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HISTORY OF CHANGES		
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1.0	14/09/2020	First version for internal review by WP7 partners
2.0	18/09/2020	Incorporate WP7 participants feedback. Version for all partners review.
3.0	24/09/2020	Final version to submit to EGNSS

Executive Summary

The present document constitutes the first complete version of deliverable D7.1 “Integration of SIA with end-user information systems”” in the framework of the Project titled “System for vehicle-infrastructure Interaction Assets health status monitoring” (Project Acronym: SIA; Grant Agreement No 776402).

Based on the work carried out in the project, a software application (SIA_VP) for the management of maintenance of railway sector assets has been implemented. This application uses extensively georeferenced data provided by Galileo, the European Global Navigation Satellite System, and includes four services focused in catenary (called iCatMon), pantograph (iPantMon), rail (iRailMon) and wheelset (iWheelMon). This document describes how SIA software application can be integrated with other external information systems that end users may operate, bringing additional value

Firstly, Chapter 2 of this document describes the architecture of SIA focusing on SIA_VP and the external interfaces assessing them to evaluate which ones require integration with external systems.

Then, Chapter 3 explains the methodology followed to collect feedback from SIA end user partners about relevant external information systems they use.

After assessing the information collected from SIA end users, Chapter 4 details the solution adopted in SIA both to exchange data with other applications flexibly.

Finally, Chapters 5 to 8 describe for each end user partner (FGC, VIAS, TELICE and OBB) the integration in SIA of the external data they have provided. They serve as a sample reference implementation of the integration features developed in SIA to use them with more third-party information systems not considered in the SIA project.

Table of Contents

Abbreviations and acronyms

Acronym	Description
ABA	Axel Box Acceleration
API	Application Programming Interface
CDM	Component Degradation Models
CEIT	ASOCIACION CENTRO TECNOLOGICO CEIT-IK4 (SIA coordinator)
CSV	Comma Separated Values
DH	Data Hub
DOW	Description of work
DLR	Deutsches Zentrum für Luft- und Raumfahrt e. V. (SIA partner)
EGNSS	European Global Navigation Satellite System
FGC	Ferrocarrils de la Generalitat de Catalunya (SIA partner)
GIS	Geographical Information System
GNSS	Global Navigation Satellite System
HTTP	Hypertext Transfer Protocol
INECO	INGENIERIA Y ECONOMIA DEL TRANSPORTE, S.A. (Services provider for railway sector)
INGECONTROL	INGENIERIA Y CONTROL ELECTRONICO S.A. (SIA partner)
IT	Information Technologies
KP	Kilometer Point
KPI	Key Performance Indicator
MERMEC	MERMEC Group (Services provider for railway sector)
OBB	OBB-Infrastruktur AG (SIA partner)
PANT	Pantograph-to-catenary
POS	Positioning
TELICE	TELEFONOS LINEAS Y CENTRALES S.A. (SIA partner)
TOC	Train Operating companies
VIAS	VIAS Y CONSTRUCCIONES S.A. (SIA partner)
VP	Visualisation Platform
WP	Work Package

1 Introduction

1.1 SIA Overview

The SIA project (System for vehicle-infrastructure Interaction Assets health status monitoring) has the objective of developing four ready-to-use new services (iWheelMon, iRailMon, iPantMon and iCatMon) to provide prognostic information about the health status of the railway's most demanding assets in terms of maintenance costs (wheel, rail, pantograph and catenary).

1.2 Purpose and Scope of this Document

This document covers deliverable D7.1 "Integration of SIA with end-user information systems" of the SIA project. The deliverable describes the integration carried out in Work Package 7 "Integration with end-user specific application layer" of SIA with other information systems of end-users of the consortium. This work addresses the requirement SIA_OR_3 – Interoperability, defined in WP6 deliverables [1], providing SIA end users with the ability to exploit together SIA services with already in use external systems. The sample integrations implemented in the SIA project increase the overall value for customers and raise a key feature for entering with SIA systems in the railway sector. This deliverable is the final output of WP7 and has been led by INGECONTROL with contributions from end users FGC, VIAS, TELICE and OBB, and technology providers CEIT and DLR.

2 SIA architecture overview

According to the deliverable D2.2 SIA Architecture [2], the following sub-systems have been defined for the SIA system:

- Pantograph/catenary interaction assessment subsystem (SIA_PANT)
- Wheel/rail interaction assessment subsystem (SIA_ABA)
- Positioning subsystem (SIA_POS)
- Data Hub (SIA_DH)
- Component Degradation modelling and algorithms (SIA_CDM)
- Visualisation Platform (SIA_VP)

2.1 Architecture description

As a visual representation of the above subsystems, the following diagram (Figure 2-1) was created to define the overall architecture and the associated interfaces of the SIA system.

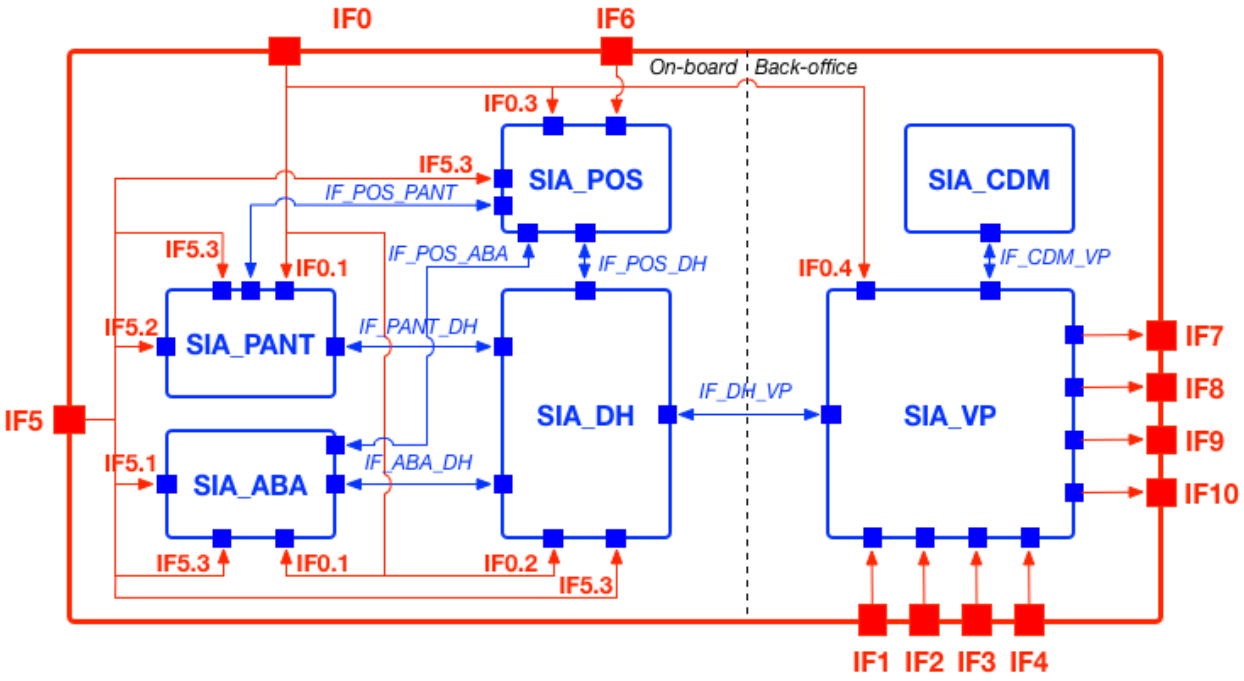


Figure 2-1: SIA Architecture

With this architecture, SIA will provide four services with characteristics defined below:

- *iWheelMon*, which is intended for TOCs and integrated operators, will provide real time information about the status of the wheels (e.g. the presence of wheel flats) and prognostic health status information within a certain time frame such as predicted wear, RCF and polygonization, and maintenance recommendations for meeting ISO 1005-8 [3] and TOC specific requirements.

- *iPantMon*, which is intended for TOCs and integrated operators, will provide real time information about the status of the pantograph (e.g. if there is incorrect vertical damping forces of upper arm) and prognostic health status information in a certain time frame such as wearing of contact stripes, and maintenance recommendations for meeting EN 50405 [4] and TOC specific requirements.

- *iRailMon*, which is intended for IMs and maintenance subcontractors, will provide real time information about the status of the rail (e.g. broken rail) and prognostic health status information in a certain time frame such as squats, corrugation, wear and RCF, and maintenance recommendations according to ISO 5003:2016 [5] and IM specific maintenance requirements.

- *iCatMon,* which is intended for IMs and maintenance subcontractors, will provide real time information about the catenary status (e.g. wearing of cable) and prognostic health status information in a certain time frame such as inclination of the mooring balance with respect to the rail, break of the automatic regulation pulley, wear of cables, and maintenance recommendations for meeting EN50119 [6].

These services will be delivered by the different sub-systems of the SIA system according to the next table.

SIA Subsystems	**SIA Services**			
	iWheelMon	***iPantMon***	***iRailMon***	***iCatMon***
SIA_PANT		√		√
SIA_ABA	√		√	
SIA_DH	√	√	√	√
SIA_POS			√	√
SIA_VP	√	√	√	√
SIA_CDM	√	√	√	√

Table 2-1: Table: SIA services mapped to sub-systems

The integration with SIA of external IT systems already operated by end users is carried out by means of SIA_VP subsystem external interfaces displayed in Figure 2-1, which are described in next section.

2.2 SIA_VP Components

In this section SIA_VP subsystem is described focusing in its external interfaces to asses which may be related to existing external IT systems. Next Figure 2-2 displays the architecture of SIA_VP subsystem in a schematic view:

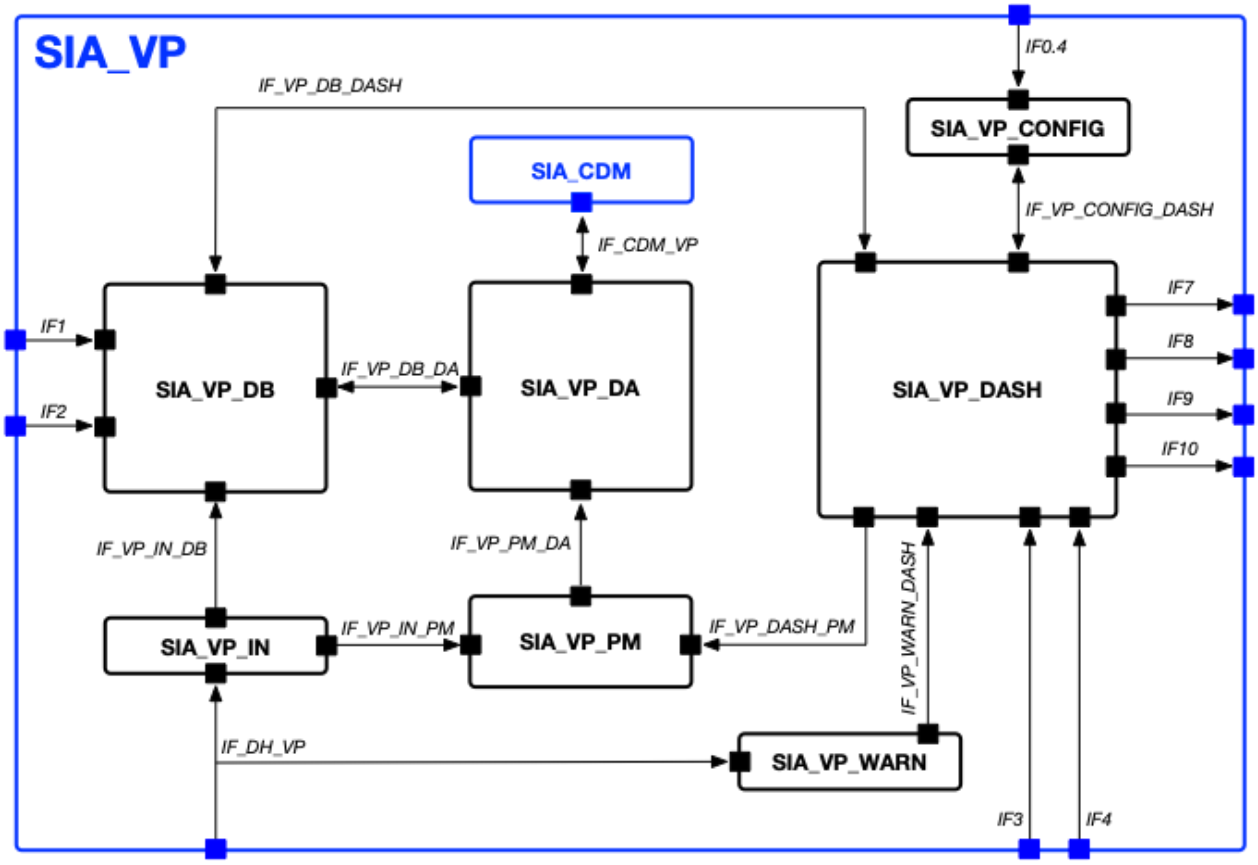


Figure 2-2: SIA_VP subsystem architecture (including SIA_CDM)

Namely, the SIA_VP modules are listed next:

- SIA_VP_DB: Database
- SIA_VP_DA: Algorithms and data analytics (linked to SIA_CDM, hosted in the same server)
- SIA_VP_DASH: Dashboard, Visualization & Reporting
- SIA_VP_CONFIG: Platform configuration (by an end user administrator)
- SIA_VP_IN: Data Input (received from SIA_ABA, SIA_PANT and SIA_POS via SIA_DH)
- SIA_VP_PM: Process Manager
- SIA_VP_WARN: Real-Time Event Manager (connected to onboard SIA_DH in real time)

2.3 SIA_VP External Interfaces

In Figure 2-1: SIA ArchitectureFigure 2-1 and Figure 2-2, SIA_VP interfaces are displayed at both system and subsystem level respectively. They are classified in 2 types as external and internal, but we are going to focus on the External Interfaces, which are those that may be required to integrate with external IT systems. On the other hand, External Interfaces can be classified depending on if they exchange input or output information between SIA_VP and end users. Visual interfaces described in SIA Deliverables D6.1 and D6.2 [1] enable this exchange of information with end-users, either input or output, but sometimes it is better to automate this flow when origin or destination are other external applications, particularly when the amount of data is too big and may lead to human errors and a huge time consumption.

2.3.1 Input External Interfaces

These are the Input External Interfaces:

- IF0.4: Configuration parameters and SIA_VP parametrization by means of SIA_VP_CONFIG.
- IF1.1.1: GIS map of the line(s).
- IF1.1.2: Composition of the infrastructure (e.g. sections, curvature, switches and crossings, tunnels, components, materials, etc.)
- IF2: Maintenance procedures.
- IF3: Auscultation raw data.
- IF4: Inspection raw data.

The following table assesses if there is a visual interface in SIA_VP (already described in SIA Deliverables D6.1 and D6.2 [1]) enabling end users to provide the required info, and if it might be beneficial to implement automated means to import data into SIA.

SIA_VP Interface	Visual Interface	Automated Interface	Comments
IF0.4	Yes	No	SIA specific configuration
IF1.1.1.	No	No	Direct input in SIA_VP_DB when commissioning SIA, rarely updated.
IF1.1.2	Yes	No	Direct input in SIA_VP_DB when commissioning SIA. There are visual interfaces to manage assets.

IF2	Yes	No	Direct input in SIA_VP_DB when commissioning SIA. There are visual interfaces to manage maintenance
IF3	No	Yes	Specific external data
IF4	No	Yes	Specific external data

Table 2-2: SIA_VP Input External Interfaces assessment

Section 4.1 of this document described the integration of data coming from third parties' software into SIA.

2.3.2 Output External Interfaces

These are the SIA_VP External Output Interfaces:

- IF7: Asset Status
- IF8: Early detection of component failure
- IF9: Maintenance recommendations
- IF10: External interfaces

External Output Interfaces enable end users to access the information provided by SIA. Table 2-3 assesses if there is a visual interface in SIA_VP, described in SIA Deliverables D6.1 and D6.2 [1], and if it might be beneficial to implement automated means to export data from SIA.

