



My TRAVel Companion.

**Deliverable D5.4**

**Final version of My-TRAC application**

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## D5.4 Final version of My-TRAC application

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Editor name	Organisation
<b>Joan Guisado-Gómez</b>	Universitat Politècnica de Catalunya
<b>Alberto Rivas</b>	Universidad de Salamanca
<b>Javier Gavilanes</b>	EXPERIS Manpowergroup SL
<b>Benekos Ioannis</b>	Ethniko Kentro Erevnas Kai Technologikis Anaptysis
<b>Eva Bozou</b>	AETHON Symvouli Michaniki Monoprosopi IKE
<b>Ismini Stroumpou</b>	Sparsity Technologies

Modifications Introduced			
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			Giorgos Diafas Javier Gavilanes Bernat Gomez Ismini Stroumpou
8	13/04/2021	Final release	Ismini Stroumpou

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## Executive Summary

My-TRAC is a novel transport services platform for multimodality, designed for public and private transport users and operators to provide an improved passenger experience by developing and applying advanced behavioural and transport analytics and Artificial Intelligence algorithms to meaningful data gathered from diverse public transport operators and Open Data sources. The main goal of this deliverable is to explain the evolution that My-TRAC's technologies have suffered due to i) development pace and ii) changes that have been done in My-TRAC after the evaluation and conclusions obtained through the first phase and the second phase of the My-TRAC's pilots.

First, an overview of the My-TRAC's ecosystem is presented to show the interaction of the different modules and components. Then each component developed under the framework of My-TRAC is duly explained. The stand-alone components are presented as separated sections in detail. Nevertheless, the focus of this deliverable is the My-TRAC application and its functionalities which are a result of the orchestration of its different components. For that reason, in this document we have also included the updated use cases and functionalities of My-TRAC. Therefore, this deliverable provides information about the current state of My-TRAC as well as providing the evolution of the app through the lifetime of the project. This document represents the evolution of technologies and builds on D5.1, D5.2 and D5.3, however it is also connected with D6.2 which provides the analysis of the feedback gained from My-TRAC's pilots and D6.3 that aims providing suggestions to improve all modules and components of My-TRAC.

To this end, the present document starts with an introduction of My-TRAC's ecosystem and the orchestrator of My-TRAC's components; the My-TRAC platform. Then follows the presentation of My-TRAC's uses cases, the evolution of My-TRAC app and its functionalities and also the relationship between the different models follows. Additionally, social market, My-TRAC operators' portal and the analytics tool of DeepInt (Deep Intelligence) are explained in order to give to the reader a good insight to the technologies that they were based and the added value that they offer to the My-TRAC's ecosystem.

## Abbreviations and Acronyms

<b>AR</b>	Augmented Reality
<b>GDPR</b>	General Data Protection Regulation
<b>GTFS</b>	General Transit Feed Specification
<b>ML</b>	Machine Learning
<b>MaaS</b>	Mobility as a Service
<b>OTP</b>	OpenTripPlanner
<b>PoI</b>	Point of Interest
<b>PT</b>	Public Transport
<b>TC</b>	Travel Companion
<b>TSPs</b>	Travel Service Providers
<b>UI</b>	User Interface
<b>UX</b>	User eXperience
<b>WP</b>	Work package



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## BACKGROUND

This deliverable aims to present the final version of My-TRAC application. My-TRAC application is developed in WP5 however it takes input, and it is interacting with all the WPs of My-TRAC (**Figure 1**). WP5 is placed in the middle, the models created in WP2, WP3 and WP4 (which are the scientific work packages) are deployed and integrated to be presented in the application. Moreover, WP5 highly interacts with the WP6 the pilots of My-TRAC by providing to it the different version and technical support during pilots as well as integrating the feedback retrieved by the pilots. To that end, frequently there is a reference to other deliverables and tasks of My-TRAC trying not to duplicate information and on the same time allow the reader to be follow the work that has been conducted and it is reported in this document.

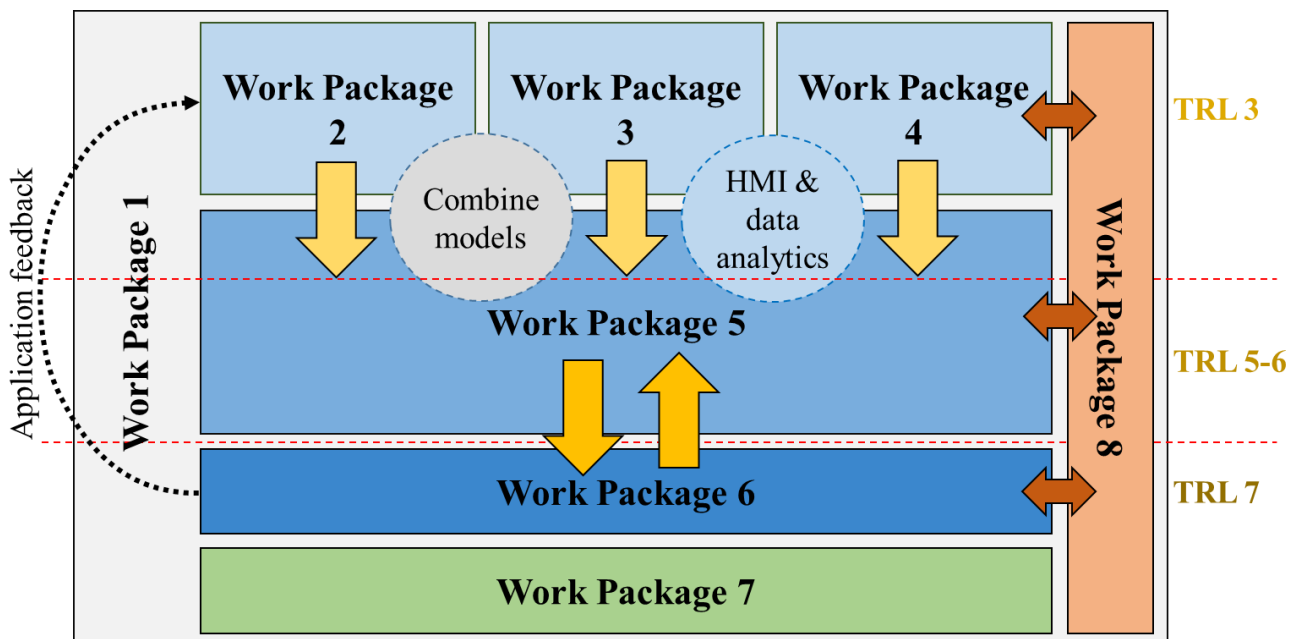


Figure 1: My-TRAC's WPs

Moreover, this deliverable aims to present the development of My-TRAC technologies, the way of connection the different components of the My-TRAC ecosystem are and the application functionalities per se. However, the evaluation of My-TRAC solution is performed in WP6 the pilots of My-TRAC and the results are presented in D6.2 and the potential improvements in D6.3. These deliverables are stand-alone documents but also a natural continuation of this document.



## INTRODUCTION TO My-TRAC

My-TRAC (My TRAVel Companion) project aim was to develop a novel transport services platform, designed for both private and public transport (PT) users as well as for operators, to provide an improved passenger experience and personalized travel recommendations by developing an ecosystem of models and algorithms for user choice simulation, data and behavioural analytics, and implement different components such as the social market, the operators' portal and 3<sup>rd</sup> parties service to meet the aforementioned objectives (**Figure 2**). Its main outcome is a travel companion capable of understanding user needs to better recommend routes, times of departure, modes of travelling and activities. In more detail, the application understands the user in a way that it can infer her travel preferences and other characteristics to suggest trip plans, actions upon transportation network disruptions, activities, etc. in a more personalized way. The architecture of this environment, depicted in **Figure 2**, consists of four main interrelated components presented in a simplistic way. Each of these components is in charge of implementing different aspects of the project and will be described in the next section.

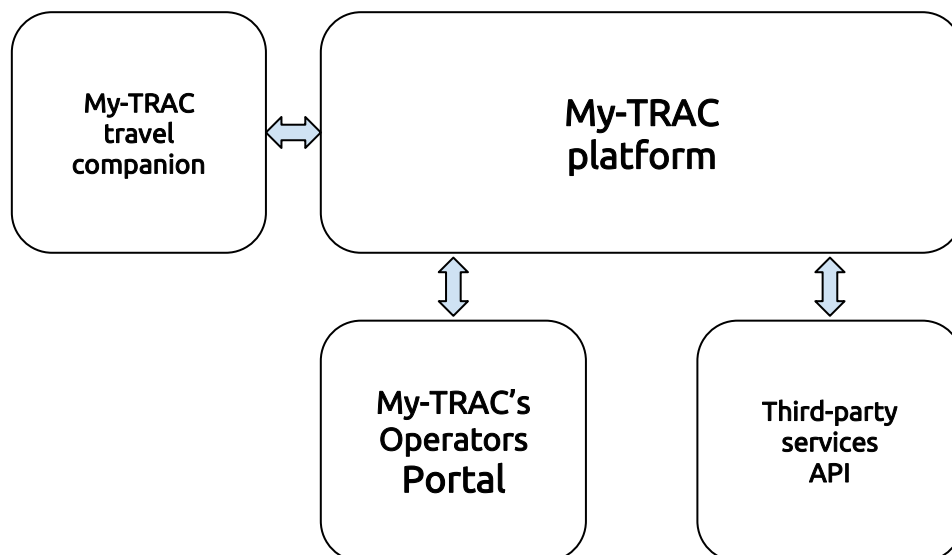


Figure 2: My-TRAC Architecture





## My-TRAC ECOSYSTEM

Extending the presented **Figure 2**, this section aims to provide an overview of My-TRAC ecosystem and provide guidance to the structure of this report. Hence, this section lists the major components of My-TRAC and presents their interaction.

**My-TRAC Platform** is the backbone of My-TRAC software infrastructure. It is an event sourcing platform, composed by two main components: CIGO!-Core and My-TRAC Algorithms which allow My-TRAC app to provide personalized recommendation to its users and connects the different components such as the third party services APIs with the app.

**My-TRAC travel companion** has released various versions during the project life span, to improve its features and functionalities as well as to extend them.

The *first version* of the application, which was released and tested in summer 2019, had the basic functionalities of a travel companion. According to the plans at that moment, it just included a trip planner, which was fed with GTFS files from the pilots' locations and very basic models aimed at collecting data to calculate the final models. Also, the pilots experience was useful to test the usability of My-TRAC and based on the opinion of real users, redesign the app. Since the end of the 1<sup>st</sup> phase of the pilots (M28), the partners have been working on evolving the app; to improve the models based on the collected data, to redesign the app to increase the usability and achieve a better user experience, and to develop new features that were not ready in the first version of the app and implement everything into My-TRAC.

The 2<sup>nd</sup> phase of the pilots found us in an odd situation, as COVID-19 was spreading in Europe. Hence, the consortium decided to postpone the pilots and focus on improving the technologies. Hence, on September 2020 the users faced a completely new application (an *almost final version*), all the models of My-TRAC were deployed and integrated and in many cases extended or and new components were added. With regards to the new features that were not ready for the first version of the usable My-TRAC, we have implemented two main components that are described in detail in this deliverable; the **Social Market**, which aims at adding value to the single ticket via a platform for rewarding the use of public transport, and the **Analytics Tool** of DeepInt, which allows monitoring events and all the information gathered on the My-TRAC servers.

**Figure 3** shows the overview of My-TRAC's ecosystem to provide a full picture to the reader and the connections between its different components. As it is mentioned before My-TRAC platform is the backbone of this system and My-TRAC app is the travellers' interface.

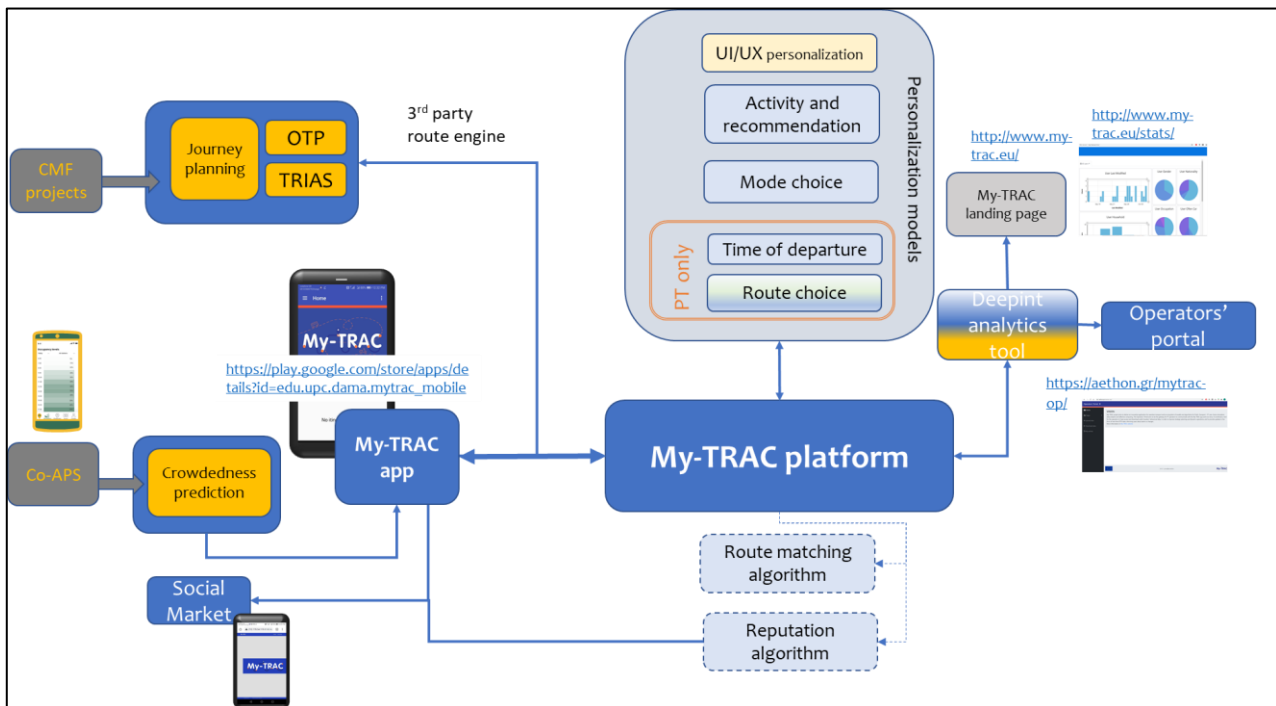


Figure 3: Overall scheme of My-TRAC's ecosystem

As **Figure 3** shows My-TRAC is an ecosystem that various components and stakeholders interacted to achieve its development.

The **personalization models** namely activity and recommendation models (2.2.1.5), route choice model (2.2.1.3), mode (2.2.1.1) and time of departure (2.2.1.2) choice models are, embedded in Docker<sup>1</sup> deployed and integrated at My-TRAC platform. UI/UC personalization model is a model which has been integrated to the source code of the app (2.2.1.6). The **route matching algorithm** (D2.5) and the **reputation algorithm** (D2.4 and D2.5) are utilizing data from My-TRAC users to calculate their results and they are running offline, both algorithms were developed for monitoring reasons. The work that has been conducted to develop these models and algorithms is reflected in D2.2, D2.3, D2.5, D3.2, D3.3 and D3.4, however for complicity reasons as the models are interwoven with some of the functionalities of My-TRAC app providing an added value, we briefly mention them in section 2.2.1.

**Social Market**, **My-TRAC operators' portal** and **Deepint analytics tool** are **standalone components** which are connected to My-TRAC like 3<sup>rd</sup> party services. My-TRAC is also connected with other 3<sup>rd</sup> party services such as the **Open Trip Planner** (OTP) (<http://www.opentripplanner.org/>) and to the **journey planner** part of travel shopping provided by the CFM projects of Shift2Rail. Moreover, **Co-APS library** was integrated in My-TRAC to provide the app with two additional features. Co-APS is funded by EIT Urban Mobility initiative and the results of this library are demonstrated in My-TRAC as a collaboration between the two projects. All the aforementioned aspects are contributing to the set of functionalities that My-TRAC offers to its users and differentiate My-TRAC from the other existing travel companions.

**Table 1** concentrates the information above adding a brief explanation and mentioning the dedicated task for the model or component created and the dedicated section in this deliverable.

<sup>1</sup> <https://www.docker.com/>

Table 1: My-TRAC ecosystem; components and features

My-TRAC's components and features			
Name of component	Task relation	Role in My-TRAC ecosystem	Dedicated section in this deliverable
My-TRAC platform	5.2	Orchestration of the different components, backend of My-TRAC app	1.1.1
My-TRAC's route engines. a. Open trip planner b. Travel Shopping, Shift2Rail	5.2 and 1.5	My-TRAC platform gets routing results from its two integrated 3 <sup>rd</sup> parties route engines	1.1.3
My-TRAC app	5.1, 5.2 and 5.3	Interface of My-TRAC users/travellers. Presentation of the results provided by all components	2.1
Mode choice model	2.3	Provide a personalized suggestion to the user concerning mode preference	2.2.1.1
Time of departure choice model	2.3	Provide a personalized suggestion to the user concerning the type of departure preference	2.2.1.2
Route choice model	2.3 and 3.2	Provide a personalized suggestion to the user concerning route preference	2.2.1.3
Activity and recommendation choice model	2.2, 2.3, 3.2	Provide a personalized suggestion to the user concerning activities (points of interest) preference	2.2.1.5
UI/UX personalization	4.2	Allows the user to change the look and feel of My-TRAC app in case that the user prefers a high contrast UI and in case that the user declares that has a visual impairment	2.2.1.6
Route matching algorithm	2.3	Post processes the GPS traces to understand the real choice of the user	2.2.1.7
Reputation algorithm	2.4	Measures the engagement of the user with the app	2.2.1.8
Co-APS	5.2 and 1.5	It provides two additional functionalities in My-TRAC namely crowdsourcing and crowdedness predictive analytics	2.2.1.10
Deepint analytics tool	5.5	Deepint analytics tools provides statistics and analytics of the My-TRAC app	3
Social market	5.4	Gives the user the opportunity to buy. in a secure manner thanks to the blockchain technology, products and tickets with a discount based on coupons and points	4

		gained by the usage of My-TRAC (the coupons are inactive as My-TRAC does not have a provider in the consortium)	
My-TRAC operators' portal	5.6	It is the interface of the operators (TSPs) which allows them to see statistics of My-TRAC and also create real time GTFS files in a user-friendly way.	5

## 1.1 MY-TRAC COMPONENTS

My-TRAC's components interact in order to provide to My-TRAC app its functionalities. Therefore, the following sections are dedicated to the My-TRAC components starting from My-TRAC Platform is the backbone of My-TRAC software infrastructure. It is an event sourcing platform, composed by several modules as depicted in **Figure 4**. However, the following sections also detail way of interaction between the different components to allow the reader to have a holistic view of the My-TRAC ecosystem.

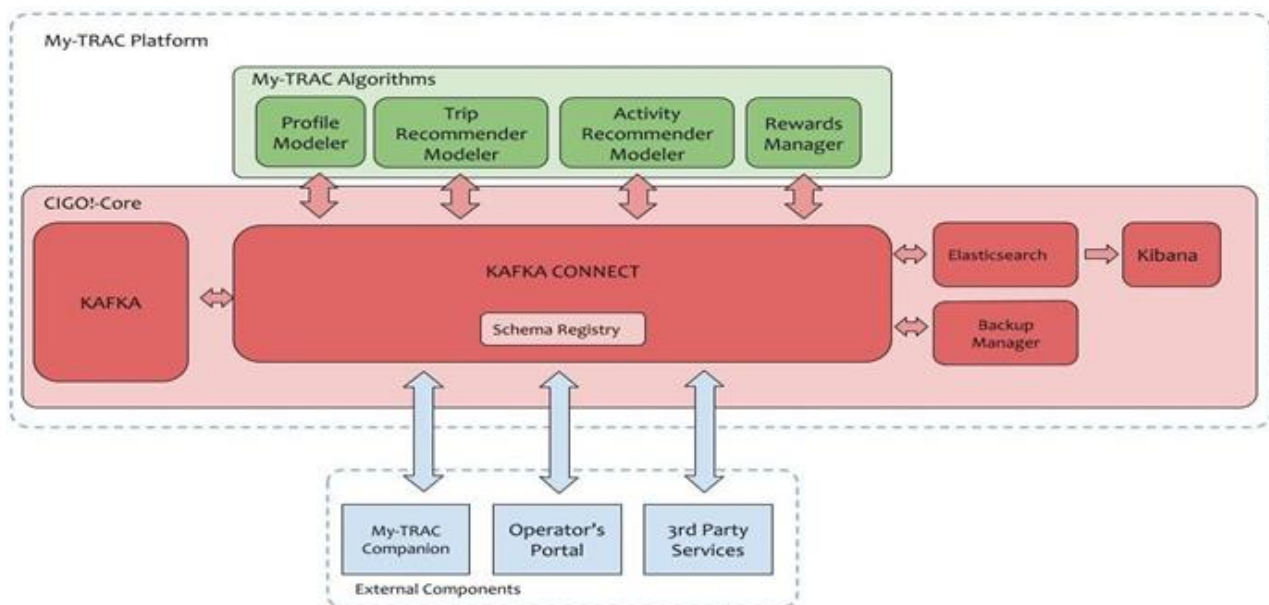


Figure 4: My-TRAC Platform architecture

### 1.1.1 CIGO!-CORE

My-TRAC faces multiple challenges when it comes to fulfil its purpose. To provide with meaningful suggestions for the travellers, My-TRAC needs to integrate and combine data from a myriad of heterogeneous data sources. On the one hand, operators must be engaged to provide the system with relevant information regarding the transport, including transport schedules, GTFS data, occupancy data, real-time data, and information about disruptions on their services, available station facilities (e.g., presence of elevators for disabled people or stores) if they are available, etc. On the other hand, environment data like weather or traffic, that might affect user's trip plans and that can be used to predict disruptions to the service information have to be also be incorporated. Also, data about



the surrounding activities such as amenities and events (e.g., restaurants, museums, concerts, etc.) that can be recommended to the traveller during their trips had to be taken into consideration.

Moreover, My-TRAC Companion must be able to adapt to the user needs over time and under different circumstances. As more and more travellers use the app, the application must learn from their previously observed user actions to improve future recommendations. This requires the combination of multiple machine learning (ML) techniques to create different models, each of them consuming different types of data.

This scenario calls for a carefully designed software architecture to fulfil many non-functional requirements (listed below) that, if not achieved, could put the success of the project at risk:

- The calculus of complex models should not become a bottleneck for the user experience. Thus, the current application used by travellers has to be capable of working and providing results while those models are being calculated asynchronously by the different ML components of the platform.
- My-TRAC has to be capable of serving a huge number of users simultaneously that is expected to grow over time. This calls for an architecture that is designed to scale and to adapt to varying workloads.
- The number of different components in My-TRAC is expected to be large and heterogeneous, from batch processing ML jobs to web services, components that acquire data from different external sources or those that manage the backups, etc. Each of them requires different data needs and must be easy to integrate and talk to each other in a consistent way.
- As new components are being developed to satisfy new functional requirements identified during the project, My-TRAC has to be able to integrate them at the lowest possible cost in terms of time and programming efforts, without breaking the existing ones.
- Personal data and sensitive personal data from the users are being collected, thus, My-TRAC has to guarantee an ethical and secure treatment of this information. My-TRAC app must be compliant with GDPR and ensure the privacy and security of the traveller's provided.
- My-TRAC must provide a universally available service which is also safe to crashes, thus being capable of recovering if an unexpected event happens.

To accomplish the aforementioned requirements, we have designed and implemented CIGO!-Core. Additionally, we have evaluated its capability of handling simultaneously numerous different clients.

**CIGO!-Core:** Keeps a persistent source of truth of all the events happening in the public transport network, including user's activity, network disruptions, etc. It offers an interface to publish and poll events, classified by topics which are compliant to a predefined data-model, allowing different components to communicate asynchronously through the stream of events without knowing each other. Furthermore, CIGO! Core is a technology based on the Confluent [1] software stack, which consist of:

- **Apache Kafka [2]:** At its core, it relies on Apache Kafka, which is a persistence, fault-tolerant distributed log used to record all the events happening in the public transport network. Components, either internal or external, can publish (*source* components) or subscribe (*sink* components) to the different events, classified by topics. For instance, an activity recommendation module, responsible of generating models for recommending activities to users, will be subscribed to all the events consisting of users performing and rating activities. From time to time, such component would generate new recommendation model parameters which will be published as a new event, consumed by My-TRAC Companion app to be used to serve the recommendations to the end users.
- **Kafka Connect [3]:** To ease the connection between components and Kafka, instead of directly connecting, they connect via Kafka Connect plugins. Kafka Connect is responsible of automatically keeping the modules





data consistent with the events in Kafka. For instance, a component such as a Routing Modeler might use, internally, a MySQL instance to store the public transport network information as well as its usage. Such component would synchronize its MySQL instance with Kafka via Kafka Connect, thus every time that an operator publishes an update to its public transport network, Kafka Connect would automatically update the corresponding table in the MySQL database. Similarly, updates to MySQL would be automatically propagated as events into Kafka.

- **Schema Registry [4]:** In order to guarantee a shared data model, the schema registry stores for each topic the schema of its messages. This not only forces that topics comply to a particular schema, but also offers several valuable functionalities like schema versioning, schema compatibility checks, etc.
- **Elasticsearch [5]:** Is a search engine based on Lucene. In My-TRAC, it is used to index all the events happening in My-TRAC, which can then be used to perform queries to analyse the events flow and the usage of the platform.
- **Kibana [6]:** Is an open-source visualization tool for Elasticsearch, which allows to visualize the results of different queries performed against Elasticsearch indexes.
- **Backup Manager:** This component is the responsible of registering all the events that enter the platform and to store them to an external cloud storage. It has the form of a Kafka Connect plugin, thus guaranteeing that all data is persisted to the cloud. If for some reason data is lost from the logs, this can be replayed from the backups.

#### 1.1.1.1 CIGO!-CORE EVALUATION

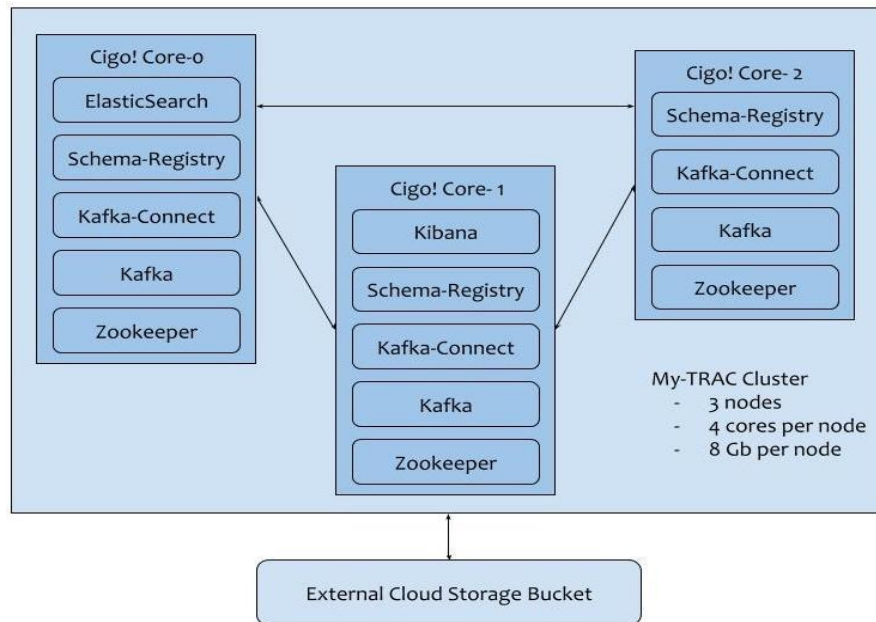
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One of the main requirements of My-TRAC is its capability for handling simultaneously thousands of clients. To guarantee this specific requirement we evaluated the performance of CIGO!-Core and the way of how the evaluation was performed as well as its results are detailed in the following sections.

##### 1.1.1.1.1 CIGO! CORE HARDWARE SETUP

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**Figure 5** shows the characteristics of the hardware infrastructure that will be used as a reference to deploy the CIGO!-Core which consists of a cluster of three commodity level computing nodes. Each computing node contains an instance of Kafka, Kafka-Connect, Zookeeper and Schema Registry. The replicated nature of the setting not only guarantees the required throughput but also the high availability of the system and the durability of the platform's data. Additionally, a bucket of cloud storage is also used to store the required backups of the data. Non-critical components such as Kibana and Elasticsearch are instantiated only once.

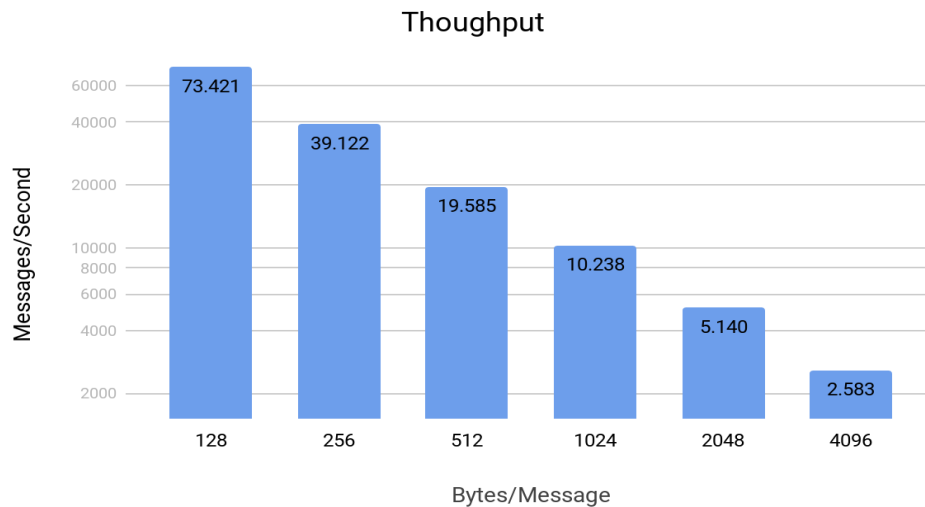


**Figure 5: My-TRAC evaluation setup.**

The cluster is managed using the container orchestrator **Kubernetes** [7,8], which allows for an easy configuration and deployment of multiple containerized services on clusters and define scalability and replication rules. This allows us to increase the number of replicas if necessary or adding new computing nodes to accommodate My-TRAC Algorithms components. As such, we have prepared custom docker images to ease the process of service replication.

#### 1.1.1.1.2 PERFORMANCE RESULTS

We have conducted a performance evaluation of My-TRAC Platform using the reference cluster described in **Figure 5**. The test uses the official Kafka-producer-perf script which allows generating messages of different sizes and reports the achieved average throughput. **Figure 6** shows the results for different message sizes in bytes. We see that after the message size of 256 bytes, the throughput decreases linearly proportionally to the size of the message. We expect most messages in My-TRAC to fall within the range of 512 to 1024 bytes, thus achieving a throughput between 19585 and 10238 messages per second. This showcases the performance capabilities of the reference platform to deal with a large number of concurrent users. Please note that for all message sizes, the amount of transferred MBs per second saturates at 10MB/s (e.g.,  $4096 \cdot 2583 = 10580$  MB/s), which is the maximum bandwidth of the network where the tests have been performed and suggesting that the cluster would possibly be capable of reaching a higher throughput if the network was not acting as a bottleneck.

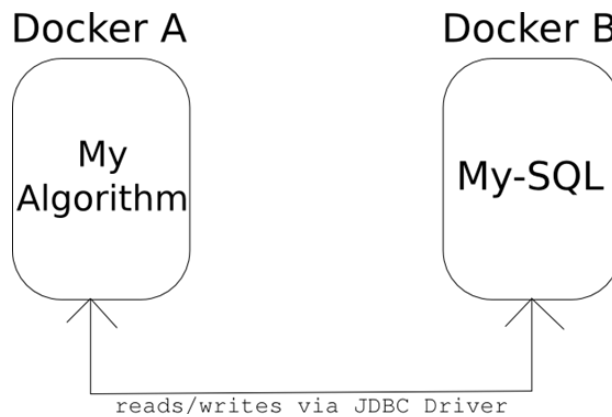


**Figure 6: Throughput (messages/second) of CIGO!-Core for different message sizes.**

#### 1.1.1.2 MY-TRAC PLATFORM COMMUNICATION

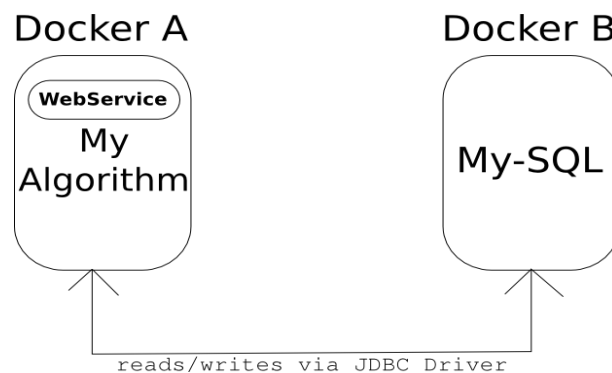
One of the main characteristics of My-TRAC Platform is the capability for an easy communication among the different modules. Therefore, CIGO!-Core is in charge of such interoperability due to the use of Kafka and Kafka Connect, and, thus, it is an event driven Platform. Although connectors can be implemented ad-hoc, to ease the process of the overall implementation we have decided to use one of the most common connectors, My-SQL. For that, each module of My-TRAC Platform consists of, as depicted in **Figure 7**, two dockers: one which implements the functionality and the other that deploys a My-SQL that the algorithm uses to read data from the platform and to write data into the platform. In more detail, the leftmost side of **Figure 7** Docker A, represents the docker of the algorithm itself. It can be whatever functionality that is required by My-TRAC. For example, it could be, the Algorithm in charge of predicting activities for the user or the transport choice mode. The rightmost side of **Figure 7** Docker B, is the particular My-SQL database of the module. This My-SQL is being used by My-TRAC to synchronize (i.e., push/pull information from My-TRAC Platform to/from Docker A). In other words, the information shared across the different modules, which is represented in the data model (i.e., <https://github.com/My-TRAC/data-model>) is generated by the algorithms (Docker A). Then, this information is stored in the specific module database (Docker B) and, finally, automatically, via connectors, it is be pushed to My-TRAC Platform and accessible by other modules. Reciprocally, the data that our algorithm (Docker A) requires is also going to be automatically accessible from the specific module database (Docker B), again, via connectors.





**Figure 7: Module design**

Also, in case of implementing a service which needs to be accessible from the outside of My-TRAC Platform, the algorithm should implement a WebService as depicted in **Figure 8**.



**Figure 8: Module design with WebService**

As already introduced, the communication between the module's My-SQL and CIGO!-Core is done thanks to the connectors. Namely, there are two kind of connectors, JDBC SOURCE CONNECTOR, when data needs to be propagated from the module into CIGO!-Core as in **Figure 9** (left). In this way, everything that is written into the My-SQL is propagated automatically into CIGO!-Core, organized in a topic which corresponds to the tables' names. Symmetrically, as depicted in **Figure 9** (right), a module that needs to obtain data from CIGO!-Core, will subscribe to a topic and every new event in CIGO!-Core under this topic, will update the contents of the table with the same name in the module's My-SQL.

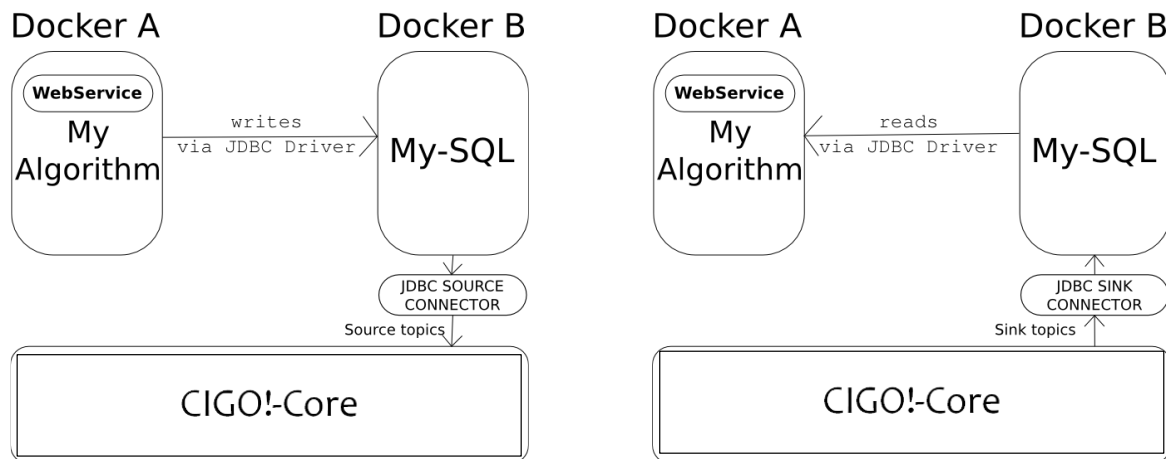


Figure 9: Source connector (left) and Sink connector (right)

### 1.1.1.3 DATA CONSUMPTION

Based on the My-TRAC platform communication capabilities introduced in the previous section and due to the diversity of My-TRAC partners experience and the accessibility of the data generated by KAFKA in the CIGO environment, we have developed two different ways accessing the My-TRAC's data.

- Web Services: We have developed several web services which allow to consume information from the database. Those webservice are developed according to the requirements of each partner.
- MySQL VIEWS: It is also possible to access to the data directly in the database through MySQL Views.

