

INFORMATION TECHNOLOGIES FOR SHIFT TO RAIL

D6.6 Business Analytics Final Integration Report

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Name	Company	Details of Contribution
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	POLIMI	<p>Test Category:</p> <p>6.10 – User Preference Mining</p>
	CYB	Document review.
	RINA C-BE	Quality Check

EXECUTIVE SUMMARY

This deliverable contains a complete report concerning tests envisaged for the Business Analytics planned for the IT2Rail Final Release. Furthermore the document includes a complete description concerning the configuration for the infrastructure and hardware in order to run the tests described in this document.

Finally, a list of all tests is provided along with a short description concerning which functionality the test verifies, preconditions, expected and observed results. All tests are grouped by category and verify the effectiveness of the Business Analytics functionalities developed for the IT2Rail Final Release. The last section of the document describes the test runs with the observed results.

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1. INTRODUCTION

The following sections of this document describe:

- the description of the configuration needed for running all tests;
- the system used for running the tests;
- all tests planned and executed for verifying the functionalities of the IT2Rail Business Analytics for the Final Release;
- the expected and observed results achieved by means of this test campaign.

2. REFERENCED DOCUMENTS

2.1 APPLICABLE DOCUMENTS

This chapter lists the applicable documents for the current deliverable:

- **D6.7 – Business Analytics Ontology document**
- **D6.2 – Business Analytics Specifications document**
- **D6.5 – Business Analytics Additional Integration Report**

2.2 NORMATIVE DOCUMENTS

Not Applicable.

3. CAMPAIGN STRATEGY

This campaign strategy has the aim to test and verify the Business Analytics functions delivered for the IT2Rail Final Release.

The following chapters will describe:

- the test materials description meant as infrastructure and hardware settings in order to perform the test cases planned for this IT2Rail release (Final Release);
- the detailed test cases planned for this campaign;
- the tests execution.

4. TEST MATERIALS DESCRIPTION

This chapter lists the assets required to perform the Business Analytics test use cases.

4.1 CONFIGURATION

This paragraph describes the configuration of the Business Analytics platform envisaged for the Final Release. The configuration includes the infrastructure and hardware settings of the Business Analytics module. The former describes the infrastructure chosen for running the software modules, the latter specifies the hardware the Business Analytics components relies on.

4.1.1 INFRASTRUCTURE AND HARDWARE

INFRASTRUCTURE

The Business Analytics components run on several virtual machines. Tomcat 8 has been chosen as the application server that is running on each virtual machine. The different VMs communicate with each other by using web services implemented with REST technology. Information formatted in JSON is exchanged by means of HTTP requests by using both POST and GET methods.

HARDWARE - LEONARDO CONTRIBUTION

The Business Analytics infrastructure is based on a cluster of nodes. Each of these nodes has the following hardware configuration:

- Centos 7 64 bit;
- 8 Gb Ram;
- CPU & Core Xeon 1.9.

HARDWARE - UPC CONTRIBUTION

The Social Network Analytics infrastructure is based on components that are distributed in, currently, one node. Each of these nodes has the following hardware configuration:

- Debian 3.16.1 64 bit;
- 32 GB Ram;
- 2 TB disk;
- 8 CPUs Intel® Xeon® CPU ES-2623 v3 @ 3.00GHz.

HARDWARE - INDRA CONTRIBUTION

The Business Analytics platform also leverages on the capabilities of Sofia2 platform: Sofia2 node for interoperability, KPI management from real time processing and visualization requires approximately the following basic software and hardware characteristics:

- JRE 7 or higher version;
- Tomcat 7 application server;
- Linux 64bits distribution;
- 4 cores;
- 8GB RAM;
- 500 GB HD.

HARDWARE - CEA CONTRIBUTION

CEA infrastructure is composed by a set of (6) server nodes for the dataset repositories (distributed by default) and standard laptop size machines for analysis. Each node specification is the following:

- Centos 7 64 bit;
- 128 GB Ram;
- Intel(R) Xeon(R) CPU E5-2640 v3 @ 2.60GHz;
- 2 x 2TB HDD;

- Required tools: MongoDB v3.4.6 server.

The laptops are standard machines with:

- Ubuntu 14.04+;
- 4 GB Ram+;
- Intel(R) Core(TM) i7-4600U CPU @ 2.10GHz;
- 8GB RAM;
- 500 GB HD;
- Required tools: MongoDB client; Python; R.

HARDWARE - POLIMI CONTRIBUTION

The preference mining tool can be executed on any x86 or x86-64 compatible processor (at least a Core2 is recommended) with 512 MB of RAM. It is necessary to install Java Runtime Environment (version 1.6 or higher) and PostgreSQL (version 8 or higher).

It has been tested on an Intel Core 2 Duo CPU with 2.5 GHz and 3 GB main memory running Windows Vista.

4.1.2 SETUP & CONFIGURATION

This section contains the setup and configuration for performing the test campaign envisaged for the Final Release. In order to accomplish the test phase, the personnel in charge of testing the Business Analytics platform needs to have an internet connection perfectly working. In addition the following software applications have to be installed on the laptop where the tests are carried out:

- a web browser (Google Chrome preferably);
- POSTMAN as Google Chrome plugin;
- Any other REST client tool.

4.1.3 TESTED SYSTEM

During this test campaign several modules of the Business Analytics platform have been tested in order to verify the functionalities foreseen for the Final Release. The behaviour of the following WP6 software components has been checked against a list of tests defined in the following sections:

- The **Presentation component** of the Business Analytics module is used by the operators in order to show KPIs computed on users' answers to the questions listed in the Travel Questionnaire, additional KPIs computed on social network messages (in respect to the previous Additional Release), KPIs related to different types of information stored in the users' Cloud Wallets and KPIs related to Trip Tracking alert messages along with their associated dashboards.
- The computation capabilities of the **Information Management & Analysis** module that allow to compute the KPIs on the answers supplied by users to the questions listed in the travel questionnaire, on social network messages, on different types of information stored in the users' Cloud Wallets and on Trip Tracking alert messages.

- **Web services of the Data Management component** used by the Presentation component to retrieve information from the Business Analytics repositories. This information is concerned with KPIs computed on:
 - replies to questions in the travel questionnaire;
 - social network messages;
 - different types of information stored in the users' Cloud Wallets;
 - Trip Tracking alert messages.

The following components were previously included in the Presentation module for the Additional Release:

- weather information and forecasts of the cities included in the IT2Rail Corridor use case;
- KPIs concerning ticketing systems;
- user preferences.

The following components were previously included in the Presentation module for the Core Release:

- a web based Geographic Information System (GIS) that shows on map several data concerning events (*happenings*) and weather conditions;
- a dashboard showing KPIs selected for the Milan-Rome travel leg computed by the Information Analysis and Management component of the Business Analytics module

The web services exposed by the Business Analytics platform for the Core Release are responsible for making KPIs and happenings available to the Presentation layer.

The web services exposed by the Business Analytics platform for the Additional Release are responsible for making KPIs concerning ticketing systems and weather information and forecasts available to the Presentation layer.

4.1.4 SYSTEM DATA PARAMETERS

The following information has been used in order to test the Business Analytics components developed for the Final Release:

- Answers provided by travellers to the Travel Questionnaire;
- Social network messages collected from Twitter;
- Simulated data for computing KPIs on user's Cloud Wallets;
- Information for computing KPIs on Trip Tracking data (events, messages and alternatives);
- Data coming from Booking and Ticketing components for computing KPIs on Routes.

4.1.5 SIMULATORS

A machine learning module was developed in order to analyse negative/positive user feedbacks related to trips taken.

A number of textual feedbacks were created to generate a valid training set.

4.1.6 PERSONNEL

The personnel required to run this test campaign has to be highly qualified people with a professional background in Information Technology and Computer Science.

5. TEST DESCRIPTIONS

This chapter contains a list of test cases provided for describing how Business Analytics components are checked in order to deliver the functionalities for the IT2Rail Final Release.

5.1 [TEST CATEGORY 6.1] PROVIDING KEY PERFORMANCE INDICATORS CONCERNING REPLIES TO QUESTIONS LISTED IN THE TRAVEL QUESTIONNAIRE

One of the aims of the Business Analytics module is to compute a list of indexes and Key Performance Indicators regarding user satisfaction at the end of a trip. At the moment, the questions listed in the travel questionnaire (shown by the Travel Companion mobile application) refer to the means of transportation used by the traveller during a trip.

For a specific trip, the BA module computes percentages related to the number of stars given by the users in reply to the following questions:

1. How would you rate the quality of comfort of your travel?
2. How would you rate the quality of your customer service experience?
3. How would you rate the timeliness of your travel?
4. How would you rate the quality of cleaning on board?
5. How would you rate the quality of meals offered on board?
6. How would you rate the Internet services (e.g. WiFi connection) available on board?
7. How would you rate the travel quality experienced on board?

KPI n.1 – Percentages of users who replied to question n.1 with 1 star, 2 stars, 3 stars, 4 stars, 5 stars.

KPI n.2 – Percentages of users who replied to question n. 2 with 1 star, 2 stars, 3 stars, 4 stars, 5 stars.

KPI n.3 – Percentages of users who replied to question n. 3 with 1 star, 2 stars, 3 stars, 4 stars, 5 stars.

KPI n.4 – Percentages of users who replied to question n. 4 with 1 star, 2 stars, 3 stars, 4 stars, 5 stars.

KPI n.5 – Percentages of users who replied to question n. 5 with 1 star, 2 stars, 3 stars, 4 stars, 5 stars.

KPI n.6 – Percentages of users who replied to question n. 6 with 1 star, 2 stars, 3 stars, 4 stars, 5 stars.

KPI n.7 – Percentages of users who replied to question n. 7 with 1 star, 2 stars, 3 stars, 4 stars, 5 stars.

5.1.1 [TEST CASE 6.1.1] RECEIVING ANSWERS TO QUESTIONS LISTED IN THE TRAVEL QUESTIONNAIRE

6.1.1	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check the software component responsible for receiving questionnaire response data.
Description	This test case checks the reception of questionnaire user replies by the BA module that will be used as input for computing the Key Performance Indicators of the same. The replies of questionnaires are collected from the Travel Companion mobile application (WP5).
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • The Travel Companion and BA back-end module are both running. 				
1	The Tester proceeds with replying to the questions contained in the Travel Companion Travel Questionnaire.	On the back-end side the Tester can view that questions have been answered by checking the BA database.	On the back-end side the Tester can view that questions have been answered by checking the BA database.	Passed	[used for traceability]

5.1.2 [TEST CASE 6.1.2] COMPUTING KEY PERFORMANCE INDICATORS

6.1.2	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check that the Business Analytics module computes the 7 KPIs for the travel questionnaire replies.
Description	This test case verifies the computation for the 7 KPIs related to the travel questionnaire replies.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • An Internet connection is available. • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. • The Presentation component of the Business Analytics is available at the following URL (http://93.42.113.18:99/IT2Rail/) and can be visualized by using the web browser installed on the laptop. 				
1	Tester acting as End User sets the Rome-Milan route, Start Date = 01/05/2016, End Date = 01/05/2016 and Means of Transportation = train.	KPIs for the user replies to the travel questionnaire are computed.	KPIs for the user replies to the travel questionnaire are computed.	Passed	[used for traceability]

5.1.3 [TEST CASE 6.1.3] VISUALISING KEY PERFORMANCE INDICATORS

6.1.3	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check that the Business Analytics module computes and displays the 7 KPIs for the travel questionnaire replies.
Description	This test case verifies the computation and display of 7 KPIs for the travel questionnaire replies.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • An Internet connection is available. • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. • The Presentation component of the Business Analytics is available at the following URL address http://93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop. 				
1	Tester acting as End User sets the Rome-Milan route, Start Date = 01/05/2016, End Date = 01/05/2016 and Means of Transportation = train.	KPIs for the user replies to the travel questionnaire are computed.	KPIs for the user replies to the travel questionnaire are computed and displayed.	Passed	[used for traceability]

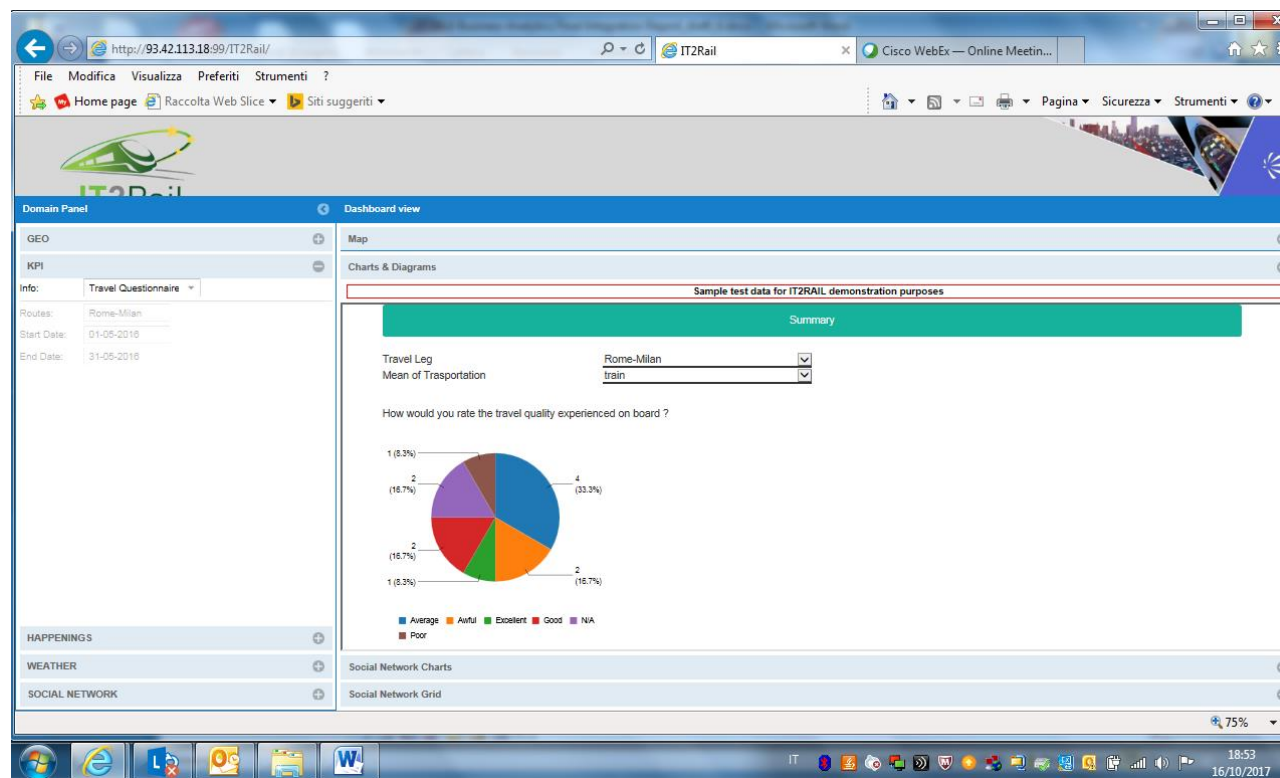


Figure 1 - Example Presentation of KPIs for Travel Questionnaire Replies

5.2 [TEST CATEGORY 6.2] PROVIDING KEY PERFORMANCE INDICATORS CONCERNING THE ROUTES FROM BOOKING&TICKETING (WP3)

For the final release, due to the limited amount of information from Booking and Ticketing stored in Rail_TSP, the functions for *collecting information from Booking and Ticketing* and *storing it in the BA repositories* will be replaced by a function able to simulate data from the routes and feed the ontologies for the analytic services. Thus for F-REL testing purposes, the information from different routes will also be simulated in aggregated mode.

One of the aims of the Business Analytics module is to increase the quality of the services offered to the users. In order to achieve it, the follow indicators show:

- The most chosen destination;

- The most chosen origin ;
- Number of search that the user did by year.