SIA_VP Interface	Visual Interface	Automated Interface	Comments
IF7	Yes	No	D6.1 and D6.2 [1]
IF8	Yes	No	D6.1 and D6.2 [1]
IF9	Yes	No	D6.1 and D6.2 [1]
IF10	No	Yes	To export data displayed in IF7, IF8 and IF9

Table 2-3: SIA_VP Output External Interfaces assessment

The ability to export data from SIA in other IT systems is described in Section 4.2 of this document.

3 Methodology

This chapter details the methodology envisioned to collect information from end-users (VIAS, TEL, OBB and FGC) about existing information systems which could be relevant to the external interfaces described in previous chapter. This information has been used to define and implement a technical solution to provide SIA with interoperability with other IT systems, saving time and giving added value to end users when loading/extracting and analysing data.

The methodological approach has consisted in developing a Microsoft Word template delivered by email with a questionnaire to collect information from SIA project end-users with five sections:

- General Information
- Assets Data
- Auscultation/Monitoring Data
- Maintenance Data
- Other Information

Questions are not only focused on external IT systems in general, but also aimed at the specific tests of the SIA system that will be carried out in WP8 by end users. So, each end user partner (FGC, OBB, VIAS, TELICE) had to fill in one template providing valuable information to assess the current situation and requirements, and design an effective integration roadmap of important existing information from external applications needed to test and validate the four SIA services. Additionally, the integration implemented with these third-party systems will serve as an example of interoperability of SIA for a future market uptake that will require integration with other external systems in new customers.

The template was an initial step of the work to be done in WP7. When the end users filled in a first version of the document, an iterative process began with Ingecontrol requesting further detailed information and collaboration to implement the WP7 objectives.

The questionnaire and the answers provided by FGC, OBB, VIAS and TELICE have been included in this deliverable in the Annexes section. Chapter 4 provides a summary of the answers received to analyse them and provide a technical solution with wide applicability in present and future SIA end users.

4 Technical solution

Based on the methodology explained in Chapter 3, a questionnaire collected information on IT systems used by SIA end users to manage assets, monitoring/auscultation and maintenance activities of railway infrastructure and rolling stock that could be suitable to consider integrating with SIA. Table 4-1 summarizes the main findings:

End user	Assets	Monitoring/Auscultation	Maintenance
VIAS (Rail)	Excel file (Madrid-Valladolid)	Auscultation reports (only out of thresholds data)	Excel files
FGC (Pantograph, catenary)	Excel file (Valles line)	Catenary (MERMEC, excel) Pantograph visual/hand measurement reports	MERMEC, Excel files and paper reports
TELICE (Catenary)	tCat (export/import files)	tCat (export/import files)	Excel files
OBB (Wheelset)	ESRI for GIS data	None to integrate in SIA	None to integrate in SIA

Table 4-1: Summary of answers received on third party IT systems used by SIA end users

The main conclusions drawn after analysing and discussing the answers received are:

- Commercial software packages used by end users are not prepared for online integration (e.g. using web services), but allow exporting data in different formats compatible with Microsoft Excel. These files are used in daily operations and to exchange with other departments and stakeholders (e.g. subcontractors, regulators).
- File formats are quite diverse.
- Real time interoperability is not a key requirement yet in the railway domain, and software vendors are wary to open their products even to customers.
- Maintenance subcontractors don't use Assets or Maintenance management software. They receive data from Train Operating Companies and Infrastructure Operators, who share as less information as possible as they are dealing with critical assets and activities.
- There is still a lot of paperwork in visual and hand measurement operations.
- In the case of infrastructure (catenary and rail), the use of software to generate and analyse reports is widely used. This software is proprietary and provided by the monitoring equipment vendor (e.g. MERMEC, TELICE). As aforementioned, data can be exported in readable formats (e.g. csv, Excel files)

OBB particularly doesn't plan to contribute loading to SIA additional data apart from those of the infrastructure and the rolling stock required for the test measurements. This is because they are very much interested in comparing the SIA low-cost sensors measurement data with OBB own data, especially those of the positioning unit, and they want to keep both data sets clearly independent.

4.1 Importing data into SIA

Based on this analysis and the needs of end users in the SIA consortium, including the availability of data to import to SIA to test it, it was decided to implement a flexible importing tool in SIA_VP so that users are able to import data form external IT programs configuring a file format mapping its content to SIA parameters, and uploading it to the system.

So, for example, in iCatMon (it works the same in the other SIA services), when end users define a type of inspection for monitoring and maintenance activities, they are able to configure an external file as data source.

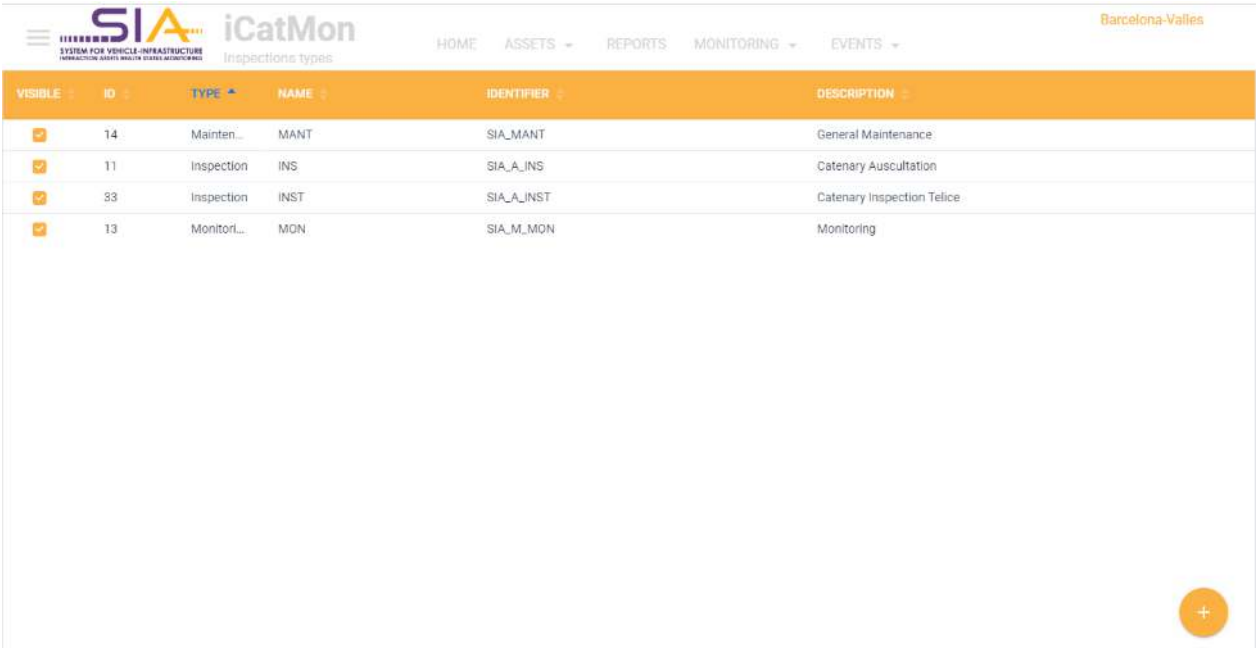


Figure 4-1: iCatMon inspection types list in Configuration menu

Opening a Catenary Auscultation Inspection type in the list or creating a new one (Figure 4-1), the Inspection type configuration screen (Figure 4-2) pops up where users can expand the File Format frame in the bottom left:

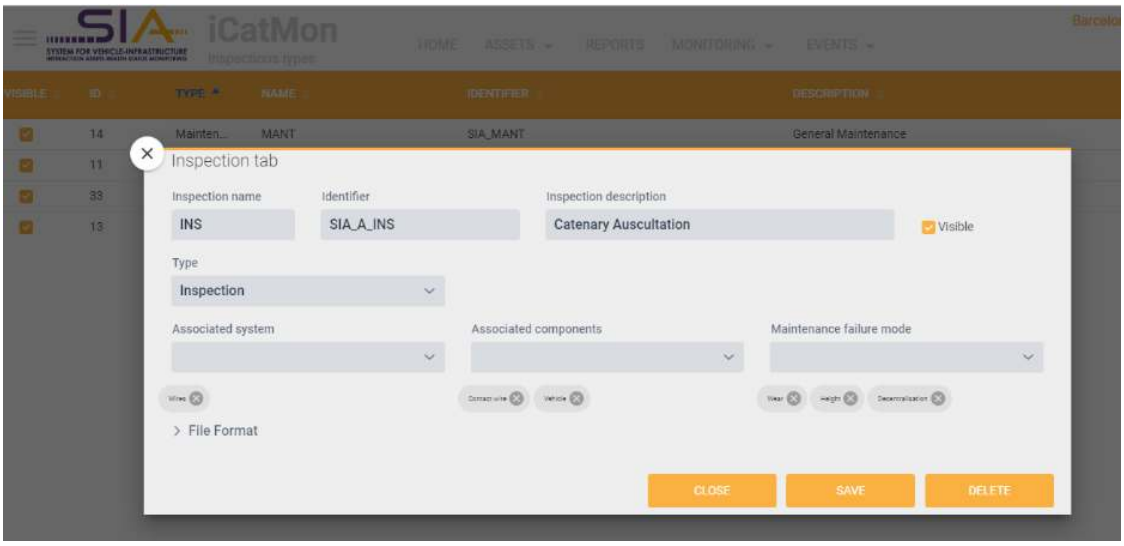


Figure 4-2: iCatMon inspection type configuration screen

Then they can configure the column-row file format that they will import into SIA to upload new data. Users can define the format for numbers, dates and column separators. They can also set in which sheet data are stored and the first line with data (Row data field). Finally, to configure the raw data import, users can define the line, track, KP (transformed automatically to UTM coordinates during importing process), date and time and up to 6 KPIs or measurements. In the example in Figure 4-3, contact wire height, decentralization and wear are the 3 KPIs selected.

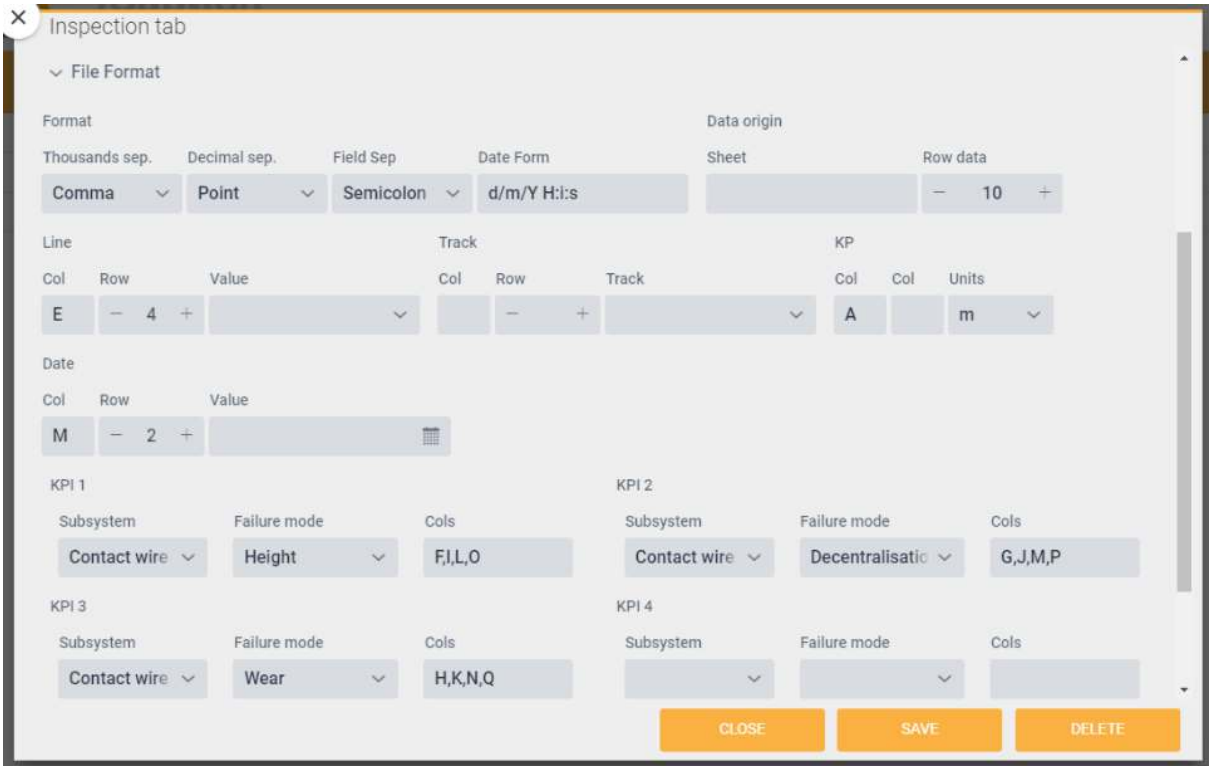


Figure 4-3: iCatMon inspection type file format configuration screen

There can be a different file format for each type of inspection, as we will see later with examples provided by SIA partners. Once the file format is defined, to import new data the user just needs to open the corresponding visualization screen (in table mode view) and push the **+** button in the bottom right (Figure 4-4).

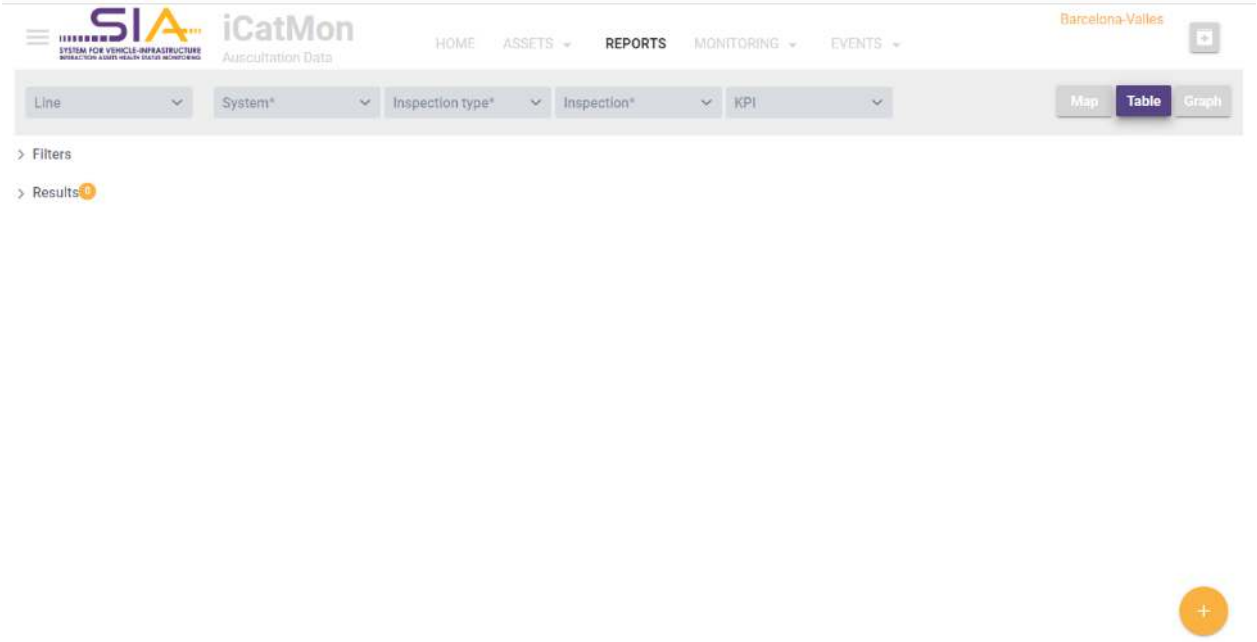


Figure 4-4: iCatMon Reports screen

Then a window will pop-up (Figure 4-5) enabling the user to select the type of inspection and the file location, as well as the line, track and date if they are not defined in the file.