Additionally, no matter the way the My-TRAC's partners accessed the data, it is important to mention that the data access was restricted under a data processing contract per each partner based on the objective and scope of the data processing. The data consumed as it was mentioned are included to My-TRAC's data model (i.e., <https://github.com/My-TRAC/data-model>) and every data processing agreement uses My-TRAC's data model as a reference.

### 1.1.2 MY-TRAC ALGORITHMS

**My-TRAC Algorithms** consists of a set of modules that, based on the observed event stream, produce model parameters for routing, activity prediction, places to visit recommendation and user profiling. They use CIGO!-Core to consume data and to publish the models in the predefined data-model, in such a way that external components such as My-TRAC Companion can use them. Although, My-TRAC algorithms are not the core subject of this report however they are briefly presented in section of My-TRAC features as they are related with the functionalities of My-TRAC app.

### 1.1.3 MY-TRAC ROUTE ENGINES

My-TRAC has the **adaptability** of including as many route engines as needed. It has been implemented as a **scalable solution** which allows to perform trip queries attaching to the best route engine. Currently, CIGO-CORE has been integrated with two different route engines, but it could be integrated with even more. In particular, we use the Open Trip Planner as the planner of My-TRAC and the route engine provided by S2R through its CFMs as a route engine.



My-TRAC's CIGO CORE chooses the best route engine (in our case, our planner and the CFM's planner) according to previous quality response (i.e., time, availability routes, route proposals) and provides it as a response. The aforementioned parameters played a crucial role as the app needs to provide quick and high-quality information, therefore the time of responses for PT urban itineraries creation is ~0.8secs, PT inter urban itineraries ~1.3secs and between different countries (e.g., Amsterdam to Brussels) ~4.6secs. These response times are for the generation of 10 different itineraries (a value decided with the modelers of route choice and time of departure choice model please see the following sections and D2.3) and values that are higher than these block the users for using My-TRAC services.

### 1.1.3.1 CIGO ROUTE ENGINE

Accessible through web-services interface. It is also composed by several inner modules and it is scalable owing its technology and it is container-based environment. It is based on several Open Trip Planner (OTP. <http://www.opentripplanner.org/>) which allow to consume routing requests from several countries/regions.

### 1.1.3.2 SHIFT2RAIL TRAVEL SHOPPING

Shift2Rail CMFs service of routing which is called Travel Shopping which is accessible using a standard interface TRIAS. This component is connected to the IP4 ecosystem that is composed by several components such as Cloud Wallet, the central component responsible for the management of users' mobility data (preferences, trips, tickets, groups, alert messages, payment means, mobility package etc.). The Cloud Wallet stores and secures the data of the users in a way that no other users can access it. The Travel Shopping component that is also connected to the Interoperability Framework, which allows the service requestors to access journey planning data of the TSPs connected to this Framework.

## 2.1 MY-TRAC TRAVEL COMPANION

My-TRAC Companion is the core product of this project and is an application that aims to act as a real travel companion providing recommendations that are helpful to improve the trips. My-TRAC app has two modes of operation as a "common" travel companion or either as personal travel companion providing recommendations, either routes or activities personalized according to the specific characteristics of the traveller and the specific trip he is doing. It is also the application in charge of collecting the data that are used to feed the models running at the backend and that are responsible for the personalized recommendations. My-TRAC Companion is designed as a client-server application. The client side is running in the traveller's mobile device and is in charge of:

- Guaranteeing a great user experience providing a visual interface to make it easy for the travellers.
- Informing the terms and conditions (data privacy and compliance with GDPR)
- Allowing signing up.
- Allowing travellers to request/delete personal data (GDPR)
- Proposing several itineraries between two points, taking into consideration the user's profile.
- Proposing events and collecting user's ratings.
- Maintaining the state of the app for the traveller. It includes a history of trips. For each trip, the activities that have been recommended, the tickets that have been purchased via the app.
- Informing about the current trip giving information about coming events such as transfers, activities, recommendations.
- Generating, modifying and maintaining groups.



On the other side, the server contains every component necessary to carry out the task of My-TRAC and serve the petitions of the mobile client. Thus, the server is in charge of doing those calculus that requires higher CPU usage. Thus, as depicted in **Figure 4**, the server side of My-TRAC Companion has the required modules to implement the responsibilities assigned in the previous section. Also, to be autonomous from My-TRAC Platform, the server side of My-TRAC Companion, has to keep the required information, such as the road network, the available activities and the models both for routing and recommending activities, to carry out the functionalities of My-TRAC. Thus, if for whatever reason the connection between My-TRAC Companion and My-TRAC Platform is down, the Companion can still serve petitions based on the information it has, even if it may not be updated.

In the following Section, we will relate the changes that the application has suffered due to the experience gained in the first phase of the pilots and the development schedule by presenting the use cases updated (please see Annex 1 My-TRAC Traveller's use cases-Updated) to reflect the interactions between the users and My-TRAC app.

### 2.1.1 MY-TRAC'S APP FUNCTIONALITIES AND FEATURES

My-TRAC app is available at the [Google Play Store](#). To reach the wanted results different versions of My-TRAC were produced with the most important which are also connected with My-TRAC milestones such as the initiation of pilot phases are depicted in **Figure 10**. Except of the functionalities planned to be developed, My-TRAC to be adaptable to the users' needs and to be a competitive travel companion was connected with Co-APS to get the crowdedness prediction functionality considering the COVID-19 situation. To this end, all the use cases produced in the first months of the project were updated during the project's lifetime to meet the technological developments. The updated use cases can be found in **Annex 1 My-TRAC Traveller's use cases-Updated**.

The following paragraphs present the milestones versions of My-TRAC app that were developed to follow the timeline of the My-TRAC pilots' phases. Hence, the intermediate versions are not presented as we focus on the ones that suffered the most critical changes and/or were presented to the general public.

**My-TRAC app V2.5.1:** This version was developed before the 1st phase of My-TRAC pilots and delivered in M24 had the basic functionalities of a travel companion and it was meant to test them to acquire feedback from real users and also define how the models how to integrate the models of My-TRAC.

**My-TRAC app V5.2:** This version was developed and launched for the 2<sup>nd</sup> phase of the My-TRAC pilots and it had the all My-TRAC's models integrated and deployed and the feedback of the 1<sup>st</sup> phase of the pilots which is reported in detail in D6.2.

**My-TRAC app V6:** This version is the current version published at the google store and has improvements as we incorporated the feedback from the pilots and some extra features provided by Co-APS.

The changes between the different versions of My-TRAC are explained in detail at the next section Change log after the brief introduction of My-TRAC's functionalities.

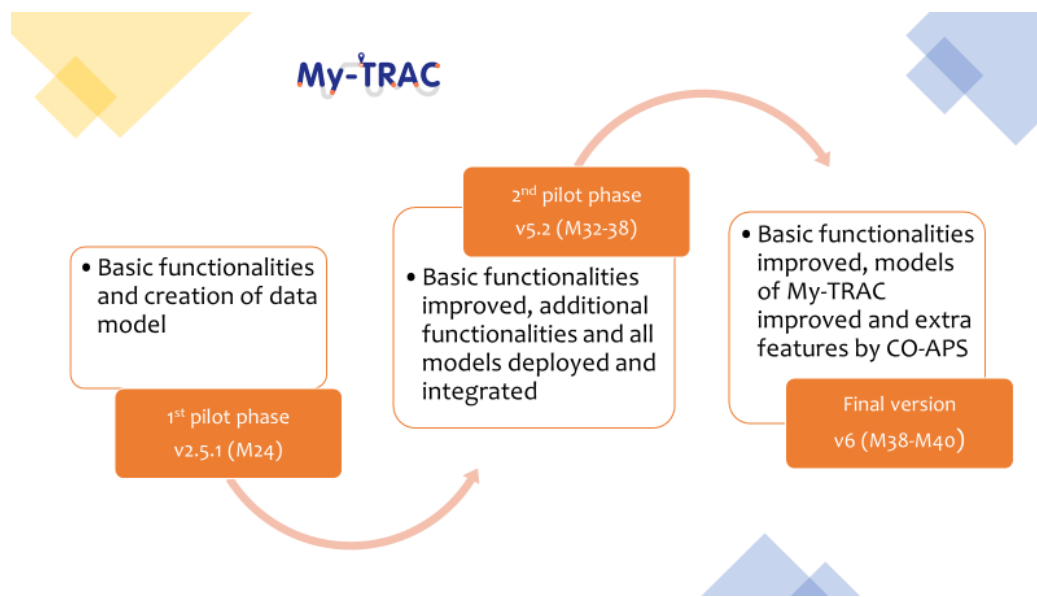


Figure 10: Versions of My-TRAC

### 2.1.1.1 CHANGE LOG

The change log is represented in **Table 2** providing the My-TRAC's app status of implementation, a brief description of its functionalities' changes and enhancement throughout the project's lifetime. These changes are related with My-TRAC's use cases, as well as with the versions presented in **Figure 10**.

The final version is the version that has been developed after My-TRAC's pilots and it is an enriched version of the 2nd phase, it includes an additional functionality of Co-APS which is devoted to gather occupancy data by the travels via crowdsourcing and combine them with other data sources such as sensors data, cameras etc. and perform in the backend predictive analytics to provide forecasting for occupancy. The latter is facilitated by Co-APS project funded by EIT Urban Mobility initiative.

Table 2: Change log of My-TRAC app functionalities

	1 <sup>st</sup> pilot phase	2 <sup>nd</sup> pilot phase	Final version
Functionality	<b>V2.5.1</b> Basic functionalities and data model (M24)	<b>V5</b> Basic functionalities improved, additional functionalities and models deployed and integrated (M32-M38)	<b>V6</b> Basic functionalities improved, models of My-TRAC improved, extra feature of crowdsourcing and occupancy prediction (only in Barcelona and Athens)



<b>Traveller's Registration<sup>2</sup></b>	<p>The terms and conditions of the app are translated (available in 6 languages: English, Spanish, Catalan, Greek, Portuguese, and Dutch), to allow all our users from our pilot site to be able to understand to what they consent.</p>	<p>The terms and conditions of the app are translated (available in 6 languages: English, Spanish, Catalan, Greek, Portuguese and Dutch), to allow all our users from our pilot site to be able to understand to what they consent. Also, the consent is generated in such way to allow the user to sign in at a 3<sup>rd</sup> party sites (Social market) as well as to participate in different My-TRAC experiments without the necessity of providing another written consent. The promotion of single sign-up process works the following way.</p> <p>This same document will always be available to users through their profile page, inside the application. Thanks to this document the application complies with the GDPR.</p>	<p>Same as v5.2</p>
<b>Trip creation</b>	<p>My -TRAC app is connected to OTP providing the options of itineraries creation with bus, train and walking</p>	<p>My-TRAC app offers multiple options of itineraries generation. Works like a “common” travel companion by providing OTPs options and has a personalization module.</p> <p>My-TRAC has developed the OTPs not only for the pilot sites (Barcelona, The Netherlands, Lisbon and Athens) but also for Belgium, Helsinki, Luxembourg and Istanbul. The GTFS data of Athens had to be created and updated as well as for the Metropolitan Area of Barcelona.</p>	<p>My -TRAC app is connected also to CFMs route engine.</p>

<sup>2</sup> It is crucial to mention that due to the changes occurred in the terms and conditions it was mandatory to erase the users of the first pilot phase in order all the users to read and accept the new terms and conditions of the app, however the updates after the initiation of the 2nd pilot were performed automatically to all the users that had downloaded the app.





Detection of changes and disruptions on a route during a trip	N/A	N/A	My-TRAC server has a set of programmed disruptions (e.g., maintenance works) and presents it as alerts to the users of the specific itinerary the disruption occurs or will be expected to be take place and can cause delays.
Activities' proposition and rating	The library of Pols was inserted by the activity and recommendation module was not integrated. So, the user could see activities but were not sorted based on the users' preferences	Extent the information provided in Pols. The user is able to see recommended activities based on his/her profile characteristics. The activity and recommendation module is running in the backend and provide these recommendation and it also provides group activities recommendations	Same as v5.2
Navigation	Navigation provided by OTP	Navigation is extended also to google navigation. The traveller to get navigation for Pols can click on the allow on the top of the Pol's description/details. On top of this navigation Pols encountered during the itinerary selected by a user are marked with an arrow (left or right). So, the user knows that the certain Pol is at his/her left or right side heading his/her destination. This is a routing feature that might assist the travellers' orientation	Same as v5.2
Using My-TRAC app in a country other than home-country	Traveller can use My-TRAC as a common travel companion	Same as v2.5.1	Same as v2.5.1
Communication with MaaS and 3rd party services	My -TRAC app is connected to OTP providing the options of itineraries creation	My -TRAC app is connected to CFMs routing service providing the options of itineraries creation with bus, train and walking	List of MaaS providers. Integration with S2R services offered by CFMs will be in place after the pilots' phase



	with bus, train and walking		
<b>Traveller's feedback and recommendations (My-TRAC rating system)</b>	N/A	<p>The user can provide feedback and rate the activities that were recommended to him/her by simply accepting to answer three questions after seeing the list of the recommended activities.</p> <p>Also, the user can provide feedback by the entering to the relevant page of his/her profile.</p>	Same as v5.2
<b>Group creation, modification: Adding a new member and deletion</b>	The user could create and group and share his/her itinerary with the group as well as modify the group.	The share itinerary is stored with the name of the group and aspects of UI/UX have been improved.	Same as v5.2
<b>Erase traveller's profile</b>	The user is able to erase his/her profile	The user is able to erase his/her profile	The user is able to erase his/her profile
<b>Request personal data</b>	The user requests his/her personal data and receives a pdf.	The user requests his/her personal data and receives a pdf. These data include also the data generated by Social market.	Same as v5.2
<b>Personalized UI/UX</b>	N/A	User is able to change the UI/UX of his application either automatically by answering that he has a visual disability at the registration or manually from his profile menu.	Same as v5.2
<b>Points and social market</b>	N/A	User is getting points with his/her interaction with My-TRAC app	Same as v5.2
<b>Booking, ticketing and payment transactions</b>	N/A	User can buy a service or a ticket from social market	User can purchase a ticket in Barcelona (demo)



Crowdedness prediction	N/A	N/A	User can check information on crowdedness prediction in public spaces and public transport station in Barcelona and Athens.
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These changes had an impacted or are caused by changes performed in the My-TRAC ecosystem. **Figure 11** depicts this evolution and therefore the main difference was between v2.5.1 and v5.2. In the latter all the My-TRAC models and algorithms have been deployed and we have also used an additional route engine (from the Shift2Rail CFMs projects) which raise the complexity of the application and its capabilities on the same time (**Figure 11** and **Figure 12**). The difference between v5.2 and v6 is that we have resolved the bugs identified by internal reviews and also by the 2<sup>nd</sup> phase of the pilots, improve aspects concerning the functionalities and that we have connected My-TRAC with Co-APS. Additionally, v6 is a version that consider in a greater extent vulnerable groups such as people with reduced mobility allowing them to identify PoIs that are accessible.

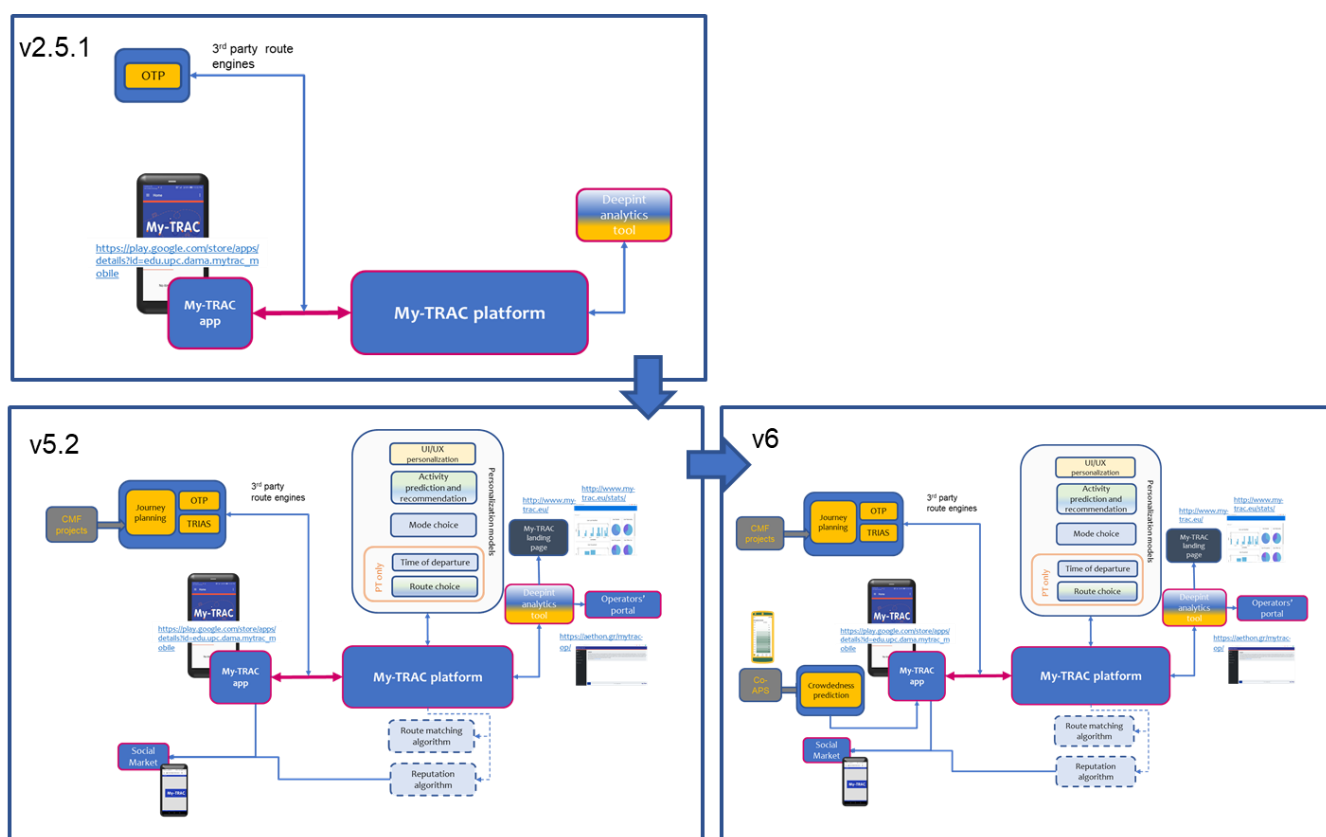


Figure 11: Representations of the My-TRAC ecosystem based on the different versions.

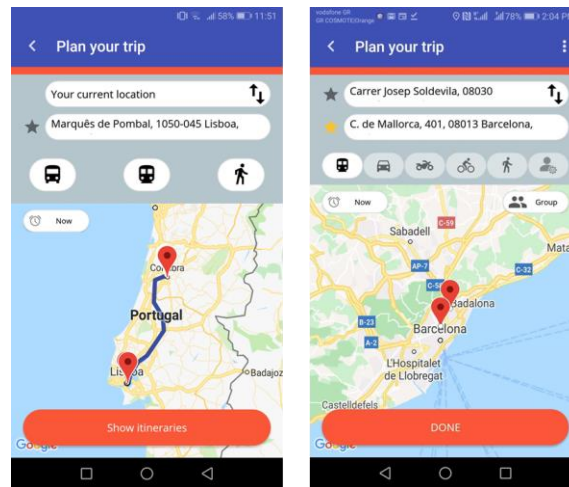


Figure 12: Screens of My-TRAC v2.5.1 and v5.2 basic different in trip creation functionalities

The functionalities have been derived by the use cases (please refer at [Annex 1 My-TRAC Traveller's use cases-Updated](#)) and provided by My-TRAC are the following:

**F1. Travellers' registration:** A traveller has downloaded My-TRAC app from google play store and decides to register to the My-TRAC app. Consequently, My-TRAC app creates an account, and the system creates his/her profile. The app requires email verification, so the traveller receives an email to verify his/her registered address. After the verification, the traveller logs in (persistent log in). The app creates a profile based on traveller's information (e.g., username, date of birth, mail). The traveller allows the connection with the preferred networks. The app creates traveller's profile A user profile has personal information provided by the user as well as parameters which are used as input for the models of mode, time of departure, route, activities and UI/UX personalization model. Furthermore, a profile in Social Market feature is automatically created without the necessity of a second registration.

**Added value:** input parameters for personalization models, single sign in and compliance with GDPR.

**F2. Trip creation:** This functionality is the functionality that mostly differentiates My-TRAC from other existing travel companions. The traveller wants to travel from point A to point B. The traveller opens My-TRAC app to determine best mode, route and time of departure using a routing option (fastest route) or considering his/her travellers' profile parameters by using the personalized button. The traveller inserts information regarding the starting point and the destination (writing the address, searching history, pointing the map, saying the address-speech to text) of the trip and the app shows all the alternatives for reaching it, so that the traveller chooses which one he/she prefers. Also, the traveller can activate and deactivate the mode of his/her preference. Origin and destination can be added to favourites and they are also stored at the history of the user. Itineraries created by a user can be shared also with groups. Connection with the different route engines (please also see [section 1.1.3](#)) choosing the fastest one to provide immediate answers to My-TRAC users.

**Added value:** Integration of different routing engines, presentation of personalization models results (also see [2.2.1.1](#), [2.2.1.2](#) and [2.2.1.3](#)). My-TRAC works in two ways as a common travel companion providing the recommendation directly from the fastest route engine or as a personal travel companion providing personalized recommendation based on the aforementioned models ([Figure 13](#)).



My-TRAC as a common travel companion

My-TRAC providing personalized recommendations

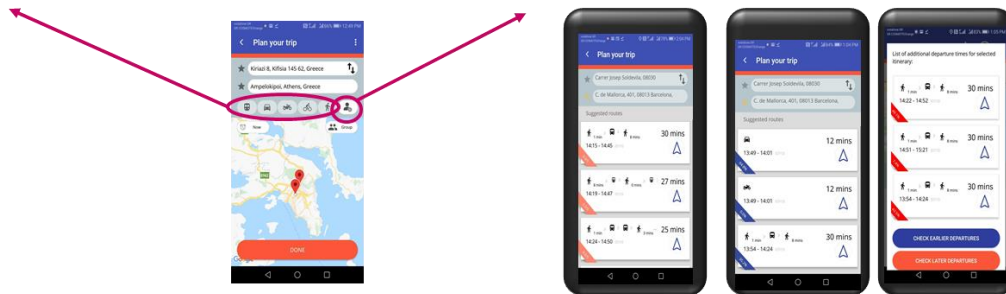


Figure 13: My-TRAC's trip creation options

### F3. Detection of disruptions

Before and during the trip, the external situation (the situation beyond the control of the user or the My-TRAC app) needs to be monitored and changes that can affect the scheduled trip need to be detected and acted upon. My-TRAC system is supporting scheduled interruptions of PT services and road maintenance which are communicated to the user based on his/her itinerary chosen. This functionality is demonstrated for Barcelona and for the Netherlands and appears to the user like a pop-up message. Additionally, My-TRAC operators' portal gives the possibility to TSPs to report changes at their services by creating real time GTFS data but due to resources limitations My-TRAC app is not demonstrating these disruptions at its users.

### F4. Activities propositions (to individual, people with reduced mobility and to groups)

Traveller needs to reach a specific destination and the app proposes activities during the route (without filtering them) and at the destination based on his/her characteristics. My-TRAC app is also recommending activities to groups combining the characteristics of the users. My-TRAC users can rate the activity performed to provide information to the activity and recommendation module.

Additionally, My-TRAC has a special category of activities/amenities which are accessible by PRMs in cities that this information is available.

**Added value:** activities recommendations based on user(s) characteristics (please also see 2.2.1.5)

### F5. Navigation

The traveller has selected a route for a trip, which is ongoing and needs to be navigated. Navigation in My-TRAC is performed in two ways. My-TRAC user can get directions from the routing engine of OTP in a list form and can also get directions for going to a selected Point of Interest (PoI) by clicking the arrow on the top of the window that redirects the users to the services of google maps.

**Added value:** Multiple navigation engines can be integrated.

### F6. Using My-TRAC app in a country other than home country

The traveller is going abroad and wants to use My-TRAC app. My-TRAC except of its pilot sites works in Helsinki, Luxembourg, and Belgium nevertheless the personalization features of mode, time of departure and route choice are calibrated for the pilot sites. Hence, the user for route choice will encounter some differences.

**Added value:** My-TRAC is working a common travel companion.



### **F7. Communication with MaaS and 3<sup>rd</sup> party services**

My-TRAC has the following connection with MaaS and 3<sup>rd</sup> party services:

- The traveller needs to find an available itinerary from origin A to destination B. My-TRAC app finds possible alternatives and contacts with service providers to verify that the alternatives are available. If the user chooses an itinerary with a car or a bike in Barcelona metropolitan area, then My-TRAC suggests the 3<sup>rd</sup> party services via the tab of booking.
- Social Market is platform aimed at offering a set of services and promotions tailored to user's travel planning, habitudes, behaviours and preferences (i.e., Gastronomic promotions, etc.). Personalization of offered services and promotions will also be based on conducted actions by users with similar behavioural patterns and will consider their reputation score to avoid unsuitable recommendations (1). This platform will fit in the traveller's interface (2), adapted for both individual and group travellers (3), and will also have a business interface, which will serve as a unique access point for local commerce to reach travellers (4). This service will relay in Blockchain technology in order to provide the user with a reliable and seamless shopping service through the use of Smart Transactions.
- Activities and Points of interest are displayed in the application. Furthermore, the user can navigate from its current location to the activity or the Point of interest itself. This is done via the usage of the 3<sup>rd</sup> party app Google Navigation, which is launched through My-TRAC application.

**Added value:** Connection with different stakeholders to extent the value of a single ticket.

### **F8. Travellers' feedback**

My-TRAC has two mechanisms to get feedback from its users.

Direct: The traveller is asked by My-TRAC mobile application to provide feedback, using the feedback and recommendations module which is implemented in the profile of the user as different polls (of the mobile application).

Indirect: Through the analytics presented in deep intelligence tool to the partners of the consortium My-TRAC is getting feedback

### **F9. Group creation, modification etc**

A traveller wants to create a group with other users of My-TRAC and wants to perform one or more trips with them. A group is created by a My-TRAC user (searched by their username) and all the travellers invited to the group are informed and accepted the invitation. After the creation of the group trip, the profiles of the group members are analysed to match their preferences thus, allowing the My-TRAC app to recommend trip modes and activities for the group's upcoming activities that meet all member's preferences. From this moment on, the group is handled by My-TRAC as a single traveller. A user can create multiple groups. The modifications can be done by every member of the group. When a group member wants to share an itinerary, he/she just have to click share with a group and choose the group's name. Then if the user presses start then the itinerary appears to the group members marked with the name of the group.

My-TRAC also recommends activities to the group of users based on a combination of their characteristics (connection with functionality no4).

**Added value:** Give to My-TRAC user the ability to travel in groups or share his/her itinerary with a low effort.

**F10. Erase users' profile**

The traveller decides to delete its profile from My-TRAC. Consequently, My-TRAC deletes all identifiable data related to the user. This use case fulfils obligations of the app concerning GDPR. As Social Market is a component of My-TRAC and the user does only one sign in process, then if he/she requests his/her to delete his/her profile he/she is also deleted from the social market.

**F11. Request of personal data**

The traveller decides to download the personal data that My TRAC has about him/her. This use case fulfils obligations of the app concerning GDPR. As Social Market is a component of My-TRAC and the user does only one sign in process, then if he/she requests his/her personal data the data generated at the social market are incorporated in the email sent to the user and the information that My-TRAC platform gets is like the information presented in **Table 35** of Annex 3.

**Added value:** Single request for retrieving his/her personal data.

**F12. UI/UX/ personalization**

The user has a visual disability, and he/she can use high contrast or low vision skins in order to be able to navigate better in the app. The app changes UI/UX skin based on the input of the user at the initial questionnaire but the user has also the opportunity to change it manually if he wishes.

**Added value:** Personalization of UI/UX to support people with vision disabilities and enhance social inclusiveness.

**F13. Points and social market**

A user is performing actions with My-TRAC app and gains points and reputation which is translated to points which can be used in the Social market (see functionality of 3<sup>rd</sup> parties' services).

**Added value:** Reward users in a comprehensive way, use the results of the analytics in a practical way in My-TRAC pilots e.g., the 20 most frequent users received a travel card.

**F14. Booking, ticketing and payment transactions**

The traveller pays for several items using the app, including transport tickets, services and activities via Social market or by connecting to the services provided in booking tab.

**Added value:** Provision of different options for the users.

**F15. Crowdedness prediction**

The traveller wants to know the amount of people travelling to avoid crowded stations and public transport mean due to COVID-19. Also, available information from TMB will be also provided to the users of My-TRAC app.

**Added value:** Connection with the results of another app (Co-APS funded by EIT Urban Mobility) and provide to the My-TRAC user the information to be able to take informed decisions and also, promote spatial distancing to keep him/her as safe as possible considering COVID-19 preventive measures.



## 2.2 MY-TRAC FEATURES AND IMPROVEMENTS

In this Section we relate the improvements that have been done in My-TRAC Companion between the two pilot phases. We can distinguish two different groups of improvements; i) those that come from the development of new features such as the groups or the introduction of models and ii) the redesign of the interface to make a more user-friendly application. Both groups of improvements are related with the usability and attractiveness of the application.

### 2.2.1 MY-TRAC FEATURES

We briefly present the different models of My-TRAC and their relevance with My-TRAC's functionalities. The models are integrated in My-TRAC app in different way. However more information concerning the models can be found in the deliverables of the scientific WPs namely WP2, WP3 and WP4.

#### 2.2.1.1 MODE CHOICE MODEL

The Mode Choice model was developed in T2.3 and it is reported in D2.3 as well as D2.5. The Mode Choice model provides an initial recommendation to the traveller regarding the travel mode that is proposed for the present trip. It processes the characteristics of the user, such as age, gender, trip purpose and derives the utility of each available mode in conjunction with the attributes of each option. Therefore, relates to the functionality of registration as it takes input from the initial questionnaire, trip creation as it provides suggested itineraries based on the predicted mode preference of the user and it is related with the OTP services. In order the user to get the result of the mode choice model he needs to press the personalization tab (a) and then more itineraries (b) and he will receive the recommendation which is presented at the third screen (e.g., My-TRAC suggest to X user to take his car 64,8% and to take public transport 35,2%, and a moto bike 0,0% as most probably the user has declared that he does not own a motor bike (**Figure 14**).

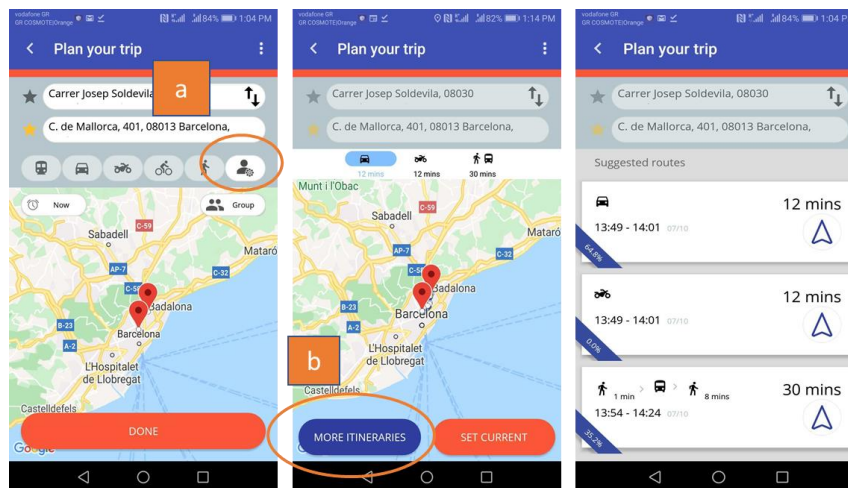


Figure 14: Mode choice screens

#### 2.2.1.2 TIME OF DEPARTURE CHOICE MODEL

The time of departure choice model was developed in T2.3 and it is reported in D2.3 as well as D2.5. The time of departure model suggests up to 3 itineraries to the user whether a different time of departure that the one that is currently selected would be more suitable to the user's needs. The mechanism behind this recommendation is founded onto the characteristics of the user, and their correlation to the choice of a trip, as this was determined during the SP survey that was designed during Task 2.3. It processes the characteristics of the user, such as occupancy, time flexibility and disruption tolerance. Therefore, relates to the functionality of registration as it takes

input from the initial questionnaire, trip creation as it provides suggested itineraries based on the predicted time of departure preference of the user and also it is related with the OTP services. In order the user to get the result of time of departure choice model needs to select a public transport itinerary and then press the clock on the top of the route detail to get the results which are itineraries taking as a baseline the selected itinerary of the user (Figure 15).

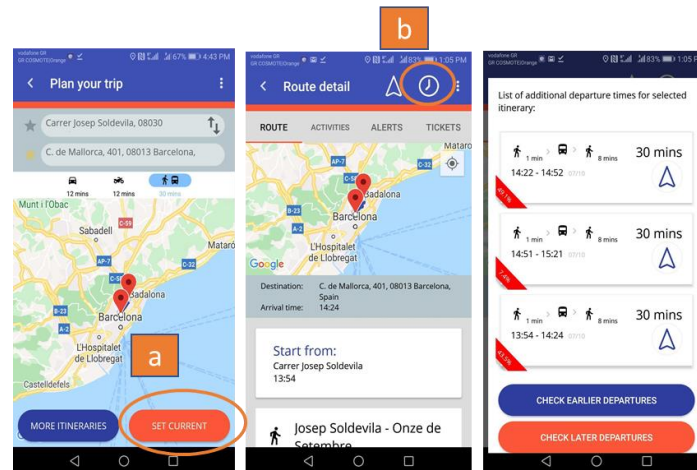


Figure 15: Time of departure screens

### 2.2.1.3 ROUTE CHOICE MODEL (POPULATION) AND ROUTE CHOICE MODEL (PERSONALIZE) (RANKING API)

Route choice population model was developed in T2.3 and it is reported in D2.3 and D2.5. This model was developed to apply population choice parameters to predict which itineraries (returned from the up to 10 itineraries from OTP for a given user request) would be most interesting for the user. Was to be applied only when the selected mode is public transport.

Route choice personalization model was developed in T3.3. This model is developed to present to the user with personalized travel advice. The personalized route choice model only works with public transport trips. When a user requests a trip, the returned itineraries are ranked by the route choice model based on the preferences (i.e., previous travel choices) of the user. It was decided to integrate in the app the ranking API. In order the user to get the results of the route choice needs to select public transport, then press more itineraries and he will receive the result of the route choice model which are 10 itineraries listed by the arrival time and marked for 1-5 based on the route preferences of the user (Figure 16).

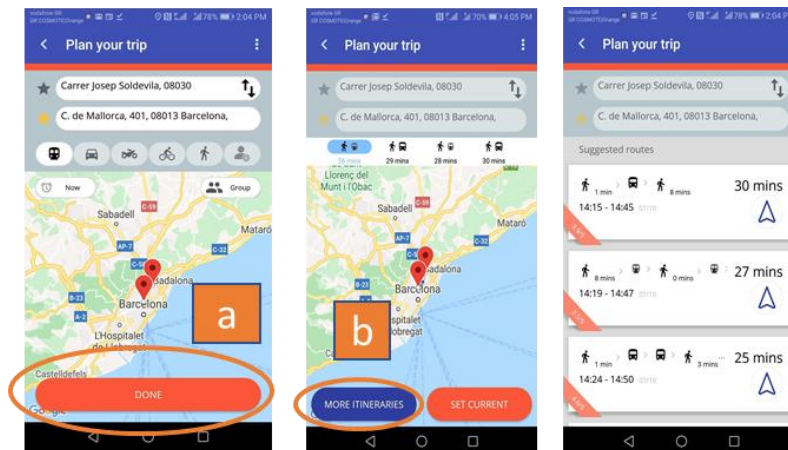


Figure 16: Route choice screens

#### 2.2.1.4 DISRUPTIONS

My-TRAC user can be alerted for possible disruption to his/her itinerary. To avoid sending irrelevant notification to our users, a disruption alert is only popped up to the user if he/she has saved a specific itinerary. Furthermore, the alerts are stored in alerts tab at the route details screen so the user can check it before proceeding to book a ticket or another transport mode or even decide to change his/her itinerary to avoid this delay (Figure 17). The disruption send to the user are scheduled disruptions. However, My-TRAC system can extent this functionality to integrate disruption reported by My-TRAC users.

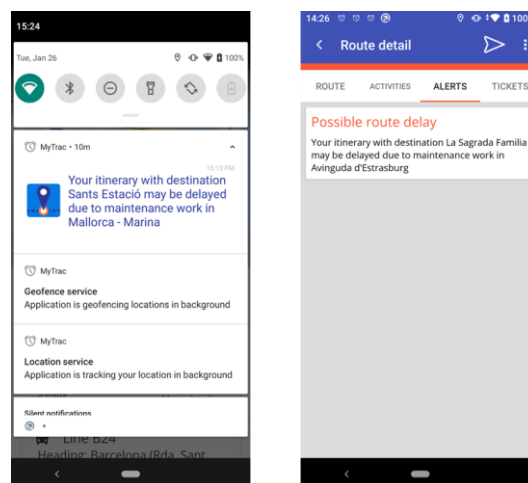


Figure 17: Screens of disruption alerts

#### 2.2.1.5 ACTIVITY AND RECOMMENDATION MODEL

Activity recommendation feature had suffered a lot of changes to include the comments of the users received by the 1<sup>st</sup> phase of the My-TRAC's pilots as well as to include the activities of T5.3: My-TRAC mobile travel companion for groups and for that reason it is detailed at a greater extend in comparison with other features.