5.2.1 [TEST CASE 6.2.1] RETRIEVE KPIs REGARDING THE PREFERRED ORIGIN/DESTINATION AND SEARCH BY YEAR

6.2.1	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check the software component responsible for retrieving the routes of the follow indicators: Number of search the user did by year and secondly store those information into the Sofia2 platform.
Description	This test case checks the correct retrieve of the information coming from the Rail_TSP for the Spanish territory developed by Indra for Work Package 3
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • The Travel Companion and Business Analytics back-end module are both running. 				
1	The Tester proceeds with the correct retrieval of the routes information from the Booking&Ticketing	Expected the correct retrieval information coming from the module Rail_TSP developed by Indra covering the routes.	The information are stored correctly into the Business Analytics platform.	Passed	[used for traceability]

5.2.2[TEST CASE 6.2.2] COMPUTING KEY PERFORMANCE INDICATORS

6.2.2	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check the Business Analytics module computes the indicators mentioned above.
Description	This test case verifies the computation for the 3 KPIs. It has a successfully connection between the Booking and Ticketing and the Business Analytics platform.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • An Internet connection is available. • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. • The Presentation component of the Business Analytics is available at the following URL address http://93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop. 				
1	The Tester proceeds with the correct computation of the routes information from the Booking&Ticketing	Expected the correct computation of the information coming from the module Rail_TSP developed by Indra covering the routes.	The information are computed correctly into the Business Analytics platform	Passed	[used for traceability]

5.2.3[TEST CASE 6.2.3] VISUALISING KEY PERFORMANCE INDICATORS

6.2.3	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check that the Business Analytics module computes and displays the indicators mentioned above.
Description	This test case verifies the computation and display of 3 KPIs mentioned above.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • An Internet connection is available. • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. • The Presentation component of the Business Analytics is available at the following URL address http://93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop. 				
1	The Tester proceeds with the correct visualization of the KPIs previously defined.	Visualization of the KPIs.	Correctly displayed the indicators.	Passed	[used for traceability]

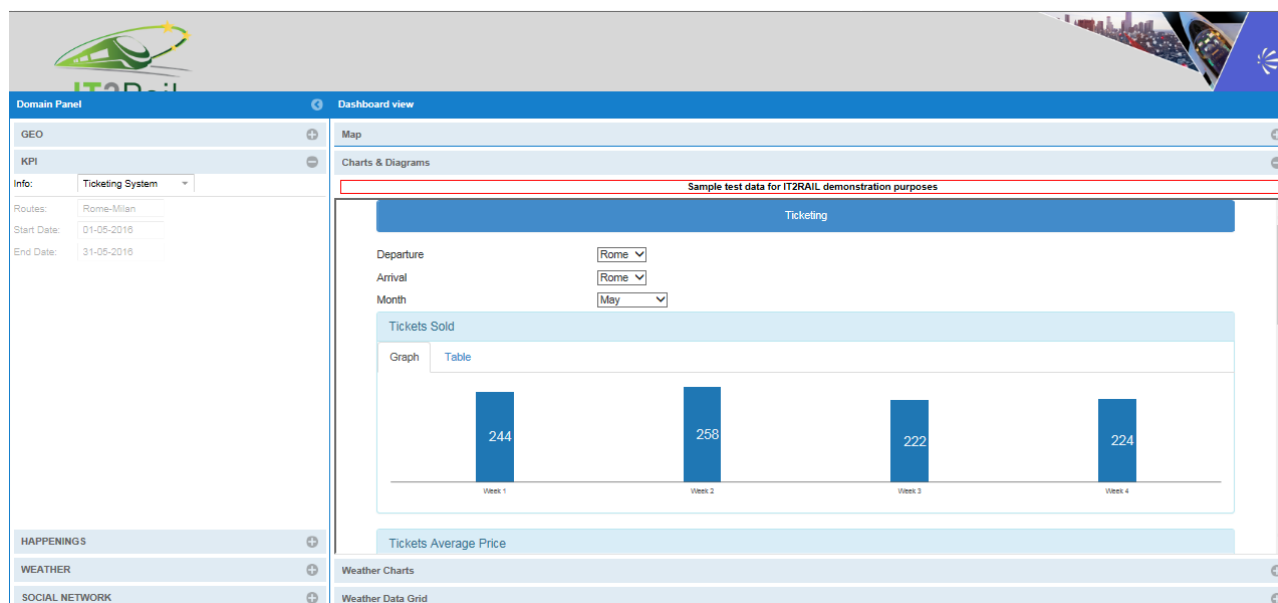


Figure 2 - Example Presentation of KPIs for Ticketing System – Tickets Sold

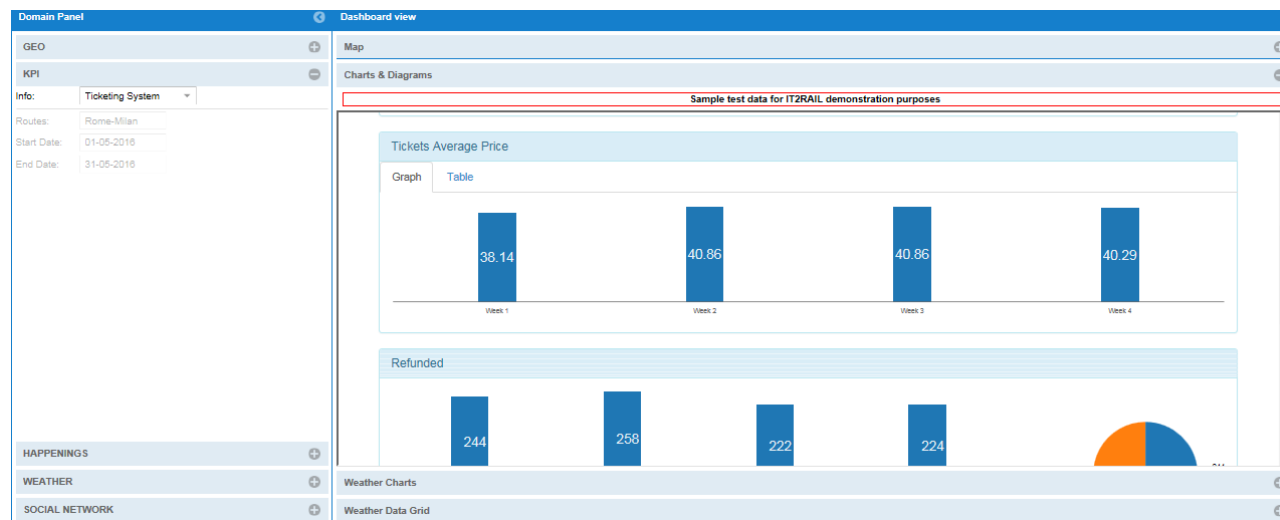


Figure 3 - Example Presentation of KPIs for Ticketing System – Tickets Average Price & Refunded

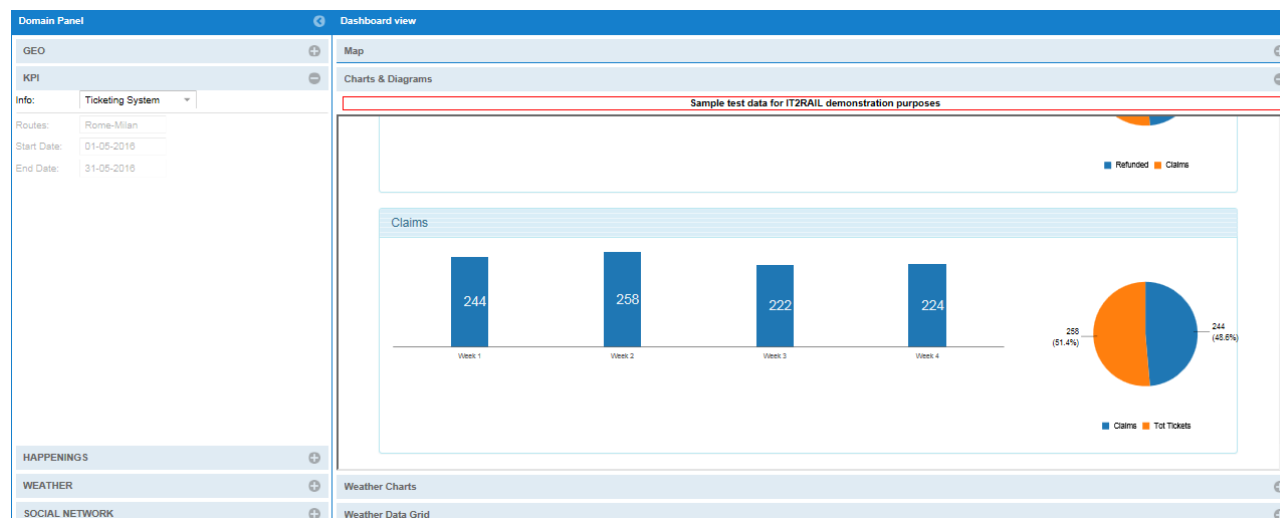


Figure 4 - Example Presentation of KPIs for Ticketing System – Claims

5.3 PROVIDING KEY PERFORMANCE INDICATORS CONCERNING TRIP TRACKING DATA (WP4)

5.3.1 [TEST CASE 6.3.1] RETRIEVE COMPLEX EVENT PROCESSING DATA AND STORE EVENTS IN THE BA REPOSITORY

6.3.1	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check that the Business Analytics platform retrieves Trip Tracking Complex Event Processing data and stores it to the BA repository.
Description	This test case verifies the retrieval and storage concerning Trip Tracking Complex Event Processing Data
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> The Trip Tracking and Business Analytics back-end module are both running. 				
1	The Tester proceeds with the proper retrieval and storage of data related to Trip Tracking Complex Event Processing data.	Expected the correct retrieval and storage related to information coming from the Log Component for Trip Tracking Complex Event Processing.	Information is properly stored within the Business Analytics repositories	Passed	[used for traceability]

5.3.2 [TEST CASE 6.3.2] COMPUTE AND DISPLAY KPIS ON COMPLEX EVENT PROCESSING DATA

6.3.2	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check that the Business Analytics platform computes and visualizes information concerning Trip Tracking Complex Event Processing data.
Description	This test case verifies the computation and visualization of KPIs concerning Trip Tracking Complex Event Processing Data
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • An Internet connection is available. • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. • The Presentation component of the Business Analytics is available at the following URL address http://93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop. 				

[Configuration to apply]					
1	The Tester proceeds with the proper computation and visualization of KPIs computed on Trip Tracking Complex Event Processing data.	Expected the proper computation and visualization of KPIs computed on Trip Tracking Complex Event Processing data.	KPIs on Trip Tracking Complex Event Processing data are properly computed and shown.	Passed	[used for traceability]

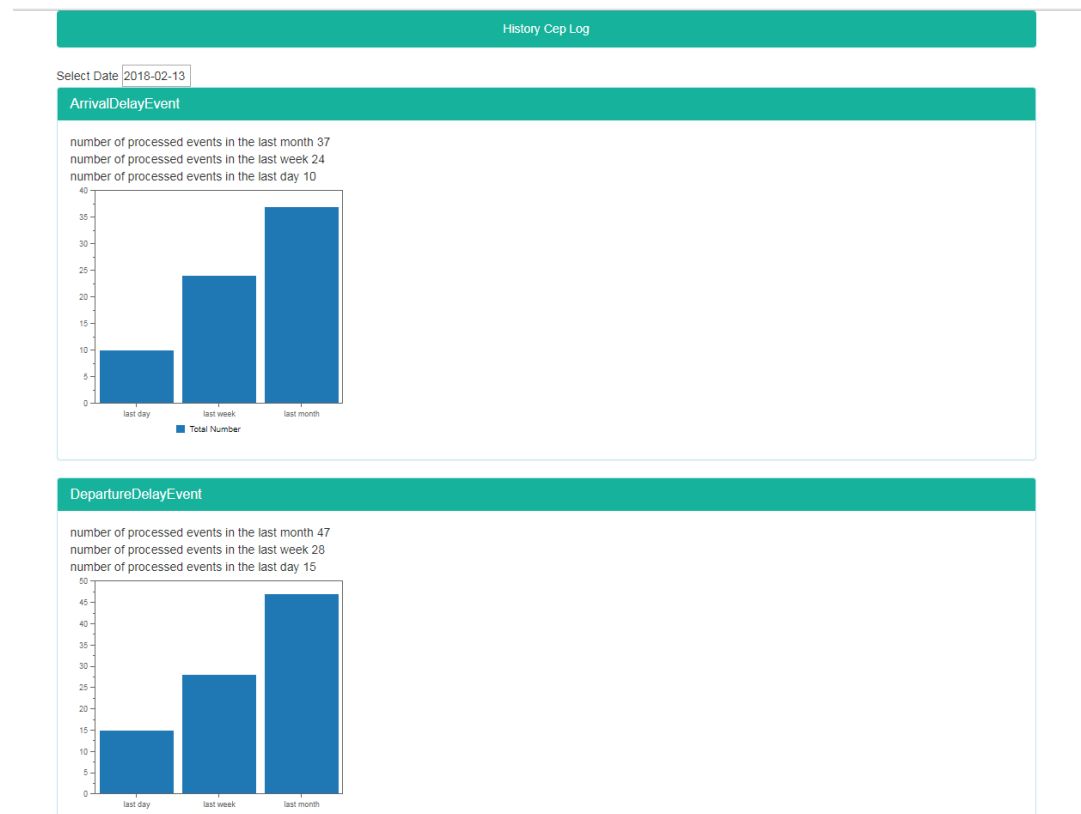


Figure 5 - KPIs on Complex Event Processing events

5.3.3 [TEST CASE 6.3.3] RETRIEVE CEP MESSAGES AND STORE THEM IN THE BA REPOSITORY

6.3.3	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check the software component responsible for retrieving the messages of the following indicators: 1) Total number messages send to the TC in case of disruption; 2) How many WARNINGS, INFORMATION and ALERT are produced in case of disruption; 3) What are the most send messages content sent to the TC; 4) Minimum and Maximum Processing Time.
Description	This test case checks the correct retrieval of the information coming from the WP4, stores the information to the Sofia 2 platform.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • The Travel Companion and BA back-end module are both running. 				
1	The Tester proceeds with the correct retrieval of the messages information from the trip tracking (WP4)	Expected the correct retrieval information coming from the module (WP4).	The information are retrieved and stored correctly to the Sofia 2 platform.	Passed	[used for traceability]

5.3.4 [TEST CASE 6.3.4] COMPUTING KEY PERFORMANCE INDICATORS FOR CEP MESSAGES

6.3.4	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check the Business Analytics module computes the indicators mentioned in the previous paragraph 6.3.3.
Description	This test case verifies the computation for the 4 KPIs. It has a successfully connection between the Trip Tracking repository and the Sofia 2 platform.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • An Internet connection is available. • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. The Presentation component of the Business Analytics is available at the following URL address http:// 93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop.				
1	The Tester proceeds with the correct computation of KPIs from the Trip Tracking	Expected the correct computation of the information coming from the module Trip Tracking	The information are computed correctly into the Sofia 2 platform.	Passed	[used for traceability]

5.3.5 [TEST CASE 6.3.5] VISUALISING KEY PERFORMANCE INDICATORS ON CEP MESSAGES

6.3.5	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check that the Business Analytics module displays the indicators listed in the previous paragraph 6.3.3 and computed in paragraph 6.3.4.
Description	This test case verifies the display of the 4 KPIs mentioned in paragraph 6.3.3 and computed in paragraph 6.3.4.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • An Internet connection is available. • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. • The Presentation component of the Business Analytics is available at the following URL address http://93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop. 				
1	The Tester proceeds with the correct visualization of the KPIs previously defined by choosing KPI and then IT2RailMessages(Chart) from Info:.	Visualization of the KPIs.	Correctly displayed the indicators.	Passed	[used for traceability]

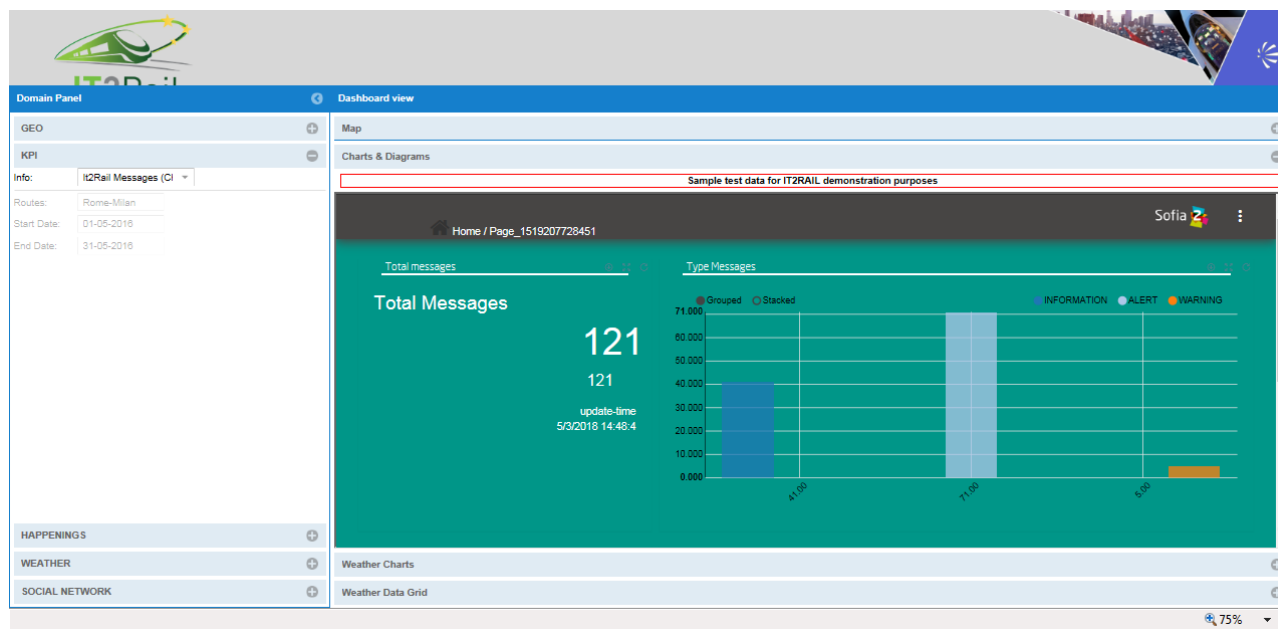


Figure 6 - KPIs on Complex Event Processing messages

5.3.6 [TEST CASE 6.3.6] RETRIEVE KPIs REGARDING THE ALTERNATIVES

6.3.6	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check the software component responsible for retrieving the alternative's information of the following indicators: 1) Number of average stops sent to the TC in case of disruption; 2) Maximum and Minimum price calculated in case of disruption; 3) Total number of alternatives sent to the TC in case of disruption; 4) Which transportation mode are the most chosen in case of disruption by the users.
Description	This test case checks the correct retrieval and storage in the Sofia2 platform of the information coming from WP4.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • The Travel Companion and BA back-end module are both running. 				
1	The Tester proceeds with the correct retrieval of the alternatives information from the trip tracking	Expected the correct retrieval information coming from the module .	The information are retrieved and stored correctly into the Sofia 2 platform.	Passed	[used for traceability]