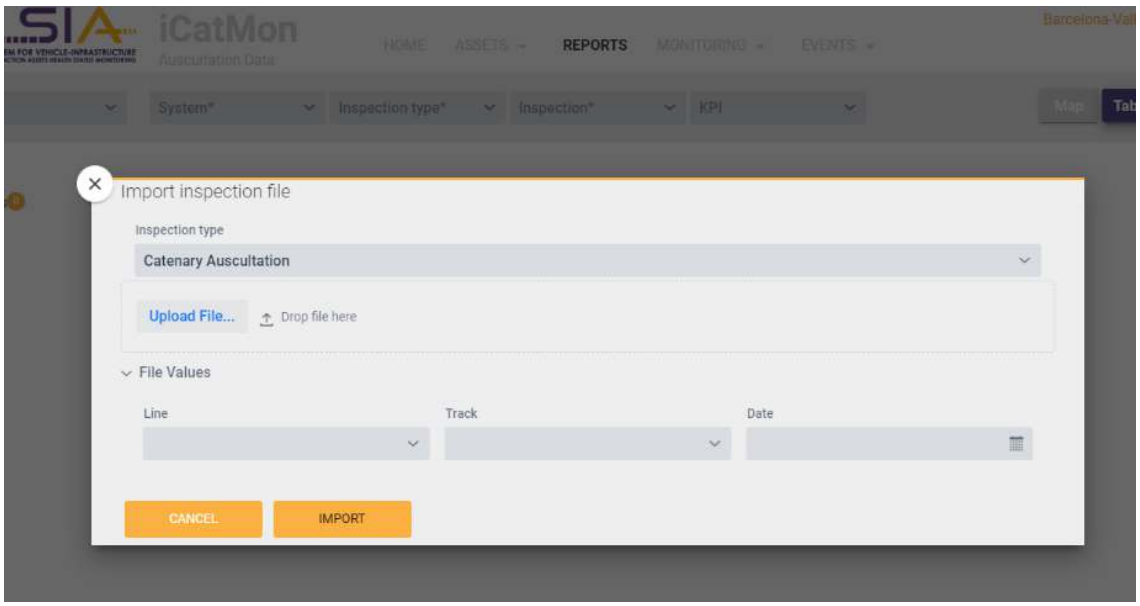


Figure 4-5: Import new report from file screen

In chapters 5, 6, 7 and 8 several examples are provided using data exported from IT systems used by the 4 SIA partners end users. The files provided by the partners have helped to fine tune the importing tool implementing a wide range of configuration options and testing them.

4.2 Exporting data from SIA

In the case of making data in SIA available for third party IT systems, exporting to a readable file format has been enabled in all visualization dashboards of the four SIA services, namely Assets, Reports, Monitoring and Events menu options. With this approach, the data file generated can be edited if needed to prepare it to be imported to other software packages either using a visual interface or importing directly into the software database. Therefore, an Export button has been included in the top right part of the table mode view of all these screens, as displayed in Figure 4-6 for iRailMon Assets Inventory:

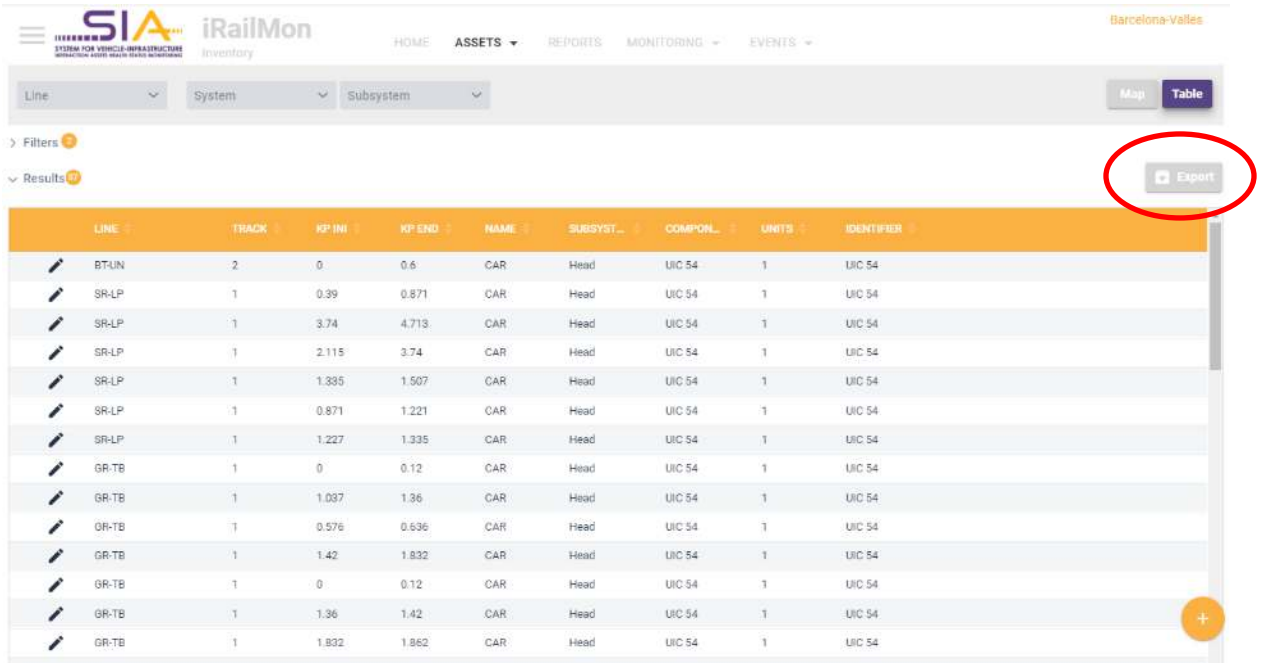


Figure 4-6: iRailMon Assets Inventory screen

The next example using a Track Inspection Report in iRailMon (Figure 4-7) shows how it works:

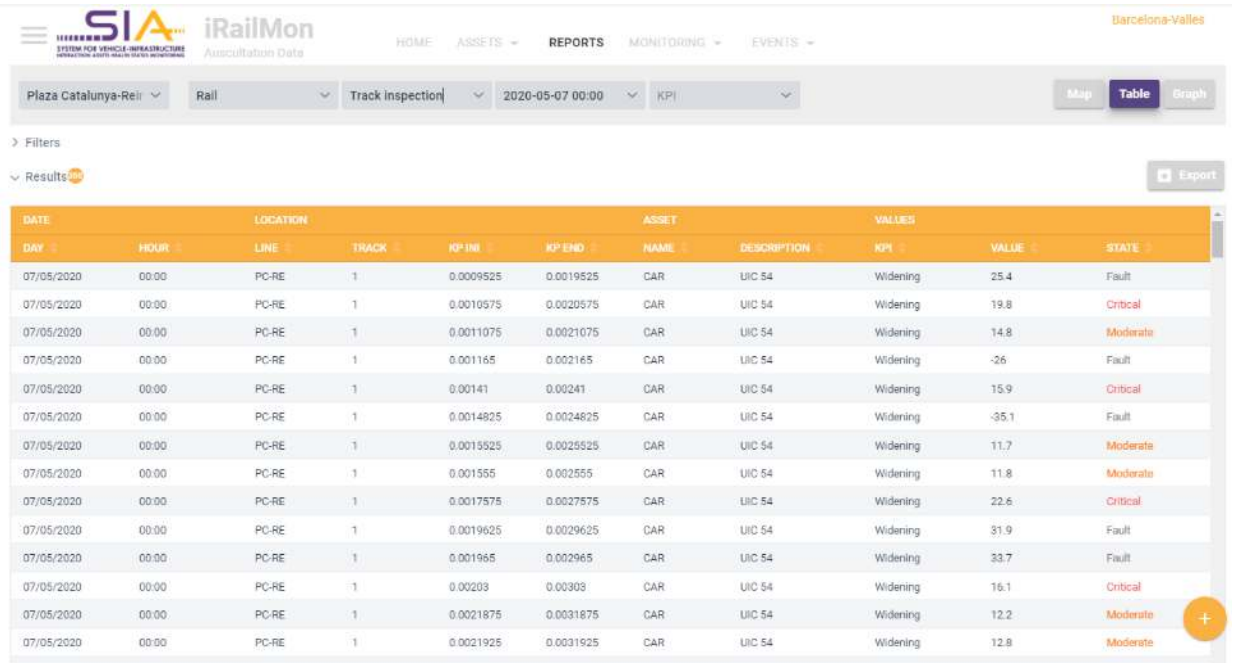


Figure 4-7: iRailMon Reports screen

After pushing the Export button, a Dialogue Window (Figure 4-8) will pop up enabling user to choose file name and type as well as storage drive location where the file with the exported data will be created.

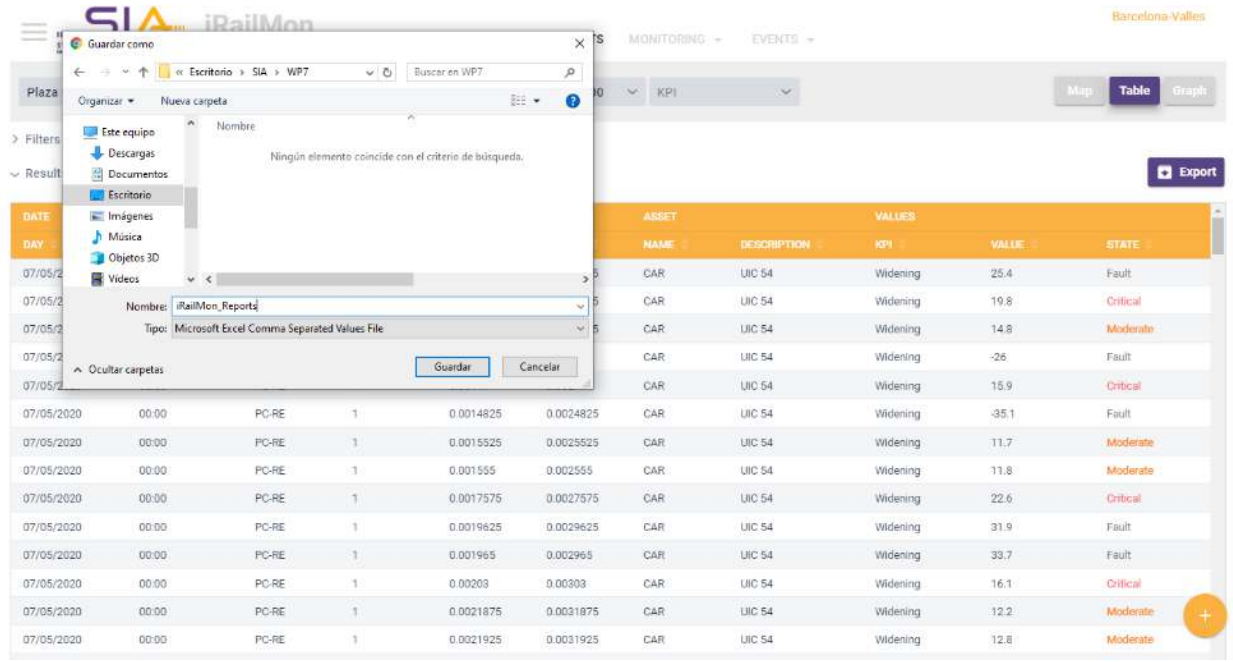
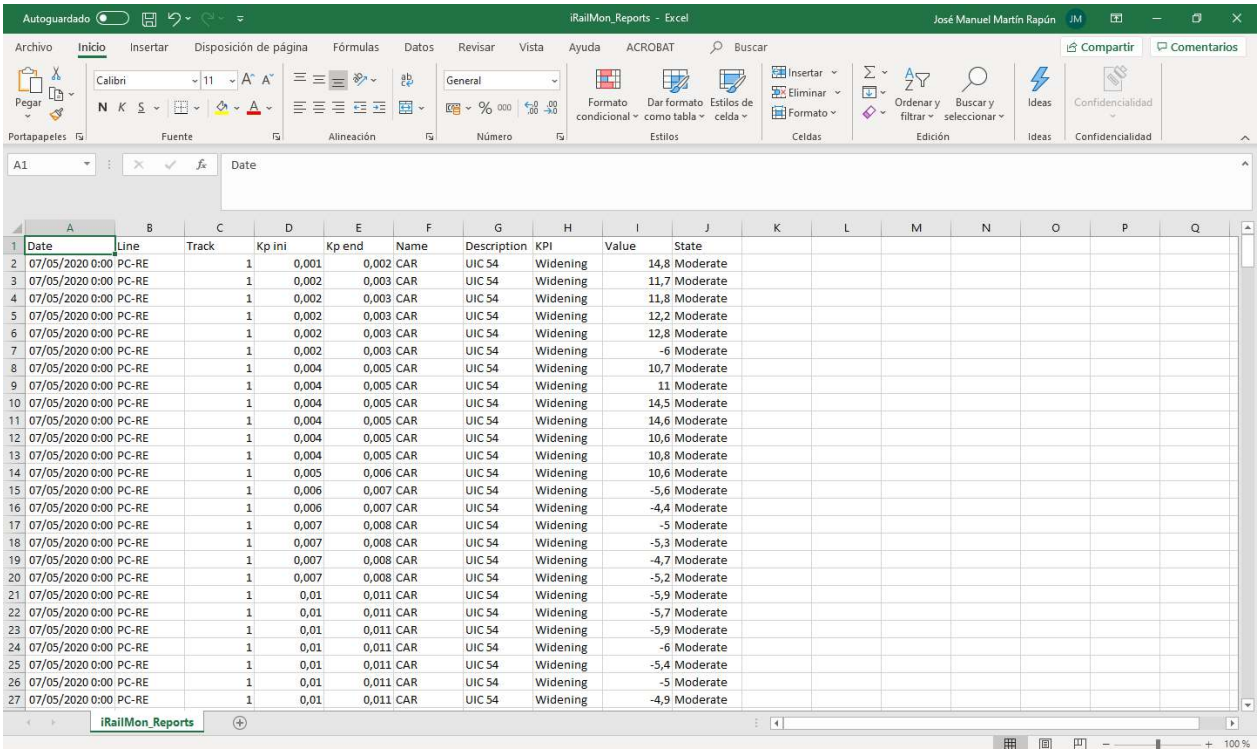


Figure 4-8: Export data Dialogue Window

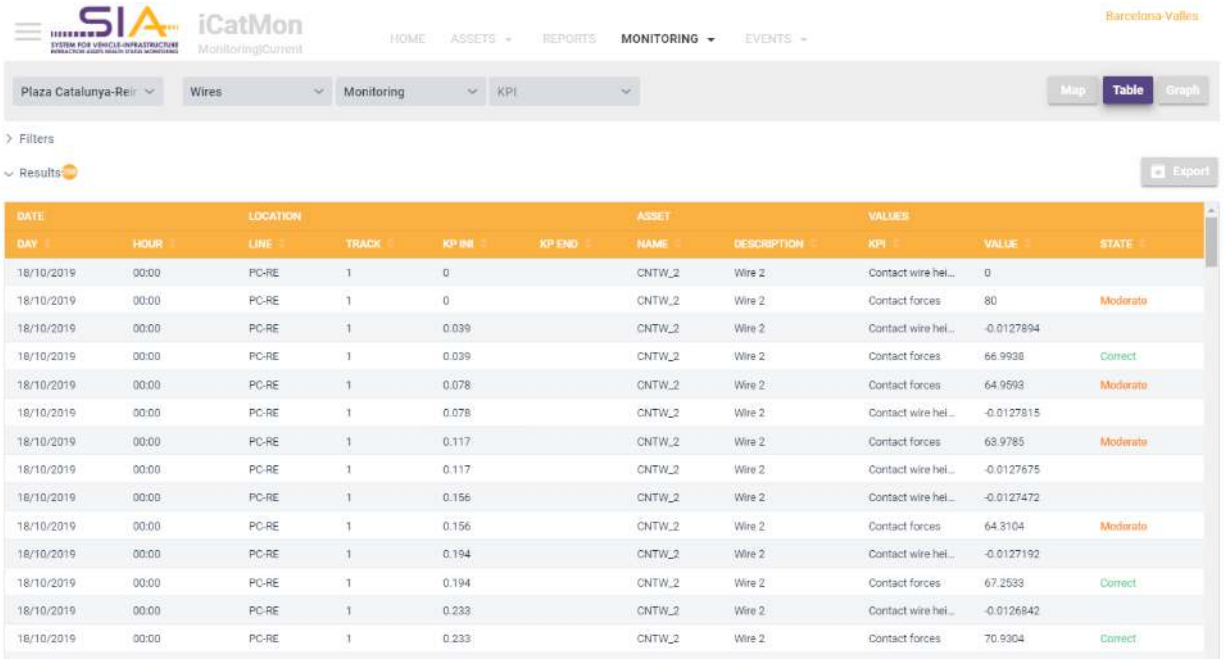
In this example, we have created a CSV format file which can be opened with Microsoft Excel or with OpenOffice Calc (free software) as displayed in Figure 4-9.