### Recommendations for individuals

Activity models and recommendation models were developed in T2.2, T2.3, T3.3 and T5.3 and it is reported in D2.2., D2.5, D3.3 and D3.5. Activity models aim to provide predictions of users' anticipated activity type. The latter is used as input by the recommendation system which enables My-TRAC application to provide personal recommendations to travellers for places of interest (PoIs) that they could visit based on their preferences, the trip that a user takes and the anticipated activity type that a user will do on a certain time interval. So, when a user schedules a trip, the recommendation system provides a list of PoIs suggested based on the user's destination and the predicted activity type. For example, if the predicted activity type is "eating", then PoIs with such amenity (e.g., restaurants, bars, etc.) will be recommended. The recommendation model, described in detail in D3.3, during T5.3 was extended to provide group recommendations. The aim of the group recommendation system is to provide a list of PoIs recommended for all the users in a group by taking into consideration the preferences of all users included in a group. A description of the group recommendation system is provided in the following sub-section.

The input of the Activity models are the user's characteristics (user's gender, age, occupation, and marital status from the sign-up questionnaire) and the sequence of actions performed by each user in the past. For the recommendation system, the input used is the output of the Activity Prediction module, which is the type of activity, the GPS coordinates of the user's destination, retrieved from My-TRAC database, and information about all the available PoIs, also retrieved from My-TRAC database. To that end, these models are interacting with different functionalities such as registration, trip creation and group creation. The user in order to see either the personalized or the group PoIs proposed (**Figure 18**) should have selected a route and then press the activities tab, then from there has two options to check the details of an activities by pressing a blue pointer (b) or check the list by pressing the relevant tab (c).

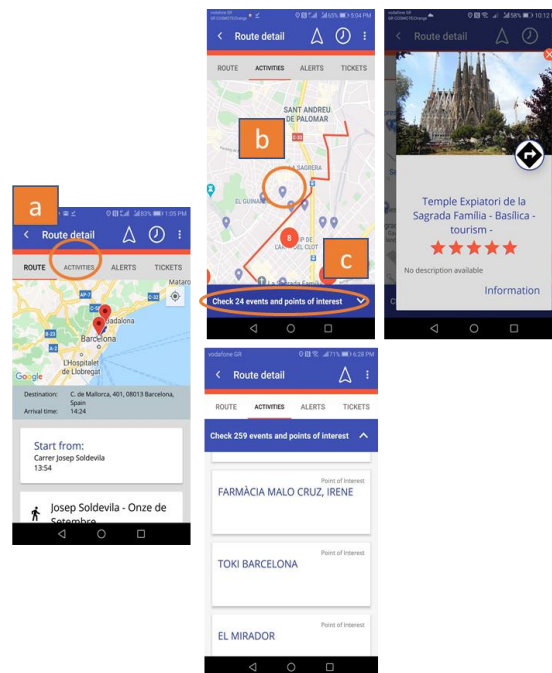


Figure 18: Activities and recommendations main screens

### Recommendations for people with reduced mobility

A special category of activity recommendations is the recommendations to people with reduced mobility. My-TRAC app considering the persons with reduced mobility and promotes accessibility. For that reason, a special library with PoIs with high accessibility was created, however we recognize that it needs to be updated constantly as new PoIs are added to the list as accessible due to the concurrent legislation for places of culture (i.e., museums, cinemas etc) and the interest of EC to support actions for inclusive mobility. Although, an initial input is taken by the initial questionnaire, these points are available to all My-TRAC users to provide the same level of information as we believed that accessibility should not be a privilege of people with reduced mobility but also for all travellers.

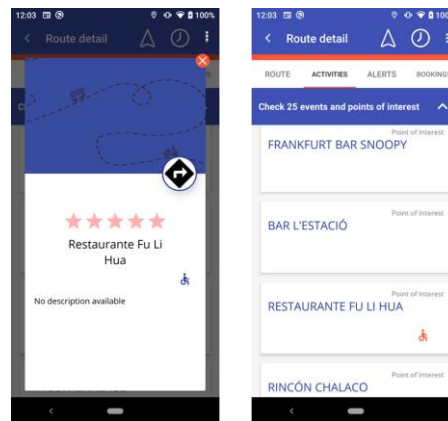


Figure 19: Screens for accessible PoIs by PRMs

#### Group recommendation system description

The group recommendation system implemented is an extension of the main recommendation system described in D3.3 and work performed for T5.3, having as a main scope to provide suggestions of PoIs that a group of users could visit. Through My-TRAC application users have the ability to create a group trip with several other users and select a certain destination and a certain timestamp to take this trip. Before a user creates a group trip, at first s/he has to create a group and invite any other users who will participate in this trip to be included in the same group. When all users accept the invitation, the initial user creates the trip, including all the needed information (e.g., destination, stops, etc.) and denote it as a group trip by sending the trip's invitation to all the users included in the group selected. During this group trip, the My-TRAC application, through the "Activities" tab, uses the group recommendation system to provide a list of PoIs/activities that all the users included in the group would like to visit.

The implemented group recommendation system is based on the suggestion of individual recommendations and the aggregation of them into group recommendations, using the distinction of group recommendation methods described in [17]. The personalised recommendation system described in D3.3 is used as basis in order to provide personalised recommendation for each user. As it is described in D3.3, this personalised recommendation system has been implemented using a neural network collaborative filtering and receives as input the demographic characteristics of the user (i.e., age, occupation, gender) and the preferences of the user as stated through the ratings s/he has provided in the past for each available PoI through the My-TRAC application. The output of this system is a list of the top-M PoIs that a specific user would like to visit on a certain trip filtered to be in a close range to the trip's destination or close to one of the stops selected by the user through the application, and the user's anticipated activity type. The activity type that a user will perform on a certain time interval is the outcome of the Activity Prediction system, described in D2.2, which is used to predict the anticipated activity type of the user on a certain time interval.

Regarding the group recommendation system (Figure 20), its input is the same as in the personalized recommendation system. The demographic characteristics and the activities a user performs daily of each and every



user included in the group of users are retrieved from the database and sent as input at first in the Activity Prediction system aiming to predict each user's anticipated activity type. The predicted activity types of users are used to form a list which will be further inserted in the filter used, aiming to filter out the POIS whose amenity is not included in the activity types predicted list. This filter also filters out the Pols that are not close to the trip's destination or not close to one of the trip's stops. Once the Pols are filtered, the demographic characteristics of all users included in the group are provided as input on the recommendation system, described in D3.3, along with the list of filtered Pols including all the available information about each Pol. As depicted in **Figure 20**, the output of the recommendation system is a table where the predicted ratings of each user – Pol pair are stored, in order to be further analysed. This table is further used as input in the aggregator, whose role is to aggregate individual ratings into a group rating (e.g., used in elections and when selecting a party leader).

According to [18], there are eleven aggregation strategies that could be used for the aggregation of the individual ratings into a group rating. These strategies are classified into three major categories (i) the majority-based strategies suggesting the most popular items, (ii) the consensus-based strategies, considering the preferences of all the group members and (iii) the borderline strategies which consider only a subset of users' preferences. The selection of the best aggregation strategy has to be chosen based on the utilized recommendation algorithm in order to maximize the efficiency of the group recommendations. The selected aggregation strategy used in the aggregator of the implemented group recommendation system is based on the preference aggregation approaches, which aggregates the users' individual predicted ratings to satisfy the greatest number of members. This aggregation strategy selected belongs to the consensus-based strategies and is a weighted form of the Average strategy, which averages individual ratings for each item using a certain weight based on several parameters in order to form the group rating of each item. Based on experiments described in literature to [18], this strategy performs better than other in heterogeneous groups<sup>3</sup> of users and increases the groups' satisfaction.

Using the weighted form of the Average strategy, the aggregator manages to calculate a group rating score per POI which will be used to finally select and recommend the top-N Pols for the group of users. The formula used to calculate the group rating is the following:

$$group\_rating = pois\_freq + \frac{\sum_{u=1}^n pred\_rating * uw}{|n|}$$

where  $n$  is the number of users included in a group,  $Pois\_freq$  is the number of times a Pol is available in the users list and  $uw$  is the weight set for each user. This weight for each user results from the similarity among users.

The different weights correspond to the similarity among users. The distance/similarity that a user has with the other users in the group is translated into the user's weight and has an important role in the group recommendation system. Users that are close to each other, in terms of similarity, tend to have the same preferences than other users inside the group which are not so similar. Before the calculation of the group rating, the similarity of users among each other is calculated aiming to set the weight for each user. Based on the similarity matrix created from the clustering method described in D2.4, the similarity among users of the group can be retrieved and summed up to form the weight for each user.

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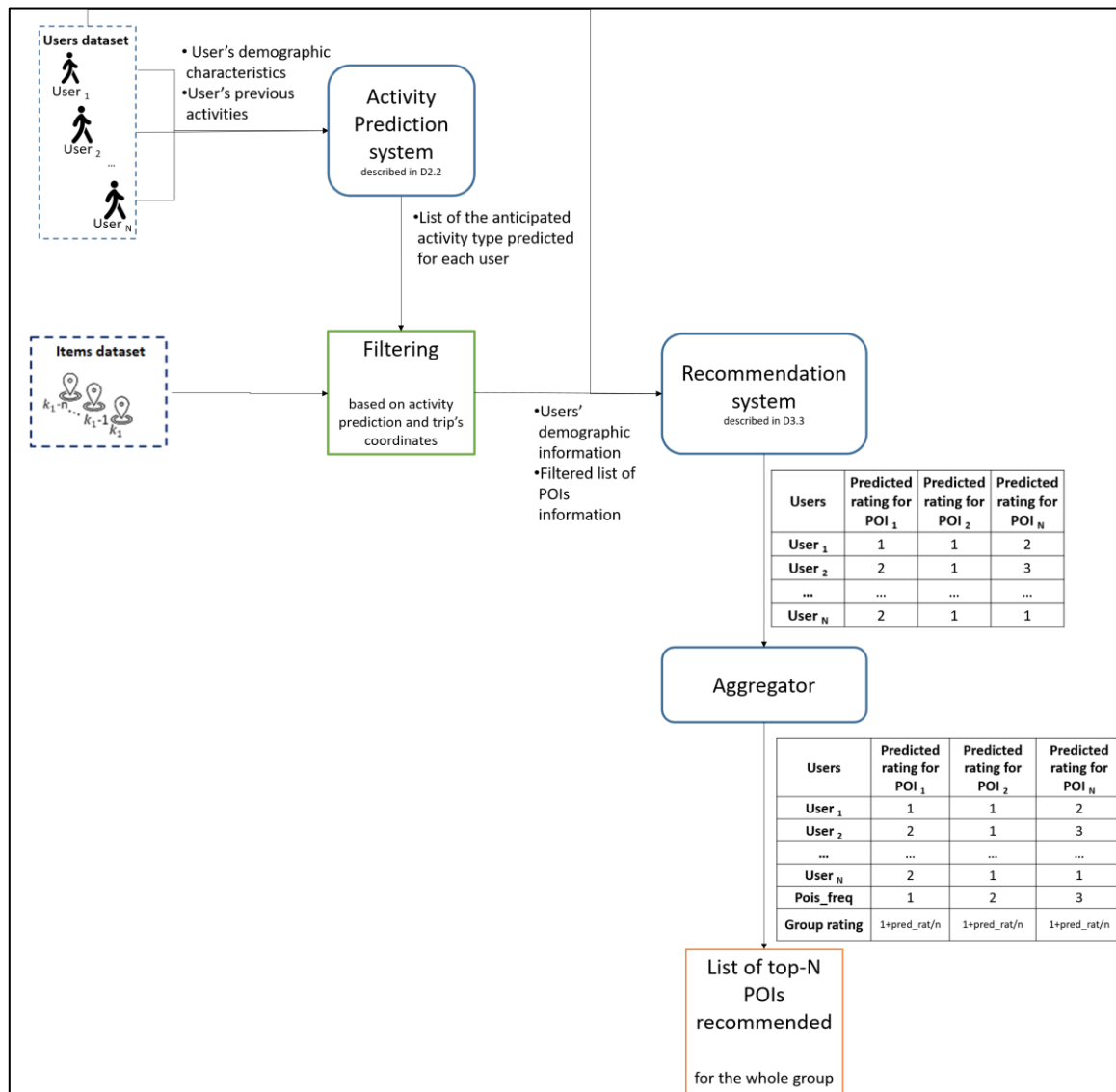
<sup>3</sup> Heterogeneous groups are dynamically created by the users [19]. Due to the usage scenarios defined for the My-TRAC application, all the groups that are created from the application are defined and handled as heterogeneous groups.



Using the weight for each user that had been calculated in the previous step, the group rating calculation takes into consideration the rating predicted for each Pol-user pair by multiplying it with the weight of each user. After this step, the average value of this score is calculated and then it is added with Pol's frequency value, which is a number depicting showing how many times a Pol has been included in the users' Pol list. We have assumed that if a Pol has been included in more than two users list, before the filtering of Pols procedure takes place, this means that more than one user, have the same activity type predicted and therefore this Pol gains a certain importance than others.

The output of this calculation is the creation of a list of Pols, including apart from other information about Pols, the calculated group rating. As a next step, this list is sorted by the group rating in descending order and by the distance between each Pol and the user's position in an ascending order. The N items with the top group ratings are further recommended to the user through the My-TRAC application. The value of N numbers is defined within the My-TRAC application. At this point it should be mentioned that any change at the group's composition does not affect the Pols recommended, since the group recommendation system predicts the ratings that each user in a group would provide for an item every time a group trip starts. For the trips that are not denoted as group trips, the personalized recommendation system described in D3.3 is used to propose Pols that a user could visit.

For the integration of the both recommendation systems in My-TRAC application, certain APIs had to be created to be able to retrieve the needed information from the database and call either the personalized recommendation system or the group recommendation system, depending on the type of the trip that a user has started. The group recommendation system has been integrated in My-TRAC application before the second phase of the pilot.



**Figure 20: Group recommendation system description**

Aiming to test the results of the group recommendation system, we defined two different cases and evaluated the POIs recommended in each case. In each case recommendations were requested for 3 users, in three different modes: personalized for each user, using the 2 out of 3 users to form a group and using all users for the creation of the group. The users selected to form a group were randomly selected. The scope of this testing is to check if the recommended POIs are different in each case, using the same features and doing the same trip (coordinates). The 50 POIs close to the coordinates described in each case were provided as input in the recommendation system. Finally, the top-5 POIs were requested as output by the system.

For the needs of this small experiment a synthetic dataset was created using 3 different users with different characteristics from the My-TRAC database. All users have provided at least 10 ratings and belong to the same region (Greece). The characteristics of these users are presented in [Table 3](#). The results of the experiment are presented in [Table 4](#).

**Table 3: Synthetic dataset created for testing the group recommendations provided.**

User	Age	Occupation	Gender	Activity Predicted for case #1	Similarity among users
A	23	Student	Female	Eating & Drinking	A-B: 0.79
B	50	Retired	Male	Work	A-C: 0.99
C	36	Private employee	Female	Eating & Drinking	B-C: 1.06e-10

As depicted in the similarity column, users B and C has not so many common features as resulted from the similarity score calculated by the clustering mechanism described in D2.4.

**Table 4: Testing the recommendations provided by the group recommendation system in different cases.**

		Mode	
Case	Description	Personalized recommendations	Group recommendations using all 3 users (top-5)
#1	Provide recommendations of the destination of the trip. Users have different predicted activity types as described.	<ul style="list-style-type: none"> <li>User A:               <ol style="list-style-type: none"> <li>1. Η γωνιά της γεύσης: cafe</li> <li>2. Ο Thanasis: restaurant</li> <li>3. Off White: cafe</li> <li>4. Χυμοποιείο: fast_food</li> <li>5. Boheme: café</li> </ol> </li> <li>User B:               <ol style="list-style-type: none"> <li>1. ΒΙΟΙΑΤΡΙΚΗ: clinic</li> <li>2. Εθνική τράπεζα: bank</li> <li>3. Τράπεζα Πειραιώς: bank</li> <li>4. Το Βραστο: restaurant</li> <li>5. Mel Mar: fast_food</li> </ol> </li> <li>User C:               <ol style="list-style-type: none"> <li>1. Just Coffee: cafe</li> <li>2. Serpe: cafe</li> <li>3. Το Κατώι: restaurant</li> </ol> </li> </ul>	<ol style="list-style-type: none"> <li>1. Τράπεζα Πειραιώς: bank</li> <li>2. Η γωνιά της γεύσης: fast food</li> <li>3. Boheme: café</li> <li>4. Roi Mat: café</li> <li>5. Serpe: cafe</li> </ol>



		4. Grand Boulevard: cafe 5. LONDON COFFEE HOUSE: cafe	
#2	Provide recommendations on an intermediate stop of the trip. All users have the same predicted activity type (i.e., eating and drinking).	<ul style="list-style-type: none"> <li>User A: <ol style="list-style-type: none"> <li>1. Burger King: fast food</li> <li>2. KFC: fast food</li> <li>3. Taco Bell: tex-mex</li> <li>4. Bar Breixán: restaurant</li> <li>5. Pannus: café</li> </ol> </li> <li>User B: <ol style="list-style-type: none"> <li>1. Burger King: fast_food</li> <li>2. KFC: fast_food</li> <li>3. Acuari: restaurant</li> <li>4. Taco Bell: fast_food</li> <li>5. Bar Breixán: restaurant</li> </ol> </li> <li>User C: <ol style="list-style-type: none"> <li>1. Babilonia: restaurant</li> <li>2. Temple Expiatori de la Sagrada Família - Basílica: tourism</li> <li>3. Burger King: fast food</li> <li>4. Caffè &amp; Lunch: cafe</li> <li>5. KFC: fast food</li> </ol> </li> </ul>	<ol style="list-style-type: none"> <li>1. Burger King: fast food</li> <li>2. KFC: fast food</li> <li>3. Acuari: café</li> <li>4. Taco Bell: café</li> <li>5. Bar Breixán: cafe</li> </ol>

According to the results, the recommendation system manages to provide different recommendations in each case. It can be noticed by analysing the group recommendations provided, that based on the users included in each group the recommendation system provides different output and as depicted in the table above the users that are closer (Table 3) have more preferred items included in the list of group recommendations, than the other users. An additional note based on the results presented concerns the use of Activity Prediction mechanism. As it can be noticed, when the activity types predicted are different, this leads to a list of Pols with various amenities and thus to more versatile recommendations. On the other hand, when the activity types are common for all users, the frequency of each Pol gains higher importance. Furthermore, the recommendation system in general will be also evaluated from the user's experience perspective and the results will be described in D6.2.

### 2.2.1.6 UI/UX PERSONALIZATION MODEL

The UI/UX personalization model are a result of WP4 and it is described thoroughly in D4.4. This model is developed to present to the user the personalized UI skin according to his/her preferences. The preferences differ based on the different user profiles that arise from specific data coming from the data model. Two different skins were developed a high contrast skin and a visual impairment skin. The latter are automatically changed if the user declares at the initial questionnaire of registration that has a visual impairment. However, any user has the chance to change the look and feel of the app manually by pressing the relevant tab at home screen. Below the home screen and then the main screens of the high contrast skin and the visual impairment skin are presented.

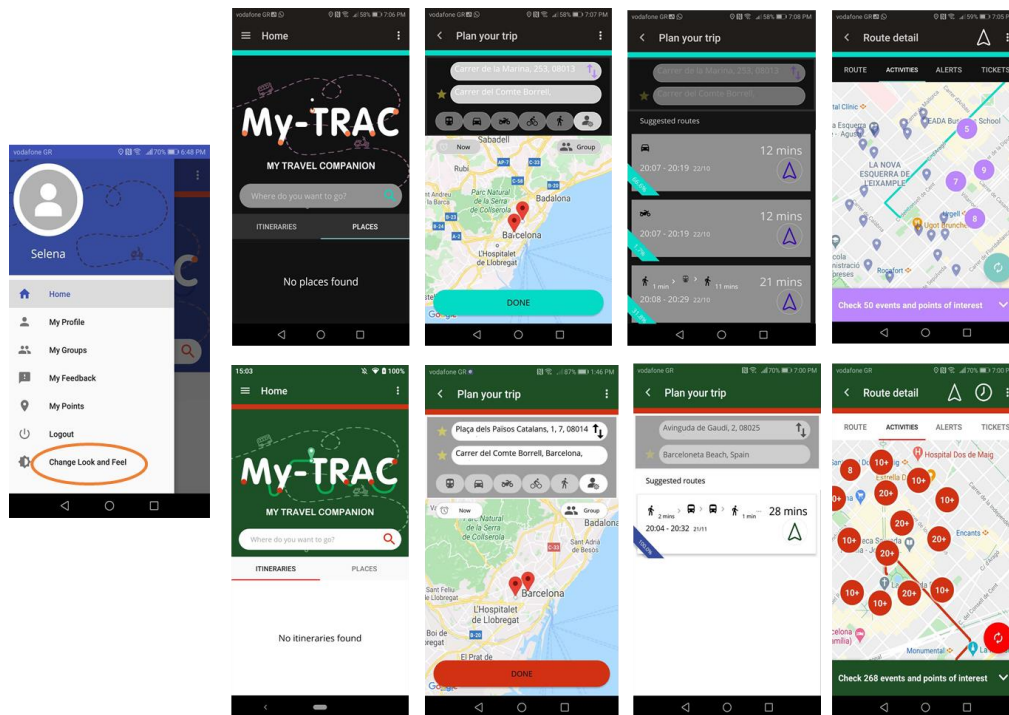


Figure 21: UI/UX personalization screens

### 2.2.1.7 ROUTE MATCHING ALGORITHM

It is able to batch-read all mobility traces that were recorded in the My-TRAC database and is able to generate trip information for each user. It then provides an estimate of the mode that was used for each trip segment, whether that is a car, public transport, bicycle, motorbike, or airplane. For the given countries of the pilot areas, it also matches GTFS data with the selected route of the user and is able to presume exactly which bus line, or tram line, or metro line a traveller has followed. Route matching algorithm is used to post process the results and allow the modelers to know if the traveller followed the suggested itinerary or decided to follow a different one.





### 2.2.1.8 REPUTATION ALGORITHM FOR SOCIAL MARKET

The main objective is to encourage users to participate and perform actions in My-TRAC by assigning a score to each user (reputation). Also, it is intended to establish a reputation ranking for users' choices. The result of the reputation algorithm is presented at the points screens of the users and facilitated us to recognize the users that had embrace My-TRAC and provide them with a compensation (e.g., a monthly card, a voucher etc.). The users' score is communicated to the social market component and to the user via the “my points” screen.

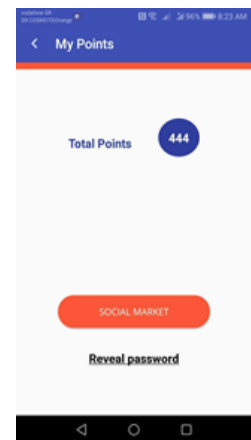


Figure 22: Reputation algorithm my points screen

### 2.2.1.9 BOOKING AND TICKETING

The user has the opportunity to get suggestions for booking and ticketing based on his/her location and the mean of transport that has chosen or it is recommended by the itinerary he or she selected. However, My-TRAC is not linked to the TSPs or MaaS providers directed via a contract hence the user has to log in and or use the providers specific system. Nevertheless, this functionality allows the users to see a variety of potentials.



Figure 23: Screen for Booking and ticketing

### 2.2.1.10 CROWDEDNESS PREDICTION/CONNECTION WITH CO-APS

My-TRAC application is compatible with Co-APS application to get the functionality of crowdedness prediction. Co-APS toolset was funded by EIT Urban Mobility initiative and one of its functionalities is the crowdedness prediction at certain locations such as stations and public spaces. My-TRAC and Co-APS taking advantage of their common pilots namely Barcelona and Athens they cooperated to provide to their users advanced travelling experience. To that end, a user of Co-APS can have access to travel companion service and vice versa a user of My-TRAC can have access to the services of Co-APS. Due to COVID, we believed that to enhance My-TRAC with crowdedness prediction will give to My-TRAC an added value. So, the users of My-TRAC can check the crowdedness prediction in Barcelona's certain metro stations (e.g., Sagrera, Sagrada Familia, Barceloneta, Zona Universitaria) and in Athens at Syntagma metro station. Moreover, they can also participate to the challenges of Co-APS providing crowdsourcing information on crowdedness of public transport stations. My-TRAC is connected to Co-APS via a microservice. **Figure 24** shows the two ways of getting the information provided by Co-APS, the first way is from the profile of the user and the second way is while searching a destination to slide over the green-yellow pointer of Co-APS and then launch

Co-APS. On the other hand, My-TRAC is also compatible with Co-APS hence a user of Co-APS can connect with My-TRAC in order to generate an itinerary and use all the functionalities of My-TRAC (Figure 25).

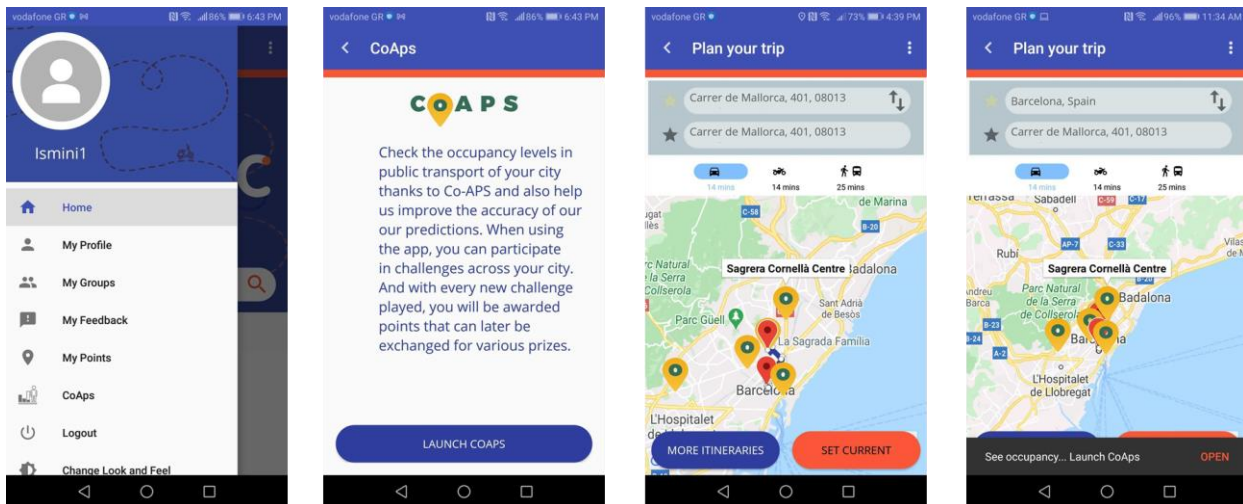


Figure 24: Screens of Co-APS in My-TRAC

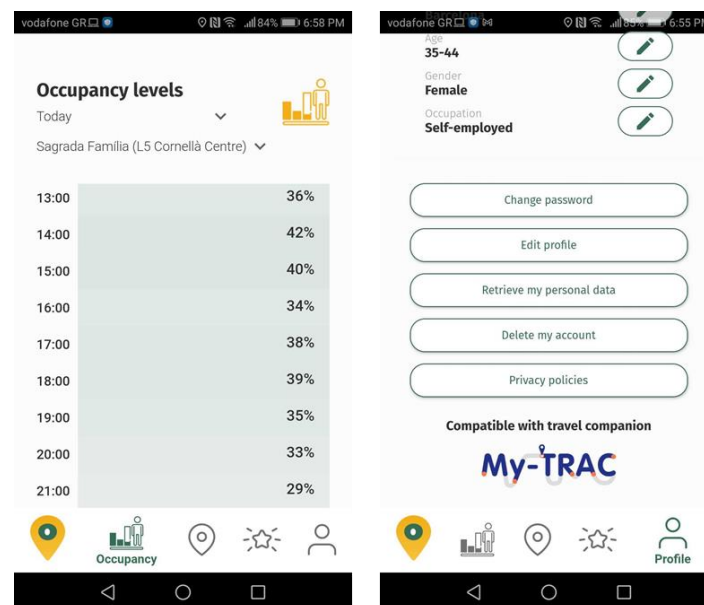


Figure 25: Screens of My-TRAC in Co-APS

### 2.2.2 INTERFACE DESIGN & WIZARD

The work presented in this section corresponds to the description of Task 4.2 “Personalized Interface Concepts” and Task 4.3 “Hands-on training schemes for users” from My-TRAC project DoA and has been described intensively in D4.2 and D4.4. However, as the implementation of My-TRAC entails coding the interfaces designed in the aforementioned tasks, this summarizes the changes. To update the wireframes, we considered in priority the 18



problems mentioned from more than 5 users during the usability testing and which had high severity as these are presented in D6.2. and summarized in **Table 5** where we also state if the problem is related to the User Interface or whether it is related to the actual functionalities of the application or the OTP results representation, which is the topic of another WP. For this report we present the main issues reported by the users and are related to the functionalities and the UI/UX of My-TRAC.

**Table 5: Usability problems matrix.**

Comment #	Description	Number of participants	Related to...
2.1	The route that is presented on the map is not readable. In most cases, especially bus routes, are presented jagged on the map, but explained correctly in the text.	14	GTFS data
1.2	The app should inform the user from the beginning what is required in each field (i.e., Latin characters).	13	UI
1.16	The wrong fields in the sign-up questionnaire should be marked more properly.	11	UI
1.4	In some answers the scale is vice versa, and this is confusing.	9	UI
2.10	Several points, which are not understandable, and their coordinates, which are not useful, appear on the map.	8	OTP results representation
1.12	The colours at the email send are hard to read.	7	UI
4.3	The proposed route is not the shortest one.	7	OTP results representation
4.7	Not all streets have their actual names on. Instead, they are mentioned like links and paths.	7	UI
1.5	At the log in it is not clear if the username or email address are required.	6	UI
1.18	Users do not understand the messages they get when they made something wrong.	6	UI
2.3	Choosing on the map is difficult. Most users could not do it.	6	Device capabilities
2.6	The system cannot find the address requested.	6	OTP
3.1	When pedestrian is de-selected then no route is proposed.	6	UI

Comment #	Description	Number of participants	Related to...
5.4	The details of the activities are missing.	6	UI
1.8	The process is too long. In the beginning of the log in questionnaire there should be a warning message that informs the user regarding this.	5	UI
1.11	Some text ("need help") is getting in the code box.	5	UI
1.13	The way we enter the date of birth was problematic. Some users asked to have the ability to type the date of birth.	5	Device related

All the issues have been solved with the new designs of the wireframes as these were presented in D4.4 and the work conducted by UPC in T5.2 and therefore is a matter of this report. **Table 6** below provides a summary list of the tasks that have been updated with new wireframes. The interested reader should refer to D4.4 for a detailed presentation and analysis of the new wireframes.

**Table 6: Updated designs of previous wireframes**

Task Title	Summary description of modifications
1: Create an account.	<p>Users assessed this task as the most difficult one. There were lots of comments and concerns related to the content of the tasks and the changes that are mentioned below tend to improve the whole “create an account” user experience.</p> <ul style="list-style-type: none"> <li>Some users could not see the “create an account” button and went directly to log in without having an account yet. We have made two very prominent buttons that separate each task.</li> <li>When the user tries to log in, he/ she requested to be able to see the password. We now provide to the user this option with the open and closed eye, next to the password.</li> <li>We created an option/ process that would allow the user to reset the account when he/ she has forgotten the username or password.</li> <li>Most of the users found the “create an account” process extremely long. In the 1<sup>st</sup> version of the app, we had a series of questions that the user had to fill in. Now we have divided these series of questions in 2 parts. The 1<sup>st</sup> part involves questions that the user has to fill in from the beginning to create a profile. The 2<sup>nd</sup> part involves a set of questions that are needed for the personalization of the models but will be requested from the user as additional, not mandatory, questions. Thus, the user will be able to run the app having answered only a basic set of questions and later on, if he/ she wants to can answer the rest of the questions.</li> </ul>



Task Title	Summary description of modifications
	<ul style="list-style-type: none"> <li>The user is enabled to see the password.</li> <li>The user can see exactly what is needed in each field when he/ she clicks on the “i” button next to each field.</li> <li>When the user fills in a field wrongly, the field is marked properly with an exclamation mark and with red fonts.</li> <li>The email that was sent to the user with the activation code has been re-designed.</li> </ul>
2: Request route, choose mode and route.	<p>Usability tests users ranked this task as the 3<sup>rd</sup> most difficult task to execute. There were some specific comments and concerns related to the representation of specific functions of the tasks and the changes that are mentioned below to improve the whole user experience.</p> <ul style="list-style-type: none"> <li>Some users did not understand that the routing starts from their current location. This was made clear, by adding “Your current location” at the origin part.</li> <li>Nevertheless, the origin location can still be modified.</li> <li>In the previous version, the routes of all modes were presented as default and the user should deselect the modes that did not want to use. This seemed to confuse the users a lot. Now each mode is presented in a different tab. The default mode for each user is different based on the results of the mode choice models.</li> <li>All the trip details requested from the users are now presented in the route details.</li> <li>The route time details are now presented in more tabs, as requested by the users.</li> <li>The path of each mode in one route is represented in a different manner.</li> <li>When a trip is to be made at a later time, it is added to the user’s itineraries.</li> </ul>
3: See events on route.	<p>Usability tests users ranked this task as the 2<sup>nd</sup> most difficult task to execute. From the user comments this happened mainly because the task was not fully functioning and not because it was difficult to do. The users did not find what they expected so the usability of the task was relatively low. Some specific comments and concerns related to the representation of the specific task and the changes that are mentioned below tend to improve the whole user experience.</p> <ul style="list-style-type: none"> <li>The activities are now sorted in categories, so the user can more easily find what he/ she is interested in, without noise.</li> <li>The activities were presented only as a list. Now the activities are presented both as a list and on the map.</li> <li>The activities in the past version did not have any details. Now the activities have specific details mentioned that assist the user in retrieving relevant information for each one.</li> </ul>



In addition, users of the 1<sup>st</sup> usability study iteration have asked for some additional functions that did not exist in the 1<sup>st</sup> version of the application which were already planned to be designed and developed in the progress of the project or that were poorly described in the project Use Cases, hence they had no sufficient designs. Thus, new wireframes (see D4.4) have been designed for some functionalities which are more advanced conceptually following the evolvement of the project activities, as well as the usability test results. These functionalities are the following:

- “Alerts, tickets and offers”: wireframes were updated so as to follow the new enhanced look and feel of the app.
- “Augmented reality” including<sup>4</sup>:
  - “Augmented Reality” Decisions: this was inspired by the user comments during the usability testing, who asked to have a visual representation of the activities that are near their current location.
  - Interface of the “Augmented Reality” library: The Augmented Reality (AR) library aims at providing a new perspective to the users, by displaying through an interface information in the real-world about the recommended places of interest (PoIs), suggested by the recommendation system implemented in WP3 and described in D3.3, that are near the users’ trip’s destination. This functionality could be available to the users from the My-TRAC application using the “cam view” button on the “Activities” tab.
- “User profile”: during the 1<sup>st</sup> pilots’ iteration phase, the user profile functionality was only partly designed and developed. Some major components of the profile functionality were missing and have now been delivered. These are the following:
  - My Groups: enables the user to add people on a specific trip.
  - My Feedback: enables the user to provide/ edit and delete feedback to a specific activity.
  - My Points: a point system has been developed in WP6 to assist the pilots and also as a gamification strategy.
  - My Profile: enables the user to add and edit his/ her profile details (i.e., photo, email address, skin).

The relevant wireframes are also presented in D4.4.

#### 2.2.2.1 GUIDED TOURS/WIZARD AND VIDEOS

Considering the comments of the users during the usability tests and wanting to also explain the element of the app we have created a wizard and videos to train the user and assist the user in every step of using the application. The wizard is applied in every screen of the app, it is launched automatically in the first usage of the app and then it can be activated manually at each step by the user if he/she thinks that it is necessary. Some examples of the wizard are presented below, and the videos are posted in the my-trac’s landing page.

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<sup>4</sup> Augmented Reality was created as it was a nice to have feature and it is not integrated in My-TRAC app.



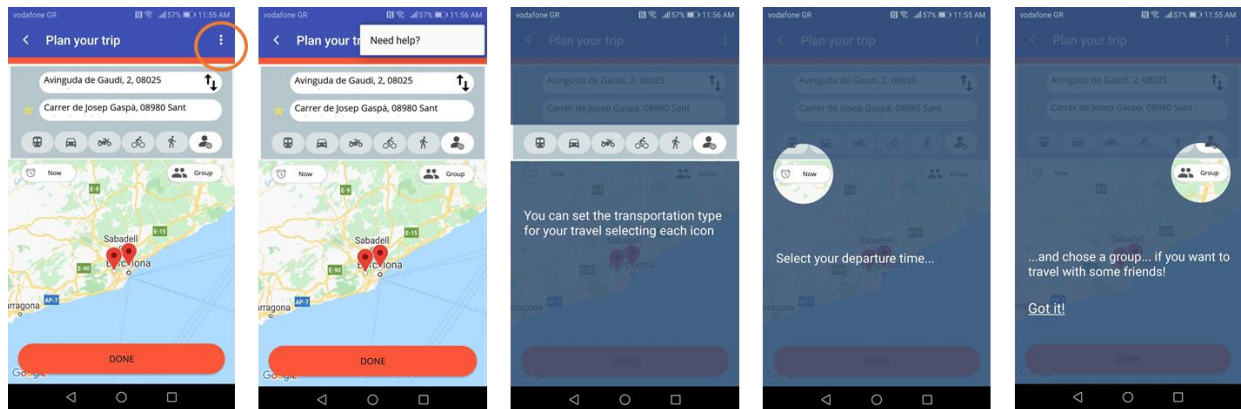


Figure 26: Wizards screens



### 3 ANALYTICS TOOL – DEEP INTELLIGENCE

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This section presents a way of exploiting the information within My-TRAC, as the solution for task 5.5 "Coordination with server Analytics". Notice that this task aims at transformation data into information, i.e., identify behavioural patterns in users, provide KPIs to operators, etc.