5.3.7 [TEST CASE 6.3.7] COMPUTING KEY PERFORMANCE INDICATORS ON ALTERNATIVES

6.3.7	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check that the Business Analytics module computes the indicators mentioned in the previous paragraph 6.3.6.
Description	This test case verifies the computation for the 4 KPIs mentioned in paragraph 6.3.6 and the existence of a successful connection between Trip Tracking and the Sofia 2 platform.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • An Internet connection is available. • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. The Presentation component of the Business Analytics is available at the following URL address http:// 93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop.				
1	The Tester proceeds with the correct computation of KPIs from the Trip Tracking	Expected the correct computation of the information coming from the module Trip Tracking	The information are computed correctly into the Sofia 2 platform.	Passed	[used for traceability]

5.3.8 [TEST CASE 6.3.8] VISUALISING KEY PERFORMANCE INDICATORS ON ALTERNATIVES

6.2.3	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check that the Business Analytics module displays the indicators listed in paragraph 6.3.6 and computed in the paragraph 6.3.7.
Description	This test case verifies the computation and display of 4 KPIs listed in paragraph 6.3.6.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	<p>Preconditions:</p> <ul style="list-style-type: none"> • An Internet connection is available. • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. • The Presentation component of the Business Analytics is available at the following URL address http://93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop. 				
1	The Tester proceeds with the correct visualization of the KPIs previously defined.	Visualization of the KPIs.	Correctly displayed the indicators.	Passed	[used for traceability]

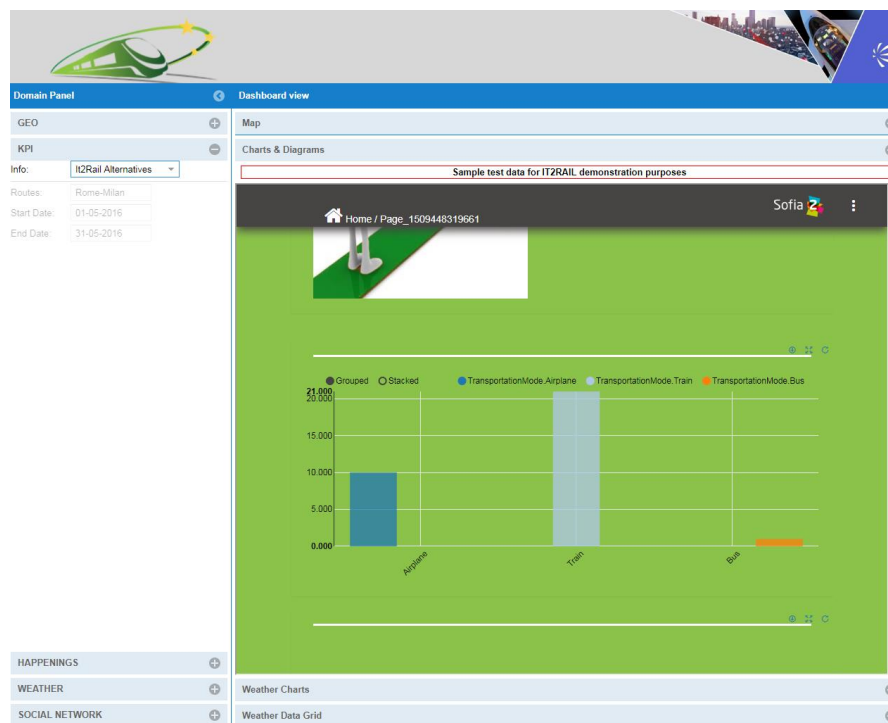


Figure 7 – KPIs on Complex Event Processing Alternatives

5.4 [TEST CATEGORY 6.4] SHOWING INDICATORS ON SOCIAL NETWORK MESSAGES

The Business Analytics platform computes additional KPIs on the basis of the messages collected from Social Networks.

The new KPIs available for the Final Release are:

- Words appearing more often in people's comments.
- Most propagated people (tied to the most propagated keywords) based on their weight of influence towards others (based on their number of followers).
- Most propagated people (tied to the most propagated keywords) based on the number of influencers that they are following.

5.4.1 [TEST CASE 6.4.1] SHOWING KPIS CONCERNING SOCIAL NETWORK MESSAGES ON TABLES

6.4.1	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To check KPIs are retrieved and shown on tables.
Description	This test checks whether KPIs concerning social network messages are retrieved and shown on tables. The Presentation layer of the Business Analytics module encapsulates a dashboard containing indicators computed on the basis of messages retrieved from Twitter.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • An Internet connection is available. • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. • The Presentation component of the Business Analytics is available at ip address http://93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop. • A remote Social Network API is available in order to retrieve the necessary information for the KPIs. 				
1	Tester acting as End User chooses the Social Network tab.	Social Network tab is presented in the forefront at the right-hand side of the window.	Social Network tab is presented in the forefront at the right-hand side of the window.	Passed	[used for traceability]
2	Tester acting as End User enters Type of Social Data, Start Date and, optionally, End Date and presses the View Social Data button.	KPIs related to filter on Social Network messages are shown on tables within the dashboard.	KPIs related to filter on Social Network messages are shown on tables within the dashboard.	Passed	

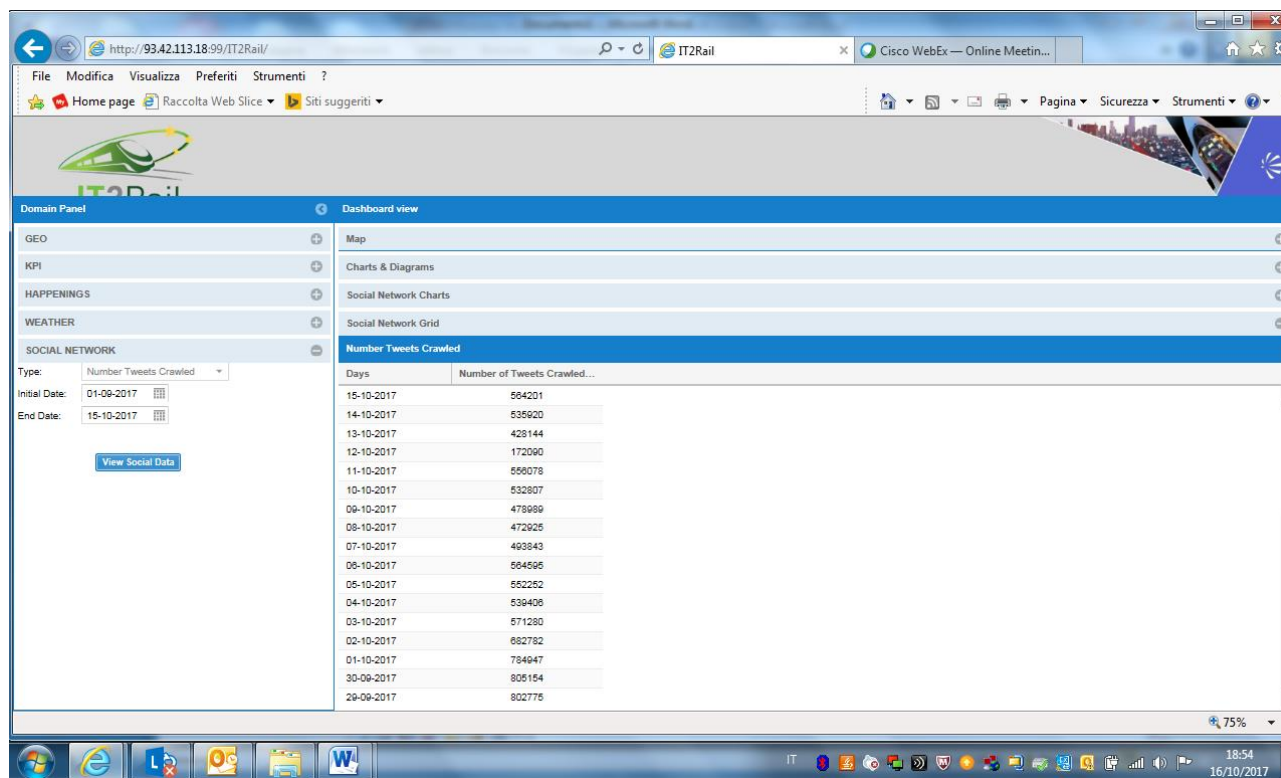


Figure 8 - Example Table Presentation of KPIs on Social Network Messages

5.4.2 [TEST CASE 6.4.2] SHOWING KPIS CONCERNING SOCIAL NETWORK MESSAGES ON CHARTS

6.4.2	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To check KPIs are retrieved and shown on charts.
Description	This test checks whether KPIs concerning social network messages are retrieved and shown on charts. The Presentation layer of the Business Analytics module encapsulates a dashboard containing indicators computed on the basis of messages retrieved from Twitter.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • An Internet connection is available. • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. • The Presentation component of the Business Analytics is available at ip address http://93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop. 				
1	Tester acting as End User chooses the Social Network tab.	Social Network tab is presented in the forefront at the right-hand side of the window.	Social Network tab is presented in the forefront at the right-hand side of the window.	Passed	[used for traceability]
2a	Tester acting as End User enters Type of Social Data, Start Date and, optionally, End Date and then presses the View Social Data button.	KPIs related to filter on Social Network messages are shown on charts within the dashboard.	KPIs related to filter on Social Network messages are shown on charts within the dashboard.	Passed	
2b	Tester acting as End User optionally presses View Cloud Data button.	KPIs related to filter on Social Network messages are shown on cloud charts within the dashboard.	KPIs related to filter on Social Network messages are shown on cloud charts within the dashboard.	Passed	

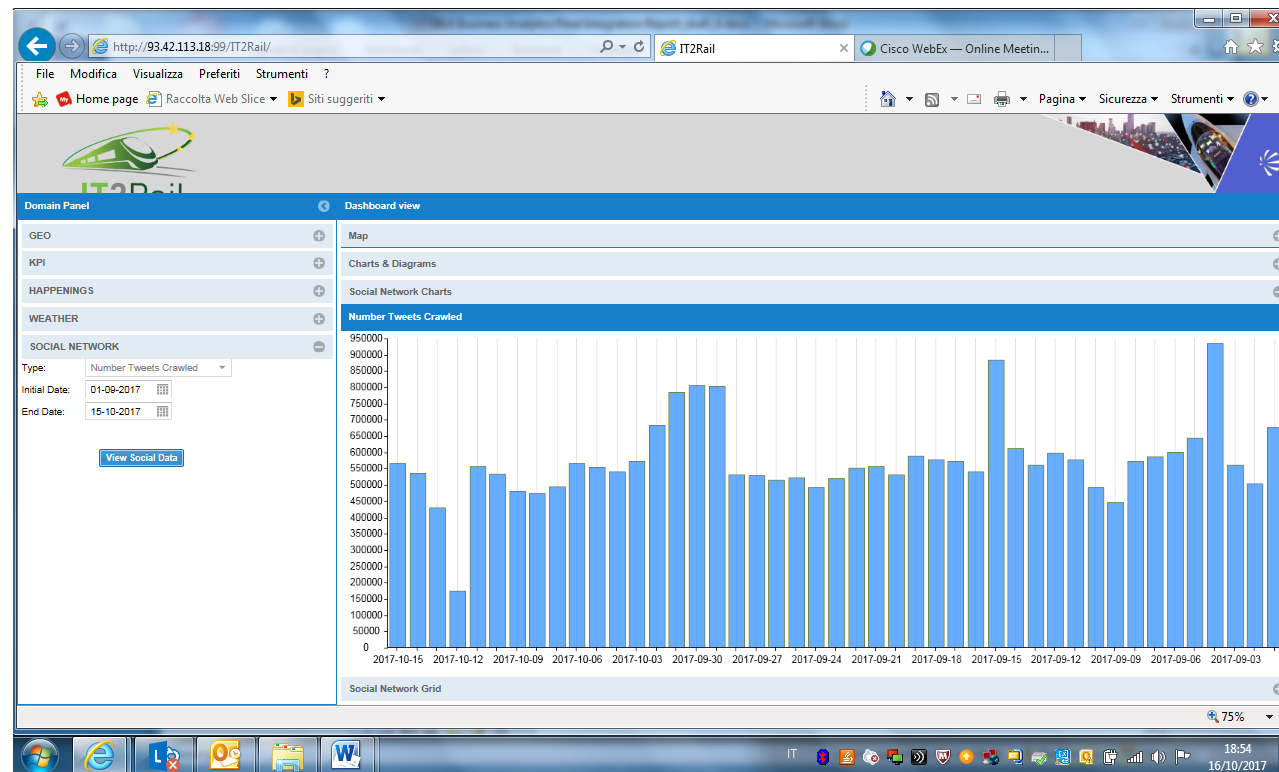


Figure 9 - Example Chart Presentation of KPIs on Social Network Messages

5.5 [TEST CATEGORY 6.5] PROVIDING KEY PERFORMANCE INDICATORS ON SOCIAL NETWORK MESSAGES

5.5.1 [TEST CASE 6.5.1] COMPUTING KPIS ON SOCIAL NETWORK MESSAGES

6.5.1	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To check the Business Analytics module computes KPIs based on social network messages.
Description	This test case verifies the KPIs computation for the messages collected from Twitter.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • Internet connection is available • Twitter APIs are available • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. • The Presentation component of the Business Analytics is available at ip address http://93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop. 				
1	Tester acting as End User chooses Social Network KPIs	Social Network Charts tab appears on the right of the application window.	Social Network Charts tab appears on the right of the application window.	Passed	[used for traceability]
2	Tester acting as End User enters values for the desired filter fields on the left-hand side of the application window: Type: List of more propagated people – tied to the list of most propagated keywords – based on the number of influencers that they are following Initial Date: 05-12-2016 End Date: 19-12-2016 and presses the View Social Data and View Word Cloud button .	The User-chosen KPI related to Twitter messages are computed and then made available to the Presentation layer.	The User-chosen KPI related to Twitter messages are computed and then made available to the Presentation layer.	Passed	

