level of end users' (citizens and visitors) acceptance regarding specific mobility measures or services operating in the city
- The level of end users' satisfaction regarding specific mobility measures or services operating in the city
- The level of utility regarding specific parameters characterizing each measure or service

Taking into consideration the users' opinions insights and suggestions, the local authorities and transport planners will be able to propose relevant modifications, in order the provided transport services to be upgraded and the users' needs and requirements to be more satisfied.

B) Need for re-scheduling transport services according to users' requirements

As the citizens' and visitors' needs differ, this service will allow the authorities and transport planners to form different categories of modifications in order to solve specific problems of each category and provide better services to the end users. This "city understanding" tool, will facilitate the local authorities and transport planners in developing alternative scenarios based on the real city's needs (SUMP facilitation)

Service 3: Future intervention assessment

This service is addressed to transport planners and city authorities, and aims to collect information from the end users (citizens and visitors), about future mobility interventions that they intend to implement in the city. The end users are asked to provide their perceptions in specific mobility 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 city's transportation system. The specific service covers the following needs of the city.

A) Need for planning and implementing effective mobility interventions in the city

The data collected will reveal

- The level of end users' future acceptance regarding specific proposed mobility measures or services planned for implementation
- The level of significance regarding the specific proposed mobility measures or services planned for implementation

Thus, the local authorities will have the opportunity to pre-define the possible impacts from the measures and services implementation.

B) Need for ex-ante assessment of the proposed interventions

The proposed interventions need to ex-ante be assessed in order to ensure that main goals and targets the city wants to achieve will be served. The assessment should examine specific indicators for each intervention (e.g. is the intervention relevant to the city's local needs and priorities, will the intervention help the city achieve specific goals and problems, what impact the intervention will have to the end users, the benefits of each intervention, etc.)

Figure 2.1 below, depicts the above mentioned operational characteristics of the MOTIVATE e-platform and the opportunities that each of them offers to the cities.

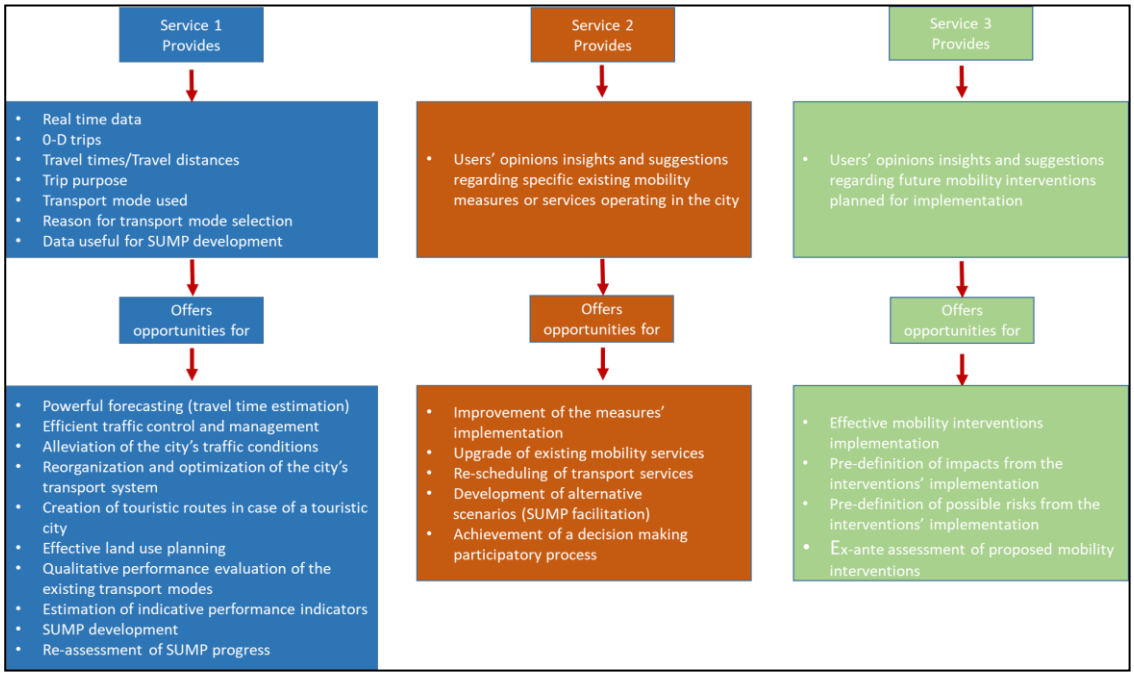

*Figure **Errore. Nel documento non esiste testo dello stile specificato.**.1: Operational characteristics of the Motivate e-platform services*

What needs to be taken into consideration is the fact that the above mentioned opportunities depend on the quantity of data collected and their potential to be statistically representative of the attributes/indicators they estimate. In practice, crowdsourcing tools such as the MOTIVATE e-platform can be used for a pre-feasibility analysis (warning about critical conditions or issues to be further analyzed) or a as a "guiding" tool which better plans traditional surveys and data collection campaign or to integrate/validate them as unique data collection procedures (to replace all the others).

2.3 Relation of the MOTIVATE platform to the SUMP cycle

The MOTIVATE platform and the relevant apps developed for the project's needs contribute to specific steps of the SUMP development process. More specifically:

Trip diaries and frequent trips

Trip diaries and frequent trips collected via the relevant application contribute to steps 3 and 8 of the SUMP cycle which target to:

- analyze the mobility situation and develop scenarios (by analyzing the collected data of trips/mode the current situation in terms of traffic flows per mode, more attracted areas, pick hours during the day etc)
- Build monitoring and assessment into the plan (the previous data can be used to assess implemented actions using before and after analysis of specific performance indicators).

Evaluation of existing transport measures

Travelers' views regarding the current mobility performance in the city (e.g. unreliable time schedules, low level of PT services) collected via the relevant app contribute to Step 3 which targets to analyze the mobility situation and develop scenarios (based on the perception of the citizens/visitors for the current operation of the transportation system and the problems that must be solved)

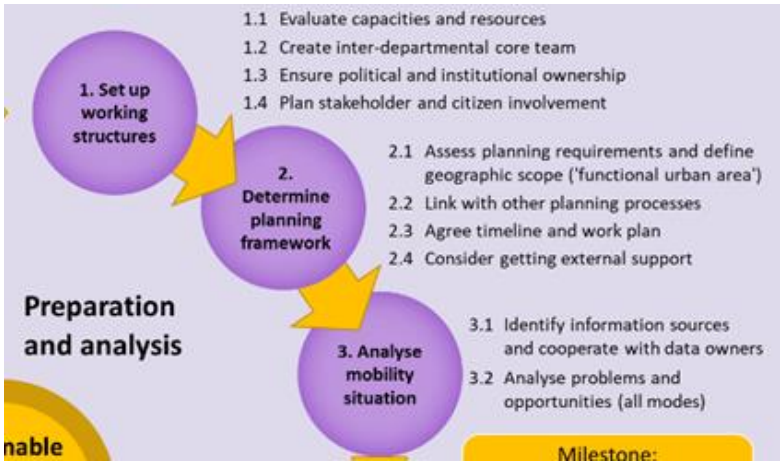

*Figure **Errore. Nel documento non esiste testo dello stile specificato.**.2: Preparation and analysis phase of SUMP cycle*

Future intervention assessment

Travelers' acceptance of planned measures that Authorities may include in the city's SUMP captured via the platform and the relevant app contribute to step 7 of the SUMP cycle where the most appropriate measures are selected to be implemented in the area.

*Figure **Errore. Nel documento non esiste testo dello stile specificato.**.3: Measure planning phase of SUMP cycle*

Motivate e-Platform

The permanent communication channel between the Authorities and travelers that can be established with the exploitation of the motivate e-platform, can be used for monitoring and assessing the measures already included in SUMP, calculating their performance and analyzing their success or failure. (Steps 11 and 12 of SUMP cycle)

The present report aims to share the results and outputs from the MOTIVATE services testing phase and spread the project's knowledge to other cities at Mediterranean and European level. For that reason, a specific methodology is presented in details in the next chapters of the current transferability manual

*Figure **Errore. Nel documento non esiste testo dello stile specificato.**.4: Implementation and monitoring phase of SUMP cycle*

3 TRANSFERABILITY METHODOLOGY

In general and according to the Transport Innovation Deployment for Europe, *"transferability"* is a process of verifying the chances of a successful implementation of a measure successfully implemented in a city (pioneer city) to the adopting city at an operational or implementation level. The use of a transferability methodology provides an opportunity to learn from a previous experience of implementation, to better exploit opportunities and to avoid repeating mistakes. Even though a successful implementation of a measure, a policy, a service, etc. in a city provides grounds for transferring the measure to other cities, the right conditions are needed to make it a reality. The replication of success in a different urban context is challenging as the cities can differ in many aspects of transport and traffic conditions (demand, supply, infrastructure, traffic control and management, etc.), geographical, environmental, demographic, socio–economic and cultural backgrounds as well as institutional and legal frameworks (CIVITAS, 2012).

3.1 Key guiding principles in transferability

According to the literature review of European projects (LEDA, TRANSPLUS, CUPID, TIDE), the following key guiding principles have been identified for transferability in general:

A) Transferability of a policy/measure depends to some extent on compatibility of institutional context. This implies attention on how a policy instrument may fit with the context of the adopter city, while the identification of comparable cities may assist assessment of potential transferability

B) Different components of transferability may be identified in terms of policy instruments transfer between territories.

- Scale of application of a policy (is it a local measure or a nation-wide measure?)
- Degree of transfer (to what extend it will be transferred e.g. within a city, between cities, between countries, etc.)
- Horizontal translation of a policy, where a policy is transferred from one region to another, without changing the scale of application
- Vertical transfer or "scaling up" or "scaling down" a policy (from local application to a nation-wide policy or vice versa)

C) Different phases in the transfer process have been identified. These are:

- Demonstration phase where the best practice is identified in the pioneer city
- Transferability phase where the compatibility of the best practice in the adopter city is examined
- Assessment phase where possible barriers and success factors are identified in the adopter city
- Implementation phase where the best practice is implemented in the adopter city thus the transfer is completed

D) Different kinds of process that assist transferability have been identified. Experience can be gathered through a range of mechanisms for seeking information.

E) Acceptability is crucial, as supportive measures of personal mobility are easily transferred unlike measures perceived as restrictive

3.2 Basic principles of MOTIVATE transferability methodology.

In general, there are four types of transferability as presented in Figure 1.1.

- Type 1 refers to the transfer of knowledge within a city
- Type 2 refers to the transfer of knowledge between cities
- Type 3 refers to the transfer of knowledge between European countries and
- Type 4 refers to the transfer of knowledge between countries

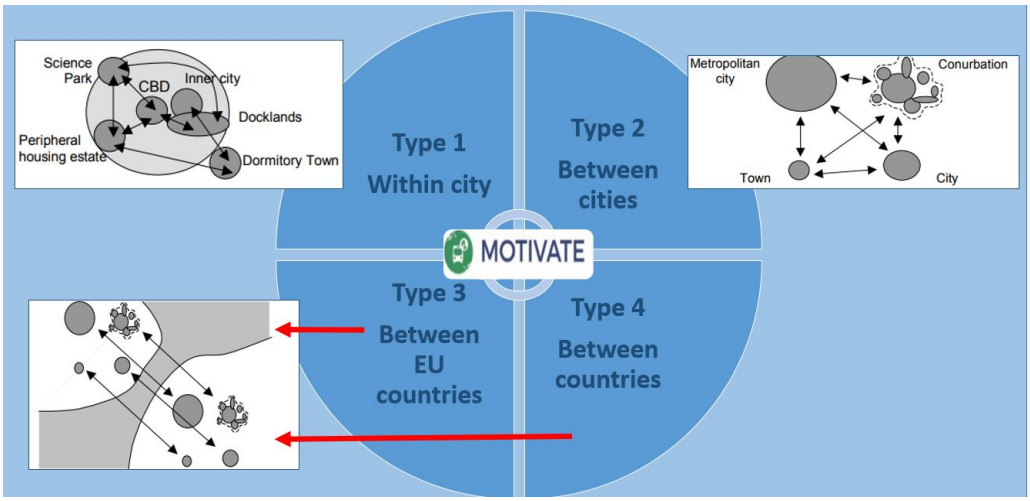

Figure **Errore. Nel documento non esiste testo dello stile specificato.**.5: Types of Transferability methodology

The transferring of the MOTIVATE platform will mainly focus on Type 2, ***"transferring between cities",*** that is the "**MOTIVATE city"** (pioneer city) and the "**adopter city"**.

There were many methodologies developed and adapted in the past years for transferring policies or measures. As the transferability of the Motivate e-platform can be considered mainly as the adaptation of an innovative urban transport and mobility measure from the pioneer to the adopter city, the TIDE methodology (based in NICHES+ methodology) was considered as the most relevant to MOTIVATE, therefore has been taken as the basis for the proposed MOTIVATE transferability methodology, described below.

The TIDE methodology has seven steps as shown in Figure below. The methodology has been produced from a desktop study, which was then further improved based on the output of a TIDE Transferability Workshop held in February 2013 (TIDE, 2013a).

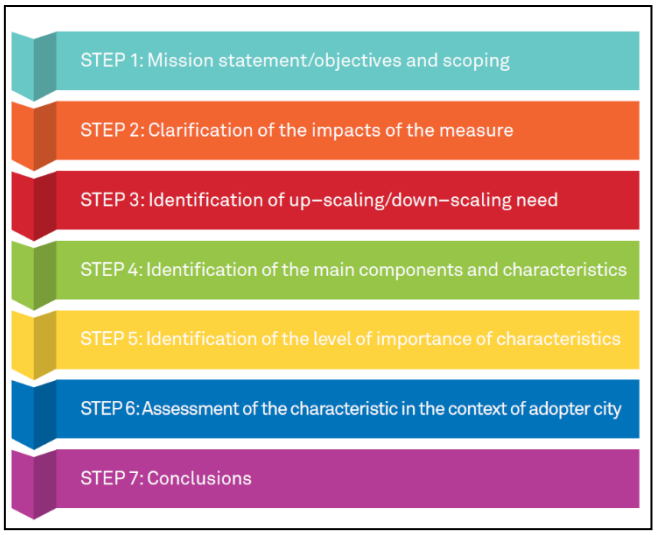

Figure Errore. Nel documento non esiste testo dello stile specificato.*.6 TIDE transferability assessment steps (source: TIDE project, Transferability Handbook)*

From the other hand, for the efficient transfer and implementation the MOTIVATE e-platform services a very close cooperation between the various relevant stakeholders should be achieved. The recently developed REFORM Project Framework for the transferability of good practices is composed of four major components, meaning building blocks of actions as is shown in figure 3.2. These components are:

- the identification of authorities and stakeholders to be involved at both regions/areas in the transferability of a given GP.
- the identification of cooperation areas for the promotion of SUMPs and mobility policies in general.
- the establishment of appropriate channels of interaction between the two regions, and
- the designation and motivation of “champions” that will undertake the primary role in the GPs transfer

Figure 3.2 illustrates the general Framework, as well as the link between the components of the Framework and the transferability manual. The figure depicts a hierarchical structure composed by four levels of components, aiming at the smooth transferability of the identified good practices to the target regions. The Framework consists of general components that need to be initiated for the realization of the above goal. Each component provides the possibility for further and more specific actions. Each component is described separately in the following section.

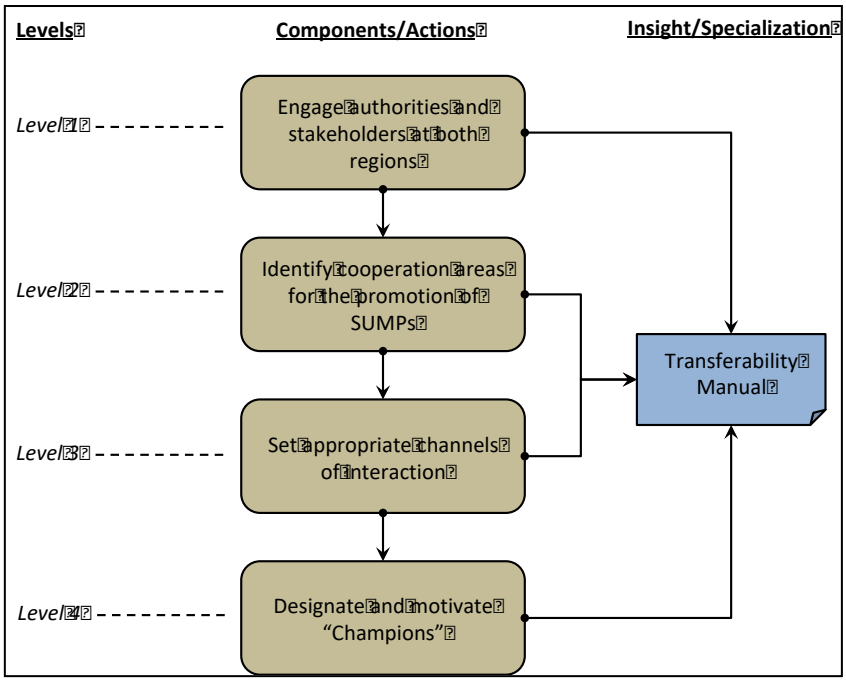

Figure ***Errore. Nel documento non esiste testo dello stile specificato.****.7: The REFORM Framework for the transferability of good practices (source: REFORM project, T1.3. Analysis of transferability of the selected policies/practices/instruments to other regions and contexts).*

Based on the above main principles the transferability methodology for the MOTIVATE e-platform was structured as detailed in the next section.

3.3 The MOTIVATE transferability methodology

The MOTIVATE platform was initially designed in order to serve the mobility planning of cities with seasonal demand. From the other hand, as a useful tool for collecting and analysing data related to sustainable mobility, the platform can be broadly transferred to any other city, in order to enhance the citizens' participation in the mobility planning procedure.

The determination of the specific profile of the adopter city/area as well as the correlated needs and targets that the platform should serve are the first steps that must be implemented in order to ensure the transferability efficiency.

The effective knowledge of the sustainable mobility planning that is the main scope of the MOTIVATE platform use, requires the involvement (to a lesser or greater degree) of authorities and appropriate stakeholders at various levels and from different scientific sectors, since the sustainable mobility planning especially in areas with seasonal demand, is by default a multi-disciplinary topic. The cooperation scheme that must be established between the authorities directly or indirectly involved in urban mobility and tourism both inside the adopter urban area and in its greater area and also between the adopter and the pioneer city, is very crucial for the transferability procedure.

The main innovation of the MOTIVATE platform is the use of the crowd sourcing techniques for collecting the mobility data and introduce a direct link of communication between citizens and authorities as regards the mobility issues. For ensuring the proper and long-lasting transferring of

this technique specific actions that will engage and activate the users/citizens/visitors of the adopter city must be planned in close cooperation with the pioneer city.

The current operation of the Motivate platform may not requires advanced technical infrastructures for its installation and operation but there are minimum requirements as regards the ICT technologies and the skills of the people who will be responsible for the data collection and analysis, which should be covered.

Finally, the MOTIVATE platform consists of an updated source of traffic data, a system which serve the communication of the citizens/visitors' needs to the city planning authorities and must be managed and monitored by a specific group of people who will be authorized to ensure its proper operation and update.

Based on the above mentioned principles, the transferability methodology of MOTIVATE e-platform was structured as presented in the following figure and analysed in the next steps.

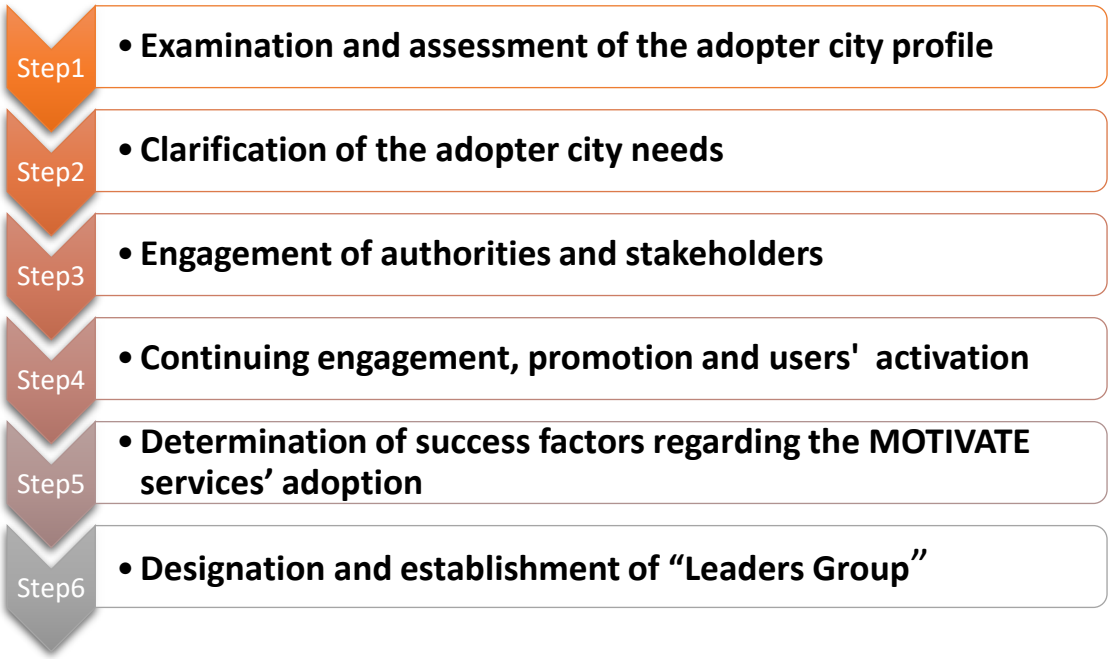

Figure Errore. Nel documento non esiste testo dello stile specificato..8: MOTIVATE transferability methodology

STEP 1: Examination and assessment of the adopter city profile

According to Macario and Marques (2008), the transferability of a measure can be predictable when there is a detailed understanding of its enabling context beyond any macro indicators such as the size of a city, the population density, the urban sprawl etc., which will probably not reflect the level of complexity involved.

In the MOTIVATE transferability case this means, that any city wishes to adopt the MOTIVATE services should at first level, examine specific characteristics regarding its mobility situation and whether the provided services are needed and will be effective for its case, while at a second level, it should start looking the preconditions for the services' implementation.

Regarding the city's characteristics, several issues need to be examined, such as:

Is the city a touristic one?
In this case, seasonality will be faced as a necessity to serve both citizens' and visitors' needs. Cities facing seasonal peaks are characterized by specific mobility problems that can negatively affect tourist experience and especially life quality and freedom of movement/accessibility of residents. Therefore in a touristic city, two different categories of end users will provide the relevant data regarding not only the trips performed but also the mobility problems faced and the mobility needs arose, during their daily trips.

Is it a sustainable city in terms of mobility?
If the city has already promoted the sustainable urban mobility, the end users will more easily accept the scope and the importance of the travel data collection as well as the evaluation of the different measures. In this case, the travelers' engagement level will be high.

What is the social awareness of the citizens?
Are the citizens environmentally aware? Are the citizens willing to share views or personal travel data for social benefit? Are there any similar applications offered by the Municipalities (for different purposes such as recycling or afforestation etc.)

Has the city a developed/under development SUMP or an under improvement/updating SUMP?
The Motivate platform aims to become a useful tool for collecting relevant data that will support Authorities who intend to develop or to evaluate their SUMPs. MOTIVATE services will help the development, update and monitoring of SUMP much more targeted and efficient. In case the adopter city has already developed its SUMP or is at the final phase, the data collected is going to be used in order to assess its progress.

Does the city operate ICT mobility systems relevant to the platform?
The use of ICT technologies for providing real or historic mobility data to the end users, increase the direct communication with users (i.e. informing about traffic conditions and real time public services) and maximize the possibilities to share their traffic data and preferences. In case the adopter city already operates such systems, what needs to be examined is whether the MOTIVATE services can be integrated in the existing systems in order to be promoted and exploited easily and cost effectively. In any other case, the adopter city needs to examine the introducing of new technology schemes for data collection and mobility systems and services evaluation.

Summing up, any city wishes to adopt the MOTIVATE services, has at first stage to answer the following questions (Table 3.1)

General characteristics of the adopter city	YES	NO
Is it a touristic city		
Is it a sustainable city in terms of mobility		
Are the city's citizens sensitized regarding sustainable mobility issues?		
Has a developed SUMP or the SUMP development is on progress		
Does the city operate ICT transport systems relevant to the MOTIVATE platform		

*Table **Errore. Nel documento non esiste testo dello stile specificato.**.1: Determination of general characteristics of the adopter city*

STEP 2: Clarification of the adopter city needs

In this step the relative level of importance (high, medium, low) of each service will be judged from the adopter city's point of view. The experience gained from the pioneer cities of MOTIVATE and useful advice from experts in urban mobility field are also valuable. The stakeholders' group of the adopter city will work together with representatives from the pioneer cities in order to understand which service are the most useful to be adopted or need to be optimized/improved. The level of importance should be supported by the relevant comments.

For the above mentioned evaluation, the city should first identify its real needs in order to understand and select which services are the most suitable for its case, answering to the questions below. The questions are all based on the needs each service covers and have to be answered by the stakeholders' group.

Thus, an assessment will be carried out between the stakeholders of the adopter city using a scale from +2 to -2 regarding the need for collecting or not the specific data:

+ 2 strong need for data collection and analysis

+ 1 low need

0 no need

-1 low need but already is being collected by other sources

-2 strong need but already is being collected by other sources

Needs the adopter city wants to cover through the MOTIVATE services use		**Need to be covered**
1	Is there a need for data collection regarding Origin–Destination trips?	
2	Is there a need for data collection regarding travel times and travel distances?	
3	Is there a need for data collection regarding the trip purpose?	
4	Is there need for data collection regarding the selection of transport mode and the reason for choosing the specific transport mode?	
5	Is there need for real time data collection?	
6	Is there need for estimation of indicative performance indicators?	
7	Is there need for data collection regarding the SUMP development	
8	Is there need for better understanding of the city's mobility requirements?	
9	Is there need for re-scheduling transport services according to users' requirements?	
10	Is there need for planning and implementing effective mobility interventions in the city?	

11	Is there a need for ex-ante assessment of the proposed interventions?	

*Table **Errore. Nel documento non esiste testo dello stile specificato.**.2: Determination of adopter city needs*

Each stakeholder will rate according his/her opinion and the average score will define the final needs for specific data collection.

In many cases, the adaptation of specific measures, services, etc. is followed by specific adjustments. In the case of the MOTIVATE services and according to the results of the above mentioned needs that will be collected and analyzed, the first service of the MOTIVATE e-platform can be adjusted accordingly. As regards the service two and service three, every adopter city will evaluate and assess different mobility interventions according to their current and future urban mobility plans.

Therefore, as result of this step and in close cooperation between the pioneer and the adopter city, all or part of the questions that is included in service one (additional to O-D data and mode that will be used) will be installed and different set of questions will be set up and inserted in the service 2 and three of the platform, in order the local authorities and transport planners to acquire an overall view regarding the specific mobility aspects

STEP 3: Engagement of authorities and stakeholders

The cooperation of the relevant Authorities/Stakeholders in the adopter city as well as between the adopter and the pioneer city, is primarily a decision that should be taken at policy level and engage authorities directly or indirectly involved in urban and regional mobility and tourism both inside the adopter urban area and in its greater area.

According to the knowledge gained by the use of MOTIVATE platform to the pioneer cities of the partnership, authorities and stakeholders that should be engaged for achieving the scopes and objectives of Motivate platform are:

- Municipal department relevant to mobility and tourism
- Transport operators and authorities
- Travel agencies
- Hotel associations
- Academic or research organizations
- SMEs related to urban mobility and tourism
- Chambers, trade unions etc.
- Citizens groups
- Media

It should be highlighted that the knowledge transfer itself is an action that requires the participation of the private sector. Both big players and SMEs on mobility, tourism, data management, ITS etc. should be convinced for the necessity of this initiative and allocate efforts to adopt the proposed services. Therefore, the above authorities should work together with the private sector in order to ensure successful knowledge and technology transfer, and most importantly adoption by all parties involved in urban mobility sector.

STEP 4: Continuing engagement and activation of users

The engagement and activation of users is a rather hard and long-standing process.