To this end, we use, 'Deep Intelligence', a tool already under development by USAL, leaders of the task, which is intended to be launched to the market for the entire community in the coming months.

The main feature of the analytics tool used is that it provides easy to use wizards that allow any stakeholder of the project to use all its functionality (integration with the data source, visualization of information, creation of dashboards and creation of basic models of Artificial Intelligence), regardless of their programming and even computer skills.

It allows to extract all the knowledge that data can provide in an easy way thanks to the creation of dynamic charts generated in real time directly from the data in the My-TRAC server, since the tool provides a direct integration with the technologies used in My-TRAC for information management (MySQL and Kafka). Whenever new data is available, the tool updates all the elements that depend on it, including the charts, so the information shown is always in real time.

Information management is also carried out securely and encrypted on European servers (Frankfurt) that comply with the regulations required by the GDPR and the tool offers functionality to manage the permissions to access information that each of the partners has through the use of roles, a very important aspect to take into account in My-TRAC when it comes to data management.

Another of the functionalities sought was the exploitation of the analyses carried out. The basic statistics of use were intended to be accessible by any of the partners involved in order to know the evolution of the pilots and, subsequently, characteristics of use of the application. In this sense, Deep Intelligence offers the possibility of creating and sharing dashboards in a public and private way and integrating them in third parties or sharing them via URL. This functionality has been used to make public the statistics of the use of the app during the drivers' stage on the project's website: <http://www.my-trac.eu/stats/>

A clear example of the advantages that it brings throughout the project, can be the use of the analysis tool for the evaluation of the system of reputation carried out during the pilots, which has allowed to validate that the behaviour of the values of reputation using real data was very close to the behaviour sought, which at the beginning of the project was simulated with the generation of synthetic data (a control panel was created accessible through: <https://mytrac.deepint.net/reputation>).

The set of features described above makes Deep Intelligence fit the desired solution much more adapted to the needs than other existing tools in the market such as PowerBI<sup>5</sup> or Tableau<sup>6</sup> (both paid, since the tools and free versions that can be found available on the Internet have a much more limited functionality).

In addition, USAL, as the developer of the tool, is capable of incorporating new functionality on demand in case it is needed (new types of representation, incorporating new technologies for data integration in case in the future it is decided to change in My-TRAC, etc.).

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<sup>5</sup> PowerBI - <https://powerbi.microsoft.com/>

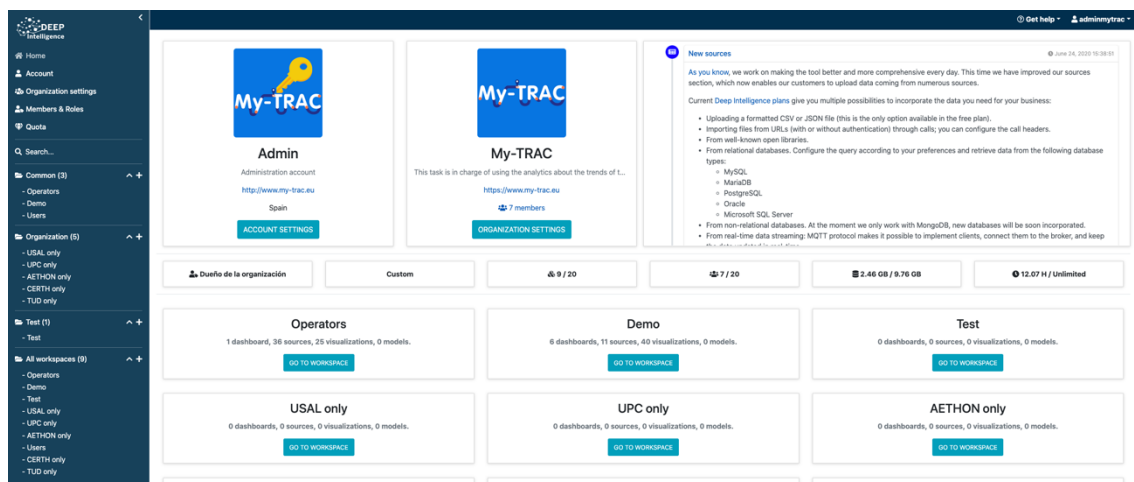
<sup>6</sup> Tableau - <https://www.tableau.com/>



Below is a description of the tool, including the technologies used for development, its main workflow, security aspects to be taken into account and the technical developments that have been incorporated into the tool to meet the needs of the My-TRAC project, which were not initially included among the functionalities of the tool.

### 3.1 TOOL DESCRIPTION

'Deep Intelligence', shown in **Figure 27**, is accessible through the URL <https://deepint.net>. It is a web tool that aims to provide solutions to all users who want to apply data analysis methodologies such as data processing, creating visualizations, creating dashboards or creating artificial intelligence models.



**Figure 27: Homepage of the analysis tool (once logged in)**

One of the main strengths of the tool is the ease of use for its users: they need no infrastructure to run it; the tool makes available the resources needed for their particular case; the tool offers a wizard for each of the steps of data analysis, so the user does not need to have advanced computer skills or programming to obtain results; users can share the results with whoever they want in a safe way.

In this way, anyone can not only use the tool to exploit the results, but also configure it according to their needs and make modifications quickly. This is a very important feature for My-TRAC, since the information has changed over time and the tool has allowed changes to be made very easily.

Below is a complete description of Deep Intelligence from three points of view:

1. The used technologies, which support all the functionalities required by My-TRAC project.
2. The workflow of the tool, where functionalities are described.
3. The components that have been specifically developed to support the needs of My-TRAC.

#### 3.1.1 TECHNOLOGIES

This section describes the technologies used in Deep Intelligence to provide the user with the web tool to perform the analysis.

To do this, it is necessary to identify the four parts depicted in **Figure 28**:



Figure 28: Technologies used in Deep Intelligence.

- Cloud environment: the cloud environment of the tool allows applying the information analysis in a fully scalable way and adjusted to the needs of each case. To do so, it uses technology provided by Amazon Web Services (AWS), such as AuroraDB (serverless relational database), Amazon Simple Storage Service (Amazon S3) or Amazon Elastic Compute Cloud (Amazon EC2).
- Data treatment: data pre-processing is performed by software developed by USAL in Java, while the components developed for the application of models based on artificial intelligence have been developed with Python and different open-source libraries available, as well as libraries developed by USAL.
- Backend: the backend that serves the web application has been developed with Node.js and TypeScript.
- Frontend: the frontend has been developed using Vue.js for the definition of the views, while for the visualization's libraries like amCharts, D3.js or OpenStreetMaps (among others) have been used.

### 3.1.2 MAIN WORKFLOW

The tool offers functionalities to cover the complete flow that is usually performed in data analysis, as in **Figure 29**: a wizard for data ingestion from multiple sources and in multiple formats, a wizard for data management (pre-processing, filtering, etc.), a wizard for applying proprietary data analysis methodologies with the advantage that no algorithm needs to be programmed or configured, a wizard for creating fully customized dynamic visualizations and dashboards using drag and drop techniques, and finally, mechanisms for exporting data and visualization results, allowing, for example, interactive sharing of analyses with any Internet user.

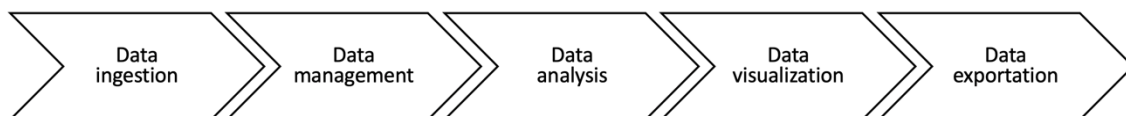


Figure 29: Workflow of the analysis tool.

#### 3.1.2.1 DATA INGESTION

In Deep intelligence the data that is incorporated into the tool, whether static or dynamic (which is kept up to date), is stored in 'data sources'. The data sources in Deep intelligence are elementary because they are the starting point for the rest of the functions that can be applied. To create a data source from data existing elsewhere, the wizard asks the user the type of media in which the original data is found, and the necessary configuration associated with that type. For example, if it is a database, the user must indicate the host, username, password, database name and the SQL query to be executed to select the necessary information. After configuring the data source, the wizard requests information on the data update frequency in case of dynamic data. Finally, data can be encrypted. This option slightly slows down all operations due to the introduction of the decryption operation that must be done each time it is used but provides an extra layer of security that other tools on the market do not offer.

Regarding the type of support in which the original data is found, the following are allowed (**Figure 30**): i) direct sources: CSV or JSON files containing the data to be imported from local files, URLs or calls to existing endpoints; ii) derived sources: new data sources obtained from existing data sources (very useful for the next step of the flow,

data management); iii) databases: both relational and NoSQL databases; iv) Other services: for data coming from well-known services such as AWS S3, CKAN or data streaming (such as MQTT).



Figure 30: Allowed data sources.

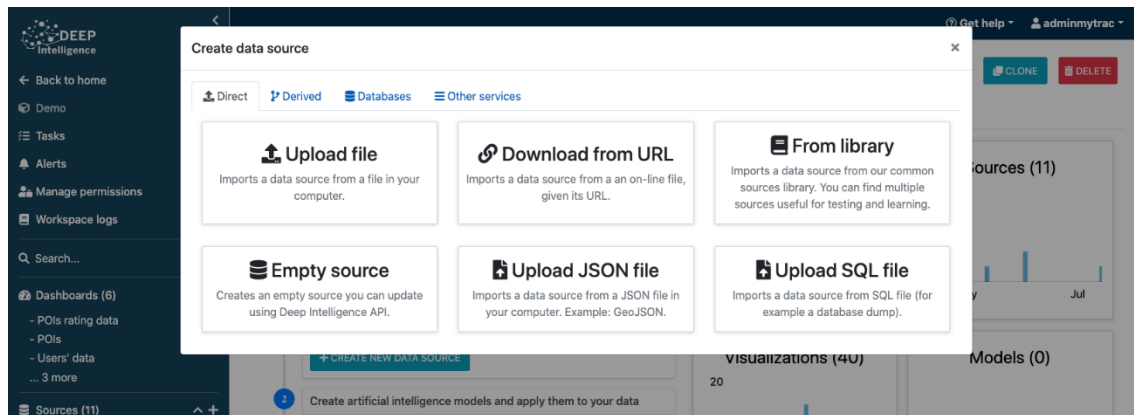


Figure 31: Wizard to create a new data source in Deep Intelligence.

### 3.1.2.2 DATA MANAGEMENT

Deep intelligence offers multiple functionalities to users to manage the information contained in data sources. To begin with, the system automatically detects the type of data and the format (for decimal data or dates), so the user can forget about the type of data. However, for certain graphs or models may be interesting to specify the type of data and Deep intelligence allows users to specify it manually or change the type that has been detected automatically (Figure 32). It also allows generating features from existing fields using user-defined expressions (Figure 33). At this point in the flow, the creation of derived data sources from existing data sources (Figure 34) should also be considered, as discussed in the previous section. More specifically, operations between data sources, filters on records or parameters in a data source, merge two data sources with the same parameters, and many other options are allowed. The tool also offers the possibility of working with data sources from an API to edit them programmatically.

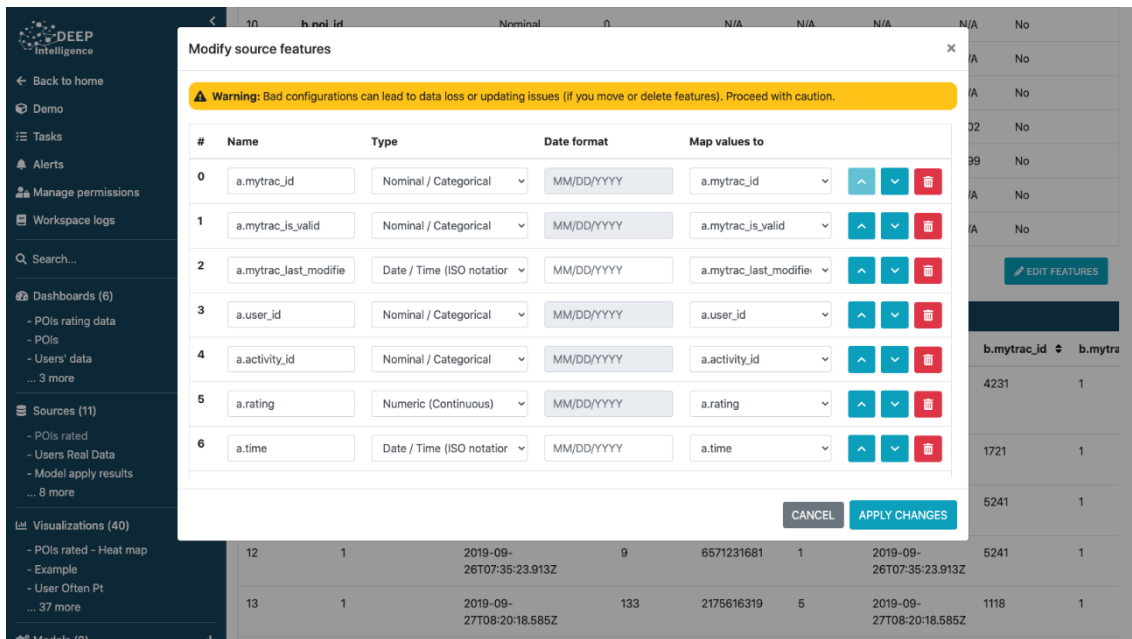


Figure 32: Data type and format definition.

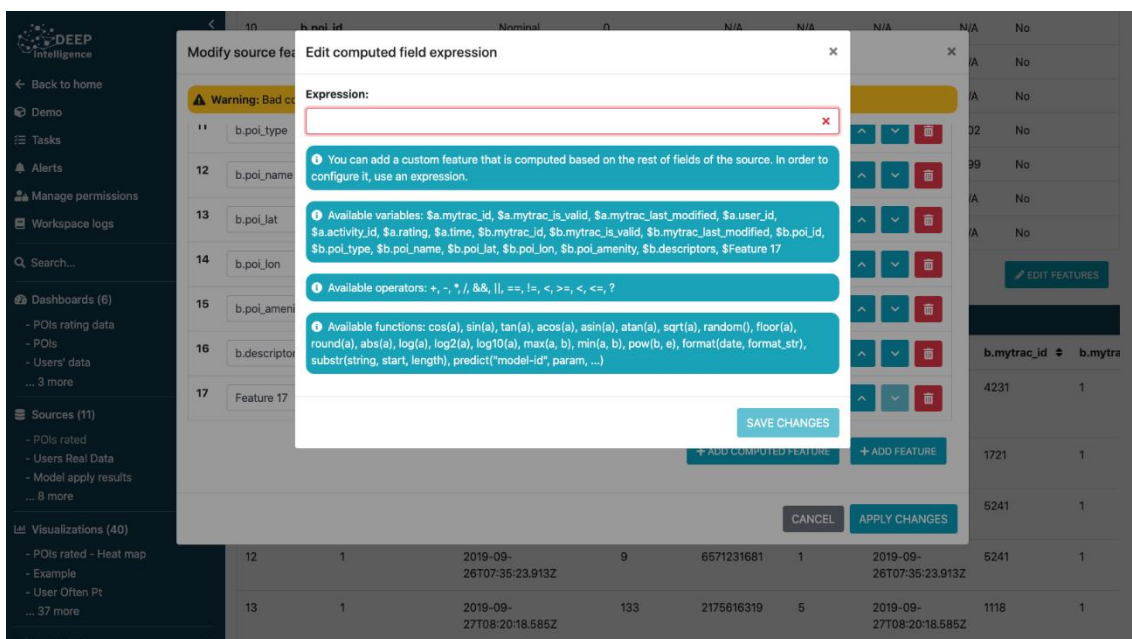


Figure 33: Creation of a new parameter from an expression using existing ones.

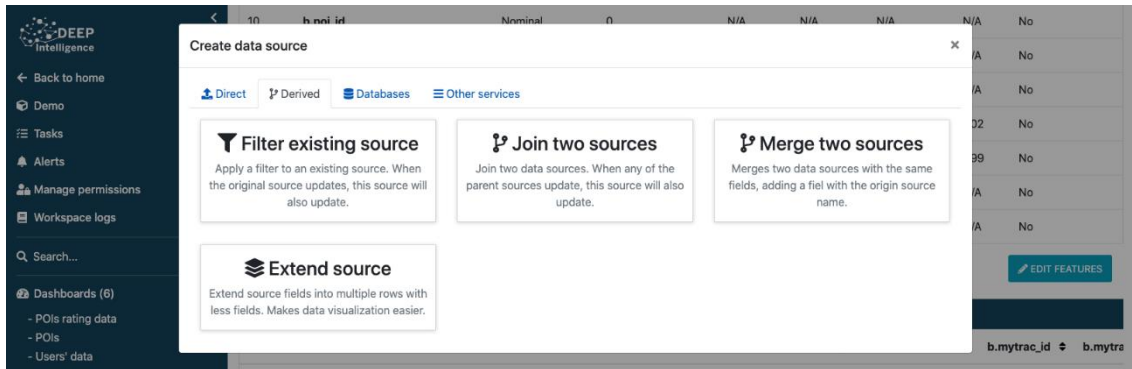


Figure 34: Working on existing data sources to create a new one.

### 3.1.2.3 DATA ANALYSIS

The platform provides a wizard for knowledge extraction within the context of various learning paradigms (Figure 35). Also, it supports multiple supervised learning methodologies, both for classification and regression problems, using algorithms such as Decision Tree, Random Forest, Gradient Boosting, Extreme Gradient Boosting, Naive Bayes, Support Vector Machines, linear and logistic regressions... In all of the cases, the configuration of the algorithms can be adjusted to achieve better performance. Additionally, there are unsupervised learning techniques available, including clustering methods (k-means or DBSCAN, among others), as well as others such as association rule learning or dimensionality reduction techniques such as PCA.

Another field of applications highlighted in the platform is Natural Language Processing, which includes topics such as text classification, text clustering, and similarity-based retrieval.

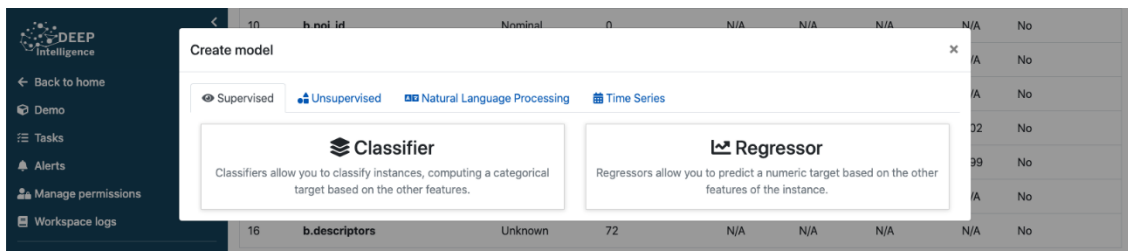


Figure 35: Wizard to create artificial intelligence models

### 3.1.2.4 DATA VISUALIZATION

The tool offers a wizard that allows creating dynamic and interactive graphics in a very easy way, in a few simple steps. In the first step, the user is asked to specify the data source he wants to use to create the visualization. There is no visualizations limit from a data source. In the same step, the source can be filtered to represent a subset that meets the conditions specified by the user (conditions can be nested with AND and OR operations). Similarly, a subset of the sample can be ordered as defined by the user or randomly for situations where large volumes of data are represented with pivot charts that may slow down the user's computer (since these are pivot charts developed in JavaScript, the processing power is provided by the client). The next step that the user has to do is to select the type of chart he wants and configure it. The configuration depends specifically on each of the types of graphics and there are more than 30 different graphics. In the same way that the information to be represented can be configured, the style (title, legend, series, colours, etc.) can be easily set using a wizard (Figure 36).



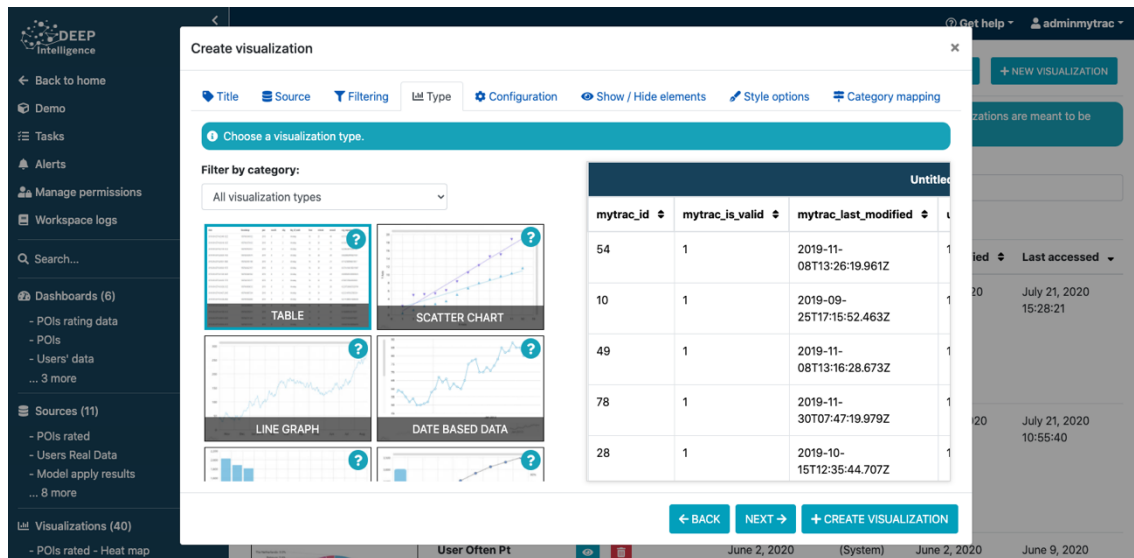


Figure 36: Wizard to create visualizations.

Once the visualizations are created, they can be added to interactive dashboards (Figure 37) and placed in the positions that the user wants by means of drag and drop. Different forms can be added with which the user can interact to filter the information that is represented (a second level of filtering added to the one that could have been put when creating the visualization). This offers multiple benefits when it comes to controlling cities and monitoring only the information that interests us at any given time.

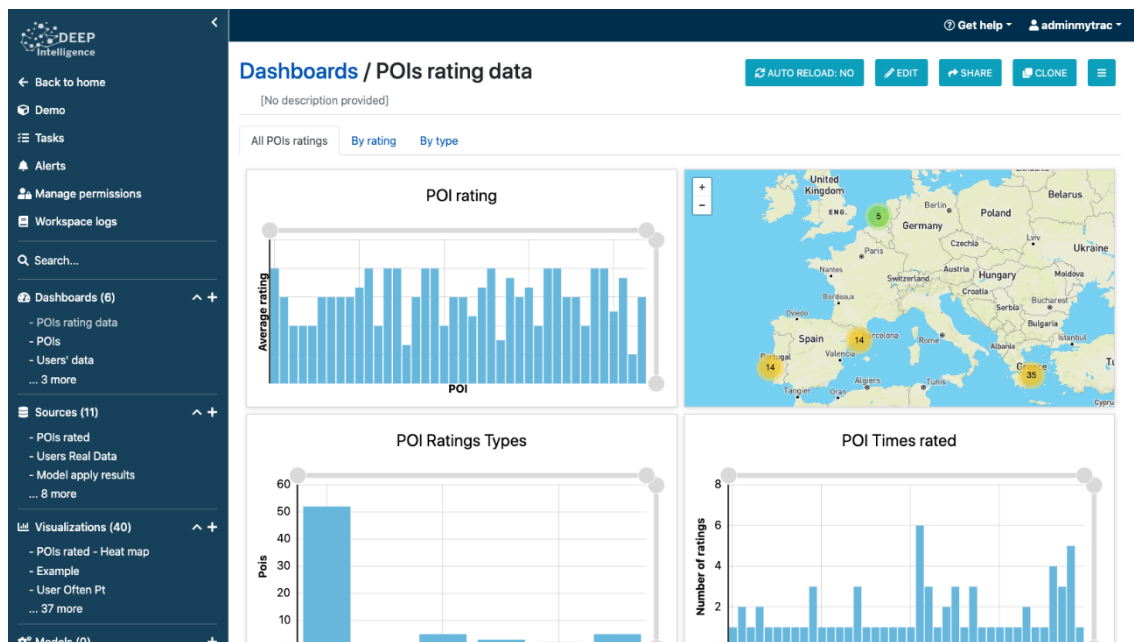


Figure 37: Example of a dashboard created with Deep intelligence.

In the dashboards other elements such as the results of the machine learning models, iframes, images or content through WYSIWYG editors, among many other possibilities can be added.



### 3.1.2.5 DATA EXPORTATION

A very important aspect when performing data analysis is being able to export the results obtained, as well as the data used as input to, for example, take them to other types of tools or allow the scientific community to reproduce the system. Deep intelligence allows the export of all data sources to CSV or JSON files, as well as the results of artificial intelligence models or visualizations created (such as static PNG images) to, for example, be able to incorporate them into documents or reports.



Figure 38. Source exportation (CSV or JSON)

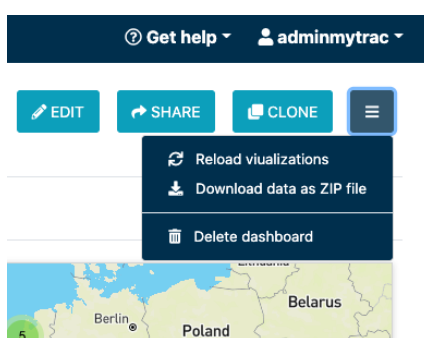


Figure 39: Download all the images included in a dashboard.

However, one of the most powerful features of the tool is the possibility of sharing the dashboards that have been created, both to the users of the tool, as well as to any user who receives a unique link. Through this link, all the functionality incorporated in the dashboards can be accessed in real-time and even integrate the dashboards into third-party tools through the use of iframes<sup>7</sup> or WebViews<sup>8</sup> (for example).

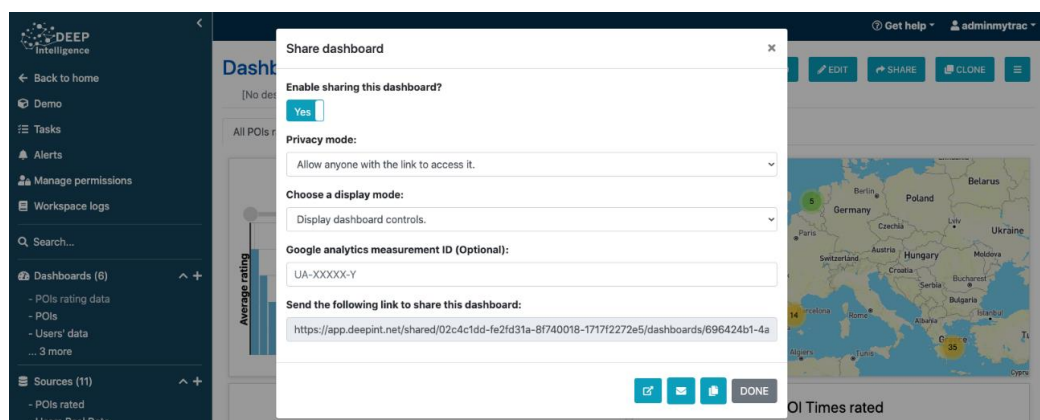


Figure 40: Dashboard sharing.

<sup>7</sup> Mozilla HTML iframe - <https://developer.mozilla.org/es/docs/Web/HTML/Element/iframe>

<sup>8</sup> Android WebView - <https://developer.android.com/guide/webapps/webview>



### 3.1.3 DATA ACCESS AND SECURITY

One of the most important aspects for My-TRAC is to ensure the security of the information and the privacy of the data being processed and displayed. For this purpose, different methodologies have been used. This One of the most important aspects for My-TRAC is to ensure the security of the information and the privacy of the data being processed and displayed. For this purpose, different methodologies have been used. This section presents in detail these methodologies based on the use of authentication and permission mechanisms, encryption and secure data sharing.

#### 3.1.3.1 ORGANIZATION MEMBERS

In Deep intelligence, users belong to an organization. When a user registers, they must indicate whether to join an existing organization, or create a new one. For the My-TRAC project, there is an organization called 'My-TRAC' and accessible to any user who registers, authenticates (**Figure 41**) and is authorized through the link:

<https://app.deepint.net/organization/join?id=c9d77a53-a6ad9101-113401d8-1717e1e42db&token=8e227846b2af1cef5a2c48591de21127f0bc429f2d794d522e2aa18a16406e07>

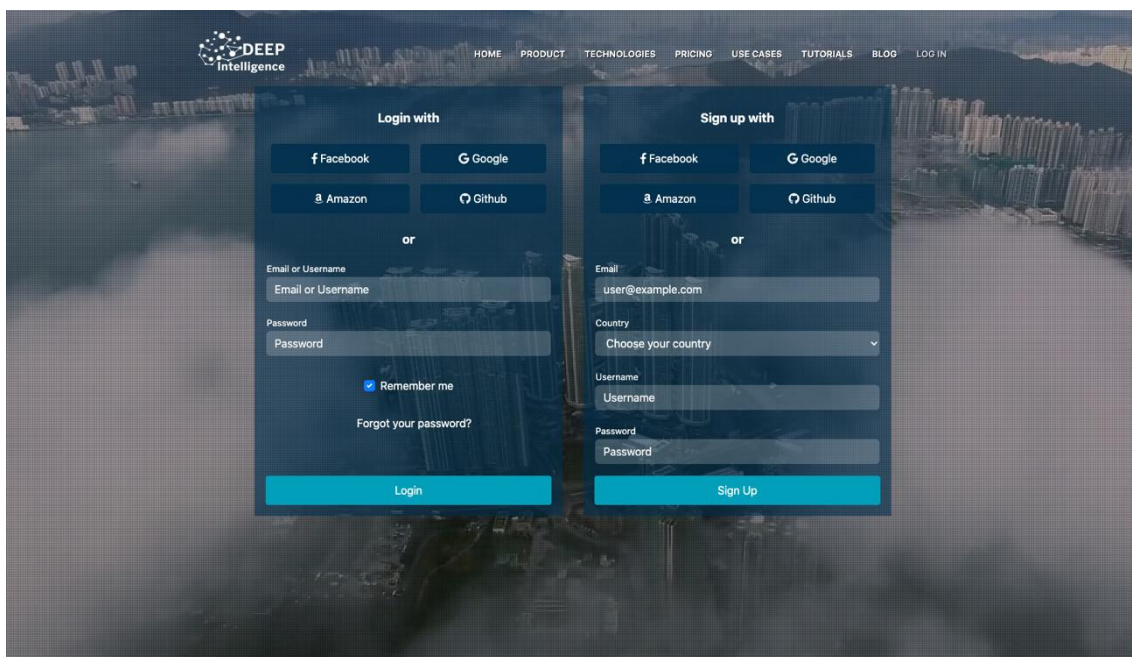


Figure 41: Deep intelligence log in page.

The link can be regenerated or emailed as many times as needed. The publication of the link does not imply any risk or commitment for the project data, given that when a user accesses it for the first time, he/she is assigned the role of 'Default user', without permission to access the information. If finally approved, an administrator of the organization must change this role from the member management page (**Figure 42**). The following section provides more information about the roles.



Figure 42: My-TRAC organization details.

### 3.1.3.2 USER AND ROLES

Roles allow creating groups for users based on their privileges, which determine the level of access they will have in each workspace. By default, there are three unmodifiable roles (owner for the organization creator, administrator for users with full privileges and default user for users who have just joined the organization). The rest of the roles can be defined by the owner or the administrators. In the case of My-TRAC, a role has been created for each partner, as all users in the organization will have the same data access privileges (Figure 43).

Role	Administration permissions	Full access to workspaces	
Owner	Yes	Yes	
Administrator	Yes	Yes	
Default user	No	No	
UPC	No	No	REMOVE
TUD	No	No	REMOVE
CERTH	No	No	REMOVE
USAL	No	No	REMOVE
AETHON	No	No	REMOVE
test	No	No	REMOVE

Figure 43: Roles created in the My-TRAC organization



### 3.1.3.3 ENCRYPTION

At creating time, data sources can be defined to be encrypted, thus unencrypted data is only be accessible to authenticated and authorized users. This slightly slows down the work with the data by introducing a decryption operation for each task performed, but it is a fundamental feature for My-TRAC due to GDPR compliance.

Figure 44: Creation of a new data source with encryption.

### 3.1.4 DEVELOPMENT FOR MY-TRAC

The development of My-TRAC has entailed huge efforts to adapt and implement Deep Intelligence, as it was an ongoing project that we needed to adapt to fulfil the project requirements. The next sections contain a brief description of the functionalities that have been incorporated throughout the development of the project in this regard.

#### 3.1.4.1 SECURITY ISSUES: ROLES, ENCRYPTION AND PRIVATE SHARING

One of the most important aspects in My-TRAC is data protection. In this task, it is something especially delicate since it is intended to analyse data coming from the users through the use of the app. Therefore, it has been necessary to make a series of adjustments and improvements to make Deep Intelligence a secure solution in all aspects.

Firstly, Deep Intelligence allowed the creation of roles, but not the very specific definition that is now available. This has been especially useful in controlling that the consortium partners work exclusively with the My-TRAC data to which they have been granted permission.

Besides, as already mentioned, there is an option when incorporating the information, which allows the encryption of all data stored in the AWS infrastructure using Deep Intelligence, ensuring that they are completely unreadable

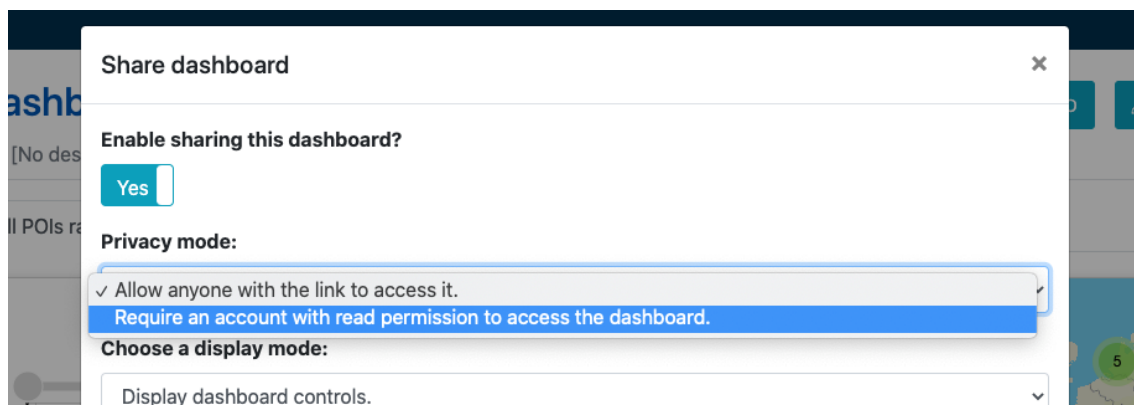


to users outside the My-TRAC organization, even if they have direct access to the data. The usable encryption is SHA-256, which guarantees a high level of security.

Encryption is optional as it slightly slows down the use of the information by introducing a decryption operation on each query. For example, for public GTFS data, this option is not necessary and speeds up the use of that part of the tool.

The final level of built-in security is the ability to require users to have read privileges from a shared dashboard, whereas previously the only security mechanism available in Deep Intelligence was the creation of links (URLs) complex enough so that only users with the link could access the dashboard.

This solution presented drawbacks if the link was made public to unauthorized persons, so it was decided to incorporate this level of security to avoid this type of problem. This solution can be applied when sharing a dashboard, as shown in **Figure 45**.



**Figure 45: Sharing only with allowed users.**

#### 3.1.4.2 MAP-BASED VISUALIZATIONS

Deep Intelligence, as a generalist data analysis tool, was not intended to work with geolocalized data, something that was considered interesting from the outset for the case of My-TRAC. Therefore, the possibility for creating map-based visualizations, based on OpenStreetMaps, has been incorporated, such as the heat map shown in **Figure 46**.

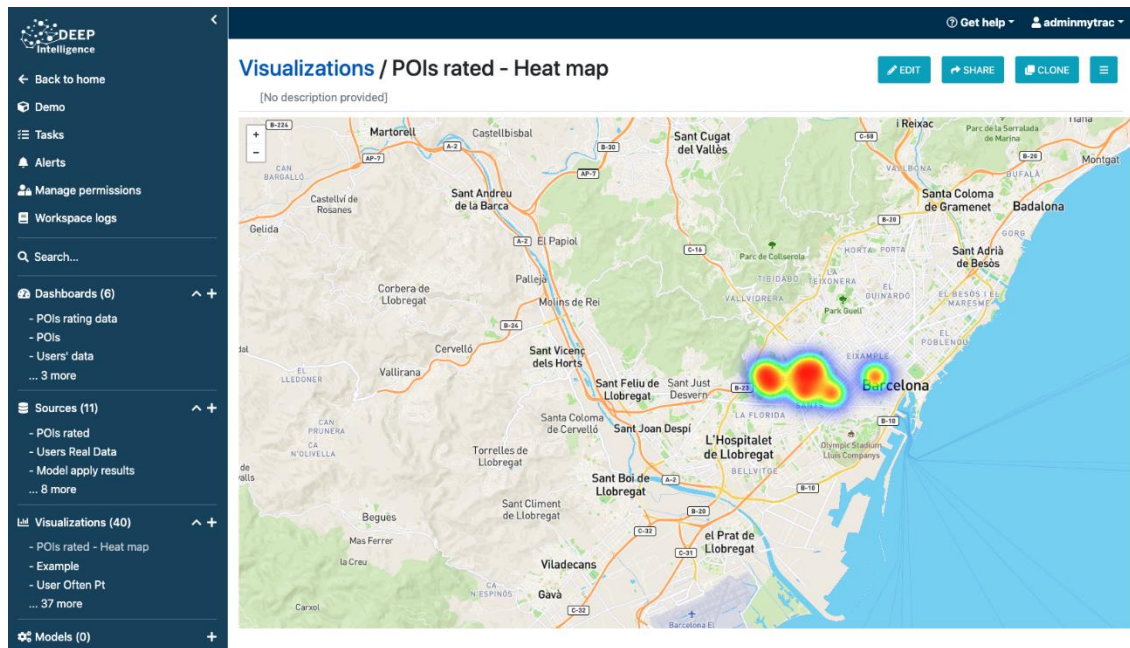


Figure 46: Example of a visualization using OpenStreetMaps (heat map)

### 3.1.4.3 ALERT SYSTEM

Deep intelligence has incorporated a system for defining alerts (Figure 47) so that when the conditions specified by a user are met, a message is sent via e-mail (to as many addresses as indicated), as well as the publication of this event in an alert feed. This will allow the system to be monitored more easily, without the need to constantly have a dashboard open to detect specific patterns.