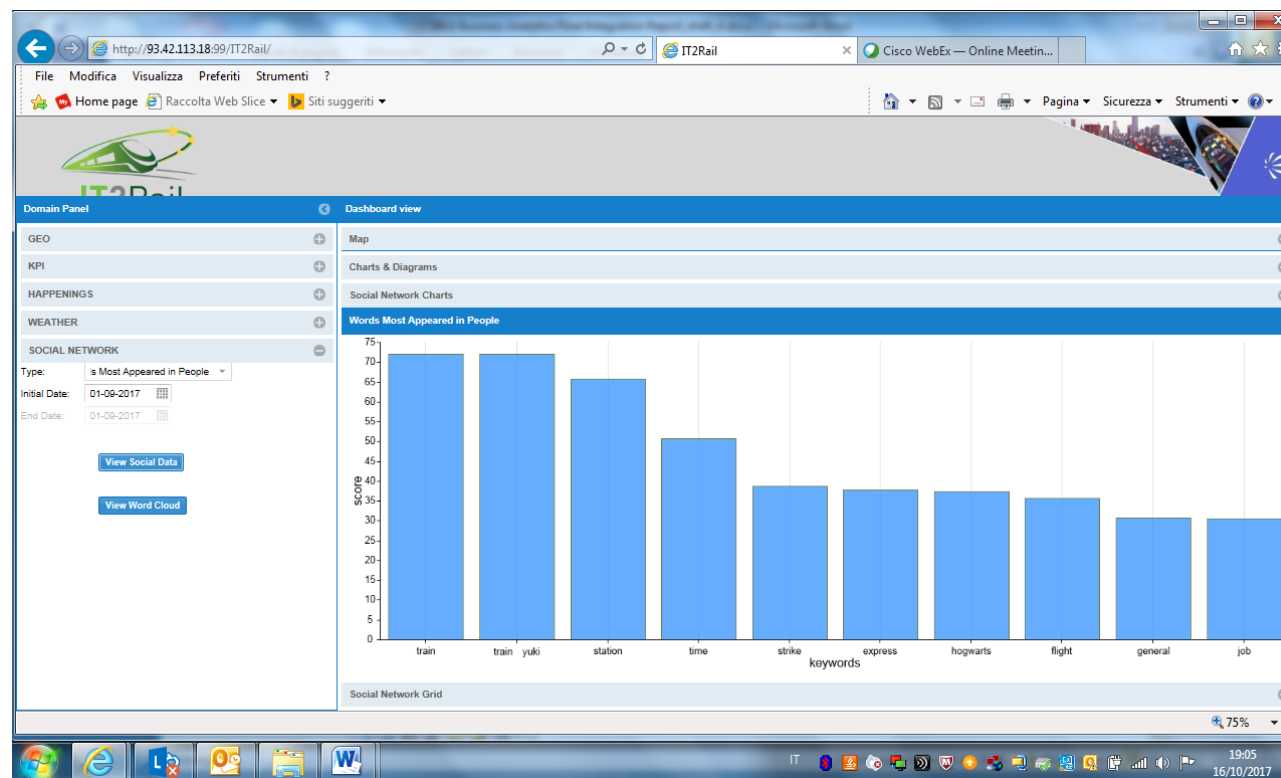
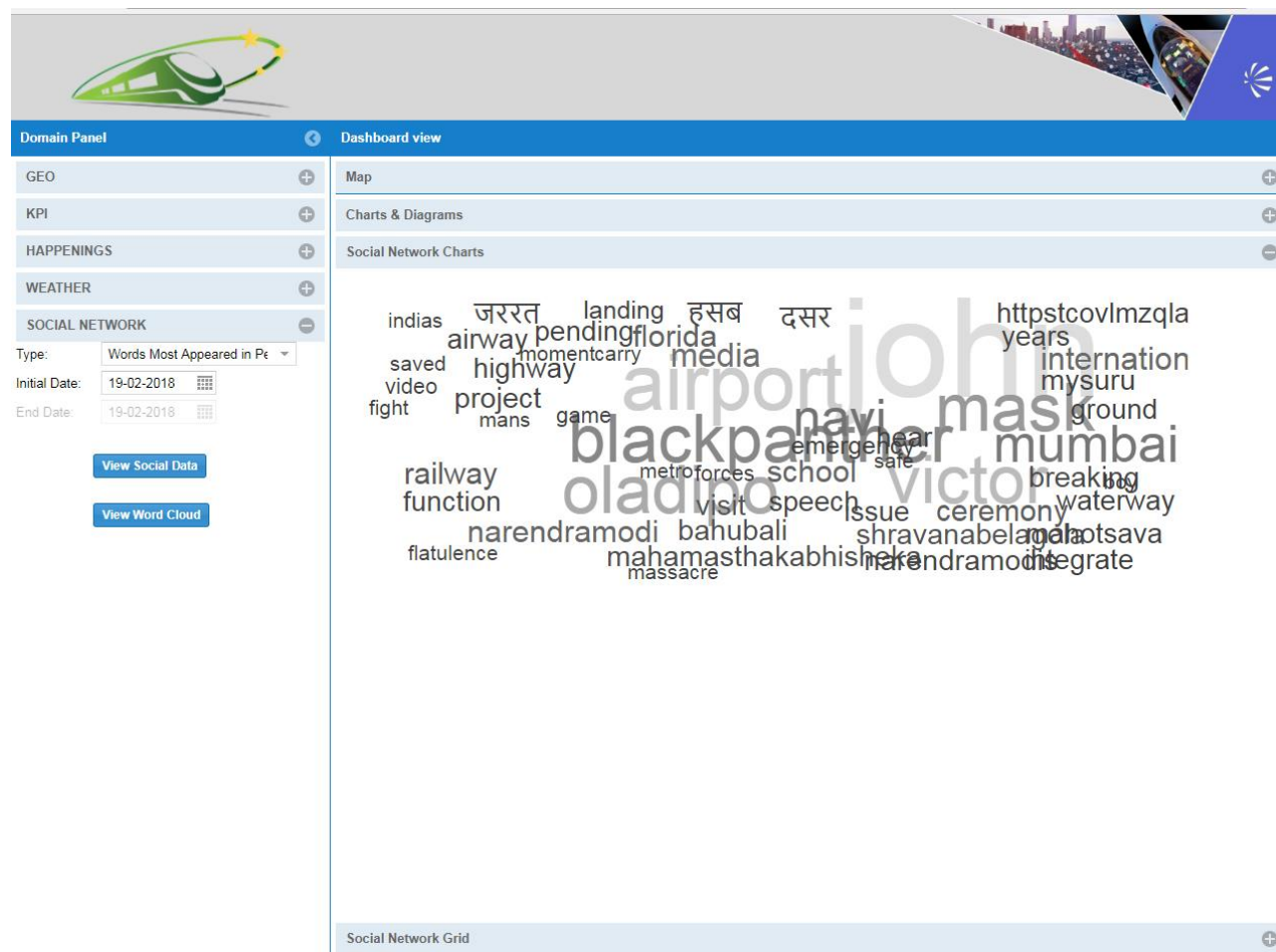


Figure 10 - Example of Words most appearing in Social Network Messages by Chart



5.5.2 [TEST CASE 6.5.2] STORING KPIS CONCERNING SOCIAL NETWORK MESSAGES INTO THE BUSINESS ANALYTICS REPOSITORIES

6.5.2	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To verify KPIs computed on social network messages are stored into the Business Analytics repositories
Description	This test verifies KPIs computed on social network messages are stored into the Business Analytics repositories.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • Internet connection is available • Twitter APIs are available • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. • The Presentation component of the Business Analytics is available at ip address http://93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop. 				
1	The BA component is running and desired KPIs are computed and presented to the Tester.	KPIs on social network messages are stored into the WP6 repositories.	KPIs on social network messages are actually stored into the WP6 repositories.	Passed	[used for traceability]

5.5.3 [TEST CASE 6.5.3] EXPOSING WEB SERVICES TO RETRIEVE KPIS COMPUTED ON SOCIAL NETWORK MESSAGES

6.5.3	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To check BA web services make the KPIs computed on social network messages available to the Presentation layer and the other IT2Rail modules
Description	This test checks whether the KPIs computed on social network messages can be retrieved by using the BA web services. The Business Analytics module exposes web services in order to collect the KPIs on social network messages stored in its repositories. These web services are created by using REST technology and enable to retrieve this kind of indicators. Data are formatted in JSON.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • Internet connection is available • Web services of the Data Management component of the Business Analytics are available and can be invoked. 				
1	<p>Tester invokes the BA social network webservice indicating a certain number of parameters such as: type of social network KPI and interval dates.</p> <p>The following URL represents an example of a webservice request:</p> <p>http://selene.pc.ac.upc.edu:9101/sts/getNumberTweetsCrawledXDay?username=it2railtest&iniDate=2018-03-01&endDate=2018-03-02&securekey=8c3862c504996960cc1714f27403c6f231024c44</p>	KPIs computed on social network messages are retrieved by using the WP6 web services.	KPIs computed on social network messages are retrieved by using the BA web services.	Passed	[used for traceability]

5.6 [TEST CATEGORY 6.6] PROVIDING KPIS ON TRAVEL COMPANION WALLET STORED USER INFORMATION

This test category describes the tests performed in order to check the Business Analytics functions used to:

- collect traveller information from WP5 wallet storage;
- compute KPIs in the Business Analytics module;
- visualize results and expose Rest Services to retrieve KPIs .

Currently the amount of information stored in the Cloud Wallet is limited in quantity, so for FREL testing purposes, information from different users will be simulated in aggregated mode. For this release, the functions of collecting information from the Cloud Wallet and storing it in the Business Analytics repositories will be replaced by a function able to simulate data from users and feed the ontologies for the analytic services.

5.6.1 [TEST CASE 6.6.1] RETRIEVE PREFERENCES FROM THE TRAVEL COMPANION WALLET (WP5)

6.1.1	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check the software component responsible for retrieving the user preferences coming from the Travel Companion Wallet. The preferences are: Direct Travel (where values are 'yes' or 'no'), Transport Preferences (where values are 'car', 'airline', 'train', 'other'), Seat (where values are 'first class', 'economy', 'business') and Carrier (where there are 21 different bus, train and airline carriers).
Description	This test case checks the connectivity between the cloud wallet and Sofia2 platform that is the B.A. module.
Status	OK
% passed	100%
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • The Travel Companion and BA back-end module are both running. 				
1	The Tester proceeds with the retrieval of the information stored in the Cloud Wallet and passes it to the Business Analytics platform. This is obtained through a REST service which is launched from the Cloud Wallet to the Sofia 2 platform.	The correct connection between the Travel Companion Wallet and the Business Analytics platform with the successful passage of data.	The correct connection between the Travel Companion Wallet and the Business Analytics platform with the successful passage of data was observed.	Passed	[used for traceability]

5.6.2 [TEST CASE 6.6.2] COMPUTING KEY PERFORMANCE INDICATORS

6.1.2	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check that the Business Analytics module computes the 4 KPIs mentioned in the previous paragraph 5.6.1.
Description	This test case verifies the computation for the 4 KPIs mentioned above.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • An Internet connection is available. • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. The Presentation component of the Business Analytics is available at the following URL address http:// 93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop.				
1	This module aims to computes the data coming from the Travel Companion Wallet and stored in Sofia's 2 platform Data Base	Expected the correct computation of the data retrieved from the Cloud Wallet.	KPIs correctly computed from Sofia 2 platform.	Passed	[used for traceability]

5.6.3 [TEST CASE 6.6.3] VISUALISING KEY PERFORMANCE INDICATORS

6.6.3	
Method Of Test	Demonstration
Type of test	Automated
Objectives	To check that the Business Analytics module computes and displays the indicators mentioned above.
Description	This test case verifies the computation and display of the 4 KPIs mentioned in paragraph 6.6.1.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • An Internet connection is available. • A web browser (preferably Google Chrome) is installed on the laptop where the test is performed. • The Presentation component of the Business Analytics is available at the following URL address http://93.42.113.18:99/IT2Rail/ and can be visualized by using the web browser installed on the laptop. 				
1	The Tester proceeds with the correct visualization of the 4 KPIs previously defined.	Visualization of the KPIs.	Correctly displayed the indicators.	Passed	[used for traceability]

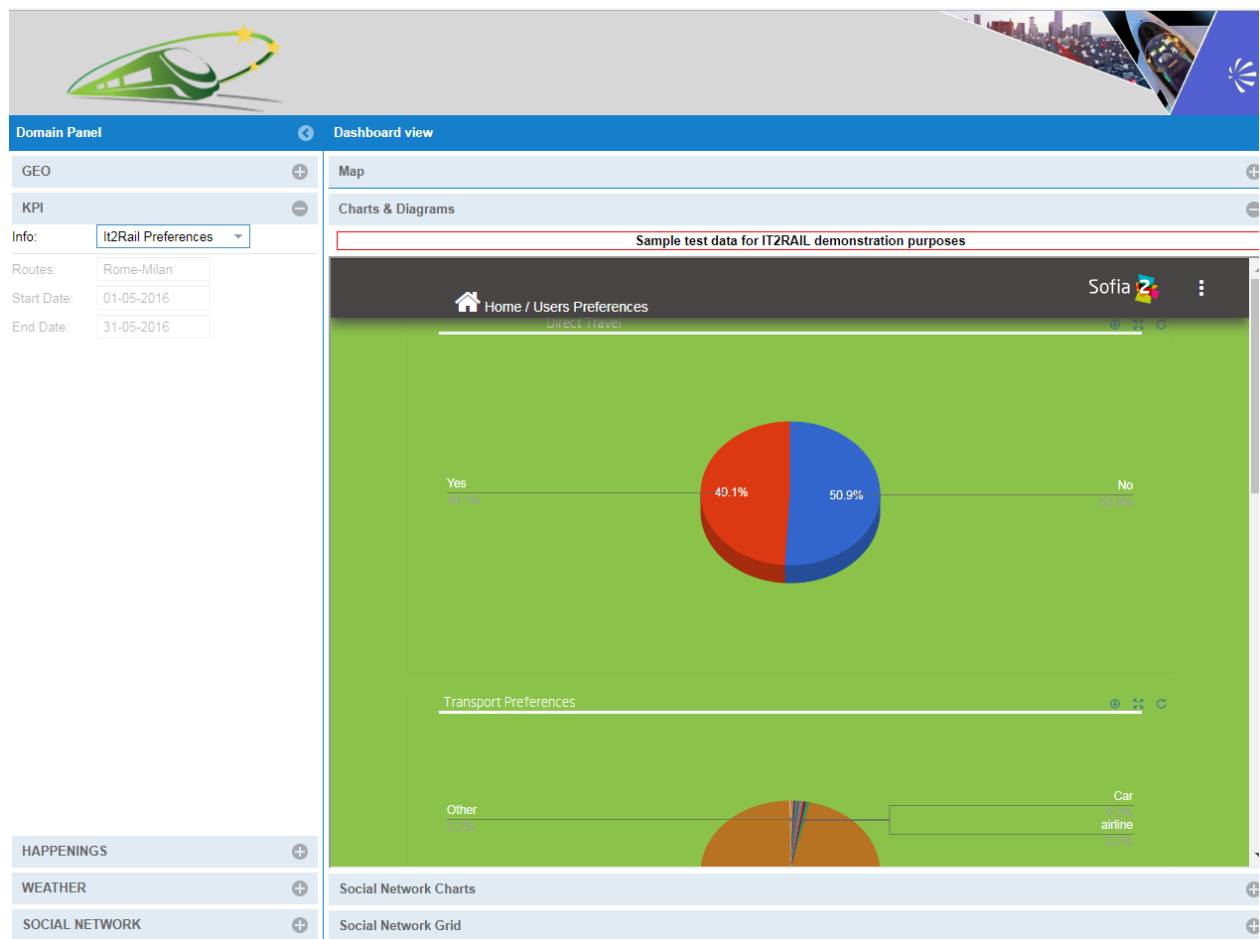


Figure 12 – KPIs on data stored within the Travel Companion Cloud Wallet

5.7 [TEST CATEGORY 6.7] SENTIMENT ANALYSIS ON USER FEEDBACKS

5.7.1 [TEST CASE 6.7.1] GENERATING A SENTIMENT ANALYSIS TRAINING SET

6.7.1	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To generate a sentiment analysis training set
Description	This test checks that a sentiment analysis training set is generated.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

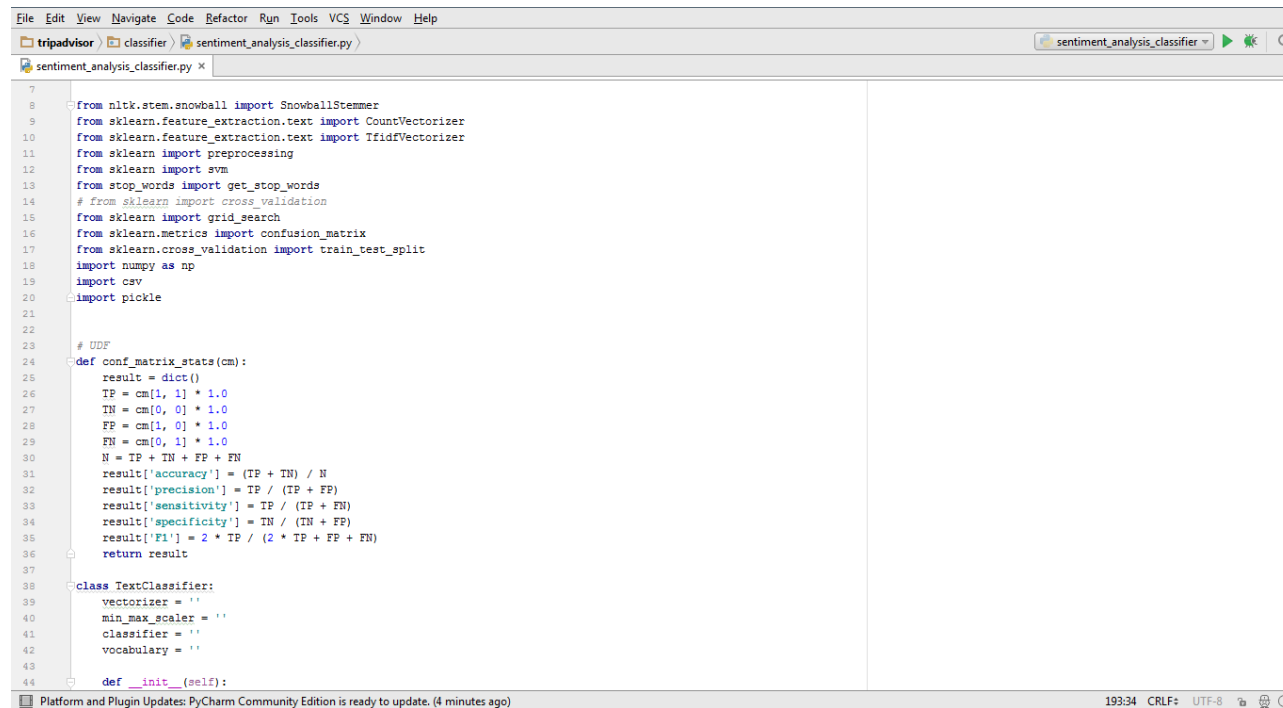
Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • A simulated repository for negative/positive user feedbacks related to trips taken 				
1	Tester manually creates a unique training set of negative/positive user feedbacks for demonstration purposes.	The training set data is successfully generated	The training set data is successfully generated	Passed	[used for traceability]