Comparing the results obtained by Siena (one of the pilot cities of MOTIVATE with an existing ICT technology embedded in the public transport system of the city) and the other MOTIVATE pilot cities, one of the conclusion that can be drawn is that the engagement of citizens and visitors is a much easier process when the city already operates a relative tool (an app, a platform, etc.). Siena's paradigm, showed that having integrated the MOTIVATE services in its own app, guaranteed a wide engagement of citizens while it also facilitated the dissemination activities and maximized the results as the promotion of the MOTIVATE services was part of the usual promotion activities of Siena's app. Instead, for the other cities which had no previous experience with the use of relevant tools, the engagement of users turned to be a rather complicated and demanding procedure. The same conclusion is also generated by the case of Rhodes, where, after the installation of the public transport information system and the integration of the Motivate platform on it, there was a great increase of the travellers' engagement and feedback.

However, a reward program could act as a useful tool to engage users continuously and gain new participants. Finally, what seems to be important is to make users feel that their voice and opinions are part of the decision-making process by giving them feedback to their responses.

More information are included in Deliverable D4.1.1 Guidelines for transferring activities coordination

STEP 5: Determination of main prerequisites for the MOTIVATE services' adoption

In this step, some main prerequisites that ensure the success (or failure) of the MOTIVATE services' transfer should be clarified to the adopter city based on the experience and lessons learnt from the MOTIVATE platform operation in the pioneer city. Each adopter city should take into consideration all the factors in order to maximize the services impacts and minimize the risk of low participation.

A) Knowledge of Sustainable Urban Mobility Planning

One of the main scope of Motivate platform is to support the SUMP development in the pioneer and adopter cities. For achieving this scope, the adopter city should be ready and willing to embrace the services in their operational framework, be familiar with sustainable mobility procedure and the use of relative planning instruments and also accept and understand the importance of the continuously data collection and analysis.

B) Familiarization with marketing and crowd sourcing techniques for citizens' engagement.

The new model of data collection that MOTIVATE promotes is based on the exploitation of social media and crowdsourcing techniques. The working team of the adopter city who will be responsible for the proper operation of the services, should be familiar with these techniques. Additionally, they should also be familiar with marketing techniques for attracting the interest of the end-users, in order to make them accept and understand the importance of sharing personal data for social benefit.

C) Equipment requirements

Regarding the equipment needed for the MOTIVATE services adoption, each adaptor city should have a server and a back-office for data analysis. Thus, the MOTIVATE e-platform is considered as a "SaaS" (Software as Service). For the data analysis, a relevant big data analytics software packages need to be purchased.

D) Technical requirements

From the technical point of view, what is needed for the services to be adopted by a city is the appropriate staff skills and knowledge for manage the platform (administrator) analyzing all the collected data and calculated specific mobility monitoring indicators. The pioneer city will guide the adopter city for the above mentioned procedure.

STEP 6: Designation and establishment of “Leaders Group”

The experience from other similar transferability attempts, has shown that a successful transferability of a good practice requires a closed group of people who should carry out the major role of leading this initiative. The term “Leaders Group” refers to those involved stakeholders and/or authorities and/or organizations that should take the lead to materialize all the above mentioned steps of the MOTIVATE e-platform transferring. This action is very important and critical for the success of the overall Transferability Framework. The ‘’the leaders group’’ will hold the responsibility to:

- Motivate and coordinate the rest of the stakeholders
- Define the agenda for knowledge transfer
- Communicate with their counterparts in the adopter city
- Promote the wide implementation of the appropriate solutions in the adopter city

The rest of the stakeholders should be defined for each area and clear roles should be attributed to all of them. Action plans, organization aspects and other issues should also be defined.

According to the experience of the MOTIVATE pioneer cities, the closed group should be coordinated by the relevant with sustainable mobility planning department of the city in close cooperation with the public transport systems operators (including taxi associations, bike or car sharing systems etc.) and the main tourism operators of the area.

4 PROCESSES, TECHNIQUES AND PROTOCOLS FOR TRANSFERRING MOTIVATE SERVICES

Motivate was developed as an open architecture platform without special requirements regarding protocols, procedures and equipment. Nevertheless, during the tested period of the pilot cases, three different types of the platform transferring have been observed.

1. Installation and operation of the MOTIVATE platform in transport authorities/cities that do not operate similar info mobility or traffic data collection systems. In such case, the MOTIVATE platform operates through HIT/CERTH's IT infrastructure.

2. Replication of the MOTIVATE functionalities on an existing APP, already operating by a transport or other authority in order to provide information services to users (residents and visitors).
3. Integration of existing information systems (e.g. traffic management system, parking management system, etc.) on the MOTIVATE Platform, using web services.

The special requirements, techniques and protocols for each of the above mentioned cases are further analyzed within the next sections.

4.1 Requirements for Transferring the MOTIVATE functionalities.

Once the conceptual necessities have been resolved for the transferring, any authority wishing to use the MOTIVATE Platform has to declare its area and delimit it by designing the geographical perimeter of it.

Once the area has been declared and designed, automatically, the MOTIVATE Platform starts collecting data regarding the trips (application of the first MOTIVATE service). Additionally, the contents of the service platform could be translated in different languages for supporting the local needs.

Additionally, each relevant authority, with the proper access rights, can insert specific questions in order to collect data regarding

a) Existing mobility measures and transport services of the relevant city (application of the second Motivate service regarding the evaluation of existing mobility measures of a city)
b) Future mobility interventions the authorities plan to implement to the relevant city (application of the third Motivate service regarding the assessment of future mobility interventions planned for implementation)

On all the above steps, the end users will be using MOTIVATE functionalities through the web MOTIVATE Platform and the relative app from App Store or Google Play.

So, the requirements for transferring the MOTIVATE functionalities at a glance are:

- City configuration (area declaration and delimitation)
- Setting the relevant questions regarding the mobility measures and the future interventions to be evaluated and assessed
- Use of MOTIVATE functionalities through the MOTIVATE Platform
- Management procedure (monitoring of the results, data analysis, etc.)

4.2 Requirements for Replication of MOTIVATE functionalities on an existing APP

Two different scenarios can be considered:

- In the first scenario the MOTIVATE functionalities are replicated in the existing APP and directly accessed by any third-party application from the platform itself using the relevant MOTIVATE's cloud functions. As on the above scenario, the relevant authority/company, has to declare and delimit the area by designing its geographical perimeter. The cloud functions are in a form of web services and provides json format to the client. MOTIVATE cloud functions contain all the required elements for exchanging the required data between the existing App and MOTIVATE Data can be directly collected by MOTIVATE platform's repository or collected by the repository of the exiting APP and later exchanged by the two platforms.
- In the second scenario the MOTIVATE functionalities are implemented "from the scratch" in the existing APP: the objective to be achieved with the functionalities is still the same (of the MOTIVATE platform) but the technical implementation, the operational procedure or the interactions with the end-user and the data involved are adapted to functional specifications and data follow of the existing APP. Data are collected by the repository of the exiting APP and later exchanged by the two platforms.

When a common repository among two different platforms is created, cloud functions of the MOTIVATE platform, can be used to enable data exchange between the two platforms. Cloud functions support the web services that the MOTIVATE platform is able to expose and share with third party interfaces in a reading mode. Web services allow data exchange between the MOTIVATE platform (and, in particular, its repository) and any possible.

4.3 Requirements for Integration of existing information systems on the MOTIVATE Platform.

As on the above scenario, the relevant authority/company, has το declare and delimit the area by designing its geographical perimeter

The integration of the MOTIVATE functionalities to an existing Information System can be achieved using the MOTIVATE's cloud functions.

As mentioned above, the MOTIVATE cloud functions contain all the required elements for exchanging the required data between the existing Information System and the MOTIVATE platform. The cloud functions are in a form of web services and provides json format to the client.

5 CONCLUSIONS

MED cities although facing the common challenge of developing a sustainable mobility background, also present particularities depending on the territorial context, budget constraints, seasonality of demand and fast evolving trends requiring continuous monitoring.

For these reasons, a sound transnational approach, is the key to guarantee the project's success. Unlike the traditional data collection methods, where citizens or visitors are "active" users of the transportation system, the innovative approach of MOTIVATE lies on their active involvement in transport data collection/management, problems identification and proposed measures evaluation.

MOTIVATE promotes new supporting tools to collect data for SUMP development based on the exploitation of social media and crowd-sourcing applications. The common model of implementing and applying these techniques that will be created 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 projects' results to other cities, will support the SUMP development and enhancement all around the Med area.

The project intends to help decision makers to gain a strong understanding of the main mobility problems that residents and tourists face. Based on that, MOTIVATE e-platform services consist a cost effective way of data collection and analysis which will make the development, update and monitoring of SUMP much more targeted and efficient.

There are already five pioneer cities (acting as pilot cities during the project implementation), who have already tested and adapted the e-platform, collecting mobility data from the citizens and the visitors. Taking this experience as a starting point and analysed the barriers and weaknesses and also the strengths and opportunities that each recognized through this procedure, MOTIVATE project developed a specific transferability methodology which goes beyond the development of typical roadmaps of actions that will facilitate the e-platform installation and operation by the interested cities. The project partners developed a strategic framework that plays the role of a knowledge transfer "mechanism" aiming to facilitate the e-platform transferability between pioneer adaptor cities. The framework contains four main components: Clarifications of city needs, Engagement of authorities, stakeholders and users; Determination of main prerequisites; Designation and establishment of "Leaders Group". The transferability manual developed includes all the information that is necessary so that the adopter city can effectively and successfully adopt the MOTIVATE e-platform.

A very useful tool that will be used for enabling the above presenting transferability framework, will be the e-training web course on the Motivate e-platform use for implementing SUMP that will be developed by the project and uploaded on the website.

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MOTIVATE: Promoting citizens’ active involvement in the development of Sustainable Travel Plans in Med Cities with Seasonal Demand, Deliverable D4.1.1: Guidelines for transferring activities coordination

Final Evaluation Report

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1 Introduction

Based on the key findings of the evaluation, the Deliverable provides a set of recommendations to the target audience (see section 4) how to design, implement and launch crowdsourcing initiatives to collect data for SUMP development/enhancement taking into account:

- The technological tool supporting the operation of crowdsourcing initiative
- The stakeholder cooperation required to set the institutional and operational cooperation to launch the crowdsourcing initiative
- The promotion activities required to disseminate the crowdsourcing initiative among the end-users (citizens and visitors).

1.1 Structure of the document

The structure of the Deliverable is presented below:

- Section 2 resumes the crowdsourcing functionalities introduced for supporting SUMP data collection which have been demonstrated in the MOTIVATE project and the different technological scenarios under which these functionalities have been implemented
- Section 3 summarizes the key findings identified by the evaluation of the crowdsourcing tools for supporting the SUMP data collection process, piloted within the MOTIVATE project. This analysis highlights the potential, barriers and risks of the adoption of this kind of innovative solution/procedure and it assesses the impacts produced on the overall process of SUMP development and data collection. The structure (sub-sections) complies with the approach of the evaluation framework ("evaluation level" as summarized in this section)
- Section 4 provides a set of recommendations to the target audience (see section 1.2) how to design, implement and launch crowdsourcing initiatives to collect data for SUMP development/enhancement
- Section 5 provides some relevant conclusions, summarizing the key outcomes from section 3 and 4.

1.2 Target audience

Errore. L'origine riferimento non è stata trovata. identifies the target groups of this Deliverable.

Table 1: Target audience of this Deliverable

Target group	Relevance
Mobility/PT stakeholder and Public Authorities of MOTIVATE pilot cities	Assessment of the potential/relevance/usability of innovative crowdsourcing tools as resulting from the evaluation of pilot results in order to decide on long-term the maintenance of tools operation and future scale up in case of SUMP development/enhancement/update
Mobility/PT stakeholder and Public Authorities of Other interested cities	Understanding the potential/relevance/usability of innovative crowdsourcing tools in order to transfer these tools in their operational practice and technological background
	Definition of the role which these tools can play in the whole data collection process for SUMP development/enhancement/update
	Provision of recommendations how to design, implement, operate crowdsourcing tools and launch the related initiative
Mobility experts, consultants and practitioners	Understanding the potential/usability of innovative crowdsourcing tools in order to exploit further the impacts of these solutions in extended pilots and operation experiences and to contribute to its wider use and exploitation at EU level

Target group	Relevance
Research organizations, IT companies	Main findings from the piloting of crowdsourcing tools in MOTIVATE project. Good practices and lessons learnt from the evaluation of the MOTIVATE pilots in order to develop further new technological solutions/functions supporting the SUMP data collection process.

2 Crowdsourcing tools demonstrated in MOTIVATE project

The functionalities supporting the SUMP data collection process to be demonstrated in MOTIVATE pilot cities were identified as results of the needs analysis carried out at a early stage of the project. These functionalities are detailed in **Errore. L'origine riferimento non è stata trovata.**.

Table 2 MOTIVATE functionalities

FUNCTIONALITIES	DESCRIPTION	DATA DETAILS COLLECTED
Trip Diary	This function collects information about the mobility patterns and behavior 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 (frequent trips). This last scenario is not implemented in Siena pilot.	Trip name (PT line used in Siena) Trip origin (address, longitudine, latitudine) (bus stop, longitudine, latitudine in Siena) Trip start time (date/hour) Trip destinations (address, long, lat) (bus stop, long, lat in Siena) Trip end time (date/hour) Transport Mode (bus as default in Siena) Trip purpose (not collected un Siena) Reason for trip (not collected un Siena)
Questionnaires for the evaluation of mobility/PT measures already operated	The end-users are asked to rate the performance of existing mobility measures giving a clear view of their satisfaction.	Votes (range values: from 0 to 7) per question
Questionnaires for the assessment of future mobility/PT intervention	The end users are asked to provide their perceptions in specific mobility interventions by rating their importance.	Votes (range values: from 0 to 7) per question

The functionalities supporting SUMP data collection process have been implemented under the different technological scenarios of the MOTIVATE pilot cities. These scenarios can be grouped into three categories:

- the implementation of MOTIVATE platform providing the defined functionalities as a “stand alone” solution. This solution has been implemented in the MOTIVATE pilot cities where any webportal/APP for citizens/visitors’ information were operated or cannot be used for the purpose of MOTIVATE demonstration (Larnaka and Almada)
- the integration of MOTIVATE platform into the web platform/APP already operated in Rhodes and Ioannina. This solution has been achieved through the use of “cloud functions” provided by MOTIVATE platform enabling the integration of the MOTIVATE functionalities into existing web platforms
- the replication of new functionalities for data collection on existing APP as piloted in Siena[1] by Tiemme. In this case the existing APP has been upgraded with the MOTIVATE functionalities and the

[1] The TIEMME Mobile APP upgraded with MOTIVATE functionalities has been tested in all the areas served by Tiemme (not only in Siena).

adopted technological solution has been designed according to the technical features and data managed by the APP itself.

3 Key findings from the evaluation of MOTIVATE pilots

This section summarizes the key findings from the evaluation of crowdsourcing tools/initiatives demonstrated in the MOTIVATE project. The key findings are provided based on the three different perspectives ("evaluation levels") defined in the evaluation framework (see section 1.1): the responsiveness of the technological solution to the requirements and the level of technical and operational performance, the actions/efforts required to implement the crowdsourcing tool and to launch the initiative, the usability of data collected and the impacts on the whole SUMP data collection process. A final sub-section is added at the end to consolidate the final results of the evaluation process and to make a comparative analysis of the strengths and weaknesses of crowdsourcing tools and traditional SUMP data collection processes.

3.1 Technical and operational responsiveness of the tools and level of performance

Errore. L'origine riferimento non è stata trovata. resumes the results of the assessment of the responsiveness of the technological solution to the requirements and the evaluation of technical and operational performance of crowdsourcing tools demonstrated in MOTIVATE project compared to the operational needs. Suggestions for further improvements are added in the table: with regard to this point, it must be highlighted that the demonstration actions held within the MOTIVATE project have a pilot approach aiming to assess firstly the role of these tools in the SUMP data collection procedures and secondly to understand how these could be fine-tuned to better cope with their primary purpose. In order to simplify the contents, the suggestions for improvements relate to the MOTIVATE Platform, the crowdsourcing tool which was demonstrated in 5 out 6 of the MOTIVATE cities.

Table 3 Key findings of the evaluation and suggestions for further improvements

ITEM UNDER EVALUATION	RESULTS OF THE EVALUATION	SUGGESTION FOR FOLLOWING IMPROVEMENTS
Architecture	The scenario where the MOTIVATE functionalities are integrated in an application (mobile/webportal) already under operation through the use of "cloud function" appears the most promising exploitation conditions	MOTIVATE functionalities can be offered under a SaaS (System-as-a-Service solution)
Technical performance	Appropriate for testing purpose. Good base for developing further	Hw platform on which MOTIVATE platform runs can be scaled up to allow better performances and higher number of cities managed (end-users accesses to the platform)

ITEM UNDER EVALUATION	RESULTS OF THE EVALUATION	SUGGESTION FOR FOLLOWING IMPROVEMENTS
Functionalities	MOTIVATE platform provides basic functionalities for data collection, reporting functions are minimal	Improvements can be planned to allow a more efficient/direct data export process from the MOTIVATE platform to sw for the creation/management of the simulation model. The reporting functionalities can be improved and make more flexible allowing the operator to customize its own report. Functionalities for the integration of the MOTIVATE Platform with open source business intelligence module could be an alternative option to be considered for improving the flexibility avoiding complex customization of the reporting functionalities.
	MOTIVATE platform does not allow to configure O/D zones	This configuration could be added to ease the data export towards the sw for model simulation.
Operational responsiveness (i.e. easiness of use, friendless of the interface and end-user interaction, etc.)	The interfaces of MOTIVATE APP are fairly easy to use	In order to improve the end-user experience, the origin/destination of the trip can be selected through the PoI geo-referenced on the map

3.2 Actions required to launch the crowdsourcing data collection

The key strength point of the adoption of crowdsourcing tools for SUMP data collection compared to traditional tools (i.e. “on-site” surveys) is represented by the low efforts require to launch the tools from the technical point of view (in any of the possible operational and technological scenarios: the tool adopted is the MOTIVATE platform itself, an already operated APP/info-portal is integrated with the MOTIVATE platform through the “cloud functions” or the MOTIVATE functionalities are replicated on the top of an already operated APP/info-portal. Considering the actions required in each case (see D3.9.2 for details) the efforts are low both for resources and budget taking into account all the different implementation phases: development, configuration and testing.

Higher efforts are required for guaranteeing the supporting conditions for launching a crowdsourcing initiative (beyond the implementation of the technological tool). The supporting conditions relate to the stakeholder cooperation and the promotion of the use of the tool among the identified target users. Nevertheless, the efforts are lower than the implementation of “on-site” surveys.

Moreover the crowdsourcing tools can be adopted over a certain time of period (even quite long) then they allow a continuous updating of data and on-going monitoring of the items which are required to be estimated/assessed. Viceversa, the traditional data collection tools are usually implemented time by time being more demanding in terms of costs and resources for their implementation.

3.3 Usefulness and relevance of the data collected

The capability of the crowdsourcing tool to replace the traditional data collection methods (i.e. “on-site” surveys) is directly related to the amount of data collected by the crowdsourcing initiative. In order to reach this objective, the amount of data collected must guarantee a statistical inference of the whole dataset to be sampled.

The piloting actions taking place within the MOTIVATE project proved that this objective is quite hard to be achieved. The need to estimate the O/D matrix for the analysis of the demand in the early stage of SUMP development requires that data are appropriately distributed over all the possible combination among origins-and destinations, over all the possible transport modes, along the whole duration of the daytime (in particular peak and low demand hours) and for each day type (working day, Saturdays, Sundays, public holidays). The need to estimate the O/D matrix according to these conditions can be complied by a traditional data collection method (which is designed to guarantee these conditions in terms of places and time where/when the data are collected). For this reason, the surveys take place usually over a certain period of time as they are repeated in different places and time to remove the uncertainty which a sample method normally introduces. When a crowdsourcing initiative is operated to support SUMP data collection, the volunteer participation of the end-users (citizens and visitors) determines how much data and which kind of information is collected: for example, it could happen that few trip diaries are notified for an O/D trip which is (statistically) very frequent whereas more trip diaries are notified for O/D trip which is (statistically) less used. On the same way, a high number of trip diaries are notified for an O/D trip on a working day but very few on Sundays. In particular this risk affects the collection of trip diaries for which the whole number of trips to be estimated is higher: the risk is minor for the questionnaires evaluating the operated services or new services to be operated as in this case the number of the questionnaires which are statistically needed for inference purposes is lower. Lower number of filled-in questionnaires achieved by the crowdsourcing initiative can be use as statistical inference.

According to this consideration, the most promising scenarios for the adoption of crowdsourcing initiative for supporting SUMP data collection are related to the: 1) ex-ante evaluation of mobility services which are already operated collected from the customers and citizens (during the demand analysis and the identification of related gaps); 2) ex-post assessment of the implementation of actions defined by SUMP (during the evaluation phase of the SUMP itself).

Crowdsourcing tools can be seen as “low-cost” solution which can be more effectively introduce in certain types of data collection with a two-fold role: 1) to discover some possible weakness of the mobility offer or new requirements of the mobility demand at a preliminary stage and then better design and implement traditional data collection surveys (being more targeted these surveys should be easier and faster to be implement and they should have a restricted number of questions contributing to save time and money for the management, processing and analysis of the collected data); 2) to act as validation tool of the results of the traditional data surveys.

Errore. L'origine riferimento non è stata trovata. and Table 4 show in a more comprehensive way the role of crowdsourcing tools in the SUMP lifecycle and the relation between them and the traditional data collection tools.

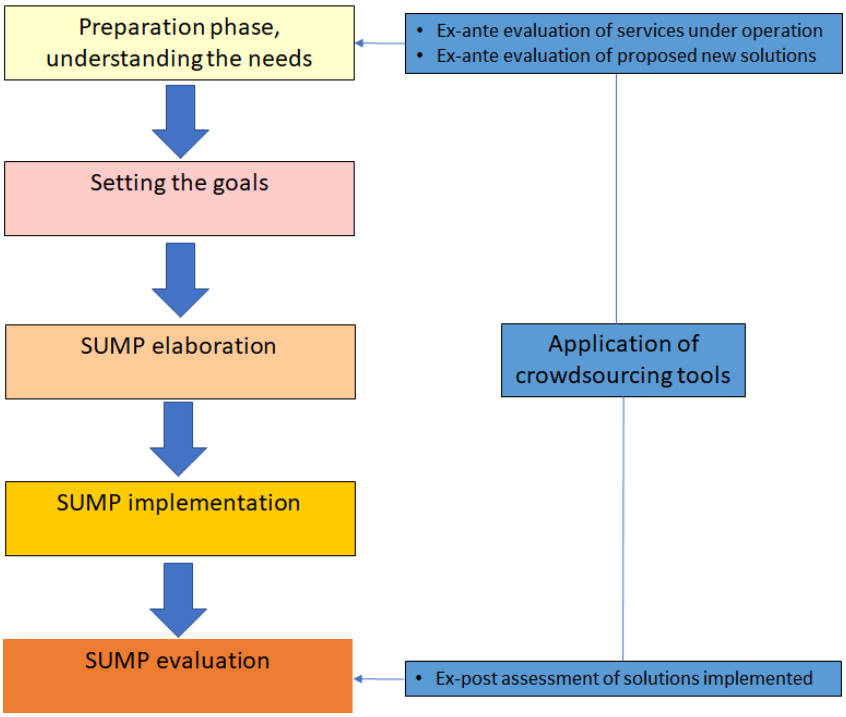


Figure 1: Role of the crowdsourcing tools in the SUMP stages

Table 4: Mutual relations between the traditional data surveys and the crowdsourcing tools

SUMP EVALUATION PHASE	ROLE OF CROWDSOURCING TOOLS	TRADITIONAL DATA COLLECTION TOOLS (SURVEYS, ETC.)
Ex-ante evaluation	"Low cost" tool for preliminary evaluation	Wider data collection focusing on the findings of preliminary evaluation
Ex-post evaluation	"Low cost" tool for validation of the findings of the assessment	Key tool for assessment

Nevertheless, the operation of crowdsourcing initiative to support SUMP data collection is still at a demonstration stage and further piloting actions are required in order to finally assess the real potential of these tools.

The suggestions to improve the level of usability of data collected through crowdsourcing tools are provided in Table 5.

Table 5: Key findings of the evaluation and suggestions for further improvements

ITEM UNDER EVALUATION	RESULTS OF THE EVALUATION	SUGGESTION FOR FOLLOWING IMPROVEMENTS
Amount of collected data able to guarantee statistical inference	The amount of data is not directly linked to the efforts produced for stakeholder engagement and tools promotion	Proper design of dissemination campaign Involvement of stakeholders acting as "multiplier" towards key target groups
		Incentives for the users in order to give them prizes according to the amount of data provided
Short-hand usability of data collected	Data needs to be pre-processed before to be used for O/D estimation	Possibility to configure traffic zones in the crowdsourcing tool platform in order to integrate the data flow from the crowdsourcing platform to simulation models

4 Guidelines for the implementation

This section provides a selected group of key recommendations provided to Public Authorities/Administrations and mobility stakeholder for the implementation of the crowdsourcing tools supporting the data collection for SUMP elaboration. These recommendations come from the outcomes of the demonstration of pilot actions occurred during the MOTIVATE project and the findings of the evaluation process and the knowledge/expert opinion of the MOTIVATE consortium.

The recommendations are divided for each step of the implementation of the crowdsourcing tools:

- Design of the tool
- Technical implementation
- Management of the operation (supporting activities, launch and monitoring of results/performance)
- Evaluation of the results compared to the targets

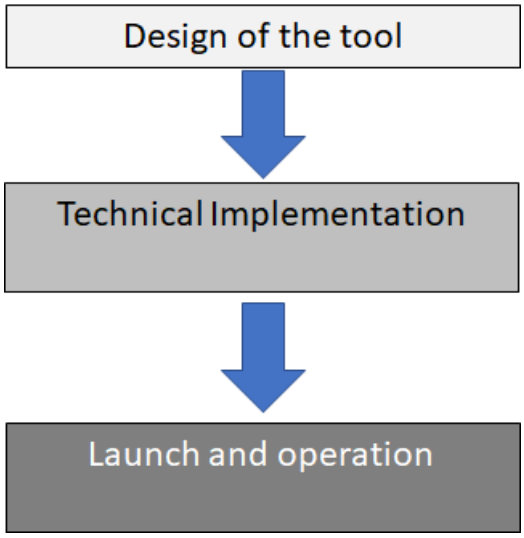


Figure 2: Implementation stages of crowdsourcing tools

The recommendations are given under the form: **To Do's** or **Not To Do's**.

4.1 Design

The key recommendations for the design of the crowdsourcing tools are listed in Table 6.

Table 6: Recommendations for the design of the crowdsourcing tools supporting data collection for SUMP

DEFINE THE OBJECTIVES OF THE INTRODUCTION OF CROWDSOURCING TOOLS

To Do's:
• Identify **the role** of the crowdsourcing tool **in relation with the traditional data collection** tools and how to combine the two approaches (according to the indications provided in section 3.3):
  ○ to act as "pre-assessment tool" to better target traditional data collection surveys
  ○ to act as validation tool of the results of the traditional data surveys
  ○ combination of the two approaches listed above
• Identify **the type of data** to be collected and the services (already operated/new) which could be assessed through the crowdsourcing tools
• Involve **the key stakeholder from the early stage** of the process clarifying their role in the design, implementation and operation stage
• Address properly **the design of the technological tool** as well as **the planning of the actions required for the launch** of the crowdsourcing initiative
• Look at **relevant experiences** (such as MOTIVATE) to get best practice for the design

Not to Do's: • **Not to replace the traditional data collection** tools with the crowdsourcing tools • **Not to overestimate the potential** of the crowdsourcing tools for supporting data collection for SUMP • **Not to underestimate the time** required for the design
INTEGRATE THE FUNCTIONALITIES OF THE CROWDSOURCING TOOL INTO AN EXISTING APP/WEB-PORTAL ALREADY OPERATED FOR PROVIDING INFO/SERVICES ABOUT MOBILITY TO THE CITIZENS
To Do's: • Identify **the most promising APP/web-portal to integrate** the crowdsourcing functionalities (based on the number of users among the target groups). Identify **the (info)services** provided to the users by the selected APP/web-portal on the top of which the crowdsourcing functionalities can be developed and more easily • Define **the technical and functional specifications** for the integration • Specify **the use case scenarios** to be supported by the crowdsourcing functionalities according to the need of data collection and type of data identified in the planning phase
Not to Do's:

• **Not** to implement the crowdsourcing tool as a **stand-alone application**: this will lead to enter into the "market" from the scratch and to possibly fight with other APPs/portals already operated • **Not** to define use case scenario which require **demanding interactions** to the users: the user must be able to understand the "logic" of the tool and provided functionalities immediately and to complete the operation of data provision just in a few steps

4.2 Technical Implementation

The key recommendations for the implementation of the crowdsourcing tools are listed in *Table 7*.