Date	Line	Track	Kp ini	Kp end	Name	Description	KPI	Value	State
07/05/2020 0:00	PC-RE	1	0,001	0,002	CAR	UIC 54	Widening	14,8	Moderate
07/05/2020 0:00	PC-RE	1	0,002	0,003	CAR	UIC 54	Widening	11,7	Moderate
07/05/2020 0:00	PC-RE	1	0,002	0,003	CAR	UIC 54	Widening	11,8	Moderate
07/05/2020 0:00	PC-RE	1	0,002	0,003	CAR	UIC 54	Widening	12,2	Moderate
07/05/2020 0:00	PC-RE	1	0,002	0,003	CAR	UIC 54	Widening	12,8	Moderate
07/05/2020 0:00	PC-RE	1	0,002	0,003	CAR	UIC 54	Widening	-6	Moderate
07/05/2020 0:00	PC-RE	1	0,004	0,005	CAR	UIC 54	Widening	10,7	Moderate
07/05/2020 0:00	PC-RE	1	0,004	0,005	CAR	UIC 54	Widening	11	Moderate
07/05/2020 0:00	PC-RE	1	0,004	0,005	CAR	UIC 54	Widening	14,5	Moderate
07/05/2020 0:00	PC-RE	1	0,004	0,005	CAR	UIC 54	Widening	14,6	Moderate
07/05/2020 0:00	PC-RE	1	0,004	0,005	CAR	UIC 54	Widening	10,6	Moderate
07/05/2020 0:00	PC-RE	1	0,004	0,005	CAR	UIC 54	Widening	10,8	Moderate
07/05/2020 0:00	PC-RE	1	0,005	0,006	CAR	UIC 54	Widening	10,6	Moderate
07/05/2020 0:00	PC-RE	1	0,006	0,007	CAR	UIC 54	Widening	-5,6	Moderate
07/05/2020 0:00	PC-RE	1	0,006	0,007	CAR	UIC 54	Widening	-4,4	Moderate
07/05/2020 0:00	PC-RE	1	0,007	0,008	CAR	UIC 54	Widening	-5	Moderate
07/05/2020 0:00	PC-RE	1	0,007	0,008	CAR	UIC 54	Widening	-5,3	Moderate
07/05/2020 0:00	PC-RE	1	0,007	0,008	CAR	UIC 54	Widening	-4,7	Moderate
07/05/2020 0:00	PC-RE	1	0,007	0,008	CAR	UIC 54	Widening	-5,2	Moderate
07/05/2020 0:00	PC-RE	1	0,01	0,011	CAR	UIC 54	Widening	-5,9	Moderate
07/05/2020 0:00	PC-RE	1	0,01	0,011	CAR	UIC 54	Widening	-5,7	Moderate
07/05/2020 0:00	PC-RE	1	0,01	0,011	CAR	UIC 54	Widening	-5,9	Moderate
07/05/2020 0:00	PC-RE	1	0,01	0,011	CAR	UIC 54	Widening	-6	Moderate
07/05/2020 0:00	PC-RE	1	0,01	0,011	CAR	UIC 54	Widening	-5,4	Moderate
07/05/2020 0:00	PC-RE	1	0,01	0,011	CAR	UIC 54	Widening	-5	Moderate
07/05/2020 0:00	PC-RE	1	0,01	0,011	CAR	UIC 54	Widening	-4,9	Moderate

Figure 4-9: iRailMon Track Inspection Report exported data

Similarly to this example, SIA data displayed in table mode in Monitoring (Figure 4-10) and Events (Figure 4-11) sections of SIA_VP of the 4 SIA services can be exported to be used with other external software tools.



DATE		LOCATION				ASSET		VALUES		
DAY	HOUR	LINE	TRACK	KP INI	KP END	NAME	DESCRIPTION	KPI	VALUE	STATE
18/10/2019	00:00	PC-RE	1	0		CNTW_2	Wire 2	Contact wire hei...	0	
18/10/2019	00:00	PC-RE	1	0		CNTW_2	Wire 2	Contact forces	80	Moderate
18/10/2019	00:00	PC-RE	1	0.039		CNTW_2	Wire 2	Contact wire hei...	-0.0127894	
18/10/2019	00:00	PC-RE	1	0.039		CNTW_2	Wire 2	Contact forces	66.9938	Correct
18/10/2019	00:00	PC-RE	1	0.078		CNTW_2	Wire 2	Contact forces	64.9593	Moderate
18/10/2019	00:00	PC-RE	1	0.078		CNTW_2	Wire 2	Contact wire hei...	-0.0127815	
18/10/2019	00:00	PC-RE	1	0.117		CNTW_2	Wire 2	Contact forces	63.9785	Moderate
18/10/2019	00:00	PC-RE	1	0.117		CNTW_2	Wire 2	Contact wire hei...	-0.0127675	
18/10/2019	00:00	PC-RE	1	0.156		CNTW_2	Wire 2	Contact wire hei...	-0.0127472	
18/10/2019	00:00	PC-RE	1	0.156		CNTW_2	Wire 2	Contact forces	64.3104	Moderate
18/10/2019	00:00	PC-RE	1	0.194		CNTW_2	Wire 2	Contact wire hei...	-0.0127192	
18/10/2019	00:00	PC-RE	1	0.194		CNTW_2	Wire 2	Contact forces	67.2533	Correct
18/10/2019	00:00	PC-RE	1	0.233		CNTW_2	Wire 2	Contact wire hei...	-0.0126842	
18/10/2019	00:00	PC-RE	1	0.233		CNTW_2	Wire 2	Contact forces	70.9304	Correct

Figure 4-10: iCatMon Monitoring screen with export button

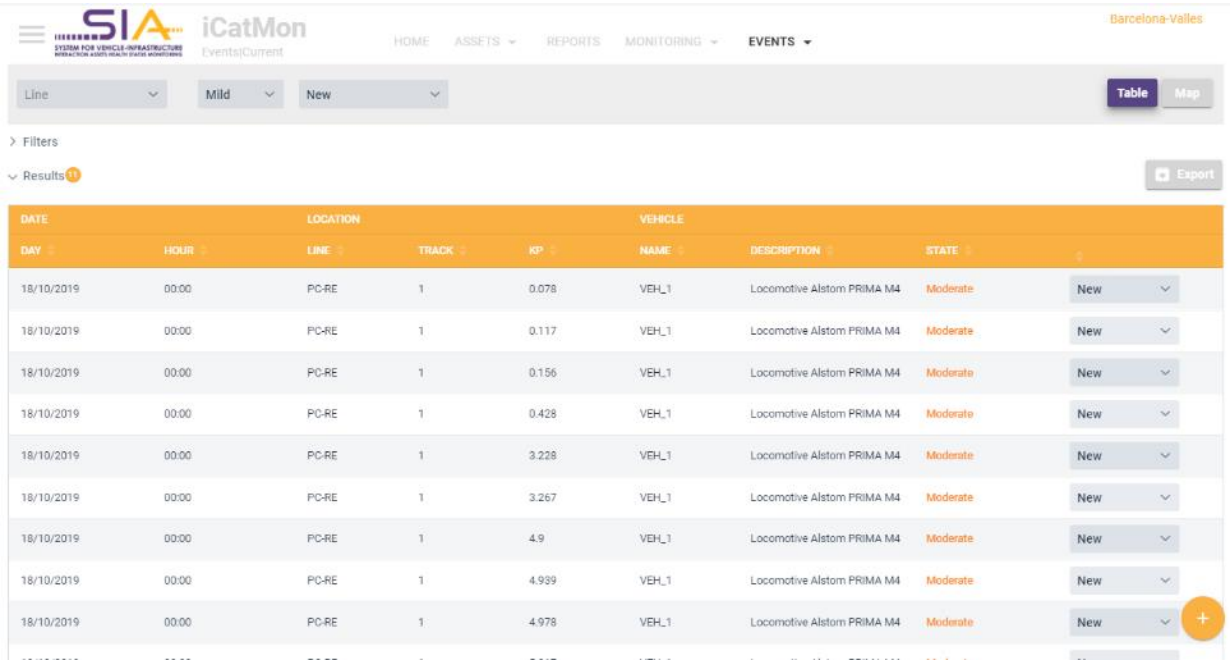


Figure 4-11: iCatMon Events screen with export button

5 Integration of SIA with information system of FGC

In this and the following chapters, the import tool implemented in SIA and described in the previous chapter is going to be used to import data generated with external IT systems into SIA. FGC is going to test iCatMon and iPantMon services mainly, so they are interested in loading in the system the auscultation reports they obtain from MERMEC software. They get an Excel file with the following aspect (Figure 5-1):

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	INFORME DATOS HILO																
2	Nombre Archivo				2011_09_28_00_33_LP_TR_Via_1.geo					Fecha			28/9/2011 0:33:1				
3	Linea				LP_TR_Via_1					Vehiculo			Rubi				
4	Tramo				1					Via			1				
5	Tipo de carril				UIC54					Posición inicial			3,14				
6																	
7	Punt Km		Tipo Hilo	Tipo Via	Eventos	Hilo 1			Hilo 2			Hilo 3			Hilo 4		
8	Linea	Registrado				Altura	Descent.	Desgaste	Altura	Descent.	Desgaste	Altura	Descent.	Desgaste	Altura	Descent.	Desgaste
9																	
10	6,00	6,00	120 cm	Recta	And.	5012,0	-94,0	1,3	5012,0	-41,0	2,0						
11	7,00	7,00	120 cm	Recta	And.	5014,0	-96,0	1,3	5010,0	-45,0	1,9						
12	8,00	8,00	120 cm	Recta	And.	5017,0	-96,0	1,5	5011,0	-46,0	2,0						
13	9,00	9,00	120 cm	Recta	And.	5016,0	-95,0	1,5	5008,0	-48,0	1,9						
14	10,00	10,00	120 cm	Recta	And.	5009,0	-98,0	1,5	5004,0	-52,0	1,3						

Figure 5-1: Sample catenary auscultation report to import into SIA

So, when creating this type of inspection (Catenary Auscultation) in iCatMon, the file format configuration expected is the one displayed in next Figure 5-2:

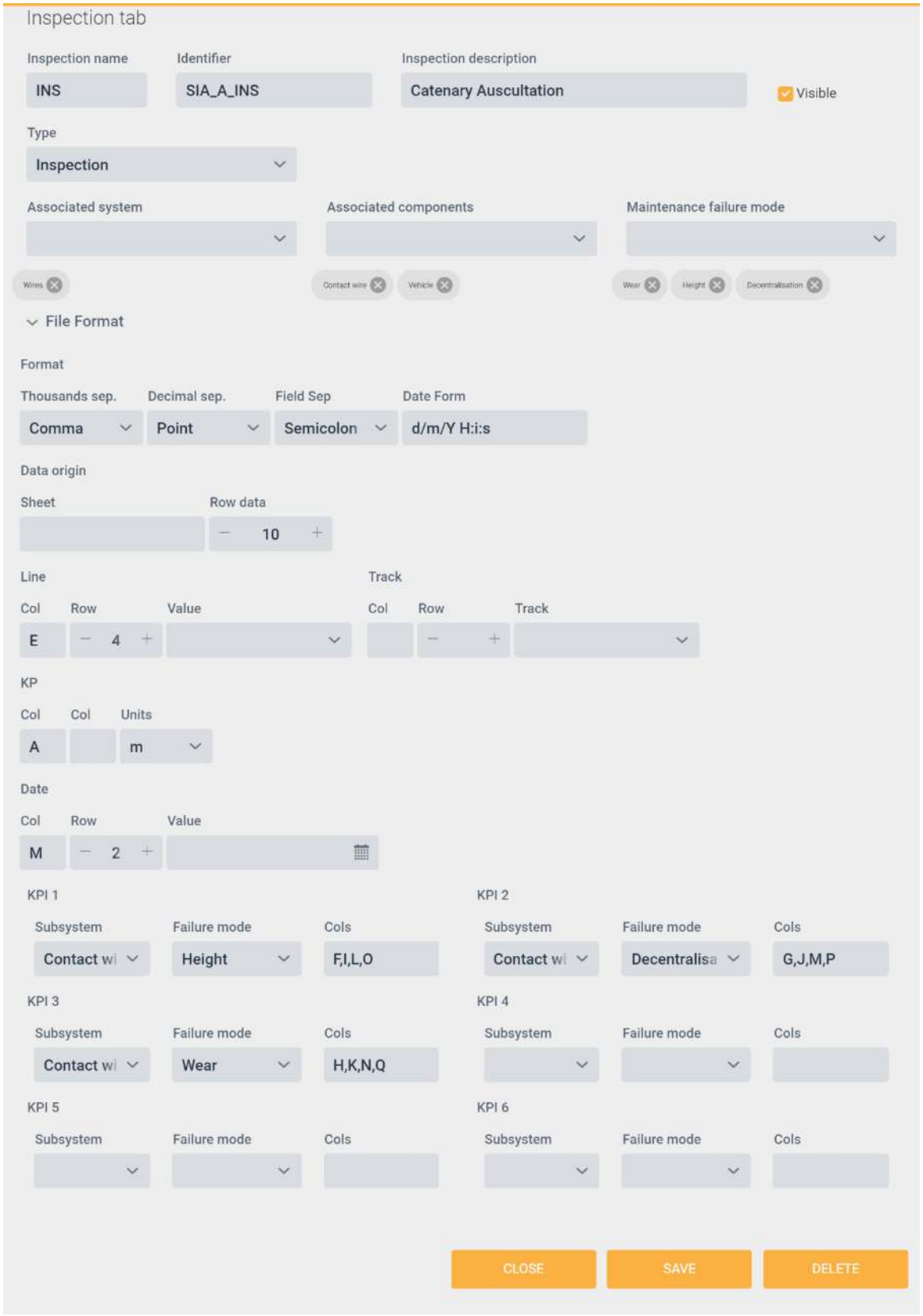


Figure 5-2: Configuration required to import the sample file displayed in Figure 5-1

To import the Auscultation Report displayed in Figure 5-1, users can do that in the Reports screen (Table mode view) as described in Chapter 4 with the next configuration (Figure 5-3):

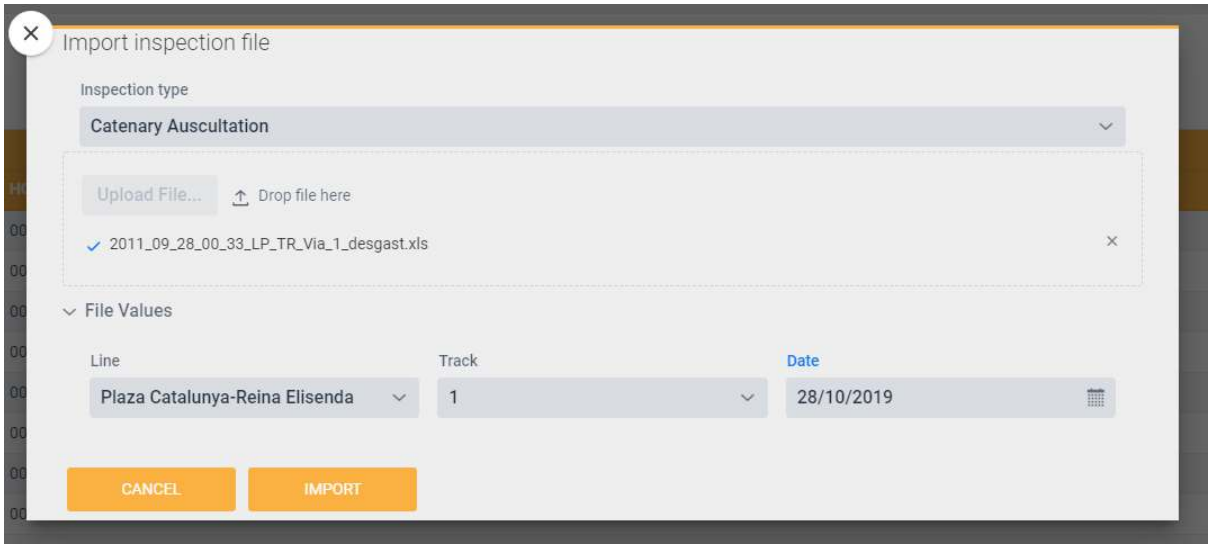


Figure 5-3: Input information needed to import FGC auscultation report sample file

Afterwards, the imported data are displayed in SIA and users can analyse them in Map (Figure 5-4), Table (Figure 5-5) or Chart (Figure 5-6) view.

