MY TRAVEL COMPANION

Deliverable D5.1

Elicitation of requirements document for My-TRAC

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D5.1 Elicitation of Requirements document for My-TRAC

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Executive Summary

The aim of D5.1 Elicitation of requirements document of My-TRAC is to identify the set of requirements of the My-TRAC app that will guide the development of the rest of the tasks of Work Package 5. As specified on the Description of Actions (DoA) document, My-TRAC's goal is to develop a Travel Companion-TC (smartphone application) for public and private transport users and a transport services platform for operators. The TC will improve travellers' experience by offering trip planning information according to their preferences and state-of-mind. On the other hand, the operators will receive access to aggregated anonymized behavioural data, in order to improve and update their models and services via My-TRAC operators' platform.

"Elicitation of Requirements document for My-TRAC" deliverable presents the requirements that will differentiate My-TRAC app from the rest of the applications existing in the market. With more than two million mobile apps available on both App Store and Google Play and almost sixty thousand new apps added per month, it is crucial to understand that the key to success is to develop an app that provides a new experience and an added value to the users. To establish these values, an elicitation of requirements process is necessary.

In the following document, a literature review of the available requirements' elicitation techniques was conducted, in order to decide which one is the most suitable for our case. The use case analysis technique prevailed, as it offers a simple, storytelling-like way to produce the system requirements. In comparison to the other techniques, this was the one feasible within the timeline, and that can be easily coupled with other elicitation of requirements techniques such as brainstorming, content analysis and focus groups. However, the generation of the My-TRAC use cases requires strong collaboration of all consortium partners, technical and non-technical. To enhance this collaboration KIPO (Knowledge-Intensive Process Ontologies) business process modelling approach was used. KIPO defines the collaboration among consortium partners and takes into consideration the expertise and knowledge of each partner.

Furthermore, in the Methodology Section, the steps followed when implementing the use case analysis, are explained thoroughly. To facilitate the process of producing the use cases, storylines were created first. With the collaboration of all partners, and the guidance of the storylines, we produced use cases. This led us to the identification of the general functionalities and finally to the requirements of both the app and the operators' platform.

The Elicitation of Requirements Section is divided in the four steps of the methodology. The first step is to demonstrate the storylines in readable schemes with a description for each one and to analyse the use cases in detailed tables. The following step is to describe in detail the derived functionalities and present them in sequence diagrams, and also to analyse and depict the functional and non-functional requirements.

Abbreviations and Acronyms

D	Deliverable
DoA	Description of Action
GDPR	Genera Data Protection Regulation
KIP	Knowledge-Intensive Process
KIPO	Knowledge-Intensive Process Ontologies
MaaS	Mobility as a Service
P/M	Person/Month
PT	Public Transport
TC	Travel Companion
UI	User Interface
UX	User Experience
WP	Work Package

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1. INTRODUCTION

This report aims to address Deliverable 5.1 "Elicitation of requirements". The purpose of this document is to extract the technical requirements of My-TRAC app, which will be used as guidelines from the developers of WP4: Personalized Human Machine Interface and WP5: "My Travel Companion" development & integration, in order to design the My-TRAC products from a User Experience (UX) point of view. To achieve this goal, the report was created through a clearly defined, extensive and collaborative process, explained in Sections 2 and 3, which used the framework defined in My-TRAC DoA and also the focused work from the partners, taking into account the latest findings and breakthroughs of the project from other tasks (i.e. T2.1, T2.2, T3.1, etc.). The requirements and functionalities displayed in this document are created so that My-TRAC technological products "provide the best solutions for the users and heed the traveller's and operators' needs".

The main goal of My-TRAC is to develop an innovative transport services platform for the rail sector, designed for public and private transport users (travellers) and operators, in order to provide an improved passenger experience. My-TRAC platform will provide interfaces for both travellers and operators, the former will receive improved trip planning information customized to their needs and preferences, while the latter will benefit from receiving access to anonymized and aggregated behavioural data to improve demand forecasting models. At this point, we should highlight that the users from now on, are both the travellers and the operators. The distinction between travellers and operators as well as the main components of My-TRAC are shown in Figure 1.

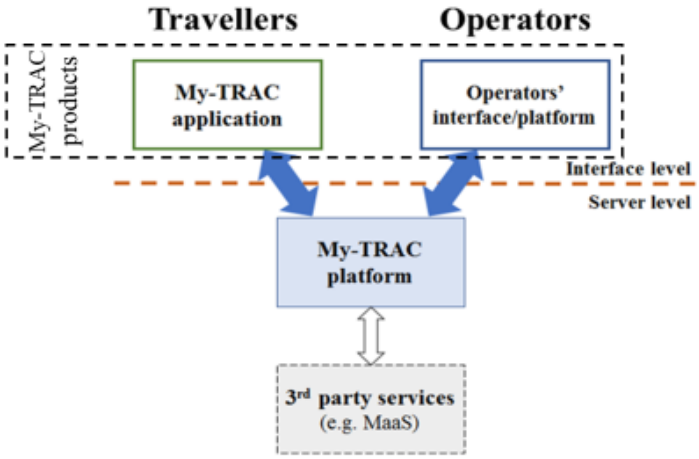


Figure 1: My-TRAC components and definitions

My-TRAC smartphone application (app) will connect information from various sources: (i) Public Transport (PT) operators for schedules and actual information (i.e., delays, disruptions), (ii) MaaS providers (i.e., car-sharing, bike-sharing, taxi services), (iii) Datasets related to the service and trip (i.e., parking availability, crowd density at stations, security) and relate this information with users' preferences and state-of-mind. My-TRAC application will personalize the information provided to the user, enhancing travellers' satisfaction and quality of service. The complexity of the aforementioned operations is immense, encompassing generation and integration of models and algorithms generated for various purposes and from different consortium partners. In order to efficiently coordinate these tasks, especially concerning the final outcome and integration, the consortium uses an application-oriented approach as the connection link among various technical and research tasks. This document provides a preliminary overview of the "end-functionalities" (functionalities that will be enjoyed by the end-users) and will serve as a

guideline for the developers of the app and the research partners that create the models/algorithms using the various data sources that will be connected to the My-TRAC platform for running the pilots.

My-TRAC operators' platform will visualise and demonstrate the aggregated/anonymized data collected by the My-TRAC app and provide interactive components for the operators to communicate with the My-TRAC platform (e.g., delays) and the passengers (e.g., push messages). The visualisation aspects and the interactive components are a significant task requiring standardized interfaces and easy-to-use modules. The conceptualisation and functional requirements definition is performed in this document.

2. BACKGROUND TO ELICITING REQUIREMENTS IN A COLLABORATIVE SETUP

Elicitation of requirements is the process of seeking, uncovering and elaborating requirements and needs of the customer/end user of the software, so that software developers can construct a system that resolves customer problems and addresses their needs. It is a complex process involving many activities with a variety of available techniques, approaches and tools for performing them. Furthermore, the requirements for a software system, such as the My-TRAC platform, may be spread across different sources. These include the problem owners, the stakeholders, documentation and other existing systems. Requirements should be versatile in principle and should change over a period of time, as the process of selecting an elicitation technique is affected by a lot of parameters. For that reason, the process of determining requirements extends until the creation of the technology products while the process of eliciting the requirements involves a lot of actors.

The requirements' elicitation process involves a set of activities that should be performed early and should continue during software development. It can be characterized as Knowledge-Intensive Process (KIP) as it is highly dependent on the knowledge embedded in the participants' minds (i.e. My-TRAC's consortium and stakeholders), in the tasks and activities that compose it, while it encompasses a highly dynamic complexity [1] [2]. Finding an appropriate methodology to apply for determining requirements and representing the design of the My-TRAC system was a scrutinous task. Various business process modelling approaches that can be applied such as UML [3] and ARIS [4] are meant for deterministic systems with well-structured and pre-agreed workflows which are inflexible when considering the multi-actor/multi-disciplinary approach of My-TRAC. Furthermore, more flexible approaches such as BPKM [5] or DECOR [6] are at the inception level, not widely used and not addressing all the characteristics of a KIP [7]. On the other hand, an approach that increases the involvement of a high number of participants and experts in order to carry out actions that are highly creative and innovative, is the process presented in [1].

In [1], authors identify the existence of "KIPO Agents" that operate in Knowledge-Intensive Processes, such as elicitation of requirements for the My-TRAC project, based on some *Intention* that is highly affected by their *Beliefs* (e.g., their understanding of the My-TRAC project) and their *Experiences* (e.g., knowledge within their organisation). The experiences of the different actors/consortium partners/KIPO agents in My-TRAC are broad due the multi-disciplinary nature of the consortium. KIPO (Knowledge-Intensive Process Ontologies) defines the concepts and relationships of the agents to be based on semi-deterministic collaboration actions. This approach, although not entirely adopted in this research, is crucial for creating a methodology that will allow smooth and meaningful collaboration among consortium partners through the low-level actions (e.g., meetings, brainstorming, report's review) by applying high-level collaboration principles (e.g., purpose of information exchange, business logics, socialisation, decision-making).

The definition of the high-level collaboration principles, considering that the requirements are created for software engineering actions (i.e., development of My-TRAC products), was based on the approach presented in **Error! Reference source not found.** [8]. The purpose of applying the KIP approach of [1] is to strengthen the involvement and interaction of the multidisciplinary team that participates in Task 5.1 and My-TRAC's stakeholders. Furthermore, the approach in **Error! Reference source not found.** is useful for identifying and applying the most appropriate requirements' elicitation techniques (presented in this Section) that could lead to the description of My-TRAC's system's functionalities and its non-functional attributes.

Figure 2 presents schematically the process' steps/activities that My-TRAC consortium performed in order to define the elicitation methodology under the coordination of AETHON. The steps of the process are explained below [8]:

1. **Background knowledge**: The elicitation requirements analysts need to understand the background, the domain of transport engineering, travellers' behavioural analytics, data management and processing, UX design and development, as well as market trends and business analytics. This information will be filtered through the intentions and experiences of each analyst [1].
2. **Requirements gathering**: It is an activity involving stakeholders and users (e.g. public transport operators, union of passengers, travellers, etc.). Therefore, it is necessary to identify the appropriate method that would allow the involvement of different actors.
3. **Requirements classification**: This activity includes organizing the requirements gathered from different sources. Therefore, the method that will assist the classification of requirements based on the functionalities that My-TRAC platform, needs to be identified.
4. **Conflicts resolution**: This activity involves stakeholders and engineers in order to align the project's and the business rules requirements. Therefore, it is necessary to identify a method that will involve different experts of the consortium and external advisors/consultants if it is necessary.
5. **Requirements prioritisation**: This activity aims to organize the requirements based on their importance to the stakeholders. Therefore, a method that could enhance the prioritization of requirements based on what we have already described in the DoA is required.
6. **Requirements check**: This activity aims to determine whether the requirements fit with the needs of the stakeholders and with the background knowledge of the team. Thus, during this activity, the consortium checks if what is envisioned (during the previous steps) is feasible technically and financially.

The requirements' elicitation process has seven feedback loops which make the process more complicated but on the same time more robust. Based on this process and the analysis of the most common techniques of requirements' elicitation which are presented below, we decided to generate a methodology which would fulfil My-TRAC's platform objectives and needs (the methodology is duly explained in Chapter 3).

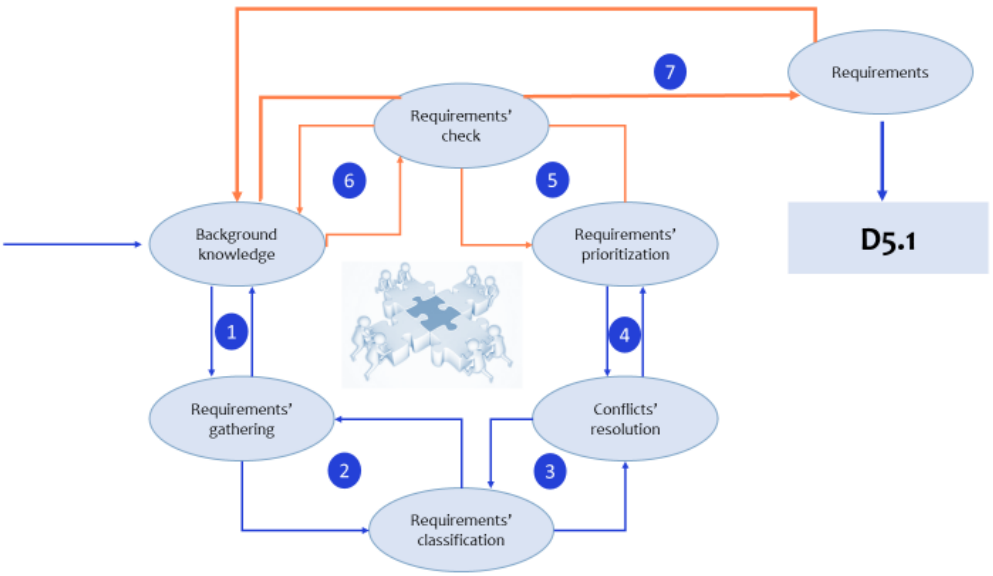


Figure 2: Requirements' elicitation process

To apply the general methodology described above, a number of collaboration techniques were researched and identified [9] [10] [11] [12] [13]. Although the literature covers a wide variety of techniques for requirements elicitation, this review will focus on the most effective techniques which do not originate from the traditional areas of software engineering or computer science research but derive mostly from the social sciences, organizational theory, group dynamics, knowledge engineering and very often from practical experience such as marketing. Requirement elicitation techniques can be divided into four categories, traditional, collaborative, cognitive, observational [13].

1) Traditional Techniques:

- **Interview** is a method of identifying facts and opinions of users and other stakeholders of the system under development by face to face conversation. There are two different kinds of interviews: The structured interview, where the interview is conducted with a pre-defined set of questions, and the open interview, where the requirements engineers and stakeholders discuss to find out their expectations from a system.
- **Questionnaire/Survey** is a technique of eliciting requirements from many people in reduced cost and time. Questionnaire surveys can be useful for eliciting requirements from the stakeholders

2) Collaborative Techniques:

- **Focus Group/Workshops** is a technique where stakeholders from different backgrounds, with different skills gather together to discuss in a free form about features of the system that will be created. In the end a complete set of requirements is provided.
- **Brainstorming** provides an open environment of discussion, where stakeholders representatives gather together to discuss and develop their requirement and expectation of the system. Its main characteristic is that it encourages "out of the box" ideas.
- **Joint Application Development (JAD)** is a requirement definition and software system design methodology in which stakeholders, end-users, and developers attend group sessions to work out a system's detail. JAD is conducted in the same way as brainstorming with the difference that stakeholders participate also in the process, the number of participants usually does not exceed 20 to 30 people.
- **User centred design:** This method is similar with JAD, the main difference is that the user acts as part of the development team.
- **Models** include diagrams such as Data flow diagram, UML diagram to elicit requirement. The models use for the purpose to help the customer to think the process. Models are useful for eliciting requirement and to resolve conflict between stakeholders.
- **Use cases/Scenarios**: Use cases describe interactions between the user and the system to find user need. It specifies a sequence of interaction between the system and the user It is made up of a set of possible sequences of interactions between software and users leading to a goal. The use case should contain all system activities that have significance to the users.

3) Cognitive Techniques:

- **Content analysis** is the process of reading and studying the available documents related to the problem, to gather the information relevant to the requirement elicitation tasks.
- **Card sorting** is the method that is used to generate information about the associations and grouping of specific data items. Stakeholders are asked to organize individual, unsorted items into groups. In this way, individual activity is followed by group discussion of individual differences.

- **Protocol analysis** is a method of conducting a meeting where stakeholders and analysts speak out loud and explain their thoughts about the requirements of the system.
- **Laddering** is a form of structured interview in which the set of questions is arranged in hierarchical order. The requirement for the success of this technique is that stakeholders have the domain knowledge.

4) Observational Techniques:

- **Observation** is about the investigation of user's work and taking detailed notes on the activities that takes place. It allows the observer to view what users do in practice, when they encounter a problem and how they overcome these issues.
- **Ethnography/Social analysis** is the process of interacting with stakeholder and user of different background and spend an amount of time in their society or culture to understand working and cultural environment.

In My-TRAC project, people from different countries and different scientific fields and backgrounds are involved. Determining the appropriate methodology to be used is a task that requires the understanding and identification of available tools listed above but also of the practical/physical (i.e., partners are based at different countries) and time requirements. The use cases offer a simple, storytelling-like way to capture the system requirements. This method is understandable by all within the consortium and can be included in a single text file that can be easily distributed, thus improving the collaboration mechanisms and communication among partners. Use-cases facilitate elicitation of requirements from stakeholders, technical and non-technical, which makes them an important and useful tool for software development. In comparison to the other techniques, this was the one feasible within the timeline, that provides a simple mechanism for updating the requirements throughout project duration and that can be easily coupled with other methodologies such as brainstorming, content analysis and focus groups.