5.7.2 [TEST CASE 6.7.2] PERFORMING MACHINE-LEARNING TRAINING

6.7.2	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To use the previously generated training set in order to trigger machine-learning by the Sentiment Analysis module
Description	Trigger machine-learning by the Sentiment Analysis module using the previously created training set.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • The Sentiment Analysis module is installed on the machine. • PyCharm Community Edition 2017.3 is running. • Python is installed on the machine where the test will be performed. • The training data set was created manually and is made available. 				
1	<ul style="list-style-type: none"> • Tester configures the Sentiment Analysis module developed in Python within the PyCharm Environment. • Tester launches the Sentiment Analysis module within the PyCharm IDE. 	The Sentiment Analysis module trains a model able to successfully distinguish if a user feedback is positive or not.	The Sentiment Analysis module trains a model able to successfully distinguish if a user feedback is positive or not.	Passed	[used for traceability]



```
7
8 from nltk.stem.snowball import SnowballStemmer
9 from sklearn.feature_extraction.text import CountVectorizer
10 from sklearn.feature_extraction.text import TfidfVectorizer
11 from sklearn import preprocessing
12 from sklearn import svm
13 from stop_words import get_stop_words
14 # from sklearn import cross_validation
15 from sklearn import grid_search
16 from sklearn.metrics import confusion_matrix
17 from sklearn.cross_validation import train_test_split
18 import numpy as np
19 import csv
20 import pickle
21
22
23 # UDF
24 def conf_matrix_stats(cm):
25     result = dict()
26     TP = cm[1, 1] * 1.0
27     TN = cm[0, 0] * 1.0
28     FP = cm[1, 0] * 1.0
29     FN = cm[0, 1] * 1.0
30     N = TP + TN + FP + FN
31     result['accuracy'] = (TP + TN) / N
32     result['precision'] = TP / (TP + FP)
33     result['sensitivity'] = TP / (TP + FN)
34     result['specificity'] = TN / (TN + FP)
35     result['F1'] = 2 * TP / (2 * TP + FP + FN)
36     return result
37
38 class TextClassifier:
39     vectorizer = ''
40     min_max_scaler = ''
41     classifier = ''
42     vocabulary = ''
43
44     def __init__(self):
```

Platform and Plugin Updates: PyCharm Community Edition is ready to update. (4 minutes ago) 193:34 CRLF: UTF-8

Figure 13 - Sentiment Analysis module within PyCharm Environment

5.7.3 [TEST CASE 6.7.3] PERFORMING MACHINE-LEARNING VALIDATION

6.7.3	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To validate the behaviour of the Sentiment Analysis module
Description	This test checks whether the Sentiment Analysis module is behaving properly when fed with a validation set.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • The Sentiment Analysis module is installed on the machine. • PyCharm Community Edition 2017.3 is running. • Python is installed on the machine where the test will be performed. • The validation set is made available by partitioning the original training data set. 				
1	<ul style="list-style-type: none"> • Tester configures the Sentiment Analysis module developed in Python within the PyCharm Environment. • Tester launches the Sentiment Analysis module within the PyCharm IDE. 	The Sentiment Analysis Module properly classifies the elements included in the validation set.	The Sentiment Analysis Module properly classifies the elements included in the validation set.	Passed	[used for traceability]

5.8 [TEST CATEGORY 6.8] PROVIDING KEY PERFORMANCE INDICATORS REGARDING TRAVEL COMFORT

This test category describes the tests performed in order to assess travel comfort related services that have not been integrated within the IT2Rail system. Currently the services provide air quality inference models of air in underground public transport stations based on meteorological measurements and forecast.

5.8.1[TEST CASE 6.8.1] BUILDING AIR QUALITY INFERENCE MODEL

6.8.1	
Method Of Test	
Type of test	Automated
Objectives	To estimate an air quality inference model based on meteorological data
Description	This test creates a model capable of inferring air quality parameters in underground public transport stations based on ambient meteorological parameters and access its performances.
Status	OK
% passed	100%

Id	Step description	Expected result	Observed result	State	Associated defect
	<p>Preconditions:</p> <ul style="list-style-type: none"> Tools, libraries and packages have been installed following the README.md: <ul style="list-style-type: none"> R (v3.4.3) Python (v2.7.12) NodeJS (v9.4.0) MongoDB (v3.4.10) libssl-dev, libsass2-dev and libxml2-dev debian packages pymongo, numpy, scipy, pandas, scikit-learn python packages . SETUP-ENV.sh has been executed on a shell for project deployment (the environment variables IT2RAIL_APP_HOST, IT2RAIL_APP_PORT, MONGO_HOST and MONGO_PORT can be defined to meet specific requirements during deployment or left as is if there is no conflict between port with other services) R packages have been installed correctly with: <pre>`Rscript \${SCRIPTS_R_PATH}/r.libPath.and.dependencies.R install`</pre> command line App is running with ./start-demo.sh at <code>http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}</code> 				

Id	Step description	Expected result	Observed result	State	Associated defect
1	<p>Identify performances of predicting CO2, PM10, NO, NO2, TEMP, HUMI within a station (Auber) from external meteo data (Paris-Montsouris).</p> <p>The purpose of this test is to retrieve for the given metro station (Auber here fixed), the performance indicator of a model predicting several air quality indexes within the station given only external meteorological observations.</p> <p>The result appear while performing a GET query on app with: http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}/business-analytics/services/identifyAirQualityPrediction</p> <p>where \${IT2RAIL_APP_HOST} and \${IT2RAIL_APP_PORT} are defined inside SETUP-ENV.sh (following Preconditions)</p>	<p>The inference model is able to estimate air quality parameters based on meteorological measurements. The tester should see after some time a JSON output describing the performances of the learned model for predicting several air quality indices. The time taken depends on the learning phase and a set of monte carlo simulations to provide accurate estimates.</p>	<p>The JSON output corresponding to the performances of the model in predicting each air quality variable (CO2, PM10, NO, NO2, TEMP, HUMI) within the station.</p>		

Id	Step description	Expected result	Observed result	State	Associated defect
2	<p>Visualize performances of predicting CO2, PM10, NO, NO2, TEMP, HUMI within a station (Auber) from external meteo data (Paris-Montsouris).</p> <p>The purpose of this test is to visualize for the given metro station (Auber here fixed), the performance indicator of a model predicting several air quality indexes within the station given only external meteorological observations.</p> <p>The result appear while performing a GET query on app with: http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}/business-analytics/services/visualizeAirQualityPrediction</p> <p>where \${IT2RAIL_APP_HOST} and \${IT2RAIL_APP_PORT} are defined inside SETUP-ENV.sh (following Preconditions)</p>	<p>The inference model is able to estimate air quality parameters based on meteorological measurements. The tester should see after some time a Barplot visualization output describing the performances of the learned model for predicting several air quality indices. The time taken depends on the learning phase and a set of monte carlo simulations to provide accurate estimates.</p>	<p>The Barplot output corresponding to the performances of the model in predicting each air quality variable (CO2, PM10, NO, NO2, TEMP, HUMI) within the station.</p>	Passed	

```
{
  "stds": {
    "CO2": 0.21224414380467707, "PM10": 2.6439227042942446, "TEMP": 0.13521957251808744, "NO": 5.805057194814156, "HUMI": 0.31226104034272734, "NO2": 0.9657671318721089
  },
  "means": {
    "CO2": 92.02034439440062, "PM10": 51.95813373234755, "TEMP": 95.36026392730713, "NO": 15.710477776823975, "HUMI": 89.85248782975316, "NO2": 80.25450217800022
  }
}
```

Figure 14 - Air quality parameters inference based on temperatures and rain rate at the Metro Station Auber in Paris (JSON output)

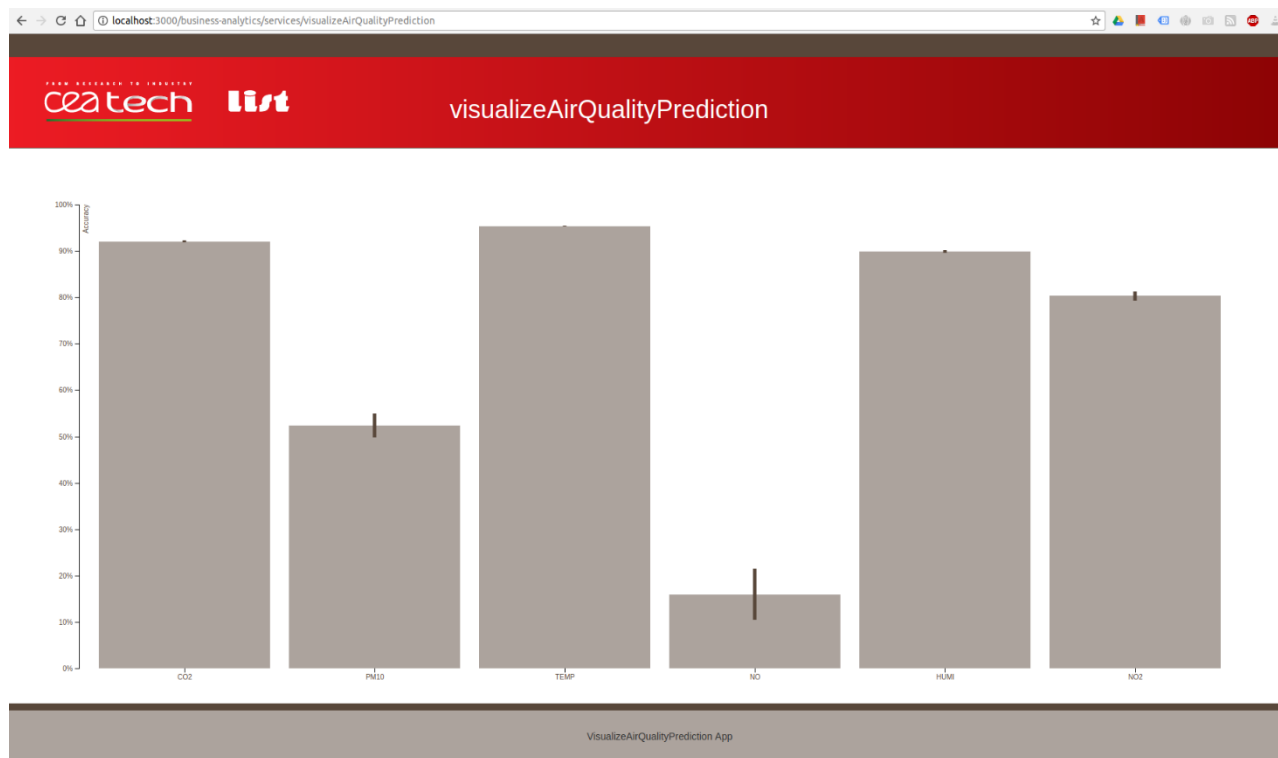


Figure 15 - Air quality parameters inference based on temperatures and rain rate at the Metro Station Auber in Paris (Barplot output)

5.9 [TEST CATEGORY 6.9] PROVIDING KEY PERFORMANCE INDICATORS REGARDING TRAVEL DATA

This test category describes the tests performed in order to assess travel data related services that have not been integrated within the IT2Rail system. The services provide KPIs on a historical database of official messages related to perturbation or delays for a set of line ids.

5.9.1 [TEST CASE 6.9.1] IDENTIFY MOST INFORMATIVE TERMS FROM TRAVEL DATA MESSAGES

6.9.1	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To have an overview of most informative terms in the travel data messages database
Description	This test provides a set of parameterized most informative terms frequencies given a railroad or metro line id.
Status	OK
% passed	100%

Id	Step description	Expected result	Observed result	State	Associated defect
	<p>Preconditions:</p> <ul style="list-style-type: none"> Tools, libraries and packages have been installed following the README.md: <ul style="list-style-type: none"> R (v3.4.3) Python (v2.7.12) NodeJS (v9.4.0) MongoDB (v3.4.10) libssl-dev, libsass2-dev and libxml2-dev debian packages pymongo, numpy, scipy, pandas, scikit-learn python packages . SETUP-ENV.sh has been executed on a shell for project deployment (the environment variables IT2RAIL_APP_HOST, IT2RAIL_APP_PORT, MONGO_HOST and MONGO_PORT can be defined to meet specific requirements during deployment or left as is if there is no conflict between port with other services) R packages have been installed correctly with: <pre>`Rscript \${SCRIPTS_R_PATH}/r.libPath.and.dependencies.R install`</pre> command line App is running with ./start-demo.sh at <code>http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}</code> 				

Id	Step description	Expected result	Observed result	State	Associated defect
1	<p>Identify most informative terms from travel data messages.</p> <p>The purpose of this test is to retrieve for the given metro line and time window, a list of most informative term from travel data messages (JSON content response).</p> <p>The result appear while performing a GET query on app with:</p> <p>http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}/business-analytics/services/identifyInformativeTermsFromTravelDataMessages</p> <p>where \${IT2RAIL_APP_HOST} and \${IT2RAIL_APP_PORT} are defined inside SETUP-ENV.sh (following Preconditions)</p>	A list of terms associated with an informativeness score in JSON output.	The JSON output of list of terms associated with their informativeness score.	Passed	

```
[{"term": "incident", "score": 315.3537}, {"term": "retour", "score": 289.5624}, {"term": "ensemble", "score": 288.2606}, {"term": "régulier", "score": 288.2606}, {"term": "terminé", "score": 286.9166}, {"term": "entre", "score": 269.1598}, {"term": "colis", "score": 259.8495}, {"term": "suspect", "score": 259.8495}, {"term": "voyageur", "score": 247.6557}, {"term": "interrompu", "score": 245.184}, {"term": "ralenti", "score": 241.3569}, {"term": "trafic", "score": 233.6579}, {"term": "montrouge", "score": 199.5546}, {"term": "chatillon", "score": 195.8494}, {"term": "reprise", "score": 195.8494}, {"term": "malaise", "score": 190.1071}, {"term": "denis", "score": 189.598}, {"term": "estimée", "score": 175.7833}, {"term": "perturbé", "score": 162.3619}, {"term": "station", "score": 139.8985}, {"term": "technique", "score": 139.8985}, {"term": "fourche", "score": 137.2051}, {"term": "pleyel", "score": 137.2051}, {"term": "rame", "score": 131.6858}, {"term": "panne", "score": 125.9801}, {"term": "sécurité", "score": 123.0535}, {"term": "police", "score": 123.0535}, {"term": "carr", "score": 123.0535}, {"term": "varenne", "score": 120.0754}, {"term": "vanves", "score": 120.0462}]
```

Figure 16 - JSON output of (normalized) most informative terms corresponding to travel data messages for French metro company RATP line 'Ligne13' between '2017-01-01 00:00:00 BST' and '2017-07-04 00:00:00 BST'. From top to bottom and left to right, retained terms

5.9.2 [TEST CASE 6.9.2] VISUALIZE MOST INFORMATIVE TERMS FROM TRAVEL DATA MESSAGES

6.9.2	
Method Of Test	Demonstration
Type of test	Manual
Objectives	Visualize most informative terms in the travel data messages database
Description	This test provides a visualization of the most informative terms.
Status	OK
% passed	100%

Id	Step description	Expected result	Observed result	State	Associated defect
	<p>Preconditions:</p> <ul style="list-style-type: none"> Tools, libraries and packages have been installed following the README.md: <ul style="list-style-type: none"> R (v3.4.3) Python (v2.7.12) NodeJS (v9.4.0) MongoDB (v3.4.10) libssl-dev, libsasl2-dev and libxml2-dev debian packages pymongo, numpy, scipy, pandas, scikit-learn python packages . SETUP-ENV.sh has been executed on a shell for project deployment (the environment variables IT2RAIL_APP_HOST, IT2RAIL_APP_PORT, MONGO_HOST and MONGO_PORT can be defined to meet specific requirments during deployment or left as is if there is no conflict between port with other services) R packages have been installed correctly with: <pre>`Rscript \${SCRIPTS_R_PATH}/r.libPath.and.depe ndencies.R install`</pre> command line App is running with ./start-demo.sh at http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT} 				

Id	Step description	Expected result	Observed result	State	Associated defect
1	<p>Visualize most informative terms from travel data messages.</p> <p>The purpose of this test is to visualize for the given metro line and time window, a list of most informative term from travel data messages.</p> <p>The result appear while performing a GET query on app with:</p> <p>http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}/business-analytics/services/visualizeInformativeTermsFromTravelDataMessages</p> <p>where \${IT2RAIL_APP_HOST} and \${IT2RAIL_APP_PORT} are defined inside SETUP-ENV.sh (following Preconditions).</p>	<p>A wordcloud of most informative terms showing relative importance.</p>	<p>A wordcloud of most informative terms showing relative importance.</p>	Passed	