Input an email list, separated by commas.  
example@site.com,example2@site2.com

Alert color:  
#1ed600

Choose a condition for the alert:  
Trigger when a data source updates and the new instances matches a condition.

Choose a data source to watch:  
SELECT DATA SOURCE

Name	Features	Instances
user - Pilot 1	38	4573

Condition to match:  
Single condition  
mytrac\_id Equals to (=) 1000

Instances

Figure 47: Example of an alert created that will notify that the number of users registered in My-TRAC has reached 1000.



#### 3.1.4.4 CLONE WORKSPACES

To facilitate the creation of multiple working environments for different pilots, a functionality has been created that allows easily replicating all the visualizations and dashboards created for other pilots, having only to update the query that is made to obtain the data from the database. This will greatly speed up the deployment of pilots from a demo workspace (Figure 48).

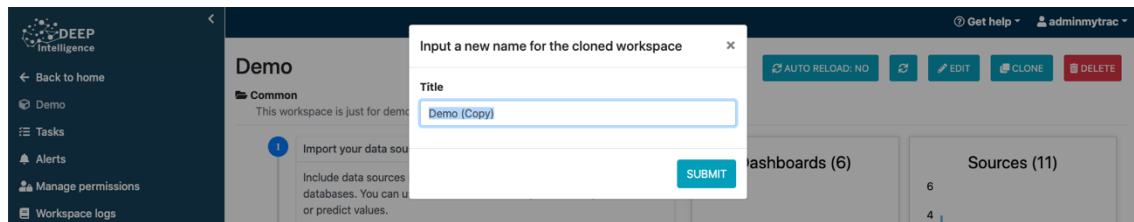


Figure 48: Creating a copy of an existing workspace.

## 3.2 DATA ACCESS

Access to the information intended to be used for the analyses is divided into two main parts. On the one hand, there is all the information stored by the My-TRAC app, related to user behaviour, whose analysis and representation can be very interesting to detect patterns when using the app or public transport. On the other hand, we have the information related to public transport, obtainable from GTFS.

This section describes the procedure followed to incorporate this information into Deep Intelligence as data sources that will be processed and used to create interactive visualizations and dashboards.

### 3.2.1 DATA MODEL

To work with the information that is generated from the use of the My-TRAC application, it is necessary to consider the My-TRAC data model, published in the GitHub repository, and accessible through the following URL: <https://github.com/My-TRAC/data-model>. This data model specifies both the structure and the type of information that is stored in detail.

To be able to consult it, first access to the required information needs to be granted (at least reading permission). UPC has been responsible for managing which data can be accessed by each of the members of the My-TRAC's consortium.

When working with the data model to prepare reference workspaces to be created in the next phases of the project, test data, synthetically generated, were used, so all members could access all the information. In this way, the creation of visualizations and configuration of dashboards has been possible without restriction of access to data.

To create in Deep Intelligence a source of data from the My-TRAC application, it is necessary to create a relational database type source with the information provided by UPC. In this case, the information used to connect to the test database is displayed:

- Relational database management system: MySQL or MariaDB
- Database name: mytracastshare
- Hostname: 35.189.241.175





- Username: <provided\_by\_upc>
- Password: <provided\_by\_upc>

Also, the user must specify the SQL query that will allow retrieving the data. **Figure 49** shows an example to retrieve the user ratings to activities, whose information, according to the data model, is stored in a table called "user\_evaluates\_activity", so the query to obtain all the information stored in it will be:

```
SELECT * FROM user_evaluates_activity
```

**Figure 49: Connection to the My-TRAC data model.**

It will be necessary to create new data sources for each of the tables from the My-TRAC data model to be incorporated into the tool. However, many of them are related to each other. For example, the case of user ratings, referred to above, is related on the one hand to the user's personal information and, on the other hand, to the information of the activity he has rated. These relationships are identified using identifiers (main keys in the tables). To define the relationships and to be able to work with all the available information, Deep Intelligence counts with a tool for the creation of derived sources (**Figure 50**).

**Figure 50: Creation of derived data sources (filter, join, merge or extend existing sources).**



More specifically, for the aforementioned scenario, the option 'Join two sources' should be chosen. It will indicate the two sources to be joined, for example, the assessment with the activity and specify which field of a table refers to which field of another table (Figure 51). The result will be a data source composed of the information from the two original sources Figure 52.

Figure 51: Creating a derived data source.

#	Name	Type	Null count	Min	Max	Mean	σ	Computed?	Graph
0	a.mytrac_id	Nominal	0	N/A	N/A	N/A	N/A	No	
1	a.mytrac_is_valid	Nominal	0	N/A	N/A	N/A	N/A	No	
2	a.mytrac_last_modified	Date / Time	0	N/A	N/A	N/A	N/A	No	Start: 2019-09-20T09:37:31.372Z, End: 2019-12-17T11:39:54.447Z
3	a.user_id	Nominal	0	N/A	N/A	N/A	N/A	No	

Figure 52: Derived data source (result).

### 3.2.2 GTFS

The aim is to obtain data (GTFS) on public transport agencies in Barcelona (Spain), Athens (Greece), the Netherlands and Lisbon (Portugal) since these are the places where the My-TRAC pilots will take place.

First of all, we tried to find the web addresses that offer these data. After a thorough search the following websites were chosen:



- Barcelona (<https://developer.tmb.cat>): This source was relatively easy to find as it belongs to TMB, which is a metropolitan transport company in Barcelona. TMB offers the static GTFs of its transports on the condition after logging in into its website.
- The Netherlands (<http://gtfs.ovapi.nl/>) In the case of the Netherlands, a page was found that contains a large number of GTFs from various agencies in the area. It was the location from which the largest amount of data was found.
- Lisbon (<https://www.transporlis.pt>): Lisbon has been a complex case, as there was a large amount of data, but it was very dispersed, and no single agency gave enough information to establish the study from its data. Therefore, the data from the agencies participating in the previously attached website was extracted and unified using a script developed in Python.
- Greece (<http://www.trainose.gr/en/gtfs/>): Greece, and in particular Athens, has been the most difficult place to extract data from.

For these data to be updated to possible changes, their extraction and storage process has been automated. In this way the data provided in the dashboards will always be realistic and up to date. To automate the extraction of this data, a Python crawler has been implemented which first downloads the zips from all these websites.

It is worth mentioning the case of Barcelona, where the page itself required a previous login to be able to access the GTFs. This was a challenge when it came to automate the download, finally a GitHub account was created, and the login was automated.

Most of the data are downloaded as zip files, so they must be extracted before including them in Deep Intelligence. As the format of the GTFs is txt they are all converted to CSV (required by the analysis tool).

In the case of Portugal, the previously mentioned Python script is used, which unifies all the files from the different agencies downloaded, generating a single file of each type for the whole city, thus obtaining a greater variety and quantity of data. Another script has been created to make use of the downloaded data. This script is called MergeFiles.py and, as its name indicates, it is in charge of unifying GTF files from one location through their ids in order to obtain a file that contains a greater amount of data and be able to display it more widely in the visualization tool.

Once the data has been downloaded and given the desired format it is then uploaded to Deep Intelligence using the API provided by the tool<sup>9</sup>. A different policy is used depending on the size of the file:

- In the case of small files, all the information is sent to the tool through a POST, so that the information that previously existed is replaced by the new one.
- In medium size files, a policy of update by phases is carried out, firstly all the existing data in the tool is deleted and then it is uploaded by parts.
- Finally, there are two files (NetherlandsShapes and NetherlandsStopTimes) in which it is impossible to carry out a phased update as this could take longer than one day due to their size. For these files a different policy has been applied, the last file downloaded is compared with the previous version of the same (which will be stored), and in the visualization tool an update of the modifications is carried out, this avoids a large workload.

---

<sup>9</sup> Deep Intelligence API definition: <https://app.deepint.net/api/v1/documentation/> (last access September 8<sup>th</sup> 2020)



### 3.3 DATA VISUALIZATION

---

Deep Intelligence allows creating interactive visualizations and dashboards so that users can monitor the information recorded in the tool. This will allow the discovery of patterns in an evident way and can be used as feedback to try to improve the recommendations, detect outliers or illicit uses of the application, among many other functionalities.

This section presents separately some of the visualizations created to analyse information from the My-TRAC application, as well as information from GTFS.

#### 3.3.1 DATA MODEL

---

More than 40 standard visualizations have been created for use once the actual information is available. For that purpose, it is enough to clone the workspace and update the information concerning each of the sources created (the data with the information from the new database).

Below, we provide details of the visualizations created, but for reading sake, we will show only one visualization per type.

##### 3.3.1.1 HEAT MAP

---

A visualization has been created showing a heat map over OpenStreetMaps of the information related to the location of the PoIs that users are evaluating. The aim is to clearly represent the areas where users are recording the most activity in terms of ratings. The score given is not considered but is simply intended to represent the volume of ratings.

To do this, when creating a visualization, after assigning a title, the data source is chosen (created from the data model), as shown in [Figure 53](#). The type of visualization is then selected, in this case "MAP (HEAT)" ([Figure 54](#)). In the next tab the user is asked to configure the visualization. The configuration tab is unique for each chart type as it depends on the specific configuration of the chart type. In the case of heat maps ([Figure 55](#)), the user is asked what is the parameter for each coordinate (latitude and longitude) and whether it is intended to represent a magnitude (and the attribute to be represented if this is the case) or simply the repetition volume (as is the case here). Finally, in the 'Style options' tab ([Figure 56](#)), the user can configure different options related to the style (zoom, centre of the map, colours, etc.).



Choose the data source you want to use for the visualization.

Choose a data source from the workspace:

SELECT DATA SOURCE RELOAD DATA

Name	Features	Instances
POIs rated	17	72


Choose the max number of instances to show in the visualization:

100

**Warning:** Too many instances can crash your web browser, proceed with caution. Group your instances with aggregation operations if you need to represent large ranges.

Sort instances?



--- Do not sort / Take a random sample ---






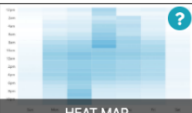
← BACK NEXT → REFRESH PREVIEW SAVE CHANGES

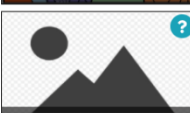
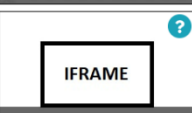
Figure 53: Visualization wizard - Source selection.

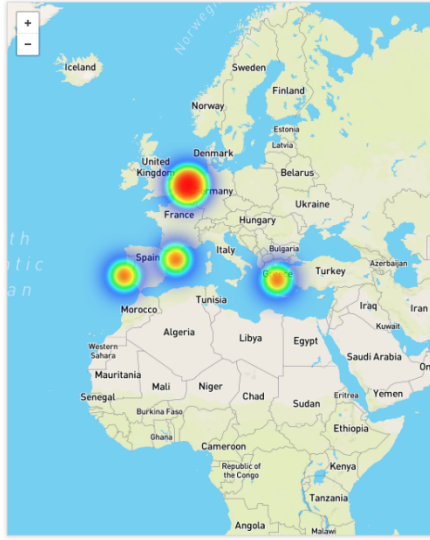
Choose a visualization type.

 WORD CLOUD
  MAP (STREETS)

 MAP (HEAT)
  TREE MAP

 TREE MAP (VORONOI)
  HEAT MAP

 IMAGE DISPLAY
  IFRAME



← BACK NEXT → REFRESH PREVIEW SAVE CHANGES

Figure 54: Visualization wizard - Type selection.



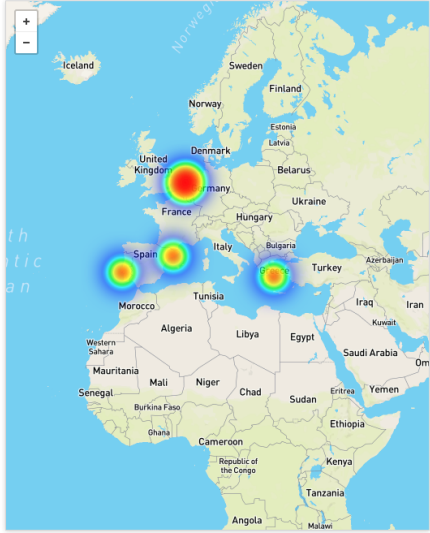
[Title](#)
[Source](#)
[Filtering](#)
[Type](#)
[Configuration](#)
[Show / Hide elements](#)
[Style options](#)
[Category mapping](#)

Configure your visualization. Choose the features you want to represent.

Feature for latitude (Lat):

Feature for longitude (Lng):

Use magnitude?



[← BACK](#)
[NEXT →](#)
[REFRESH PREVIEW](#)
[SAVE CHANGES](#)

Figure 55: Visualization wizard - Heat map configuration.

[Title](#)
[Source](#)
[Filtering](#)
[Type](#)
[Configuration](#)
[Show / Hide elements](#)
[Style options](#)
[Category mapping](#)

Customize the style of the visualization.

Center the map:

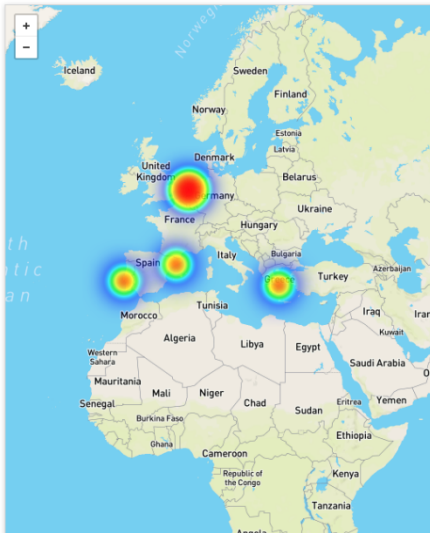
Map initial zoom:

Zoom level to reach max intensity:

Points radius:

Blur level:

Decimal digits



[← BACK](#)
[NEXT →](#)
[REFRESH PREVIEW](#)
[SAVE CHANGES](#)

Figure 56: Visualization wizard - Heat map style options.





### 3.3.1.2 PIE CHARTS

Pie charts are quite used visualizations and easy to understand. Below is an example of how to create and configure this visualization to represent the preferences of users registered in the My-TRAC application. More specifically, we will show an example of one of the asked questions when registering: *How often do you use your car?*

To do this, the user must select the data source containing the user information in the 'Source' tab. In the 'Type' tab, select 'Pie chart' and proceed to the 'Configuration' tab, where the user will specify what information to represent in the chart (**Figure 57**).

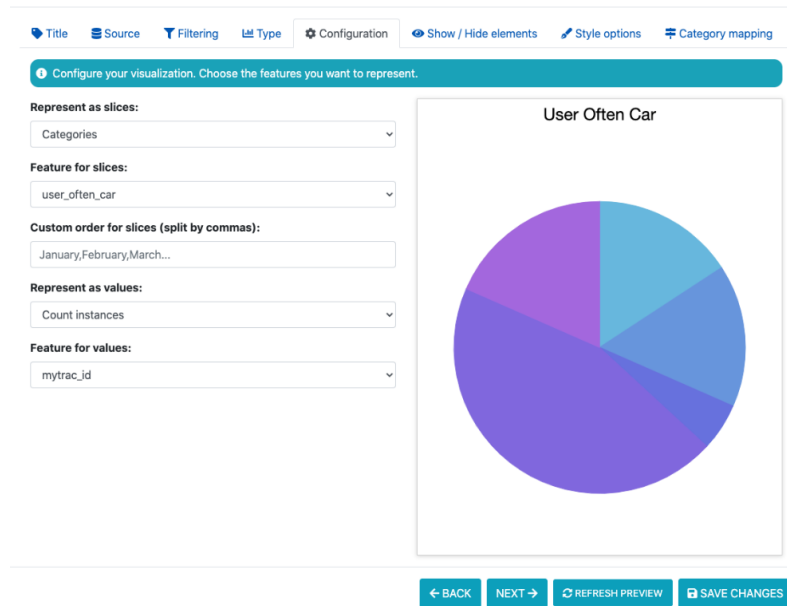


Figure 57: Visualization wizard - Pie chart configuration.

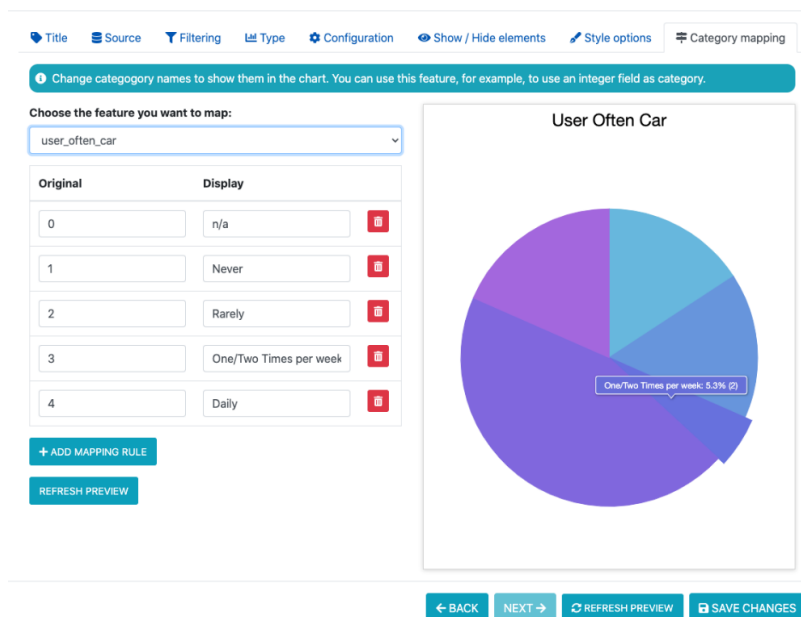


Figure 58: Visualization wizard - Category mapping.

In the configuration, it is specified the will to represent the variable "user\_ofTEN\_car", which is the one that registers the information that is intended to be shown in the example. Also, it is specified which type of values are to be represented in each slice: how many instances of each type there are.

Another important aspect is the mapping of the information categories contained in the "user\_ofTEN\_car" parameter, which according to the data model is:

- 1 (when the user never uses the car)
- 2 (when the user rarely uses the car)
- 3 (when the user uses the car one or two times per week)
- 4 (when the user uses the car daily)

If the final user looking at the pie chart were to visualize these numerical values stored in the data model, he or she would probably not know exactly what they are intended to reflect. To solve this issue, the wizard offers the 'Category mapping' tab, where the user can select the attribute whose information wants to map ("user\_ofTEN\_car") and set the original value and associated label, as shown in [Figure 58](#). In this way, when the user interacts with the slices, he will see the label associated with each one of them.

### 3.3.1.3 COLUMN CHART

Another popular type of visualization is the column chart. In this case, the configuration of the chart requires indicating which parameters are to be represented on each of the axes. An example showing the assessment of all the POIs is shown in [Figure 59](#).

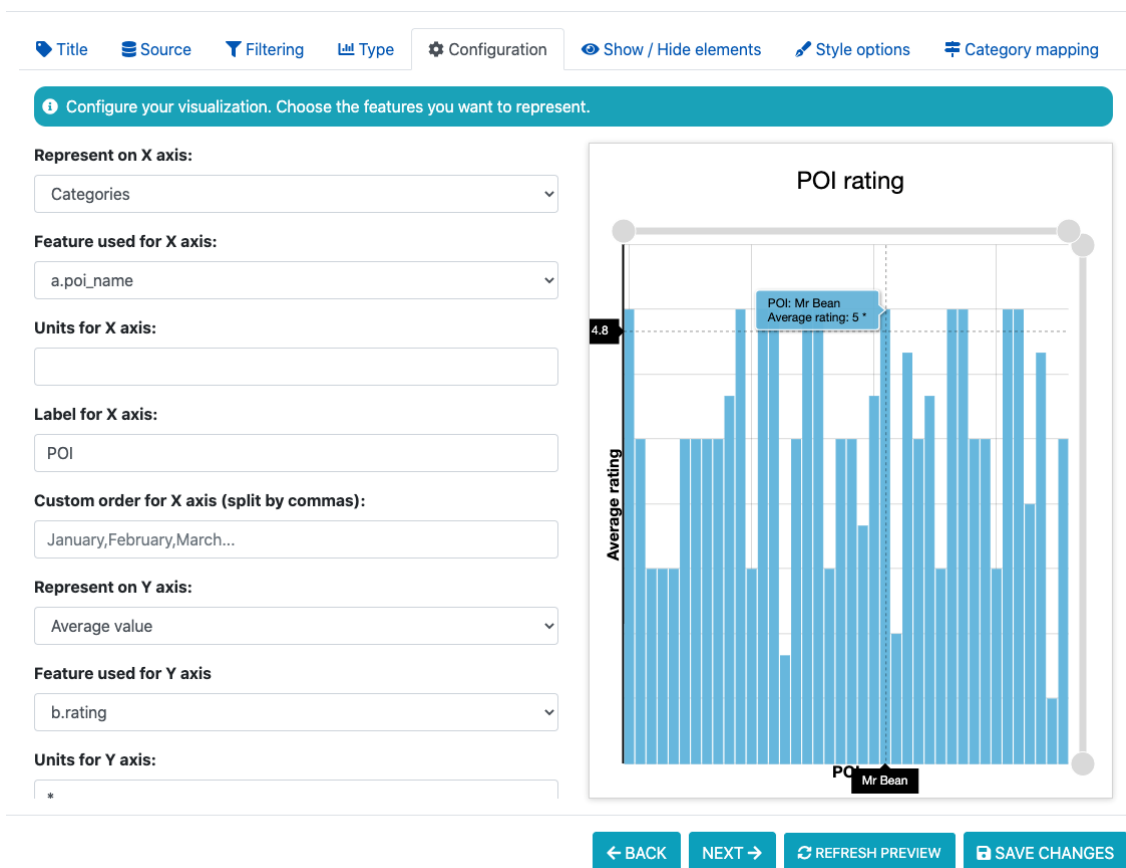


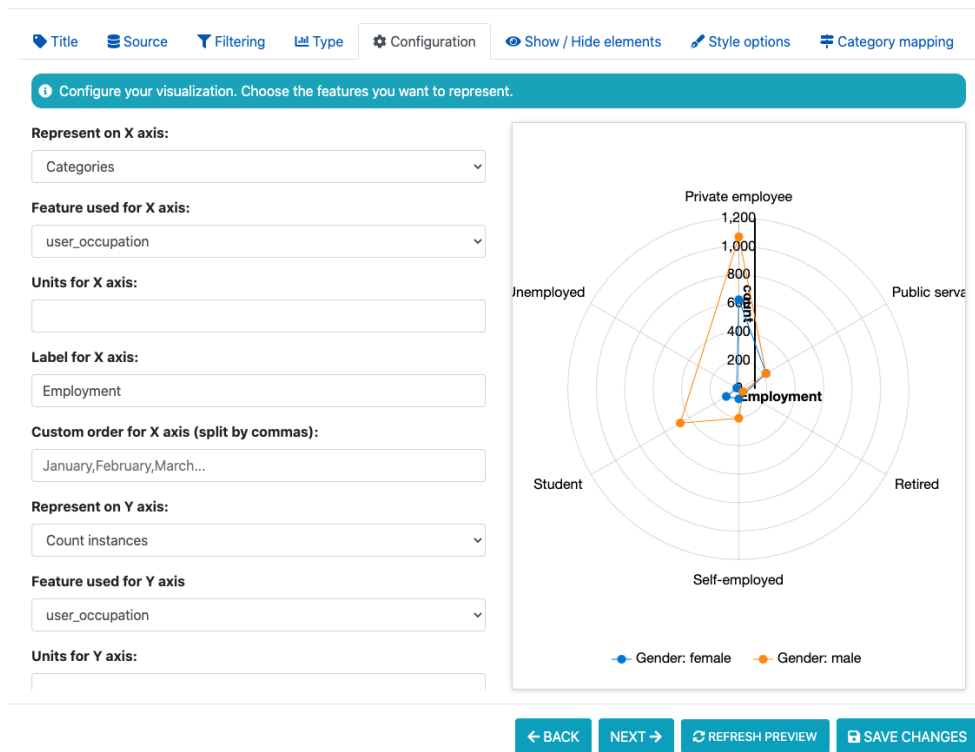
Figure 59: Visualization wizard - Column chart configuration.



### 3.3.1.4 RADAR CHART

Another very popular way of presenting information of various types in a dynamic graph is by means of radar charts.

**Figure 60** is an example showing the occupation of users according to their gender.



**Figure 60: Visualization wizard - Radar chart configuration.**

### 3.3.1.5 DASHBOARDS

Once multiple visualizations related to the user's activity have been created, it is possible to define dashboards that group related visualizations, interesting for the user in charge of visualizing the analyses.

Within each dashboard, filters can be incorporated that limit the information used in the included visualizations to the options indicated. For example, a dashboard has been created that shows all the information about the users, together with a series of sections (tabs) that allow filters to be applied according to the criteria specified by the final user.

**Figure 61** shows a screenshot of the result of a dashboard showing all the information stored in the My-TRAC application about the users, while **Figure 62** shows a tab with different filters available to the user, where it has been specified that only information about users with no impairments, male and Hellenic is shown in the visualizations.

This demo dashboard is accessible through the following URL:

<https://app.deepint.net/shared/02c4c1dd-fe2fd31a-8f740018-1717f2272e5/dashboards/c40d8e77-05e7a465-3bc63a96-172756c6462>

Other dashboards have been created to analyse, in addition to the data provided by users in the tool when registering, their behaviour when evaluating activities and Pols. An example is shown in Figure 63. And it is accessible through the following URL:

<https://app.deepint.net/shared/02c4c1dd-fe2fd31a-8f740018-1717f2272e5/dashboards/696424b1-4a4a0d1e-b3b0a7af-17275b252d4>

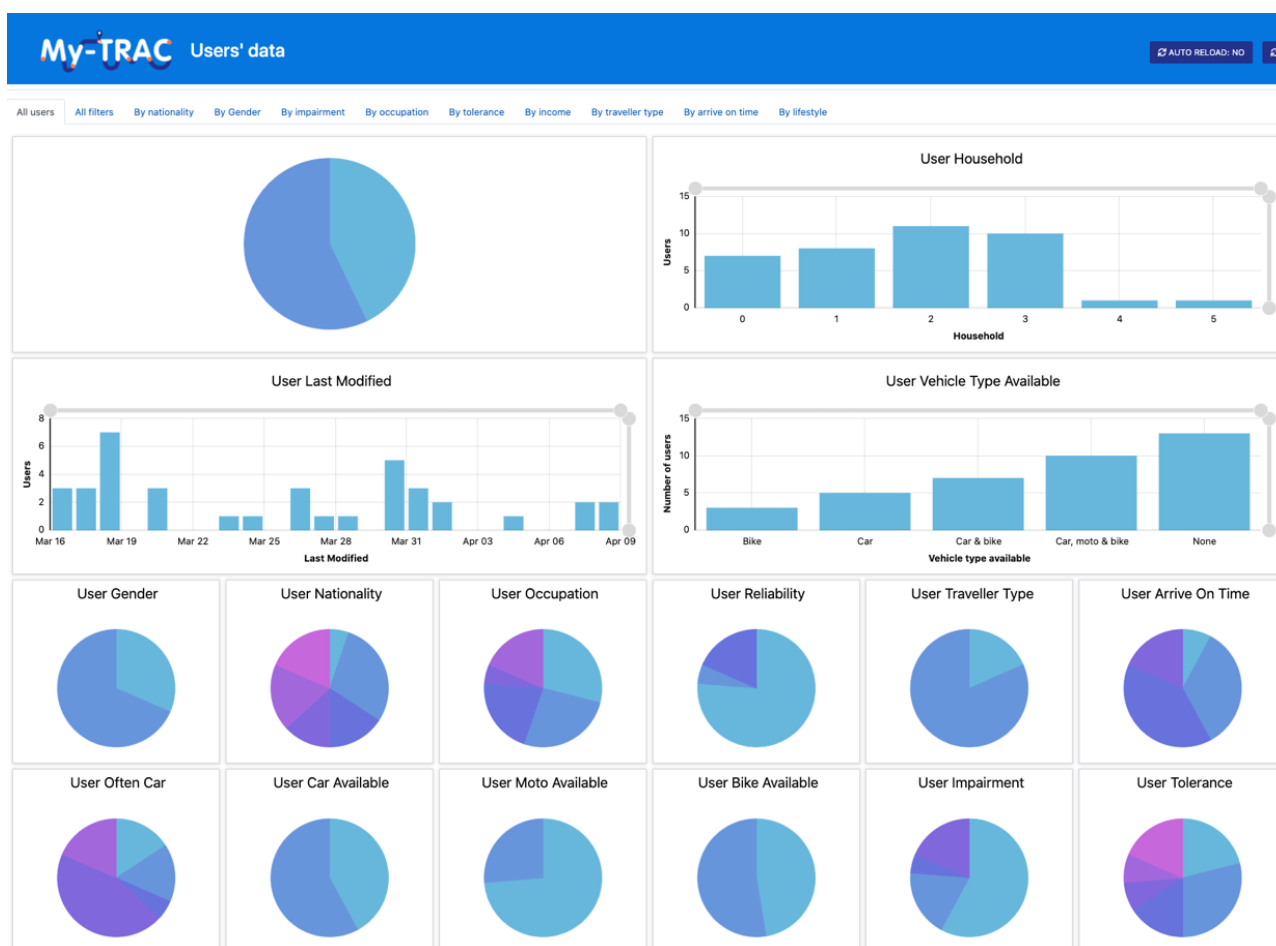


Figure 61: Dashboard - User data

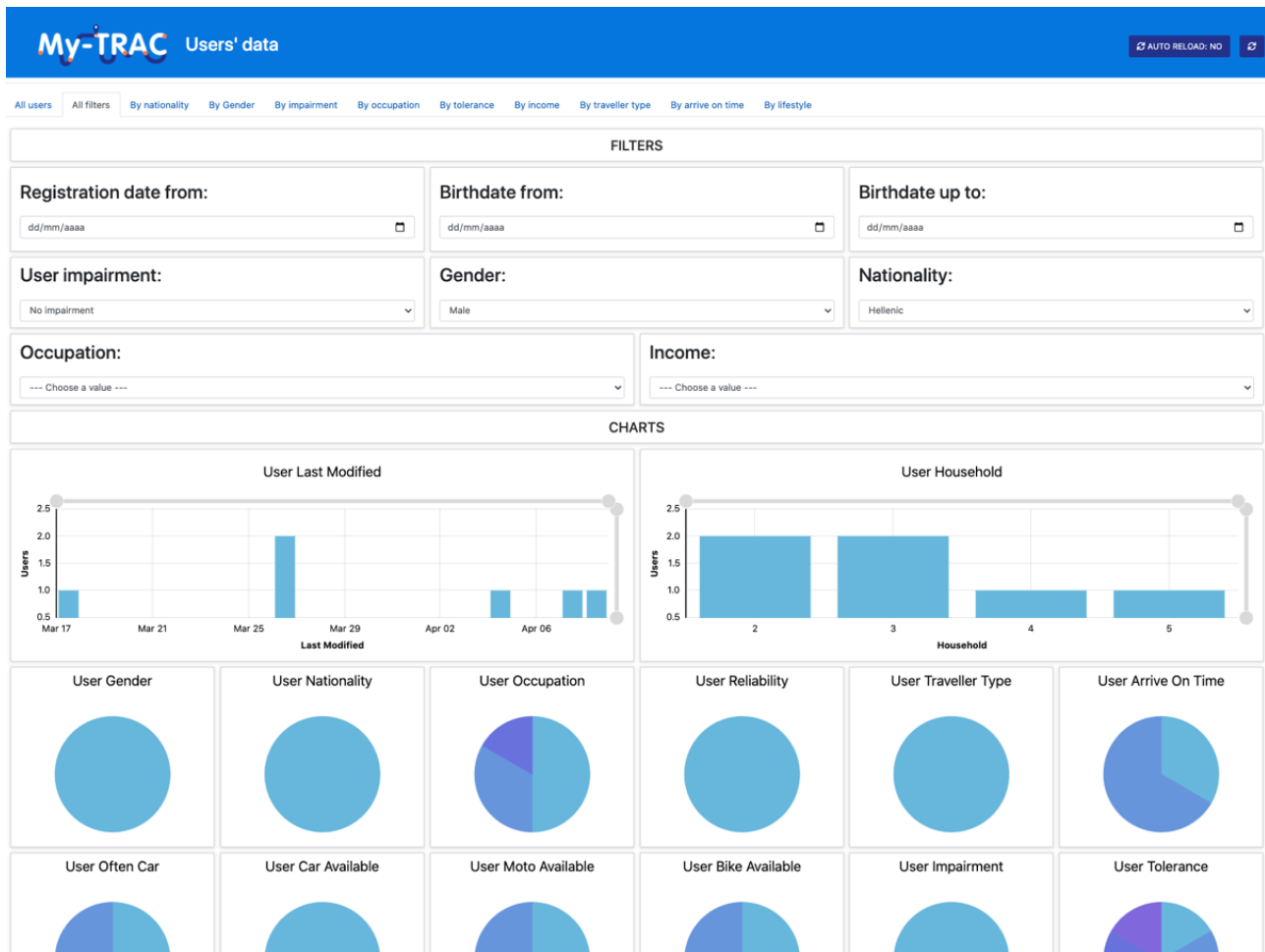


Figure 62: Dashboard - User data with filters



Figure 63: Dashboard - POI ratings.

### 3.3.2 GTFS

To provide visualizations of the GTFS data, a demo dashboard has been created with four different sections, one for each of the mentioned locations. Some examples of the visualizations are shown in the figures that follow. This demo is accessible through the following URL: <https://app.deepint.net/shared/563c7c89-3aa67e1d-42b248ed-1718206bf4f/dashboards/ebe87df5-fe2327ac-f0bed973-173948dbb38>

Barcelona Lisbon Netherlands Greece

Data provided by

Lisbon agencies					
agency_id	agency_name	agency_url	agency_timezone	agency_lang	type_of_transport
2	Metro de Lisboa	<a href="http://www.metrolisboa.pt/">http://www.metrolisboa.pt/</a>	Europe/Lisbon	pt	Metro
71	Caristur	<a href="https://caristur.pt/">https://caristur.pt/</a>	Europe/Lisbon	pt	Bus
3	CP	<a href="https://www.cp.pt/">https://www.cp.pt/</a>	Europe/Lisbon	pt	Train
11	TST	<a href="http://www.tsuldotejo.pt/">http://www.tsuldotejo.pt/</a>	Europe/Lisbon	pt	Bus
13	Fertagus	<a href="https://www.fertagus.pt/">https://www.fertagus.pt/</a>	Europe/Lisbon	pt	Train

Figure 64: Lisbon agencies.



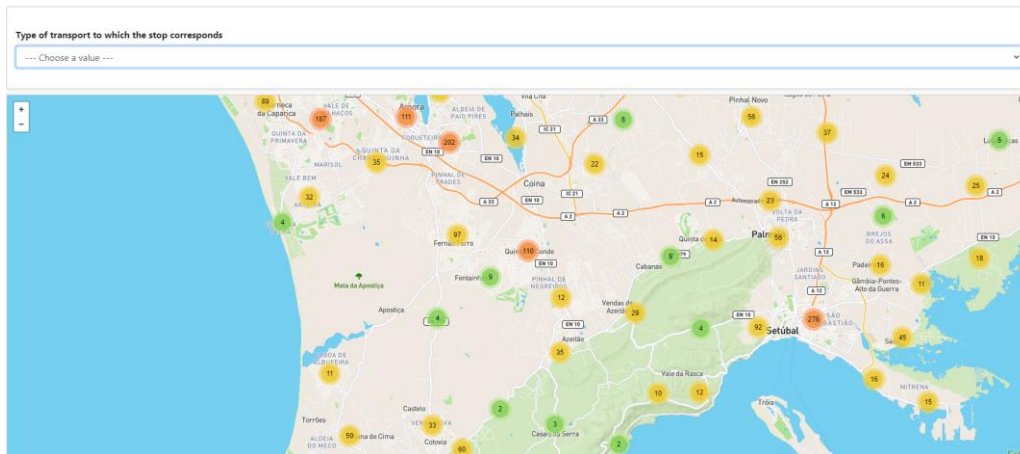


Figure 65: Lisbon stops.