3. METHODOLOGY FOR REQUIREMENTS ELICITATION

This Section presents the methodology that was used for eliciting the requirements for the My-TRAC products. The methodology tackles the technical part of generating the requirements while Section 2 tackles the non-technical part of requirements elicitation. Thus, methodological attributes of the collaboration and co-design principles laid down in Section 2 are infused into the methodology described below and/or have affected the generation of the following methodology.

3.1 GENERAL METHODOLOGY

Based on the process steps (**Error! Reference source not found.**) and the elicitation of requirements' techniques presented in Background, My-TRAC team developed the following methodology which incorporates the techniques (i) brainstorming, (ii) Focus Group/Workshops and (iii) Use case analysis which were presented in Section 2. Due to the size and the complexity of the project, storylines were produced first, to help identify, co-design and brainstorm various aspects of the My-TRAC products in a way that utilizes tangible and close-to-reality examples.

Storylines are short descriptions of the processes that travellers or operators could possibly apply through My-TRAC app. They express one very specific need that the user may have. More specifically, storylines depict a series of actions that the user and the application perform and the interaction among the two based on specific stories/scenarios (e.g., a user commutes from A to B). A typical storyline will have enough information to help the developer understand the requirements that the must be capable of accomplishing but it is not meant to be a complete description of how the software is implemented. The purpose of the storylines is to also identify and incorporate all possible *experiences* and *intentions* [1] of consortium partners. Thus, storylines were also useful for parameterizing the use-cases by understanding the views of each partner on the final product.

The storylines were performed by online brainstorming sessions chaired by the task leader. All the partners participated in the formation of the final storylines by providing their own point of view and expertise. More specifically, this process was iterative:

1. A storyline was produced by the task leader and presented to the consortium.
2. A brainstorming session was initiated to discuss on the accuracy of:
   a. User actions (i.e., choices),
   b. Application actions (i.e., recommendations).
3. The task leader corrected the storyline, produced a new and presented it to the consortium to the next meeting.

Following the generation of the storylines, the consortium created a list of preliminary functionalities of the My-TRAC app based on the application actions of the storylines. The storylines show a potential usage of the app thus, it depicts what is expected from the app to be performed. These preliminary functionalities assisted in the identification of the *Beliefs* of partners (see Section 2). The classification of the functionalities was performed according to the workflow of the project. Thus, each functionality was assigned to a specific Work Package. The classification assisted in the generation of use-cases and to assign the authoring of the use-case to a specific organization whose background matched the technical specificities of the use-case.

Finally, after the production of the use cases, the general functionalities were defined which led to the identification of the requirements. The identified functionalities were also discussed at the 1st My-TRAC workshop which took place in Vienna on the 17thof April 2018. The workshop assisted in validating or changing the functionalities according to the comments and remarks made by the stakeholders. Furthermore, the functionalities related to the private data sharing and processing were discussed thoroughly with the DPO of My-TRAC consortium in special meetings.

This discussion led to two additional use-cases that specifically and holistically tackle personal data aspects (e.g., withdrawal of informed consent).

Figure 3 presents the timeline and the methodological steps that partners of T5.1 followed in order to generate this deliverable.

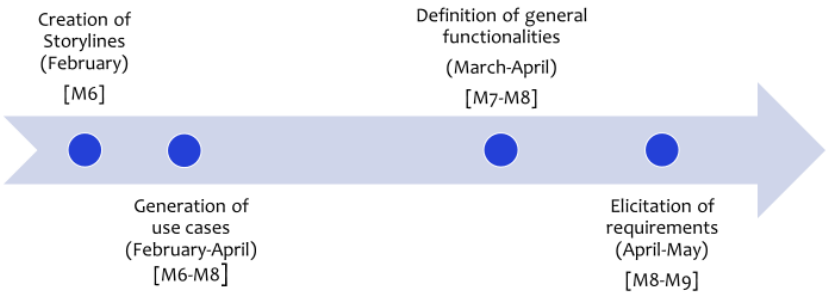


Figure 3: Timeline and methodological steps of My-TRAC Requirements Elicitation

In the scheme of Figure 4, the breakdown of a storyline and the logical process of the applied methodology (from storyline to requirements) is presented. Multiple replicates of the following scheme were generated according to the number of storylines.

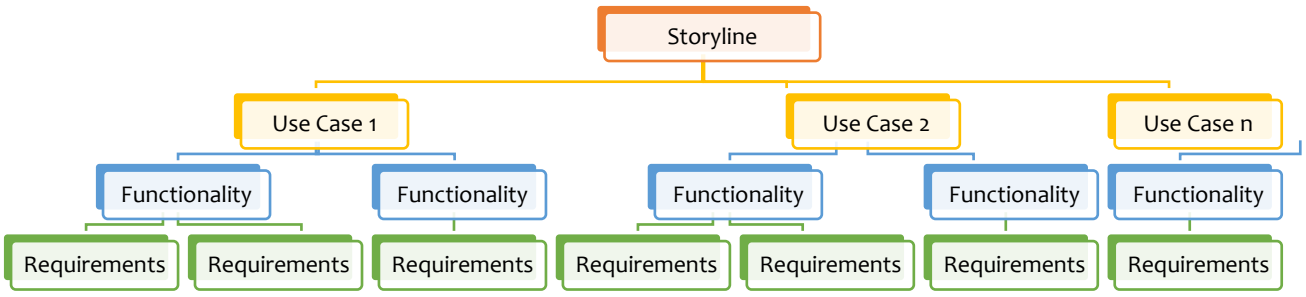


Figure 4: My-TRAC elicitation requirements' methodology

3.2 FROM USE-CASES TO REQUIREMENTS

The **use cases** produced contain the description of a set of interactions between My-TRAC products and users (travellers and operators). A use case is a methodology used in system analysis to identify, clarify, and organize system requirements [14]. It is made up of a set of possible sequences of interactions between software and users (and possibly other systems) in an environment and related to a particular goal. The use case should contain all system activities that have significance to the users. It can be thought of as list of actions or event steps, typically defining the interactions between a role (known as an actor) and a system, to achieve a goal. Occasionally, use case and goal are considered to be synonymous.

A use case is described by the following information [15]:

- **Actor** can be any entity (a human or other external system) that interacts with the app. In our case, both the travellers and the operators.
- **Description** provides a brief explanation of the sequence of actions and the outcome of the use case.
- **Trigger** is what initiated the interaction between the actor and My-TRAC app.
- **Preconditions** are any conditions that must be true, before the use case starts.
- **Postconditions** are the conditions that must be true when the use case ends, no matter which scenario is executed.
- **Normal flow** is a detailed list of actions, which define the interactions between the actor and My-TRAC app and lead to achieve the actors' goal.
- **Alternative flows** are the deviations from the main scenario, meaning that the actor uses different steps from the normal flow, but in the end the original goal is achieved.
- **Exceptions** are anything that lead to not achieving the use case's goal.
- **Frequency of use** is an estimation of the number of times this use case will be performed by the actors.
- **Special requirements** are anything that needs to be explicitly defined for a specific use case.
- **Notes and issues** are any additional comments or issues that need to be solved.

For the description of the use cases, a template was created that contains the above information:

Use Case ID:			
Use Case Title:			
Created By:		Last Updated By:	
Date Created:		Last Revision Date:	
Actors:			
Description:			
Trigger			
Preconditions:			
Postconditions:			
Normal Flow:			
Alternative Flows:			
Exceptions:			
Frequency of Use:			
Special Requirements:			
Notes and Issues:			

Use-cases are the stepping stone between the theoretical and abstract understanding of the My-TRAC products and the requirements that this document is created to depict. By defining the flows in the use-cases, it is possible to generate general functionalities. **Functionalities** represent the intended behaviour of the system, which can be

interpreted as services, tasks or features that My-TRAC app is required to perform. Functionalities are the sum of what a product - such as a software application - can do for a user.

After the identification of the general functionalities, **sequence diagrams** will be drawn to present them. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. The main purpose of a sequence diagram is to define event sequences that result in some desired outcome. The focus is more on the order in which messages occur. The diagram conveys this information along the horizontal and vertical dimensions: the vertical dimension shows, top down, the time sequence of messages/calls as they occur and the horizontal dimension shows, left to right, the object components that the messages are sent to [16].

When drawing a sequence diagram, lifeline notation elements are placed across the top of the diagram. Lifelines represent either roles or object instances that participate in the sequence. Lifelines are drawn as a box with a dashed line descending from the centre of the bottom edge. The first message of a sequence diagram always starts at the top and is typically located on the left side of the diagram for readability. Subsequent messages are then added to the diagram slightly lower than the previous message. To show an object sending a message to another object, a line is drawn to the receiving object with an arrow. The message is placed above the arrowed line and is sent to the receiving object. Besides message calls, return messages are also included on the sequence diagram. These return messages are optional; a return message is drawn as a dotted line with an open arrowhead back to the originating lifeline and is placed above this dotted line.

By creating the functionalities and schematizing them with the form of sequence diagrams, it is possible to generate functional and non-functional **requirements** which aim to cover the development of the app and meet the needs of the user. The functional requirements specify a behaviour or function that the system should have, such as technical details. On the other hand, non-functional requirements specify the system's quality (e.g., reliability, security, etc.). The difference between functional and non-functional requirements is that the former describes what the system is supposed to accomplish while the latter describes how the system works. At this point, it is crucial to understand, which of all functionalities derived above are technically feasible in order to produce the necessary (functional and non-functional) requirements.

4. ELICITATION OF REQUIREMENTS

This chapter contains the outcomes of the implemented methodology described in detail in Section 3. It contains the generated storylines, use-cases, sequence diagrams and requirements.

4.1 STORYLINES

The storylines were created first, to assist and improve the co-design of the use cases. As it was mentioned in the Methodology, the storylines are short descriptions containing only the necessary information to describe the needs of the user. A total of seven storylines (5 for the travellers and 2 for the operators) and their description are displayed below, each followed by a figure for visualising the storyline. In all the storyline visualisations, there are 3 levels/actors that interact: Traveller makes a choice, Operator has access to data through the platform and My-TRAC Application (for the travellers) or Platform (for the operators). These levels assist on demonstrating the interactions and the exchange of information among them. Table 1 lists the storylines created:

Table 1: My-TRAC storylines

TRAVELLER	OPERATOR
#S1: Traveller's registration in My-TRAC app	#S6: Operator's registration and data queries
#S2: Point-to-point single trip	#S7: Operator's information provision
#S3: Trip with a group of individuals	
#S4: Trip with transaction for ticket	
#S5: Trip to another country	

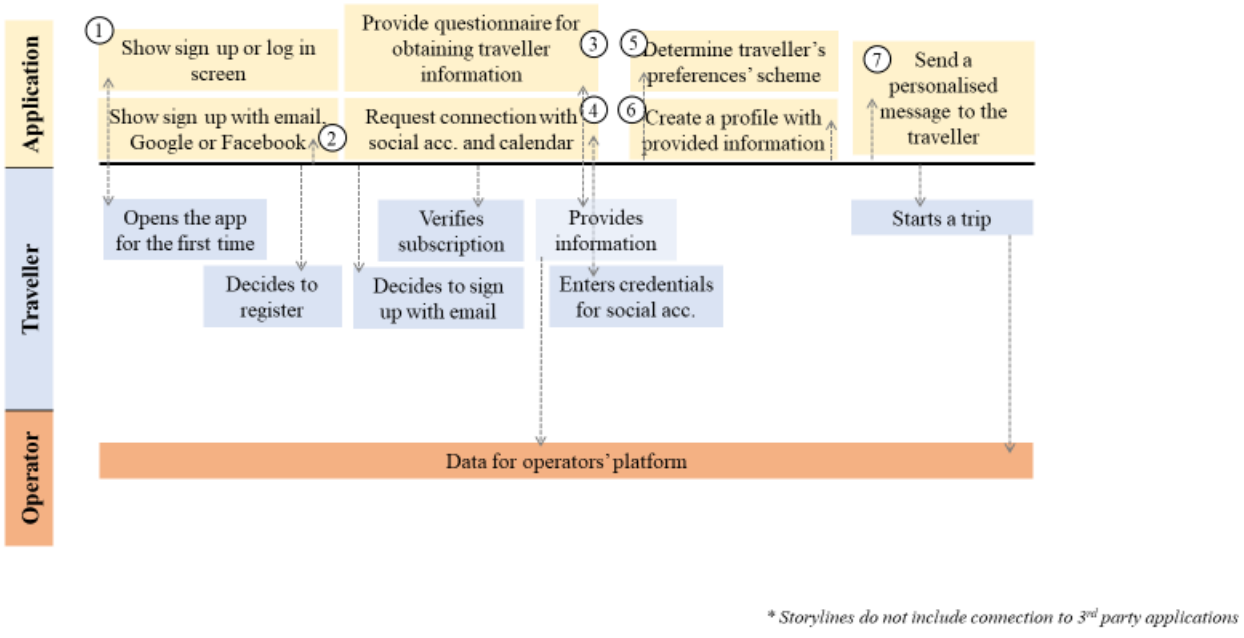
4.1.1 TRAVELLER'S STORYLINES

In traveller's storylines, there is a direct interaction between the My-TRAC app and the traveller. The latter has a need, e.g., perform a trip, and the former attempts to understand, predict and recommend mode, destination and travel time. Interactions between the operator and the traveller do not exist in the storylines; only the application can provide the traveller's choices and actions to the operators' platform as behavioural data. This is performed so that the My-TRAC platform has full control over data sharing thus, enforce aggregation techniques that preserve traveller's anonymity.

The line between the traveller and the application shows the level of understanding during the trip process, while the dotted arrows present the order of the actions. The small chart on the top right corner of each storyline diagram, appears only when there is a trip process during which the application learns and understands the traveller. The descending line shows that as much as the traveller uses the application, the level of understanding of the My-TRAC app increases. The red circle and arrow shows which one is analysed in the specific scheme.

Storyline #1: Traveller's registration in My-TRAC app

First storyline describes the registration of the traveller, for the first time in My-TRAC app. It displays the questions and requests of the app and presents how the traveller responds to them. As soon as the traveller opens the app for the first time, he/she encounters a signup/login screen. After registering with his/her email, he/she answers to a questionnaire for assisting the application to obtain some basic information about the new user and allows connection with his/her social media and calendar. With the provided information, the app is now able to determine the preferences of the traveller and create a personalized profile. The traveller is ready to start his/her trip and My-TRAC to assist the traveller to perform it. It is worth mentioning that all the provided information constitutes useful behavioural data for operators' platform.



** Storylines do not include connection to 3rd party applications*

Figure 5: Traveller's registration in My-TRAC app

Storyline #2: Point-to-point single trip

In the specific storyline a single trip is presented. When the traveller inserts the starting and destination point of his/her journey, the app shows all the available choices, always based on the preferences scheme and profile of the specific traveller. After boarding the mode of his/her preference, a notification about an upcoming disruption pops up on the screen. The application shows a list of alternatives routes and the traveller makes a decision on whether to reroute and how. Personalized activities and last-mile options are recommended at the transfer point, while waiting to get on board. When he/she departs, a notification for traffic appears, with a proposition for alternate mode and route. At the same time the app, which is connected to the calendar, reads the schedule of the traveller and detects an appointment that it will be affected by the delay and propose sending an "I'm late" message. As soon as the traveller reaches his/her destination, My-TRAC already plans the return trip. In the end, the app requests from the traveller to rate and review the assistance of My-TRAC during the previous trip, to improve future recommendations. All the decisions and preferences of the traveller can be used for the operator's platform, as anonymized behavioural data.