Table 7: Recommendations for the implementation of the crowdsourcing tools supporting data collection for SUMP

SET THE GROUND FOR AN EFFICIENT MANAGEMENT OF THE IMPLEMENTATION IN THE CONTRACTING PHASE
To Do's: • **Specify the use case** scenarios defined in the design phase **in the specifications for** the implementation **contracting**: this will prevent the generation of "extra-costs" during the implementation occurring when the operative scenarios to be supported by the crowdsourcing functionalities are not duly reflected in the contracting package • Identify **intermediate steps** for the implementation: this approach will allow a proper monitoring of the tool development, an effective testing and acceptance process and a smooth operation • Define **the acceptance criteria** and **the performance indicators** to be achieved by the tool for each implementation step
Not to Do's: • **Not to underestimate the time** required for the contracting phase
TAKE INTO ACCOUNT FUTURE EXTENSION OF THE TOOL (to be guaranteed by the implementation itself)
To Do's: • The crowdsourcing tool must be **flexible** in terms of configuration and administration functionalities in order to be scaled up to different context and areas • The crowdsourcing tool must manage **different data collection procedures** and questionnaires to be applied in different context or areas

4.3 Launch and operation

The key recommendations for the launch and operation of the crowdsourcing tools are listed below:

Table 8: Recommendations for the launch and operation of the crowdsourcing tools supporting data collection for SUMP

TESTING THE CROWSOURCING TOOL FOR THE SIGN-OFF
To Do's:

- Define a **two-steps testing** procedure: the first to be carried out by a restricted group of tester (hopefully the technicians/stakeholder involved in the design), a second enlarged to a selected group of users (representative of the target groups to be addressed in the promotion)
- Identify and engage **the target users** which can be involved in the testing more easily
- **Define** the testing scenarios and **the tests** to be carried out
- Define the **modalities to collect feedbacks** from the test users (living labs, etc.)

Not to Do's:

- **No to limit** the testing of the crowdsourcing tool **to the technicians** or people already involved in the design
- **Schedule the release** of final version of the crowdsourcing tool (ready for testing) **very close to** the planned **launch** date

PUT IN PLACE A STRONG PROMOTION OF THE CROWDSOURCING TOOL

To Do's:

- Identify and engage **key stakeholder** able **to produce a "multiplying" effect** for the promotion
- Identify specific **promotion channels** and modalities for each target groups
- Explore full potential of **social media**
- **Be innovative** in the design of promotion strategies and initiatives
- Explore the role of **incentives and prizes**
- Plan **various repetitions** of the promotional initiatives at least at the beginning of the operation period: if the impacts of the first promotion initiatives towards the target users are lower than expected, try to **understand what** is going **wrong** and find other ways to overcome barriers and reach the goal

Not to Do's:

- **Not** to focus **only** on **traditional promotion channels** and initiatives
- **Not to** limit to some the planned actions and **wait for results:** be proactive

SET AN APPROPRIATE PROCEDURE FOR ON-GOING MONITORING OF THE OPERATION RESULTS

To Do's:

- Define **responsibilities** and **appropriate timing** to carry out an assessment of the results of the operation of crowdsourcing tool (from the quantitative – amount of data collected – and qualitative – relevance for statistical inference point of view. **Check** continuously the **data collected** assessing their usability (consistency, statistical relevance, etc.)
- Plan and put into practice **corrective actions**, if the results do not comply with the target value of the performance indicators

5 Conclusions

The evaluation of the crowdsourcing tools supporting the data collection for SUMP which have been demonstrated in MOTIVATE project has been carried out from three different perspectives: responsiveness to functional and technical requirements and performance indicators, required actions for launching the crowdsourcing tools comparing them with the implementation of traditional data collection procedures, usefulness and potential of the crowdsourcing tools to feed/enhance the data collection procedures for SUMP development and sustainable urban mobility planning process.
MOTIVATE have demonstrated piloting actions based on key functionalities for data collection (estimation of O/D matrix and evaluation of services already operated/assessment of the acceptance of new services and solutions): these functionalities and the related technical performances are appropriate for the piloting purpose representing the base for following improvements. These technical improvements focus on two main issues: the reporting functions offered by the tool (which should guarantee a high level of flexibility including the possibility to export data to an open source business intelligent module) and the possibility to decrease the work for manual post-processing of collected data providing an export functionality towards a suite for simulation.

Comparing the crowdsourcing tool with traditional data collection procedure, the first require low efforts to be launched even the time for the design (in particular when the crowdsourcing functionalities are integrated in an APP/webportal already under operation) and the supporting stakeholder engagement and promotion campaign must not be underestimated. Assessing further the potential of crowdsourcing tool supporting data collection for SUMP, the piloting actions taking place within the MOTIVATE project have proved that it is not easy to collect a high amount of data to comply with the requirements of SUMP (need for statistical relevance) and to replace the traditional data collection procedure. Further piloting actions are required in order to finally assess the real potential of these tools which are at first stage of implementation: the actual situation shows that the most promising scenarios for the adoption of crowdsourcing initiative for supporting SUMP data collection are related to the: 1) ex-ante evaluation of mobility services; 2) ex-post assessment of the implementation of actions defined by SUMP. The role of crowdsourcing tools can be: 3) to identify possible gaps or requirements to be fully analysed with targeted traditional data collection procedure (contributing on this way to decrease the cost and the time to carry out these), 4) to validate the results of traditional data collection procedure (based on a sample).

A set of recommendations can be identified for guiding future piloting experience: these recommendations cover the whole cycle of the tool implementation from the design to the operation. For the design it is recommended to identify in a clear way the role of the crowdsourcing tool and how to combine it with traditional data collection procedure, to identify the data to be collected and select an APP/webportal already operated where the crowdsourcing functionalities can be replicated or integrated. The technical design must specify the use case scenarios and how the new functionalities will be integrated in the already operated APP/webportal. Primary role for a successful management of the implementation phase is given to the contracting package both from the technical point of view (specifications as resulting from the design) and from the contractual (implementation steps, target performance indicators, etc.). An appropriate testing procedure must be put into practice: this should not be restricted to the people involved in the design and contracting but extended to a wider group of test users representative of the main target users addressed by the crowdsourcing initiative. Stakeholder which can facilitate the contact with target users and produce a “multiplying” effect for promotion must be involved from the design. Promotion must be differentiated per channels and strategies based on the different target users to be addressed and well embedded in the strategies of concurrent stakeholder: the promotion must be approached in a pro-active way not limited to implement what has been decided in the design phase but including also procedures to carry out an on-going monitoring of the impacts of the promotion and corrective actions, if necessary, such as the implementation of new strategies and actions.

Annex I
MOTIVATE
PILOT CASES

1 CITY OF ALMADA

Almada is located on the south bank of the Tagus River across from Lisbon (which is the capital of Portugal). It includes two cities (Almada and Costa da Caparica), suburban neighborhoods and rural areas, Almada is one of the 18 municipalities that compose the Lisbon Metropolitan Region, with 174 000 full-time residents in an area of 72 km2.

In spite of being mostly urban, Almada still manages to maintain and preserve 25% of its territory as a natural protected area of great natural richness and biodiversity. Almada confines with water to the East and North (Tagus River) and to the West (Atlantic Ocean). Almada´s Atlantic beachfront extends for approximately 13 km and is a popular leisure destination within the Lisbon Metropolitan Area.

Due to its location in the Lisbon Metropolitan Area and its urban nature, transports and buildings (comprising services and residential) are the most important sectors in terms of energy consumption and greenhouse gas emissions in Almada.

Almada has committed to the principles of sustainable development in many ways. In 1998 launched a local Agenda 21 process which in turn led to the City Council's 'Local Strategy for Sustainable and Solidary Development'. Almada has also developed its Local Strategy for Climate Change and, in accordance with the principles of sustainable development, joined the Cities for Climate Protection Campaign and ratified both the Aalborg Chart, also known as the European Sustainable Cities & Towns Campaign, and the Aalborg commitment. More recently, the municipality has committed to reduce its greenhouse gas emissions by 80% by 2050, as established by the Paris Declaration adopted by Almada City Council during COP 21, and to support the global effort to combat climate change.

The public transport system in Almada is based on the following main components:

- Train, bus and ship services (including ferries), for the commuters from and to Lisbon and the southern regions.
- Bus and tram services for the transport services inside the Almada area.

1.1 Study area

In order to assess the whole universe of trips to/from Almada, the study area covered the whole Lisbon Metropolitan Area as depicted in Figure 4.1, due to the fact that around 40% of Almada residents work in another Municipality, in particular Lisbon and Seixal. There are also important flows of people from neighboring Municipalities to Almada to work and visit the beachfront during summertime.

Figure 1-1: Area covered by Almada pilot city

Regarding the mobility measures decided by the Local Authorities to be evaluated through the second service of the MOTIVATE platform these are:

1. **The online PT Guide for Almada**

A useful and handy manual, available online, which gives the best mobility options to those who already use, or want to use, the wide range of public transport

The Municipality of Almada and the Local Energy Management Agency of Almada, AGENEAL, have been working with the different collective transport operators to achieve a better and more efficient articulation between the various modes of transportation, as a way to improve the service rendered and adequate the needs of the population.

In order to promote the use of public transport in daily home-work and home-school trips, to make known the various modes of collective transport available and to contribute to the promotion of a more sustainable mobility, the first Public

Transport Guide was launched in 2009 of the Municipality of Almada. It is now time to present an updated version of this Guide, in digital version.

The Guide provides complete and systematized information on all internal and external connections to Almada by Ferry, Tram, Rail, Bus, Flexibus, Beach Train and "Boca do Vento" Lift. The information is organized by public transport mode containing, for each alternative, the service in the area, the routes, connections, schedules and conditions for the transport of bicycles. It also includes a PT route planner to better organize journeys.

The online guide provides maps with the public transport network of Almada and the main connections to the neighboring territories, as well as the location of tourist attractions and points of interest to help discover the best that exists in the Municipality. Available at http://transportesalmada.ageneal.pt

2. The quality of the Public Transport services in Almada

The Municipality of Almada offers a vast and complex transport network, which encompasses several modes: bus (TST), tram (Metro Sul do Tejo), train (Fertagus and Transpraia) and boat (Transtejo):

However, the spatial and temporal coverage of the various modes of public transport is very asymmetric in the territory, subsisting less densely populated areas of the county, where the offer of public transport is less attractive. According to the Mobility Survey of 2015, the modal split of journeys in Almada is 47% private car (PC), 31% public transport (PT), 5% PC + PT, 17% on foot and 1% in bicycle . However, the tram service introduced in 2008, the introduction of pedestrian zones in the city center, the development of the Almada Cycling Plan and the optimization of TP-TP and TP-bicycle intermodality helped to make the Almada transport system more diversified and competitive.

3. Almada BUS Saúde

Almada Bus Saúde is a new, flexible and inclusive public transportation service that allows quick, convenient and safe connection between the Garcia de Orta Hospital, Almada Health Centers of Cova da Piedade and Pragal, and other public services in the its area of influence.

Almada Bus Saúde has a 6km course (between Largo 5 de Outubro, in Cova da Piedade, and Garcia de Orta Hospital), marked on the floor with a red line, and has no fixed stops - passengers can hop on/hop off throughout the entire journey. Just raise your hand.

Almada Bus Saúde circulates every day of the week, including holidays (with a 20' interval during weekdays, 40' interval during weekends and holidays).

While the future Interventions Assessment included:

1. Cacilhas GO real time information panel

Currently, Largo Alfredo Diniz, adjacent to Cândido dos Reis Street and where the intermodal terminal of Cacilhas is located, is the main access of the inland waterway connection and one of the main entrance doors in the Municipality of Almada. This terminal is served by several means of public transport, namely the ferry (Transtejo), bus (Transportes Sul do Tejo) and tram (Metro Sul do Tejo), in addition to individual car traffic. The organization of this public space makes it difficult for residents and visitors to apprehend the public transport options they should adopt, the destinations served, the location of the nearest stop to be used and the departure/arrival times, something that current bus stops do not provide properly. These difficulties are especially pressing for potential bus users, given the proliferation of stops with 25 destinations, 3 career types (Urban, Suburban and Special) and about 800 daily circulations.

On the other hand, the logistics activities of restaurants and other commercial establishments at Rua Cândido dos Reis, and the congestion associated with road traffic and uncontrolled parking in its direct surroundings, are factors that strongly influence the experience and accessibility of public space users (residents, workers and visitors). In order to respond to these challenges, the Cacilhas GO initiative integrates the following operations: (i) installation of a real-time Information panel; (ii) Circulation control and requalification of public space.

Almada City Council and AGENEAL intend to develop a panel with real-time information on the various modes of collective transportation of Almada. The Cacilhas GO information panel will be linked to a centralized database, which stores the necessary information of the service to provide users. This database is currently available from the TRANSPORLIS consortium (www.transporlis.pt). In parallel, several actions will be carried out to requalify the public space and alter the road traffic and parking, in order to facilitate pedestrian and cycling in the area of implementation of the LVpD Almada, as well as remove the existing obstacles to the smooth functioning of the activities of logistics and waste collection.

2. The expansion of the MST tram service to Costa da Caparica beachfront

The MST service is an tram that circulates in the municipalities of Almada and Seixal.

In full operation since November 2008, the MST currently runs about 22 km, divided into three lines, covering public transport interfaces, commercial zones, universities and areas of great population density.

The MST is synonymous with urban qualification. Its construction was used to revolutionize the central axis of the city of Almada, endowing it with new squares, public spaces and green areas.

The Municipality of Almada defends the expansion of this transportation system to the Costa da Caparica and to Trafaria, in addition to the execution of the following phases already planned, with the connection to Seixal and Barreiro. In this way, it would constitute an alternative means of public transportation for all those who annually visit the beachfront of Costa de Caparica, reducing car need.

MST is an environmentally friendly means of transport, since it does not produce local emissions of GHG.

3. The expansion of the cycling network of Almada

The expansion of the Almada Cycling Network, through the Almada Cycling Plan, is part of a mobility policy developed by the Municipality, which aims to:

- Diversifying the supply of transport, promoting vehicles with greater energy and environmental efficiency - agreements have already been established with some of the transport companies that operate in the county, in order to facilitate the integration of the bicycle in their networks. Transtejo users already have a combined user + bicycle pass. Fertagus allows the free transport of these vehicles to any day of the week, outside peak hours or in the opposite direction of the large flow of passengers.
- Delineate a policy of effective integration of the bicycle as a smooth mode of travel - the benefits are clear: reduced congestion, greenhouse gas emissions and noise, better public space savings, the possibility of reclassifying these spaces and the health benefits of its users.
- Contribute to the goals of the Kyoto Protocol - in Almada alone, transport accounts for about 45% of greenhouse gas emissions.

With the Almada Cycling Plan, in particular, the aim is to promote the use of the bicycle in an urban context of proximity, in short distance travel, associating it with the public transport network and with collective equipment and green spaces.

1.2 Technological implementation of the crowdsourcing tool in the city

In the case of Almada pilot case, it was decided to adopt the installation and operation of the MOTIVATE platform through HIT/CERTH's IT infrastructure, since Almada City Council did not have any technological solution with similar functionalities.

Promotion of crowdsourcing initiative in the city

Short description of methods used for informing the public about the MOTIVATE app (WSs, LLs, social media, mobility week, etc.). Problems occurred and solutions found

Almada City Council, with the support of AGENEAL, Local Energy management Agency of Almada, developed a serious of local initiatives for dissemination of the MOTIVATE app and to familiarize users with its functionalities. The use of social media like Facebook and Youtube (https://www.youtube.com/watch?v=bQY4LQvDJjY) was extensively used, as well as flyers, the Municipal Bulletin and the City Council webpage.

Almada organized a Stakeholder Engagement Workshop during AGENEAL General Meting in 2017, which happens twice per year. The main objective of this event is to present to the local/national stakeholders (e.g. public transport operators; universities; EDP, Portuguese Electricity Company; ADENE, National Energy Agency; etc.), among other topics, a presentation about the EU-funded projects that are currently being developed in Almada (in which MOTIVATE project is included), in order to presenting it to local/national stakeholders.

Figure 1-2: First Motivate Stakeholder engagement in Almada

Almada also organized 2 Living Labs: the first LL, organized in 2017, focused in sharing MOTIVATE objectives and demo actions internally among different City Council areas/staff involved in the project, in order to obtain technical feedback related to the platform functionalities and supporting ideas for the successful implementation of the testing phase.

Figure 1-3: First Motivate Living Lab in Almada

The objective of the Living Lab 2, organized in 2018 for students and researchers in the Faculty of Sciences and Technologies of NOVA University, was to share MOTIVATE objectives and demo actions externally, in order to achieve a higher level of participation and app use from the local community. The focus on the University population is because they are regular users of the PT system of Almada and highly adept of social media, which makes them ideal users of the MOTIVATE app. This was also useful to obtain technical feedback related to the platform functionalities and supporting ideas for the successful implementation of the testing phase, since part of the attendees were researchers in the field of sustainable mobility. This was an informal event, but with good levels of discussion.

Figure 1-4: Second Motivate Living Lab in Almada

Very important for the dissemination strategy of Almada was European Mobility Week, which is held in Almada since 2002 and has become a staple in the City, with both national and international recognition (Almada City won the EMW Award in

2010). In EMW 2018 AGENEAL organized a one day dissemination event in the Faculty of Sciences and Technologies of NOVA University to reinforce the App use through the students, with a stand and a demonstration to interested persons.

Figure 1-5: The Motivate platform in the EMW 2018

Finally, in EMW2019 Almada organized its 3rd Living Lab and Transferability workshop. The objective of the Living Lab /Transferability Workshop was to showcase MOTIVATE platform and the results obtained in Almada to a wider audience, in order to share experiences and knowledge about mobility Apps because during this event other technological solutions and Mobility Apps were presented. The outcome of the event was an exchange of information process with cities, companies and PT operators that are using applications based on social media and crowd sourcing techniques for enhancing Sustainable Mobility and SUMP development. The event also included a Q&A and "hands down approach" to the several Apps presented.

Figure 1-6: Third Motivate Living Lab in Almada

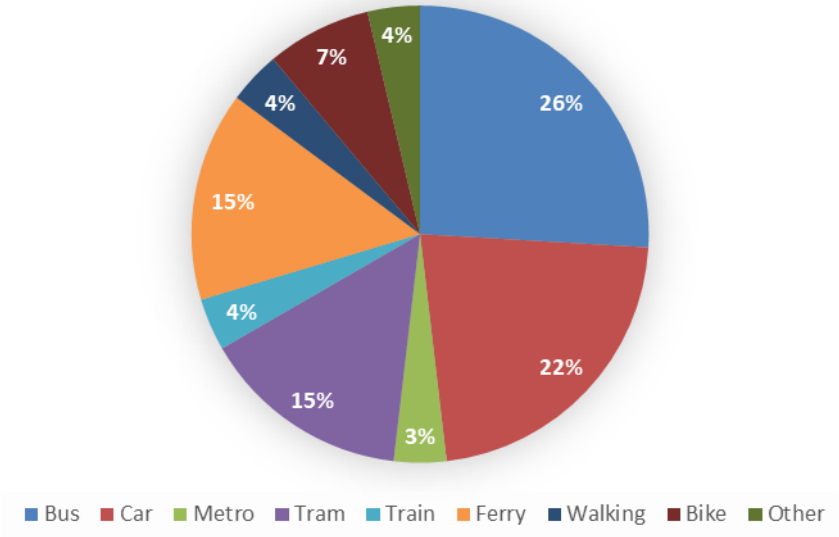
1.3 CROWDSOURCING DATA ANALYSIS

Trips data

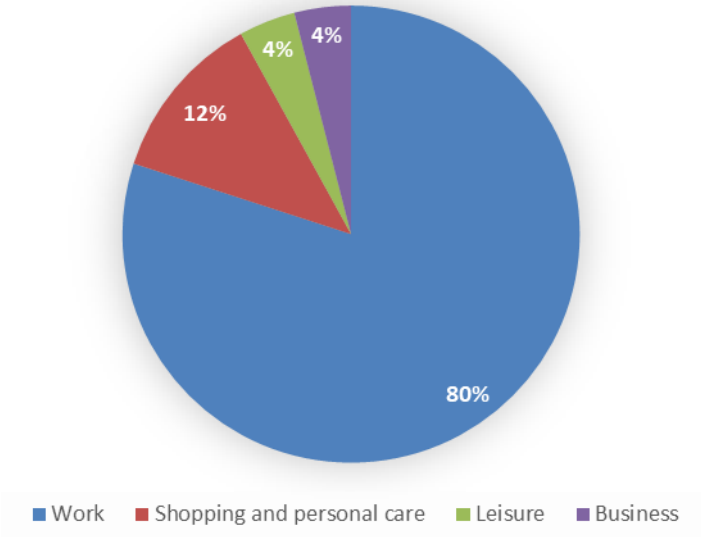
In terms of trips data, between 01/01/2018 and 23/10/2019 only 30 trips have been registered by Almada residents and visitors. Only 11 of the respondents declared their

gender (all males), and also only 8 declared that they were residents of the city. 33% of the respondents are car owners.

In terms of modal share of trips, Bus, Car and Ferry were the majority of transport modes used, comprising 63% of all transport modes.



The vast majority of the declared trips were commuting trips, as can be seen in the chart below.



As expected, most of the origins of the trips are the Municipality of Almada (64%) and Lisbon (31%). The most common destinations are the same Municipalities of Almada (81%) and Lisbon (16%), which is explained with the majority of trips being commuting reasons (to and from work).

Existing measures evaluation

Between 01/01/2018 and 23/10/2019, around 15 users expressed their opinion about the existing measures. The main results of each measure are summarized in the pictures below. Overall, the Online PT Guide of Almada and the "Almada BUS Saúde" service got very positive feedback and evaluation, while the general PT service of Almada was not so well evaluated.

Online PT Guide of Almada

- Is the information provided updated and accurate?
- Is the information easy to understand?
- Does the information answer to your needs?
- Does this service help in the increase of Public Transport use?
- Are you a user of the PT Guide of Almada?

Quality of PT service in Almada

- How satisfied are you with the existing coverage of the public transport network?
- How satisfied are you with the Integration between the different public transport modes in Almada?
- How satisfied are you with the Information and reliability in the public transport system of Almada?
- How satisfied are you with the quality and safety of fleet (cleanliness, comfort, noise, etc.) of the existing public transport system of Almada?
- How satisfied are you with the operating hours and frequency of the existing public transport system of Almada?
- How satisfied are you with the ticket costs of the public transport system of Almada?

Almada BUS Saúde service

- How useful do you think this service is?
- Does this service respond to your needs?
- How do you evaluate this service in terms of punctuality and reliability?
- Have you used Almada BUS Saúde?

Future mobility interventions assessment

Between 01/01/2018 and 23/10/2019, around 18 users expressed their opinion about the future and planned mobility interventions. The main results of each measure are summarized in the pictures below. Overall, these interventions got very positive feedback and assessment In the case of the expansion of the Cycle network, that most users are not frequent bike users, which indicates a strong potential of the intervention in the dissemination of this transport mode.

Cacilhas GO real time PT info panel

- How useful do you believe that the CacilhasGO initiative will be?
- Will this intervention help in the increase of Public Transport use?
- Will the provision of information be useful for your needs?

Expansion of the tram to Costa da Caparica beachfront

- How important do you think will it be to expand the MST tram to Costa da Caparica?
- How useful do you believe the MST tram service is?
- Do you believe that MST expansion will motivate you to use public transport for your trips?
- Are you a frequent user of the MST?

Expansion of the cycle network of Almada

- Do you believe that the expansion of the cycling network will be useful?
- Do you believe that this expansion will motivate you to use the bike more often?
- Are you a frequent user of bicycle?

2 CITY OF RHODES

The island of Rhodes/ Greece is situated at the SE of the Aegean Sea. The island occupies an area of approximately 1,400 square kilometers and has an actual population of 115.490 people. Almost 50% of the population resides in the city of Rhodes in an area of 20,34 square kilometers, no more than 1,46% of the total area of the island. The municipality of Rhodes is the administrative authority of the island.

The city of Rhodes has a history of 2400 years. The different people who settled in the island left their mark in all aspects of the island's culture: art, language, architecture. The Medieval city of Rhodes, built by the Knights of St. John, is one of the best preserved Medieval Cities in Europe and it is a UNESCO World Heritage Site since 1988.

Rhodes is a popular international tourist destination. The economy of the island is tourist-oriented. Almost 75% of the active population is engaged in the tertiary sector and tourism.

Rhodes's strategy is primarily based on the promotion of the sustainable development of the area. Therefore, the municipality is actively engaged in the HABITAT Agenda as well as Local Agenda 21. Furthermore the municipality became a signatory to the Covenant of Mayors in January 2010 making a commitment to achieve the EU target of 20% of reduction of CO2 emissions.

"RODA" is the municipal transport company that services the urban and suburban area of the city of Rhodes, as well as the interurban areas at the west side of the island. Daily an average of 3.900 kilometres is travelled during winter-time and around 5.400 during the summer. The company annually transports approximately 2.000.000 passengers.

Rhodes is historic city with a unique urban structure. The city centre and the medieval city are situated at the northern edge of the island. The entire major port infrastructure of the island is situated within the city's limits at the southeast waterfront area. There are only two road arteries with limited geometrical characteristics that connect the residential areas and the rest of the island to the city centre, resulting to major traffic congestion a while before approaching the city and a traffic confusion in the city and the city centre especially during the tourism season when the population of the island is at least doubled. Moreover Rhodes, as most medium sized Greek cities, has high percentage of car ownership and ineffective public transportation system.

While several traffic studies have been conducted for the city, the last one a few years ago, none of them has ever been fully implemented. Sustainable mobility measures are developed and implemented fragmentary in the city while there is not an overall

SUMP. The fact that the legal framework in Greece doesn't guarantee the citizens participation in public policies, results to locals often being conservative to changes in the urban environment and defend, sometimes successfully, the status quo.

There is planning for sustainable mobility measures such as the creation of peripheral parking bays so as to approach the city centre by foot, bicycle, or mini bus and the construction of a cycling network. The peripheral highway of the city is under construction. Rhodes has currently installed a public bicycle sharing system and has invested on the construction of waterfront pedestrian roads in the city centre so as to facilitate pedestrians. A real time traffic information system (DIAVLOS) is also developed. The municipality of Rhodes has recently obtained funding up to 60.000€ from the Green Fund in order to develop a SUMP.

The SUMP of the city should deal with its unique urban structure and the seasonal variation of population, propose/develop strategies that promote sustainable mobility and motivate citizens to adopt new mobility patterns and measures.

The city's effort currently is to increase the use of public transport. Mainly by integrating three (3) projects (DIAVLOS, MOTIVATE, ΕΥ-ΚΙΝΗΣΗ) the city of Rhodes has developed a mobility center available through web at mobility.rhodes.gr and by mobile at RHODES PUBLIC TRANSPORT where real time information for traffic and public buses is provided. The information is also projected within the buses and at the bus stops.

2.1 Study area

The study area covered the whole island, as depicted in the Figure below.