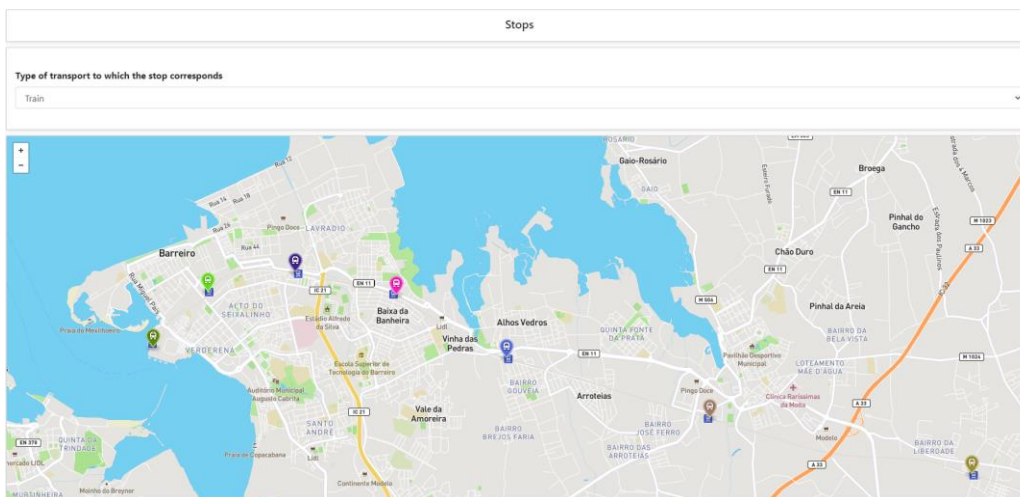


Figure 66: Some train stops in Lisbon.

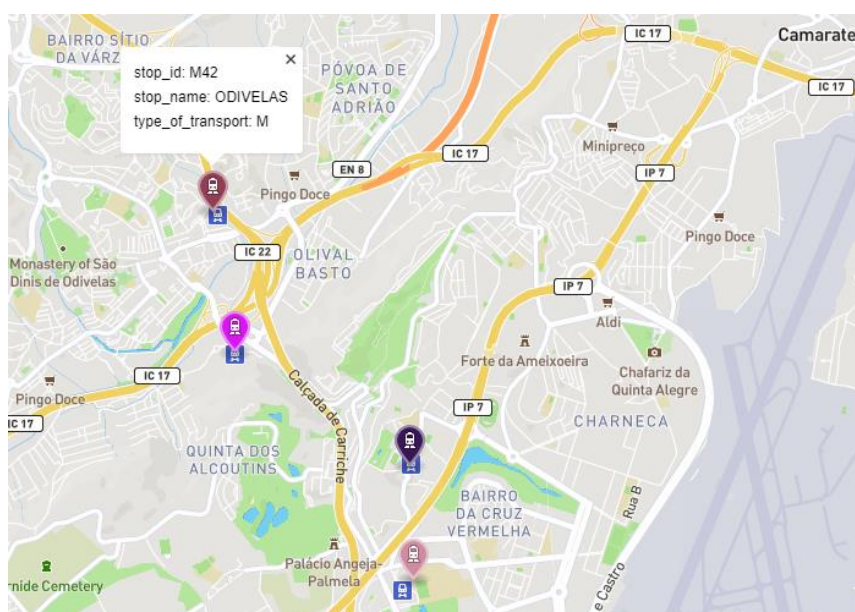


Figure 67: Metro stop Lisbon.

Stop times

Stop id

Q

Trip id

Q

Lisbon Stop Times

trip_id	arrival_time	departure_time	stop_id	stop_sequence	type_of_transport
27199269	14:53:19	14:53:19	1_6502	7	Bus
27212526	07:32:44	07:32:44	1_2213	36	Bus
27194511	16:33:06	16:33:06	1_12006	48	Bus
27222539	22:40:05	22:40:05	1_83106	30	Bus
27229489	08:47:25	08:47:25	1_10913	8	Bus

Figure 68: Lisbon Stop Times.

Stop times

Stop id

M42

Trip id

Lisbon Stop Times

trip_id	arrival_time	departure_time	stop_id	stop_sequence	type_of_transport
26843689	06:30:00	06:30:00	M42	0	Metro
26843675	06:30:00	06:30:00	M42	0	Metro
26843693	06:30:00	06:30:00	M42	0	Metro
26843692	06:51:54	06:52:34	M42	12	Metro
26843688	06:51:54	06:52:34	M42	12	Metro

Figure 69: Lisbon Stop Time by Stop id.

Stop times

Stop id

Q

Trip id

Q

26843689

Lisbon Stop Times

trip_id	arrival_time	departure_time	stop_id	stop_sequence	type_of_transport
26843689	06:30:00	06:30:00	M42	0	Metro
26843689	06:31:32	06:31:56	M41	1	Metro
26843689	06:34:25	06:34:46	M40	2	Metro
26843689	06:35:57	06:36:21	M39	3	Metro
26843689	06:37:30	06:37:54	M38	4	Metro

Figure 70: Lisbon Stop Time by Trip id.

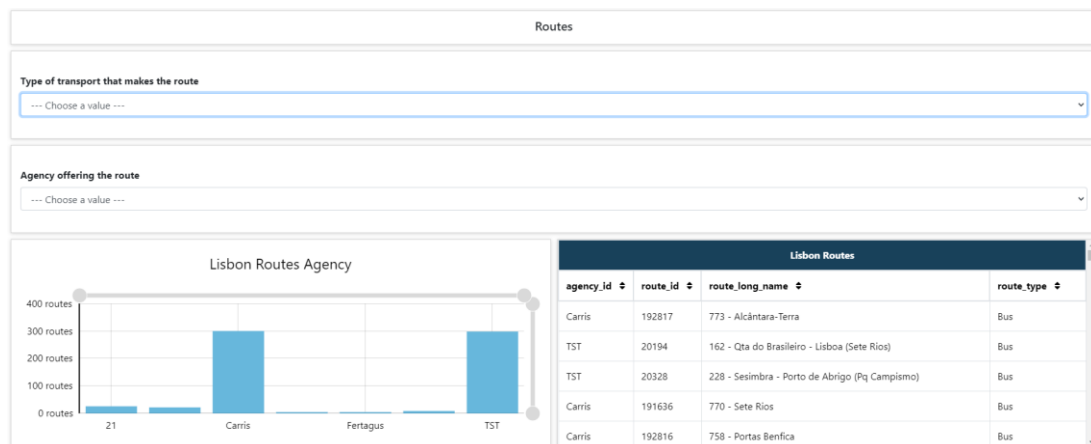


Figure 71: Lisbon routes.



Frequencies					
Trip id					
Q 27246958					
Lisbon Frequencies					
trip_id	start_time	end_time	headway_secs	exact_times	type_of_transport
27246958	03:30:00	04:30:00	3600	1	Bus

Figure 72: Lisbon frequencies example.

Calendar

Start date:

04/09/2020

End date:

07/09/2020

Lisbon Calendar Services Disponibility

service_id	monday	tuesday	wednesday	thursday	friday	saturday	sunday	start_date	end_date	type_of_transport
27112276	Available	Available	Available	Available	Available	Not Available	Not Available	2020/07/08	2021/07/08	Bus
27217799	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	Not Available	2020/08/04	2020/12/31	Bus
27115813	Available	Available	Available	Available	Available	Not Available	Not Available	2020/07/13	2021/07/13	Bus
27257216	Available	Available	Available	Available	Available	Not Available	Not Available	2020/08/30	2020/12/12	Train
27114022	Available	Available	Available	Available	Available	Not Available	Not Available	2020/07/13	2021/07/13	Bus
27114730	Available	Available	Available	Available	Available	Not Available	Not Available	2020/07/13	2021/07/13	Bus
27113560	Not Available	Not Available	Not Available	Not Available	Not Available	Available	Not Available	2020/07/10	2021/07/10	Bus
27115114	Available	Available	Available	Available	Available	Not Available	Not Available	2020/07/13	2021/07/13	Bus

Figure 73: Lisbon calendar.

## 4 SOCIAL MARKET – EXTEND SINGLE TICKET VALUE

As it has already been introduced in previous deliverables and it is connected with use case Points and social market, the My-TRAC Social Market is a place where users can spend the points, they earn by using the My-TRAC application in third-party coupons. These coupons can be free items, discounts, etc. It is aimed at extending the value of a transport ticket, by rewarding the users for making the trip with the assistance of the application. Different actions, such as starting trips or completing surveys, reward My-TRAC points, that can be later spend in the Social Market. It also encourages group traveling since more points are earned for using the My-TRAC application in a group. It also provides a way for local commerce to reach travellers, since they can use the Social Market to promote their products by creating coupons that can be exchanged for gifts or discounts.

The Social Market considers the preferences of the user and of other users with similar behaviour to recommend the mentioned coupons, to offer a tailored experience of each traveller. The platform is based on blockchain, and all transactions are carried out securely and automatically thanks to the use of smart contracts. Due to its modular design, it can easily be adapted to perform a different type of transactions. Finally, the Social Market is accessible from the main interface of the mobile application.

### 4.1 IMPLEMENTATION

This section describes the different modules of the architecture presented in Deliverable D5.3:

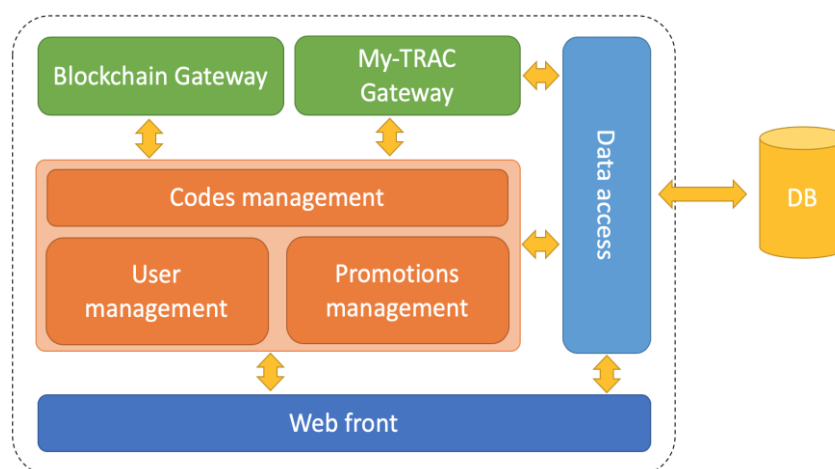


Figure 74.:Social Market architecture

#### My-TRAC Gateway

This interface allows the social market to receive the reputation from a certain user from the reputation module.

It expects a list of pairs “ID-points”, where ID is the identification of the user in the My-TRAC platform and the points are the amount of points that the user earned that day; and a date.

In order to update the points, a call must be sent to the following endpoint:

<http://212.170.54.119:8180/mytrac-webcontroller/movilPoint/processListMovilPoint>

Below is the JSON that must be sent to the endpoint:



```
[
{
  "idUser":
  "nPoints":
  "date":
}
]
```

Up to 100 users can be updated in the same call.

## Web Front

The web front allows users to browse and purchase the available coupons. The figure below shows the coupons page, as an example:

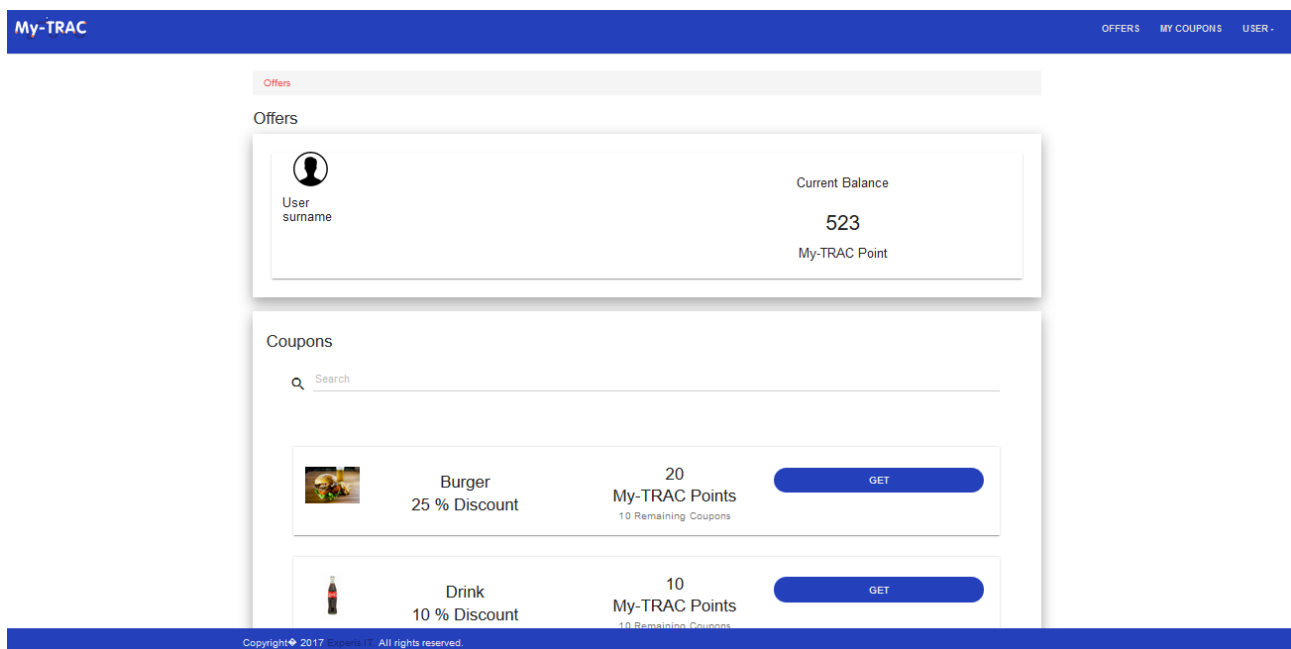


Figure 75: Social Market's web front

The different components that form the front end are described below:

- **HTML pages:** visible pages of the Social Market:
  - **checkCoupon.html:** page that validates a coupon and marks it as used in case the coupon is ready to be redeemed, or else it will inform that the coupon is already used or invalid. This page does not require a login to be accessed.
  - **coupon.html:** page for coupon management. It shows the created coupons to the provider, allowing them to edit them or create new ones.
  - **myCoupons.html:** page that shows the purchased coupons to the user, both used and redeemable ones.
  - **offers.html:** page that shows the offered coupons to the user, who is able to purchase them should they have sufficient points.



- **popUpCoupon.html:** pop-up page for the provider to view, create or edit a coupon.
- **popUpShowMyCoupon:** pop-up page that allows the user to view a purchased coupon and present the QR code.
- **user.html:** page that allows the user to visualize their data and change preferences such as language.
- **login.html:** login page
- **Controller.js files:** Controller.js files are JavaScript code that is run client-side and provide functionality to the HTML pages. Each of the previously described html pages have a controller file associated. E.g. checkCoupon.html has an associated checkCouponController.js file.
- **Service.js:** service.js files are client-run code that carries out the connection with the Social Market's backend. They can be called from the different Controller.js files:
  - **blockChainService.js:** calls the BlockchainController.java class to create blockchain requests.
  - **CouponService.js:** calls CouponController.java to perform actions on the coupons, such as creation of modification of them.
  - **fileService.js:** provides a service for file upload, for the coupons' images.
  - **languagesServices.js:** calls LanguageController.java to retrieve the user language.
  - **PointCouponService.js:** calls PointCouponController.java to carry out tasks related to users' coupons, such as creation or usage.
  - **pointService.js:** calls Point.java to obtain the points of a user.
  - **rolesService.js:** calls RoleController.java to obtain the role of the user (user or provider)
  - **session.js:** takes care of login calls.
  - **userService.js:** calls UserController.java to obtain or update user information.
  - **utisService.js:** generic utilities for the different .js files.
- **Factories.js:** JavaScript code that helps in page navigation:
  - **navigationFactory.js:** allows navigation and page switching.
  - **parameterFactory.js:** allows to pass information among different pages and JS code.
- **Translations:** JSON files that contain the tags to present the Social Market in the available languages (currently Spanish and English):
  - **en.json:** English tags
  - **es.json:** Spanish tags

### Codes management

This component is in charge of the creation of QR codes for the coupons, and of handling the validation of said coupons, keeping control of whether they have been used. It is made of two main classes:

- The **QRService.java** class is in charge of the generation of a unique code that will identify the coupon purchased by the user, and the generation of the QR graphic that contains the URL to a call to the Social Market with the coupon code. Once scanned, it calls the endpoint CheckCouponController.java, described below.
- The **CheckCouponController.java** class contains the endpoint which, after the call generated by reading the QR code, tags the coupon as “used” through the **PointCouponService.java** class. Besides, the PointCouponService.java class calls the BlockchainService.java, which controls the blockchain calls to confirm the validation of the transaction. At that point, the coupon can no longer be used and the blockchain will return the transaction address of the validation.





### Promotions management

The management of the coupons is performed through the `CouponController.java` and `CouponService.java` classes:

- **`CouponController.java`** receives petitions from the frontend and calls `CouponService.java`.
- **`CouponService.java`**: it contains the logic that handles the coupons created by the provider.

### User management

The classes that manage the users are:

- **`UserController.java`** and **`UserService.java`**: manage the user ID, passwords and authentication in the blockchain.
- **`PointService.java`**: manages the points of the user.
- **`PointCouponController.java`** and **`PointCouponService.java`**: manage the coupons purchased by the user.

### Data access

Classes for accessing the database are the following. The database schema has been described in D5.3.

- **`CouponDao.java`**: class for accessing the coupons' data.
- **`LanguageDao.java`**: class for accessing the language table, which contains the different application languages.
- **`MovilPointDao.java`**: class for accessing the “movil\_points” table, which holds the points sent by the mobile application.
- **`PointCouponDao.java`**: class for accessing the “point\_coupon” table, which holds the coupons purchased by the user.
- **`PointDao.java`**: class for accessing the “point” table, which holds the points of the user.
- **`RoleDao.java`**: class for accessing the roles table, which contains the user role (user or provider).
- **`UserDao.java`**: class for accessing the user table.
- **`UserRoleDao.java`**: class for accessing the relationship table “user\_role”, which relates the user and role tables and provides the roles a user can interact with.

## 4.2 OFFERS PERSONALIZATION

The Social Market provides personalized offers to the different users, according to their travel preferences. Hence, the offers that are present first for each user are those that belong to the user's preferred category (culture, hobbies, shopping or eating & drinking).

The recommendations will be performed on two levels: via an integration with My-TRAC's activity recommendation module to obtain the user's preferred category, and via a user-based recommender, which takes into account similar users' preferences to recommend offers. Based on the information received from these two modules, the final offer list is sorted.



#### 4.2.1 ACTIVITY MODULE INTEGRATION

---

The activity module API is available at:

160.40.49.106:90/api/getPrediction/userId/{**user id**}

It expects the id of the user for which the preferences list is desired.

The reply (JSON) will be:

```
{  
  "predicted_activity": "eating",  
  "status": "ok"  
}
```

or

```
{"status": "error"} in case of error
```

The model is refreshed every hour. The list of possible activities is:

- Culture (museums, theatre, movies...)
- Hobbies (sports, workshops...)
- Eating & Drinking (restaurants, bars...)
- Shopping (shops, malls...)

#### 4.2.2 USER-BASED RECOMMENDER

---

As mentioned before, the user-based recommender takes into account other users' preferences to obtain the recommendations. In order to assess how much a user “likes” an offer, it considers two variables:

- Offers purchased
- Offers checked

These interactions are stored and then passed to the recommender whenever it is called. According to them, It returns the list of items that are preferred by a certain user.

The recommender is based on Mahout libraries. Apache Mahout is a project of the Apache Software Foundation to produce free implementations machine learning algorithms focused primarily on linear algebra.

This module has been configured to offer a maximum of three recommendations, but the actual number depends on the total number of user interactions, published offers and the interactions between users and offers.

The final list of offers will be created based on the output of the recommender and the output of the activity module, prioritizing the latter and ensuring that at least one offer that belongs to the preferred activity is occupying the first place in the list.



### 4.3 INTEGRATION WITH MY-TRAC

The Social Market can be accessed from a browser providing user credentials. However, My-TRAC users can also access the Social Market seamlessly from the My-TRAC application. In order to achieve this, the application sends a request to the Social Market to create a new user, whenever a user is registered in the mobile application, including the username, email address and the password. From that point forward, when a user accesses the corresponding section in the application, a request is sent to the social market including the name of the user and the password. The social market returns a token, which is used to authorize the user for that session, giving them the possibility of opening a web browser instance to their Social market account and check their points.

The APIs offered by the Social market to achieve this integration are described in [Table 7](#).

**Table 7: Social Market API**

Type	Method:	Parameters:	Returns:
URL: <a href="http://212.170.54.119:8180/mytrac-webcontroller/getToken">http://212.170.54.119:8180/mytrac-webcontroller/getToken</a>			
GET	getToken	<b>user:</b> mobile application user  <b>password:</b> mobile application password	<p>Returns a set of user data, one of them being the token that will be used to authorize access to the Social Market. It will only be valid for a certain time, which, in principle, it will be 30 seconds. The token will look like:</p> <pre>Bearer eyJhbGciOiJIUzUxMiJ9.eyJqdGkiOiJNeVRyYWNLV1QiLCJzdWIiOiJlc2VyQXBwQHVzZXIuZXMiLCJhdXRob3JpdGllcyI6WyJST0xFX1VTRVliXSwiaWF0IjoxNTk1OTI5OTYLCjleHAiOiJlOTU5MzA1MDJ9.TpQDo3_zE9Lz6W_NPf7KfK-4MesK5LQdX6Vs997sPreZzBMd-5gMe1ig1cu7m_7VNeFtA-TFPMDSZ9dqrVkm3w</pre> <p>With this token, the Social Market can be opened in the browser with the following URL:</p> <pre><a href="http://212.170.54.119:8180/#/loginT?token=Bearer%20eyJhbGciOiJIUzUxMiJ9.eyJqdGkiOiJNeVRyYWNLV1QiLCJzdWIiOiJlc2VyQXBwQHVzZXIuZXMiLCJhdXRob3JpdGllcyI6WyJST0xFX1VTRVliXSwiaWF0IjoxNTk1OTI5OTYLCjleHAiOiJlOTU5MzA1MDJ9.TpQDo3_zE9Lz6W_NPf7KfK-4MesK5LQdX6Vs997sPreZzBMd-5gMe1ig1cu7m_7VNeFtA-TFPMDSZ9dqrVkm3w">http://212.170.54.119:8180/#/loginT?token=Bearer%20eyJhbGciOiJIUzUxMiJ9.eyJqdGkiOiJNeVRyYWNLV1QiLCJzdWIiOiJlc2VyQXBwQHVzZXIuZXMiLCJhdXRob3JpdGllcyI6WyJST0xFX1VTRVliXSwiaWF0IjoxNTk1OTI5OTYLCjleHAiOiJlOTU5MzA1MDJ9.TpQDo3_zE9Lz6W_NPf7KfK-4MesK5LQdX6Vs997sPreZzBMd-5gMe1ig1cu7m_7VNeFtA-TFPMDSZ9dqrVkm3w</a></pre>
<a href="http://212.170.54.119:8180/#/loginT?token=Bearer%20eyJhbGciOiJIUzUxMiJ9.eyJqdGkiOiJNeVRyYWNLV1QiLCJzdWIiOiJlc2VyQXBwQHVzZXIuZXMiLCJhdXRob3JpdGllcyI6WyJST0xFX1VTRVliXSwiaWF0IjoxNTk1OTI5OTYLCjleHAiOiJlOTU5MzA1MDJ9.TpQDo3_zE9Lz6W_NPf7KfK-4MesK5LQdX6Vs997sPreZzBMd-5gMe1ig1cu7m_7VNeFtA-TFPMDSZ9dqrVkm3w...">http://212.170.54.119:8180/#/loginT?token=Bearer%20eyJhbGciOiJIUzUxMiJ9.eyJqdGkiOiJNeVRyYWNLV1QiLCJzdWIiOiJlc2VyQXBwQHVzZXIuZXMiLCJhdXRob3JpdGllcyI6WyJST0xFX1VTRVliXSwiaWF0IjoxNTk1OTI5OTYLCjleHAiOiJlOTU5MzA1MDJ9.TpQDo3_zE9Lz6W_NPf7KfK-4MesK5LQdX6Vs997sPreZzBMd-5gMe1ig1cu7m_7VNeFtA-TFPMDSZ9dqrVkm3w...</a>			
The LoginT call should be opened in the browser. The value of the token must be the reply of the getToken method			
URL: <a href="http://212.170.54.119:8180/mytrac-webcontroller/movilPoint/createUser">http://212.170.54.119:8180/mytrac-webcontroller/movilPoint/createUser</a>			
POST	createUser	JSON with the following structure: <pre>{   "username": "user email address",   "password": "user password",   "id": "user id" }</pre>	<p>If successful, a message like the following will be returned:</p> <pre>User created:prue1146@user.es id: 333</pre>



		<p>Example:</p> <pre>{   "username": "prue1146@user.es",   "password": "test",   "id": 333 }</pre>	
http://212.170.54.119:8180/mytrac-webcontroller/movilPoint/processListMovilPoint2			
POST	processListMovilPoint2	<p>Expects a JSON with a set of users and their points:</p> <pre>[ {   "idUser": user id,   "nPoints": number of points,   "date": date in milliseconds }, ... ]</pre> <p>Example:</p> <pre>[ {   "idUser": 12,   "nPoints": 11,   "date": 1588606475356 } ]</pre>	<p>The system will add the received points to the user account.</p> <p>Points can be sent once per day as a maximum.</p>
http://212.170.54.119:8180/mytrac-webcontroller/movilPoint/processReputation			
POST	processLReputation	<p>Expects a JSON with a set of users and a reputation value for each of them.</p> <pre>[ {   "idUser": user id,   "reputation": reputation %,   "date": date in milliseconds }, ... ]</pre> <p>Example:</p> <pre>[ {   "idUser": 12,   "reputation": 11,   "date": 1588606475356 } ]</pre>	<p>The system will add points to the user account according to the reputation received. The conversion between points and reputation will be done with a predefined algorithm.</p>
URL: http://212.170.54.119:8180/mytrac-webcontroller/movilPoint/getPoints			
GET	getPoints	Expects a JSON with the user id	Returns the number of points of the user



		<pre>{   "id": user id }</pre> <p>And returns their current points.</p> <p>Example:</p> <pre>{   "id": 20 }</pre> <p>Reply:</p> <p>325</p>	
http://212.170.54.119:8180/mytrac-webcontroller/movilPoint/giveMeMyData			
POST	giveMeMyData	<pre>{   "username": "prue1643@user.es",   "password": "prue" }</pre>	Return JSON with user data
http://212.170.54.119:8180/mytrac-webcontroller/movilPoint/deleteUser			
POST	deleteUser	<pre>{   "username": "prue1643@user.es",   "password": "prue" }</pre>	User deleted:prue1643@user.es

## 4.4 GDPR COMPLIANCE

In order to comply with the GDPR, the Social Market must provide the possibility of retrieving and deleting all user data. In order to achieve that, an API exposing those functionalities has been created, as shown in [Table 8](#).

**Table 8: Social Market API, GDPR Compliance**

Type	Method:	Parameters:	Returns:
http://212.170.54.119:8180/mytrac-webcontroller/movilPoint/giveMeMyData			
POST	giveMeMyData	<pre>{   "username": "prue1643@user.es",   "password": "prue" }</pre>	Return JSON with user data
http://212.170.54.119:8180/mytrac-webcontroller/movilPoint/deleteUser			



POST	deleteUser	<pre>{   "username": "prue1643@user.es",   "password": "prue" }</pre>	User deleted:prue1643@user.es
------	------------	---	-------------------------------

These functionalities can be accessed directly from the Social Market, but if the request is done from the mobile application, it can call the corresponding API so data from both platforms will be deleted or given to the user at the same time upon request.

Regarding the delete process, after receiving the request (from the social market or from the API), user data are physically eliminated from all the related tables, and no registry is kept. After that, any attempt to access information from that user will return an “unknown user” error.

In order to be able to delete data from the social market, the user must be logged in with their credentials. The API call must also be authenticated. The following tables will be eliminated:

- user
- user\_role
- point
- point\_coupon
- click\_coupon
- movil\_points

## 4.5 USER MANUAL

This section provides an overview of how the Social Market is used, both from the perspective of a provider to create offers, and from a user, to browse and purchase coupons and to trade them.

### 4.5.1 PROVIDER ROLE

A provider can log in the Social Market with their provider credentials. Once logged in, they can click on “Coupons”, and they will be presented with the list of offers they have created:



**My-TRAC** COUPONS PROVIDER

Coupons

Coupon management (Current Balance : 999138):

**NEW OFFER**

Items per page: 10

Offer	% Discount	Cost	Quantity	Remaining	Start	End	Options
Pizza 2x1	50	5	5	5			
Popcorn	50	20	10	10	18-03-2020	25-03-2020	
Burger	25	20	10	9	18-03-2020	25-03-2020	
Drink	10	10	10	9	18-03-2020	25-03-2020	

Figure 76: Provider's offers list

In that screen, they can edit or delete the offer.

Clicking on “New offer”, a provider can create a new offer. They will be presented with the creation screen, shown below, where they will be asked for the following information:

- Offer: description of the offer
- % Discount: how much the item will be discounted
- Cost: price (in My-TRAC points) of the coupon
- Quantity: how many coupons will be available for that offer
- Start/End: dates between which the coupons will be available
- Image: an image to show for the offer

**New Coupon**

Offer\*

% Discount\* Cost\* Quantity\*

Start: DD-MM-YYYY End: DD-MM-YYYY

Examinar... No se ha seleccionado ningún archivo.

Name	Size	Progress	Status	Options
	MB			

SAVE CANCEL

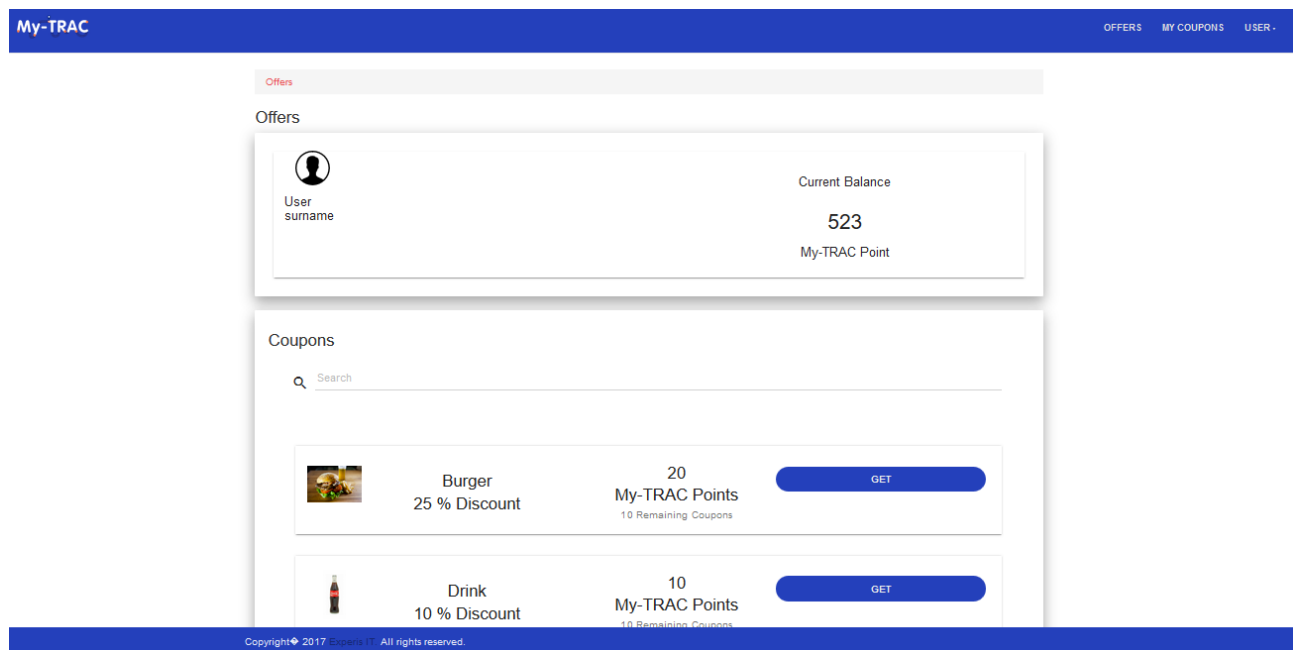
Figure 77: Offer creation screen



The created offer will be available for travelers once the transaction has been confirmed in the blockchain.

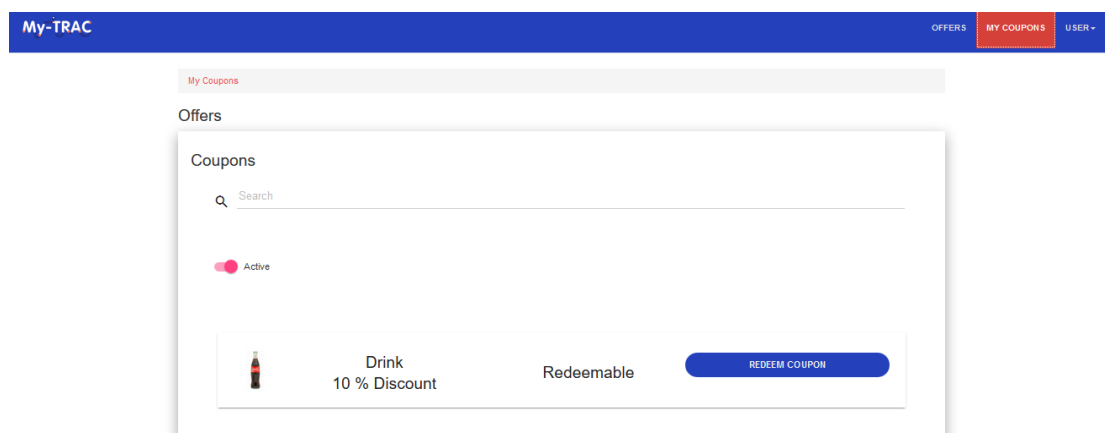
#### 4.5.2 TRAVELLER ROLE

A traveller can log in the Social Market with their user credentials. Once logged in, they will be presented with their current points balance and a list of available offers to purchase, as shown in **Figure 78**.



**Figure 78: User's offer list**

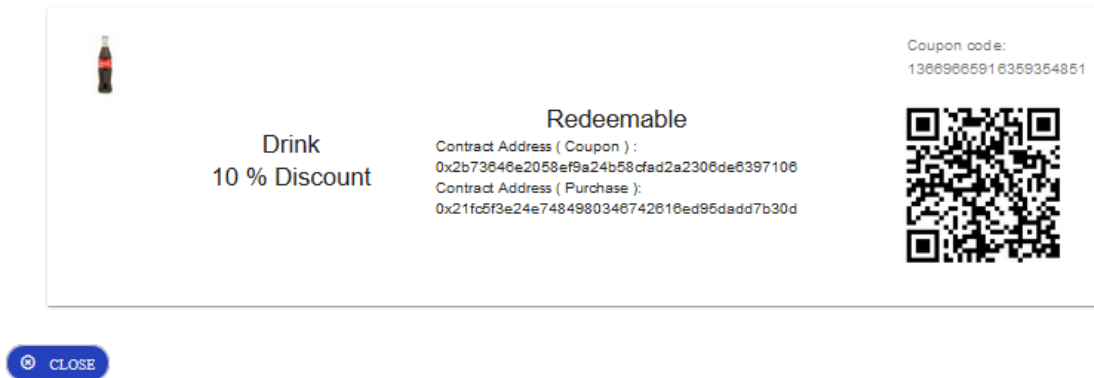
From that screen, they can select an offer and purchase it, by clicking on the “Get” button. They will be shown a confirmation screen with a summary of the coupon. Confirming the purchase will add the coupon to the “My Coupons” tab and will remove it from the offers list. The “My Coupons” tab contains all purchased coupons, as shown in **Figure 79**.



**Figure 79: User's coupons**

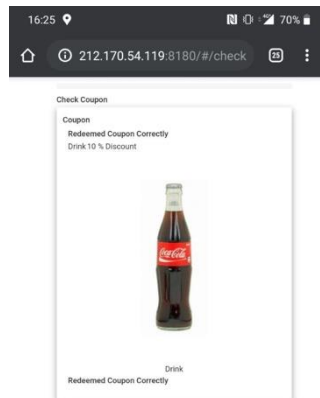


For each coupon, if it has not yet been used, the button's text will read "Redeem coupon", whereas if it has already been used, it will read "View coupon". Clicking on the button will show the coupon's information and its associated QR code, as depicted in **Figure 80**.



**Figure 80: Coupon's information and QR code**

Reading the QR code will open a website, as shown in **Figure 81**, that shows the coupon's information along:

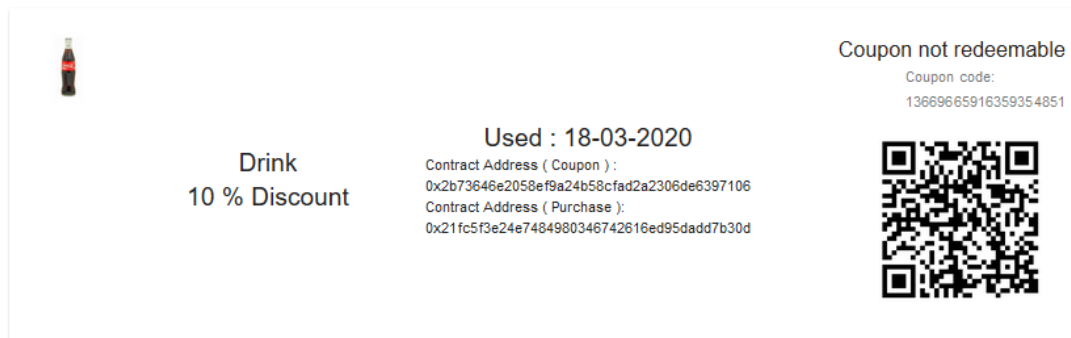


**Figure 81: Coupon's information shown after reading QR code**

Once the QR code is read, the coupon will disappear from the "active" coupons list, and clicking on "View coupon" (the "Active" toggle has to be unchecked in order to see the used coupons) will show the information about the coupon but it will read "used" and indicate that the coupon is no longer redeemable, as in **Figure 82**.