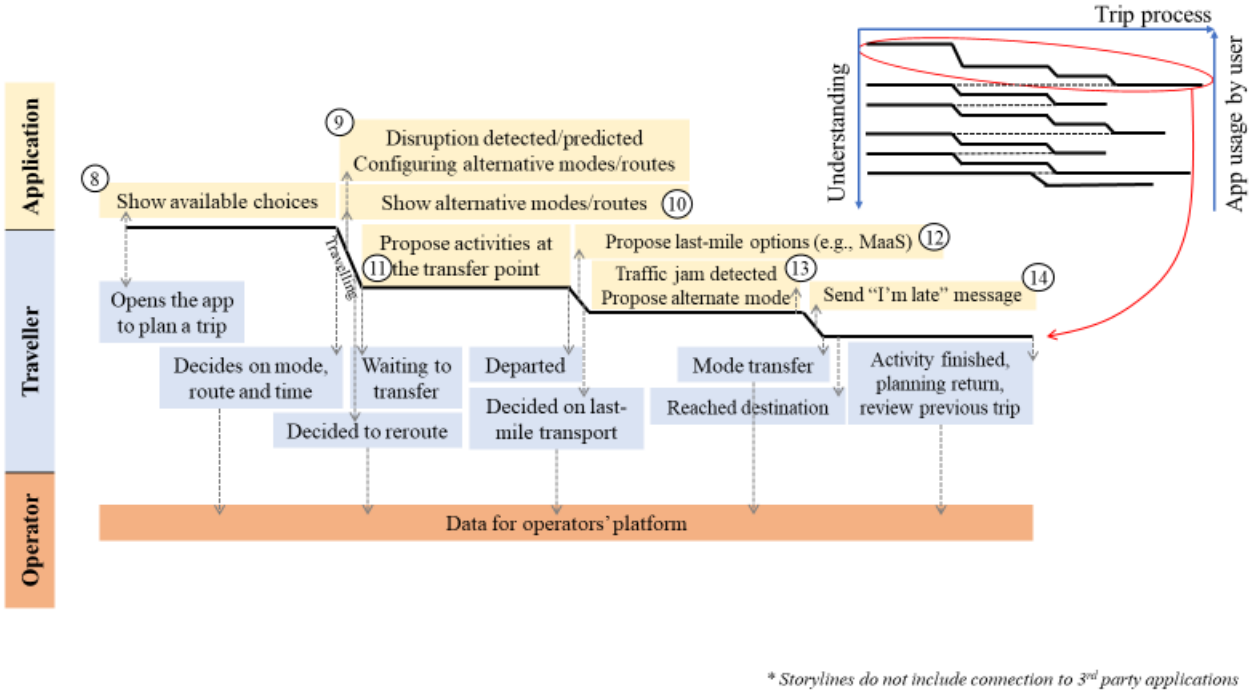


Figure 6: Point-to-point single trip

Storyline #3: Trip with a group of individuals

This storyline is about travelling with a group of people. In this case the app takes into consideration the preferences and previous travels of the group members in order to create the most satisfactory route for the overall group and also to propose group activities which are suited for everyone in the group. The traveller, after creating the group trip, gets notified about group activities and personalized opportunities during the trip. Once the admin of the group decides the trip configuration (i.e. origin, destination, mode and departure times), the My-TRAC companion will suggest the set of plans that fit with the trip configuration. Then, once the admin has selected the desired route, My-TRAC companion will inform him/her about every disruption during the trip as well as propose alternatives to overcome the disruption or proposes activities based on the waiting time caused by the disruption itself (as in a single trip). Similarly to the single trip, as the group reaches the destinations of the trip, My-TRAC companion proposes activities. All the decisions and preferences of the travellers can be sent to operator's platform, as anonymized behavioural data.

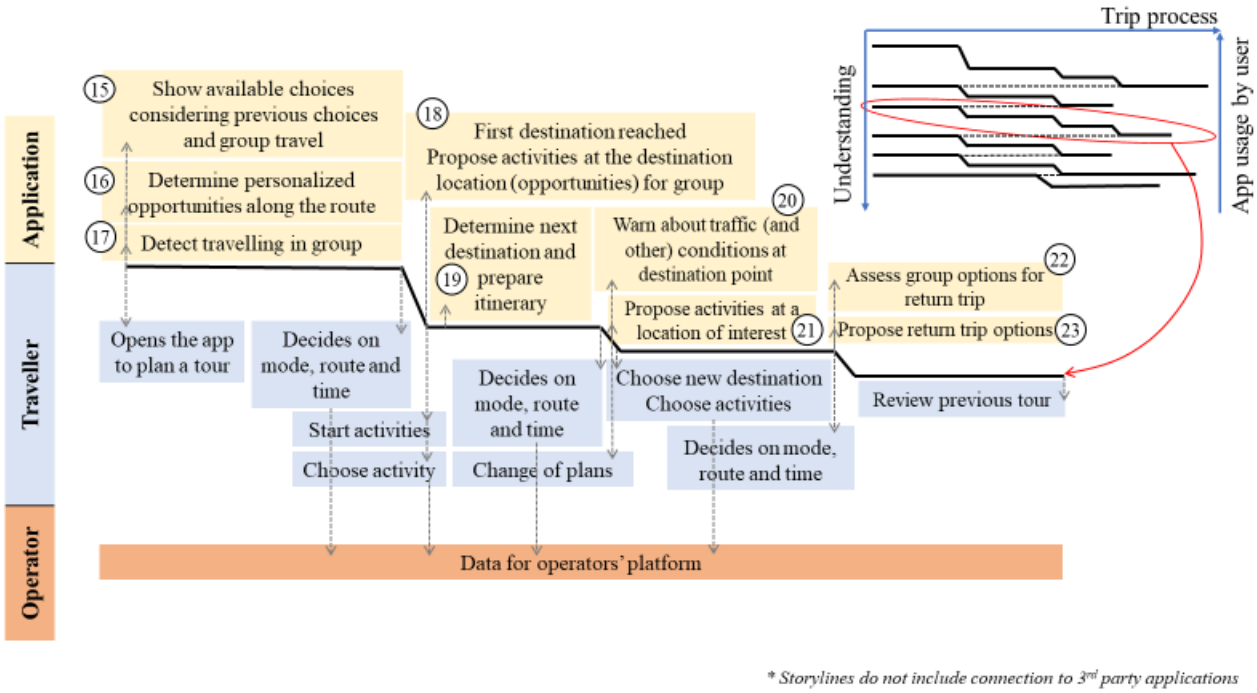


Figure 7: Trip with a group of individuals

Storyline #4: Trip with transaction for ticket

This storyline presents a trip that includes a ticket purchase. My-TRAC app predicts or reads from the calendar the activity that is about to be performed and presents a list of ticket purchase options for the traveller to choose. The traveller gets notified and selects the route, mode and time of departure and purchases the corresponding ticket. However, while travelling, a change in the itinerary is detected and after warning the traveller, the app proposes alternative options to continue his/her trip. The traveller decides to reroute and the itinerary adjusts to the changes. The application notifies the traveller about new activities to perform at waiting point, and after selecting his/her favourite, the trip starts. Moreover, last-mile options are proposed, and the traveller chooses to call a taxi through My-TRAC app, which is connected to taxi services (e.g. Uber). In the end of the trip, the app requests from the traveller to rate and review My-TRAC's guidance throughout the tour. All the decisions and preferences of the traveller can be sent to operator's platform, as anonymized behavioural data.

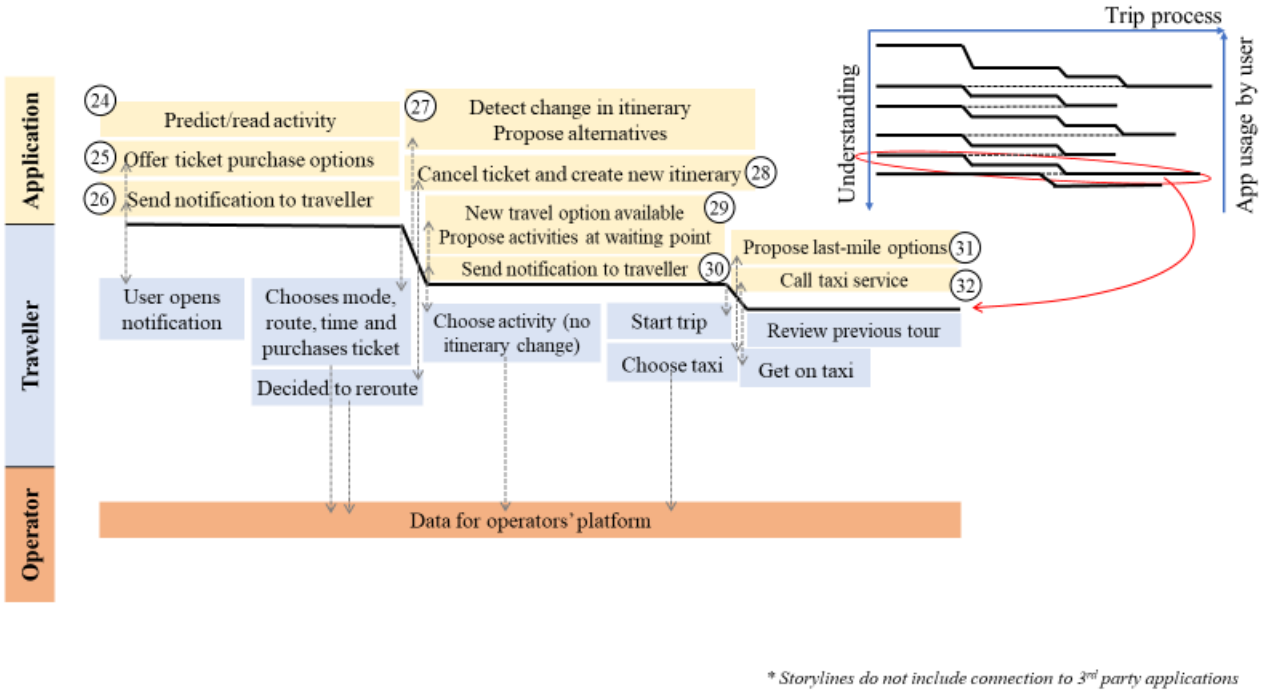


Figure 8: Trip with transaction for ticket

Storyline #5: Trip to another country

The last traveller's storyline depicts a trip to another country. In this case the app needs to adjust and determine the new conditions (such as hotel location, availability of a car, no commuting pattern) and to get updated of the traveller's program, from calendar. The app provides information about public transportation of the new country, such as prices, schedules etc. and shows a list of available options for the traveller to choose. After deciding which route and mode he/she will follow, My-TRAC proposes activities after matching existing preferences with conditions at the new location. The traveller begins to travel, while the application indicates the arrival and intermediate stations in a navigation-like screen (each station that the user reaches, is indicated). This functionality will assist travellers to overcome difficulties with the pronunciation of foreign stations (station identification) or information provision about station names. My-TRAC app also proposes last-mile options to reach the destination on time. In the end, the app requests from the traveller to rate and review the assistance of My-TRAC during the previous trip, to improve future recommendations. Traveller's choices and decisions during the trip are aggregated and provided to the operator's platform of the corresponding country, as anonymized behavioural data.

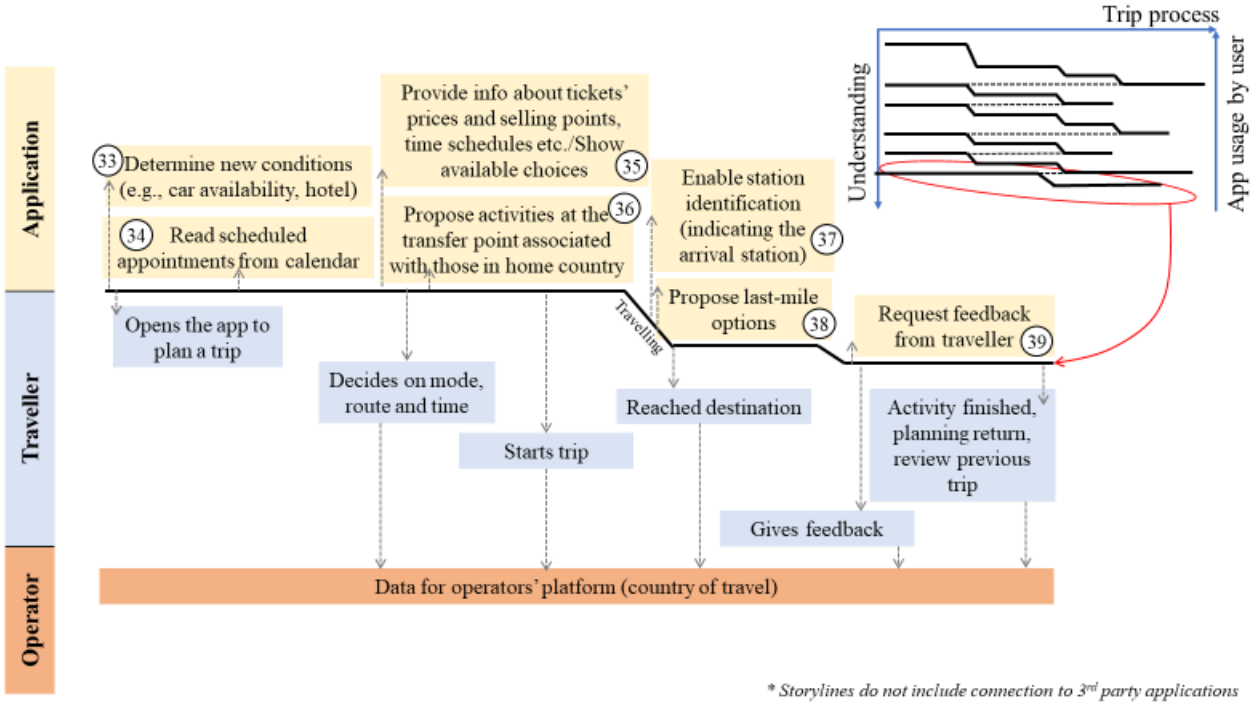


Figure 9: Trip to another country

4.1.2 OPERATOR'S STORYLINES

For the operator's storylines, focus shifts to the interactions between the operator and the My-TRAC platform. The difference with the traveller's storylines is that there is no level of understanding between the platform and the operator, as there is no trip process. Generally, direct interactions between the operator and the traveller do not exist.

Storyline #6: Operator's registration and data queries

This storyline describes the registration of an operator to My-TRAC. The moment the operator opens My-TRAC to register, a sign up/log in screen appears, requesting a list of necessary information for identification. After the verification of the requested documents, a profile with all the provided information is created and a tutorial with instructions about uploading and retrieving data, appears. The operator can use the search module to retrieve data by typing down search terms. The platform, after validating the query, searches for relevant information and the result is sent to the platform's front-end. The operator is now able to see, examine and even download the requested information. In the end, My-TRAC requests feedback from the operator using a five-star rating system or writing down a review. In this case, there is no exchange of information between the traveller's app and the operator's platform.