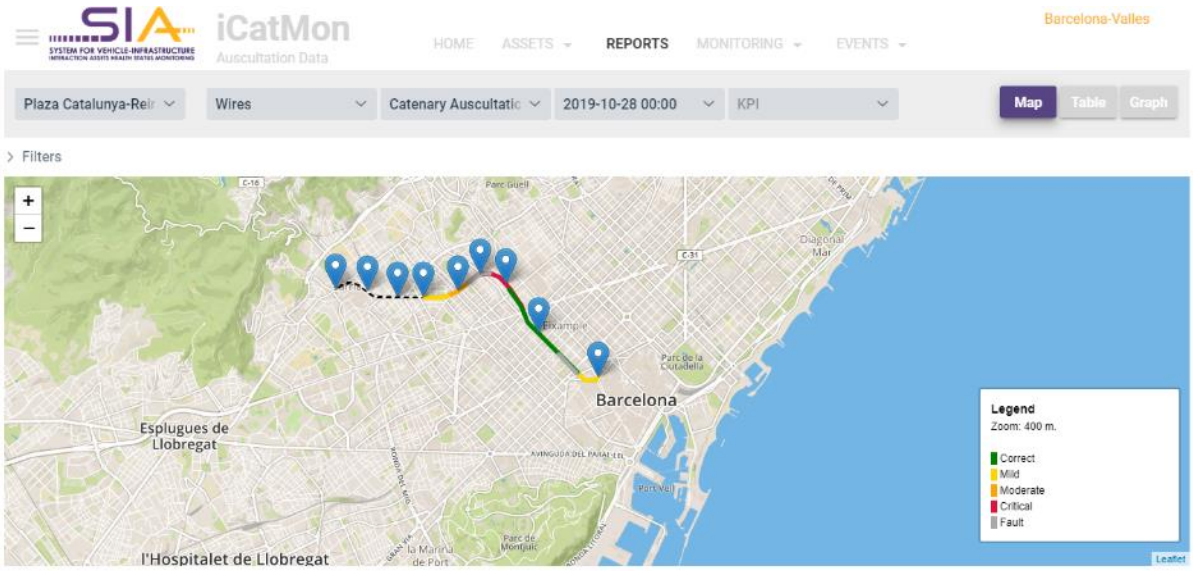


Figure 5-4: Imported auscultation report displayed in SIA in map mode

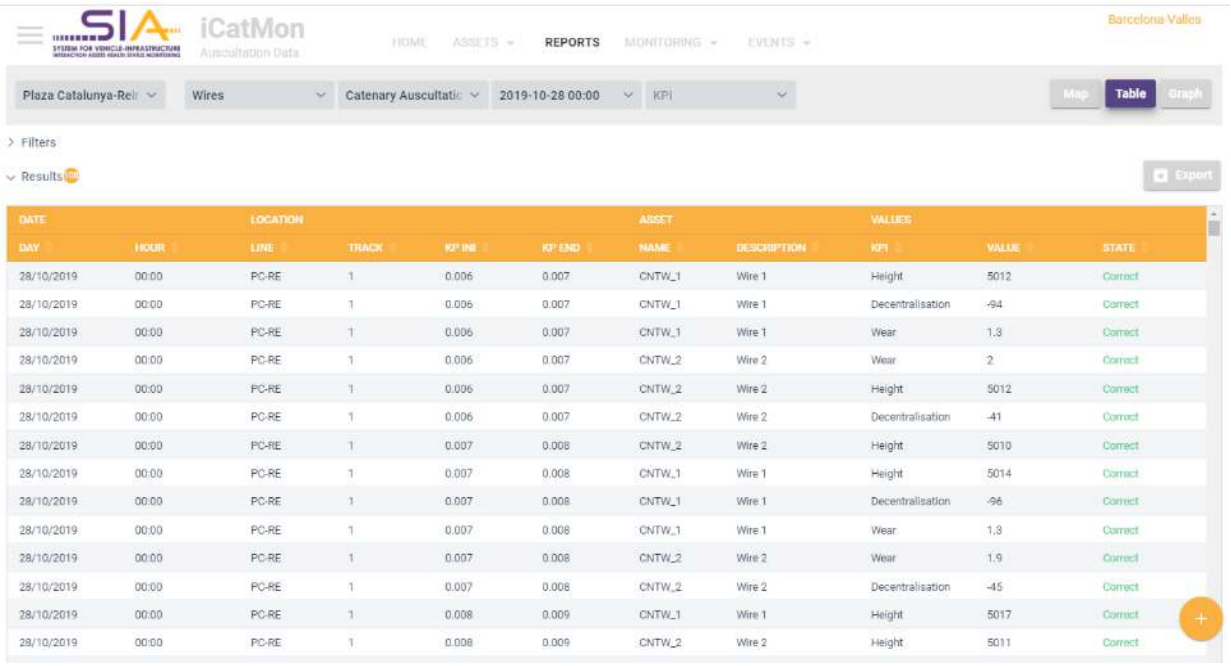


Figure 5-5: Imported auscultation report displayed in SIA in table mode

Figure 5-6: Imported auscultation report displayed in SIA in chart mode

6 Integration of SIA with information system of VIAS

Chapter 6 shows how data used by VIAS in its rail infrastructure operations can be uploaded to SIA. Next Figure 6-1 shows a sample file of a comfort and rail auscultation of a high speed railway track in Spain between Madrid and Valladolid. In this case only out of limits measurements are available, and the values in the first two colums to the left, indicating the measurements locations (start and end kilometer points) have been erased in the screenshot for privacy/security issues.

P.K. Inicio	P.K. Final	Velocidad km/h	Ac. Lateral.	Ac. Vert. C grasa Bogie 2, eje 2, caja 1. m/s2	Ac. Vert. C grasa Bogie 2, eje 2, caja 2. m/s2	Ac lat. caja. Veh. m/s2	Ac. vert. Caja Veh. m/s2	Observaciones
		263,672			50,191			Recta
		269,922		-36,384				Aparato
		270,312			30,543			Aparato
		270,312		41,499	36,676			Transición
		270,703		46,768				Transición
		270,312			30,832			Transición
		271,094			31,839			Recta

Ac m/sg2	Seguimiento	Sondeo	Maquinaria	Act. Inmediata
Ac. Lateral	2,5 < S < 3,0	3,0< M <4,0	4,0< M <6,0	A > 6,0
Ac.Vert.Caja Grasa	30< S <40	40< M <50	50< M <70	A > 70
Ac.Lat.Caja Veh.	0,8< S <1,3	1,3< M <1,5	1,5< M <2,0	A > 2,0
Ac.Vert.Caja Veh.	0,8< S <1,3	1,3< M <1,5	1,5< M <2,0	A > 2,0

Figure 6-1: Sample rail and comfort auscultation report to import into SIA

In this case the type of inspection is relevant for iRailMon and iWheelMon. So, for example, when creating this type of inspection in iWheelMon, the file format configuration expected is the one displayed in Figure 6-2:

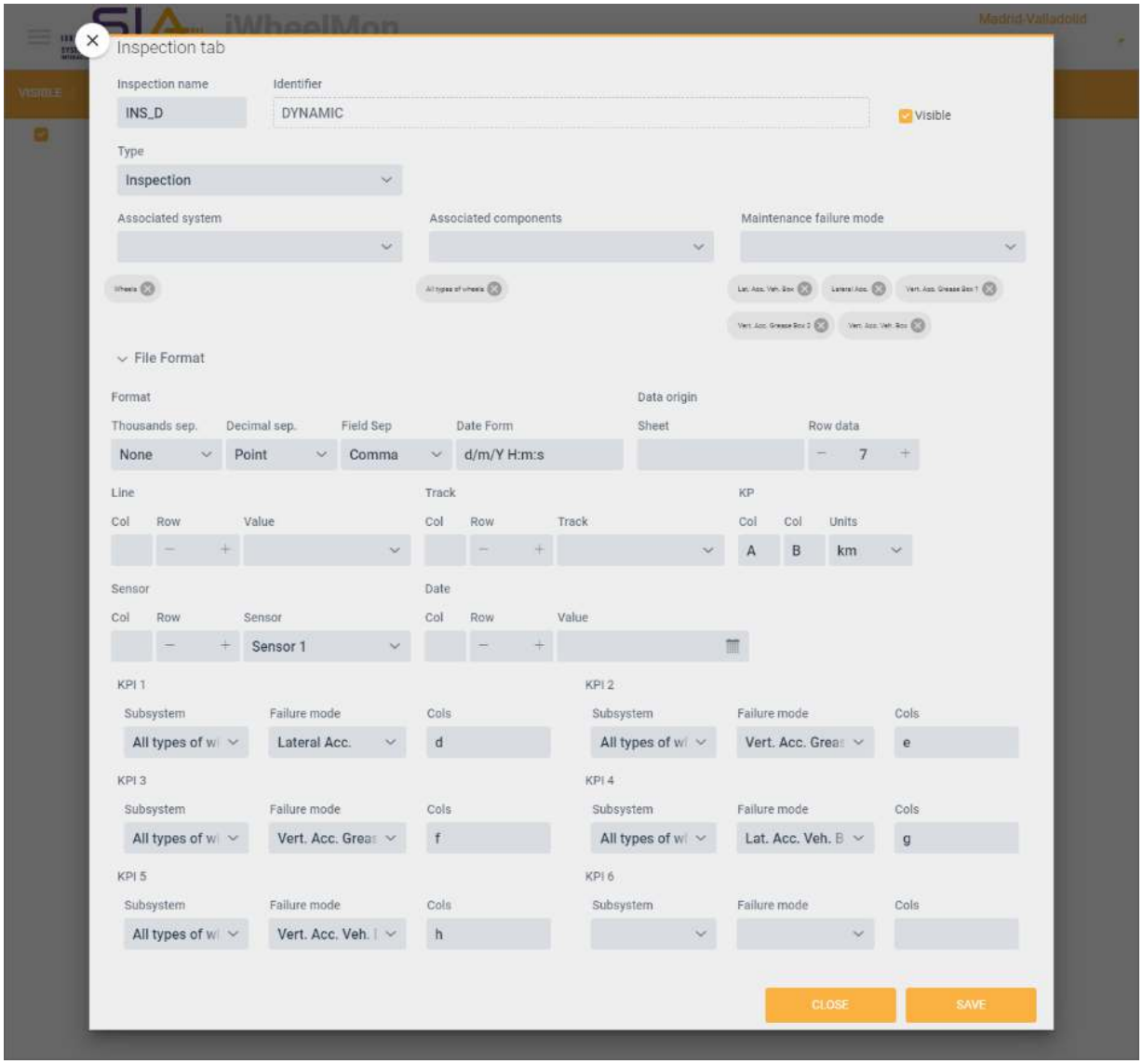


Figure 6-2: Configuration required to import the sample file displayed in Figure 6-1

Next, to import into iWheelMon the Auscultation Report showed in Figure 6-1, users can do that in the Reports screen (Table mode view) as described in Chapter 4 with the following configuration (Figure 6-3):

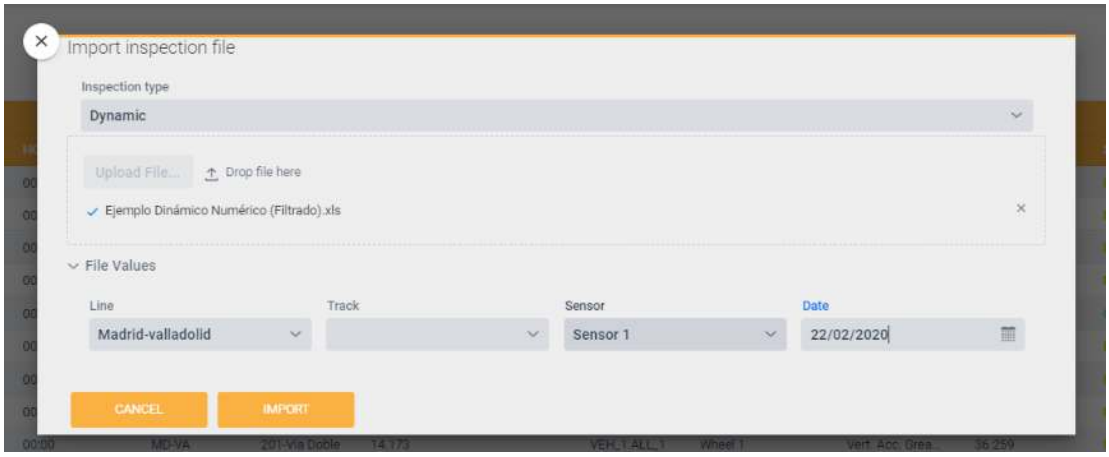


Figure 6-3: Input information needed to import VIAS auscultation report sample file

Once successfully imported, the data are displayed in SIA and users can analyse them in the Map (Figure 6-4), Table (Figure 6-5) or Chart (Figure 6-6) views.