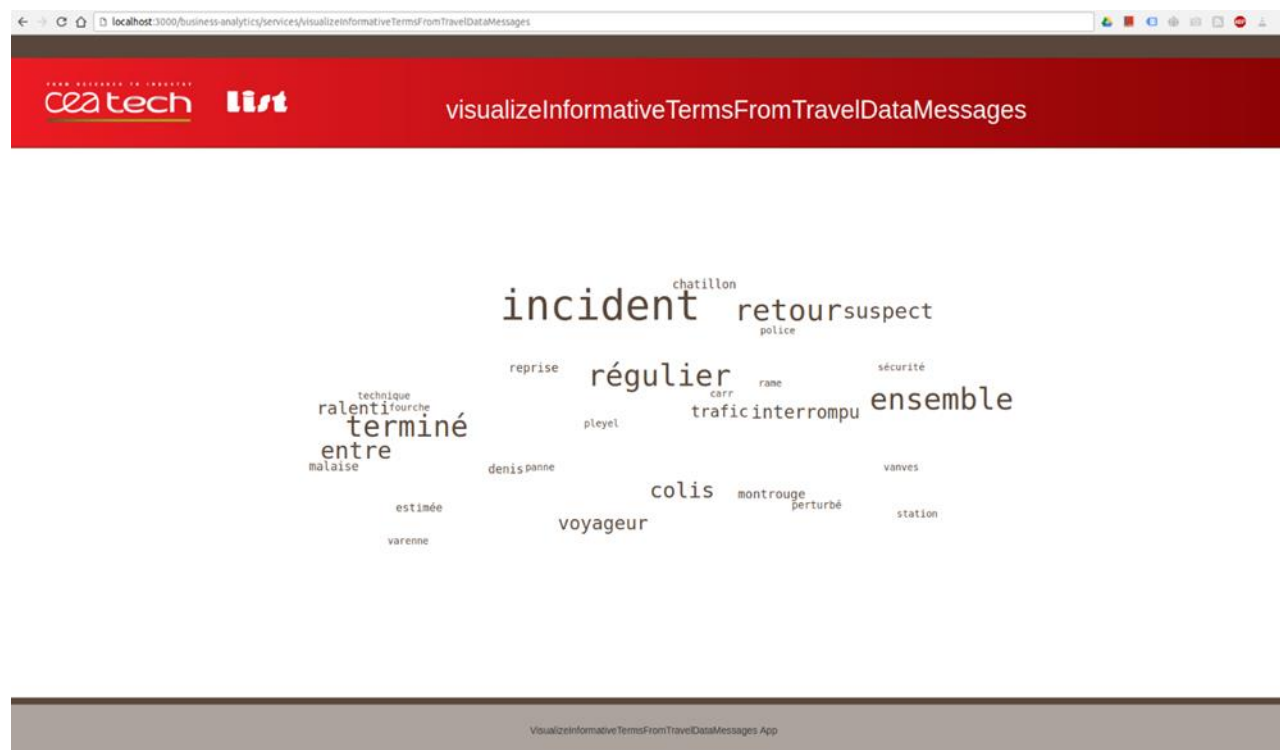


Figure 17 - Wordclouds of (normalized) most informative terms corresponding to travel data messages for French metro company RATP line 'Ligne13' between '2017-01-01 00:00:00 BST' and '2017-07-04 00:00:00 BST'. From top to bottom and left to right, retained terms

5.9.3 [TEST CASE 6.9.3] IDENTIFY MOST INFORMATIVE CO/OCCURRING TERMS FROM TRAVEL DATA MESSAGES

6.9.3	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To identify co-occurring terms in the travel data messages database
Description	This test provides a set of parameterized co-occurring terms given a railroad or metro line id.
Status	OK
% passed	100%

6.9.3					
Id	Step description	Expected result	Observed result	State	Associated defect
	<p>Preconditions:</p> <ul style="list-style-type: none"> Tools, libraries and packages have been installed following the README.md: <ul style="list-style-type: none"> R (v3.4.3) Python (v2.7.12) NodeJS (v9.4.0) MongoDB (v3.4.10) libssl-dev, libssl-dev and libxml2-dev debian packages pymongo, numpy, scipy, pandas, scikit-learn python packages . SETUP-ENV.sh has been executed on a shell for project deployment (the environment variables IT2RAIL_APP_HOST, IT2RAIL_APP_PORT, MONGO_HOST and MONGO_PORT can be defined to meet specific requirments during deployment or left as is if there is no conflict between port with other services) R packages have been installed correctly with: <code>`Rscript \${SCRIPTS_R_PATH}/r.libPath.and.depe ndencies.R install`</code> command line App is running with <code>./start-demo.sh</code> at <code>http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}</code> 				

6.9.3					
1	<p>Identify most informative co occurring terms from travel data messages.</p> <p>The purpose of this test is to retrieve for the given metro line and time window, a graph of most informative co occurring terms from travel data messages (JSON content response).</p> <p>The result appear while performing a GET query on app with:</p> <p>http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}/business-analytics/services/identifyInformativeCoOccurringTermsFromTravelDataMessages</p> <ul style="list-style-type: none"> - where \${IT2RAIL_APP_HOST} and \${IT2RAIL_APP_PORT} are defined inside SETUP-ENV.sh (following Preconditions). 	<p>A graph of co-occurring terms associated with an informativeness score. Graph is outputted as a list of vertices and a list of edges in JSON format</p>	<p>The JSON output of a graph of co-occurring terms that is meaningful regarding travel data.</p>	Passed	

```
{
  "vertices": [
    {
      "name": "arrêt",
      "community": 1,
      "betweenness": 0,
      "degree": 3,
      "_row": "arrêt"
    },
    {
      "name": "chs",
      "community": 1,
      "betweenness": 5,
      "degree": 8,
      "_row": "chs"
    },
    {
      "name": "clemenceau",
      "community": 1,
      "betweenness": 19,
      "degree": 7,
      "_row": "clemenceau"
    },
    {
      "name": "elysees",
      "community": 1,
      "betweenness": 20,
      "degree": 6,
      "_row": "elysees"
    },
    {
      "name": "marqué",
      "community": 1,
      "betweenness": 0,
      "degree": 3,
      "_row": "marqué"
    },
    {
      "name": "mesure",
      "community": 1,
      "betweenness": 4,
      "degree": 8,
      "_row": "mesure"
    },
    {
      "name": "sécurité",
      "community": 1,
      "betweenness": 54,
      "degree": 8,
      "_row": "sécurité"
    },
    {
      "name": "fermée",
      "community": 1,
      "betweenness": 272,
      "degree": 8,
      "_row": "fermée"
    },
    {
      "name": "station",
      "community": 1,
      "betweenness": 5,
      "degree": 7,
      "_row": "station"
    },
    {
      "name": "elysées",
      "community": 1,
      "betweenness": 10,
      "degree": 5,
      "_row": "elysées"
    },
    {
      "name": "ensemble",
      "community": 2,
      "betweenness": 0,
      "degree": 5,
      "_row": "ensemble"
    },
    {
      "name": "incident",
      "community": 2,
      "betweenness": 0,
      "degree": 6,
      "_row": "incident"
    },
    {
      "name": "retour",
      "community": 2,
      "betweenness": 0,
      "degree": 5,
      "_row": "retour"
    },
    {
      "name": "régulier",
      "community": 2,
      "betweenness": 0,
      "degree": 5,
      "_row": "régulier"
    },
    {
      "name": "terminé",
      "community": 2,
      "betweenness": 0,
      "degree": 5,
      "_row": "terminé"
    },
    {
      "name": "trafic",
      "community": 2,
      "betweenness": 242,
      "degree": 8,
      "_row": "trafic"
    },
    {
      "name": "équipes",
      "community": 10,
      "betweenness": 2,
      "degree": 5,
      "_row": "équipes"
    },
    {
      "name": "clichy",
      "community": 3,
      "betweenness": 3,
      "degree": 3,
      "_row": "clichy"
    },
    {
      "name": "courtilles",
      "community": 3,
      "betweenness": 29,
      "degree": 6,
      "_row": "courtilles"
    },
    {
      "name": "denis",
      "community": 13,
      "betweenness": 2,
      "degree": 7,
      "_row": "denis"
    },
    {
      "name": "dir",
      "community": 3,
      "betweenness": 50,
      "degree": 7,
      "_row": "dir"
    },
    {
      "name": "matériel",
      "community": 3,
      "betweenness": 0,
      "degree": 1,
      "_row": "matériel"
    },
    {
      "name": "panne",
      "community": 3,
      "betweenness": 107,
      "degree": 4,
      "_row": "panne"
    },
    {
      "name": "rame",
      "community": 3,
      "betweenness": 0,
      "degree": 7,
      "_row": "rame"
    },
    {
      "name": "stationne",
      "community": 3,
      "betweenness": 0,
      "degree": 7,
      "_row": "stationne"
    },
    {
      "name": "chatillon",
      "community": 3,
      "betweenness": 68,
      "degree": 16,
      "_row": "chatillon"
    },
    {
      "name": "malaise",
      "community": 3,
      "betweenness": 116,
      "degree": 11,
      "_row": "malaise"
    },
    {
      "name": "montrouge",
      "community": 3,
      "betweenness": 175,
      "degree": 16,
      "_row": "montrouge"
    },
    {
      "name": "ralenti",
      "community": 3,
      "betweenness": 115,
      "degree": 7,
      "_row": "ralenti"
    },
    {
      "name": "vers",
      "community": 3,
      "betweenness": 1,
      "degree": 4,
      "_row": "vers"
    },
    {
      "name": "voyageur",
      "community": 3,
      "betweenness": 219,
      "degree": 15,
      "_row": "voyageur"
    },
    {
      "name": "estimée",
      "community": 13,
      "betweenness": 209,
      "degree": 15,
      "_row": "estimée"
    },
    {
      "name": "reprise",
      "community": 13,
      "betweenness": 21,
      "degree": 12,
      "_row": "reprise"
    },
    {
      "name": "technique",
      "community": 13,
      "betweenness": 39,
      "degree": 4,
      "_row": "technique"
    },
    {
      "name": "ascieres",
      "community": 3,
      "betweenness": 0,
      "degree": 3,
      "_row": "ascieres"
    }
  ]
}
```

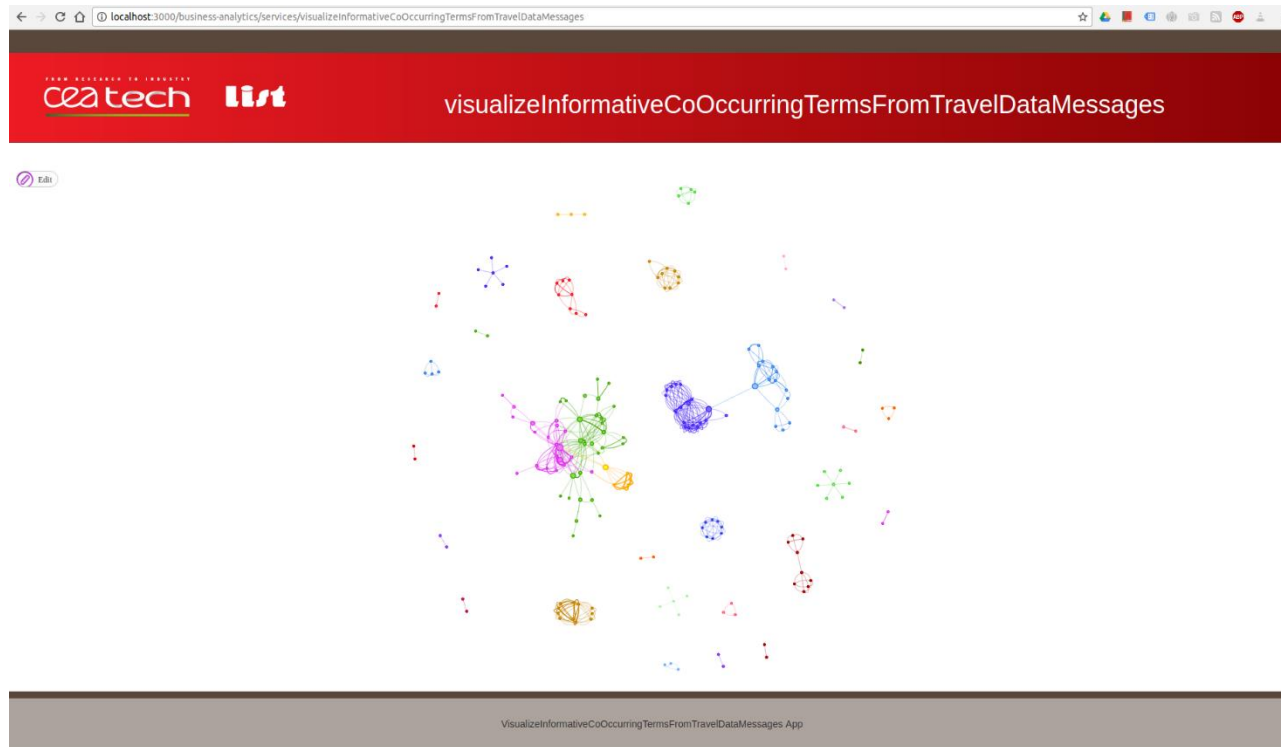
Figure 18: Graph of (normalized) most informative co-occurring terms corresponding to travel data messages for French metro company RATP line ‘Ligne13’ between ‘2017-01-01 00:00:00 BST’ and ‘2017-07-04 00:00:00 BST’ as JSON output.

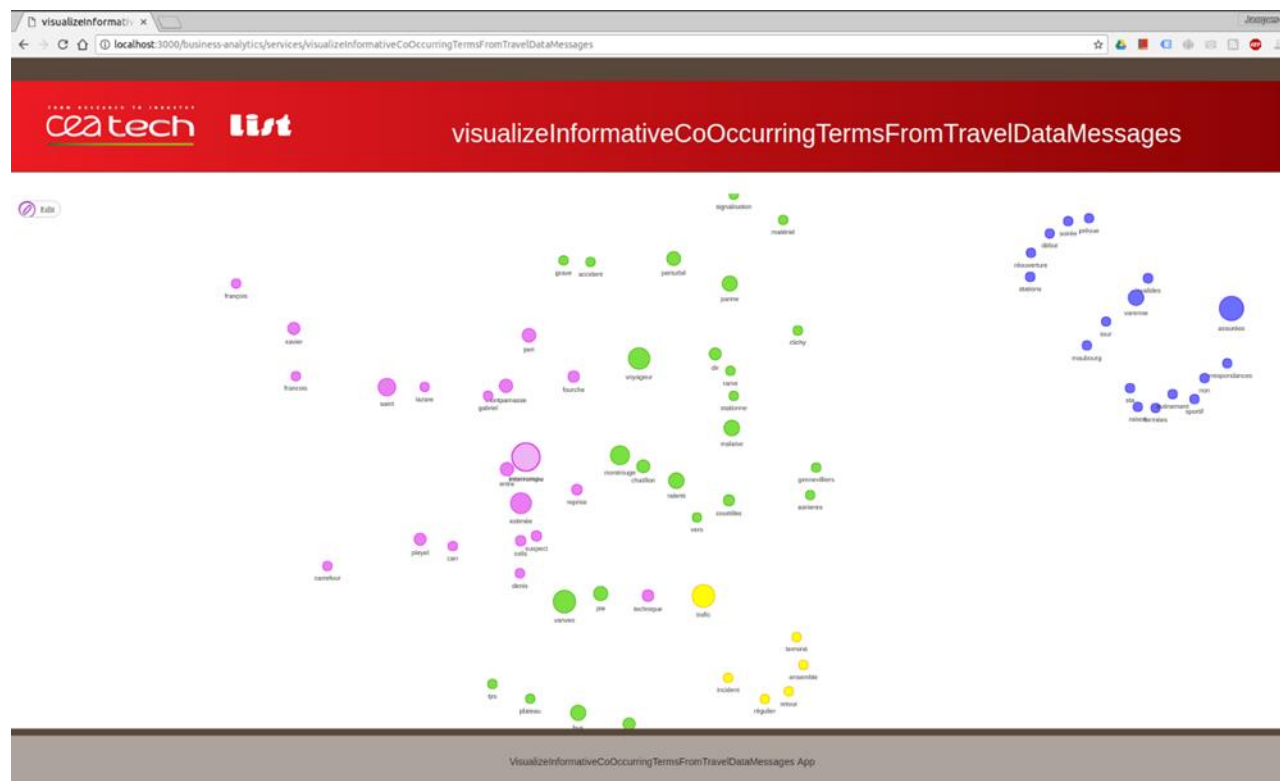
5.9.4 [TEST CASE 6.9.4] VISUALIZE MOST INFORMATIVE CO-OCCURRING TERMS FROM TRAVEL DATA MESSAGES

6.9.4	
Method Of Test	Demonstration
Type of test	Manual
Objectives	Visualize most informative co-occurring terms in the travel data messages database
Description	This test provides a visualization of the most informative co-occurring terms.
Status	OK
% passed	100%

Id	Step description	Expected result	Observed result	State	Associated defect
	<p>Preconditions:</p> <ul style="list-style-type: none"> Tools, libraries and packages have been installed following the README.md: <ul style="list-style-type: none"> R (v3.4.3) Python (v2.7.12) NodeJS (v9.4.0) MongoDB (v3.4.10) libssl-dev, libsasl2-dev and libxml2-dev debian packages pymongo, numpy, scipy, pandas, scikit-learn python packages . SETUP-ENV.sh has been executed on a shell for project deployment (the environment variables IT2RAIL_APP_HOST, IT2RAIL_APP_PORT, MONGO_HOST and MONGO_PORT can be defined to meet specific requirments during deployment or left as is if there is no conflict between port with other services) R packages have been installed correctly with: <pre>`Rscript \${SCRIPTS_R_PATH}/r.libPath.and.depe ndencies.R install`</pre> command line App is running with ./start-demo.sh at <code>http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}</code> 				

Id	Step description	Expected result	Observed result	State	Associated defect
1	<p>Visualize most informative co occurring terms from travel data messages.</p> <p>The purpose of this test is to visualize for the given metro line and time window, a graph of most informative co occurring terms from travel data messages.</p> <p>The result appear while performing a GET query on app with:</p> <p>http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}/business-analytics/services/visualizeInformativeCoOccurringTermsFromTravelDataMessages</p> <p>where \${IT2RAIL_APP_HOST} and \${IT2RAIL_APP_PORT} are defined inside SETUP-ENV.sh (following Preconditions).</p>	<p>A graph of co-occurring terms associated with an informativeness score. Graph is outputted as a list of vertices and a list of edges in a GraphViz output.</p>	<p>The Graph visualization output of a graph of co-occurring terms that is meaningful regarding travel data.</p>	Passed	





Figures 19 - Graph of (normalized) most informative co-occurring terms corresponding to travel data messages for French metro company RATP line 'Ligne13' between '2017-01-01 00:00:00 BST' and '2017-07-04 00:00:00 BST'.