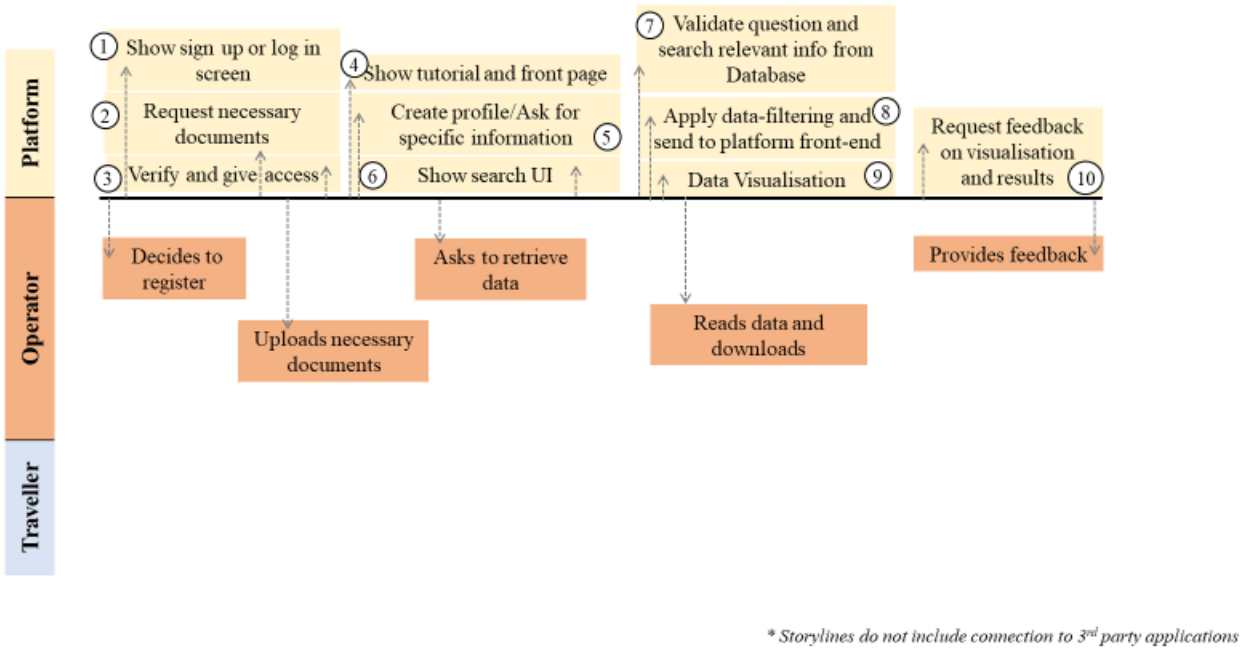
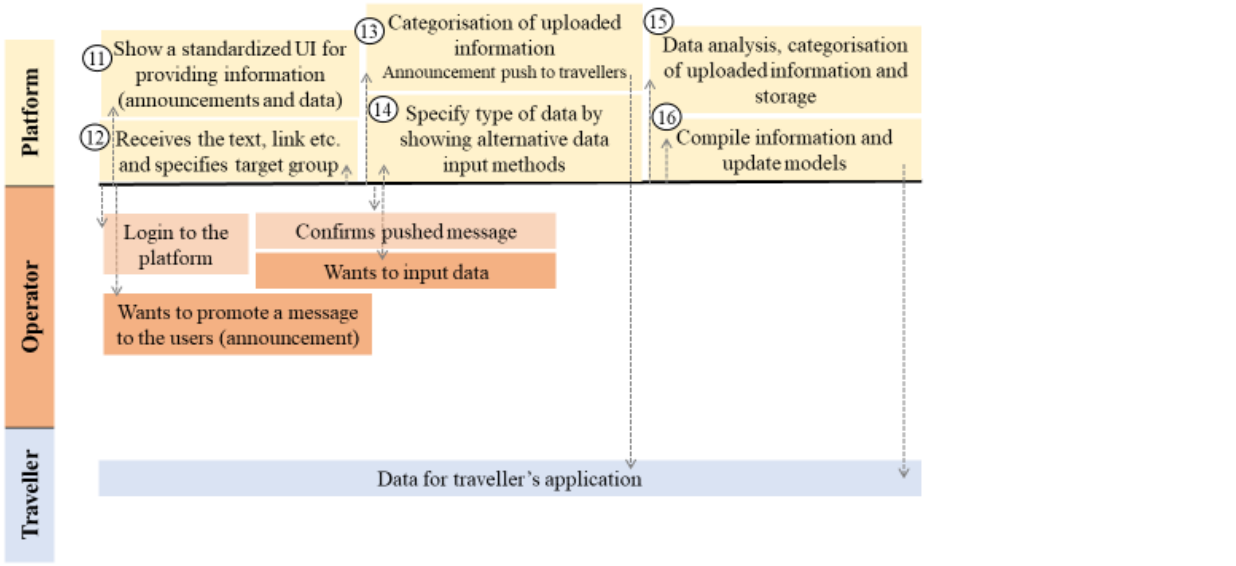


Figure 10: Operator's registration and data queries

Storyline #7: Operator's information provision

The operator can also provide information to the platform through a UI. The operator first promotes an important message/announcement to the platform, in order to inform the travellers. The platform receives the information in a specific form (e.g. text) and specifies the travellers that may be interested about the announcement. Then, the uploaded information is stored and categorized and the announcement is pushed immediately to specific travellers (i.e. pops up on their phones). The operator is also able to upload useful data to the platform through a standardised form (e.g. maintenance work causing a delay are entered on an interactive map). For this reason, there is a categorization of uploaded information in order to analyse and store them. All this information is compiled and used to update the already stored data and models. The new data are delivered to the traveller's app, through a notification to his/her phone.



** Storylines do not include connection to 3rd party applications*

Figure 11: Operator's information provision

4.2 USE CASES

Following the generation of the storylines, the use cases were defined. Each storyline has the ability to generate multiple use-cases. For the elicitation and organization of the requirements, a total of 18 use cases were produced through collaboration of all the partners. It is worth mentioning that the list of use cases is not meant to be comprehensive as it will be updated as the project evolves. The numbering of the use cases is not linear. The use cases are clustered by their main theme such as T2.1-T2.5 refers to a logical sequence of a trip, T8.1-T8.4 refers to groups of travellers and T9.1-T9.2 refer to legislation issues (GDPR).

Table 2: Use cases for the TC and operators' platform of My-TRAC

TRAVELLER
#T1: Traveller's registration
#T2.1: Trip creation
#T2.2: Detection of changes and disruptions on a route during a trip
#T2.3: Activities' proposition
#T2.4: Navigation
#T2.5: Using My-TRAC app in a country other than home-country
#T3: Service providers' notifications
#T4: Payment transactions
#T5: Communication with MaaS and 3rd party services
#T6: Itinerary creation and manipulation (Trip chain)
#T7: Traveller's feedback and recommendations (My-TRAC rating system)
#T8.1: Group creation
#T8.2: Group modification: Adding a new member
#T8.3: Group modification: Remove a member
#T8.4: Group deletion
#T9.1: Erase traveller's profile
#T9.2: Request personal data
OPERATOR
#O1: Operator's registration
#O2: Operator 's visualization of statistics
#O3: Operator's information provision

4.2.1 TRAVELLER'S USE CASES

Table 3: Traveller's registration

Use Case ID:	#T1		
Use Case Title:	Traveller's Registration		
Created By:	Eleni Antoniou	**Last Revision By:**	Alexandros E. Papacharalampous
Date Created:	21/2/2018	**Last Revision Date:**	21/3/2018
Actors:	Traveller		
Description:	The traveller decides to register to the My-TRAC app. Consequently, My-TRAC app creates an account, connects with social media (if applicable) and creates a profile.		
Trigger:	The traveller downloaded the My-TRAC app and opened the app for the first time where he/she encountered the sign-up screen.		
Preconditions:	1. The traveller must have the application installed on his/her mobile phone. 2. Network connection must be active (Wi-Fi, 3G, 4G). 3. The traveller can disallow the collection of data (e.g., location) any time through his/her profile settings.		
Postconditions:	The app must ensure traveller's data privacy		
Normal Flow:	1. The traveller opens the app for the first time and a sign up/log in screen appears. 2. The app asks the traveller to subscribe using an email, Google or Facebook account. 3. The traveller chooses to sign up with email. 4. The app requests information (i.e. First name, last name, username, email and password). 5. The traveller fills in all the required information, so he/she can have a complete account. 6. The app requires email verification. 7. The traveller receives an email to verify his/her registered address. 8. After the verification, the traveller logs in (persistent log in). 9. A "terms and conditions" screen appears. 10. The traveller accepts the terms and conditions and proceeds on using the app. These terms and conditions comply with the GDPR. 11. The app presents a questionnaire for obtaining information about the traveller. 12. The traveller answers the questionnaire to proceed and use the app (questionnaire persists). 13. The app creates a profile based on traveller's information (e.g., username, date of birth, mail) to which the answers to the questionnaire are also associated (user can change the answers in the future). 14. The app requests connection with user's social accounts and calendar (e.g. google calendar). 15. The traveller allows the connection with the preferred networks (not-persistent). 16. The app creates a traveller's preferences scheme (activities' preferences) associated with traveller's profile with information from social accounts and others.		

	17. A traveller's profile is also created in the database of the platform, so that the server collects and analyses information to improve its recommendations. 18. The traveller is ready to start his/her trip.
Alternative Flows:	Alternative Flow 1 3. The traveller chooses to sign up with Facebook or Google. 4. Steps 4-8 are not realised. We go straight to Step 9. Alternative Flow 2 4. The traveller inserts wrong email. 5. The app asks to insert email again. Alternative Flow 3 15. The traveller does not allow connection with social accounts. 16. The app creates a basic profile using averages from users with similar profiles. Alternative Flow 4 3. The traveller can't register and needs to contact the online support (e.g. the traveller didn't get the confirmation email). 4. Traveller uses the online form for contacting online support. 5. Online support categorizes the problem and assists the traveller to solve it. 6. Traveller tries again to register successfully.
Exceptions:	-
Frequency of Use:	Low (only once).
Special Requirements:	The traveller has an email address or account to social media.
Notes and Issues:	The traveller, after the registration, will remain logged in constantly and will be able to edit the information on his/her profile anytime.

Table 4: Trip creation

Use Case ID:	#T2.1		
Use Case Title:	Trip creation		
Created By:	Eleni Antoniou	**Last Revision By:**	Arnau Prat-Pérez
Date Created:	15/3/2018	**Last Revision Date:**	9/4/2018
Actors:	Traveller		
Description:	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. 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.		
Trigger:	The traveller enters the start point and the destination before the trip or opens the app during the trip.		
Preconditions:	1. The traveller has the My-TRAC app already installed. 2. The traveller has registered in My-TRAC app. 3. Mobile internet connection must be active when creating the trip. 4. GPS connection is available.		
Postconditions	-		
Normal Flow:	1. The traveller opens My-TRAC app. 2. The traveller specifies 'from' and 'to' locations. 3. The traveller inserts trip characteristics (obligatory: day, route preferences etc./optional: time of departure-arrival, mode etc.). 4. The app presents available choices of modes and routes (retrieved from #T5.1). The traveller can sort the choices based on different criteria (price, time travel, etc.). 5. The traveller chooses a route to get more information about: a. The estimated time of arrival in each intermediate station (if any) and at destination. b. The potential activities that can be performed along the route. c. If the traveller confirms the route, continue. Otherwise, go to point 4. i. The traveller has the option to purchase all or part of the tickets for the whole route (#T4). 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: a. The traveller arrives at an intermediate transfer location and the app notifies the next steps to continue his/her trip (#T6). b. The app proposes activities to perform at a given trip step (#T2.2). c. The app detects a disruption and proposes a modification to the route if necessary (#T5.2).		
Alternative Flows:	-		
Exceptions	1. 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.		

	2. The app notifies the traveller about this issue.
Frequency of Use:	High (approximately every time the traveller uses the app).
Special Requirements:	Connection to 3rd party services 1. My-TRAC app contacts a 3rd party service responsible for route finding. Several alternative routes are found. 2. For every route alternative, My-TRAC app finds all 3rd party services that affect the conditions of the route (e.g. corresponding PT operator for ticketing, schedule and delays, weather web-service, traffic jams, car/bike sharing availability, etc.). Each such a web-service is polled and real-time data on current conditions are collected. 3. My-TRAC app collects the data to present the current overview of the conditions on every route (e.g. crowdedness, delays, roadworks). My-TRAC app uses these additional conditions to calculate the personalized suitability of the route to the traveller.
Notes and Issues:	• The traveller can abort the process of creating a trip at any point between 2 and 5 (inclusive). • The traveller can remove a created route at any given time and stop tracking for that route.

Table 5:Detection of changes and disruptions on a route during a trip

Use Case ID:	#T2. 2		
Use Case Title:	Detection of changes and disruptions on a route during a trip		
Created By:	Viktoriya Degeler	**Last Revision By:**	Eleni Antoniou
Date Created:	06/04/18	**Last Revision Date:**	24/05/18
Actors:	Traveller		
Description:	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.		
Trigger	Change in the external situation that significantly affects the traveller's current route.		
Preconditions:	A route is chosen by the traveller. There is a change in external situation that affects the ability of the traveller to complete the trip as planned.		
Postconditions:	The change is processed and the trip is changed. The new trip is completed.		
Normal Flow:	1. The traveller has chosen a route for a trip request (See #T2.1) 2. Before the trip starts and while the trip is ongoing, the app keeps track of all external conditions that may affect the trip's progress. Any change is being evaluated for a potential disruption that might affect the traveller's itinerary. 3. The trip change may be triggered by one of the following conditions becoming true: a. New external conditions have a major change to the factors that are important to the traveller's happiness (e.g. trip's comfort, crowdedness) b. New external conditions affect trip's characteristics (e.g. time of arrival, number of transfers, route, etc.) c. New external conditions prevent the trip from being completed (e.g. train cancellation). d. The traveller makes a change to their preferences. 4. When a change is detected, the app performs a new search of possible routes, using the newly available information. For the ongoing trip the app performs the search taking into account the next planned location of the traveller. 5. A notification pops up, the reason for update and the new route choices are shown. 6. The traveller chooses the new route, after which the use case resets to step 1.		
Alternative Flows:	Alternative Flow 1 1. The app detects the change and sends a notification. 2. The traveller receives the notification but does not react to it. 3. The app continues to monitor the conditions and constantly recalculates routes based on the current situation. 4. The traveller finally reacts. 5. If the trip is not yet complete the app proposes to modify the rest of the route. Alternative Flow 2		

	1. The app detects divergence and notifies the traveller about it with a pop-up notification. The app proposes to the traveller one of three choices: a. The app gives suggestion on how to return on track. b. The traveller modifies their trip details, the app recalculates the new route. c. Ticket cancellation and money return (if applicable). Alternative Flow 3 1. Something unexpected happens real time and the app is not informed about it yet. 2. The traveller can communicate the service providers of the application, letting them know of the unexpected event, in order to warn other fellow travellers. 3. The application validates the information and sends a notification to the interested travellers.
Exceptions:	No GPS available; the traveller doesn't want to change the route deliberately and mention it in the beginning of the journey.
Frequency of Use:	Trip tracking – High (every trip). Trip changes mid-trip – Low.
Special Requirements:	-
Notes and Issues:	-

Table 6: Activities proposition

Use Case ID:	#T2.3		
Use Case Title:	Activities' proposition		
Created By:	Eleni Antoniou	**Last Revision By:**	Arnau Prat-Pérez
Date Created:	19/3/2018	**Last Revision Date:**	09/4/2018
Actors:	Traveller		
Description:	Traveller needs to reach a specific destination and the app proposes activities during the route. Even when a disruption is detected, the app needs to recommend some updated activities, not only for the final destination, but also for the intermediate stations along the route. The traveller can also request about activities at destination or at any location of interest.		
Trigger:	The traveller opens the My-TRAC app, to be informed about activities during his/her trip or at destination.		
Preconditions:	1. The traveller is already registered in My-TRAC app.		
Postconditions:	-		
Normal Flow:	1. During a trip, My-TRAC app notifies the traveller with possible activities to be performed at trip locations (either because of waiting times or because of a disruption that provoked a delay). 2. The app proposes a list of activities to perform at the given location, personalized by based on his/her preferences and similar travellers' choices. a. The user decides not to do any activity and finishes. Otherwise, go to 3. 3. The user selects an activity in order to get more details about the activity (e.g. description, location, time, price, etc.). 4. The user confirms he/she wants to perform the activity, and the app triggers the process of booking such activity (#T4). 5. The user discards the activity and goes to 2.		
Alternative Flows:	Alternative Flow 1 1. The traveller asks about possible activities at a location of interest (current location, future station, destination, etc.). 2. Continue from point 2 of normal flow. Alternative Flow 2 1. The traveller does not have mobile internet connection. 2. The traveller can plan his/her trip before the departure. 3. The traveller saves the itinerary in "My trips" section. 4. The app can assist the traveller through his/her trip, without internet connection. 5. The traveller completes the trip. 6. The app stores it in the "Previous trips" section.		
Exceptions:	-		
Frequency of Use:	High		

Special Requirements:	The traveller has completed Use case #T1 and #T2.1
Notes and Issues:	-

Table 7: Navigation

Use Case ID:	#T2.4		
Use Case Title:	Navigation		
Created By:	Arnau Prat-Pérez	**Last Revision By:**	Joan Guisado-Gámez
Date Created:	09/04/2018	**Last Revision Date:**	11/04/2018
Actors:	Traveller		
Description:	The traveller has selected a route for a trip, which is ongoing.		
Trigger:	The traveller opens the My-TRAC app to get assisted on his/her trip.		
Preconditions:	1. The traveller has the My-TRAC app already installed. 2. The traveller has registered in My-TRAC app. 3. Mobile internet connection must be active when creating the trip. 4. GPS connection is available.		
Postconditions:	-		
Normal Flow:	1. The traveller opens the app and presses "Start a trip". 2. The app asks for permission to enable GPS location. 3. The traveller allows the connection. 4. The app shows: a. a map with the trip's route on top of it b. the current position of the traveller 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.) 5. The traveller can tap any location of the route in search for Activities (#T2.1) and/or Services (#T3.1) in that location.		
Alternative Flows:	Alternative Flow 1 1. The traveller opens the app while performing a trip. 2. The flow continues from point 2 of Normal Flow.		
Exceptions:	1. The traveller does not allow the connection with GPS. 2. 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.		
Frequency of Use:	Moderate/High		
Special Requirements:	-		
Notes and Issues:	-		

Table 8: Using My-TRAC app in a country other than home-country

Use Case ID:	#T2.5		
Use Case Title:	Using My-TRAC app in a country other than home-country		
Created By:	Alexandros E. Papacharalampous	**Last Revision By:**	Eleni Antoniou
Date Created:	22/05/2018	**Last Revision Date:**	24/05/2018
Actors:	Traveller		
Description:	The traveller is going abroad and wants to use My-TRAC app.		
Trigger:	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.		
Preconditions:	1. The traveller has created a trip (#T2.1) or an Itinerary (#T6). 2. The My-TRAC app operates in the country that the traveller is currently located at. 3. GPS geolocation and mobile data/Wi-Fi are activated.		
Postconditions:	-		
Normal Flow:	1. Traveller is travelling abroad and opens My-TRAC app. 2. The app detects that the traveller is at a country other than the home-country. 3. Traveller wants to plan a trip. 4. My-TRAC app reads appointments from the calendar and asks the traveller about new conditions at current country (hotel location, car availability) to which the traveller responds. 5. My-TRAC app and traveller interaction resume as in #T2.1. 6. My-TRAC app associates activities of traveller (determined at home location) with choices at current location. 7. After association of activities, My-TRAC app proposes activities to the traveller. 8. The traveller selects an activity resulting in a change of trip chain. 9. My-TRAC app calculates the rest of the trip given the new conditions. 10. Traveller decides to take public transport. 11. My-TRAC app enables real-time station identification to warn the traveller to alight.		
Alternative Flows:	**Alternative flow 1** 1. My-TRAC app reads appointments from the calendar and asks the traveller about new conditions at current country (hotel location, car availability) to which the traveller does not respond. 2. My-TRAC app and traveller interaction resume as in #T2.1 but car is not an option.		
Exceptions:	-		
Frequency of Use:	Low (depends on traveller)		
Special Requirements:	-		
Notes and Issues:	Traveller downloads the My-TRAC app while being abroad. Then the app resumes operations but without learning or storing information about the traveller.		