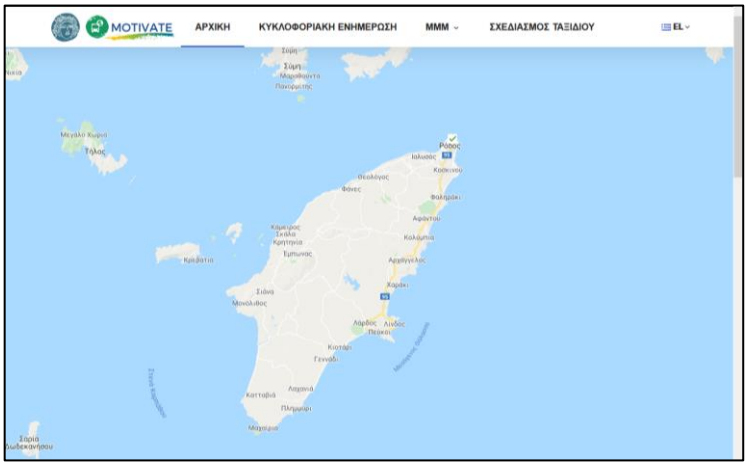


Figure 2-1 Rhodes study area

2.2 Introducing the mobile app "Rhodes Public Transport"

Rhodes pilot lies in the third scenario described in section 2.3 of the current deliverable. The Municipality of Rhodes developed a new mobile application the "Rhodes Public Transport". The mobility application for android and ios uses the API of MOTIVATE platform and includes all the functionality of the questionnaires. The crowdsourcing functionality evaluates the existent ITS system and also the new system, developed within the MOTIVATE project.

The developed mobile application is available at these URLs (iOS): https://apps.apple.com/us/app/rhodes-public-transport/id1451318391 and for Android at https://play.google.com/store/apps/details?id=gr.noveltech.cityguide.motivate The new platform offers real time information for traffic events, public buses routes, estimated time of arrival for all bus stops, city guide for the Rhodes island and also it is integrated with the MOTIVATE platform.

The "Rhodes Public Transport" application informs citizens, drivers and passengers in real-time on current traffic conditions and traffic events as well as information related to the Public transport in the Municipality of Rhodes. Moreover the application can perform a trip planning combination of Public transport and car as well as seeing estimated bus arrival times at stops.

In case that device has GPS, the application can communicate with it to read the user's current location to use it as an input parameter when searching for information.

More specifically, the application provides the following functions:

- ✓ Route Information
- ✓ Traffic Conditions
- ✓ Travel Planning
- ✓ Combination of Public Transport And Car
- ✓ Rhodes City Guide

Let's get MOTIVATED

Motivate Platform	Google Play	App Store

Integrating the MOTIVATE platform in the "Rhodes Public Transport" mobile app

The MOTIVATE platform was implemented as an extension of the existing platform of DIAVLOS and incorporated the following (new) systems:

- ✓ Control Centre (C.C.). It is the existing C.C., which incorporates the following applications:
  - Application of management and monitoring of public transport vehicles with passenger information capabilities.
  - Application of time travel estimates to public transport routes.
  - Application of an information system interface with the existing website of Diavlos project.
- ✓ Application of management and monitoring of public transport vehicles with passenger information capabilities. Existing vehicle telematic equipment and existing electronic signs were interconnected with the fleet management application to provide passengers with information on expected bus arrival

times at the associated stops. Communication of existing equipment and application is ensured through GPRS technology.

- ✓ Permanent Traffic Recording Stations. The two new permanent traffic data stations were installed as an extension of the existing permanent data traffic stations and collect traffic data for 365 days a year, which is sent in "real" time via GPRS technology to the software available at the Municipal C.C.
- ✓ Bluetooth Stations. The eight new Bluetooth stations are collecting the relevant data for 365 days a year, which are sent in "real" time via GPRS technology to the route estimation application installed at the Municipal JS.
- ✓ Route time estimation application. The Route Estimator app collects data from Bluetooth meters to calculate travel times on monitored routes and then distributes these estimates to other platform applications.
- ✓ Implementation of an information system interface with the existing website of Diavlos project. The actual interconnection concerns only the arrival times of buses at bus stops and timetables and nothing more than the existing system.
- ✓ Mobile application for traffic conditions and bus arrival times. The mobile application is specially designed for access to smart phones (Android, IOS), providing a user-friendly graphical interface to obtain information on the current state of the Rhodes road network and estimated bus arrival times of Rhodes public transport company on the stands. Current traffic information is derived from the existing traffic management application, while information on estimated bus arrival times is based on the fleet management application installed under this project. All relevant information is collected through a GPRS network and appropriate interfaces from the relevant applications.

2.3 Integrating the MOTIVATE platform in the “Rhodes Public Transport” mobile app

The new mobile application (Rhodes Public Transport) uses the API of the MOTIVATE platform. The use of this API, enables the user to use all the MOTIVATE platform functionality embedded in the mobile application. The user can fill in all the questionnaires of MOTIVATE platform and also can evaluate the existent traffic management system of Rhodes

Promotion of crowdsourcing initiative in the city

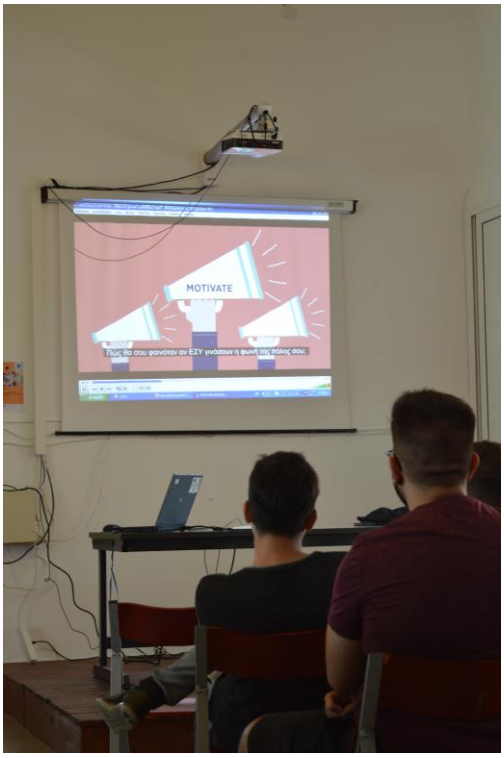
The municipality of Rhodes invested a lot of effort in communicating the project through several events. The motivate team of the city of Rhodes, held or participated at the following events to inform the public about the MOTIVATE app.

- Stakeholder Engagement Workshop, 24/4/2017, Rhodes

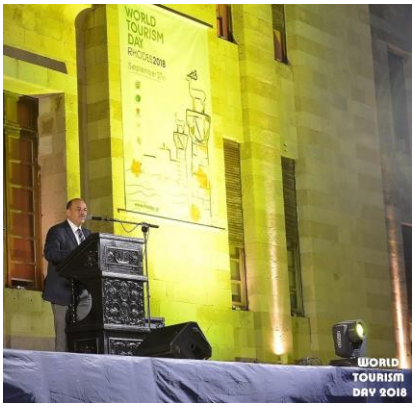

- 1st Living Lab 25/9/2017, Rhodes


- 2rd Living Lab 19/06/2018, Rhodes


- Living Labs at schools 11-05-2018, 07-05-2018 and 17-05-2018

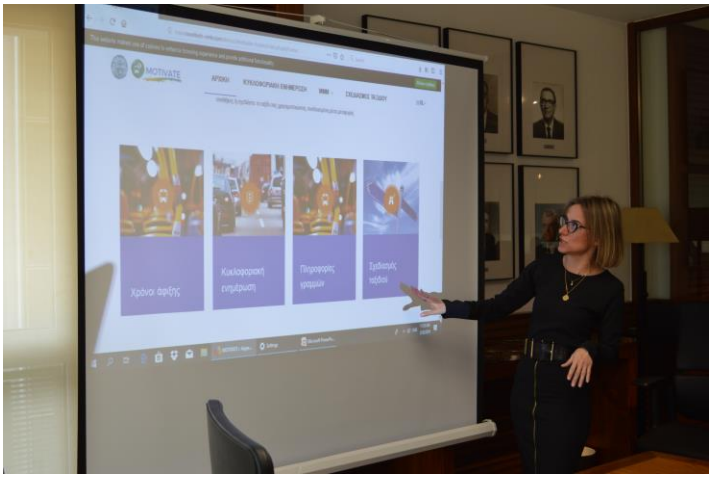


- “World Tourism Day” 29/09/2018, Rhodes



- 3rd Living Lab 30/01/2019, Rhodes

- Technical meeting project ΕΥ-ΚΙΝΗΣΗ, 28-03-2019, Limassol, Cyprus

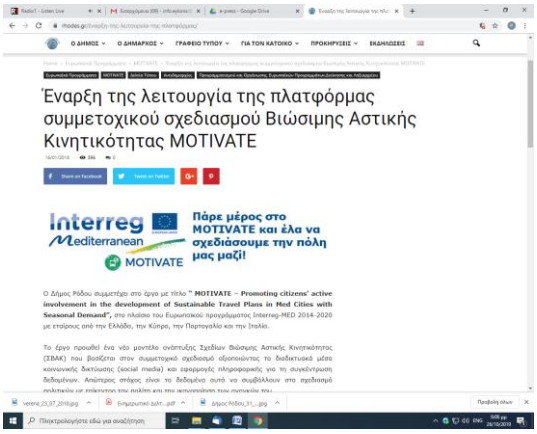


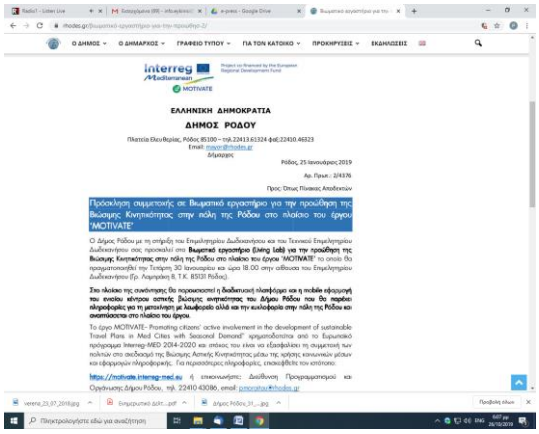

- Local transferring workshop 28/06/2019, Rhodes


- Conference “Transport and tourism” 04/09/2019, Rhodes


- 4th Living Lab 16/10/2019, Rhodes

All events were also communicated through the municipality's website, www.rhodes.gr. Several articles were published at the local papers and websites.





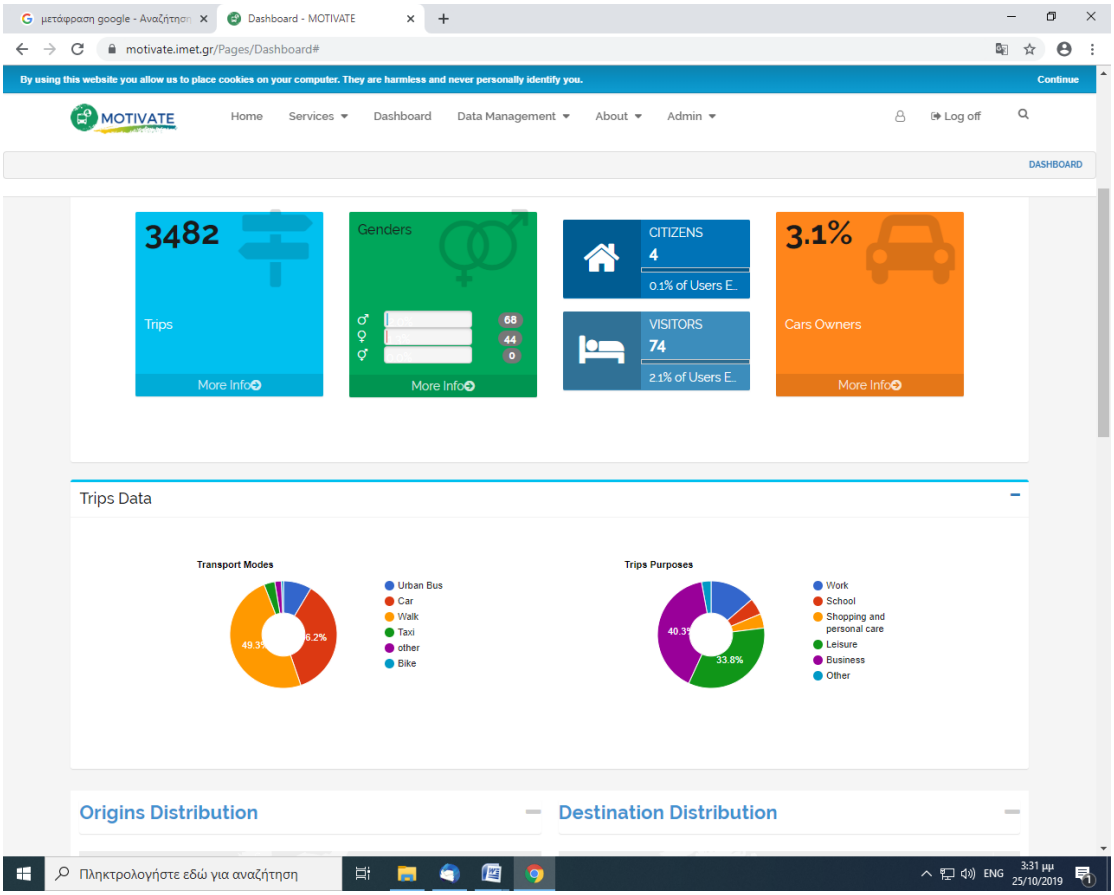
Furthermore leaflets and thematic folders where designed, printed and distributed at events and at the information desks of the municipality.

2.4 CROWDSOURCING DATA ANALYSIS

The testing period in Rhodes included high and low season. Data collected dealt with residents/tourists' trips, preferences and evaluation of the existing mobility and info mobility services. The data collected have been processed and the relevant findings have been used for obtaining two sets of information, regarding i) needed improvements of mobility services; ii) needed improvements/changes on the quantity and type of information provided by info mobility APP. Results of these analysis are presented in the next paragraphs.

Trips data

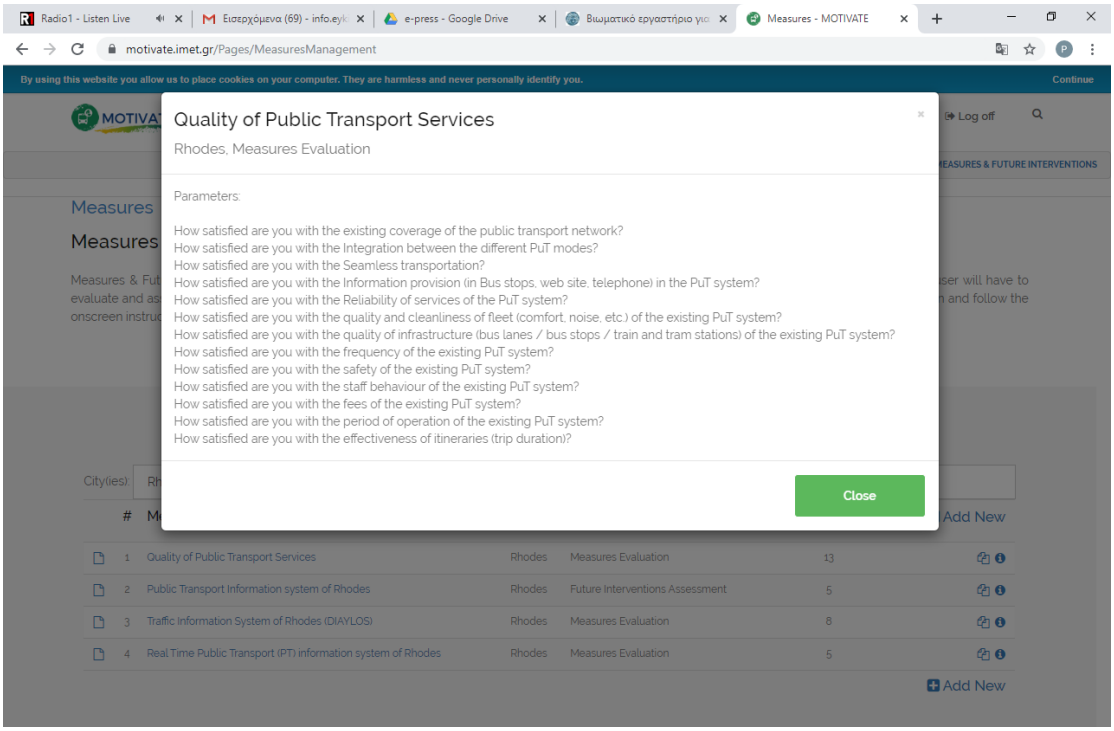
3482 trips where recorded, 68% of the users where male and 44% female

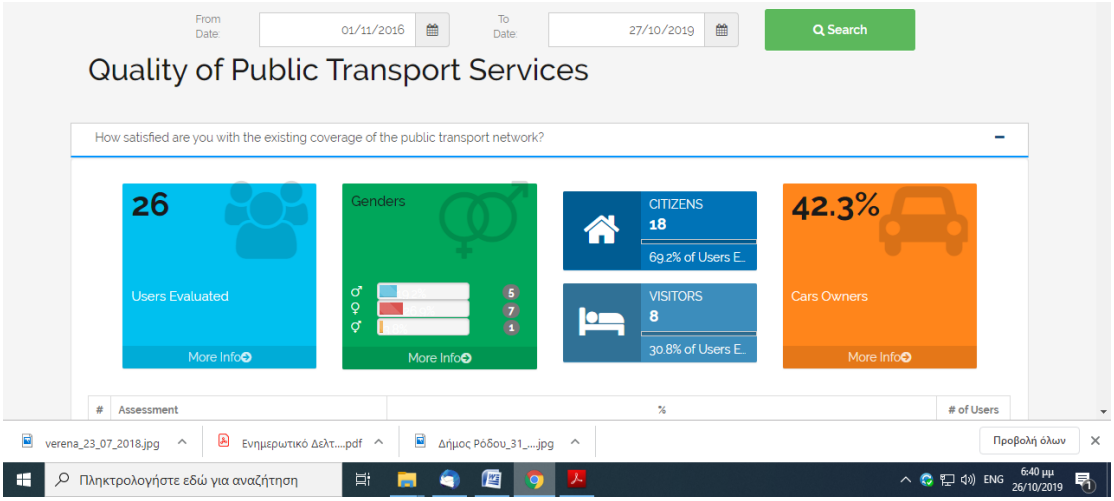


Existing measures evaluation

The services evaluated where

a)“Quality of public Transport Services” and the b)Traffic Information System of Rhodes (DIAVLOS) and c) the newly developed Real Time Public Transport (PT) information system of Rhodes.





26 users evaluated the Quality of public transport services. Some of the questions and their answers are listed below :

How satisfied are you with the existing coverage of the public transport network?

26,90 % answered “average”

How satisfied are you with the Integration between the different PuT modes?

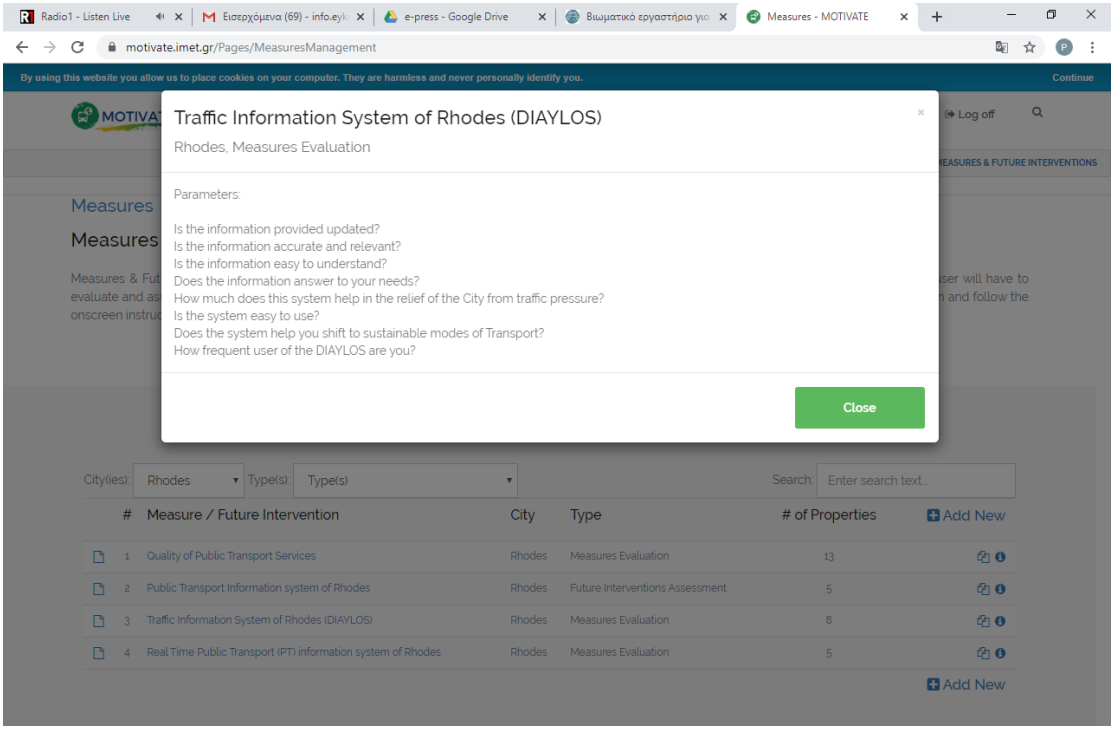
30,80% answered “Poor/Not Acceptable/Bad/Not Existing”

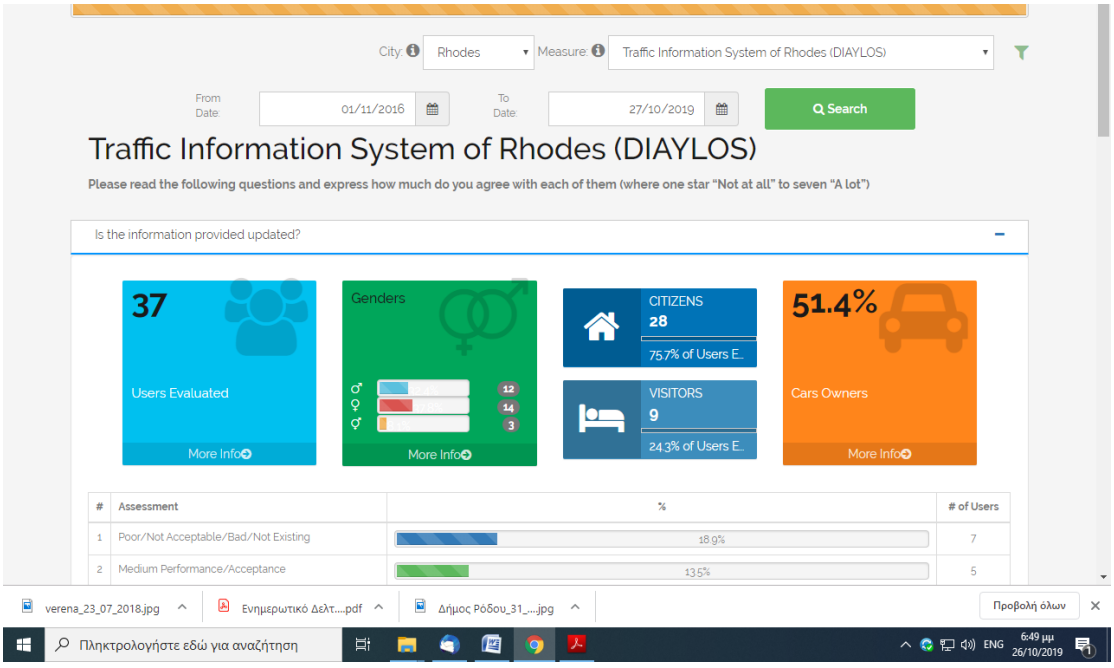
How satisfied are you with the Seamless transportation?

29,20% answered How satisfied are you with the Information provision (in Bus stops, web site, telephone) in the PuT system?

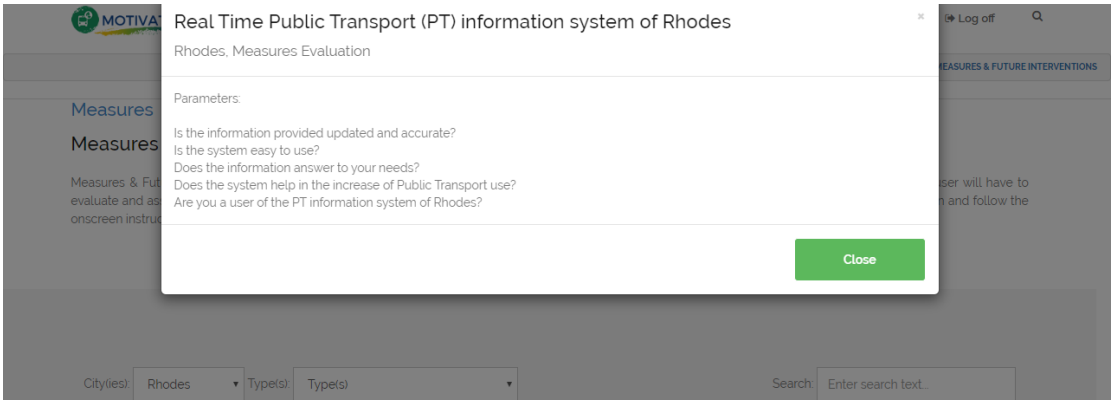
How satisfied are you with the Information provision (in Bus stops, web site, telephone) in the PuT system?