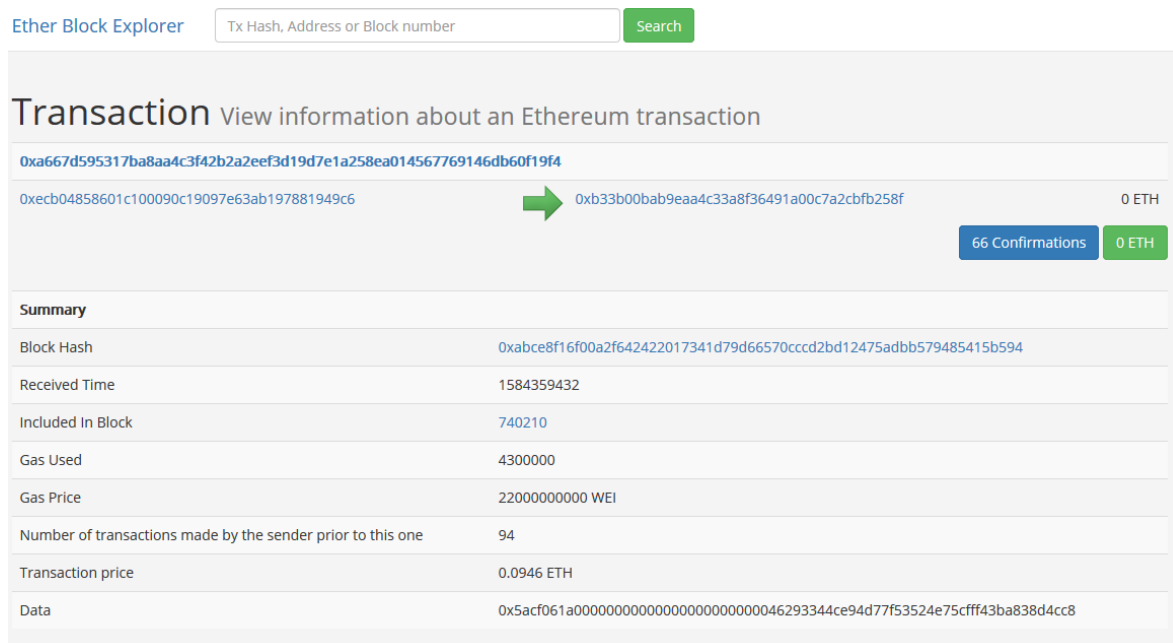


Contract No. H2020 – 777640



**Figure 82: Used coupon's information**

As shown in the previous Figures, a purchased coupon, used or not, includes a “contract address” for the purchase and for the coupon. The platform is based on blockchain, and the purchases of coupons are carried out by means of smart contracts. Thus, the coupon address corresponds to the address of the smart contracts that controls the “parent” offer, the purchase address corresponds to the transaction that obtained that very coupon. Both addresses are clickable, and lead to an Ethereum explorer that shows the transaction in the blockchain, as **Figure 83** shows.



**Figure 83: Transaction in the blockchain explorer**



## 5 OPERATORS PORTAL

My-TRAC operators' portal aims to be the gateway for PT operators to communicate with My-TRAC and vice versa. It will constitute a tool for the operators to have access and download useful travellers' behavioural data to improve strategic planning and dynamic operations, and to provide updates in the form of real-time GTFS data, informing about alerts or changes. My-TRAC operators' portal is duly presented in D5.6 but for complicity reasons its main parts are presented also in this deliverable. The following paragraphs are based on the updated use cases presented in Annex 2 Operator's portal use cases Updated.

The portal consists of two main pages one for allowing operators to upload data and the other to download data. The first one collects information from operators that can take the form of announcements (alerts or updates) and posts (promotional messages). It provides standardized input methods for operators to provide the aforementioned information which will be sent to My-TRAC's servers, to update the recommendations provided to travellers. Currently, operators have to conduct expensive surveys and time-consuming data analysis, to retrieve similar data. Behavioural data from the portal will assist operators to provide the passengers with travel options tailored to their preferences.

Furthermore, the portal provides tools for extraction of aggregated information concerning user choices, user feedback, user habits, etc., in CSV format. The operators can use these data to improve planning and operations. User data on the portal are aggregated and contain non-sensitive data, according to GTFS regulation thus, operators will not be able to micro-target specific individuals or extract information from specific individuals. Behavioural data retrieved from the portal can efficiently enhance planning activities of the operators and improve Quality-of-Service.

The main objectives of the portal's creation are:

- provide the operators with a way to connect with My-TRAC environment
- provide real-time and historic data concerning behavioural analytics of travellers to public transport (PT) operators, which can be used to assist them with their planning operations and to optimize their services.
- upload useful real-time GTFS data<sup>10</sup> about alerts, announcements or disruptions, to help travellers with their everyday trips and increase reliability of My-TRAC app.

Figure 84: Operators' portal sitemap presents the sitemap (blue boxes) and the functionalities (orange boxes) of each page. Each page is explained separately below the figure:

<sup>10</sup> <https://developers.google.com/transit/gtfs-realtime>

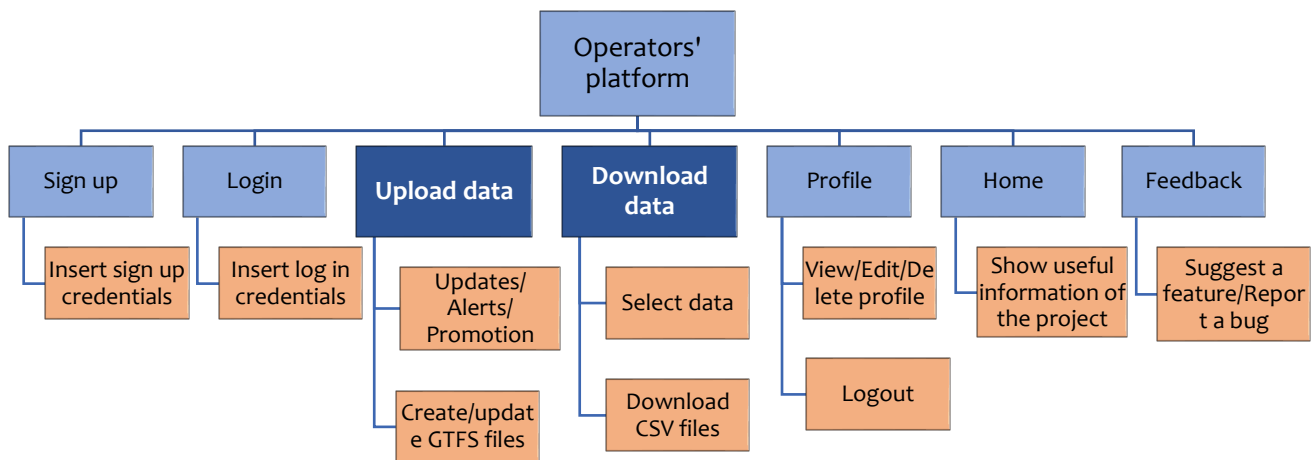


Figure 84: Operators' portal sitemap

### 1. Home page

Home page is the first page that the operator encounters in the web-portal. It contains basic information about the My-TRAC project's vision, the official link to the website of My-TRAC project and interesting graphs concerning the travellers' behaviour.

### 2. Signup page

In this page, the operators can be registered, in order to have access to the functionalities that the portal offers. Credentials regarding the user of the portal and the company that they represent, are required for the registration. After filling all the required fields, the operators have to wait for a confirmation of their registration. Until then, the users' registration is pending. Every time a new operator is registered a profile is created in the database to store all the provided information.

### 3. Login page

After the registration (and confirmation), the user can login in order to have access to the main pages of the portal. The only credentials required are the operator's representative unique username and password. The portal is not accessible by anyone, but only from verified users.

### 4. Profile page

After the successful registration, a profile for the user and the company is created, displaying all the information retrieved from the registration process. The profile is only visible to the registered operators, making it easier to revise their information and edit them anytime. All the information can be updated except from the username. There is also the possibility of uploading profile image and company's logo while the *Logout* and *Delete profile* options are also in the page. When a profile is deleted, the corresponding company is also deleted automatically.

### 5. Feedback page

In the feedback page, the users can assist on the improvement of the portal, providing their opinion for the portal by suggesting a new feature that would be useful to be added or by pointing out an error that disrupts the proper functioning of the portal. In the comments box they can offer reviews, suggestions, changes, and improvements.





The company name and the email of the user are required, so that we are aware of the identity of the user. This communication between the operators and the portal is crucial for the continuous improvement and update of My-TRAC and to ensure the quality of the portal.

The two main purposes of the portal's creation are described in detail in the following sections.

## 5.1 MAIN FUNCTIONALITY #1: UPLOAD DATA

The first main functionality of the portal is the upload of useful real-time GTFS data about alerts, announcements, or disruptions, to help travellers with their everyday trips and increase reliability of My-TRAC app. The operators enter the My-TRAC portal to upload useful data about the operations of the PT, such as changes on the timetable of a trip, or an urgent message that a specific train stopped working. They can choose among "Trip updates", "Service alerts" and "Promotional messages" (Figure 85: Upload data page) depending on the kind of information to be uploaded. The first two categories are based on the GTFS real-time (Google LLC 2019), while the last one consists a new functionality that allows operators to promote important messages to travellers through the app (users of My-TRAC). The system categorizes the uploaded data (if it concerns stations, routes, delays, etc.) in the corresponding tables and stores them for future use. My-TRAC has collected the GTFS files of Belgium, Greece (Athens), the Netherlands, Catalonia (Barcelona) and Portugal (Lisbon), which allows for the presentation of a list with all the available IDs and routes that an operator would need to change or update, depending on the country. Each input assists on the more appropriate categorization and the update of the corresponding GTFS files. Some of the fields are required or conditionally required, while other are optional. Next to each field there is a help tip, explaining in detail, what needs to be filled and in what format. Depending on the choice, different input forms appear, and the operator can select which category suits best to the data that need to be uploaded (Table 9: Upload data definition). More specifically:

The *Trip updates* (Figure 86: Trip updates form) are real-time updates on the progress of a vehicle along a trip. They usually represent fluctuations or future changes in the timetables, or even cancelled or added trips to the schedule. This form is separated in 4 sections: i) Trip Descriptor, where the updated trip is specified, ii) Vehicle Descriptor where (optionally) the vehicle of the specific trip is described, iii) Stop Time Update that constitutes the real-time update for arrival and/or departure events for a given stop on a trip and, iv) Event Time where timing information for a single predicted event is provided in the corresponding input fields, based on the GTFS Realtime Reference.

*Service alerts* (Figure 87: Service alerts form) indicate some sort of incident in the PT network. They usually constitute urgent messages (and not permanent changes) that should be promoted to the travellers through the My-TRAC app which can be executed in multiple ways such as direct messages ("popups") or used to update the recommendations provided by My-TRAC models. Service alerts affect only some travellers travelling on a specific route, line or vehicle. Thus, dissemination of the service alert should involve only affected individuals. This assists on enhancing the precision of My-TRAC app, leading to better services for the travellers. Service alert form is divided in i) Alert description where details of the alert are provided, ii) Time range that specifies that the alert will be displayed within the given time range, iii) Entity selector that indicates exactly which parts of the network this alert affects and iv) Trip Descriptor where the affected trip is specified. Below, the operator can also choose the cause, the effect and the relation between the trip and the static schedule.

The *Promotional messages* (Figure 88: Promotional messages form) on the other hand, are short messages, containing advertisements or announcements that the operators wish to promote to travellers. The operators can also specify the time range and the frequency of the messages' appearance, the group age that these messages respond to and the mode choice. This way, the messages will be forwarded only to specific travellers, improving the user experience of My-TRAC users. This functionality is central for the business model of the Operators' Portal.



When the operators submit the completed fields, the GTFS files are updated/created automatically. Information about updates and future events are propagated to My-TRAC app users and even other operators, that need to stay informed about the services of each PT.

The data provided by the operators through the functionality discussed in this chapter will be fundamental for developing and improving transport models and for building a system that learns from real events which enhance My-TRAC reliability and precision.

What kind of data do you want to upload?

**Trip updates**  
 Realtime update on the progress of a vehicle along a trip

**Service alerts**  
 An alert, indicating some sort of incident in the public transit network

**Promotional messages**  
 A message that must be forwarded to all or some passengers

Figure 85: Upload data page

What kind of data do you want to upload?

☒ **Trip updates**  
 Realtime update on the progress of a vehicle along a trip

☐ **Service alerts**  
 An alert, indicating some sort of incident in the public transit network

☐ **Promotional messages**  
 A message that must be forwarded to all or some passengers

---

**Trip Descriptor**

Trip ID  Route ID  Direction ID  Start time  Start date

**Vehicle Descriptor**

ID  Label  License plate

**Stop Time Update**

Stop sequence  Stop ID

**Event time**

Delay  Time  Uncertainty

Schedule relationship

Figure 86: Trip updates form



What kind of data do you want to upload?

**Trip updates**  
 Realtime update on the progress of a vehicle along a trip

**Service alerts**  
 An alert, indicating some sort of incident in the public transit network

**Promotional messages**  
 A message that must be forwarded to all or some passengers

**Alert description**

URL  Header text  Write your description here. . .

**Time range**

Start  End  Entity selector

**Trip Descriptor**

Trip ID  Route ID  Direction ID  Start time  Start Date

Schedule relationship

Cause

Effect

Figure 87: Service alerts form

What kind of data do you want to upload?

**Trip updates**  
 Realtime update on the progress of a vehicle along a trip

**Service alerts**  
 An alert, indicating some sort of incident in the public transit network

**Promotional messages**  
 A message that must be forwarded to all or some passengers

**Time range**

Start  End

**Frequency**

Frequency

**Target group**

Age range  Mode choice

Figure 88: Promotional messages form

Table 9: Upload data definition

DATA input fields		Definition
Trip updates		
Trip Descriptor	Description of the specific trip (trip ID, route ID, direction ID, start time and start date)	
Vehicle Descriptor	(optional) Description of the vehicle of the specific trip (ID, label, license plate)	
Stop Time Update	Real-time update for arrival and/or departure events for a given stop on a trip (stop sequence, stop ID)	
Event time	Specifications of the time of the event/update (delay, time, uncertainty)	
Schedule relationship	Relation between the trip and the static schedule	
Service alerts		
Alert description	(optional) Description of the alert, along with a link	
Time range	The time range that covers the entire time the alert is useful to appear	
Trip Descriptor	Description of the specific trip (trip ID, route ID, direction ID, start time and start date)	
Entity selector	Parts of the network this alert affects	
Schedule relationship	Relation between the trip and the static schedule	
Cause	The cause of the alert	
Effect	The effect of this alert	
Promotional messages		
Message	Message that needs to be promoted	
Time range	The time range that covers the entire time the message is useful to be seen	
Target group	Specification of age and mode that this message refers to	
Frequency	The frequency of time that this message appears	

## 5.2 MAIN FUNCTIONALITY #2: DOWNLOAD DATA

The following functionality “Download data” is about providing real-time and historic data concerning behavioural analytics of travellers to PT operators, which can be used to assist them with their planning operations and to optimize their services. It is crucial for the improvement of the PT services, to obtain this kind of data. They are usually hard to be obtained since the collection and analysis is an expensive and time-consuming procedure. My-TRAC app clusters travellers according to their behavioural patterns and summarizes information of the most repeated activities and actions, specifying their preferences.

The operators can retrieve real-time and historic data concerning behavioural analytics of travellers and travel patterns (e.g., how many students used the metro, during a day, for the past month). The extracted data will be based on travellers’ behaviour (derived from travellers’ everyday trips and preferences stated in My-TRAC app). The operators can download the data required in a CSV file, for further usage. , i.e., processing and analyzing the raw data in order to create analytics and make conclusions for the improvement of their planning and operations They



have the possibility to download the data they need by choosing route, mode and dates from a calendar. They can also select the aggregation of their data which can be based on sex, day of the week, and occupation (**Figure 89**: Download data page, **Figure 90**: Download data form). The aggregated data will be an additional source of information for the operators, for improving and updating their PT operations. The timetables, routes and general services of operators will be always up to date, offering the best experience for the travellers and users of My-TRAC app, since the operators will have a better overview of travellers' behaviour. The retrieved data can also concern crowdedness allowing the operators to allocate PT capacity more efficiently. It is not feasible for the operators to download directly analytics outcomes. However, after the login, they have access to the analytics provided and presented on the operators' portal home screen (**Figure 91**) regarding car users, the gender, and the date of birth.

What data are you searching for?

**Travellers' choices**

Route choice  Mode choice

**Date-Time choices**

From date\*  To date\*

Timeslot\*

**Aggregated on**

☐ Gender  
☐ Occupation  
☐ Day of the week

[Download CSV file](#)

Figure 89: Download data page

What data are you searching for?

**Travellers' choices**

Route choice  PT

**Date-Time choices**

09/01/2020  09/03/2020

Show data by the hour

**Aggregated on**

☒ Gender  
☒ Occupation  
☐ Day of the week

[Download CSV file](#)

September 2020						
Su	Mo	Tu	We	Th	Fr	Sa
30	31	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	1	2	3
4	5	6	7	8	9	10

Figure 90: Download data form



Figure 91: Operators' portal analytics

Table 10: Download data definition

DATA input fields	Definition
Route choice	(Optional) The specific route of the travellers
Mode choice	(Optional) The specific PT mode of the travellers
Date choice	Date range of the required data
Timeslot	Data presented are divided by 1, 2 or 6 hours
Aggregated on	Aggregation of travellers (can be more than one option)





## CONCLUSIONS

This deliverable presents the evolution of My-TRAC travel companion and its ecosystem. My-TRAC is a novel transport services platform, designed for both private and public transport (PT) users as well as for operators, to provide an improved passenger experience and personalized travel recommendations by developing an ecosystem of models and algorithms for user choice simulation, data, and behavioural analytics, and implement different components such as the social market, the operators' portal, and 3rd parties service to meet the aforementioned objectives. Building on the work presented on D5.3, this report detailed the changes in My-TRAC ecosystem, the updates on its use cases which are reflected on the functionalities that My-TRAC app has to offer to the user. Furthermore, each feature and standalone component is explained in a separate chapter.

The application has been developed and tested in a real environment with real travellers who have given feedback allowing us to significantly improve the application. Also, the usage of My-TRAC by real users with their needs, has allowed us to calibrate the models in a real environment making scheduling of technical developments and orchestration of components integration a challenge.

My-TRAC pilots were conducted in two phases (please see more information on the pilots results in D6.2). At the first phase the system had the basic functionalities. At the second phase of My-TRAC pilots the application had many additions and all the My-TRAC models integrated and deployed. However, this pilot phase was challenging as it was conducted during COVID-19 pandemics but with careful planning and conduction of a series of virtual experiments we managed to get sufficient feedback to improve My-TRAC's technologies. To that end, both back end and front end of the application have suffered a lot of changes (i.e., resolution of bugs, issues etc.) to meet the objectives of the project and the travellers. The latest update of My-TRAC application can be found at [Google Play Store](#). My-TRAC app has several functionalities such as registration, trip creation activities recommendation etc. and its functionalities makes it stand out of the existing travel companions. My-TRAC gives personalized recommendations by using its models that are running in the backend (i.e., mode, time of departure, route, activity, and recommendation) to its users and that is what makes it unique. Furthermore, it supports mechanism that provide to the system scalability and resilience by orchestrating different components such as routing engines or Pools libraries. Moreover, My-TRAC allows the users to connect with each other and gain points by the usage of My-TRAC app. These points can be used to in shopping and ticketing with the assistance of the Social Market that utilizes Blockchain technology to facilitate secure payments. Additionally, My-TRAC established a collaboration with Co-APS project to get information on crowdedness as My-TRAC consortium was keen to offer this information to its user to adopt with the situation of COVID-19 and facilitate him to take informed decisions.

Furthermore, we have extracted some conclusions and lessons learned concerning the combination of different expertise, the way of integrating new components and features as well as to receive comments and feedback to align the requests of My-TRAC's modelers and of My-TRAC's users/travellers.

- a. Drafting and revising of use cases is a power tool to combine the views of a multidisciplinary team. As it allows to communicate the way the modelers envision the interaction of travellers with the system and the way that the developers can integrate the models in the system. However, during the actual implementation of these use cases, changes might occur leading us to the next conclusion.
- b. There are always alterations from the envisioned features and the implemented features as different kind of barriers must be overpassed and or needs must be served. For example, not all partners were able to use KAFKA, so a hybrid system with KAFKA and microservices was developed. Another example is that to secure the performance and stability of the app we had to integrate two route engines.
- c. Integration of components and features is not always a straightforward process and needs a lot of revisions to reach a good final result and therefore might take longer than initially expected. My-TRAC had different



- iterations between v2.5.1 that was presented at the 1<sup>st</sup> phase of the pilots and v5.2 that was presented in 2<sup>nd</sup> phase of the pilots.
- d. The orchestration of different components is served well by the architecture of My-TRAC as it allows standalone components to be connected.
  - e. Complying with GDPR is crucial and it is always an additional effort at the integration process of different components (e.g., social market).
  - f. My-TRAC personalization models are data intensive and interconnected making the UI/UX a crucial aspect of the app.
  - g. Testing is incredibly important to ensure performance, scalability, reliability, and stability. Therefore, receiving structured feedback by provision of screens shoots and videos is useful for encountering bugs and perform changes for improving the application.
  - h. The functionalities of the app need to be extended or adjusted in different situations e.g., COVID -19 situation, to serve the needs of the users hence, the adaptability and scalability of My-TRAC platform can serve at a great extent these purposes.
  - i. Having a powerful analytics tool with a user-friendly interface assisted us a lot to monitor the different aspects of My-TRAC ecosystem as well as to generate real time statistics for My-TRAC's usage.

We must not forget that My-TRAC has also an interface for the operators that provides them the opportunity to get statistics and insights of the travellers and to upload data and create real time GTFS. Transport operators are a key stakeholder at My-TRAC ecosystem and need to be involved especially for sharing information about disruptions.

Nevertheless, My-TRAC ecosystem is an ecosystem that can be evolved and the roadmap for the app improvements and its extension is detailed in D6.3 combined with the results of the post analysis of the pilots' information.



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## ANNEX 1 MY-TRAC TRAVELLER'S USE CASES-UPDATED

The **use cases** produced contain the description of a set of interactions between My-TRAC components (**Figure 3**) and users (travellers and operators). A use case is a methodology used in system analysis to identify, clarify, and organize system requirements. Although, in D5.1 provides a detailed description of My-TRAC Use Cases, it has been necessary, as it was expected, to review and update them based on the methodology explained in D5.1. This is nothing extraordinary, as all major projects require a periodic revision and revisions to guarantee the best approach. Reviewed and updated use cases are the following:

**Table 11: List of use cases for the travel companion of My-TRAC**

TRAVELLER
#T1: Traveller's registration ( <b>Table 12</b> )
#T2: Trip creation ( <b>Table 13</b> )
#T3: Detection of changes and disruptions on a route during a trip ( <b>Table 14</b> )
#T4: Activities' proposition ( <b>Table 15</b> )
#T4.1: Activities' proposition in groups ( <b>Table 16</b> )
#T5: Navigation ( <b>Table 17</b> )
#T6: Using My-TRAC app in a country other than home-country ( <b>Table 18</b> )
#T7: Communication with MaaS and 3rd party services ( <b>Table 19</b> )
#T8: Traveller's feedback and recommendations (My-TRAC rating system) ( <b>Table 20</b> )
#T9.1: Group creation ( <b>Table 21</b> )
#T9.2: Group modification: Adding a new member ( <b>Table 22</b> , <b>Table 23</b> )
#T9.3: Group itinerary creation ( <b>Table 24</b> )
#T9.4: Group deletion ( <b>Table 25</b> )
#T10: Erase traveller's profile ( <b>Table 26</b> )
#T11: Request personal data ( <b>Table 27</b> )
#T12: 1UI/UX personalization ( <b>Table 28</b> )
#T13: Points and rewards system ( <b>Table 29</b> )
#T14: Booking and ticketing ( <b>Table 30</b> )
#T15: Occupancy prediction ( <b>Table 31</b> )

Table 12: Traveller's registration

<b>Use Case ID:</b>	#T1		
<b>Use Case Title:</b>	Traveller's Registration		
<b>Created By:</b>	Eleni Antoniou	<b>Last Revision By:</b>	Ismini Stroumpou
<b>Date Created:</b>	21/2/2018	<b>Last Revision Date:</b>	21/09/2020
<b>Actors:</b>	Traveller		
<b>Description:</b>	The traveller decides to register to the My-TRAC app and to Social Market. Consequently, My-TRAC app creates an account, and the system creates his/her profile. A user profile has personal information provided by the user as well as parameters which are used as input for the models of mode, time of departure, route, activities and UI/UX personalization model.		
<b>Trigger:</b>	The traveller downloaded the My-TRAC app and opened the app for the first time where he/she encountered the sign-up screen.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller must have the application installed on his/her mobile phone.</li> <li>2. Network connection must be active (Wi-Fi, 3G, 4G, 5G).</li> </ol>		
<b>Postconditions:</b>	The app must ensure traveller's data privacy		



<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller opens the app for the first time and a sign up/log in screen appears.</li> <li>2. The app asks the traveller to subscribe using an email.</li> <li>3. The traveller signs up with his/her email.</li> <li>4. The app requests information (e.g., First name, last name, username, email and password, age, gender, occupancy).</li> <li>5. The traveller fills in all the required information, so he/she can have a complete account.</li> <li>6. The app displays the “terms and conditions” screen.</li> <li>7. The traveller has to read and scroll the terms and conditions (acceptance button is activated after some seconds).</li> <li>8. The traveller accepts the terms and conditions and proceeds on using the app. These terms and conditions comply with the GDPR and also registers to the My-TRAC social market.</li> <li>9. The app requires email verification.</li> <li>10. The traveller receives an email to verify his/her registered address.</li> <li>11. After the verification, the traveller logs in (persistent log in).</li> <li>12. The app creates a profile based on traveller’s information (e.g., username, date of birth, mail).</li> <li>13. The traveller allows the connection with the preferred networks (not persistent).</li> <li>14. The app creates traveller’s profile.</li> <li>15. The traveller is ready to start his/her trip.</li> </ol>
<b>Alternative Flows:</b>	<p>Alternative Flow</p> <ol style="list-style-type: none"> <li>1. The traveller cannot register and needs to contact support (e.g., the traveller didn't get the confirmation email).</li> <li>2. Traveller uses the online form for contacting online support.</li> <li>3. Online support categorizes the problem and assists the traveller to solve it.</li> <li>4. Traveller tries again to register successfully.</li> </ol>
<b>Exceptions:</b>	<p>Exception 1</p> <ol style="list-style-type: none"> <li>1. The traveller inserts existing email.</li> <li>2. The app asks to insert email again.</li> </ol> <p>Exception 2</p> <ol style="list-style-type: none"> <li>1. The traveller inserts wrong email.</li> <li>2. The app asks to insert email again.</li> </ol> <p>Exception 3</p> <ol style="list-style-type: none"> <li>1. The traveller inserts wrong verification code.</li> <li>2. The traveller requests the verification code again.</li> </ol>





<b>Frequency of Use:</b>	Low (only once).
<b>Special Requirements:</b>	The traveller has a valid email address
<b>Notes and Issues:</b>	<p>The traveller, after the registration, will remain logged in constantly.</p> <p>The traveller needs to erase his/her account to make a new account with the same email.</p> <p>The traveller cannot have more than one account in the same device.</p> <p>The traveller can sign in directly to the Social Market if he/she knows his/her credentials.</p>



Table 13: Trip creation

<b>Use Case ID:</b>	#T2		
<b>Use Case Title:</b>	Trip creation		
<b>Created By:</b>	Eleni Antoniou	<b>Last Revision By:</b>	Ismini Stroumpou
<b>Date Created:</b>	15/3/2018	<b>Last Revision Date:</b>	13/8/2020
<b>Actors:</b>	Traveller		
<b>Description:</b>	The traveller wants to travel from point A to point B. The traveller opens My-TRAC app to determine best mode, route and time of departure considering latest updated time schedules, traffic, delays etc using the OTP routing options and/or trip planner of Shift2Rail CFM options or considering his/her travellers' profile parameters by using the personalized button. The traveller inserts information regarding the starting point and the destination of the trip, and the app shows all the alternatives for reaching it, so that the traveller chooses which one he/she prefers.		
<b>Trigger:</b>	The traveller enters the start point and the destination before the trip or opens the app during the trip.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller has the My-TRAC app already installed.</li> <li>2. The traveller has registered and logged in My-TRAC app.</li> <li>3. Internet connection must be active when creating the trip.</li> <li>4. GPS connection is available.</li> </ol>		
<b>Postconditions</b>	-		



<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller opens My-TRAC app.</li> <li>2. The traveller specifies 'from' and 'to' locations (origin and destination) with the three following alternative ways: a. type the address; b. choose from the map c. choose from history if it is not the first time using the app.</li> <li>3. The traveller inserts trip characteristics (obligatory: day, route preferences etc./optional: time of departure-arrival, mode etc.).</li> <li>4. The app presents available choices of modes and routes (retrieved from the route engine).</li> <li>5. The traveller chooses a route to get more information about: <ol style="list-style-type: none"> <li>a. The estimated time of arrival in each intermediate station (if any) and at destination.</li> <li>b. The potential activities that can be performed along the route.</li> <li>c. The potential mode based on his/her travel profile.</li> <li>d. The potential time of departure based on his/her travel profile.</li> <li>e. The potential activities at the destination based on his/her profile.</li> <li>f. The potential routes if he/she chooses public transport based on his/her profile.</li> <li>g. If the traveller confirms the route, continue.</li> </ol> </li> <li>6. The traveller starts the trip. The app tracks the traveller during his trip until he/she reaches his/her destination, reacting to several circumstances including: <ol style="list-style-type: none"> <li>a. The traveller arrives at an intermediate transfer location and the app notifies the next steps to continue his/her trip.</li> <li>b. The app proposes activities to perform at a given trip step.</li> <li>c. The app proposes activities to perform at the destination based on the profile of the user.</li> </ol> </li> </ol>
<b>Alternative Flows:</b>	Itinerary is proposed by a group member
<b>Exceptions</b>	The traveller does not allow connecting with the GPS, so the My-TRAC app is not able to locate the traveller and assist his/her trip. The app notifies the traveller about this issue.
<b>Frequency of Use:</b>	High (approximately every time the traveller uses the app).
<b>Special Requirements:</b>	<p>Connection to 3<sup>rd</sup> party services</p> <ol style="list-style-type: none"> <li>1. My-TRAC app contacts a 3<sup>rd</sup> party service responsible for route finding. Several alternative routes are found.</li> <li>2. My-TRAC is connected to the OTP and the CFMs routing functionalities utilizing TRIAS.</li> <li>3. My-TRAC uses the fastest service option</li> </ol>

**Notes and Issues:**

- The traveller can abort the process of creating a trip at any point between 2 and 4 (inclusive).
- The traveller can remove a created route at any given time and stop tracking for that route.



Table 14: Detection of changes and disruptions on a route during a trip

<b>Use Case ID:</b>	#T3		
<b>Use Case Title:</b>	Detection of changes and disruptions on a route during a trip		
<b>Created By:</b>	Viktoriya Degeler	<b>Last Revision By:</b>	Eleni Antoniou
<b>Date Created:</b>	06/04/18	<b>Last Revision Date:</b>	24/05/18
<b>Actors:</b>	Traveller		
<b>Description:</b>	Before and during the trip, the external situation (the situation beyond the control of the user or the My-TRAC app) needs to be monitored and changes that can affect the scheduled trip need to be detected and acted upon.		
<b>Trigger</b>	Change in the external situation that significantly affects the traveller's current route.		
<b>Preconditions:</b>	A route is chosen by the traveller and an itinerary is saved. There is a change in external situation such as maintenance or construction works that affects the ability of the traveller to complete the trip as planned.		
<b>Postconditions:</b>			
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller has chosen a route for a trip request (See #T2)</li> <li>2. Before the trip starts and while the trip is ongoing. Changes are being evaluated for a potential disruption that might affect the traveller's itinerary.</li> <li>3. The app notifies to the user before his/her trip initiation or during the trip if the app identifies that the user is close to this location about the disruption, so the user can decide about a new trip or continuing with the current one.</li> </ol>		
<b>Alternative Flows:</b>	Something unexpected happens real time and the app does not inform about it yet.		
<b>Exceptions:</b>	No GPS available or internet connection		
<b>Frequency of Use:</b>	Trip tracking – High (every trip). Trip changes mid-trip – Low.		
<b>Special Requirements:</b>	Connection to 3 <sup>rd</sup> parties which provide: Disruptions that occur in some of the areas that My-TRAC works. Matching the disruption with ongoing or planning trips which are affected. The user needs to have stored the itinerary		



Notes and Issues:	-
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Table 15: Activities proposition

<b>Use Case ID:</b>	#T4		
<b>Use Case Title:</b>	Activities' proposition		
<b>Created By:</b>	Eleni Antoniou	<b>Last Revision By:</b>	Jordi Urmenta
<b>Date Created:</b>	19/3/2018	<b>Last Revision Date:</b>	13/01/2021
<b>Actors:</b>	Traveller		
<b>Description:</b>	Traveller needs to reach a specific destination and the app proposes activities during the route and at the destination. The activities proposed are the points of interest (POI) available in a certain range close to the traveller. Activities are retrieved from either database or 3rd party WebServices.		
<b>Trigger:</b>	The traveller opens the My-TRAC app, to be informed about activities during his/her trip or at destination.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller is already registered and logged in My-TRAC app.</li> <li>2. The traveller has created a route.</li> </ol>		
<b>Postconditions:</b>	-		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. During a trip, My-TRAC app presents the traveller with possible activities to be performed either on trip's origin, destination or at a specific stop.</li> <li>2. The app proposes a list of activities to perform at the given location. The activities proposed are personalized based on traveller's preferences, the coordinates on which the traveller requests to receive proposal and the time of the day the traveller chooses to receive proposals. <ol style="list-style-type: none"> <li>a. The traveller decides not to do any activity and finishes. Otherwise, go to 3</li> </ol> </li> <li>3. The traveller decides to see an activity's details (image, multilanguage description, location, website, wheelchair accessibility, etc.). <ol style="list-style-type: none"> <li>a. The traveller can also check the details of route navigation to a concrete activity.</li> </ol> </li> <li>4. The traveller can see with the arrow up right if the location is at his/her left or right side of the road.</li> <li>5. After performing the activity, the traveller can rate it.</li> </ol>		



<b>Alternative Flows:</b>	<p>Alternative Flow 1</p> <ol style="list-style-type: none"> <li>1. The traveller asks about possible activities at a location of interest (current location, future station, destination, etc.).</li> <li>2. Continue from point 2 of normal flow.</li> </ol>
<b>Exceptions:</b>	-
<b>Frequency of Use:</b>	High
<b>Special Requirements:</b>	The traveller has completed Use case #T1 and #T2
<b>Notes and Issues:</b>	Not all the Pols contain the same amount of information



Table 16: Activities' proposition in groups

<b>Use Case ID:</b>	#T4.1		
<b>Use Case Title:</b>	Activities' proposition in groups		
<b>Created By:</b>	Maria Tsourma	<b>Last Revision By:</b>	Ismini Stroumpou
<b>Date Created:</b>	24/8/2020	<b>Last Revision Date:</b>	26/8/2020
<b>Actors:</b>	Traveller, member in a group of travellers		
<b>Description:</b>	A group of travellers needs to reach a specific destination and create a group trip. The app proposes activities for all users included in a group, during the trip, on several stops selected, and at the trip's destination. The activities proposed refer to the places of interest (Pols) that the travellers could visit and are in a certain range close to them. The preferences of all travellers are taken into consideration for the proposal of activities. The list of activities proposed refers to all the travellers included in the group.		
<b>Trigger:</b>	One traveller opens the My-TRAC app and wants to be informed about activities during his/her trip or at destination for a created group trip.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller is already registered and logged in My-TRAC app.</li> <li>2. The traveller has created a route.</li> <li>3. The traveller has created a group of users.</li> <li>4. A group has been selected and attached to the created route.</li> </ol>		
<b>Postconditions:</b>	-		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. During a trip, My-TRAC app present the traveller with possible activities to be performed at trip's locations.</li> <li>2. The app proposes a list of activities to perform at the given location, by taking into consideration the preferences of all travellers included in the selected group, the coordinates on which the traveller requests to receive recommendations and the time of the day the traveller chooses to receive proposals. <ol style="list-style-type: none"> <li>a. The user decides not to do any activity and finishes. Otherwise, go to 3.</li> </ol> </li> <li>3. One of the group's travellers selects to see an activity's details (Pols have more information e.g., description, location, etc.).</li> <li>4. One of the group's travellers can see with the arrow up right if the location is at his/her left or right side of the road.</li> <li>5. After performing traveller user can rate it.</li> </ol>		



<b>Alternative Flows:</b>	<p>Alternative Flow 1</p> <ol style="list-style-type: none"> <li>One of the group's travellers asks about possible activities at a location of interest (current location, future station, destination, etc.).</li> <li>Continue from point 2 of normal flow.</li> </ol> <p>Alternative Flow 2</p> <ol style="list-style-type: none"> <li>The traveller does not have internet connection.</li> <li>The traveller can plan his/her trip before the departure.</li> <li>The traveller saves the itinerary in "My trips" section.</li> <li>The traveller selects the saved itinerary and asks about possible activities at a location of interest (current location, future station, destination, etc.).</li> <li>Continue from point 2 of normal flow.</li> <li>The traveller completes the trip.</li> </ol>
<b>Exceptions:</b>	-
<b>Frequency of Use:</b>	High
<b>Special Requirements:</b>	The traveller has completed Use case #T1 and #T2
<b>Notes and Issues:</b>	-