Table 9: Service providers' notifications

Use Case ID:	#T3		
Use Case Title:	Service providers' notifications		
Created By:	Arnau Prat-Pérez	**Last Revision By:**	Arnau Prat-Pérez
Date Created:	22/3/2018	**Last Revision Date:**	09/4/2018
Actors:	Traveller		
Description:	The app establishes a channel with the traveller which is used to notify him/her with available services and offers/discounts during his/her trip, tailored to his/her needs and interests. When such offers are available, a notification is sent to the traveller. Alternatively, the traveller can proactively request offers for nearby services or at specific places.		
Trigger	The app informs the system about the position of the traveller to the system, which detects offers and warnings that might be of the traveller's interest.		
Preconditions:	1. The traveller has the My-TRAC app already installed. 2. The traveller has registered in My-TRAC app. 3. Mobile internet connection must be active. 4. The traveller has completed use case #T1 and #T2.1.		
Postconditions:	The traveller has a list of one or more service offers.		
Normal Flow:	1. Given the traveller's current trip (if any) and its position, the system detects that the traveller would like to be informed of possible offers/discounts for services. 2. The app sends a push notification to the traveller's app notifying him/her with a message, that depends on the number of offers/discounts detected: a. Just one offer/discount: The message of the notification contains a summary of the offer. b. More than one offer/discount: The message of the notification contains a summary of offers/discounts available. 3. The traveller taps into the proposed offers notification (go to step 5) or closes the notification (finishes). 4. A screen with a list of the proposed offers/discounts is shown. Each entry of the list contains a summary of the offer. 5. A list of all the offers available is shown, sorted by potential interest based on traveller's profile. 6. The traveller taps into an offer of the list to see the detailed information about it (#T4).		
Alternative Flows:	1. The traveller accesses the "nearby offers/discounts" option. 2. A list of all the offers available is shown, sorted by distance to the traveller and potential interest based on traveller's profile. 3. The traveller taps into an offer of the list to see the detailed information about the offer.		
Exceptions:	-		
Frequency of Use:	Moderate/High		

Special Requirements:	Offers are provided by station operators.
Notes and Issues:	Offers may not be available because shop owners are not actors of the My-TRAC app. Adding offers should be resolved carefully outside of the current scheme. This is out of scope for this report.

Table 10: Payment transactions

Use Case ID:	#T4		
Use Case Title:	Payment transactions		
Created By:	Miguel Monteiro	**Last Revision By:**	Joan Guisado-Gámez
Date Created:	23/03/2018	**Last Revision Date:**	11/04/2018
Actors:	Traveller		
Description:	The traveller pays for several items using the app, including transport tickets, services and activities.		
Trigger	The traveller selects an item he/she wishes to purchase. This item can either be the tickets from a route (#T2.2), an Activity (#T2.2) or a Service (#T3.1).		
Preconditions:	1. The traveller must have the application installed on his/her mobile phone. 2. Network connection must be active. 3. The traveller has not bought the ticket yet. 4. The traveller must have one of the supported payment means (i.e. PayPal, credit card, etc.).		
Postconditions:	-		
Normal Flow:	1. The traveller opens the app and taps the "purchase an item" option. 2. The app shows a list of categories of items (e.g. tickets, activities or services). 3. The traveller chooses the item he/she is willing to purchase. 4. The app presents a description of the item and its price. 5. The traveller chooses to pay and selects a payment method. a. The app redirects the traveller to the specific payment gateway (credit card, PayPal, etc.). b. The traveller confirms the payment. 6. The traveller receives the receipt. 7. The app stores the purchased item and receipt. 8. The app keeps track of the items that the traveller has bought on a section "My previous items".		
Alternative Flows:	-		
Exceptions:	The traveller has no payment method.		
Frequency of Use:	Moderate		
Special Requirements:	-		
Notes and Issues:	The traveller should have a means to list all the purchased items at any moment and retrieve the receipts.		

Table 11: Communication with MaaS and 3rd party services

Use Case ID:	#T5		
Use Case Title:	Communication with MaaS and 3rd party services		
Created By:	Viktoriya Degeler	**Last Revision By:**	Alexandros E. Papacharalampous
Date Created:	23/03/18	**Last Revision Date:**	22/05/2018
Actors:	Traveller		
Description:	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.		
Trigger	The traveller started the process of creating a new trip (#T2.1).		
Preconditions:	Same as (#T2.1).		
Postconditions:	1. Route alternatives are found. 2. Current conditions of each alternative are assessed.		
Normal Flow:	1. The traveller starts trip planning by entering origin/destination and trip characteristics or restrictions (time, mode preference, etc.) (See #T2.1). 2. The traveller wants to use a MaaS service. 3. My-TRAC app communicates with the app requesting the service. 4. My-TRAC app requests from the traveller to share his/her information with the MaaS in order to do the booking. 5. Traveller accepts. 6. My-TRAC performs the booking and notifies the traveller (with information about pick-up, costs, live location etc.).		
Alternative Flows:	Alternative Flow 1 1. MaaS requests that the traveller is redirected to another app to perform the booking 2. My-TRAC app notifies the traveller about switching apps. 3. My-TRAC monitors the trip passively showing options along the path (#T2.2, #T2.3).		
Exceptions:	Traveller does not accept to share information with MaaS so My-TRAC app provides alternatives		
Frequency of Use:	High (Every time an app is used to find a route)		
Special Requirements:	Each connection to a MaaS service must be examined separately to determine possibility of data exchange especially in the case when the user switches app		
Notes and Issues:	-		

Table 12: Itinerary creation and manipulation (Trip chain)

Use Case ID:	#T6		
Use Case Title:	Itinerary creation and manipulation (Trip chain)		
Created By:	Viktoriya Degeler	**Last Revision By:**	Arnau Prat-Pérez
Date Created:	06/04/18	**Last Revision Date:**	10/04/18
Actors:	Traveller		
Description:	The traveller plans a long and complex travel (e.g. vacation), that consists of several individual trips. My-TRAC app keeps track of individual trips and if a change occurs in one trip, the app may propose mitigating changes in other trips.		
Trigger	The traveller plans a complex travel that consists of several trips.		
Preconditions:	Origin/destination/a set of intermediate destinations and other itinerary restrictions are known.		
Postconditions:	The itinerary is successfully executed.		
Normal Flow:	1. The traveller starts a complex itinerary planning, by entering origin/destination/a set of intermediate destinations and trip characteristics or restrictions (e.g. strict/loose order of intermediate destinations, time periods in which the trip may be created, preferred modes of transportation, etc.) (#T2.1). 2. The app creates several alternative propositions of the itinerary, based on given restrictions, using the following information for each viable itinerary: a. The exact route of the trip is chosen as defined in #T5.1. b. In between trips, the My-TRAC app seeks and proposed activities as defined in #T2.2. 3. If the number of viable alternatives is large, the app choses the ones that are calculated to be the most fitting according to the traveller's characteristics and presents these alternatives to the traveller. 4. The traveller has the ability to change the individual trips within the itinerary without affecting the whole itinerary. 5. For every trip in the itinerary the app tracks the possible changes or disruptions, as defined in #T5.2. If a disruption is detected, the app not only updates the current trip, but also checks and updates (if affected) the related trips within the itinerary.		
Alternative Flows:	Alternative Flow 1 1. The itinerary is being started but is not completed. 2. My-TRAC app asks the traveller if he/she will continue the trip as planned. 3. The traveller does not respond. 4. The app detects the abandonment of the itinerary and stops proposing changes and next trips to the traveller. Alternative Flow 2 1. The traveller plans two different trips within a close timeframe, but with the destination of the first trip being different to the origin of the second trip. The app detects that a possible trip leg is missing and proposes to the traveller to add a missing leg to the itinerary. The addition follows the logic of T2.1.		

Exceptions:	
Frequency of Use:	Low-Medium.
Special Requirements:	The trips are not so far into the future so that the My-TRAC app is able to find recent and relevant information from the 3rd party services.
Notes and Issues:	-

Table 13: Traveller's feedback and recommendations (My-TRAC rating system)

Use Case ID:	#T7		
Use Case Title:	Traveller's feedback and recommendations (My-TRAC rating system)		
Created By:	Eleni Chalkia	**Last Updated By:**	Joan Guisado-Gámez
Date Created:	22/3/2018	**Last Revision Date:**	09/04/2018
Actors:	Traveller		
Description:	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 the following: a. Accuracy and reliability of information. b. Usefulness of information in the trip process. c. System usability. d. Possibility of recommending the application to others. e. Emotions that emerge while using the application.		
Trigger	After the user has realised a trip, My-TRAC mobile application asks for feedback by means of a pop-up notification, using the feedback and recommendations module.		
Preconditions:	1. The traveller must have the application installed in his/her mobile phone. 2. Network connection must be active. 3. The traveller is familiar with the application and has used it at least once.		
Postconditions:	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.		
Normal Flow:	1. The traveller has reached a destination. 2. The system asks the traveller to rate the My-TRAC application, by a pop-up window. 3. The traveller accepts to rate My-TRAC application by clicking "Rate My-TRAC". 4. The system asks the traveller a set of questions related to his/her overall experience when using the application, about the following: a. Accuracy and reliability of information. b. Usefulness of information in the trip process. c. System usability. d. Possibility of recommending the application to others. e. Emotions that emerge while using the application. 5. The traveller rates the application answering to every question. 6. The system asks the traveller to provide recommendations for the system in descriptive format. 7. The traveller adds a recommendation and clicks on the "Finish" icon. 8. The application receives the information and stores it.		

Alternative Flows:	Alternative Flow 1 3. The traveller rejects to rate My-TRAC application by clicking "Not Now". Alternative Flow 2 3. The traveller rejects to rate My-TRAC application by clicking "Never Ask Again". Alternative Flow 3 1. The traveller is using the app and receives recommendations. 2. The system sends (push) messages to the traveller, asking him/ her to rate the trip and the recommendations of other travellers provided to him/her, , related to the following issues: a. Accuracy and reliability of information. b. Usefulness of information in the trip process.
Exceptions:	1. The traveller rejects to rate My-TRAC application by clicking "Never Ask Again". 2. The traveller changes his/ her mind and wants to provide feedback related to My-TRAC app. 3. The traveller visits "My Profile" section. 4. The check box "disable My-TRAC Rating system" is checked. 5. The traveller checks the "My-TRAC Rating system enable". 6. The check box "disable My-TRAC Rating system" is automatically unchecked.
Frequency of Use:	To be defined.
Special Requirements:	-
Notes and Issues:	-

Table 14: Group creation

Use Case ID:	#T8.1		
Use Case Title:	Group creation		
Created By:	Joan Guisado-Gámez	**Last Updated By:**	Eleni Antoniou
Date Created:	22/3/2018	**Last Revision Date:**	24/5/2018
Actors:	Traveller		
Description:	A traveller wants to create a group with other users of My-TRAC and wants to perform one or more trips with them.		
Trigger	The traveller creates a new group.		
Preconditions:	1. The traveller has the My-TRAC app already installed. 2. The traveller has registered in My-TRAC app. 3. Mobile internet connection must be active. 4. Every member of the group has previously registered in My-TRAC app and has a profile. 5. Every traveller of the group has completed Use case #T1.		
Postconditions:	• A group is created and all the travellers of the group are informed. • 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 trip 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 #T2.1.		
Normal Flow:	1. The traveller goes to the Group section of My-TRAC. 2. The traveller selects to create a new group. The traveller starts typing his/her traveller partner's username/email in the "Add a new member" text box. 3. As the traveller types, the system shows a drop-down list with previously co-travellers first and with the usernames of those registered, that match with the letters typed by the traveller. 4. The traveller selects a traveller partner. 5. The text box is filled with the selected traveller. 6. The system asks the traveller if he/she wants to add more members to the group. a. Go to Step 3 until all members of the group have been added. b. The traveller presses the Confirm Group button when all members are added. 7. The system informs the members about the invitation of the admin, with a notification on their screen. 8. The selected travellers accept the invitation and the group is created. 9. The admin has the option to name the group and add a picture to it. 10. 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.		
Alternative Flows:	Alternative Flow 1		

	4. 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. Alternative Flow 2 8. Traveller declines the invitation. 10. The app informs the admin about the rejection of the selected traveller and asks him/her if he/she wants to add another one. 11. The admin adds a new one, which accepts the invitation. 12. The rest of the travellers accept and the group is created.
Exceptions:	-
Frequency of Use:	Low/Moderate (under user demand)
Special Requirements:	-
Notes and Issues:	-

Table 15: Group modification: Adding a new member

Use Case ID:	#T8.2		
Use Case Title:	Group modification: Adding a new member		
Created By:	Joan Guisado-Gámez	**Last Updated By:**	Alexandros E. Papacharalampous
Date Created:	9/4/2018	**Last Revision Date:**	10/5/2018
Actors:	Traveller		
Description:	A group member wants to modify the current configuration by adding a new member.		
Trigger	The traveller creates a new group and/ or a group member invites a new member to join an existing group.		
Preconditions:	1. The traveller has the My-TRAC app already installed. 2. The traveller has registered in My-TRAC app. 3. Mobile internet connection must be active.		
Postconditions:	The group is modified.		
Normal Flow:	1. The traveller goes to the Group section of My-TRAC. 2. The traveller selects "My Group Trips". 3. The traveller selects one of the groups where he/she participates. 4. The traveller selects the "Add a new member" 5. The traveller starts typing his/her traveller partner's username/email or other identification in a text box. 6. As the traveller types, the system recommends usernames in a drop-down list. 7. The traveller selects a traveller partner from the recommendations. 8. The text box is filled with the selected traveller. 9. Go to Step 4 until all members of the group have been added. 10. The traveller presses the "Modify Group" button. 11. The admin of the group accepts the modification. 12. The system informs the new members that are now part of the group.		
Alternative Flows:	Alternative Flow 1 6. The system does not find any traveller with the given username. 7. The system informs that the introduced username does not exist and proposes to invite the member to download the My-TRAC app.		
Exceptions:	-		
Frequency of Use:	Low/Moderate (under user demand)		
Special Requirements:	Every traveller of the group has completed use case #T1.		
Notes and Issues:	-		