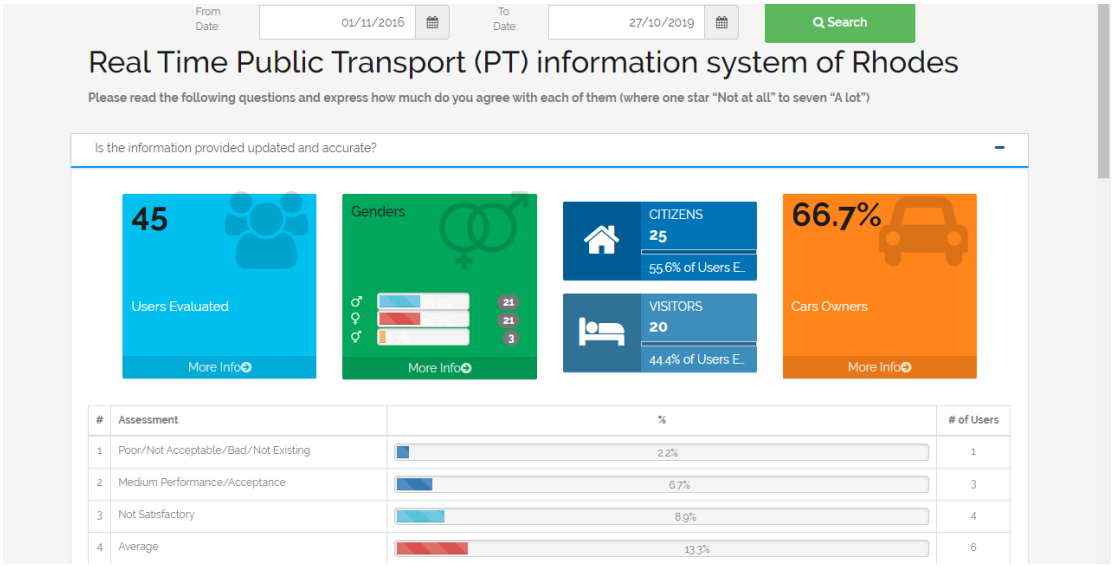
30,80% answered “Poor/Not Acceptable/Bad/Not Existing”





37 users evaluated the Traffic information system of DIAVLOS. At the question “Is the information provided updated ?” 18,90% answered “Poor/Not Acceptable/Bad/Not Existing”

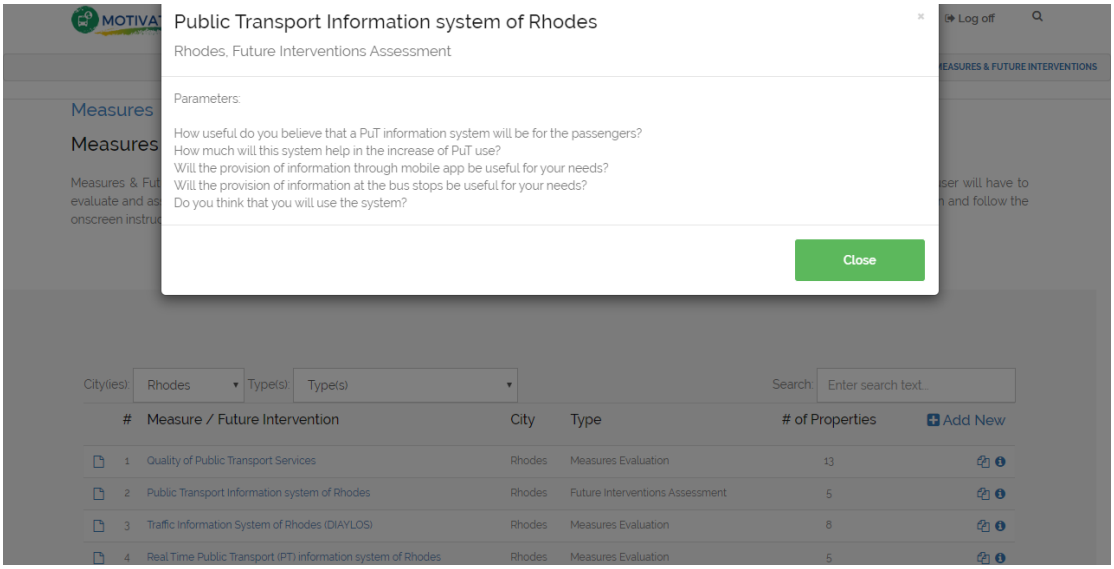


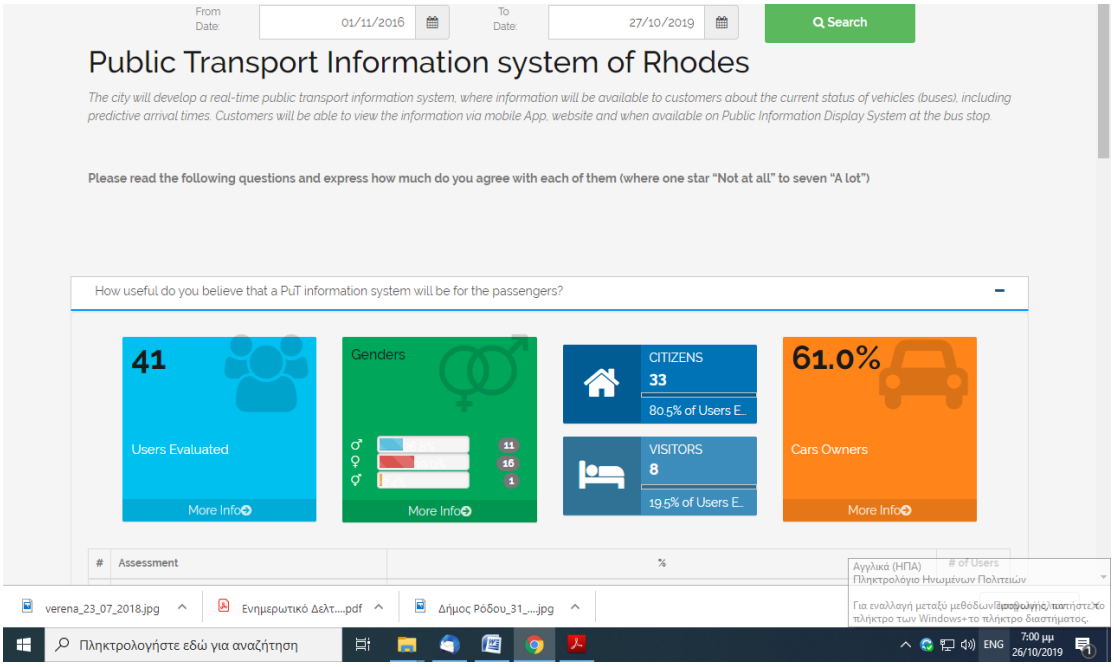


45 users evaluated the Real Time Public Transport (PT) information system of Rhodes. At the question "Is the information provided updated and accurate?" 42,2 % of the users answered "Very Good/Very Acceptable"

Future mobility interventions assessment

The future mobility service evaluated was the Public Transport Information System of Rhodes.





41 users evaluated the Public Transport Information System of Rhodes. At the question "How useful do you believe that a PuT information system will be for the passengers?" 58,50 % of the users answered "Very Good/Very Acceptable"

3 THE PILOT CITY OF SIENA

As the Tiemme Mobile App covers the whole area served by Tiemme, the new version of the App (upgraded with MOTIVATE functionalities) was published on the whole area too. Nevertheless the proper piloting of the App as crowdsourcing tool to support data collection from users to enhance service optimization and re-planning (inside Tiemme) and for contributing to the SUMP mobility datasets (outside Tiemme) was carried out in the Siena city (which is one of the main four cities served by Tiemme): the activities supporting the crowdsourcing initiative was focused in this city (according to the MOTIVATE project objectives). In the following a brief description of Tiemme is provided in terms of covered area, type of offered services, key figures on Public Transport offer and ITS operated: then some details are provided about the city of Siena and the peculiarities of the pilot compared to the others of the project: finally the Tiemme Mobile App is introduced as technological background for the development of the crowdsourcing tool demonstrated in MOTIVATE project.

3.1 The area served by Tiemme

Tiemme Spa was born in 2010 as merging of 4 former Public Transport Operators: Train, LFI, ATM and RAMA operating the bus services in Southern and Eastern area of Tuscany Region.

Into details Tiemme SpA covers the area included in the Provinces of Siena, Arezzo, Grosseto and Val di Cornia area (rural area surrounding Piombino in the southern area of Livorno Province) (see figure below) for a total of around 13.000 sqKm.

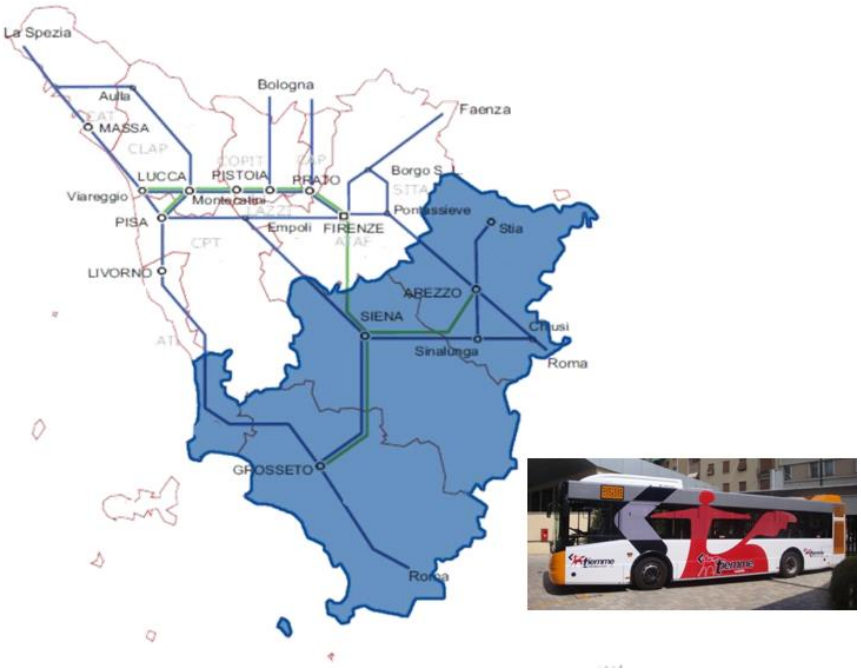


Figure 3-1 Area covered by TIEMME

The geographical area served by Tiemme consists in a number of medium/small urban areas (Siena, Arezzo, Grosseto between 70.000 and 80.000 inhabitants and Piombino – 30.000 inhabitants), smaller urban areas (Poggibonsi, Colle Val d'Elsa, Chianciano, Chiusi, Cortona, Arcidosso) and small villages dispersed in the rural area.

Tiemme operates bus services including:

- urban and interurban services (regulated under the service contracts signed with the Tuscany Region administration);
- Demand Responsive Transport service (on-demand) in some peripheral areas around Siena;
- school services and Park&Ride service (contracted by the Municipalities);
- rental services.

Tiemme carries out also supporting activities for bus operation as maintenance of the vehicles, sub-contracting of services and externalization of activities, administration and corporate (staff management, purchasing, accounting, ecc.).

Tiemme SpA operates 34 millions km/year for about 40 millions of yearly passengers. The fleet is 700 vehicles, the employees are about 1050 (including administration, service control and management, drivers, maintenance, administration/accounting, etc.). The total turnover is about 90 millions Euro.

Based on these figures, Tiemme is in the ten biggest Public Transport Operators in Italy.

Tiemme operates a wide range of ITS supporting the services operation as indicated in figure below:

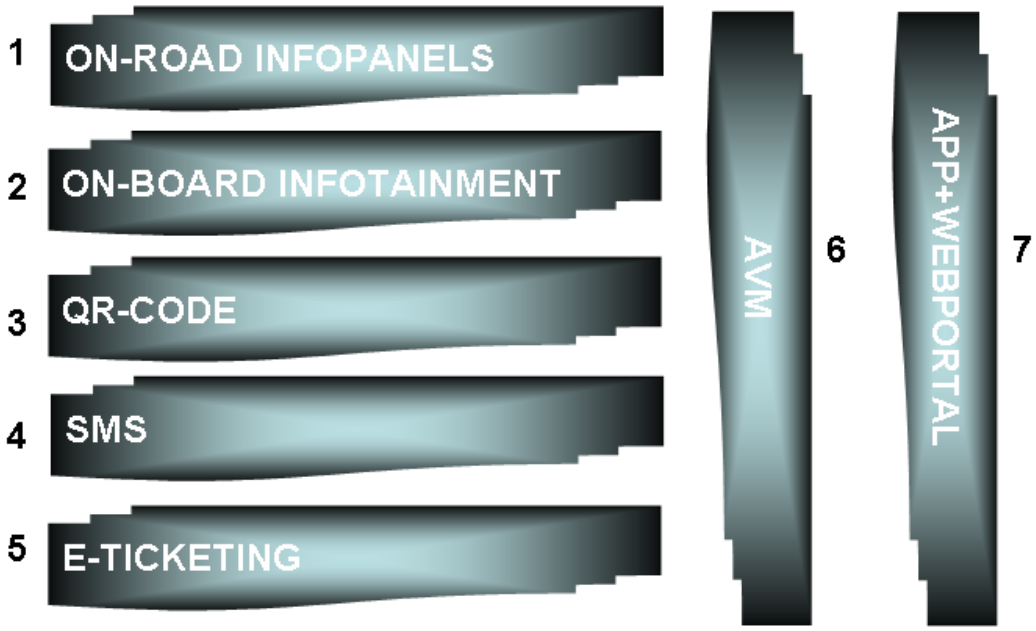


Figure 3-2 – ITS operated by Tiemme

E-ticketing system includes contactless smart card (subscriptions and e-purse), chip-on-paper (multitickets), SMS, QR code and bank card under demonstration in the urban area of Grosseto and on the line connecting Siena and San Gimignano.
A mobile APP "TIEMME Mobile" (iOs and Android version) is available for all end users of PT providing information on PT services (such as stop points, departure times, routes, journey planning, ticket purchase, news, location-based access to information, QR code interaction at stops and download of timetables).

3.2 Siena area

The city of Siena is located in the Tuscany Region in central Italy and it is one of the nation's most visited tourist attractions, with more than 4.000.000 tourists per year with high level of permanence, mainly concentrated during the spring and summer seasons and staying in the area for an average of 3 days.

Figure 3-3 - Tuscany Map and Siena location
Source: discoverTuscany

Siena is a mid-sized historical town declared by UNESCO a World Heritage Site and world-wide known for the "Palio", the annual historic horse-races that take place on 2 July and 16 August. Siena is also home to one of the oldest Universities in Europe with 16.000 university guests. Within an area of 119 km^2 the city counts around 54.000 inhabitants[1] (density of 455 inhabitants/km^2) and more than 13.000 commuters per day (71% for working reasons and 29% for studying reasons[2]).

The overall Siena Province instead counts 267.000 inhabitants and around 160.000 cars with an average of 1,7 / family, meaning 640 cars every 1.000 inhabitants.

Siena town is characterized by a wide historical area (a part of this is pedestrian), a network with narrow streets and high gradient and more than 750 shops in the inner city centre, administrative and bank offices, university structures, cultural and historical sites.

Figure 3-4 – Pictures of Siena: Image of the Palio (left side) and view of the historical centre (right side)

[1] https://www.tuttitalia.it/toscana/88-siena/statistiche/popolazione-andamento-demografico/
[2] https://www.osservatoriopums.it/siena

Figure 3-5 - Main Square in Siena City Centre

The tourist flow generates a strong pressure on the city mobility with a total number of nearly 30.000 tourist buses/year (with peaks of 280 buses/day) and 500.000 private cars per year.

Since the sixties, a large Pedestrian Area was realized, representing the first Blue Zone of Europe. In the historical center the RTZ (Restricted Traffic Zone) area with an extension of 1.74 sq.km was operated with a specific admission and access regulatory policy admitting different user categories (resident people, freights vehicles for the delivery service, tourists direct to the hotels).

The city is well equipped with different infrastructure and technological systems, including Integrated Parking Management, Touristic Bus Parking Management, Automated Access control to the RTZ with enter/exit portals, , Traffic information based on (VMS) Variable Message Signals, on-line traffic and environment data collection infrastructures, etc.

Public Transport Services in the urban and surrounding area of the city are operated by Tiemme, In the urban context of Siena, TIEMME operates 14 lines. The number of buses that every day exit from depots for the urban service are around 60, the yearly Kms travelled are 4 Million and the number of yearly passengers is around 10 ml. All bus stops in the city of Siena are equipped with info-panels providing real time information. Short vehicles are used for the operation of the city lines travelling in the narrowest street of the historic center.

Figure 3-6 - Tiemme Small Vehicle for Siena inner center service

A DRT service which serves a part of the suburban area of the city is also operated only on working days.

The general transport policy is based upon the concept of sustainable mobility and is defined by the PUM (Plan for Urban Mobility) and by the PGTU (Plan for Urban Traffic) which represent the short-medium term instruments for mobility planning, providing the general rules for mobility planning, viability measures, the organization and development of public transport network. A preliminary report on SUMP guidelines and principles was elaborated in November 2015 and the City Council decided to develop a SUMP in February 2016. A tender for contracting the elaboration of SUMP was published in February 2017 and a first release of SUMP by the awarding contractor was provided to the Municipality in December 2017. Consultation activities and SUMP refinement were performed until December 2018 and the City Council has planned to conclude the SUMP definition in February 2020.

MOTIVATE crowdsourcing approach has allowed the collection of a series of data (residents/tourists trips, O/D, preferences and evaluation on the existing mobility and info mobility services) which represent useful information for planners and PT operators to understand which could be possible improvements of the mobility services.

3.3 The peculiarities of Siena pilot and Tiemme involvement in MOTIVATE

The MOTIVATE pilot experience in Siena can be considered the demonstration of the possible contribution a Public Transport Operator (such Tiemme) can provide to the Public Administrator for SUMP development bringing data about Public Transport and exploring the use of crowdsourcing initiative to enhance the data reported by operated ITS (i.e. AVM for the assessment of service performance, e-ticketing for the number of passengers, etc.).

It has to be underlined that the MOTIVATE pilot site in Siena has two main peculiarities:

1) It was not led by a Municipality as for the other MOTIVATE pilot cases, but by a Transport Operator. The pilot was therefore focused mainly on the perspective of the **PT services**: all data collected through the new crowdsourcing functionalities implemented in the info-mobility App primarily served to analyse which PT service could have been improved besides providing also useful indications for Sustainable Urban Mobility Plan;

2) a commercial company info-users APP (Tiemme Mobile) was already operated by Tiemme before the starting of the MOTIVATE project.

3.4 The Tiemme Mobile App

The company APP, optimised for both smartphone and tablet and available on Android and iOS platforms, provides transport and services information to all the users of public transport services operated by Tiemme. In the following a brief introduction to the Tiemme Mobile App is provided; the description will be detailed later on. End users' services are accessible from the main screen (from bus journey planner to scheduled/real-time info (stop points, departure times, routes), from news/info about service operation (i.e. lines diversions, service disruptions,
strike, etc.) to tickets/subscriptions purchase (QR code, SMS)
from fines payment to booking of special services.No
registration is needed to use the App.The APP provides location-based access to information (visualization of nearest stops, selected by user terminal location by GPS)The APP is multi-language (Italian/English for publication) then extendible to other languages.

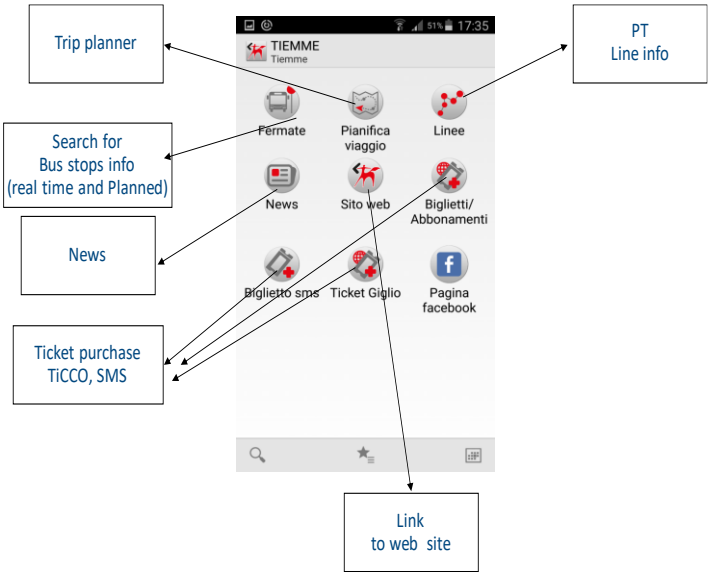


Figure 3-7 – Tiemme Mobile APP before MOTIVATE project

Siena, among the other MOTIVATE sites, represents a specific case involving the implementation of MOTIVATE functionalities in an environment already equipped with a real used APP, situation that is common to different European and Mediterranean SM towns.

Moreover, the Siena site is relevant for understanding also the level of technologies and complexity involved to replicate MOTIVATE functionalities on an existing APP and then integrating it with MOTIVATE platform in order to share the collected data.

The figure below shows the modules of systems (AVM) and modules needed for providing the related time and scheduled PT services (when real-time info are not available for technical and/or operational reasons) to the users by different media channels including Tiemme Mobile app.

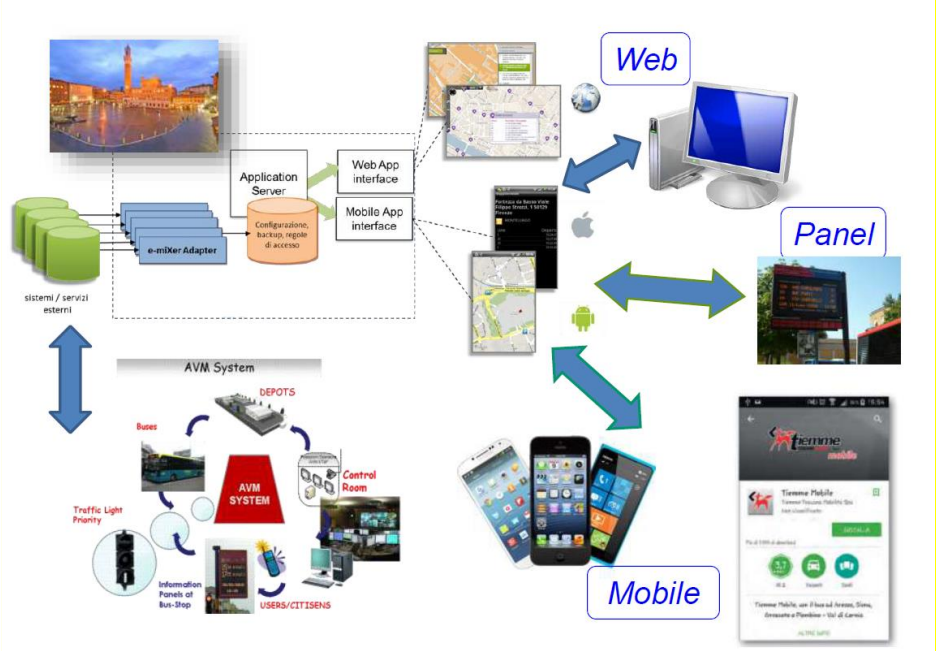


Figure 3-8 System architecture to feed TIEMME MOBILE

Within MOTIVATE, Tiemme Mobile app has been enhanced and enforced with new crowdsourcing functionalities dedicated to:

- travel diary related to the use of PT service/lines by the tourist/citizens,
- evaluate the operated services (lines), in terms of frequency, time coverage, connections options, etc.;
- evaluate the APP in terms of usability, reliability, etc.

3.5 Upgrading of Tiemme Mobile App as crowdsourcing tool through replication of MOTIVATE functions

As already indicated in chapter 4, the presence of TIEMME MOBILE APP managed by Tiemme allowed to replicate the new MOTIVATE functionalities rather than developing a completely brand-new APP. Siena pilot therefore lies in the second scenario described in chapter 2.2 above: MOTIVATE functionalities were thus implemented "from the scratch" in the existing APP. There were several reasons behind this choice:

- avoid promoting another APP at city level as this could have created possible confusion and misunderstanding for the end-users;
- avoid duplication of efforts for technical development and marketing, communication activities;
- optimize promotional activities building on the past promotional campaigns;
- having a greater leverage, taking advantage of Tiemme Mobile APP users as potential users of MOTIVATE functionalities.

M. Pallari – Tiemme IT responsible

"The new functionalities for collecting feedbacks on PT services and APP itself were developed according to the same design used for MOTIVATE platform but implemented as improvement of the existing Tiemme Mobile APP. This facilitated the usability and help to not generate confusion between two products. From our experience, it is preferable to ***avoid the integration between two different systems****, in this case, the Tiemme Mobile APP as data collecting interface and the MOTIVATE platform. Moreover, Tiemme Mobile APP was already interconnected with a background module easily expandable for allowing to collect, store and report users' feedbacks". Then data will be shared "off-line" by the two platforms using MOTIVATE "cloud" functions*

This scenario is also useful for transferability purposes: in fact, many other cities are operating existing APP/web portal for users' information (city APP, PT company APP, tourism applications, etc.) and they could be interested in developing the MOTIVATE crowdsourcing tool, starting from the experience of Tiemme.

SIENA pilot case as a specific reference scenario for transferability

MOTIVATE functionalities were thus replicated on Tiemme Mobile APP, adapted to the functionalities and operational scenarios already supported by Tiemme Mobile and designed to manage the different areas of services covered by Tiemme. The technical implementation, the operational procedures, the interactions with the end-user and the collected data are **adapted to functional specifications and data follow of the existing APP**: Tiemme Mobile APP is connected to a back-end module (in the Tiemme Mobile platform). The back-end module of Tiemme Mobile platform stores the data collected by the APP front-end interface. The back-end module of Tiemme Mobile guarantees that data collected can be published through webservices that can be read by external systems due that the data format is based on standards (SIRI, MOTIVATE "cloud" functions, etc.).

Therefore, the operational steps undertaken in the MOTIVATE project at Siena site level were the following ones:

- design of the new functionalities (travel diary, evaluation of existing bus services (lines));
- definition of the modalities of data exchange flow between Tiemme Mobile APP and MOTIVATE platform (travel diary data in particular);
- integration of the new MOTIVATE functionalities in the Tiemme Mobile APP;
- upgrade of the components of Tiemme platform (APP User interface, APP module for data processing and local data storage and back-end module for data storing, data reporting and transmission to external data sources);
- release of a beta version;
- organisation of lab testing and focus groups with specific users for testing the new version following the methodology set by MOTIVATE;
- publication on the market Android and iOS in order to make the app downloadable by the users;
- periodic initiatives of APP promotion with spotlight on “MOTIVATE”
- organization of dedicated local workshop and/or living labs as indicated in the MOTIVATE project to present the new version;
- final improvement and revamping of the app in terms of usability and graphics;
- continuous monitoring of collected data;
- evaluation of the role/potential of data in optimization/improvement of PT service planning process (qualitative analysis – relevance for stakeholders);

The functions to upgrade Tiemme Mobile APP were the following:

- Travel diary
- Public Transport Lines and Tiemme Mobile APP evaluation
- Transmission to MOTIVATE platform of data collected by Tiemme Mobile

The figure below shows the functionalities deisgned, implemented and added to the existing Tiemme Mobile App. These new functions are shown in blu box.

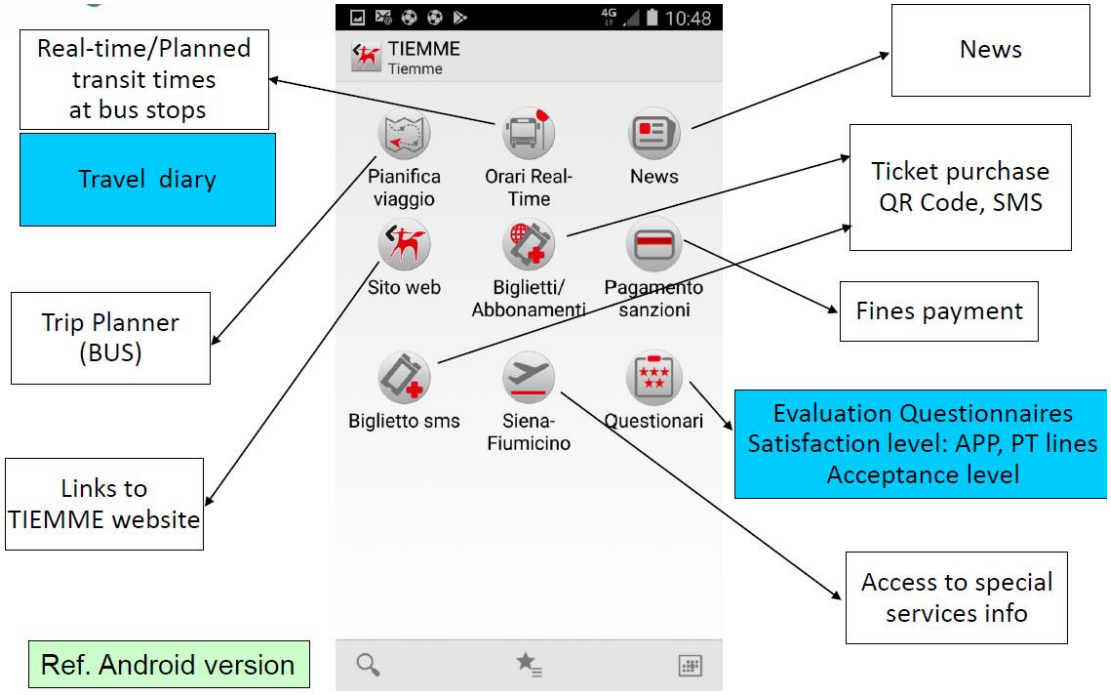


Figure 3-9 – Tiemme Mobile APP with the new MOTIVATE functionalities (in blue)

Travel diary

The real-time information on arrival time of buses at bus-stops was the base for the Travel diary function. This functionality proved to be the most used by end-users basically for knowing the real-time information on bus arrival at the stop.
The bus stop is also fundamental to estimate an O/D matrix for Public Transport. Considering the above, it was decided that the real-time function could have been used to link the travel diary function in a friendly way for the user. In fact, once the user selects a bus stop to access real-time info, the origin point of the trip is represented by this selected bus stop. The APP then presents the list of next stops to be selected by the user (if the user does not select any stops, the final destination of the trip is assumed as trip destination by default).
Each trip is registered separately:

- Bus stop code – estimated trip origin
- Time when the trip is started
- Line/Trip code – estimated line used by the user
- Bus stop code – trip destination

Therefore, there is a simplified interaction to manage the functionality for travel diaries collection: data can be reduced at origin bus stop, route/line, destinations bus stops: this is enough if we are looking at trip diary from the perspective of Public Transport (transport mode is the bus, network is the bus network) The APP stores the line number selected by the user when he accesses to real-time information and he select the line.