Table 17: Navigation

<b>Use Case ID:</b>	#T5		
<b>Use Case Title:</b>	Navigation		
<b>Created By:</b>	Arnau Prat-Pérez	<b>Last Revision By:</b>	Ismini Stroumpou
<b>Date Created:</b>	09/04/2018	<b>Last Revision Date:</b>	22/01/2020
<b>Actors:</b>	Traveller		
<b>Description:</b>	The traveller has selected a route for a trip, which is ongoing. My-TRAC is using the Google navigation service.		
<b>Trigger:</b>	The traveller opens the My-TRAC app to get assisted on his/her trip.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller has the My-TRAC app already installed.</li> <li>2. The traveller has registered in My-TRAC app.</li> <li>3. Internet connection must be active when creating the trip.</li> <li>4. GPS connection is available.</li> </ol>		
<b>Postconditions:</b>	-		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller opens the app and presses “Start a trip”.</li> <li>2. The app asks for permission to enable GPS location.</li> <li>3. The traveller allows the connection.</li> <li>4. The app shows: <ol style="list-style-type: none"> <li>a. a map with the trip’s route on top of it</li> <li>b. the current position of the traveller</li> <li>c. the steps of the route, highlighting the next step to be taken by the traveller (e.g., pick a Train, go a station, etc.)</li> </ol> </li> <li>5. The traveller can tap any location of the route in search for Activities (#T4, or #T4.1) and/or Services (#T9) in that location.</li> <li>6. The traveller sees a list of activities and enters in the detail of one.</li> <li>7. The traveller presses the navigation button.</li> <li>8. Google Navigation app is launched from current location to activity’s location.</li> </ol>		
<b>Alternative Flows:</b>	Alternative Flow 1 <ol style="list-style-type: none"> <li>1. The traveller opens the app while performing a trip.</li> <li>2. The flow continues from point 2 of Normal Flow.</li> </ol>		



<b>Exceptions:</b>	The traveller does not allow the connection with GPS. If the traveller does not have GPS enabled, the app might guess where the traveller is based on the time and the schedules of his/her trip. Also, Wi-Fi can be used to locate the traveller.
<b>Frequency of Use:</b>	Moderate/High
<b>Special Requirements:</b>	-
<b>Notes and Issues:</b>	-

Table 18: Using My-TRAC app in a country other than home-country

<b>Use Case ID:</b>	#T6		
<b>Use Case Title:</b>	Using My-TRAC app in a country other than home-country (by home country we mean the country that the user normally uses the app)		
<b>Created By:</b>	Alexandros E. Papacharalampous	<b>Last Revision By:</b>	Ismini Stroumpou
<b>Date Created:</b>	22/05/2018	<b>Last Revision Date:</b>	13/08/2020
<b>Actors:</b>	Traveller		
<b>Description:</b>	The traveller is going abroad and wants to use My-TRAC app.		
<b>Trigger:</b>	The traveller opens the My-TRAC app while on another country and wants to execute an action (e.g., plan a trip) or My-TRAC's app passive tracking detected that the user is abroad.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller has created a trip (#T2.1) or an Itinerary (#T6).</li> <li>2. The My-TRAC app operates in the country that the traveller is currently located at.</li> <li>3. GPS geolocation and mobile data/Wi-Fi are activated.</li> </ol>		
<b>Postconditions:</b>	-		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. Traveller is travelling abroad and opens My-TRAC app.</li> <li>2. The app detects that the traveller is at a country other than the home-country.</li> <li>3. Traveller wants to plan a trip.</li> <li>4. My-TRAC app and traveller interaction resume as in #T2.1.</li> <li>5. My-TRAC app associates activities of traveller (determined at home location) with choices at current location.</li> <li>6. After association of activities, My-TRAC app proposes activities to the traveller.</li> <li>7. The traveller selects an activity resulting in a change of trip chain.</li> <li>8. My-TRAC app calculates the rest of the trip given the new conditions.</li> <li>9. Traveller decides to take public transport.</li> <li>10. My-TRAC app enables real-time station identification to warn the traveller to alight.</li> </ol>		
<b>Alternative Flows:</b>	<p><b>Alternative flow 1</b></p> <ol style="list-style-type: none"> <li>1. My-TRAC app and traveller interaction resume as in #T2.1</li> </ol> <p><b>Alternative flow 1</b></p> <ol style="list-style-type: none"> <li>1. A trip is suggested by a group</li> </ol>		





<b>Exceptions:</b>	-
<b>Frequency of Use:</b>	Low (depends on traveller)
<b>Special Requirements:</b>	-
<b>Notes and Issues:</b>	<p>Traveller downloads the My-TRAC app while being abroad. My-TRAC can be downloaded in Greece, Spain, Portugal, the Netherlands, Belgium, and Sweden.</p> <p>My-TRAC personalization models work for My-TRAC pilot areas meaning Athens, Barcelona metropolitan area, Lisbon, and the Netherlands.</p>



Table 19: Communication with MaaS and 3rd party services

<b>Use Case ID:</b>	#T7		
<b>Use Case Title:</b>	Communication with MaaS and 3 <sup>rd</sup> party services		
<b>Created By:</b>	Viktoriya Degeler	<b>Last Revision By:</b>	Jordi Urmeneta
<b>Date Created:</b>	23/03/18	<b>Last Revision Date:</b>	22/12/20
<b>Actors:</b>	Traveller		
<b>Description:</b>	The traveller needs to find an available itinerary from origin A to destination B, possibly with restrictions (see #T2.1). My-TRAC app finds possible alternatives and contacts all service providers to verify that the alternatives are available.		
<b>Trigger</b>	The traveller started the process of creating a new trip		
<b>Preconditions:</b>	Same as (#T2)		
<b>Postconditions:</b>	<ol style="list-style-type: none"> <li>1. Route alternatives are found.</li> <li>2. Current conditions of each alternative are assessed.</li> </ol>		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller starts trip planning by entering origin/destination and trip characteristics or restrictions (time, mode preference, etc.)</li> <li>2. A list of 3<sup>rd</sup> party services are available in route details under Booking tab.</li> </ol>		
<b>Alternative Flows:</b>	Alternative Flow 1 <ol style="list-style-type: none"> <li>1. MaaS requests that the traveller is redirected to a website to perform the booking.</li> <li>2. My-TRAC app notifies the traveller about it.</li> <li>3. My-TRAC monitors the trip passively showing options along the path</li> </ol>		
<b>Exceptions:</b>	MaaS not available No 3 <sup>rd</sup> party services for a specific case		
<b>Frequency of Use:</b>	Medium		
<b>Special Requirements:</b>	-		
<b>Notes and Issues:</b>	-		

Table 20: Traveller's feedback and recommendations (My-TRAC rating system)

<b>Use Case ID:</b>	#T8		
<b>Use Case Title:</b>	Traveller's feedback and recommendations (My-TRAC rating system)		
<b>Created By:</b>	Eleni Chalkia	<b>Last Updated By:</b>	Joan Guisado-Gómez
<b>Date Created:</b>	22/3/2018	<b>Last Revision Date:</b>	09/04/2018
<b>Actors:</b>	Traveller		
<b>Description:</b>	<p>The traveller is asked by My-TRAC mobile application to provide feedback, using the feedback and recommendations module (of the mobile application). The traveller is asked to provide feedback about My-TRAC app or a questionnaire that it is requested at the time. The traveller is also asked to provide feedback with a pop-up message to rate the activity recommendation and prediction module. The latter is automatic, and both are non-mandatory for the user.</p>		
<b>Trigger</b>	After the user has visit the tab of activities recommendations, My-TRAC mobile application asks for feedback by means of a pop-up notification.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller must have the application installed in his/her mobile phone.</li> <li>2. Network connection must be active.</li> <li>3. The traveller has visited the activity recommendation tab</li> <li>4. The traveller wants to provide feedback</li> </ol>		
<b>Postconditions:</b>	The traveller's feedback is collected from the system and it is used to enhance the user experience, by learning and enriching the traveller's profile. Also, the traveller's recommendations are used, in order to upgrade the system components and HMI.		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller has seen the recommended activities</li> <li>2. The system asks the traveller to rate the My-TRAC application, by a pop-up window.</li> <li>3. The traveller accepts to rate My-TRAC application by clicking "Open".</li> <li>4. The system asks the traveller a set of questions related to the activity prediction and recommendation. The user opens it if he wants.</li> <li>5. The traveller provides answers to every question.</li> <li>6. The application receives the information and stores it.</li> </ol>		



<b>Alternative Flows:</b>	The traveller goes to his/her profile and clicks on the tab of feedback
<b>Exceptions:</b>	
<b>Frequency of Use:</b>	Every time that the user exits the activities recommendation list
<b>Special Requirements:</b>	-
<b>Notes and Issues:</b>	-

Table 21: Group creation

<b>Use Case ID:</b>	#T9.1		
<b>Use Case Title:</b>	Group creation		
<b>Created By:</b>	Joan Guisado-Gámez	<b>Last Updated By:</b>	Ismini Stroumpou
<b>Date Created:</b>	22/3/2018	<b>Last Revision Date:</b>	13/8/2020
<b>Actors:</b>	Traveller		
<b>Description:</b>	A traveller wants to create a group with other users of My-TRAC and wants to perform one or more trips with them.		
<b>Trigger</b>	The traveller creates a new group.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller has the My-TRAC app already installed.</li> <li>2. The traveller has registered in My-TRAC app.</li> <li>3. Internet connection must be active.</li> <li>4. Every member of the group has previously registered in My-TRAC app and has a profile.</li> <li>5. Every traveller of the group has completed Use case #T1.</li> </ol>		
<b>Postconditions:</b>	<ul style="list-style-type: none"> <li>• A group is created by one user and all the travellers invited to the group are informed and accepted the invitation.</li> <li>• After the creation of the group trip, the profiles of the group members are analysed in order to match their preferences thus, allowing the My-TRAC app to recommend trip modes and activities for the group's upcoming activities that meet all member's preferences. From this moment on, the group is handled by My-TRAC as a single traveller, so it follows the logic of #T2.</li> </ul>		



<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller goes to the Group section of My-TRAC.</li> <li>2. The traveller selects to create a new group and types the name of the group. The admin has the option to add a picture to the group.</li> <li>3. The traveller starts typing his/her traveller partner's username/email in the "Add a new member" text box.</li> <li>4. As the traveller types, the system shows a drop-down list with the first 3 letters of usernames of the travellers registered in My-TRAC.</li> <li>5. The traveller selects a traveller partner.</li> <li>6. The text box is filled with the selected traveller.</li> <li>7. The system informs the members about the invitation of the admin, with a notification on their screen.</li> <li>8. The selected travellers accept the invitation, and the group is created</li> <li>7. The original traveller who started the action becomes the admin of the group. This is shown in the traveller's profile. He/she is responsible for accepting or rejecting any modification of a group.</li> </ol>
<b>Alternative Flows:</b>	<ol style="list-style-type: none"> <li>1. Traveller declines the invitation.</li> <li>2. The app informs the admin about the rejection of the selected traveller and asks him/her if he/she wants to add another one.</li> <li>3. The admin adds a new one, which accepts the invitation.</li> <li>4. The rest of the travellers accept, and the group is created.</li> </ol>
<b>Exceptions:</b>	- 1. The system does not find any traveller with the given username. The system informs that the introduced username does not exist, with a notification and proposes to search again.
<b>Frequency of Use:</b>	Low/Moderate (under user demand)
<b>Special Requirements:</b>	-
<b>Notes and Issues:</b>	The invitation remains active until the user accepts or declines to join a group. User can be invited only by their My-TRAC username.



Table 22: Group modification Adding a new member

<b>Use Case ID:</b>	#T9.2		
<b>Use Case Title:</b>	Group modification: Adding a new member		
<b>Created By:</b>	Joan Guisado-Gómez	<b>Last Updated By:</b>	Ismini Stroumpou
<b>Date Created:</b>	9/4/2018	<b>Last Revision Date:</b>	21/11/2020
<b>Actors:</b>	Traveller		
<b>Description:</b>	A group member wants to modify the current configuration by adding a new member.		
<b>Trigger</b>	The traveller creates a new group and/ or a group member invites a new member to join an existing group.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller has the My-TRAC app already installed.</li> <li>2. The traveller has registered in My-TRAC app.</li> <li>3. Internet connection must be active.</li> </ol>		
<b>Postconditions:</b>	The group is modified.		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller goes to the Group section of My-TRAC.</li> <li>2. The traveller selects “My Groups”.</li> <li>3. The traveller selects one of the groups where he/she participates.</li> <li>4. The traveller selects the “Add a new member”</li> <li>5. The traveller starts typing his/her traveller partner’s username/email or other identification in a text box.</li> <li>6. As the traveller types, the system recommends usernames in a drop-down list.</li> <li>7. The traveller selects a traveller partner from the recommendations.</li> <li>8. The text box is filled with the selected traveller.</li> <li>9. Go to Step 4 until all members of the group have been added.</li> <li>10. The traveller presses the “Modify Group” button.</li> <li>11. The admin of the group accepts the modification.</li> <li>12. The system informs the new members that are now part of the group.</li> </ol>		
<b>Alternative Flows:</b>	Another member of the group enters or leave the group so the group is automatically modified		
<b>Exceptions:</b>	-		





<b>Frequency of Use:</b>	Low/Moderate (under user demand)
<b>Special Requirements:</b>	Every traveller of the group has completed use case #T1.
<b>Notes and Issues:</b>	-



Table 23: Group modification: Remove a member

<b>Use Case ID:</b>	#T9.3		
<b>Use Case Title:</b>	Group modification: Remove a member		
<b>Created By:</b>	Joan Guisado-Gámez	<b>Last Updated By:</b>	Ismini Stroumpou
<b>Date Created:</b>	9/4/2018	<b>Last Revision Date:</b>	13/08/2020
<b>Actors:</b>	Traveller		
<b>Description:</b>	The admin of a group or a member wants to leave the group		
<b>Trigger</b>	A member of the group (or admin) wants to leave		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller has the My-TRAC app already installed.</li> <li>2. The traveller has registered in My-TRAC app.</li> <li>3. Mobile internet connection must be active.</li> <li>4. The traveller is the admin of an existing group.</li> <li>5. Every traveller of the group has completed use case #T1 and use case #T8.1.</li> </ol>		
<b>Postconditions:</b>	The group is modified.		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller goes to the Group section of My-TRAC.</li> <li>2. The traveller selects “My Groups”.</li> <li>3. The traveller selects one of the groups from which he/she is the admin.</li> <li>4. The traveller selects the “Remove a group member” option.</li> <li>5. The admin traveller selects which travellers he/she wants to remove within the group.</li> <li>6. The admin traveller presses “Confirm modification”.</li> <li>7. The system informs the members of the group that a member has been removed with a notification.</li> </ol>		



<b>Alternative Flows:</b>	<p>Alternative Flow 1</p> <ol style="list-style-type: none"> <li>1. A traveller, which is not the admin of the group wants to be removed from a group trip.</li> <li>2. The traveller selects the group trip that he/she wants to be deleted from.</li> <li>3. The traveller selects “Leave the group” option”.</li> <li>4. The application asks to confirm this decision.</li> <li>5. The traveller confirms and he/she is deleted successfully.</li> <li>6. The admin receives a message that the traveller has been removed.</li> </ol> <p>Alternative Flow 2</p> <ol style="list-style-type: none"> <li>1. The admin of the group wants to be removed from the group trip.</li> <li>2. He/she informs the system by pressing the “Leave the group” option”.</li> <li>3. The system sets as admin the first person that was added to the group or the admin suggests which one to be the next admin.</li> <li>4. A notification appears on the screen of the chosen group member.</li> <li>5. The group member accepts or declines the suggestion.</li> </ol>
<b>Exceptions:</b>	-
<b>Frequency of Use:</b>	Low/Moderate (under user demand)
<b>Special Requirements:</b>	-
<b>Notes and Issues:</b>	-



Table 24: Group itinerary creation

<b>Use Case ID:</b>	#T9.4		
<b>Use Case Title:</b>	Group itinerary creation		
<b>Created By:</b>	Ismini Stroumpou	<b>Last Updated By:</b>	Jordi Urmeneta
<b>Date Created:</b>	13/08/2020	<b>Last Revision Date:</b>	1/11/2020
<b>Actors:</b>	Traveller		
<b>Description:</b>	The admin or group member wants to create and share an itinerary with group A		
<b>Trigger</b>	The traveller wants to travel with group A.		
<b>Preconditions:</b>	1. A group has been created		
<b>Postconditions:</b>	All group members have the suggested itinerary at their homepage. Create a route without having the GPS.		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The group owner or a group member selects a route from A to B.</li> <li>2. The user indicates the group that he/she wants to share the itinerary by pressing select group and save the name of the group.</li> <li>3. In the itineraries detail, the user presses set current and the save arrow button in order to share the itinerary.</li> <li>4. My-TRAC system sends a notification to the group members.</li> <li>5. The planned Itinerary is presented in all group members homepage with an indication of which group the itinerary was suggested/created (e.g., co-workers, family weekend)</li> </ol>		
<b>Alternative Flows:</b>			
<b>Exceptions:</b>	-		
<b>Frequency of Use:</b>	Low/Moderate (under user demand)		
<b>Special Requirements:</b>	-		
<b>Notes and Issues:</b>	-		

Table 25: Group deletion

<b>Use Case ID:</b>	#T9.5		
<b>Use Case Title:</b>	Group deletion		
<b>Created By:</b>	Eleni Antoniou	<b>Last Updated By:</b>	Ismini Stroumpou
<b>Date Created:</b>	24/5/2018	<b>Last Revision Date:</b>	25/05/2018
<b>Actors:</b>	Traveller		
<b>Description:</b>	The admin of a group wants to delete completely an entire group.		
<b>Trigger</b>	The traveller creates a new group.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller has the My-TRAC app already installed.</li> <li>2. The traveller has registered in My-TRAC app.</li> <li>3. Mobile internet connection must be active.</li> <li>4. The traveller is the admin of the group.</li> </ol>		
<b>Postconditions:</b>	-		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller goes to the Group section of My-TRAC.</li> <li>2. The traveller selects “My Groups”.</li> <li>3. The traveller selects one of the groups from which he/she is the admin.</li> <li>4. The traveller selects the “Delete group” option.</li> <li>5. My-TRAC app asks for confirmation.</li> <li>6. The admin traveller presses “deletion”.</li> <li>7. The system informs the members of the group that the group no longer exists, with a notification on their screen.</li> </ol>		
<b>Alternative Flows:</b>	-		
<b>Exceptions:</b>	-		
<b>Frequency of Use:</b>	Low/Moderate (under user demand)		
<b>Special Requirements:</b>	If a group member, which is not the admin, tries to delete the whole group, the app informs him/her, that he/she is not authorized to complete this action.		
<b>Notes and Issues:</b>	-		

Table 26: Erase traveller's profile

<b>Use Case ID:</b>	#T10		
<b>Use Case Title:</b>	Erase traveller's profile		
<b>Created By:</b>	Joan Guisado-Gámez	<b>Last Revision By:</b>	Alexandros E. Papacharalampous
<b>Date Created:</b>	03/05/2018	<b>Last Revision Date:</b>	10/5/2018
<b>Actors:</b>	Traveller		
<b>Description:</b>	The traveller decides to delete its profile from My-TRAC. Consequently, My-TRAC deletes all identifiable data related to the user. This use case fulfils obligations of the app concerning GDPR.		
<b>Trigger:</b>	The traveller goes to its profile section and selects the option of deleting its own profile.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller must have the application installed on his/ her mobile phone.</li> <li>2. Internet connection must be active.</li> <li>3. The traveller has a profile in My-TRAC.</li> </ol>		
<b>Postconditions:</b>	The user and all data about the user are deleted.		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller opens My-TRAC app.</li> <li>2. The traveller goes to Profile section of My-TRAC app.</li> <li>3. The traveller selects "Erase my profile" option.</li> <li>4. The system requests confirmation that the traveller wants to completely delete the profile by warning that the operation cannot be undone.</li> <li>5. The traveller confirms.</li> <li>6. The system deletes every personal data about the user and removes him/her from the database.</li> <li>7. The user is logged out and his/her credentials are no longer valid.</li> </ol>		
<b>Alternative Flows:</b>	-		
<b>Exceptions:</b>	-		
<b>Frequency of Use:</b>	Low (only once)		
<b>Special Requirements:</b>	-		



Notes and Issues:	-
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Table 27: Request personal data

<b>Use Case ID:</b>	#T11		
<b>Use Case Title:</b>	Request personal data		
<b>Created By:</b>	Joan Guisado-Gómez	<b>Last Revision By:</b>	Ismini Stroumpou
<b>Date Created:</b>	03/05/2018	<b>Last Revision Date:</b>	24/12/2020
<b>Actors:</b>	Traveller		
<b>Description:</b>	The traveller decides to download the personal data that My TRAC has about him/her. This use case fulfils obligations of the app concerning GDPR.		
<b>Trigger:</b>	The traveller goes to its profile section and clicks on the “Request data” button.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller must have the application installed on his/ her mobile phone.</li> <li>2. Mobile internet connection must be active.</li> <li>3. The traveller has a profile in My-TRAC.</li> </ol>		
<b>Postconditions:</b>	Every single piece of information about the user is sent to the user.		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller opens My-TRAC companion.</li> <li>2. The traveller goes to Profile section of My-TRAC.</li> <li>3. The traveller selects “Request data”.</li> <li>4. My-TRAC indicates that the personal data will be sent to the mail that the traveller used to register into My-TRAC.</li> <li>5. The system sends a notification also to social market to get the personal data used in this module, it compiles them with the personal data gathered by the travel companion and then sends the personal data to the traveller’s mail.</li> <li>6. The traveller receives his/her personal data.</li> </ol>		
<b>Alternative Flows:</b>	User requests his/her personal data from the module of Social market only.		
<b>Exceptions:</b>	-		
<b>Frequency of Use:</b>	Low		
<b>Special Requirements:</b>	-		



Notes and Issues:	-
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Table 28: UI/UX personalization

<b>Use Case ID:</b>	#T13		
<b>Use Case Title:</b>	UI/UX personalization		
<b>Created By:</b>	Ismini Stroumpou	<b>Last Update By:</b>	Jordi Urmeneta
<b>Date Created:</b>	25/09/2020	<b>Last Revision Date:</b>	24/12/2020
<b>Actors:</b>	Traveller		
<b>Description:</b>	Traveller has some visual disability or just wants to have a different looks & feel for My-TRAC app.		
<b>Trigger:</b>	The traveller answers at the registration questionnaire that has a visual disability		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller has installed the application and created a profile in My-TRAC.</li> <li>2. During the profile creations answers that has a visual disability</li> </ol>		
<b>Postconditions:</b>	If traveller answers that has a visual disability My-TRAC has a dedicated skin		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller has started the registration procedure</li> <li>2. The traveller answers that has a visual disability.</li> </ol>		
<b>Alternative Flows:</b>	The user wants to change manually the looks & feels by pressing the dedicated tab at the profile menu.		
<b>Exceptions:</b>			
<b>Frequency of Use:</b>	Medium		
<b>Special Requirements:</b>			
<b>Notes and Issues:</b>			

Table 29: Points and rewards system

<b>Use Case ID:</b>	#T14		
<b>Use Case Title:</b>	Points and rewards system		
<b>Created By:</b>	Javier Gavilanes	<b>Last Update By:</b>	Ismini Stroumpou
<b>Date Created:</b>	08/09/2020	<b>Last Revision Date:</b>	21/11/2020
<b>Actors:</b>	Traveller, third party provider		
<b>Description:</b>	<p>Travellers earn <i>My-TRAC points</i> for performing certain actions within the application (see D2.5 for more details about how points are earned).</p> <p>They can then spend those points in the Social Market platform, in coupons for free items or discounts that have been created by interested third parties.</p>		
<b>Trigger:</b>	The traveller goes to the My Points section and clicks on the Social Market button.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller has installed the application and created a profile in My-TRAC.</li> <li>2. In order to be able to purchase coupons, the traveller must have earned some points by using the application.</li> </ol>		
<b>Postconditions:</b>	If the traveller purchases a coupon, said coupon is added to their coupons list and its cost taken from the traveller's total amount of points.		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller uses the My-TRAC for a period of time to earn some points</li> <li>2. The traveller goes to the My Points section where they can check their points credit.</li> <li>3. The traveller clicks on the Social Market button, which opens the coupons page.</li> <li>4. The traveller browses the available coupons and buys one.</li> <li>5. The coupon is added to the traveller's coupons section and the corresponding points decreased from their account.</li> <li>6. The traveller redeems the coupon following the procedure defined by the coupon's creator.</li> </ol>		
<b>Alternative Flows:</b>	<p>Alternative Flow 1:</p> <ol style="list-style-type: none"> <li>1. A third party wants to create an offer.</li> <li>2. The person in charge logs in the Social Market with provider credentials and is presented with their current offers.</li> <li>3. The provider clicks on "create new offer" and introduces the required information.</li> <li>4. After clicking "save", the offer is available for travellers.</li> </ol> <p>Alternative Flow 2:</p> <ol style="list-style-type: none"> <li>1. A provider wants to edit or delete an offer.</li> <li>2. The provider logs in the Social Market with provider credentials.</li> <li>3. They click on the "edit" or "delete" button on the offer they want to edit or delete.</li> <li>4. If the provider chooses to edit, a window is presented with the already introduced information in editable form. If the provider chooses to delete the offer, a confirmation window appears.</li> <li>5. The offer is edited or deleted.</li> </ol>		



<b>Exceptions:</b>	The traveller does not have enough credit to purchase the selected coupon. The platform notifies the user in that case and the operation is not executed.
<b>Frequency of Use:</b>	Medium
<b>Special Requirements:</b>	None
<b>Notes and Issues:</b>	



Table 30: Booking and Ticketing.

<b>Use Case ID:</b>	#T15		
<b>Use Case Title:</b>	Booking and ticketing		
<b>Created By:</b>	Ismini Stroumpou	<b>Last Update By:</b>	Jordi Urmeneta
<b>Date Created:</b>	12/12/2020	<b>Last Revision Date:</b>	5/1/2020
<b>Actors:</b>	Traveller, third party provider		
<b>Description:</b>	Travellers want to book a service or to buy a ticket. The service or ticket can be bought in Social market (see <b>Table 29</b> ) or by the provider website.		
<b>Trigger:</b>	The traveller goes to Booking tab		
<b>Preconditions:</b>	The traveller has installed the application and created a profile in My-TRAC.		
<b>Postconditions:</b>			
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller has chosen an itinerary.</li> <li>2. Traveller clicks on the booking tab and selects a service.</li> <li>3. Traveller is directed to the webpage of the MaaS provider</li> </ol>		
<b>Alternative Flows:</b>	Traveller buys a ticket or a service by social market		
<b>Exceptions:</b>			
<b>Frequency of Use:</b>	Medium		
<b>Special Requirements:</b>	Each webpages of 3 <sup>rd</sup> parties should be online		
<b>Notes and Issues:</b>			



Table 31: Crowdedness prediction

<b>Use Case ID:</b>	#T15		
<b>Use Case Title:</b>	Crowdedness prediction		
<b>Created By:</b>	Damaris Coll	<b>Last Updated By:</b>	Jordi Urmeneta
<b>Date Created:</b>	28/12/2020	<b>Last Revision Date:</b>	30/12/2020
<b>Actors:</b>	Traveller		
<b>Description:</b>	A traveller wants to check the occupancy prediction for a certain station in their current or destination location.		
<b>Trigger</b>	The traveller has already requested an itinerary (route) of travel.		
<b>Preconditions:</b>	<ol style="list-style-type: none"> <li>1. The traveller has the My-TRAC app already installed.</li> <li>2. The traveller has registered in My-TRAC app.</li> <li>3. The traveller has requested a route.</li> <li>4. The app shows the route in the map.</li> </ol>		
<b>Postconditions:</b>			
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The traveller checks the route in the map.</li> <li>2. A group of markers are displayed in the map. Those markers represent the locations where the partner app “Co-Aps” has information regarding the occupancy.</li> <li>3. The traveller taps one of the icons.</li> <li>4. There is an informative text shown that directs the traveller to open the “Co-Aps” app to check the occupancy information for that location.</li> <li>5. The traveller presses on the link and the Google Play store is opened with the official “Co-Aps” product page displayed.</li> <li>6. If the user has already the “Co-Aps” installed it is prompted to open it, otherwise to install it.</li> <li>7. The traveller can check the requested information within “Co-Aps”</li> </ol>		
<b>Alternative Flows:</b>	<ol style="list-style-type: none"> <li>1. The traveller checks the route in the map.</li> <li>2. A group of markers are displayed in the map. Those markers represent the locations where the partner app “Co-Aps” has information regarding the occupancy.</li> <li>3. The traveller taps one of the icons.</li> </ol>		





	<ol style="list-style-type: none"> <li>4. There is an information shown that directs the traveller to open the “Co-Aps” app to check the occupancy information for that location.</li> <li>5. The traveller doesn’t tap on the link and continues using My-TRAC.</li> </ol>
<b>Exceptions:</b>	
<b>Frequency of Use:</b>	Low/Moderate (under user demand)
<b>Special Requirements:</b>	The user must agree to install another app to get this information.
<b>Notes and Issues:</b>	Only information of occupancy for Barcelona and Athens, as they are the two common locations for My-TRAC and Co-Aps.



## ANNEX 2 OPERATOR'S PORTAL USE CASES UPDATED

**Table 32** presents the use cases that have been created for the operators which lead us to the functionalities implemented in the operators' portal which are operator's registration (**Table 33**), visualization of statistics-download data (**Table 34**) and provision of information-upload data (**Table 35**).

**Table 32: List of operators' use cases**

OPERATOR
#O1: Operator's registration
#O2: Operator 's visualization of statistics
#O3: Operator's information provision

**Table 33: Operator's registration**

<b>Use Case ID:</b>	#O1		
<b>Use Case Title:</b>	Operator's registration		
<b>Created By:</b>	Emy Apostolopoulou	<b>Last Updated By:</b>	Eleni Antoniou
<b>Date Created:</b>	23/3/18	<b>Last Revision Date:</b>	08/09/2020
<b>Actors:</b>	Operator (OP)		
<b>Description:</b>	The operator registers in the platform, so that he can have access to the portal's services		
<b>Trigger</b>	The operator accesses the operator's platform and clicks sign up to start registration process.		
<b>Preconditions:</b>	The operators must have a network connection.		
<b>Postconditions:</b>	GDPR compliance		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The operator opens the operator's portal for the first time and a sign up/ log in screen appears on the sidebar.</li> <li>2. The operator inserts his email address and defines a password.</li> <li>3. The portal requests information (i.e., first &amp; last name, username, password, email, operator company's name, address, telephone, and website).</li> <li>4. The operator fills in all the required information, clicks "Submit" button and a message appears, "Thank you for your registration."</li> <li>5. The account is activated manually. After the activation of the account, the operator can log in and see his profile as well as his company's profile.</li> <li>6. The operator can now access all the available pages of the portal</li> </ol>		
<b>Alternative Flows:</b>	<p>Alternative Flow 1</p> <ol style="list-style-type: none"> <li>5. The operator does not send the automated verification message.</li> <li>6. A message is sent, reminding the operator to verify its registration.</li> </ol> <p>Alternative Flow 2</p>		



	<ol style="list-style-type: none"> <li>The operator has not completed all the required fields, or the format of a specific field is not right.</li> <li>The operator clicks the “Submit” button, an error message appears, and the registration can not be completed.</li> <li>The operator corrects the missing / wrong field and the registration is successful.</li> </ol> <p>Alternative Flow 3</p> <ol style="list-style-type: none"> <li>The documents provided by the operator are not confirmed or not uploaded in a specific format (pdf).</li> <li>A message is sent asking to check the documents and upload them again if needed.</li> <li>The operator uploads the right documents this time.</li> <li>The flow continues from step 7 of Normal Flow.</li> </ol>
<b>Exceptions:</b>	Interruption of communication between servers of platform and operator.
<b>Frequency of Use:</b>	Low (only once)
<b>Special Requirements:</b>	
<b>Notes and Issues:</b>	Constant log. 24/7

Table 34: Operator's upload data

<b>Use Case ID:</b>	#O3		
<b>Use Case Title:</b>	Operator's upload data		
<b>Created By:</b>	Emy Apostolopoulou	<b>Last Updated By:</b>	Eleni Antoniou
<b>Date Created:</b>	23/3/18	<b>Last Revision Date:</b>	08/09/2020
<b>Actors:</b>	Operator (OP)		
<b>Description:</b>	The Operator uploads data, announcements and information to the operator's portal (e.g. runs and directionality, real-time updates or alerts) to update the information used by My-TRAC companion.		
<b>Trigger</b>	The operator accesses My-TRAC's platform in order to upload important information.		
<b>Preconditions:</b>	Operator has registered in the operator's platform.		
<b>Postconditions:</b>	<ol style="list-style-type: none"> <li>Data is saved into the platform.</li> <li>Data is processed and analysed.</li> <li>Decisions on what information must be pushed to the travellers is taken.</li> </ol>		
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>Operator opens the operator's portal and logs in.</li> <li>Operator chooses “Upload data” option.</li> <li>Operator selects the category of data that wants to upload/share. (e.g. Trip updates, Service alerts, Promotional messages).</li> <li>Operator chooses to upload “Trip updates” to the platform.</li> </ol>		



	<ol style="list-style-type: none"> <li>5. A form with empty fields, based on GTFS format appears and the operator fills all the required ones and submits his answer.</li> <li>6. The GTFS data are updated and available for the My-TRAC platform.</li> </ol>
<b>Alternative Flows:</b>	<p>Alternative Flow 1</p> <ol style="list-style-type: none"> <li>4. Operator chooses to upload “Service alerts” to the platform.</li> <li>5. A form with empty fields, based on GTFS format appears and the operator fills all the required ones and submits his answer.</li> <li>6. The GTFS data are updated and the necessary information are available for the My-TRAC platform.</li> </ol> <p>Alternative Flow 2</p> <ol style="list-style-type: none"> <li>4. Operator chooses to upload “Promotional messages” to the platform.</li> <li>5. A form with empty fields, appears and the operator fills all the required ones and submits his answer.</li> <li>6. The promotional message is available for the My-TRAC platform.</li> </ol> <p>Alternative flow #3 (Smart data insertion)</p> <ol style="list-style-type: none"> <li>4. The operator selects the button “Smart data insertion” (it only applies to Trip updates, Service alerts)</li> <li>5. The operator clicks the name of the line that he is interested in uploading information for</li> <li>6. Then, he is asked to select among a list of route names</li> <li>7. The operator selects a specific route and clicks the service ID of his choice</li> <li>8. A list of departure times for this route appear, and clicks one</li> <li>9. Then (this only applies to Trip updates), he selects a stop name and clicks ok</li> <li>10. The corresponding fields are filled automatically with the right IDs</li> </ol> <p>Alternative flow #4 (Smart data insertion)</p> <ol style="list-style-type: none"> <li>4. The line that the operator is looking for, does not exist</li> <li>5. He tries to write it in a different way</li> <li>6. The line is found, and he can continue with the smart data insertion</li> </ol>
<b>Exceptions:</b>	Interruption of communication between servers of portal and operator.
<b>Frequency of Use:</b>	High
<b>Special Requirements:</b>	-
<b>Notes and Issues:</b>	-



## ANNEX 3 DATA RETRIEVED BY SOCIAL MARKET

Table 35: Data retrieved by social market.

```
{
  "social_market": {
    "user": {
      "id": 159,
      "name": "Clark Kent",
      "email": "superman@gmail.com",
      "password": "$2a$10$ZpovCUDVPIhNMjDo/8bR7OT9X7GL5C3DoMAqXzxq6Mm/u5./p7ary",
      "enabled": true,
      "deleted": false,
      "createdDate": "Sep 16, 2020 12:06:28PM",
      "blockChainId": "0x711aa3ba1645b10be138a82014e380ebacbfdb4d",
      "language": {
        "id": 2,
        "code": "en",
        "description": "ingles"
      },
    },
    "roles": [
      {
        "id": 2,
        "name": "user"
      }
    ],
  },
  "point": {
    "id": 142,
    "createdDate": "Sep 16, 2020 12:06:28 PM",
    "deleted": false,
    "modifiedDate": "Oct 13, 2020 11:50:47AM",
    "nPoints": 659,
    "codUser": 10,
    "reputation": 1,
    "user": {
      "id": 159,
      "name": "Clark Kent",
      "email": "superman@gmail.com",
      "password": "$2a$10$ZpovCUDVPIhNMjDo/8bR7OT9X7GL5C3DoMAqXzxq6Mm/u5./p7ary",
      "enabled": true,
      "deleted": false,
      "createdDate": "Sep 16, 2020 12:06:28PM",
      "blockChainId": "0x711aa3ba1645b10be138a82014e380ebacbfdb4d",
    }
  }
}
```



```
"language": {
  "id": 2,
  "code": "en",
  "description": "ingles"
},
"roles": [
  {
    "id": 2,
    "name": "user"
  }
]
},
"pointCoupon": [],
"clickCoupon": null,
"movilCoupon": [
  {
    "id": 859,
    "idUser": 159,
    "nPoints": 34,
    "date": "Jan 19, 1970 12:00:00 AM",
    "processed": 4,
    "deleted": false,
    "createdDate": "Sep 29, 2020 4:32:46 PM",
    "createdUser": 0,
    "modifiedDate": "Sep 29, 2020 4:32:46 PM",
    "modifiedUser": 0
  },

```