Table 16: Group modification: Remove a member

Use Case ID:	#T8.3		
Use Case Title:	Group modification: Remove a member		
Created By:	Joan Guisado-Gámez	**Last Updated By:**	Eleni Antoniou
Date Created:	9/4/2018	**Last Revision Date:**	22/5/2018
Actors:	Traveller		
Description:	The admin of a group wants to modify the current configuration by removing a member.		
Trigger	The traveller creates a new group.		
Preconditions:	1. The traveller has the My-TRAC app already installed. 2. The traveller has registered in My-TRAC app. 3. Mobile internet connection must be active. 4. The traveller is the admin of an existing group. 5. Every traveller of the group has completed use case #T1 and use case #T8.1.		
Postconditions:	The group is modified.		
Normal Flow:	1. The traveller goes to the Group section of My-TRAC. 2. The traveller selects "My Group Trips". 3. The traveller selects one of the groups from which he/she is the admin. 4. The traveller selects the "Remove a group member" option. 5. The admin traveller selects which travellers he/she wants to remove within the group. 6. The admin traveller presses "Confirm modification". 7. The system informs the members of the group that a member has been removed with a notification.		
Alternative Flows:	Alternative Flow 1 3. A traveller, which is not the admin of the group wants to be removed from a group trip. 4. The traveller selects the group trip that he/she wants to be deleted from. 5. The traveler selects "Leave the group" option". 6. The application asks to confirm this decision. 7. The traveller confirms and he/she is deleted successfully. 8. The admin receives a message that the traveller has been removed. Alternative Flow 2 3. The admin of the group wants to be removed from the group trip. 4. He/she informs the system by pressing the "Leave the group" option". 5. 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. 6. A notification appears on the screen of the chosen group member. 7. The group member accepts or declines the suggestion.		
Exceptions:	-		

Frequency of Use:	Low/Moderate (under user demand)
Special Requirements:	-
Notes and Issues:	-

Table 17: Group deletion

Use Case ID:	#T8.4		
Use Case Title:	Group deletion		
Created By:	Eleni Antoniou	**Last Updated By:**	Ismini Stroumpou
Date Created:	24/5/2018	**Last Revision Date:**	25/05/2018
Actors:	Traveller		
Description:	The admin of a group wants to delete completely an entire group.		
Trigger	The traveller creates a new group.		
Preconditions:	1. The traveller has the My-TRAC app already installed. 2. The traveller has registered in My-TRAC app. 3. Mobile internet connection must be active. 4. The traveller is the admin of the group.		
Postconditions:	-		
Normal Flow:	1. The traveller goes to the Group section of My-TRAC. 2. The traveller selects "My Group Trips". 3. The traveller selects one of the groups from which he/she is the admin. 4. The traveller selects the "Delete group" option. 5. My-TRAC app asks for confirmation. 6. The admin traveller presses "Confirm deletion". 7. The system informs the members of the group that the group no longer exists, with a notification on their screen.		
Alternative Flows:	-		
Exceptions:	6. The admin traveller presses "Cancel deletion".		
Frequency of Use:	Low/Moderate (under user demand)		
Special Requirements:	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.		
Notes and Issues:	-		

Table 18: Erase traveller's profile

Use Case ID:	#T9.1		
Use Case Title:	Erase traveller's profile		
Created By:	Joan Guisado-Gámez	**Last Revision By:**	Alexandros E. Papacharalampous
Date Created:	03/05/2018	**Last Revision Date:**	10/5/2018
Actors:	Traveller		
Description:	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.		
Trigger:	The traveller goes to its profile section and selects the option of deleting its own profile.		
Preconditions:	1. The traveller must have the application installed on his/ her mobile phone. 2. Mobile internet connection must be active. 3. The traveller has a profile in My-TRAC.		
Postconditions:	The user and all data about the user are deleted.		
Normal Flow:	1. The traveller opens My-TRAC app. 2. The traveller goes to Profile section of My-TRAC app. 3. The traveller selects "Erase my profile" option. 4. The systems requests confirmation that the traveller wants to completely delete the profile by warning that the operation cannot be undone. 5. The traveller confirms. 6. The system deletes every personal data about the user and removes him/her from the database.		
Alternative Flows:	-		
Exceptions:	5. The traveller cancels.		
Frequency of Use:	Low (only once)		
Special Requirements:	-		
Notes and Issues:	-		

Table 19: Request personal data

Use Case ID:	#T9.2		
Use Case Title:	Request personal data		
Created By:	Joan Guisado-Gámez	**Last Revision By:**	Alexandros E. Papacharalampous
Date Created:	03/05/2018	**Last Revision Date:**	10/5/2018
Actors:	Traveller		
Description:	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.		
Trigger:	The traveller goes to its profile section and clicks on the "Request data" button.		
Preconditions:	1. The traveller must have the application installed on his/ her mobile phone. 2. Mobile internet connection must be active. 3. The traveller has a profile in My-TRAC.		
Postconditions:	Every single piece of information about the user is sent to the user.		
Normal Flow:	1. The traveller opens My-TRAC companion. 2. The traveller goes to Profile section of My-TRAC. 3. The traveller selects "Request data". 4. My-TRAC indicates that the personal data will be sent to the mail that the traveller used to register into My-TRAC. 5. The system sends the personal data to the traveller's mail. 6. The traveller receives his/her personal data.		
Alternative Flows:	-		
Exceptions:	-		
Frequency of Use:	Low		
Special Requirements:	-		
Notes and Issues:	-		

4.2.2 OPERATOR'S USE CASES

Table 20: Operator's registration

Use Case ID:	#O1		
Use Case Title:	Operator's registration		
Created By:	Emy Apostolopoulou	**Last Updated By:**	Joan Guisado-Gámez
Date Created:	23/3/18	**Last Revision Date:**	12/4/2018
Actors:	Operator (OP)		
Description:	The operator registers in the platform with required documents (e.g. proof of legal entity status, proof of registration as a transport operation under the national law etc.)		
Trigger	The operator accesses the operator's platform and clicks sign up to start registration process.		
Preconditions:	The operators must have a network connection.		
Postconditions:	GDPR compliance		
Normal Flow:	1. The operator opens the operator's portal for the first time and a sign up/ log in screen appears. 2. The platform asks the operator to subscribe using an email. 3. The operator inserts his/her email address and defines a password. 4. The portal requests information (i.e. operator company's name, username, operator's official email, second email (optional)). 5. The operator fills in all the required information. 6. The platform requests from the operator to provide a list of documents (e.g. VAT registration number, proof of legal entity status, proof of registration as a transport operator under the national law etc.). 7. The operator uploads the required documents in a specific format. 8. The system sends email to operator's given email to verify registration. 9. The operator sends an automated verification message to platform. 10. After the verification, the operator logs in. 11. A "terms and condition" screen appears. 12. The operator accepts them in order to proceed and use the platform. 13. The portal presents two options "see users' information" and "provide information".		
Alternative Flows:	Alternative Flow 1 6. The operator does not send the automated verification message. 7. The platform sends message reminding the operator to verify its registration. Alternative Flow 2 10. The registration process fails for whatever reason (e.g. the operator does not get the confirmation e-mail). 11. The operator contacts the online support. 12. Online support categorizes the problem and assists the operator to solve it. 13. Operator tries again to register successfully.		

	Alternative Flow 3 7. The documents provided by the operator are not confirmed or not uploaded in a specific format (pdf). 8. The platform shows a "please check the documents and upload them again if needed" message. 9. The operator uploads the right documents this time. 10. The flow continues from step 8 of Normal Flow.
Exceptions:	Interruption of communication between servers of platform and operator.
Frequency of Use:	Low (only once)
Special Requirements:	Back-up restoration
Notes and Issues:	Constant log. 24/7

Table 21: Operator's visualization of statistics

Use Case ID:	#O2		
Use Case Title:	Operator 's visualization of statistics		
Created By:	Emy Apostolopoulou	**Last Updated By:**	Joan Guisado-Gámez
Date Created:	23/3/18	**Last Revision Date:**	11/4/18
Actors:	Operator (OP)		
Description:	The operator demands information related to users' travel behaviour and preferences from the platform database.		
Trigger	Exploitation of user-inserted info (e.g. itinerary, access/egress modes, ticket option preferences, interest on special offers and special events, interaction with other services, preferred activity at interchanges or major stations, user feedback, complaints and recommendations).		
Preconditions:	Operator has registered in the operator's platform.		
Postconditions:	-		
Normal Flow:	1. Operator opens the operators' portal & logs in. 2. Operator chooses "Get statistics" option. 3. The portal allows selecting those statistic that can be or have been calculated as the required data is available. 4. Operator chooses the statistics that is willing to visualize. 5. The portal returns the desired statistics.		
Alternative Flows:	Alternative Flow 1 1. Operator opens the operators portal & logs in. 2. The log in fails. 3. The operator's portal requires again the log in.		
Exceptions:	Interruption of communication between servers of platform and operator.		
Frequency of Use:	High		
Special Requirements:	Operator alert when aggregated post-incident user information is available.		
Notes and Issues:	-		

Table 22: Operator's information provision

Use Case ID:	#O3		
Use Case Title:	Operator's information provision		
Created By:	Emy Apostolopoulou	**Last Updated By:**	Joan Guisado-Gámez
Date Created:	23/3/18	**Last Revision Date:**	9/4/2018
Actors:	Operator (OP)		
Description:	The Operator uploads data, announcements and information to the operator's portal (e.g. runs and directionality, real-time Automatic Vehicle Location) to update the information used by My-TRAC companion.		
Trigger	The operator accesses My-TRAC's platform in order to upload important information.		
Preconditions:	Operator has registered in the operator's platform.		
Postconditions:	1. Data is saved in to the platform. 2. Data is processed and analysed. 3. Decisions on what information has to be pushed to the travellers is taken.		
Normal Flow:	1. Operator opens the operator's portal and logs in. 2. Operator chooses "Introduce data" option. 3. . 4. Operator selects the kind of data that wants to upload/share. (e.g. train runs between terminal stations, directionality, real time AVL location / timestamp, Operator Control Centre (OCC) info, planned schedule versus real-time schedule, weight of trains, maps, schedules). 5. Operator uploads/shares the data to the platform. 6. The platform will push the relevant information to the users.		
Alternative Flows:	-		
Exceptions:	Interruption of communication between servers of platform and operator.		
Frequency of Use:	High		
Special Requirements:	-		
Notes and Issues:	-		

4.3 General Functionalities

Functionalities are used to describe the services that are being provided and the way they are useful to satisfy the user needs from a general point of view. Table 23 contains all the general functionalities derived from the storylines and the use cases. The functionalities are then analysed for both the travellers and the operators.

Table 23: General Functionalities of the My-TRAC products

TRAVELLER (My-TRAC app)
#F1: Traveller's registration or sign-in (with e-mail or Facebook)
#F2: Traveller's profile and preferences' scheme creation and association
#F3: Recommendations provision to the traveller
#F4: Trip tracking and navigation
#F5: 3rd party services connection, service providers' notifications and ticketing
#F6: Network changes update, based on location
#F7: Group recommendations
#F8: Traveller's feedback
#F9: GDPR compliance
OPERATOR (My-TRAC operator's platform)
#F10: Operator's registration with necessary documents provided and profile's creation or log in
#F11: Operator's announcements and data provision
#F12: Operator's information demand
#F13: Operator's feedback

4.3.1 Travellers' App Functionalities

F1: Traveller's Registration or sign in (with e-mail or Social Media)

When the traveller downloads the My-TRAC app and decides to subscribe, the app shows a sign-up screen with two options "Create an account" and "Sign up with social media" account (e.g., Facebook. Twitter) or simply by "Sign up with e-mail". If he/she presses the first option, the app requests the following information (to be reviewed): full name, username, mail, password. If the username is already used, the traveller is asked to type a new one. Then, the traveller is asked to retype his/her password and if it matches the original, a confirmation mail is sent to his/her inbox.

Otherwise, if he/she presses "Sign up with social media", the application requests the login information of the corresponding account and asks permission to collect information. The registration is completed, and a confirmation mail is sent to authenticate the user. The traveller has the option to change the email address provided by the social media and add another one. The traveller has also the option to revoke the connection anytime.

In the case that the traveller has registered manually (without connection to social accounts), the application requests connection to Facebook, in order to collect useful information about his/her current state and preferences.

If the traveller does not allow connection, he/she is given the option of answering only the questionnaire, which is mandatory in any case. Finally, a "terms and conditions" document appears that the traveller has to accept in order to proceed and use the app.

On the other hand, if the traveller already has an account, he/she presses "Log-in" button and if the username and the password are correct, he/she access to the application and stays logged in continuously. Whenever the information inserted is wrong, a message "username or password are wrong, please insert them again" appears. Underneath the "insert password" box, the traveller can click "forgot my password", and he/she can receive a mail with a new temporary password and instructions of creating a new one.

F2: TRAVELLER'S PROFILE AND PREFERENCES' SCHEME CREATION AND ASSOCIATION

As described above, the travellers allow access to their social media, if they want. This not only eases the registration of the user, but it also contributes in extracting data and information to predict traveller's behaviour and activities (always ensuring data privacy). A traveller's preferences scheme is created and the server collects, stores and analyses information about traveller's preferences and current state to improve its recommendations. But, if the traveller does not allow the connection of My-TRAC with social accounts, the preferences scheme is created based on the answers provided in the questionnaire, on his/her previous trips, groups and on information derived from people of the same age, educational attainment and country of origin. At this point, it is crucial for the traveller to declare any special need (e.g., reduced vision, use of wheelchair, etc.), so that the application can take them into consideration and adjust its results.

A profile visible to the users is also created, based on the answers of the questionnaire that includes the basic information about the traveller (age, occupation, country, etc.), his/her preferences scheme, previous completed trips and groups that he/she participated in and any other information that the traveller has provided. The profile is associated with the preferences' scheme and enriched by the connection to the social media. The traveller is able to edit the profile (add/delete information) and he/she can also disable the connection with his/her social media and calendar, anytime.

F3: RECOMMENDATIONS PROVISION TO THE TRAVELLER

When the traveller inserts the origin and destination point of his/her trip, the application compares different travel options and combines them, in order to provide personalised recommendations, according to the traveller's preferences and travel happiness. The app's response contains travel modes, routes, transfer/interchange locations, estimated time of arrival and cost of the trip. Along with the trip propositions, My-TRAC app also provides non-transport related information for the traveller to perform, either at a location of interest, or at intermediate station (due to interchange or delay), such as coffee places, tourist information, shops etc. The traveller selects the best option for his/her trip and follows the directions and advice of My-TRAC. When a traveler uses the My-TRAC application, the level of understanding of My-TRAC's algorithms increases, leading to better recommendations and choices predictions.

In the event of lack of internet connection, the traveller can start planning his/her trip before the time of departure and then save the itinerary at "My trips". In this way, he/she is able to reach all the necessary information about the tour and have a guidance throughout the trip, without Wi-Fi. When the trip is completed, it is stored at the "Previous trips" section.

F4: TRIP TRACKING AND NAVIGATION

When the traveller presses "Start a trip", the message "My-TRAC app needs your permission to enable GPS location" appears in the screen, in order to locate and guide the traveller through the trip. If the traveller presses "Allow" then the app can extract the best possible travel option for the specific traveller, locating his/her exact spot and provide him/her with recommendations about nearby places of interest or disruption along the route. The application should also be able to provide reliable assistance in foreign countries by enabling stations' identification (indicating the arrival station).

On the other hand, the traveller can open the application, during the trip and not before. In this case, My-TRAC first locates the exact place of the traveller and then adjusts its recommendations, based on the location.

F5: 3RD PARTY SERVICES CONNECTION, SERVICE PROVIDERS' NOTIFICATIONS AND TICKETING

My TRAC app has the ability to connect and interact with all the apps and service providers that assist to improve the travel experience. 3rd party services can be anything that adds value to the trip of the traveller. It incorporates transaction services for buying tickets, so that the traveller can accept both trip and ticket with one click. For example, when a traveller wants to plan a trip abroad he/she can choose the preferred transport mode and then buy the tickets through the application, book accommodation (e.g., Airbnb), call a taxi (e.g., Uber) or use MaaS.

The application will have access to 3rd party APIs to collect data about weather conditions, public transport schedules (from the operators' platform) and more to better suggest routes and modes.

Additionally, My-TRAC supports enhanced interactions between travellers and a set of service providers during the trip (e.g., offering tailored discounts to the customer for taxi, hotel or museums, access to Wi-Fi in stations).

F6: NETWORK CHANGES UPDATE, BASED ON LOCATION

My-TRAC app detects and warns the traveller about possible disruptions or delays during a trip (in collaboration with the operators). First, a warning message or notification appears at the screen of the traveller and meanwhile a calculation of new possible modes, routes and time of departure is performed, using the newly available information. The traveller clicks his/her favourite option from the provided list and the trip continues in order to be successfully completed. In the case of a slight modification, the traveller is given the choice of waiting and not changing his/her original route. Activities at the waiting point are proposed, based on the traveller's profile. My-TRAC app also offers the alternative of ticket's cancellation and money return if applicable.

There is also the possibility of the traveller changing the planned route by his/her own will. In this case the app warns the traveller and offers him/her two options, either to return back on track or to recalculate the route, from this point (connection with F4 "Trip tracking and navigation").