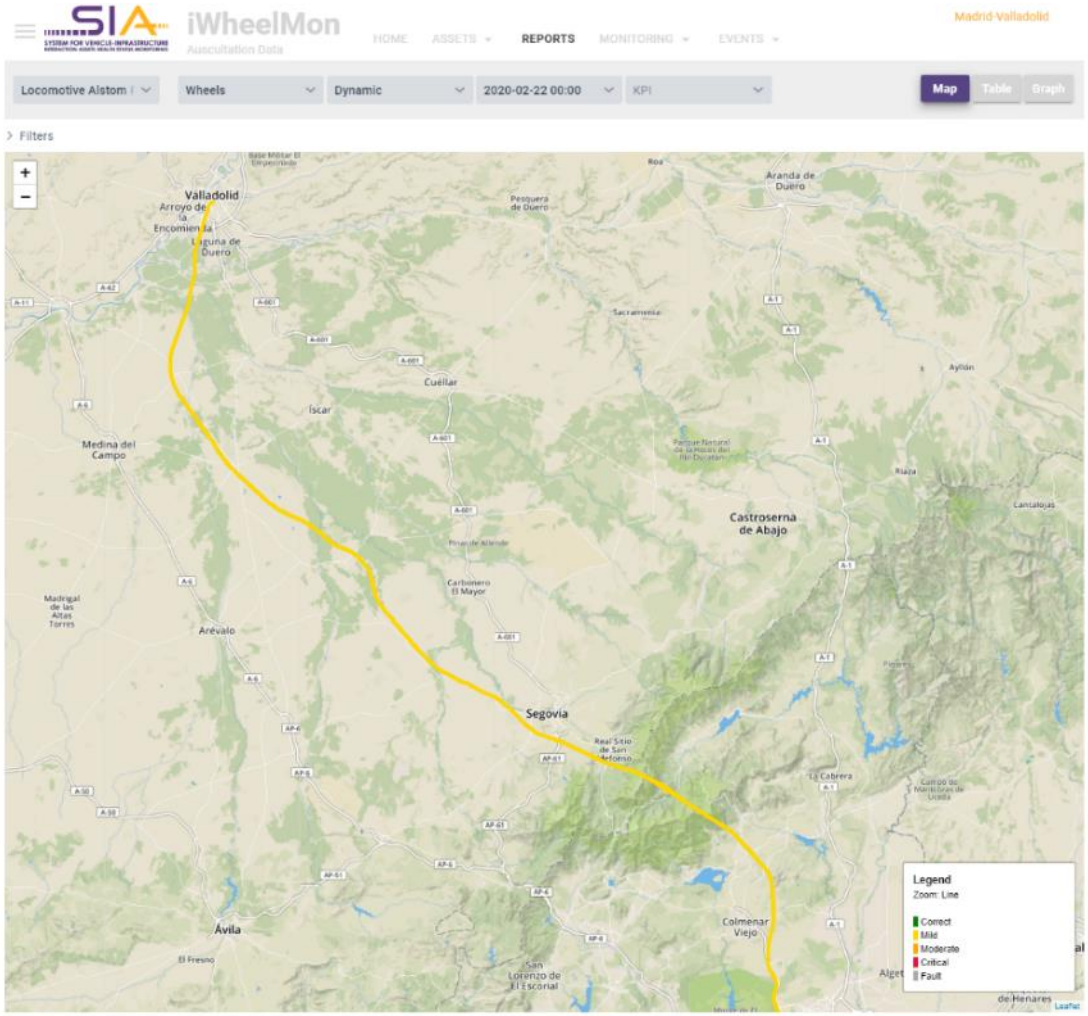


Figure 6-4: Imported VIAS auscultation report displayed in SIA in map mode

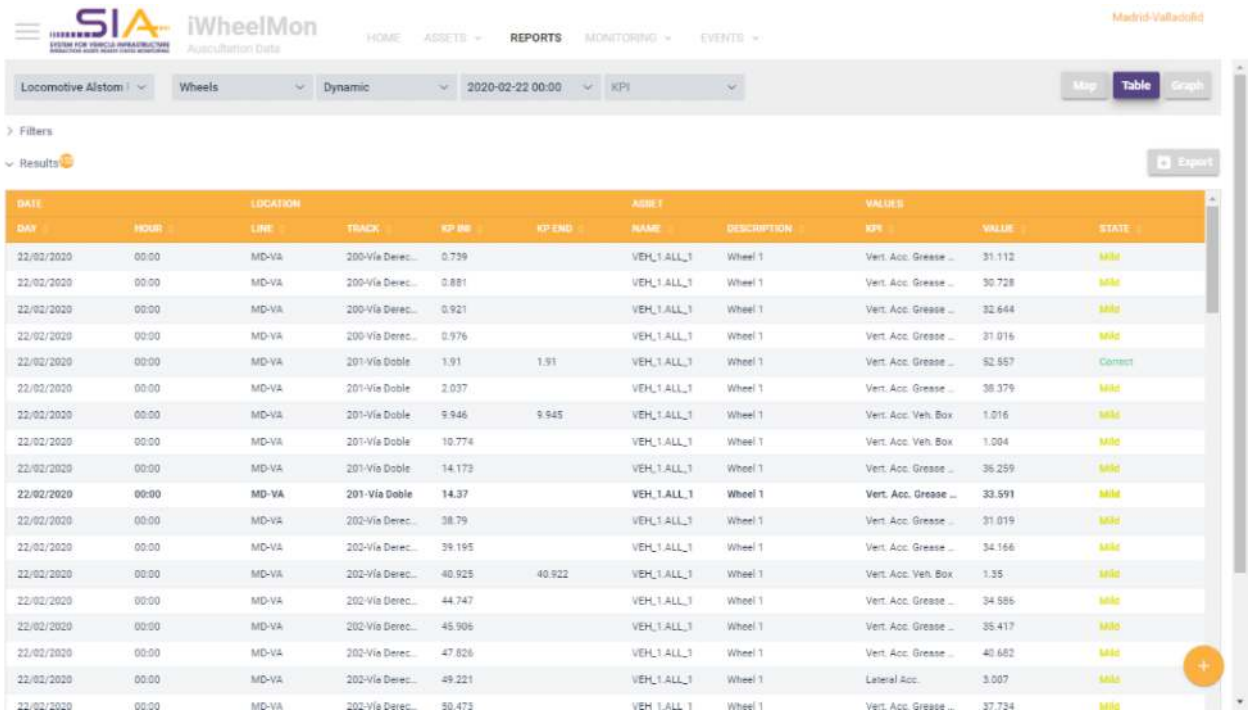


Figure 6-5: Imported VIAS auscultation report displayed in SIA in table mode

Figure 6-6: Imported VIAS auscultation report displayed in SIA in chart mode

7 Integration of SIA with information system of TELICE

Chapter 7 addresses the interoperability with the IT systems used by TELICE. This is a special case within SIA as TELICE performs their maintenance operations using its own equipment for catenary auscultation: tCat Workstation [7].

Figure 7-1: tCat workstation

tCat is a track trolley-type device to measure the geometrical parameters of the contact wire. It is used in conjunction with a proprietary software platform (Figure 7-2). tCat enables a swift and reproducible workflow for measuring all relevant overhead contact line geometrical parameters, including tunnel profiling, with scant user intervention.

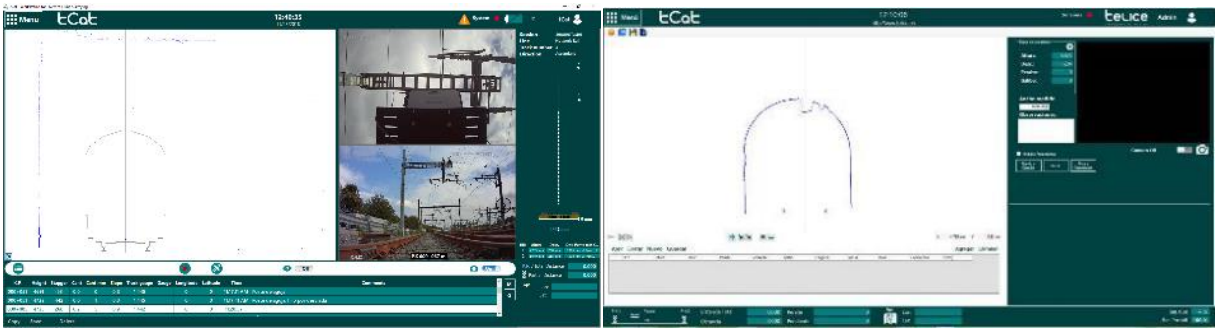
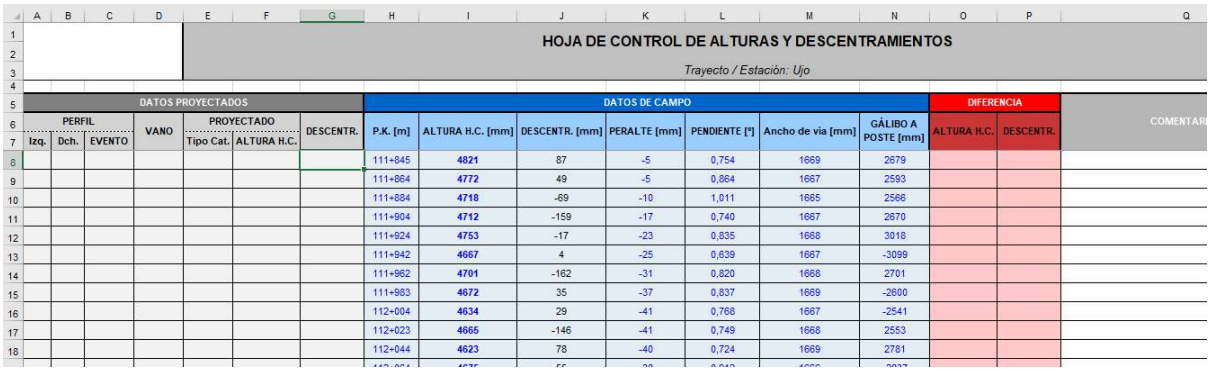


Figure 7-2: tCat software screenshots

Additionally, tCat software generates tailored reports as the one displayed in next Figure 7-3 which can be imported into SIA using iCAtMon.



HOJA DE CONTROL DE ALTURAS Y DESCENTRAMIENTOS

Trayecto / Estación: Ujo

DATOS PROYECTADOS							DATOS DE CAMPO							DIFERENCIA		
PERFIL			VANO	PROYECTADO		DESCENTR.	P.K. [m]	ALTURA H.C. [mm]	DESCENTR. [mm]	PERALTE [mm]	PENDIENTE [º]	Ancho de vía [mm]	GÁLIBO A POSTE [mm]	ALTURA H.C.	DESCENTR.	COMENTARI
Izq.	Dch.	EVENTO		Tipo Cat.	ALTURA H.C.											
							111+845	4821	87	-5	0,754	1669	2679			
							111+864	4772	49	-5	0,864	1667	2593			
							111+884	4718	-69	-10	1,011	1665	2566			
							111+904	4712	-159	-17	0,740	1667	2670			
							111+924	4753	-17	-23	0,835	1668	3018			
							111+942	4667	4	-25	0,639	1667	-3099			
							111+962	4701	-162	-31	0,820	1668	2701			
							111+983	4672	35	-37	0,837	1669	-2800			
							112+004	4634	29	-41	0,768	1667	-2541			
							112+023	4665	-146	-41	0,749	1668	2553			
							112+044	4623	78	-40	0,724	1669	2781			

Figure 7-3: Sample tCat catenary auscultation report

Similarly to what we did in Chapter 5 for the auscultation report provided by FGC, the user can create a new type of catenary auscultation report (Catenary Inspection TELICE) for tCat generated reports and configure the file format expected for this type of inspection (Figure 7-4):

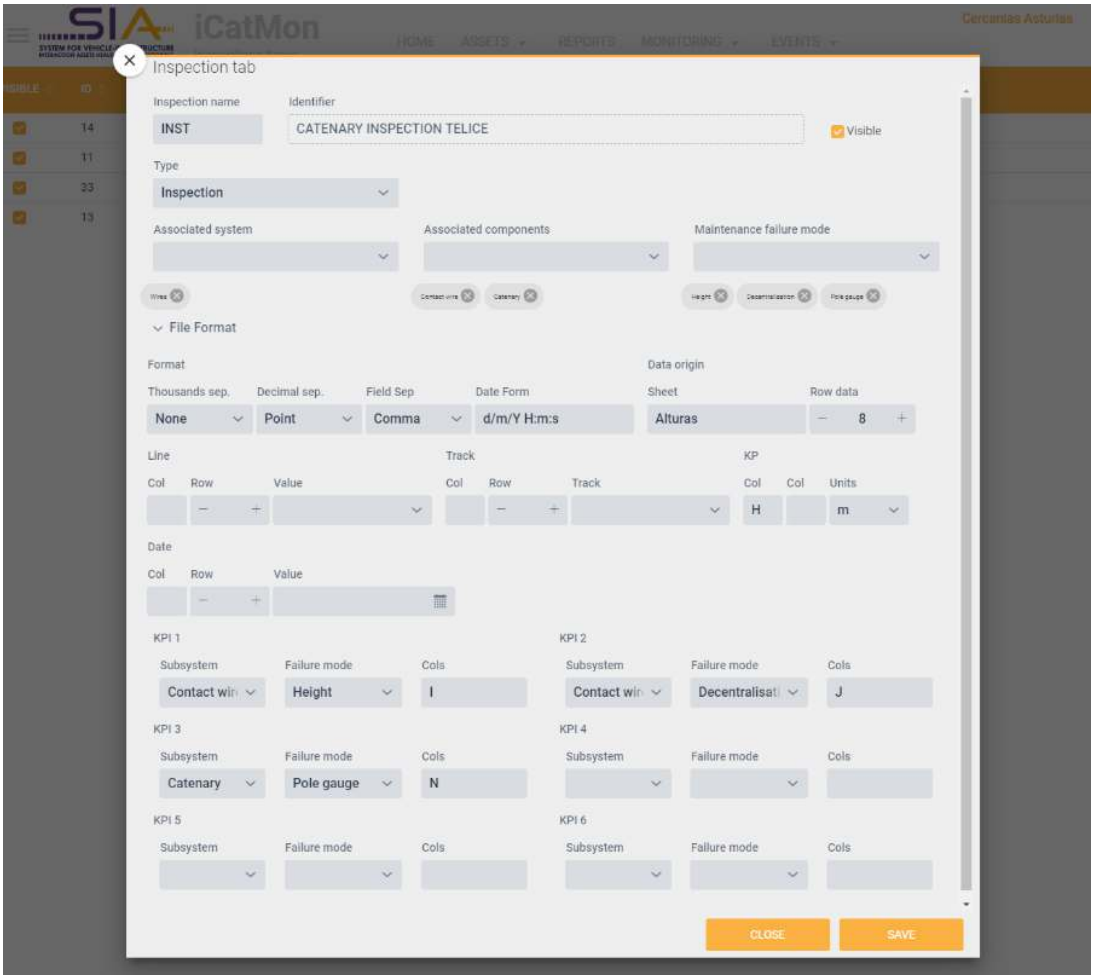


Figure 7-4: Configuration required to import the tCat sample file displayed in Figure 7-3

In this case the catenary report used as example corresponds to a commuter train line in Asturias, in the north of Spain. After creating the model in a new SIA instance, the user can upload tCat catenary inspections in iCatMon Reports screen as described in Chapter 4 using the following configuration (Figure 7-5):

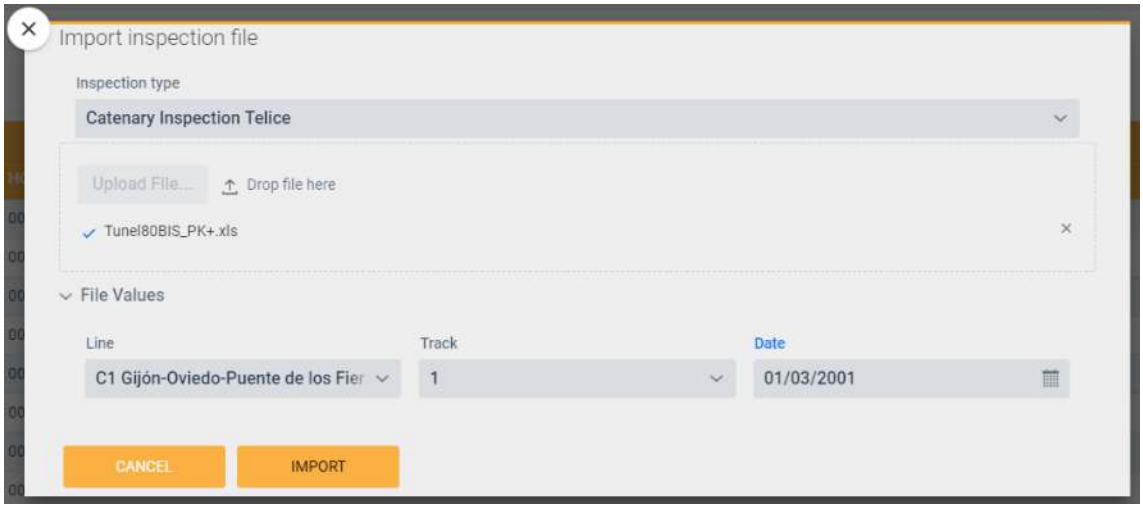


Figure 7-5: Input information needed to import tCat auscultation report sample file

Afterwards, the user can analyse in SIA the tCat imported data displaying them in Map (Figure 7-6), Table (Figure 7-7) or Chart mode (Figure 7-8).