5.9.5 [TEST CASE 6.9.5] IDENTIFY TRAVEL DATA ITEMS OF INTEREST TIMELINES

6.9.5	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To identify timelines for terms of interest in the travel data messages database
Description	This test provides a structural time series for set of terms of interest given a railroad or metro line id and within a specific time window.
Status	OK
% passed	100%

Id	Step description	Expected result	Observed result	State	Associated defect
	<p>Preconditions:</p> <ul style="list-style-type: none"> Tools, libraries and packages have been installed following the README.md: <ul style="list-style-type: none"> R (v3.4.3) Python (v2.7.12) NodeJS (v9.4.0) MongoDB (v3.4.10) libssl-dev, libsass2-dev and libxml2-dev debian packages pymongo, numpy, scipy, pandas, scikit-learn python packages . SETUP-ENV.sh has been executed on a shell for project deployment (the environment variables IT2RAIL_APP_HOST, IT2RAIL_APP_PORT, MONGO_HOST and MONGO_PORT can be defined to meet specific requirements during deployment or left as is if there is no conflict between port with other services) R packages have been installed correctly with: <pre>`Rscript \${SCRIPTS_R_PATH}/r.libPath.and.dependencies.R install`</pre> command line App is running with ./start-demo.sh at <code>http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}</code> 				

Id	Step description	Expected result	Observed result	State	Associated defect
1	<p>Identify terms of interest timelines from travel data messages.</p> <p>The purpose of this test is to retrieve for the given metro line and time window, a list of timelines of terms of interest from travel data messages (JSON content response).</p> <p>The result appear while performing a GET query on app with:</p> <p>http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}/business-analytics/services/identifyTermsOfInterestTimelineFromTravelDataMessages</p> <p>where \${IT2RAIL_APP_HOST} and \${IT2RAIL_APP_PORT} are defined inside SETUP-ENV.sh (following Preconditions).</p>	A time series of messages containing terms of interest in JSON format.	The JSON output of time series of messages containing terms of interest.	Passed	

```
{
  "incident <not> termin ": [
    {
      "id": "816665954667134977",
      "created": "2017-01-04 15:21:51"
    },
    {
      "id": "816675769447514112",
      "created": "2017-01-04 16:00:51"
    },
    {
      "id": "816942527077031936",
      "created": "2017-01-05 09:40:51"
    },
    {
      "id": "816944539881668608",
      "created": "2017-01-05 09:48:51"
    },
    {
      "id": "818131863558586369",
      "created": "2017-01-08 16:26:51"
    },
    {
      "id": "819814450391715840",
      "created": "2017-01-13 07:52:51"
    },
    {
      "id": "819944053680865285",
      "created": "2017-01-13 16:27:50"
    },
    {
      "id": "820132545509605380",
      "created": "2017-01-14 04:56:50"
    },
    {
      "id": "820136571978584064",
      "created": "2017-01-14 05:12:50"
    },
    {
      "id": "822359719947993089",
      "created": "2017-01-20 08:26:50"
    },
    {
      "id": "828676590460686341",
      "created": "2017-02-06 18:47:49"
    },
    {
      "id": "828677596896444417",
      "created": "2017-02-06 18:51:49"
    },
    {
      "id": "829288324334493697",
      "created": "2017-02-08 11:18:38"
    },
    {
      "id": "829298945096556545",
      "created": "2017-02-08 12:00:50"
    },
    {
      "id": "832000720635383808",
      "created": "2017-02-15 22:56:44"
    },
    {
      "id": "832009812003155968",
      "created": "2017-02-15 23:32:51"
    },
    {
      "id": "833092818205802500",
      "created": "2017-02-18 23:16:20"
    },
    {
      "id": "833702600230985728",
      "created": "2017-02-20 15:39:23"
    },
    {
      "id": "834832361250496521",
      "created": "2017-02-23 18:28:40"
    },
    {
      "id": "835766115825516544",
      "created": "2017-02-26 08:19:04"
    },
    {
      "id": "837811085252124673",
      "created": "2017-03-03 23:45:03"
    },
    {
      "id": "839896327383306240",
      "created": "2017-03-09 17:51:03"
    },
    {
      "id": "843827268933861376",
      "created": "2017-03-20 14:11:13"
    },
    {
      "id": "844533782321487873",
      "created": "2017-03-22 12:58:39"
    },
    {
      "id": "848063064377315330",
      "created": "2017-04-01 07:42:45"
    },
    {
      "id": "848065482397798400",
      "created": "2017-04-01 07:52:21"
    },
    {
      "id": "851711518727122944",
      "created": "2017-04-11 09:20:24"
    },
    {
      "id": "851714271692115970",
      "created": "2017-04-11 09:31:21"
    },
    {
      "id": "854725122862833664",
      "created": "2017-04-19 16:55:23"
    },
    {
      "id": "854727136191672320",
      "created": "2017-04-19 17:03:23"
    },
    {
      "id": "857993159938383872",
      "created": "2017-04-28 17:21:24"
    },
    {
      "id": "858722962286968832",
      "created": "2017-04-30 17:41:23"
    },
    {
      "id": "858726233546293249",
      "created": "2017-04-30 17:54:23"
    },
    {
      "id": "858729919148417028",
      "created": "2017-04-30 18:09:01"
    }
  ]
}
```

Figure 20: JSON output sample of set of terms of interest corresponding to travel data messages for French metro company RATP line ‘Ligne13’ between ‘2017-01-01 00:00:00 BST’ and ‘2017-07-04 00:00:00 BST’.

5.9.6 [TEST CASE 6.9.6] VISUALIZE TIME SERIES TERMS OF INTEREST FROM TRAVEL DATA MESSAGES

6.9.6	
Method Of Test	Demonstration
Type of test	Manual
Objectives	Visualize time series terms of interest in the travel data messages database
Description	This test provides a visualization of the time series related to terms of interest.
Status	OK
% passed	100%

Id	Step description	Expected result	Observed result	State	Associated defect
	<p>Preconditions:</p> <ul style="list-style-type: none"> Tools, libraries and packages have been installed following the README.md: <ul style="list-style-type: none"> R (v3.4.3) Python (v2.7.12) NodeJS (v9.4.0) MongoDB (v3.4.10) libssl-dev, libsass2-dev and libxml2-dev debian packages pymongo, numpy, scipy, pandas, scikit-learn python packages . SETUP-ENV.sh has been executed on a shell for project deployment (the environment variables IT2RAIL_APP_HOST, IT2RAIL_APP_PORT, MONGO_HOST and MONGO_PORT can be defined to meet specific requirements during deployment or left as is if there is no conflict between port with other services) R packages have been installed correctly with: <pre>`Rscript \${SCRIPTS_R_PATH}/r.libPath.and.dependencies.R install`</pre> command line App is running with ./start-demo.sh at <code>http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}</code> 				

Id	Step description	Expected result	Observed result	State	Associated defect
1	<p>Visualize terms of interest timelines from travel data messages.</p> <p>The purpose of this test is to visualize for the given metro line and time window, a list of timelines of terms of interest from travel data messages.</p> <p>The result appear while performing a GET query on app with:</p> <p>http://\${IT2RAIL_APP_HOST}:\${IT2RAIL_APP_PORT}/business-analytics/services/visualizeTermsOfInterestTimelinesFromTravelDataMessages</p> <p>where \${IT2RAIL_APP_HOST} and \${IT2RAIL_APP_PORT} are defined inside SETUP-ENV.sh (following Preconditions).</p>	A set of barcodes time series for terms of interest.	A set of barcodes time series for terms of interest.	Passed	

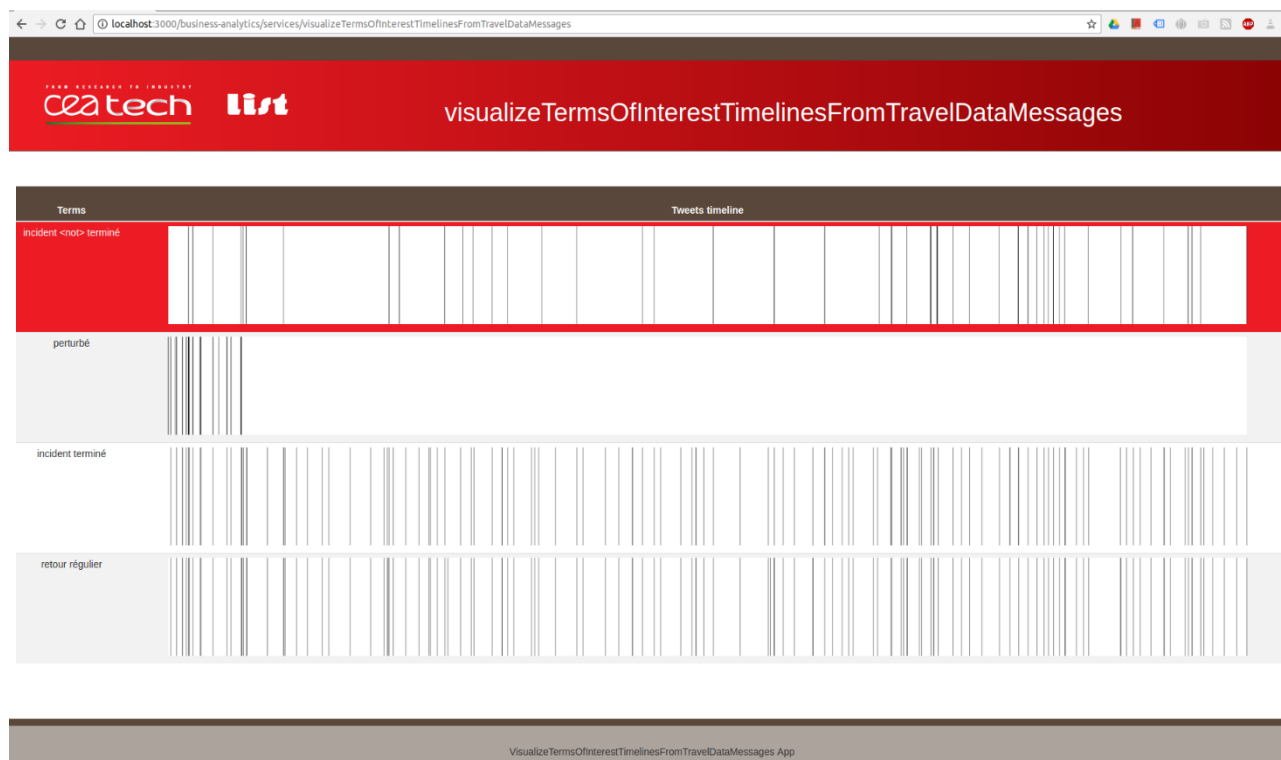


Figure 21 - Bar plot of set of terms of interest corresponding to travel data messages for French metro company RATP line 'Ligne13' between '2017-01-01 00:00:00 BST' and '2017-07-04 00:00:00 BST'.

5.10 [TEST CATEGORY 6.10] USER PREFERENCE MINING

The User Preference Mining module implements a mechanism to mine users' preferences in order to be able to suggest and tailor options depending on the context in which the single user operates. This module has not been integrated within the IT2Rail system.

5.10.1 [TEST CASE 6.10.1] GENERATING A PREFERENCE MINING TRAINING SET

6.7.1	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To generate a preference mining training set
Description	This test checks that a preference mining training set is generated.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • A simulated repository of user activities in different contexts 				
1	Tester creates a training set of possible context aware user preferences. Since no user data are available, the experiments are carried out on a dataset for a different application case, namely a real dataset containing context-aware preferences for TV program . 75% of the real dataset has been used as training set	The training set data is successfully generated	The training set data is successfully generated	Passed	[used for traceability]

5.10.2 [TEST CASE 6.10.2] PERFORMING MINING ALGORITHM TRAINING

6.7.2	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To use the previously generated training set in order to mine contextual preferences by the Preference Mining module
Description	Test the mining algorithm by the Preference Mining module using the previously created training set.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • The Preference mining module is installed on the machine. 				
1	Tester launches the Preference Mining module over the training set that has previously been generated	The Preference Mining module is able to successfully infer the properties of the programs that have been preferred in the different contexts.	The Preference Mining module mines the TV programs having properties similar to those that have been preferred in the different contexts. The experiments have been carried out on a dataset divided into TRAINING SET and TEST SET, without user interaction.	Passed	[used for traceability]

5.10.3 [TEST CASE 6.10.3] PERFORMING MINING ALGORITHM VALIDATION

6.7.3	
Method Of Test	Demonstration
Type of test	Manual
Objectives	To validate the behaviour of the Preference mining module
Description	This test checks whether the Preference mining module is behaving properly when fed with a validation set.
Status	OK
% passed	100%

[Configuration to apply]	
Regression	N
Test Case Tester	[ID of tester]

Id	Step description	Expected result	Observed result	State	Associated defect
	Preconditions: <ul style="list-style-type: none"> • The Preference Mining module is installed on the machine. 				
1	Tester feeds the validation set (the last 25% of the initial dataset) to the module and checks the performance of the trained module.	The Preference mining Module behaviour is consistent with the validation set, i.e. the TV programs proposed to a user are consistent with the programs really chosen by the users in the same context (recorded in the validation set)	The Preference mining Module behaviour is consistent with the validation set.	Passed	[used for traceability]

6. TEST EXECUTION

The following table provides the results of the tests described in the previous paragraphs.