Evaluation and assessment functionalities

The evaluation and assessment functionalities concerned a series of questionnaires that Tiemme Mobile APP users can access to evaluate:

- The App itself
- The bus lines

The evaluation is simply done by answering each question with a star rating system:

Level of Satisfaction

★ = Not satisfied at all
★★★★★★★ = Fully satisfied

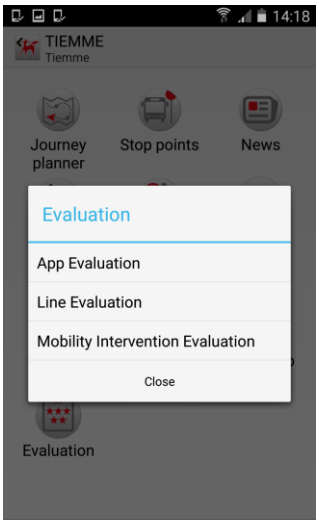


Figure 3-10 Evaluation and Assessment Functionalities

The questionnaires on the evaluation of the bus lines have the following objectives:

- Collect specific data to enhance traditional customer surveys
- Improving the traditional customer surveys, moving further to a more continuous process than the current adopted one (based on periodic surveys).

The questionnaires on the evaluation of the APP have the following objectives:

- Collect specific and relevant data to improve/change the quantity and type of services/information provided by TIEMME APP;
- Reinforce the quality of TIEMME APP with new functionalities or specific solutions to answer to users' needs (i.e. enhancement of user experience, easiness of interaction, simplified interface, improved layout/graphics)

Data exchange between Tiemme Mobile Platform and MOTIVATE platform

Once the Tiemme Mobile APP back end was integrated with MOTIVATE cloud functions ,data exchange between the two platforms was enabled.

Cloud functions supports the webservices the MOTIVATE platform is able to expose and share with third party interfaces in a reading mode. Webservices allow data exchange between MOTIVATE platform (and, in particular, its repository) and Tiemme Mobile APP. The data transmission procedure is from Tiemme Mobile platform to MOTIVATE platform.

Thus, the repository of MOTIVATE platform collects the data gathered by the MOTIVATE APP.

New version of the APP

Tiemme started working on the overall restyling of the APP in the second half of 2018 in order to attract more users. The need to improve the graphics and enhance the user experience was identified through multiple processes: focus group, expert assessment and also the results of the MOTIVATE questionnaires. During the first quarter of 2019, a new demo version of the APP was available. All the "graphic" of the APP was re-designed and all functionalities (travel diary and evaluation questionnaires included) have been maintained, ensuring a long-term perspective to MOTIVATE functionalities, also after the end of the project.

Figure 3-11 – New demo version of Tiemme Mobile APP

3.6 Web portal

Tiemme operates the MOTIVATE platform (web interface) as webportal for data collection as it was not efficient to replicate the MOTIVATE functionalities on the company website.

For this the MOTIVATE platform was configured as indicated in section 2.1:

- Creation of main cities served by Tiemme (Siena, Arezzo, Piombino, Grosseto)
- Updating of city boundaries
- Translation of text (static and dynamic) in italian
- Link configured from the company website to the MOTIVATE platform (web)

The following map depicts the boundaries of the Siena area (as an example). The area was identified and configured considering that Tiemme service cover both urban/suburban and rural area around Siena.

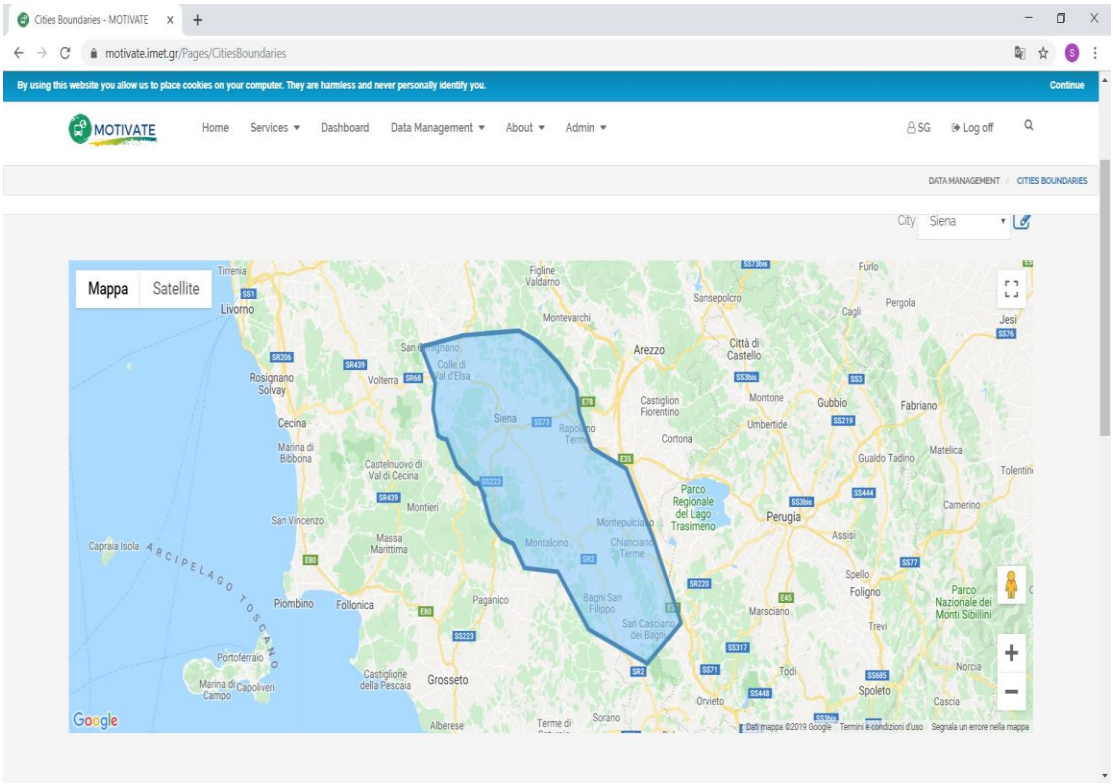


Figure 3-12 – Study area of Siena pilot

Promotion of crowdsourcing initiative in the city

As one of the largest PT operator in Italy, Tiemme has always given a specific attention to the promotion of its services. Before the beginning of MOTIVATE project, Tiemme Mobile App already counted 15.000 active users since 2014.
During MOTIVATE lifetime, Tiemme organized 5 events in total, two workshops and 3 living labs. Here below a short summary of the approach and methodology used for each of them:

- The **first Living Lab** was held in Tiemme headquarter in Siena on the 9th of May 2017 involving Tiemme IT and marketing/communication staff and a restricted audience of selected technicians (from a PT Operator providing end-users services on APP platform and from Siena University working on IT and APP development) that could have validated the solutions defined for the upgrading of Tiemme Mobile APP to MOTIVATE purposes and functionalities. The format of the event was a brainstorming discussion on different use case scenarios allowing to collect MOTIVATE data (travel diaries, evaluation of the service, evaluation of the APP) with a simplified interaction required to the users according to the functionalities provided at the time by Tiemme APP.
The results of the discussion gave useful insights for the further development of the new functionalities of the Tiemme Mobile App.

Figure 3-13 Tiemme 1st Living

a Stakeholders' Engagement Workshop, an awareness-raising event aimed at promoting and informing stakeholders about the MOTIVATE project and its objectives was organized in Siena on the 10th October 2017. The workshop was attended by different groups of stakeholders from local public entities (Municipality of Siena and Grosseto), local PT operators (covering Florence Metropolitan area) and from academia (University of Siena and related incubator start-ups). The format of the event was a rather "classic" one with presentations followed by Q&A sessions. The event was promoted through Tiemme social media (web site and Facebook). This event was prepared by an acknowledgement letter sent by Tiemme to the relevant stakeholder playing for supporting the promotion activities (Siena University, Schools, Associations for Tourism Development, Hotels, Citizens Associations, etc.)

Figure 3-14 - Stakeholders' Engagement Workshop

- The **second Living Lab** was organized at the University of Siena on the 15th May 2018 and was attended by University students and Professors. The aim was to collect feedbacks on the MOTIVATE project and on the MOTIVATE functionalities developed and integrated in the former version of the Tiemme Mobile APP (real time/trip diary, evaluation and assessment functionality,) directly from the students who represent a relevant end-users category for PT services. After the presentation of the project and the functionalities of the APP, participants had the chance to express their opinions through a sli.do session and through a paper questionnaire (developed by MOTIVATE within Activity Act3.9 for the evaluation of the technical and operational performance of the crowdsourcing tool demonstrated during the project) which was distributed during the event.

Figure 3-15 - 2nd Living Lab

- A Participatory approach was instead used for **the third Living Lab** hosted on the 29th March 2019 by a higher education institution, one of the most important technical secondary school in Siena and surrounding areas. The event was attended by students of different classes of the institution and by several professors. This event focused on the evaluation of the new (improved) graphical version of the APP (still upgraded with MOTIVATE functionalities) This time, students were offered the necessary space to directly provide their feedback on the features and functionalities of the app and crowdsourcing techniques MOTIVATE put forward. In fact, some of them were selected to do the testing and evaluation of the newly released version of the APP (still in beta version) which was available in Google Play for Android one week before the event. During the event, they presented the results of their evaluation activities and of a survey they conducted with other classes that were not participating to the living lab. Students were also given the possibility to provide their opinions through a menti.meter session. The event was promoted on the local newspapers and local TV.

Figure 3-16 – TIEMME Living Lab 3 Students presentation

- The **Transferability Workshop** with the title "Innovation supporting SUMP: the MOTIVATE project and the public transport services" was organized on the 10th July 2019 in Florence. The workshop was mainly targeted to representatives of PT operators, local municipalities and provinces of the Region and aimed to inform these stakeholders about the results obtained within the MOTIVATE project and to provide insights on the usefulness of the use of crowdsourcing tool to collect relevant data for optimizing the transport offer. There was a high attendance from all these groups of stakeholders. In particular, apart from Siena, 8 other local municipalities (Lucca, Livorno, Poggibonsi, Arezzo, Grosseto, Pomarance, Calci, Pisa) spanning from 5.600 to 160.000 inhabitants, and 4 PT operators attended the event. As it can be seen from the map below the southern municipalities are served by Tiemme (Poggibonsi, Arezzo and Grosseto) while the northern ones (Livorno, Pisa, Calci, Pomarance) by another transport operator, CTT, which also attended the event.

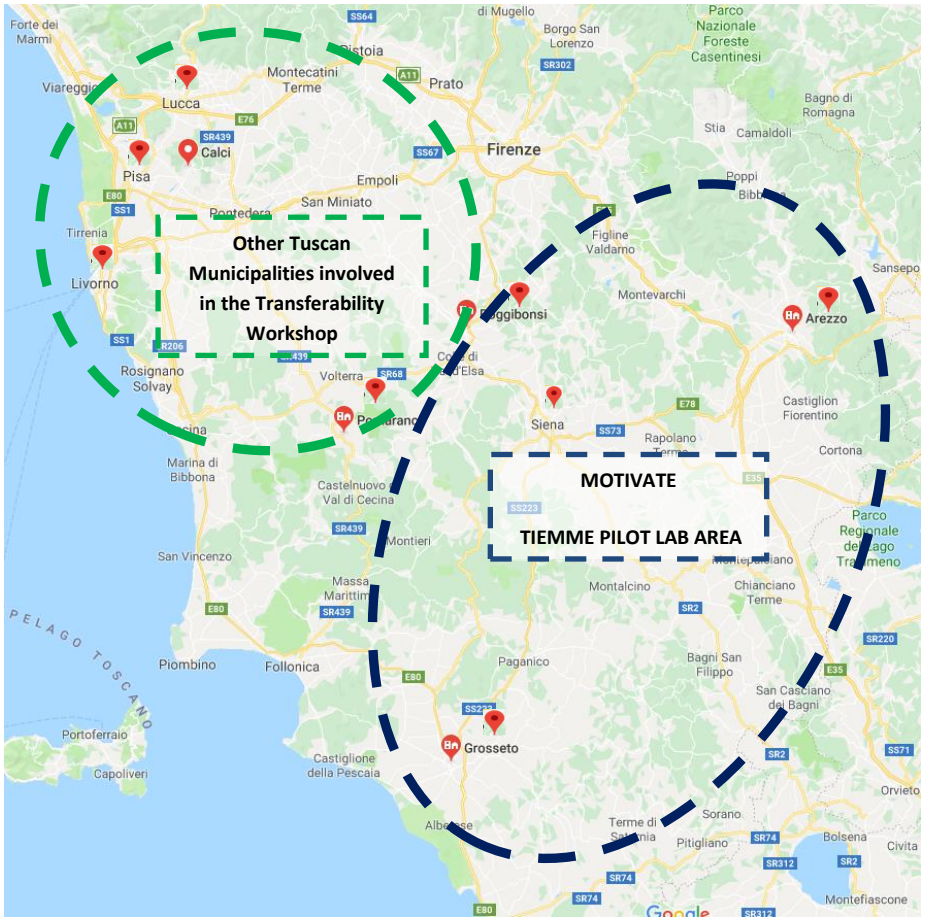


Figure 3-17 - Tuscany Map with indications of the Municipalities involved in the Transferability Workshop

The event was organized with a series of presentations followed by a round-table discussion which saw the active participation of aldermen and city council members of transport departments of the municipalities of Lucca, Siena, Pisa Grosseto and the top management of Tiemme company.

Figure 3-18 - Round Table at the Transferability Workshop

It has to be stressed that another transport operator, ATAF/Busitalia, one of largest PT Operator in Italy for urban and extraurban PT services, which attended all MOTIVATE events decided to develop the same crowdsourcing functionality (evaluation and assessment questionnaires) in the info-mobility APP providing information about transport and mobility service in the whole metropolitan area of Florence.

Tiemme was also very active in the promotion of the project through its social media (website and facebook) and through the elaboration and dissemination of different communication material in Italian, such as the project flyer, the project brochure and a video with Italian subtitles. For each organized event a specific leaflet with the programme was produced and disseminated to the target audience.

Moreover being the TIEMME General manager on of the key stakeholders of the Italian PT operators association (ASSTRA), the results of MOTIVATE have been promoted and diffused at national level among different PT operator and Mobility Agencies.

Finally Motivate project and the Siena Pilot site approach and results have been also presented to local and international events (more details in deliverable D2.5.1).

Figure 3-19 – Tiemme Promotional Material on MOTIVATE

3.7 CROWDSOURCING DATA ANALYSIS

The testing period in Siena included high and low season. Data collected dealt with residents/tourists' trips, preferences and evaluation of the existing mobility and info mobility services. The data collected have been processed and the relevant findings have been used for obtaining two sets of information, regarding i) needed improvements of mobility services; ii) needed improvements/changes on the quantity and type of information provided by info mobility APP. Results of these analysis are presented in the next paragraphs.

Trips data

The analysis refers to the period spanning from 01/01/18 to 23/10/19. As described in chapter 4, Tiemme Mobile App does not require any registration. Any user can download the APP and start using it without providing any personal data. Therefore, it is not possible to provide information about the gender and age of the Tiemme Mobile APP users. **6.428 trip diaries** were collected during the whole period. As it can be seen by the diagram below, most of them were concentrated in the Siena area (more than 5.000 within Siena area, about 700 within Arezzo area, around 500 in Grosseto and just few ones in Piombino). These other areas served by Tiemme were introduced in the boundaries of the pilot area in 2019 and this is the reason why most of the data collected refer to Siena area. Moreover, most of the promotional events about the project were organized in Siena and this also had an impact on the number of travel diaries in the city of Siena.

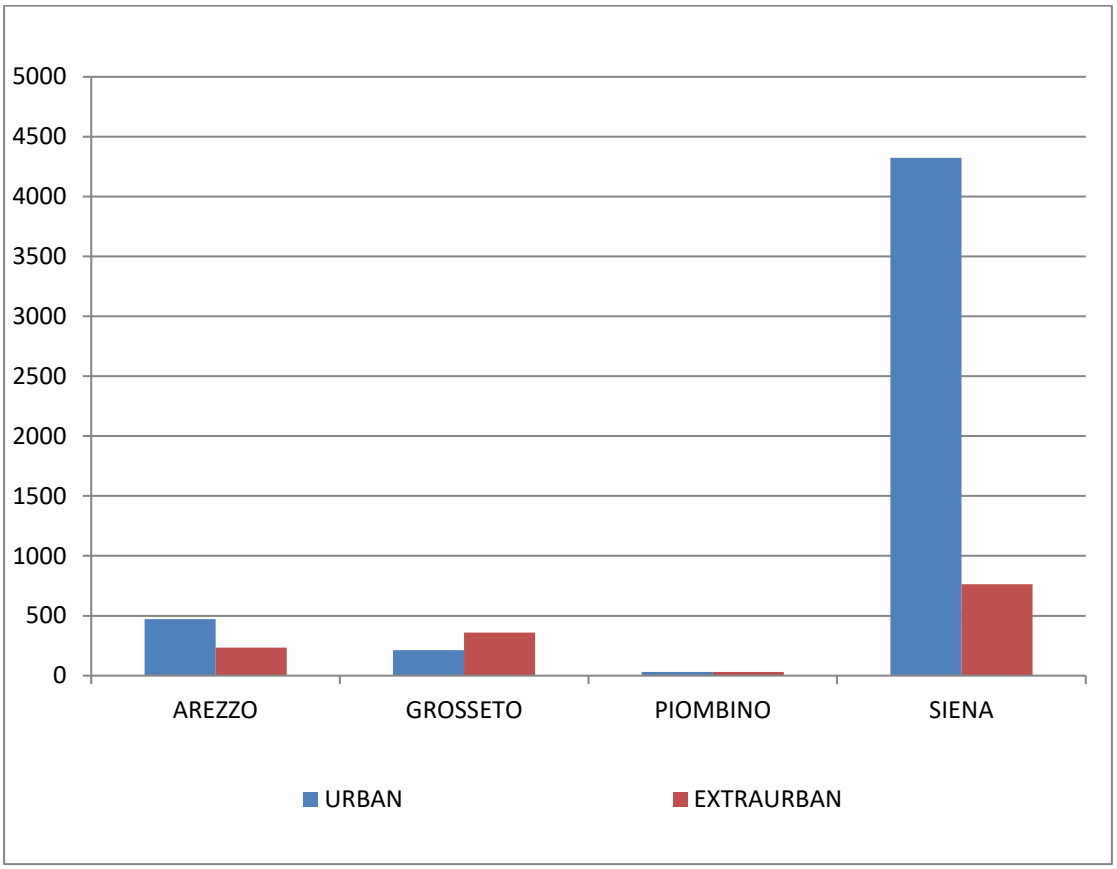


Figure 3-20 Travel Diaries from 01/01/18 to 23/10/19 divided per areas

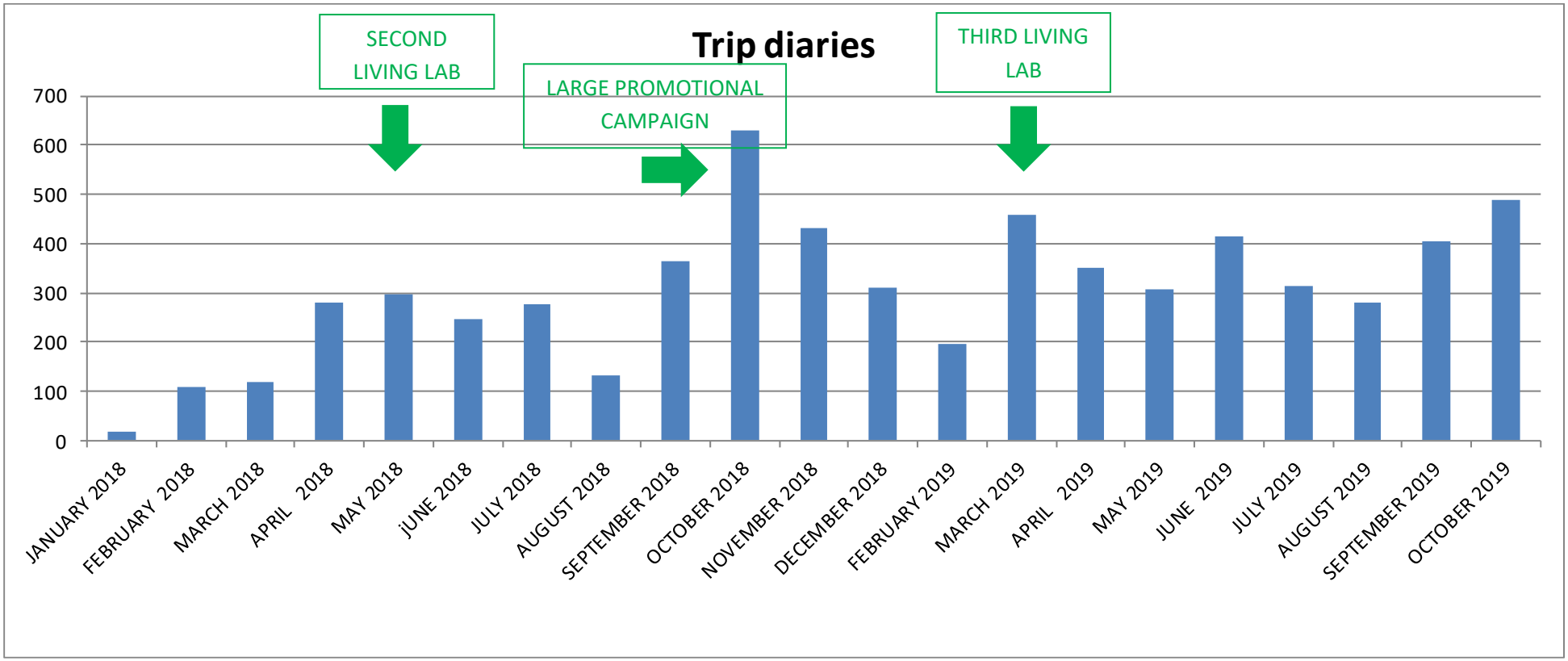


Figure 3-21 Travel Diaries from 01/01/18 to 23/10/19 divided per month

As it can be seen from the figure above the organization of the MOTIVATE events for promoting the APP were useful to increase the number of travel diaries. In October 2018 a specific promotion campaign on the use of the APP was carried out by the company and this also led to a significant increase of the number of travel diaries.

From the below diagram it can be seen that most of the users (62,69%) use the travel diary function to have real time information on the bus lines. The difference between the time of the access to the travel diary functionality on the APP and the time of their departure with the bus spanned from 0' to 30' minutes and it is higher between 0-10 minutes: this means the access to real-time info (and following notification of the trip diary) is more frequently done when the user is already at bus stop or nearby

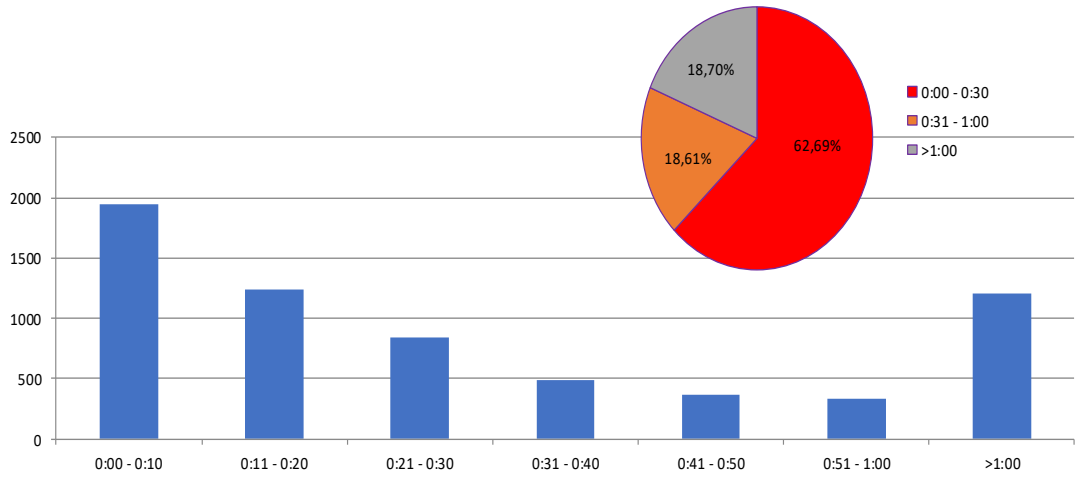


Figure 3-22 – APP Users waiting time at the bus stop after the access to the travel diary functionality

During the period taken into account, users mostly used the travel diary function during the early afternoon, as indicated by the following diagram:

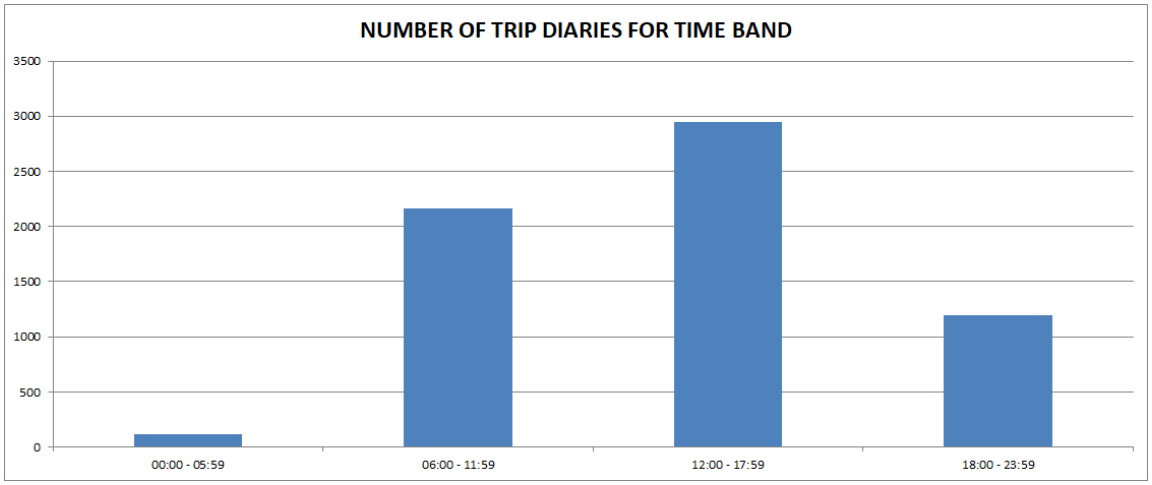


Figure 3-23 Travel diaries trend over day hours

This can be explained as this time period covers the return trips from school/university/work when the user more frequently access real-time information on bus arrival.