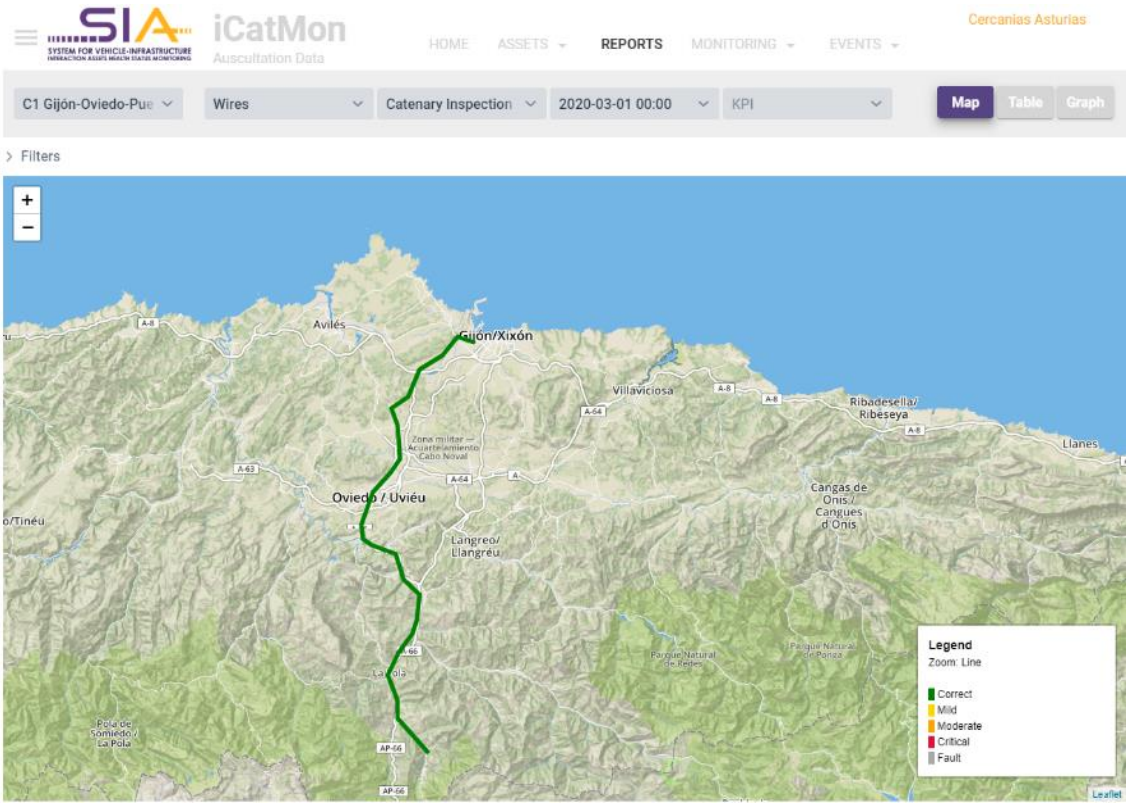


Figure 7-6: Imported tCat auscultation report displayed in SIA in map mode

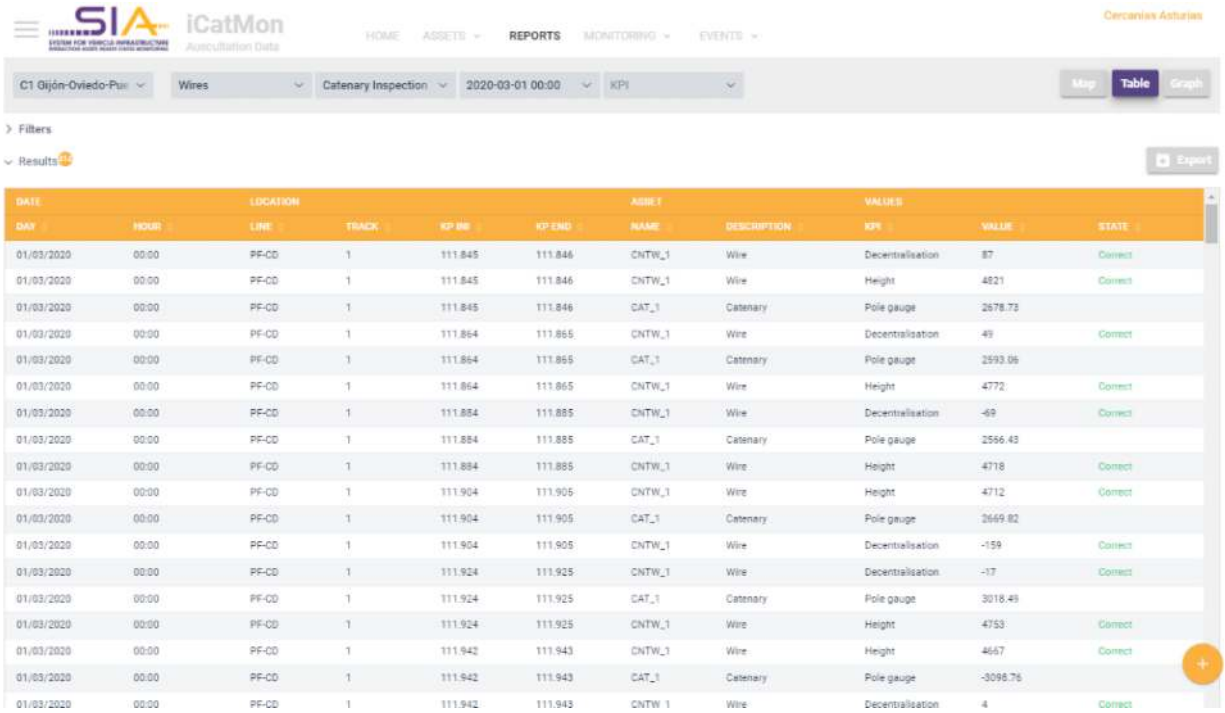


Figure 7-7: Imported tCat auscultation report displayed in SIA in table mode

Figure 7-8: Imported tCat auscultation report displayed in SIA in graphs mode

8 Integration of SIA with information system of OBB

In the case of OBB, instead of providing monitoring data as in the previous examples, they have provided the georeferenced data of the railway track they plan to use for testing the SIA system. It is located in Austria between the cities of Innsbruck and Bludenz. Chapter 8 shows how this data can be included in SIA although as stated in Section 2.3.1 there is no particular visual automated interface for IF1.1.1: GIS map of the line(s).

OBB sent ESRI shapefiles and if ESRI [8] software is not available, this type of format can be opened using opensource software QGIS [9], for example (Figure 8-1).

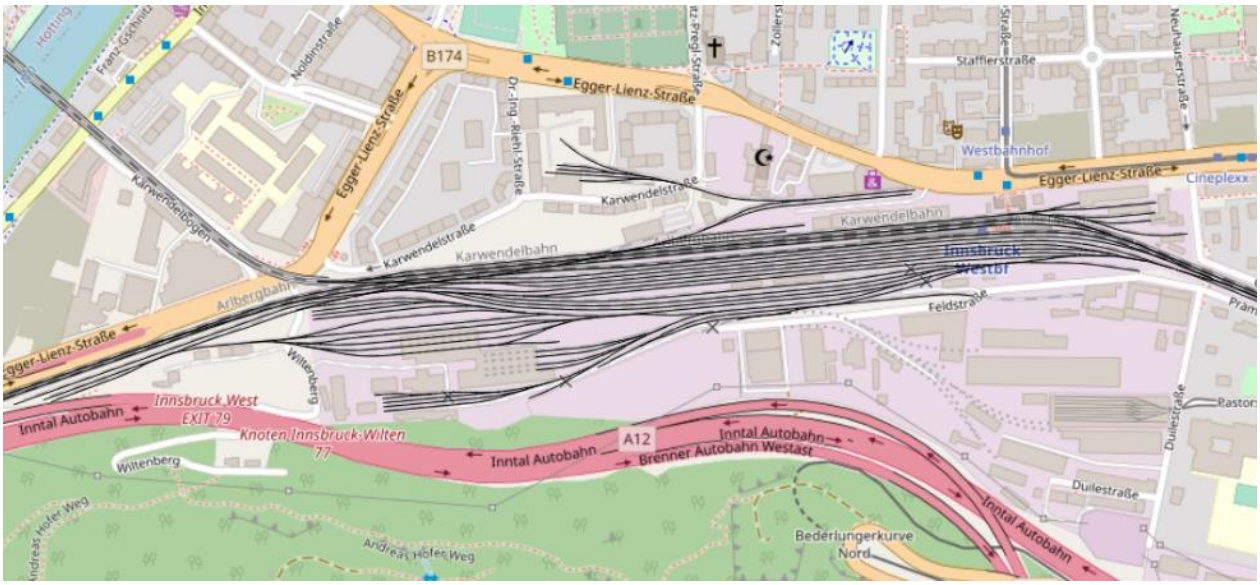


Figure 8-1: Innsbruck Westbahnhof displayed in QGIS

Thanks to QGIS, we can save the data in many different formats (Figure 8-2). In particular, PostgreSQL SQL dump is the most interesting format to easily upload the GIS data to SIA, as the SIA database is built using PostgreSQL and mapping the data fields to insert the data in the SIA data model is almost straight forward with some SQL programming skills.

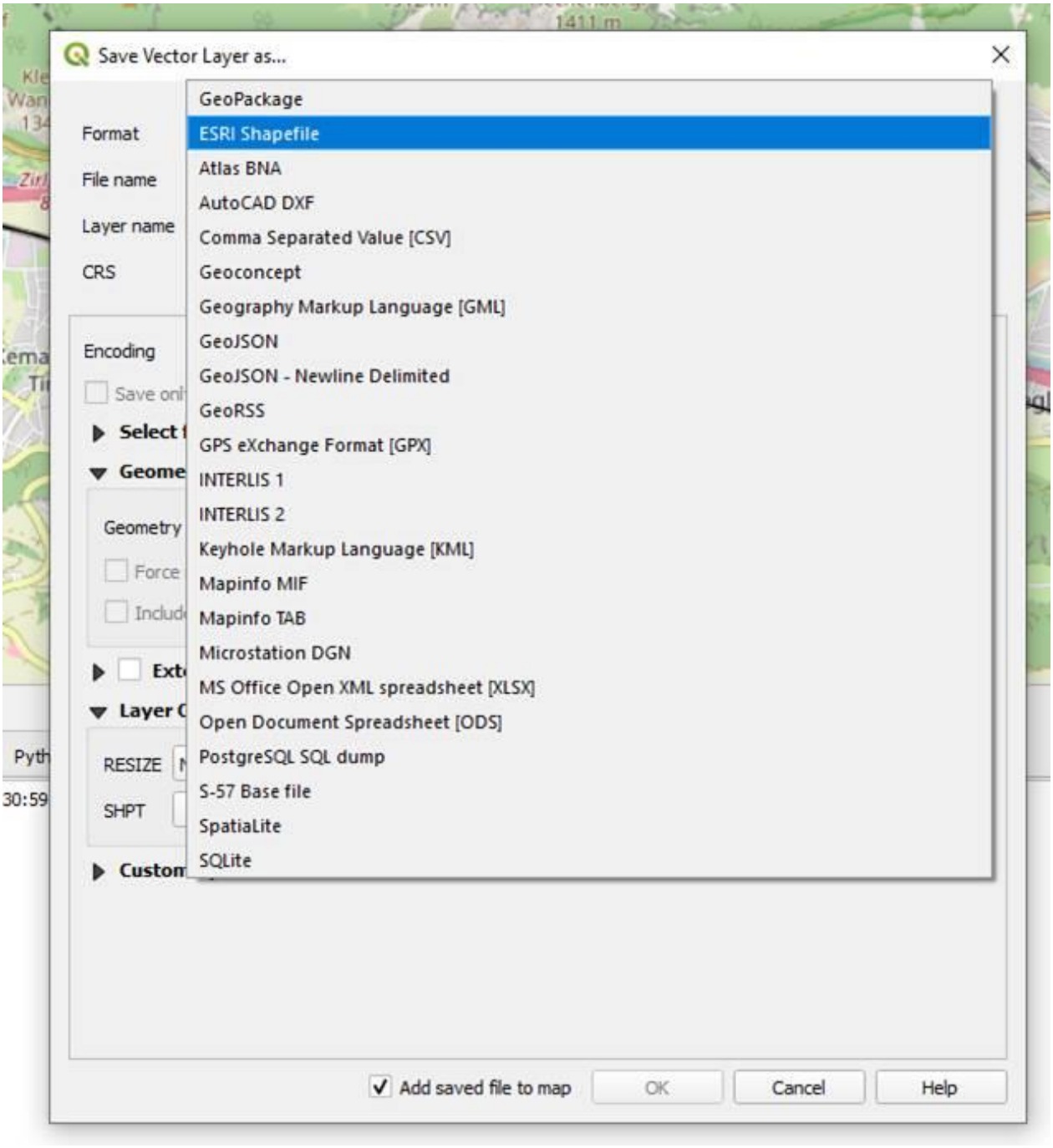


Figure 8-2: Export data formats in QGIS

After inserting the data in SIA database, they are visible in the SIA Visualization Platform. Figure 8-3 to Figure 8-5 display in iRailMon Assets Map some details of the Innsbruck-Bludenz line.