Table 1: Execution of test cases

Test Category	Test Case ID	Test Case Description	Number of test /Date of test	Results (passed/failed) More details of results in section 4	Comments / Changes to be done
6. 1: PROVIDING KEY PERFORMANCE INDICATORS CONCERNING REPLIES TO QUESTIONS LISTED IN THE TRAVEL QUESTIONNAIRE	Test Case 6.1.1	This test case checks the generation of information that will be used as input for computing the Key Performance Indicators concerning users' replies to questions in the Travel Questionnaire.	Test Run 6.1 – 27/08/2017	Passed	
	Test Case 6.1.2	This test case verifies KPIs computation for the users' replies to questions found in the Travel Questionnaire.	Test Run 6.1 - 27/08/2017	Passed	
	Test Case 6.1.3	To check that the Business Analytics module displays the Indicators concerning users' replies to questions in the Travel Questionnaire.	Test Run 6.1 - 27/08/2017	Passed	
6.2 : PROVIDING KEY PERFORMANCE INDICATORS CONCERNING THE ROUTES FROM	Test Case 6.2.1	To check the software component responsible for retrieving the routes and how many times per year the users actually perform a search from	Test Run 6.2 - 10/06/2017	Passed	

BOOKING&TICKETING (WP3)		the Booking&Ticketing module and correctly store this information in the Sofia2 platform.		
	Test Case 6.2.2	This test case verifies the computation for the Booking&Ticketing KPIs. A pre-condition is that there be a successful connection between the Booking&Ticketing module and the Sofia 2 platform.	Test Run 6.2 - 15/06/2017	Passed
	Test Case 6.2.3	To check that the Business Analytics module displays the Booking&Ticketing indicators computed in test case 6.2.2.	Test Run 6.2 - 16/06/2017	Passed
6.3: PROVIDING KEY PERFORMANCE INDICATORS CONCERNING TRIP TRACKING DATA (WP4)	Test Case 6.3.1	To check that the Business Analytics module retrieves and stores information concerning Trip Tracking Complex Event Processing Data.	Test Run 6.3 – 13/02/2018	Passed
	Test Case 6.3.2	To check that the Business Analytics module computes and displays the KPIs on Trip Tracking Complex Event Processing data.	Test Run 6.3 – 13/02/2018	Passed

	Test Case 6.3.3	To check that the Business Analytics module retrieves information concerning Trip Tracking Log Messages Data.	Test Run 6.3.3 - 14/02/2018	Passed	
	Test Case 6.3.4	To check that the Business Analytics module computes the KPIs on Messages Data.	Test Run 6.3.4 - 14/02/2018	Passed	
	Test Case 6.3.5	To check that the Business Analytics module displays information concerning KPIs computed on CEP Messages Data.	Test Run 6.3.5 - 14/02/2018	Passed	
	Test Case 6.3.6	To check that the Business Analytics module retrieves information concerning Log Alternatives Data.	Test Run 6.3.6 - 14/02/2018	Passed	
	Test Case 6.3.7	To check that the Business Analytics module computes the KPIs computed on Alternatives Data.	Test Run 6.3.7 - 14/02/2018	Passed	
	Test Case 6.3.8	To check that the Business Analytics module displays information concerning KPIs computed on the provided Alternatives.	Test Run 6.3.8 - 14/02/2018	Passed	

6.4: SHOWING INDICATORS ON SOCIAL NETWORK MESSAGES	Test Case 6.4.1	To check whether KPIs concerning social network messages are retrieved and shown on tables. The Presentation layer of the Business Analytics module encapsulates a dashboard containing indicators computed on the basis of messages retrieved from Twitter.	Test Run 6.4 - 17/10/2017	Passed	
	Test Case 6.4.2	To check whether KPIs concerning social network messages are retrieved and shown on charts. The Presentation layer of the Business Analytics module encapsulates a dashboard containing indicators computed on the basis of messages retrieved from Twitter.	Test Run 6.4 - 17/10/2017	Passed	
6.5: PROVIDING KEY PERFORMANCE INDICATORS ON SOCIAL NETWORK MESSAGES	Test Case 6.5.1	This test case verifies KPIs computation for the messages collected from Twitter.	Test Run 6.5 - 17/10/2017	Passed	
	Test Case 6.5.2	This test verifies that KPIs computed on social network messages are stored in the Business Analytics repositories.	Test Run 6.5 - 17/10/2017	Passed	
	Test Case 6.5.3	To check whether the KPIs computed on social network messages can be retrieved by using the BA web services. The Business Analytics	Test Run 6.5 - 17/10/2017	Passed	

		exposes web services in order to provide upon request the KPIs on social network messages stored in its repositories. These web services are created by using REST technology and enable to retrieve this kind of indicators. Data are formatted in JSON.		
6.6: PROVIDING KPIS ON TRAVEL COMPANION WALLET (WP5) STORED USER INFORMATION	Test Case 6.6.1	To test the correct connection between the Travel Companion Wallet and Sofia2 with successful passage of data related to the 4 KPIs: Direct Travel, Transport Preferences, Seat and Carrier.	Test Run 6.6 - 01/06/2017	Passed
	Test Case 6.6.2	To check that the Business Analytics module computes the 4 KPIs mentioned in test case 6.6.1.	Test Run 6.6 - 02/06/2017	Passed
	Test Case 6.6.3	To check that the Business Analytics module displays the 4 KPIs mentioned in test case 6.6.1.	Test Run 6.6 - 02/06/2017	Passed
6.7: SENTIMENT ANALYSIS ON USER FEEDBACKS	Test Case 6.7.1	This test checks that a sentiment analysis training set is generated.	Test Run 6.7 - 03/07/2017	Passed

	Test Case 6.7.2	To test machine-learning by the Sentiment Analysis module using the previously created training set.	Test Run 6.7 - 03/07/2017	Passed	
	Test Case 6.7.3	To check that of the sentiment analysis module has learned based on the previously generated training set.	Test Run 6.7 - 03/07/2017	Passed	
6.8 PROVIDING KEY PERFORMANCE INDICATORS REGARDING TRAVEL COMFORT	Test Case 6.8.1	This test checks if air quality parameters in underground public transportation stations can be inferred from meteorological measurements. A model is built based on French RATP air quality open data recorded in three Parisian metro stations between 2014 and 2017 and local meteorological data sensed on the same period. The Python machine learning library Scikit-Learn is used for this purpose.	Test Run 6.8 - 04/08/2017	Passed	
	Test Case 6.9.1	This test consists in showing the relevant terms corresponding to travel data messages. Those terms are likely to correspond to incident or any kind of disturbance regarding a specific line id.	Test Run 6.9 - 04/08/2017	Passed	

6.9 PROVIDING KEY PERFORMANCE INDICATORS REGARDING TRAVEL DATA	Test Case 6.9.2	This test consists in showing how we can visualize the subset of relevant terms corresponding to travel data messages.	Test Run 6.9 - 04/08/2017	Passed	
	Test Case 6.9.3	This test aims at showing how we can identify relevant co-association between terms in such a way that we can link some kind of disturbance with station names.	Test Run 6.9 - 04/08/2017	Passed	
	Test Case 6.9.4	This test aims at showing how we can visualize and offer interactivity to explore the set of relevant co-association between informative terms.	Test Run 6.9 - 04/08/2017	Passed	
	Test Case 6.9.5	This test aims at showing how we can retrieve timelines of a specific combination of (signed, e.g positive or negative form) terms of interests, so that we can detect starting time of a specific disturbance on a line id.	Test Run 6.9 - 04/08/2017	Passed	
	Test Case 6.9.6	This test aims at showing how we can visualize timelines of a specific combination of terms of interest.	Test Run 6.9 - 04/08/2017	Passed	
6.10: PREFERENCE MINING ON USER ACTIVITIES AND	Test Case 6.10.1	This test aims at checking that the preference mining training set is generated.	Test Run 6.10 - 13/10/2017	Passed	

GENERATION OF SUGGESTED TRIPS	Test Case 6.10.2	This test applies the mining algorithm to the previous generated training set. Test Run 6.10 - 13/10/2017	Passed	
	Test Case 6.10.3	This test checks whether the Preference mining module is behaving properly when fed with a validation set. Test Run 6.10 - 13/10/2017	Passed	

6.1 TEST RUN 6.1

6.1.1 PROVIDING KEY PERFORMANCE INDICATORS CONCERNING REPLIES TO QUESTIONS LISTED IN THE TRAVEL QUESTIONNAIRE – GENERATING ANSWERS TO QUESTIONS LISTED IN THE TRAVEL QUESTIONNAIRE

This test case checks the generation of information that will be used as input for computing the Key Performance Indicators concerning users' replies to questions in the Travel Questionnaire.

Test succeeded.

6.1.2 PROVIDING KEY PERFORMANCE INDICATORS CONCERNING REPLIES TO QUESTIONS LISTED IN THE TRAVEL QUESTIONNAIRE – COMPUTING KEY PERFORMANCE INDICATORS

This test case verifies KPIs computation for the users' replies to questions found in the Travel Questionnaire.

Test succeeded.

6.1.3 PROVIDING KEY PERFORMANCE INDICATORS CONCERNING REPLIES TO QUESTIONS LISTED IN THE TRAVEL QUESTIONNAIRE – VISUALISING KEY PERFORMANCE INDICATORS

To check that the Business Analytics module displays the Indicators concerning users' replies to questions in the Travel Questionnaire.

Test succeeded.

6.2 TEST RUN 6.2

6.2.1 PROVIDING KEY PERFORMANCE INDICATORS CONCERNING THE ROUTES FROM BOOKING&TICKETING - RETRIEVE KPIs REGARDING THE PREFERRED ORIGIN/DESTINATION AND SEARCH BY YEAR

To check the software component responsible for retrieving the routes and how many times per year the users actually perform a search from the Booking&Ticketing module and correctly store this information in the Sofia2 platform.

Test succeeded.

6.2.2 PROVIDING KEY PERFORMANCE INDICATORS CONCERNING THE ROUTES FROM BOOKING&TICKETING - COMPUTING KEY PERFORMANCE INDICATORS

This test case verifies the computation for the Booking&Ticketing KPIs. A pre-condition is that there be a successful connection between the Booking&Ticketing module and the Sofia 2 platform.

Test succeeded.

6.2.3 PROVIDING KEY PERFORMANCE INDICATORS CONCERNING THE ROUTES FROM BOOKING&TICKETING -VISUALISING KEY PERFORMANCE INDICATORS

To check that the Business Analytics module displays the Booking&Ticketing indicators computed in test case 6.2.2.

Test succeeded.

6.3 TEST RUN 6.3

6.3.1 RETRIEVE AND STORE EVENTS (COMPLEX EVENT PROCESSING DATA) FROM WP4 LOG COMPONENT

To check that the Business Analytics module retrieves and stores information concerning Trip Tracking Complex Event Processing Data.

Test succeeded.

6.3.2 COMPUTE AND DISPLAY KPIS ON COMPLEX EVENT PROCESSING DATA

To check that the Business Analytics module computes and displays the KPIs on Trip Tracking Complex Event Processing data.

Test succeeded.

6.3.3 RETRIEVE CEP MESSAGES AND STORE THEM IN BA REPOSITORY

To check that the Business Analytics module retrieves information concerning Trip Tracking Log Messages Data.

Test succeeded.

6.3.4 COMPUTING KEY PERFORMANCE INDICATORS FOR CEP MESSAGES

To check that the Business Analytics module computes the KPIs on Messages Data.

Test succeeded.

6.3.5 VISUALIZING KEY PERFORMANCE INDICATORS ON CEP MESSAGES

To check that the Business Analytics module displays information concerning KPIs computed on CEP Messages Data.

Test succeeded.

6.3.6 RETRIEVE ALTERNATIVES AND STORE THEM IN BA REPOSITORY

To check that the Business Analytics module retrieves information concerning Log Alternatives Data.

Test succeeded.

6.3.7 COMPUTING KEY PERFORMANCE INDICATORS ON ALTERNATIVES

To check that the Business Analytics module computes the KPIs computed on Alternatives Data.

Test succeeded.

6.3.8 VISUALIZING KEY PERFORMANCE INDICATORS ON ALTERNATIVES

To check that the Business Analytics module displays information concerning KPIs computed on the provided Alternatives.

Test succeeded.

6.4 TEST RUN 6.4

6.4.1 SHOWING INDICATORS ON SOCIAL NETWORK MESSAGES – SHOWING KPIS CONCERNING SOCIAL NETWORK MESSAGES ON TABLES

To check whether KPIs concerning social network messages are retrieved and shown on tables. The Presentation layer of the Business Analytics module encapsulates a dashboard containing indicators computed on the basis of messages retrieved from Twitter.

Test succeeded.

6.4.2 SHOWING INDICATORS ON SOCIAL NETWORK MESSAGES – SHOWING KPIS CONCERNING SOCIAL NETWORK MESSAGES ON CHARTS

To check whether KPIs concerning social network messages are retrieved and shown on charts. The Presentation layer of the Business Analytics module encapsulates a dashboard containing indicators computed on the basis of messages retrieved from Twitter.

Test succeeded.

6.5 TEST RUN 6.5

6.5.1 PROVIDING KEY PERFORMANCE INDICATORS ON SOCIAL NETWORK MESSAGES – COMPUTING KPIS ON SOCIAL NETWORK MESSAGES

This test case verifies KPIs computation for the messages collected from Twitter.

Test succeeded.

6.5.2 PROVIDING KEY PERFORMANCE INDICATORS ON SOCIAL NETWORK MESSAGES – STORING KPIS CONCERNING SOCIAL NETWORK MESSAGES INTO THE BUSINESS ANALYTICS REPOSITORIES

This test verifies that KPIs computed on social network messages are stored in the Business Analytics repositories.

Test succeeded.

6.5.3 PROVIDING KEY PERFORMANCE INDICATORS ON SOCIAL NETWORK MESSAGES – EXPOSING WEB SERVICES TO RETRIEVE KPIS COMPUTED ON SOCIAL NETWORK MESSAGES

To check whether the KPIs computed on social network messages can be retrieved by using the BA web services. The Business Analytics exposes web services in order to provide upon request the KPIs on social network messages stored in its repositories. These web services are created by using REST technology and enable to retrieve this kind of indicators. Data are formatted in JSON.

Test succeeded.

6.6 TEST RUN 6.6

6.6.1 PROVIDING KPIS ON TRAVEL COMPANION WALLET (WP5) STORED USER INFORMATION – RETRIEVE PREFERENCE FROM THE TRAVEL COMPANION WALLET (WP5)

To test the correct connection between the Travel Companion Wallet and Sofia2 with successful passage of data related to the 4 KPIs: Direct Travel, Transport Preferences, Seat and Carrier.

Test succeeded.

6.6.2 PROVIDING KPIS ON TRAVEL COMPANION WALLET (WP5) STORED USER INFORMATION – COMPUTING KEY PERFORMANCE INDICATORS

To check that the Business Analytics module computes the 4 KPIs mentioned in test case 6.6.1.

Test succeeded.

6.6.3 PROVIDING KPIS ON TRAVEL COMPANION WALLET (WP5) STORED USER INFORMATION - VISUALISING KEY PERFORMANCE INDICATORS

To check that the Business Analytics module displays the 4 KPIs mentioned in test case 6.6.1.

Test succeeded.

6.7 TEST RUN 6.7

6.7.1 SENTIMENT ANALYSIS ON USER FEEDBACKS - GENERATING A SENTIMENT ANALYSIS TRAINING SET

This test checks that a sentiment analysis training set is generated.

Test succeeded.

6.7.2 SENTIMENT ANALYSIS ON USER FEEDBACKS - PERFORMING MACHINE-LEARNING TRAINING

To test machine-learning by the Sentiment Analysis module using the previously created training set.

Test succeeded.

6.7.3 SENTIMENT ANALYSIS ON USER FEEDBACKS - PERFORMING MACHINE-LEARNING VALIDATION

To check that of the sentiment analysis module has learned based on the previously generated training set.

Test succeeded.

6.8 TEST RUN 6.8

6.8.1 PROVIDING KEY PERFORMANCE INDICATORS REGARDING TRAVEL COMFORT

This test checks if air quality parameters in underground public transportation stations can be inferred from meteorological measurements. A model is built based on French RATP air quality open

data recorded in three Parisian metro stations between 2014 and 2017 and local meteorological data sensed on the same period. The Python machine learning library Scikit-Learn is used for this purpose.

Test succeeded.

6.9 TEST RUN 6.9

6.9.1 PROVIDING KEY PERFORMANCE INDICATORS REGARDING TRAVEL DATA - IDENTIFY MOST INFORMATIVE TERMS FROM TRAVEL DATA MESSAGES

This test consists in showing the relevant terms corresponding to travel data messages. Those terms are likely to correspond to incident or any kind of disturbance regarding a specific line id.

Test succeeded.

6.9.2 PROVIDING KEY PERFORMANCE INDICATORS REGARDING TRAVEL DATA - VISUALIZE MOST INFORMATIVE TERMS FROM TRAVEL DATA MESSAGES

This test consists in showing how we can visualize the subset of relevant terms corresponding to travel data messages.

Test succeeded.

6.9.3 PROVIDING KEY PERFORMANCE INDICATORS REGARDING TRAVEL DATA - IDENTIFY MOST INFORMATIVE CO/OCCURRING TERMS FROM TRAVEL DATA MESSAGES

This test aims at showing how we can identify relevant co-association between terms in such a way that we can link some kind of disturbance with station names.

Test succeeded.

6.9.4 PROVIDING KEY PERFORMANCE INDICATORS REGARDING TRAVEL DATA - VISUALIZE MOST INFORMATIVE CO/OCCURRING TERMS FROM TRAVEL DATA MESSAGES

This test aims at showing how we can visualize and offer interactivity to explore the set of relevant co-association between informative terms.

Test succeeded.

6.9.5 PROVIDING KEY PERFORMANCE INDICATORS REGARDING TRAVEL DATA – IDENTIFY TRAVEL DATA ITEMS OF INTEREST TIMELINES

This test aims at showing how we can retrieve timelines of a specific combination of (signed, e.g positive or negative form) terms of interests, so that we can detect starting time of a specific disturbance on a line id.

Test succeeded.

6.9.6 PROVIDING KEY PERFORMANCE INDICATORS REGARDING TRAVEL DATA - VISUALIZE TIME SERIES TERMS OF INTEREST FROM TRAVEL DATA MESSAGES

This test aims at showing how we can visualize timelines of a specific combination of terms of interest.

Test succeeded.

6.10.1 PREFERENCE MINING ON USER ACTIVITIES AND GENERATION OF SUGGESTED TRIPS - GENERATING A PREFERENCE MINING TRAINING SET

This test aims at checking that the preference mining training set is generated.

Test succeeded.

6.10.2 PREFERENCE MINING ON USER ACTIVITIES AND GENERATION OF SUGGESTED TRIPS – PERFORMING MINING ALGORITHM TRAINING

This test applies the mining algorithm to the previous generated training set.

Test succeeded.

6.10.3 PREFERENCE MINING ON USER ACTIVITIES AND GENERATION OF SUGGESTED TRIPS – PERFORMING MINING ALGORITHM VALIDATION

This test checks whether the Preference mining module is behaving properly when fed with a validation set.

Test succeeded.