The next diagrams report respectively:

- The number of travel diaries for each line for the whole examined period (blue color)
- The number of passengers for each line in a typical winter working day (red color)

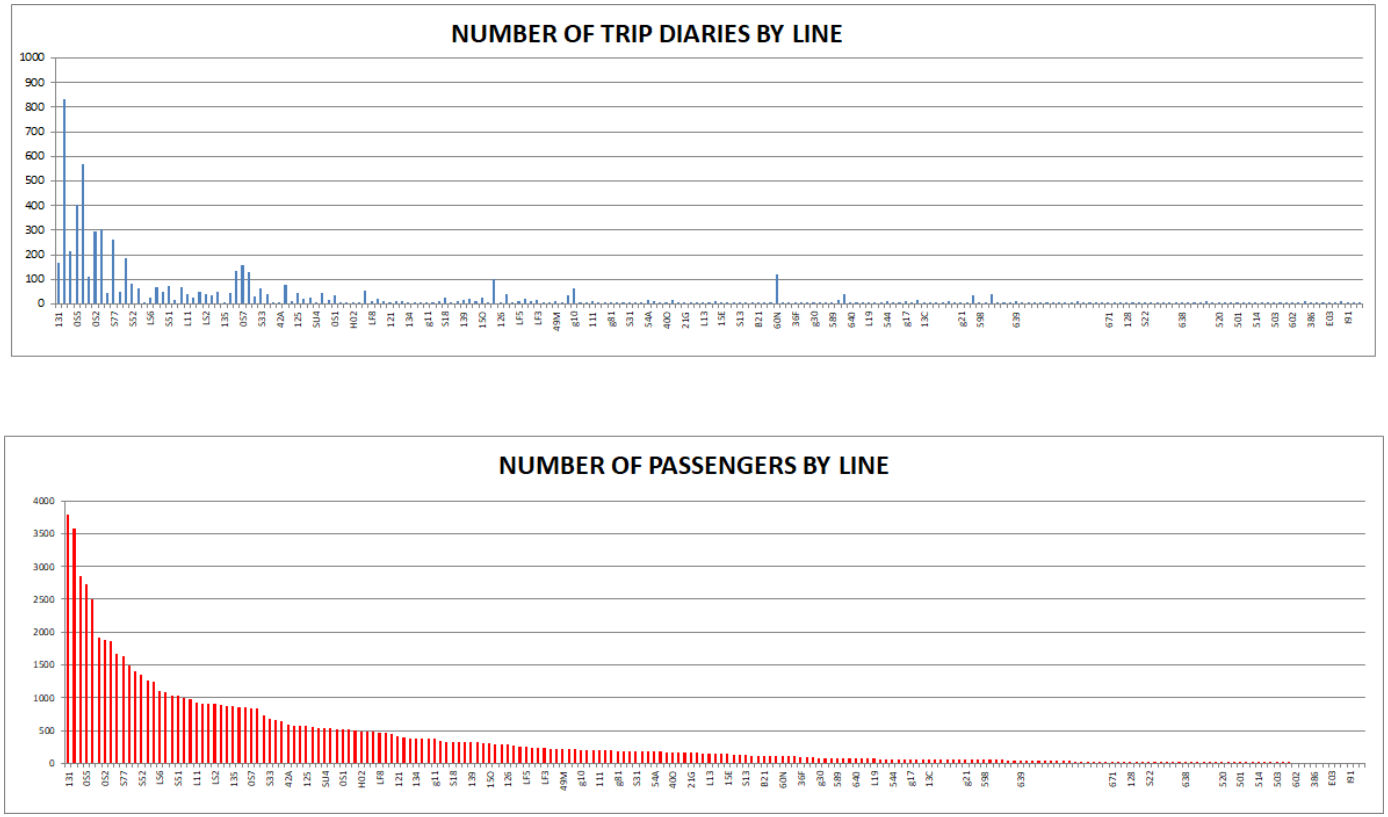


Figure 3-24 - Travel diaries for each line

These data allowed Tiemme to further understand the mobility demand and make a series of analysis on the main O/D of PT users.

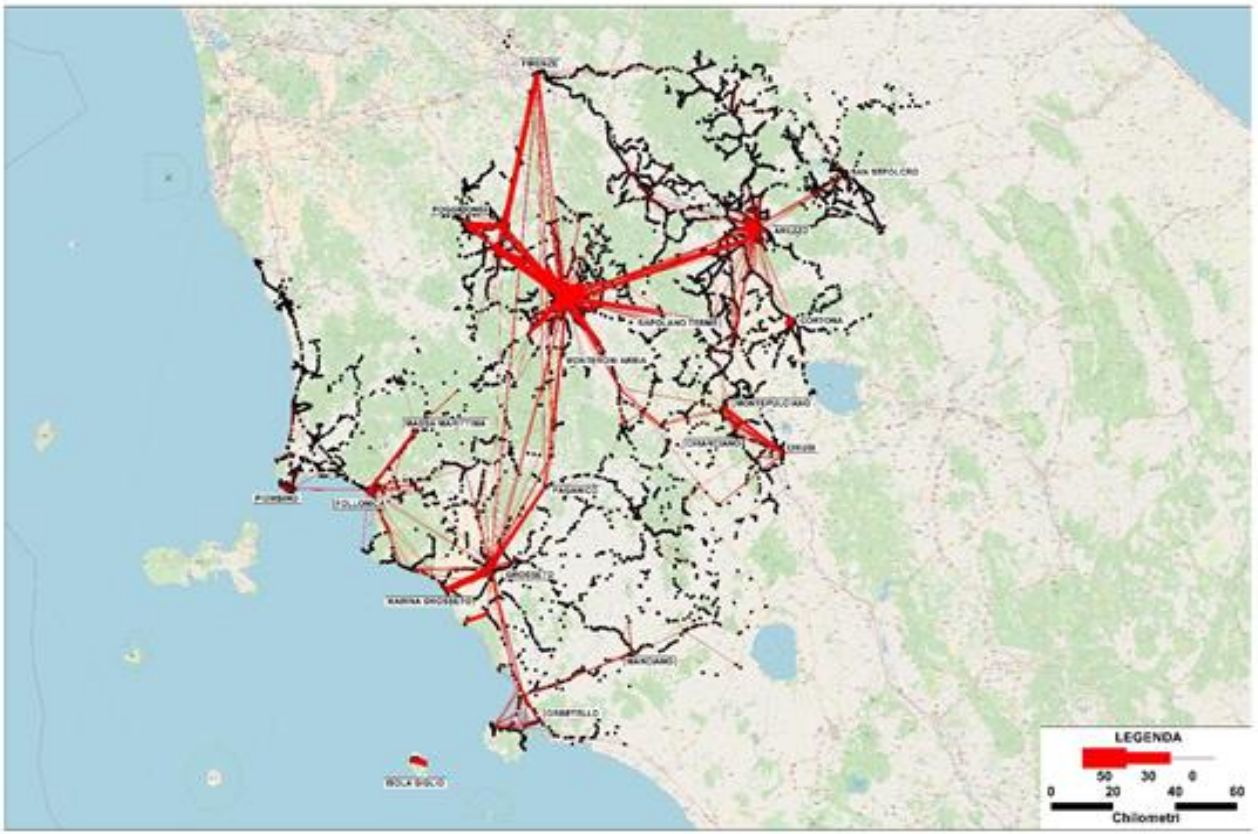


Figure 3-25 Geolocation and O/D Matrix

Restricting the analysis to the urban area of Siena, he greatest number of trip diaries had O/D in a parking area or in interchange terminals mainly used by no-regular PT users (more interested in real-time information).

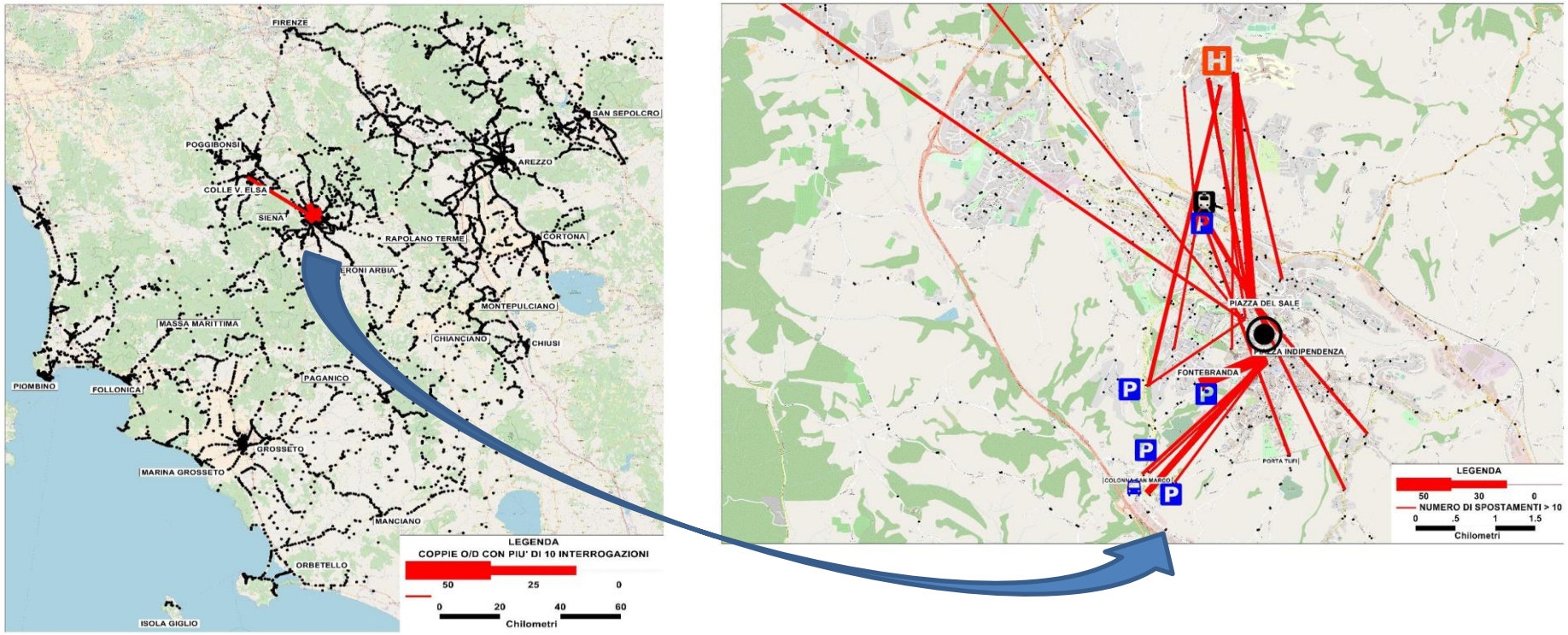


Figure 3-26 Detail of O/D couples with the highest n° of travel diaries

These results led to an internal discussion about the possibility to upgrade the APP with other information concerning the opening/closing time of the parking areas, fares of the areas, etc. that could be particularly useful for this specific target users. This could be a future improvement identified based on MOTIVATE pilot/analysis.

MOTIVATE appears as a low-cost solution to identify possible gaps to the Public Transport/Mobility services to be be further analyzed. It has to be considered as an additional tool for discovering needs and guide traditional targeted campaign.

Existing measures evaluation

In the period spanning from 01/01/18 to 23/10/19, around 1.000 questionnaires were filled in by the APP users.

The evaluation questionnaires are divided in:

- Evaluation of the Tiemme Mobile APP
- Evaluation of the existing bus lines

<u>Evaluation of Tiemme Mobile APP</u>

Here below screenshots of the nine questions related to the APP evaluation and concerning the usability, reliability, user-friendliness:

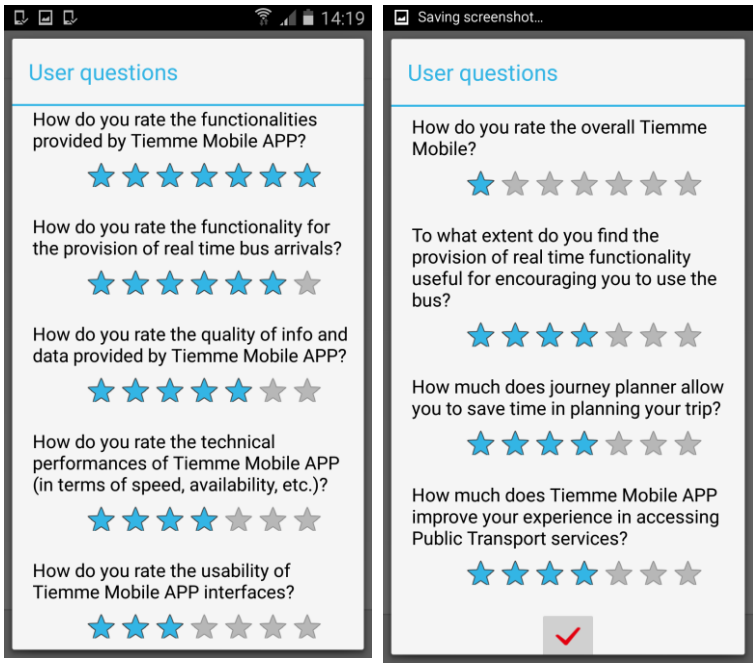


Figure 3-27 Questionnaires on APP evaluation

The evaluation of the bus lines instead consists of a series of questions (that can be done for each line) on the frequency, time coverage, overall level of satisfaction of the provided service for each line of the area served by Tiemme. This information is useful for analyzing possible improvement of the service and to get a better understanding of the users' requirements.

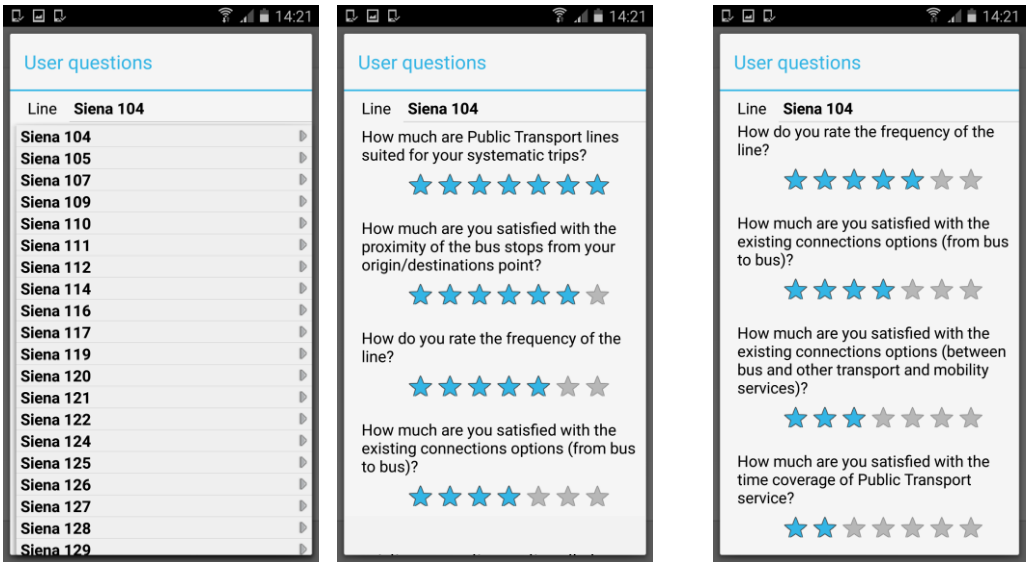


Figure 3-28 Questionnaires on Evaluation of PT Lines

4 CITY OF LARNACA

The city of Larnaca is a coastal city in the south of Cyprus with a greater area of approximately 13000 hectares and population of around 100000 people. Larnaca hosts the main international airport of the country and also has the second biggest port and marina. It is almost flat making walking and biking quite easy. On the other hand the extremely hot summer precludes people from these activities during most of the daylight time. The Public Transport system is controlled by the main Government and unfortunately needs significant improvement in order to attract more people and to make the desirable shift in the modal split. The current private contract for Public Transport of the city expires in June 2020 and hopefully the new contractor will provide a more reliable service.

4.1 Study area

The study area is depicted in the figure below and includes the city of Larnaca along with the main suburbs. It also includes the international airport and the port and marina area.

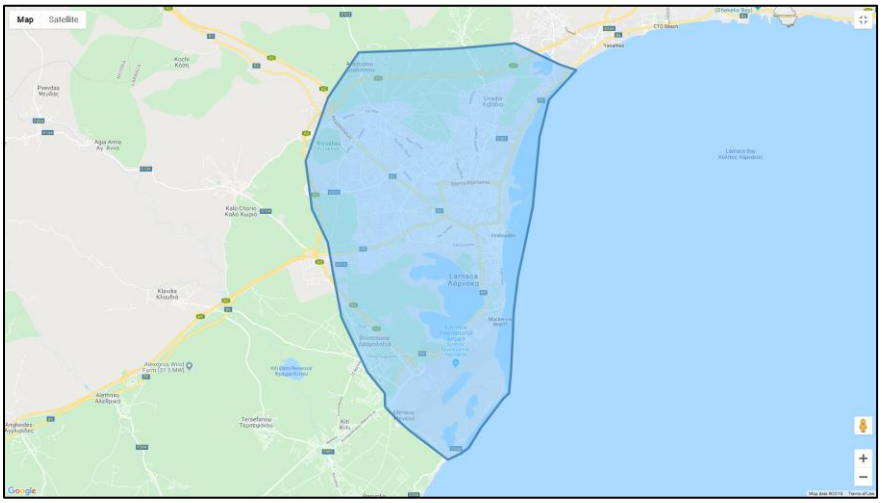


Figure 4-1: Study Area

The city evaluates the following existing services:

- The condition of the existing pavements and pedestrian routes
- The quality of the existing Public Transport Services
- The condition of the existing bicycle lanes

The future evaluation requests opinions on the provision of implementing a controlled parking system in the city of Larnaca.

4.2 Technological implementation of the crowdsourcing tool in the city

In Larnaca city, mobility applications have not yet been designed and implemented. Larnaca case therefore, lies on the first scenario described in section 2.1 of the current Deliverable. In Larnaca pilot case, it was decided to adopt the installation and operation of the MOTIVATE platform through HIT/CERTH's IT infrastructure, since Larnaca City Council did not support any technological solution with similar functionalities.

Promotion of crowdsourcing initiative in the city

Stakeholders engagement

The Municipality of Larnaca organized various stakeholder engagement meetings over the duration of the project in which the programme and application was clearly explained and presented. Some very valid and interesting suggestions of stakeholders were passed to CERTH and implemented into the application. In addition to the stakeholders meeting arranged on behalf MOTIVATE project, the project was presented on the stakeholders of the SUMP project on at least 3 occasions.

In addition MOTIVATE project was presented at the Smile 2019 6th Sustainable Mobility &Intelligent Transport Conference in Nicosia in March 2019 were international and local experts had a chance to learn about MOTIVATE and its benefits to transport planners and local authorities.

In addition to the above, MOTIVATE was also presented on the TechCamp: ICT Tools for Sustainable Urban Mobility at the University of Cyprus in March 2019.

General Public Engagement

Despite all the good will expressed by the general public during the presentation and introduction of the programme and the application the systematic use proved to be very limited. The public was informed by various methods as mentioned below:

Flyers. 1000 flyer in Greek and 1000 flyer in English were printed and given to the public during various events

Local Magazines

The project was advertised in local magazines with interviews of the Mayor and coordinator

Social Media

The project was presented in the social media pages of the Municipality of Larnaca and also in the official Web page of the city

General Public

Gatherings In every opportunity of public gathering the project was advertised and flyers were given. Examples are the events during the Mobility week, the Larnaca International Marathon, the public consultation events for the SUMP preparation.

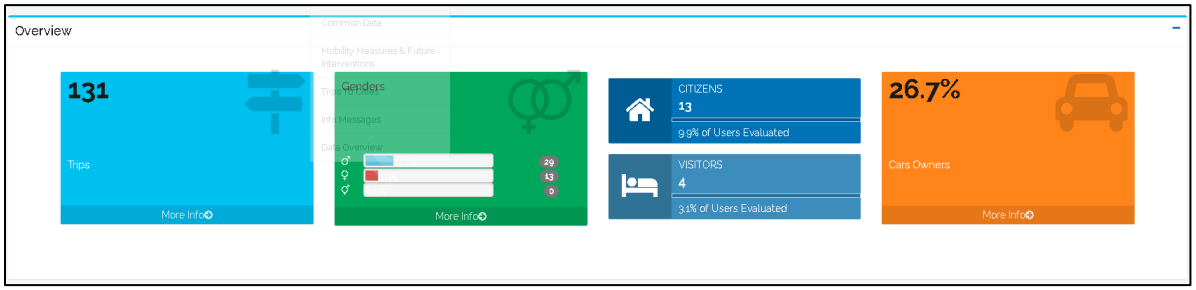
Special events

The project was presented at a Rotary Club meeting after invitation of the club, at various primary and secondary schools

4.3 CROWDSOURCING DATA ANALYSIS

Trips data

The number of trips registered between the start of the programme and October 2019 is 131. The modal split is as shown below as is the trip purpose.



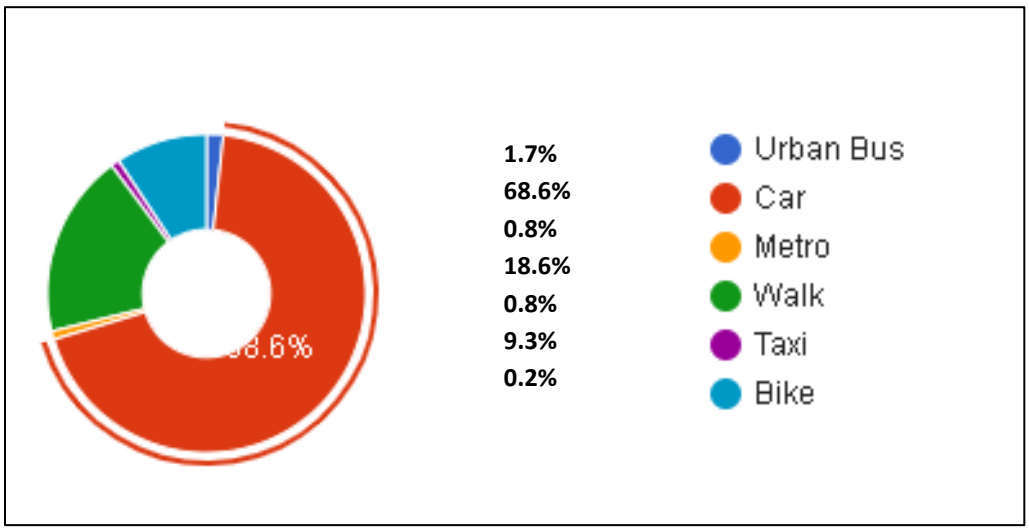


Figure 4-2: Modal split according to MOTIVATE trips

Existing measures evaluation

The services evaluated are:

- The quality of the Public Transport system
- The condition of the existing network of pedestrian routes
- The condition of the existing bicycle routes

Each service had the following questions

Quality of Public Transport system

- How satisfied are you with the existing coverage (areas that are served by P.T.) of the public transport network?
- How satisfied are you with the Integration between the different PuT modes in Larnaca?
- How satisfied are you with the Seamless transportation in Larnaca (e.g. how easy is it to take an urban P.T. mode from the port or airport to go to the city center or if needed to a terminal for transferring to an interurban bus line for reaching your final destination)?
- How satisfied are you with the Information provision (in Bus stops, web site, telephone) in the PuT system of Larnaca?
- How satisfied are you with the Reliability of services of the PuT system of Larnaca?
- How satisfied are you with the quality and cleanliness of fleet (comfort, noise, etc.) of the existing PuT system of Larnaca?
- How satisfied are you with the quality of infrastructure (bus lanes / bus stops / train and tram stations) of the existing PuT system of Larnaca?
- How satisfied are you with the frequency of the existing PuT system of Larnaca?

- How satisfied are you with the safety of the existing PuT system of Larnaca?
- How satisfied are you with the staff behaviour of the existing PuT system of Larnaca?
- How satisfied are you with the ticket costs of the existing PuT system of Larnaca?
- How satisfied are you with the operating hours of the existing PuT system of Larnaca?

The measure was evaluated by 15 users

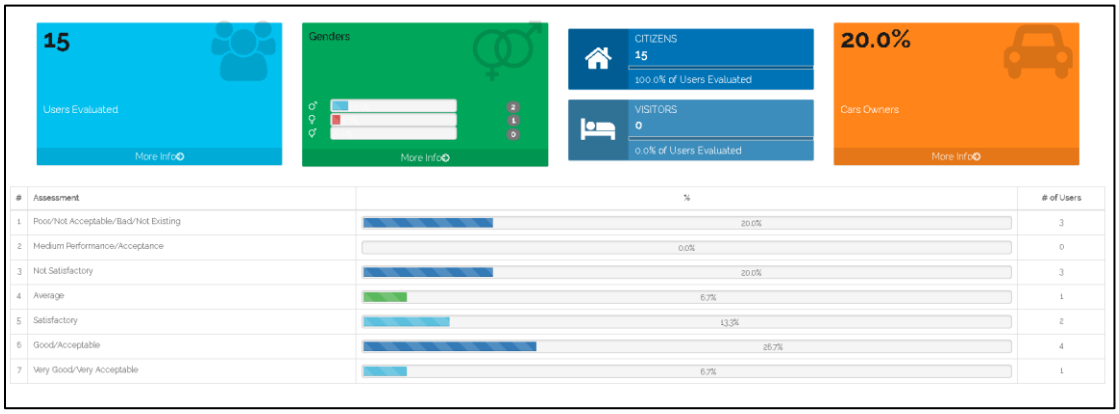


Figure 4-3: Evaluation of the PuT system in Larnaca

Condition of the existing network of pedestrian routes

- How satisfied are you with the existing coverage of the walking paths in Larnaca?
- How satisfied are you with the existing infrastructures of the walking paths in Larnaca?
- How satisfied are you with the existing signs of the walking paths in Larnaca?
- How satisfied are you with the existing lighting of the walking paths in Larnaca?
- How satisfied are you with the existing safety of the walking paths in Larnaca?
- How satisfied are you with the complementarity among walking paths and PuT system?

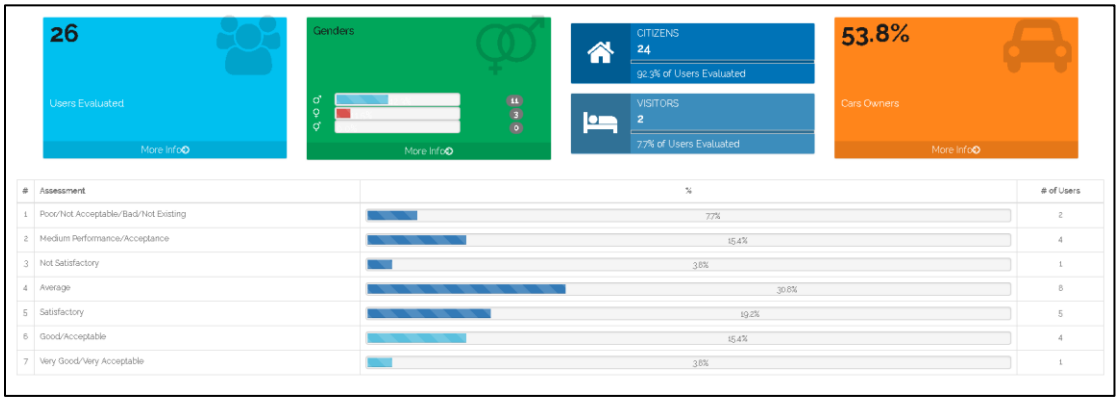


Figure 4-4: Evaluation of the existing network of pedestrian routes in Larnaca

The measure was evaluated by 26 users

Condition of the existing bicycle routes

- How satisfied are you with the existing coverage of the cycling network in Larnaca?
- How satisfied are you with the existing infrastructures of the cycling network in Larnaca?
- How satisfied are you with the existing signs of the cycling network in Larnaca?
- How satisfied are you with the existing lighting of the cycling network in Larnaca?
- How satisfied are you with the existing safety of the cycling network in Larnaca?
- How satisfied are you with the complementarity among cycling paths and PuT system

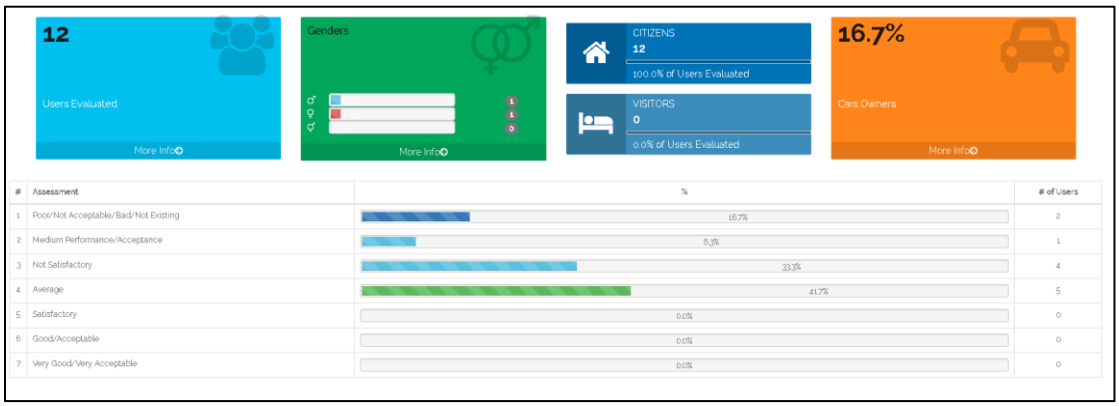


Figure 4-5: Evaluation of the existing bicycle routes in Larnaca

The results are more or less disappointing in that most of the answers fall from average to bad. This has been looked by the proper authorities and they plan to take the necessary actions in order to improve the services provided.