F7: GROUP RECOMMENDATIONS

Once a traveller wants to create a group, he/she can visit the Group section of My-TRAC app in order to add other members, already registered in My-TRAC. When the traveller presses the "Create a group" button, a list of his/her previously added co-travellers appears to choose from, otherwise the traveller can write the username or the e-mail address of the travel partner. the traveller iterates the process until all members are added and then he/she completes the creation of the group by pressing the "Confirm group" button. Once the group is created, all the members must accept the invitation of the admin traveller that appears in their screen as a notification. The admin of the group can also edit the group by adding or deleting members or confirming/rejecting additions and removals made by members of the group.

After the creation of the trip, in the database of the system 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 trip that meet all member's preferences. From this moment on, the group is handled by My-TRAC as a single traveller. My-TRAC will also be able to propose both personalized and group-wise recommendations, so that the members can perform personal activities, without the rest of the group, or create two new subgroups inside the main group for specific activities (e.g., some may want to visit a museum while the others prefer to watch a football match).

F8: TRAVELLER'S FEEDBACK

The creation of means of mutual communication for suggestions, ratings and reviews is necessary, for continuous improvement and update of the application and its recommendations. It is also important to receive feedback from people who are already using the app. The best way to achieve that, is by embedding feedback tools in the app, allowing the people to provide feedback as they are using the application. In this way, we are ensuring that they can provide up to date, valuable and targeted feedback. Providing feedback should be made easy, for example with a five-star rating system or a smiley face. My-TRAC should provide targeted and minimum feedback requests. The travellers are also able to rate the recommendations provided by other users of the app, either writing a comment or with a like/dislike button.

F9: GDPR COMPLIANCE

My-TRAC must follow the regulation of GDPR and protect the personal and sensitive data of the travellers. Specifically, the traveller is able to retrieve all the personal data that My-TRAC platform has about him/her anytime. The traveller visits his/her profile and presses the "Request data" button. The application informs the traveller that the data will be sent on the email address that was used for the registration and when the traveller accepts, he/she receives his/her data, according to GDPR.
Additionally, the traveller can erase his/her profile and all of his/her personal data. In the same way, the traveller visits his/her profile, where he/she requests to erase his/her profile entirely. The application asks for confirmation and when the traveller accepts, the profile and the personal data are deleted completely and the traveller is removed from the database, according to GDPR.

Figure 12 presents schematically the relationships between storylines (S), use cases (T) and functionalities (F) as it explained in Section 3.

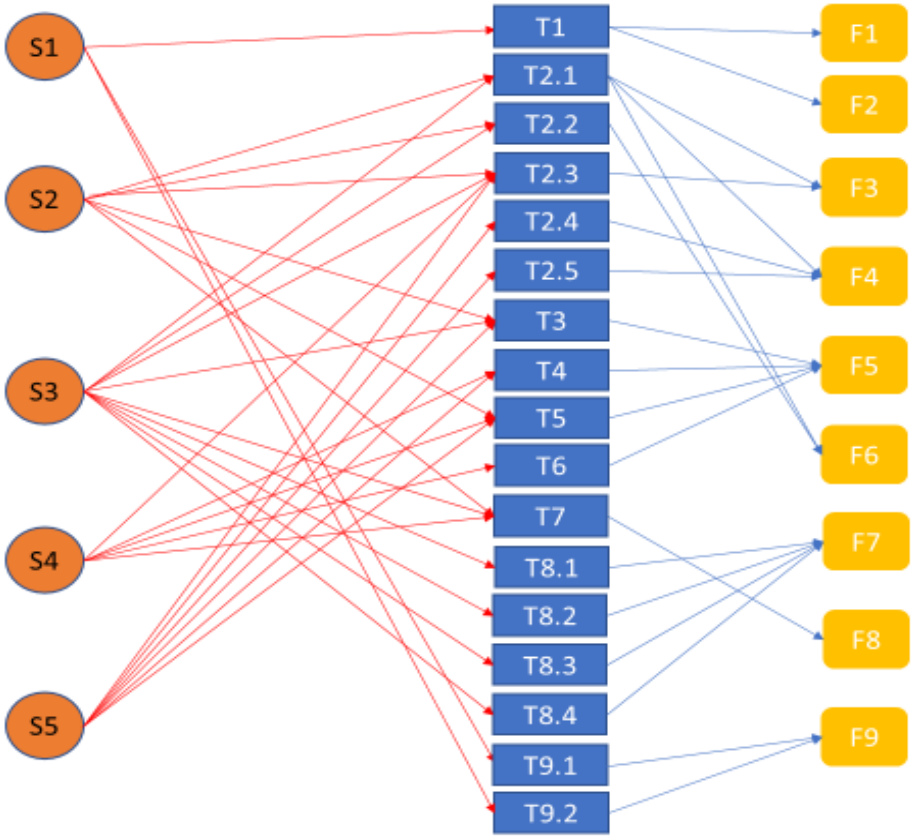


Figure 12: Association of storylines, use cases and functionalities for travellers

4.3.2 OPERATORS' PLATFORM FUNCTIONALITIES

F10: OPERATOR'S REGISTRATION WITH NECESSARY DOCUMENTS PROVIDED AND PROFILE'S CREATION OR LOG IN

The operator opens the My-TRAC platform and encounters a "sign- up" or "login" screen. If the operator chooses registration, he/she then needs to insert the name of the operator's company, the operator's official email, a username and a password. In order to get verified, operators will be requested to provide a list of documents (such as VAT registration number, proof of legal entity status, proof of registration as a transport operator under the national law etc.). A verification message, which has to be accepted to be successfully registered, is sent to the operator's official email. If any of the provided information is found false, a message "please insert information again" appears, and if any of the documents is not confirmed or not uploaded in a specific format (pdf) a message "please check the documents and upload them again if needed" is shown. Every time a new operator gets registered a profile is created in the database to store the all the provided information and previous searches.

If an operator is already registered when he/she enters the platform, he/she just clicks on the "Log-in" button and if the inserted username and password are correct, he/she is allowed access. Otherwise, a message "username or password is wrong, please insert them again" appears. Underneath the "insert password" box, the operator can click "forgot my password", and he/she can receive a mail with a new temporary password and instructions of creating a new one.

F11: OPERATOR'S ANNOUNCEMENTS AND DATA PROVISION

The operator enters the My-TRAC platform and chooses "Upload/Share information" option. Afterwards, a standardised UI (e.g., an interactive map) appears where the operator can select the kind of information to be uploaded or the data is automatically ingested via a rest API. The system then analyses, categorizes them (if it concerns stations, routes, delays, etc.) and stores them for future use. The operator has also the choice of characterizing the information as announcements. This way the system is informed that it must notify the travellers as soon as possible with a message or a notification. It is worth mentioning that the notification must pop up only to travellers concerned about the announcement. Information concerning future events can be stored and appear both at travellers and at other operators, at the "news and updates" section.

F12: OPERATOR'S INFORMATION DEMAND

The operators can also retrieve real-time and historic data concerning behavioural analytics of travellers. In the section "Request information" the operator can type his/hers search terms at the search bar and retrieve visualisations for the term that the operator was looking for. Those data that are visualised have been extracted mainly from the travellers (from their everyday trips, their preferences and the provided information) but also by other operators that have already uploaded relevant information or 3rd party data that have been retrieved during the course of My-TRAC operations (e.g., road closures). The operator can select different ways of visualising the results. The platform can store the searches of each operator in the corresponding profile and send a notification every time new data is available.

F13: OPERATOR'S FEEDBACK

Equally important is the provision of feedback and recommendations from the operators, for the improvement of My-TRAC platform. With a five-star rating system the operators can express their satisfaction from the services of the platform (e.g. how up-to-date are the provided data) and with the completion of a questionnaire or a comments box, they can offer their reviews, suggestions, changes and improvements. This communication between the operators and the platform is crucial for the continuous improvement and update of My-TRAC and it should be easy, without constant requests of rating or answering questions.

Figure 13 presents schematically the relationships between storylines (S), use cases (O) and functionalities (F) as it explained in Section 3.

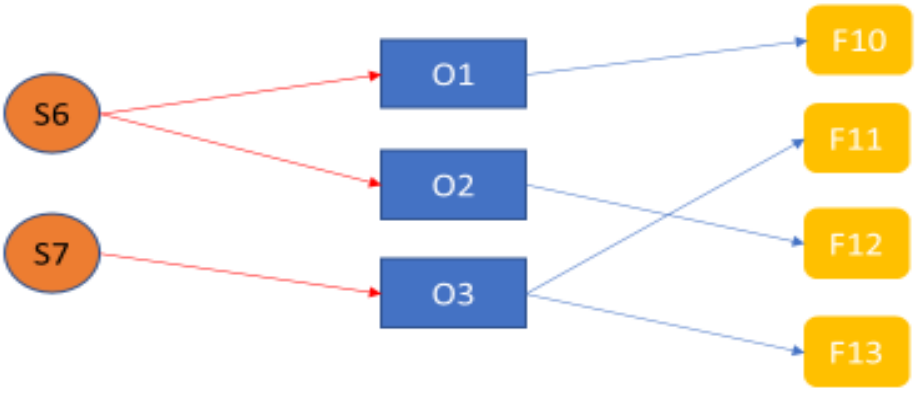


Figure 13: Association of storylines, use cases and functionalities for operators

4.3.3 PRESENTATION OF GENERAL FUNCTIONALITIES IN SEQUENCE DIAGRAMS

The sequence diagrams assist on depicting the basic functionalities derived from the storylines and use cases. Below, the sequence diagrams are presented as described in Section 3. They allow the presentation of most of the general functionalities of the traveller's app and operator's platform, in one storytelling figure which provide the added value of understanding how each functionality fits into the overall picture of My-TRAC. The coloured boxes at the right side of the figure, are the identified general software components of My-TRAC that will be in charge of a subset of responsibilities.

The first sequence diagram (**Error! Reference source not found.**) displays the possible actions of a traveller while using the app and how the other parts of the system react to them. The object initiating the sequence of messages is the traveller and the rest lifeline notations are 3 parts of the system, the 3rd party services, the My-TRAC application and the database. More specifically, the traveller registers to the application and receives an e-mail from the app that confirms access (Sign-up/in component). During the registration, he/she allows My-TRAC to connect with his/her Facebook account, in order to retrieve information to create the preferences' scheme. Additionally, after answering the questionnaire, a profile of the traveller is created (Profile creation component). The traveller is now ready to start a trip and he/she decides to call an Uber. This action defines a new software component of the app, the connection with 3rd party services. After the trip's information provision to the application, such as start point, destination point and time of departure, the application stores them in its database for future reference and analysis. The database returns similar travellers' data to the application so that the latter can provide the best recommendations about routes modes and activities, according to other travellers with common profiles (Recommendations component). The traveller organizes a group travel by adding new members while the application, after matching the preferences of the group members, returns group activities and recommendations to the administrator (Group recommendations component). In the end, the traveller provides useful feedback to the application that is stored in the database of the system for future analysis in order to improve and update My-TRAC (Feedback component).

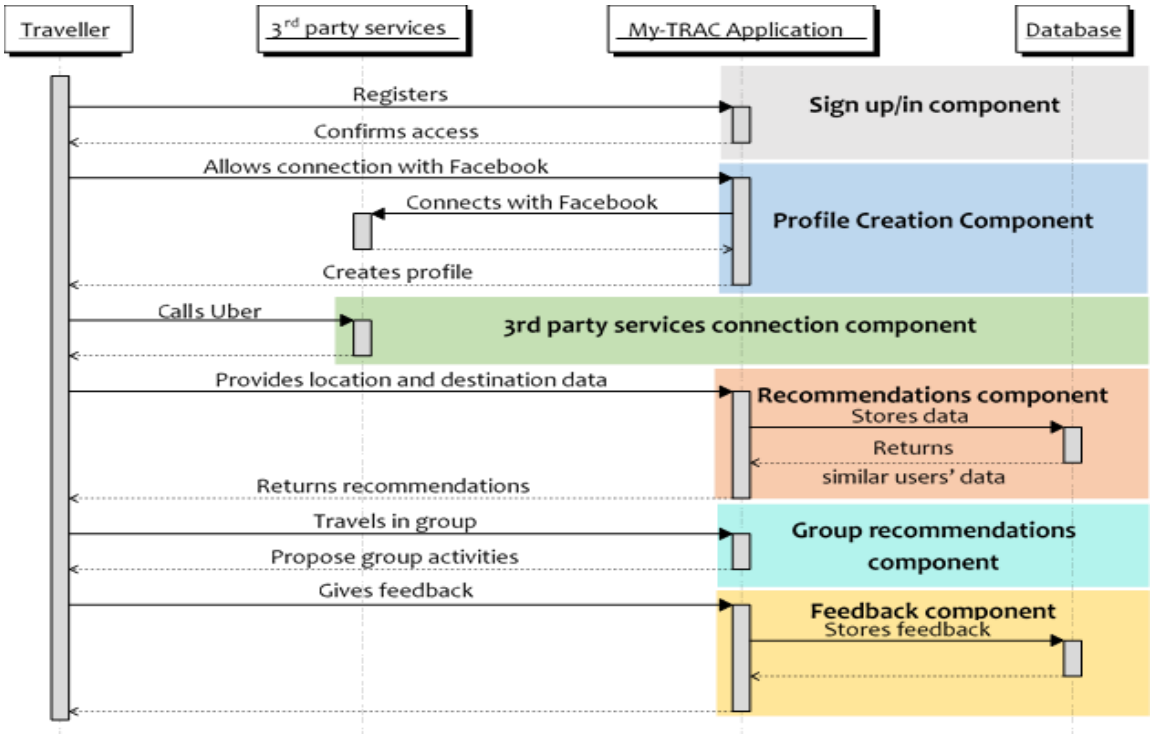


Figure 14: General Functionalities Sequence Diagram (Traveller)

The next sequence diagram (Figure 15) describes the operator's functionalities. The lifeline notations in this case are the operator, the 3rd party services, the My-TRAC platform and its database. The object initiating the sequence of messages is the operator, which registers for the first time in My-TRAC platform *(Sign up-in component)*. After providing the required documents, a profile of the operator is created in the database of the system, and My-TRAC platform returns an operator's manual, for better guidance. The operator needs to retrieve specific data from the platform. He/she inserts the information needed in the standardized UI and the system returns a list of relevant results, after searching the database and visualizing it to the platform's front-end *(Data filtering and visualization component)*. When the operator uploads important information or urgent announcements, the system stores the provided information in its database, for future analysis and updates (*Data analysis and storage component*). At the same time, the My-TRAC platform must communicate with My-TRAC application in order to update its recommendations and inform the interested travellers about the new provided data. Finally, the operator is asked to provide useful feedback that it is stored in the My-TRAC's database to be used for future improvements and updates of the platform (*Feedback component*).

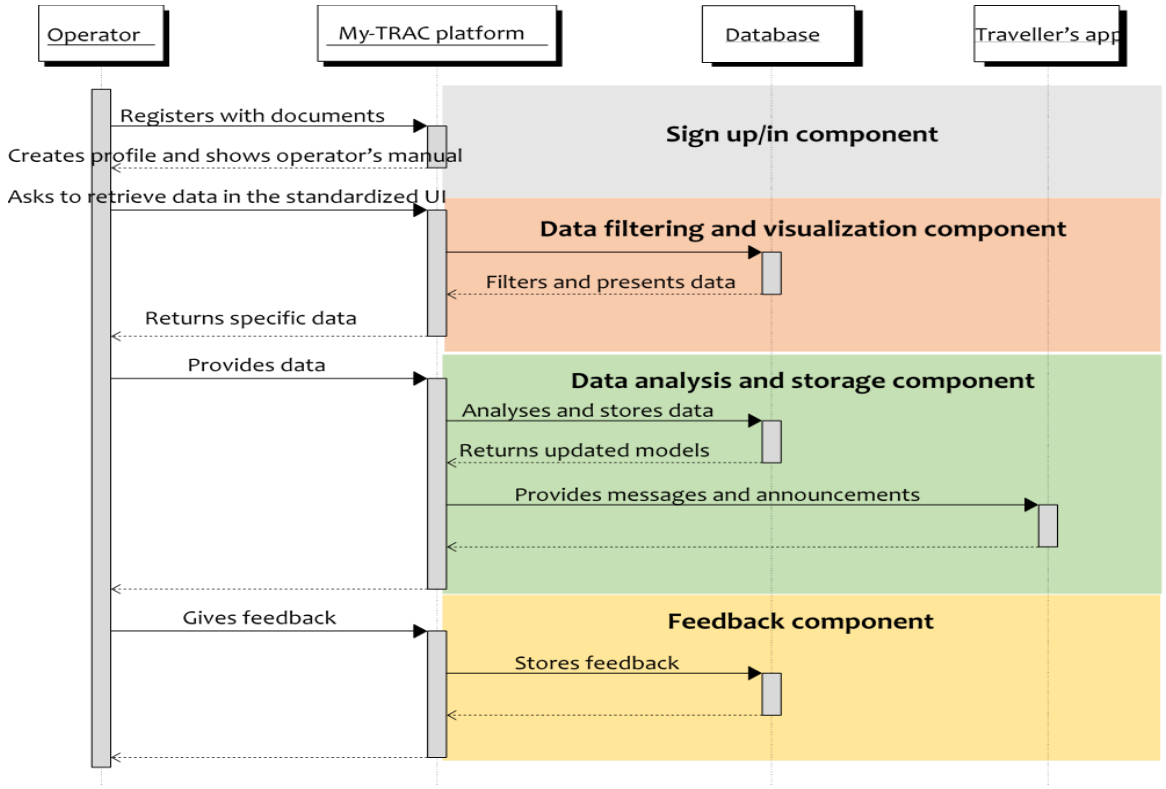


Figure 15: General Functionalities Sequence Diagram (Operator)

4.4 ELICITATION OF REQUIREMENTS

The requirements act as the foundation of My-TRAC products, listing the technical specifications and ultimately guiding the developers' team from early conceptual stages to the final stage of app development [17]. The requirements, as mentioned in Section 3, are divided in functional and non-functional requirements. A functional requirement describes *what* our system should do, while non-functional requirements explain *how* the system will do so [18].