Future mobility interventions assessment

The future intervention assessed is:

Introduction of a controlled parking system in the city

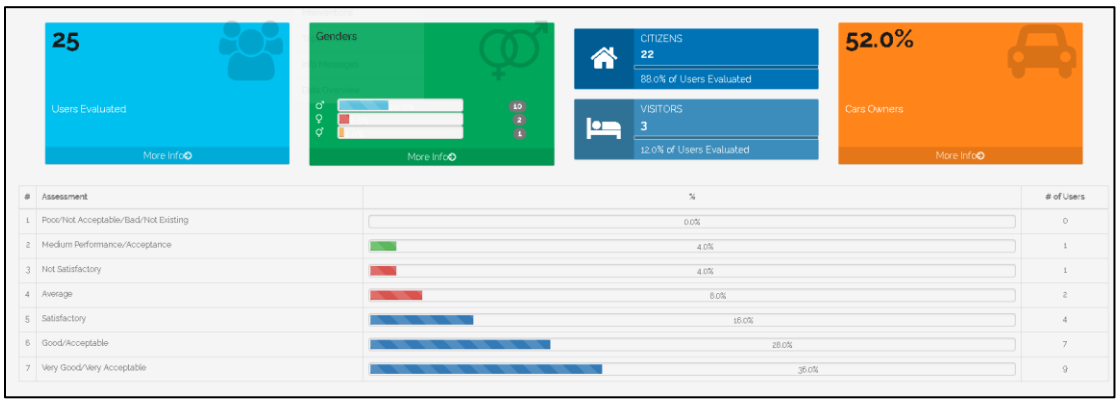
The Intervention had the following questions
How useful do you believe that a controlled parking system in Larnaca will be?

Will the pay by phone option be useful for your needs?

Will a “parking free space guide – information system” be useful for your needs?

Will an increase in the fee for illegal parking (for respecting the parking strategy) be useful?

Will a combination of the new parking system with an increase of the enforcement strategy be useful?



#	Assessment	%	# of Users
1	Poor/Not Acceptable/Bad/Not Existing	0.0%	0
2	Medium Performance/Acceptance	4.0%	1
3	Not Satisfactory	4.0%	1
4	Average	8.0%	2
5	Satisfactory	16.0%	4
6	Good/Acceptable	28.0%	7
7	Very Good/Very Acceptable	36.0%	9

Figure 4-6: Assessment of a future controlled parking system in Larnaca

Project co-financed by the European Regional Development Fund

MOTIVATE

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

Pilot Evaluation

D3.2.3 - Development of the parking control system of Ioannina Municipality

Brief description of the pilot activity of Ioannina

Document Control Record

MOTIVATE Doc. TYPE/No/Title	D3.2.3 - Development of the parking control system of Ioannina Municipality
WP	WP3: Testing
Date/Version	…/12/2018 / v.1
Diffusion Level	Consortium (confidential)
Document Responsible	Ioannina
Contributors	

Contents

1 Introduction -Brief description of the MOTIVATE project

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 the existing web server of 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 Objectives of the MOTIVATE PILOT CASE STUDY in the city of Ioannina, Greece

The pressure of traffic on modern cities keeps growing. More and more vehicles flow into the city draining the existing parking resources and increasing traffic congestions and fueling the pollution increase. MOTIVATE seeks to present a solution for a low-cost smart parking system and all the software and hardware components that were developed and integrated in a smart parking solution.

The importance of finding solutions to improve the quality of the city's life has grown in the past years and the use of IT has created a new breed of somewhat intelligent cities – often referred to as smart cities. The concept of "smart" applied to the cities has been regarded as the answer to some of the major city problems and is slowly changing the way we live and interact with our cities. A smart city can be described has "a city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, railways, subways, airports, seaports, communications, water, power, even major buildings, and that can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens".

For years, parking management systems have been amongst some of the major cities concerns, and some cities have carried out studies on the smart parking concept and what impacts these systems can bring to social, economic, political and environmental issues. However, there have been some problems related to smart parking systems implementation which raised political issues, like the existence of more than one stakeholder, which can be a problem in terms of investment management and decision making during the project.

A simple solution, as presented by the Municipality of Ioannina consists of an advanced navigation system that signals the availability and directs towards the parking spot closest to the destination chosen by the user.

The concept utilizes information on the geolocation of the vehicle, the distance between the parking areas and the total number of free slots in the parking lot. If the car park is full, the driver is redirected to another location until he can park the vehicle. It uses technology which monitors the parking lots through RFID. The system works in real-time and gives the user the choice of the most suitable parking place, sending directions to the destination. Whenever a vehicle enters or exits the park, the data is updated by communicating with the parking lot.

1.4 Scope of the Smart City Installation

- The objectives of this smart parking policy include:
- Servicing short-term parking,
- Servicing permanent residents of the central area,

- Discouraging the use of private cars; vehicle from the workers in the central area in order to release seats for visitors,
- Eliminate illegal parking and double parking phenomena in order to ensure a smooth flow of traffic.
- Finally, a significant improvement in the standard of living, achieved by faster fulfillment of citizens' obligations, prudent use of vehicles and the use of alternative means of transport, such as public transport and the bicycle.

The implementation of a controlled parking system is considered necessary to meet the above objectives.

The OVERALL PURPOSE of the installation is to provide a free “short-term” parking space, for citizens and visitors, only for urban services (short visits to public services, doctors, market etc). A total of 100 parking spaces will be placed in the city center, which will be closely monitored by the Municipal Police in real time. The period of free-parking will be calculated between 30-45 minutes and will be decided upon implementation and after consultations with the involved stakeholders.

Upon completion of the project, the following benefits are expected, which will be immediately visible. Expected benefits for the Municipality include:

- The provision by the Municipality of free and smart services that improve the quality of life of residents, given that the integrated system to be developed within the project will reduce the time of unnecessary movement for parking and will allow the service of more citizens in the area of application.
- Improving the efficiency of off-site parking control officers – MUNICIPAL TRAFFIC POLICE - as it is a system that instantly informs of phenomena of illegal occupation of parking spaces, as soon as they exceed the “free time of occupation”.
- It gives priority to parking spaces for people with disabilities.
- Limiting the consumption of fuel from municipal vehicles because they will only move when the system informs them that a space is free.
- The minimization of patrols by the Municipal Police for the control of parking violations. The system will be providing real time information if someone exceed the free time.
- Automate a process of verifying violations, using tablets, portable printers, and a call-back system for online call management through back-office software.
- Constantly informing the municipality administration about the behavior of the drivers at the limits of the project implementation so that the necessary actions - interventions can be taken
- Finally, minimization of unnecessary movement for finding a parking space is expected to reduce of CO_2 emissions.

1.5 Scope of the Report

This report describes the detailed design of the Pilot Case. In particular, the report presents the services of the platform, the user requirements, their transformation into core functions and sub-functions, 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.

1.6 Intended audience

The Municipality of Ioannina forms a complex mosaic of environments including urban, suburban and farmland areas.

Hence, the municipality's mobility profile is rather complicated, comprising of different types, needs and finally problems.

In this framework, strong steps have been taken towards the direction of completing physical infrastructure like roads, transit hubs, public infrastructure etc. However, little action has been taken on issues on:

- Smart mobility,
- Change of culture, habits etc
- People's engagement on mobility issues,
- The use of information technology and digital infrastructure,
- Connectivity,
- Operational technology and, therefore,
- Sustainability

Certain weak issues regarding sustainable mobility include:

- A gap in concrete data about mobility, especially in the urban centre.
- High percentage of our ownership
- Lack of connected infrastructure for the use of public transport and cycling.
- Interaction between local inhabitants (users of the mobility network) and the local authorities, which in turn leads to a lack of raw data, which finally leads to lack of policy tools for designing people-friendly, mobility policies.
- Serious crowding and congestion problems, especially during high traffic times.
- Expensive infrastructure maintenance.

- Problem in keeping pace with the rapid rate of urban growth.

The Municipality of Ioannina needs to create new channels of communication between people and public authorities. Through these channels, the Municipality of Ioannina aims to collect useful data in order to be able to evaluate mobility needs and assets. The final objective is to be able to design sound mobility related policies and implementing sustainable strategies.

This will be possible through MOTIVATE since, the municipality is going to fully exploit the benefits deriving from the use of social media and applications used for:

- Capturing citizens' and visitors' mobility habits & needs and composing the respective trip diaries, developing in this way a good (database) starting point for the authorities to plan interventions and improve infrastructures and services operation
- Providing the users (travelers) with personalized notifications and personalized sustainable travel plans motivating the modal shift
- Promoting to the wider public sustainable mobility interventions, achieving awareness raising
- Involving travelers in a long lasting and effective open dialogue for capturing
    - Traffic conditions.
    - Opinions & suggestions on mobility issues (current operation of public transport modes - level of service, occupancy rates, offenses etc, road network conditions, accidents etc).
    - Acceptance level for potential interventions

The following table presents the direct and indirect target groups of the MOTIVATE project and particularly the e-parking system.

Table 1: Target groups of the e-parking, pilot application

Target group	Relevance
General public – Residents – Visitors of the city	Citizens and visitors will be able to find in real time free-parking spaces in the city center in order to be serviced for short-time periods.
Non travelers and non-private vehicle users	People who do not use private vehicles are expected to meet a congestion-free city center, since cars who are wondering for long periods in order to find free parking spaces, will be serviced faster.

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 system, they will be able to understand and be familiarized with a smart city application for mobility. Finally, this groups is essential for the development of SUMPs and projects deriving from planning
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.
SUMP and mobility planners	Increasing the participatory approach in SUMP development and enhancement can only be achieved by a constant communication with this target group. This group needs to test innovative solutions in order to be able to make informed decisions and collect the necessary data.
	Data collection is a major aspect as well. Applications (with user friendly interface to support easy use) where citizens are encouraged to insert their daily trips. The aim is to Development of a big database with daily trips in a cost efficient way (no need to use particularly time and cost consuming survey techniques to obtain this kind of data)
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.

2 Methodology

The methodology proposed for the implementation of the proposed system follows the "Incremental Development" philosophy and is based on the principles of the Rational Unified Process for the successful and rapid development of information systems. The Rational Unified Process offers a framework for organizing the software development project and a set of techniques that serve to streamline it.

The important element of the proposed methodology is that the determination of the final solution is not fully covered at the beginning of the project, but the system to be implemented is progressively determined through the implementation of two or more prototypes used to extract additional requirements from the users involved. User involvement in system evaluation, from the very beginning of the project, reduces the risk, as it enables the user to better understand the final system and to identify additional critical parameters for its success.

The methodology has been used successfully by the contractor in many projects on designing and developing systems based on Internet technologies, both at national and international level. Indeed, its use in projects of varying size and various levels of complexity has shown that it can be considered the most suitable for the implementation of the proposed system. In the context of this project, we take into account that a first part of the needs is provided in the relevant Declaration at a general level. This document, combined with an in-depth knowledge of the environment of the present project, has provided us with a prime piece of information to understand the desired system and has been exploited to the fullest extent possible with the aim of producing an integrated proposal for the implementation of one technically & functionally-sound, flexible and extensible solution. However, the task record task runs the work at almost every stage and culminates before the final releases of its products are completed.

In the framework of the proposed methodology, the initial recording of requirements follows the detailed design of the system architecture and of the general technological environment (work that is considered particularly important in each project), followed by the initial design of its components and subsystems, . The completion of the system design process is accompanied by the completion of the architectural prototype, which aims to validate the pre-selected options and the first demonstration of the operation of the architecture. The assessment of this prototype provides an initial feedback for the redesign of subsequent prototypes.

The whole process leads to the implementation of an original functional prototype and its evaluation by users. This is particularly important if you take into account that users will be able to "use" a system very close to the desired and provide additional requirements and valuable feedback on all the qualitative aspects of the system. Finally, a new cycle of design, implementation and integration takes place, taking into account both the evaluation results of the first prototype and the original design of the system. The final system will work and be tested in real-time for a specific period in order to detect bugs and fine tuning.

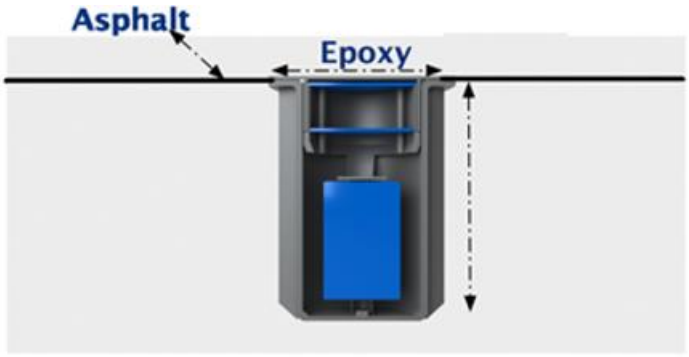
2.1 Methodology for sensors installment

The offered sensors are installed in such a way that they are fully covered by the roadway to avoid vandalism.

Installing the sensors requires a hole 9cm in diameter and 13cm deep, as shown in the following diagram. Then the surface of the sensor is covered with epoxy so that it is not visible and vandalism is avoided.

The installation of sensors will be done by qualified contractor staff with a special machine that creates the holes on the road as shown in the next photo. The top of the sensor will be installed at a depth of 1cm below the road surface.

The contractor will also take over the parking spaces. The exact locations of installation will be determined in cooperation between the contractor and the contracting authority.



High-grade cryoplastic colors (duration of approximately ~ 5 years) will be used for the on-road marking, of the parking spaces where the sensors will be installed.

The following photos depict sensor imaging images and all accompanying equipment (from a corresponding project).

Parking space sensor (I)

Parking space sensor (II)

Parking space sensor (III)

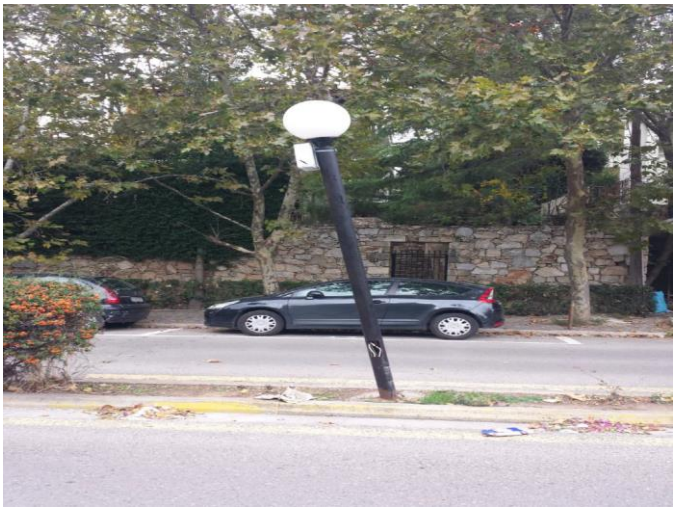
Marking – Parking space numbers (I)

Marking – Parking space numbers (II)

Marking – Parking space numbers (III)

Data collection Unit (I)

Data collection Unit (II)



Repeater (I)

Repeater (II)

Repeater (III)

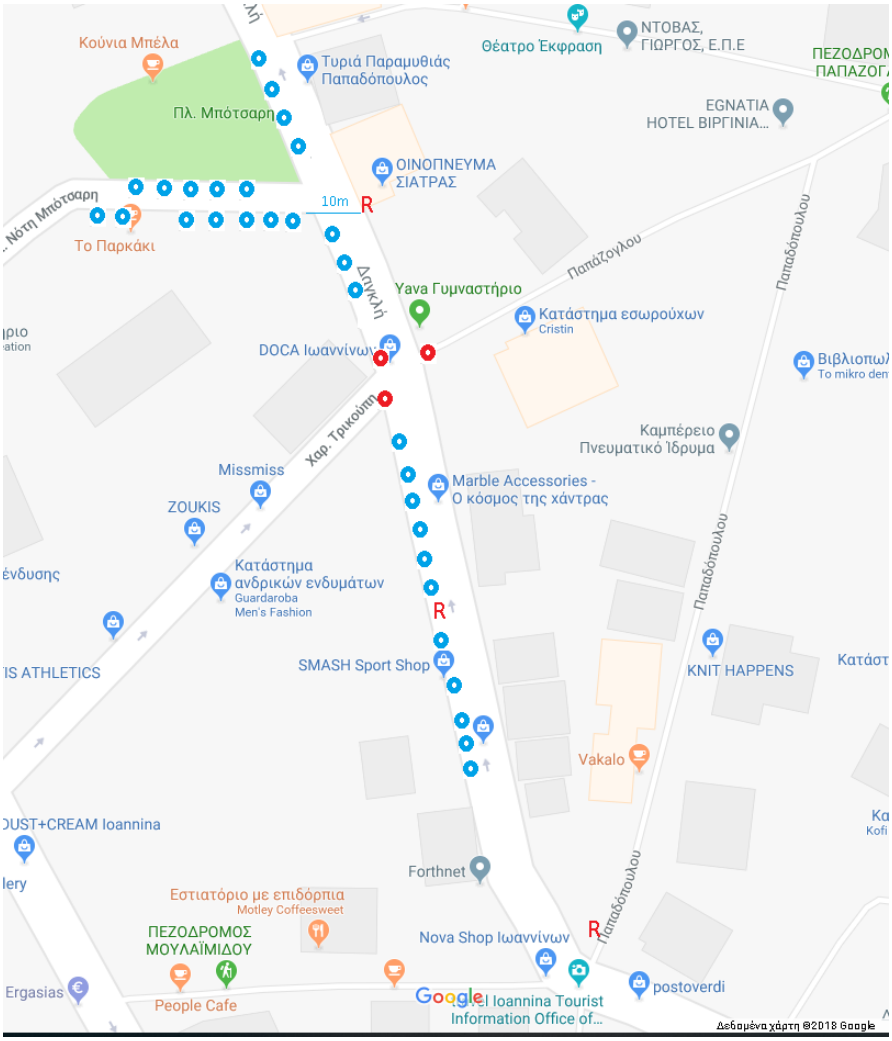
3 Design for the city of Ioannina

3.1 Description of Suggested Parking Posts

The following table shows the parking areas where the 100 sensors will be installed:

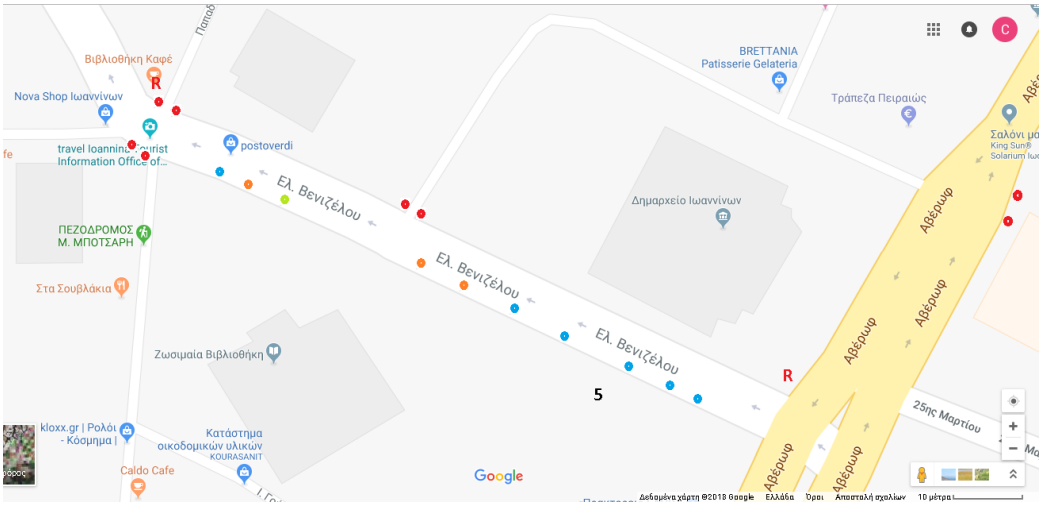
α/α	Area - Street	Total Parking spaces
1	Dagkli Str	17
2	Averoff Str	16
3	Eleftheriou Venizelou Str	18
4	Theordoridi Str	10
5	28th September and Averoff Str	**17**
6	28th September str	**6**
7	Mpotsari str	**16**
	ΣΥΝΟΛΟ	**100**

Maps of the area are provided here:

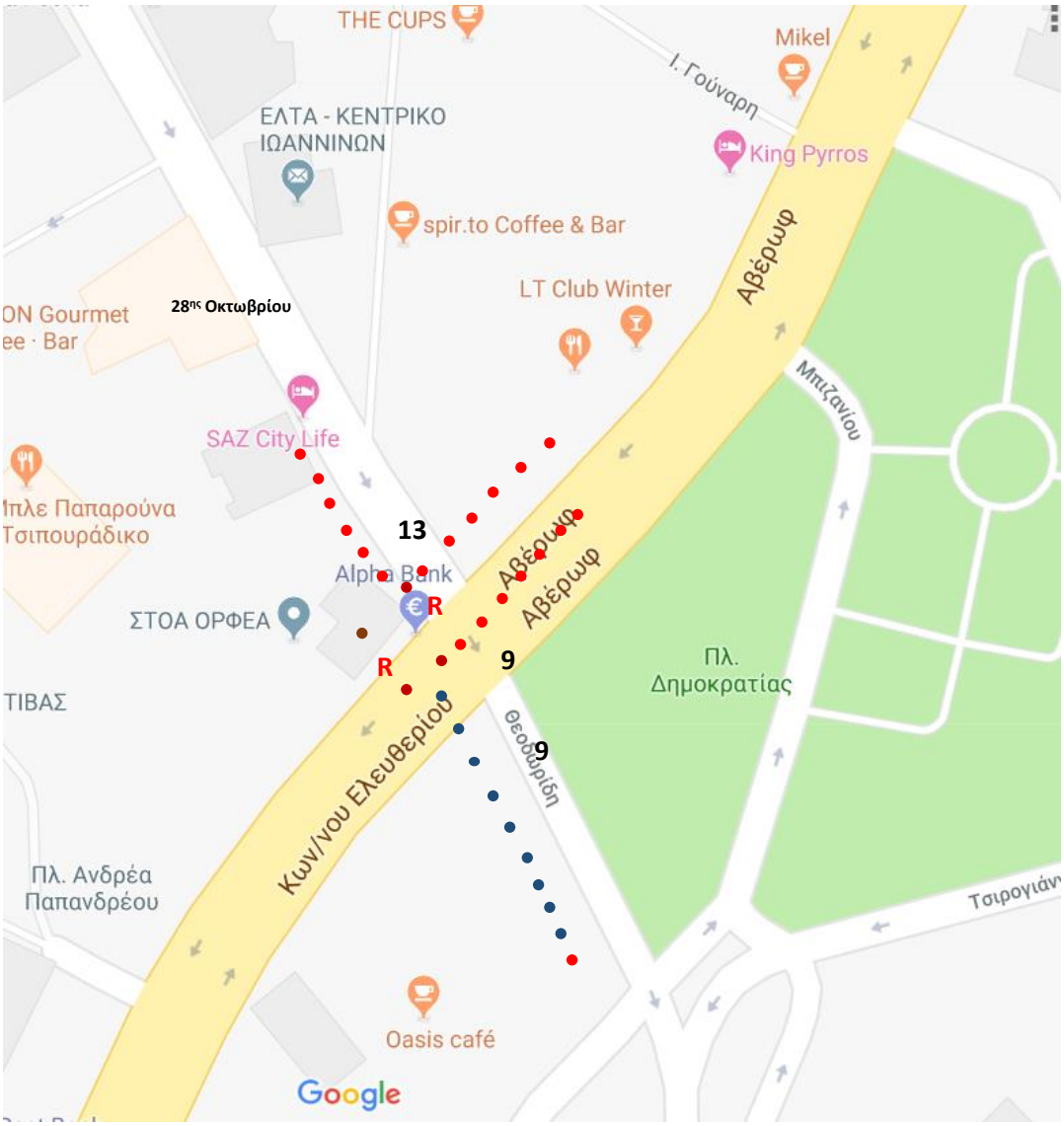

Κούνια Μπέλα
Τυριά Παραμυθιάς Παπαδόπουλος
Θέατρο Έκφραση
ΝΤΟΒΑΣ, ΓΙΩΡΓΟΣ, Ε.Π.Ε
ΠΕΖΟΔΡΟΜ ΠΑΠΑΖΟΓ
Πλ. Μπότσαρη
EGNATIA HOTEL ΒΙΡΓΙΝΙΑ...
ΟΙΝΟΠΝΕΥΜΑ ΣΙΑΤΡΑΣ
10m
Νότη Μπότσαρη
Το Παρκάκι
Παπάζογλου
Παπαδόπουλου
Δαγκλή
Yava Γυμναστήριο
Κατάστημα εσωρούχων Cristin
DOCA Ιωαννίνων
Χαρ. Τρικούπη
Καμπέρειο Πνευματικό Ίδρυμα
Missmiss
Marble Accessories - Ο κόσμος της χάντρας
ZOUKIS
Κατάστημα ανδρικών ενδυμάτων Guardaroba Men's Fashion
SMASH Sport Shop
KNIT HAPPENS
Vakalo
Forthnet
Εστιατόριο με επιδόρπια Motley Coffeesweet
ΠΕΖΟΔΡΟΜΟΣ ΜΟΥΛΑΪΜΙΔΟΥ
Nova Shop Ιωαννίνων
postoverdi
Ergasias
People Cafe
Ioannina Tourist Information Office of...
Δεδομένα χάρτη ©2018 Google

Dagkli Str

Averoff str (16)



El Venizelou



Theodoridi, Averoff and 28th of September (19 απαγόρευσης στάθμευσης, 4 διαβάσεις, 9 θέσεις στάθμευσης)

Mpotsari str

Suggested use of repeaters in Frontzou str

3.2 Description of Suggested Parking Posts

As part of the Contractor's work, an on-site visit was made to the roads proposed as possible areas for the installation of the Intelligent Parking System. The following photos show the current state of the proposed roads on parking. An understanding of the current situation allows for recognition of the future situation. More specifically and in line with the foregoing, the characteristics of the proposed routes include:

Theodoridi Street:

- One way
- Right: Bus stop
- Left: Parking of vehicles
- Main feature: Delimited parking spaces. Urban bus & coach parking (right of pavement)
- System development capability:
    - Primary Urban Services Zone, with emphasis on municipal services.
    - Secondary Shop & Go Zone

Στάθμευση επί της οδού Θεοδωρίδη - Σημερινή κατάσταση

Οδός Μπιζανίου:

- Μονής κατεύθυνσης
- Δεξιά : Στάση αστικού ΚΤΕΛ – Πιάτσα Ταξί
- Αριστερά : Στάθμευση αστικού ΚΤΕΛ – Στάθμευση οχημάτων
- Κύριο χαρακτηριστικό: Οριοθετημένες θέσεις στάθμευσης. Χώρος στάθμευσης αστικού ΚΤΕΛ & λεωφορείων (αριστερά και δεξιά του οδοστρώματος)
- Δυνατότητα ανάπτυξης συστήματος:
    - Πρωτευόντως Ζώνη Αστικών εξυπηρετήσεων, με έμφαση σε δημοτικές υπηρεσίες.
    - Δευτερευόντως Ζώνη Shop&Go

Parking on Bizani Street - Current situation (1)

Parking on Bizani Street - Current situation (2)

<u>Street El. Venizelos:</u>

One way

- Right : -
- Left: Vehicle parking - Parking for disabled people
- Main feature: Delimited parking spaces. Urban bus and coach parking
- System development capability:
    - Primary Urban Services Zone, with emphasis on municipal services.
    - Secondary Shop & Go Zone

Parking on El. Venizelou - Current situation (1)

Parking on El. Venizelou - Current situation (2)

Parking on El. Venizelou - Current situation (3)

Averoff Street

- Double direction
- Right - Left: Carriage of crash - load vehicles
- Main feature: **Delimited parks for cash, visitors and store supplies**
- System deployment capability: **Shop & Go zone**

Parking on Averoff Street - Current situation (1)

Parking on Averoff Street - Current situation (2)

Parking on Averoff Street - Current situation (3)

Parking on Averoff Street - Current situation (4)

George Soutsou Street:

- One way
- Right : -
- Left: Carriage of crash vehicles - loading and unloading vehicles
- Main feature: Delimited parks for cash, visitors and store supplies
- System development capability:
    - Primary Shop & Go Zone
    - Secondary visitor and tourist services zone

Parking on George Soutsos Street - Current situation