4.4.1 FUNCTIONAL REQUIREMENTS

As shown in Figure 4 at Section 3, one functionality can produce one or more requirements. The functional requirements define a function of a system and describe its particular behaviour, in a more detailed and technical way. Below, the requirements that were derived for each functionality are listed and described. It is worth mentioning that some of the functionalities are the same with the requirements. The functional requirements are different for traveller's app and operator's platform, since the needs of the two categories of users are not the same. In the description below, under each functionality, the functional requirements of My-TRAC are introduced.

F1: Traveller's registration or sign in

1. **Sign up or log in pop up screen:** An interface for the registration of the traveller must be created. It can be in a form of layered screens, with a progress indicator underneath. Layered screens can be designed so that, once a user inserts some information, the old screen vanishes, and a new screen appears. This prevents users from getting overwhelmed by seeing a long list of questions.
2. **Continuous log in:** The traveller must stay logged in continuously, after the registration and disconnect only if he/she asks to. This requirement makes the use of the app easier and more frequent.
3. **Online support and communication with the app:** This feature assists in cases such as when a traveller did not receive the registration's verification mail, or when they are facing a problem with the response of the application.

F2: Traveller's profile and preferences' scheme creation and association

4. **Connection to social media and calendar:** The application asks permission to connect to the social media of the traveller, in order to retrieve information about him/her. The traveller can disallow the connection anytime.
5. **Traveller's data collection:** The application collects data from the social media, from the answers of the questionnaire filled in at the registration, from previous trips and groups, and stores them in the profile of the traveller in database.
6. **Traveller's profile edit:** The traveller has the ability to edit the personal information and update his/her profile anytime he/she chooses.
7. **Traveller's historical information:** In the profile section past trips of the traveller (i.e. locations, times and modes) are stored, past choices regarding his/her preferences or activities, previous group trips that are completed or groups that he/she has participated in. In this way, the application learns about the habits of the traveller and proposes better recommendations each time.
8. **Data privacy:** My-TRAC app must be compliant with GDPR and ensure the privacy and security of the traveller's personal data (social media, real-time location etc.). In the terms and conditions document, the traveller is clearly informed of the kind of personal data that is being collected and the purpose of it and the treatment of these data. Also, in order to use the application, the traveller needs to accept that the application will use anonymously his/her information and behaviour during trips.

F3: Recommendations provision to the traveller

9. **Filtering and proposition of possible routes and modes:** My-TRAC app is able to understand passenger behaviour in order to provide tailored trip planning and recommendations, based on behavioural aspects of the traveller, preferences and data from travellers with similar ambitions, interests and behavioural patterns.
10. **Offline work:** The application assists the traveller even without internet connection. In this case, the traveller has already organized his/her trip, before the time of departure, and can retrieve the information needed anytime, in the section "My trips".
11. **Data collection and examination:** In order to improve its propositions, My-TRAC app collects and analyses data from other travellers. This information is collected from the social media & calendar of each traveller, from their answers to the first questionnaire and from their previous trips. After the collection they are anonymously analysed, so that the app can create a list of behavioural patterns. These data are then categorized and used to improve recommendations about transportation and activities.

F4: Trip tracking and navigation

12. **GPS connection:** The application asks for GPS connection to locate the exact place of the traveller and assist him/her along the route (trip tracking). If the traveller does not allow the GPS connection, he/she might insert the information of the trip and the app can guess where the traveller is, based on the time of departure and the schedule of his/her trip.
13. **Trip chain:** The application is able to integrate all trips of the traveller who can buy an all-in-one ticket. In the case of a disruption or delay, it can understand, modify and adjust the itinerary accordingly. It is also able to propose intermediate activities to be performed by the passenger and include them in the planning process. The itinerary includes information about availability and cost for each trip and the journey in total, along with the transitions required.

F5: 3rd party services connection and service providers' notifications and ticketing

14. **3rd party services connection:** The My-TRAC application creates efficient data sharing methods among various applications (e.g., MaaS, operator apps, Airbnb, booking etc.).
15. **Social Market service:** My-TRAC supports enhanced interactions between travellers and a set of service providers during the trip (e.g., offering tailored discounts to the customer for taxi, hotel or museums, access to Wi-Fi in stations).
16. **Payment transactions**: My-TRAC app incorporates transaction services for buying tickets, so that the traveller can accept both trip and ticket with one click. The traveller can add to his/her profile his/her preferred payment method (always ensuring transaction security). In case of trip's cancellation, the traveller can request a refund.

F6: Network changes update, based on location

17. **Notifications and warnings pop up:** When a disruption occurs (such as delay or change in services), a warning pops up at the screen of traveller's smartphone. Notifications can also appear when opening the application, informing about news and updates.

18. **Online support and communication with the app:** If the app is not informed about a change, the traveller can communicate the service providers of the application, letting them know of any unexpected event, in order to warn other fellow travellers.

F7: Group recommendations

19. **Match of group members' preferences:** After the creation of the group, the preferences of the members are matched, so that the app can suggest the best possible group recommendations.
20. **Traveller's ability to modify a group:** A new member can be added or deleted in the group, with group admin's approval.
21. **Communication between travellers through the app:** Members of the same group or travellers with similar itineraries should communicate through the app. This requirement applies also in individual travellers, that want to communicate with other travellers with similar interests and trip schedule. Communication does not imply Instant Messaging but can take other forms, for example, a user was recommended something outside the group and promotes it in the group for other people to join.

F8: Traveller's feedback

22. **Rating other travellers' recommendations:** The travellers are able to provide their own recommendations to the app (about places to visit or modes to use), and these recommendations can be rated by other travellers.
23. **Feedback provision for the app:** The feedback that the traveller provides, improves the application and assists on updating the app. It can be implemented with a five-star rating system or a smiley face or even the completion of a questionnaire.

F9: GDPR compliance

24. **Acquisition of personal data:** The traveller is able to retrieve all the personal data that the My-TRAC platform has about him/her anytime.
25. **Deletion of personal data and profile:** The traveller can erase his/her profile and all of his/her personal data and also be removed from the database.

F10: Operator's registration with necessary documents provided and profile's creation or log in

26. **Access only to authorized users:** Required documents must be provided in order to give access only to authorized members of the operator's company.
27. **Profile creation:** An operator's profile is created in the database of the system, so that every provided information is stored in one place.

F11: Operator's announcements and data provision

28. **Means for uploading data:** The platform offers a UI with two options, "Upload data" (through a series of standardized UIs such as an interactive map for adding disruptions or calendar like screen for schedules) or "Send announcement" (e.g., about train's delay) so that the operator can update the desired station/location/route, with the necessary information. It also provides a rest API for automated data ingestion.

29. **Data analysis and storage of operator's provided information:** The operator's provided information/announcements are analysed, categorized and stored, so that they can be successfully combined, in order to update and improve PT operations.
30. **Message push to travellers:** After the data upload from the operators, the system distinguishes the kind of uploaded information (urgent message or update) and accordingly warns or informs the interested travellers, with a message or notification.

F12: Operator's information demand

31. **Data filtering by platform's server and visualization to the operators:** When the operator asks to retrieve data in the search UI, the platform validates the question and searches its database, to provide the most relevant results to the front-end. My-TRAC app communicates travellers' data to the operator, anonymously in order to improve PT operations.

F13: Operator's feedback

32. **Rating system of the platform:** Operators must provide their reviews through the completion of a questionnaire or rate the platform with a five-star rating system for continuous improvement of the platform.

The functionalities and the associated requirements are represented in Figure 16**: Elicitation of requirements**.

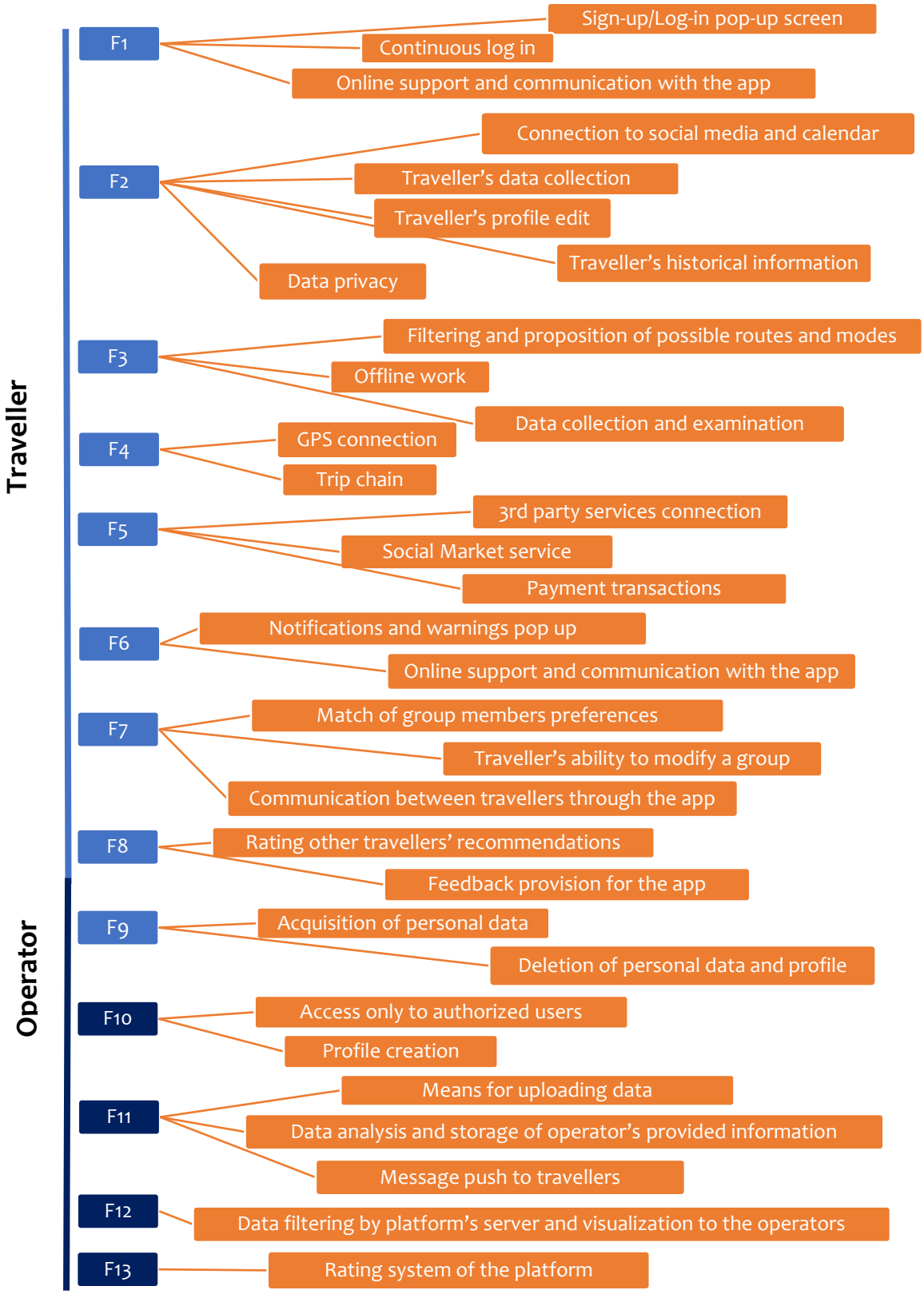


Figure 16: Elicitation of requirements

4.4.2 NON-FUNCTIONAL REQUIREMENTS

Non-functional requirements cover all the remaining requirements which are not covered by the functional requirements. They specify criteria that judge the architecture and the operation of the system, rather than specific behaviours. Travellers' application and operators' platform share the same non-functional requirements, which are elaborated below:

1. **Performance:** My-TRAC app/platform provides information in a quick response time.
2. **Usability:** My-TRAC app/platform is easy to use and handle, offering user-friendly interfaces.
3. **Availability:** My-TRAC app/platform is available to help the users 24/7.
4. **Reliability:** My-TRAC app/platform operates without failure and informs the users if something is wrong.
5. **Recoverability:** My-TRAC app/platform has the ability to recover quickly from a system failure.
6. **Security:** My-TRAC app/platform ensures the users about the privacy of their data and actions, by preventing unauthorised access to personal information.
7. **Data Integrity:** My-TRAC app/platform assures the accuracy and consistency of its data. This is a fundamental feature since our system stores, analyses and retrieves data continuously.
8. **Extensibility:** My-TRAC app/platform stays updated by adding new features, according to the feedback of the users.

5. CONCLUSIONS

Deliverable 5.1 "Elicitation of Requirements" presents the requirements for the My-TRAC products. The key to success for a new application is to provide an added value to all users, comparing to other existing applications. The way to achieve this goal is the elicitation of requirements process in order to coordinate and create a pipeline for the development of the products. This document includes the requirements that the application should have, to meet the needs of the users and stakeholders, that the developers will implement, in order to design and develop the My-TRAC application and platform. It acts as the basis of our product, listing all the technical specifications, and ultimately guiding the developers' team from the beginning till the final stages with respect to understanding technical expectations.

In this document, we researched and analysed multiple elicitation requirements techniques that especially apply to collaborative projects such as My-TRAC. Through the comparison of the various methodologies and practices for requirements elicitation, the most applicable were recognized. The approach selected has the advantage of facilitating the collaboration of different consortium partners in a "decentralized" way: respecting partners' views on the final application while efficiently leading to a collaboration baseline for requirements elicitation. A use case analysis was chosen as the basis of the analysis due to being able to handle a Knowledge-Intensive Process without creating communication barriers. Brainstorming and workshops were also employed to foster collaboration.

To facilitate the process of producing the use cases that eventually lead to the requirements of the products, storylines were created first. With the collaboration of all consortium partners and basing on the storylines, the use cases were generated, taking into consideration the knowledge and expertise of each partner; titles and descriptions of the use cases were created centrally and each use case was assigned to the partner that has the largest expertise related to the subject of the use-case. Therefore, each use-case was elaborated according to the explicit knowledge of the partner. The process of selecting partners for a use-case was assisted by the analysis of the expertise of each partner which was guided by the KIPO approach. After the generation of the use cases, the identification of the general functionalities and requirements followed. General functionalities were produced eventually, constituting the basic structure of the elicitation of requirements document. The results of eliciting the requirements are presented in the form of descriptive figures, detailed tables and sequence diagrams.

The success or failure of any given software development project depends on the elicitation of the software requirements. A poor requirement's elicitation and the lack of user and developer involvement, can cause delays in development and testing, leading to poor quality of the final product. The elicitation of requirements document is of high importance for the development of My-TRAC's platform, since it has a significant impact on the end results of the system. It constitutes the backbone of the application's and platform's development, which must be used as a guideline for the rest of the tasks. The next step will be the definition of the My-TRAC architecture and the development of a first version of My-TRAC's app. Throughout this development cycle the elicitation of requirements document will be further extended, since new requirements can be discovered, or already existing can be changed or updated especially after interacting with the developers during the process of generating the app (thus, practical limitations may appear).

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