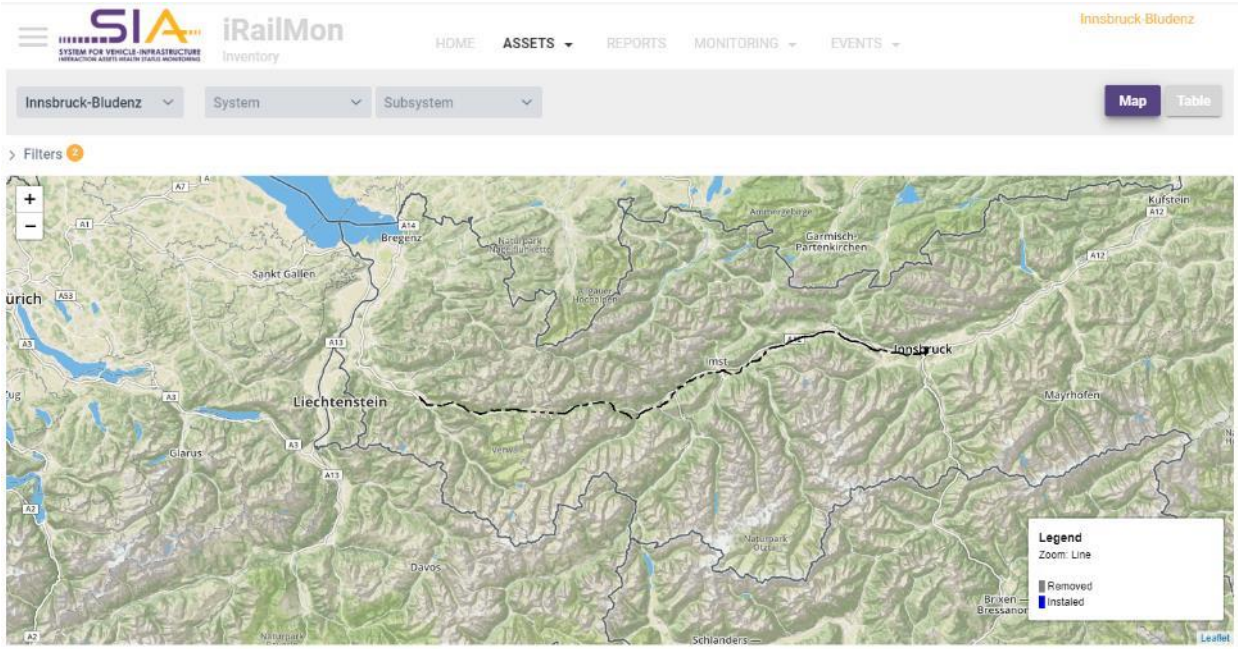


Figure 8-3: Innsbruck-Bludenz line overview in iRailMon

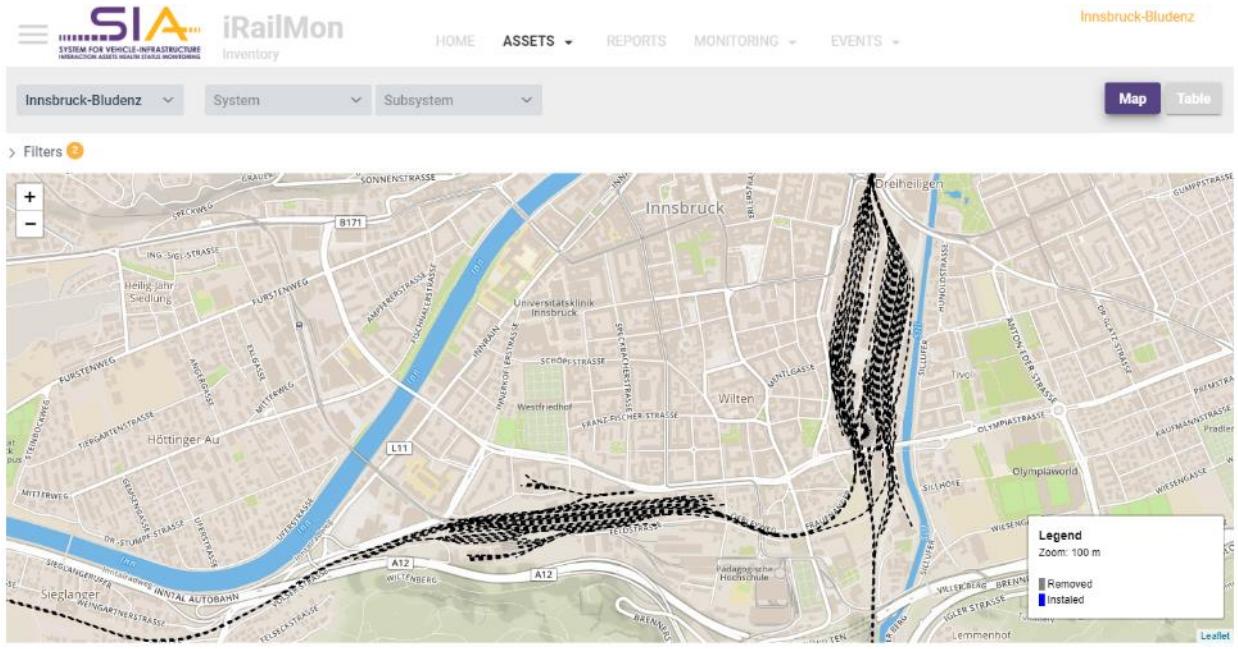


Figure 8-4: Innsbruck Hauptbahnhof and Westbahnhof

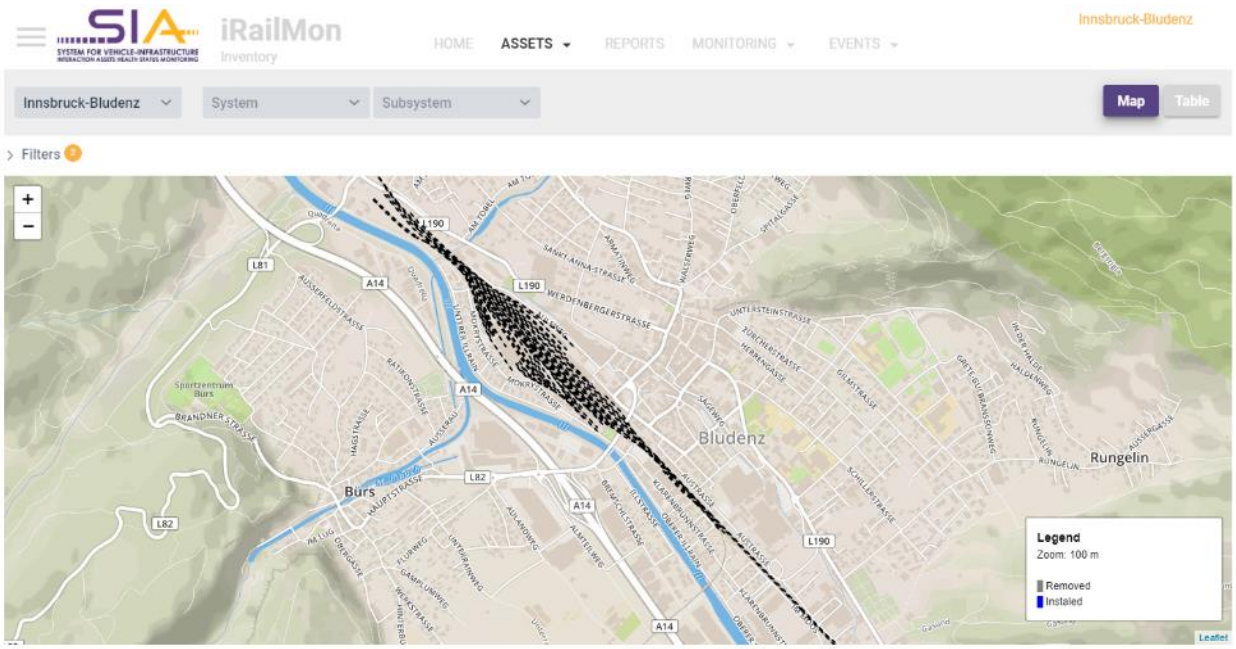


Figure 8-5: Bludenz Railway Station

9 Conclusions

The aim of this document has been to provide an overview of the work done in WP 7 and present the results achieved, namely an integration methodology of SIA system with other external information systems that end users may need.

As described in Chapter 4, other commercial software packages used by end users are not prepared for online integration, but allow exporting data in different formats. Therefore, a flexible file importing tool integrated in SIA is the key feature developed to address interoperability with other applications. This tool has been tested and demonstrated with examples provided by SIA end users.

There have been no serious deviations in WP7 from the project work programme/Annex I (DOW). As a result, no efforts have been required to manage deviations. To summarize, consortium believes WP 7 objectives have been successfully achieved.

10 References

[1] D6.1 and D6.2 SIA deliverables: Definition of vehicle and infrastructure maintenance standard views and framework development (latest version SIA_D6.1_D6.2_Def. of maintenance standard views and_v4.0)

[2] D2.2. SIA deliverable: SIA Architecture (approved version SIA_Architecture_and_Verification_Plan_v4.0)

[3] ISO 1005-8. Railway rolling stock material

[4] EN 50405. Railway applications. Current collection systems. Pantographs, testing methods for contact strips

[5] ISO 5003:2016. Flat bottom (Vignole) railway rails 43 kg/m and above

[6] EN 50119. Railway applications - Fixed installations - Electric traction overhead contact lines

[7] tCat product website (https://tcat.es/en/)

[8] ESRI product website (https://www.esri.com/)

[9] QGIS product website (https://www.qgis.org/en/site/)

11 Annexes

This section compiles the data collection templates filled out by SIA end user partners, as described in the methodological approach in Chapter 3. The common sections in the template are displayed next only once for sake of conciseness, and then there is a specific subsection for each partner with the answers provided.

SIA

Project Title:	System for vehicle-infrastructure Interaction Assets health status monitoring
Starting date:	01/03/2018
Duration in months:	36
Call (part) identifier:	H2020-GALILEO-GSA-2017-1
Grant agreement no:	776402

WP7

Integration with end-user applications template

Due date of submission	24/01/2020
Actual submission date	DD-MM-YYYY
Organization name of lead contractor for this deliverable	Ingecontrol
Dissemination level	CO
Revision	Draft

Authors

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	Partner 2 (ShortName) Contributor 1 Contributor 2
	Partner 3 (ShortName) Contributor 1 Contributor 2

DRAFT PREPARATION			
Version	**Publication date**	**Content**	**Author**
1.0	13/12/2019	▪ TOC proposal ▪ Main content	▪ José M. Martín (Ingecontrol)
2.0	20/12/2019	▪ Minor changes ▪ Call for contributions from CEIT	José M. Martín (Ingecontrol)

HISTORY OF CHANGES		
Version	**Publication date**	**Change**
3.0	28/01/2020	▪ Suggestions from CEIT included

1 Executive Summary

SIA project has the objective of developing 4 ready-to-use new services (iWheelMon, iRailMon, iPantMon and iCatMon) to provide prognostic information about the health status of the railway's most demanding assets in terms of maintenance costs (wheel, rail, pantograph and catenary).

The aim of this document is to provide a template to collect information from SIA project end-users to carry out the activities in WP7 "Integration with end-user specific application layer". WP7 aims at integrating relevant existing information systems currently operated by end-users with the SIA services. Each end user partner (FGC, OBB, VIAS, TELICE) will fill in one template providing valuable information to assess the current situation and requirements, and design an effective integration roadmap of important existing information from external applications needed to test and validate the four SIA services. Additionally, the integration implemented with these third-party systems will serve as an example of interoperability of SIA for a future market uptake that will require integration with many other external systems in new customers.

This integration also includes relevant data and information that is required to populate the DDBB of SIA services, in terms of

- Auscultations / Inspections data (5-year history) related to the use-cases defined in D2.1 of the relevant assets:
  - Overhead Contact Wire (OCW)
  - Pantograph
  - Wheelset
  - Rail
- KPIs associated with the use-cases defined in D2.1 and their correspondent ranges and thresholds that trigger maintenance actions:
  - OCW height
  - OCW stagger
  - OCW wear
  - Pantograph strips wear
  - Wheelsets out-of-roundness
  - Rail corrugation
  - Rail squats
- Maintenance actions associated to assets (5-year history)

This template is an initial step of the work to be done in WP7. When the end users fill in a first version of the document, an iterative process will begin with Ingecontrol and CEIT requesting further detailed information and collaboration to implement the WP7 objectives.

In case you have any doubt or want to comment anything about this template, please contact:

Mr. José Manuel Martín Rapún (jmmartin@inge-con.es)

Ingecontrol

2 Table of Contents

3 Abbreviations and acronyms

Abbreviation / Acronyms	Description
CMMS	Computerized Maintenance Management System
D2.1	Deliverable 2.1 "End user requirements of SIA and validation plan"
DDBB	Database
DoA	Description of Action
ERP	Enterprise Resource Planning
FGC	Ferrocarrils de la Generalitat de Catalunya. Spanish regional train operator
IS	Information Systems
OBB	Österreichische Bundesbahnen- Austrian Federal Railways, national train operator
OCW	Overhead Contact Wire
SIA	System for vehicle-infrastructure Interaction Assets health status monitoring
WP	Work Package

11.1 FGC Data Collection Template

4 General information

1. **Company name:** Ferrocarrils de la Generalitat de Catalunya

2. **Contact person and position:** Paula Ciria Espinosa – International Projects Manager.

3. **Contact details (email and phone number):** pciria@fgc.cat 667052050

4. **Which SIA services are you going to test as end user within WP8? (mostly based on DoA)**

iCatMon	x
iPantMon	x
iRailMon	☐
iWheelMon	☐

5 Assets data

5. Which infrastructure/vehicle are you going to use to test SIA services?

Please, describe the infrastructure (for Rail/Catenary) or vehicles (for Pantograph/wheels) where you plan to test SIA services. Give us as many details as possible -> Location, from-to, length, installer/manufacturer, year of installation/manufacturing…

a) Infrastructures:

Workshop tracks and Barcelona – Vallès line.

b) Vehicles:

Train unit series 112. Pantograph schunk.

6. For the SIA Services you plan to test, is the following 2-levels ontology (defined in D2.1) enough to clasiffy all the assets in the model and address defects (defined in D2.1) to components?

NOTE: Highlighted are the assets relevant to the use cases defined in D2.1.

YES

Service	System	Subsystem
iCatMon	Wires	Contact wire
		Catenary
		Feeder
	Support and sustentation	Masts and frames
		Registration Arms
		Droppers
		Rigid catenary guides
	PREQ - Protection equipment	Insulators
		Disconnectors
		Sections
		Earth wire
		Lighting conductor
		Hoods

[...]

Service	System	Subsystem
iPantMon	Pantograph head	Contact strip
		Horn
		Pantograph head support unit
		Other Components
	Frame and base frame	Insulators
		Junctions
		Operating positions
		Copper braids
		Other Components
	Drive System	Automatic dropping device
		Contact force regulation
		Electrical connections
		Other Components

[...]

Service	System	Subsystem
iWheelMon	Wheels	All types of wheels
		Monobloc wheels
		Axle
		Axle Box
		Wheelset

[...]

Service	System	Subsystem
iRailMon	Rail ends	Full section
		Head
		Web
		Foot
	Not rail ends	Full section
		Head
		Web

		Foot
	Defects caused by damages to the rail	Full section
	Welding and resurfacing	Electric flash-butt welding
		Thermite welding
		Electric arc welding
		Oxyacetylene welding
		Pressurised gas welding
		Induction welding
		Resurfacing
		Other welding methods

[…]

7. **Which relevant information systems for assets management (ERP, excel files…) do you use? Are they commercial or tailor made?**

Pantograph: maintenance visual revisions and hand measurements.

Catenary: Auscultatation machinery MERMEC, it has a MERMEC software that show the measurements. Also some of them can be exported in excel format.

8. **How do you plan to load in SIA the model data required for testing (components, inventory, location…) from those external applications?**

Send an example of this kind of information.

SIA interfaces ☐

Export/import files ☐

Automated communication (webservices…) ☐

Please, provide additional information:

[…]

9. **Could you provide technical documentation of these information systems and contact persons (if different from the one filling in this form)?**

6 Auscultation/monitoring data

10. Do you have auscultation reports that could be relevant/helpful to upload to SIA platform? Could you describe them and provide sample data?

We have auscultation reports with catenary measurements, CEIT already has a sample of them.

11. Do you already have onboard monitoring sensors apart from those developed in SIA that could be interesting to upload to SIA platform? Could you describe them (hardware, parameters, sampling rate...) and provide sample data?

No.

12. Could you provide technical documentation of these auscultation systems and monitoring sensors and contact persons (if different from the one filling in this form)?

7 Maintenance data

13. Which relevant information systems for maintenance management (CMMS, ERP, excel files...) do you use? Are they commercial or tailor made?

MERMEC program, Excels and measurements paper sheets.

14. How do you plan to load in SIA the maintenance data required for testing (configuratioon, defects, maintance operations...) from those external applications?

Send an example of this kind of information.

SIA interfaces	☐
Export/import files	☐
Automated communication (webservices...)	☐

Please, provide additional information:

[...]

15. Could you provide technical documentation of these information systems and contact persons (if different from the one filling in this form)?

8 Other information

16. Will there be any third parties involved in the systems integration process such as software vendors, maintenance operators, manufacturers, installers....? Could you please list them and describe their role.

NO.

17. Is there any approved investment to be executed during 2020 that could be relevant to the SIA project end users' IS integration and testing? Ej: new or deprecated software or software upgrades, new sensors, new contractors... Could you provide a schedule and deadlines?

NO.

18. Is there anything else you would like to add regarding the existing information systems integration in SIA platform to carry out the tests you will perform?

NO.

11.2 VIAS Data Collection Template

4 General information

1. **Company name:**

VIAS Y CONSTRUCCIONES S.A.

2. **Contact person and position:**

Manuel Menéndez Muñiz

3. **Contact details (email and phone number):**

manuel.menendez@vias.es, 914179800

4. **Which SIA services are you going to test as end user within WP8? (mostly based on DoA)**

iCatMon	☐
iPantMon	☐
iRailMon	X
iWheelMon	☐

5 Assets data

5. Which infrastructure/vehicle are you going to use to test SIA services?

Please, describe the infrastructure (for Rail/Catenary) or vehicles (for Pantograph/wheels) where you plan to test SIA services. Give us as many details as possible -> Location, from-to, length, installer/manufacturer, year of installation/manufacturing…

a) Infrastructures:

[…] Madrid – Sevilla High Speed Line, between Mora - Calatrava

b) Vehicles:

[…]Tamping machine.

6. For the SIA Services you plan to test, is the following 2-levels ontology (defined in D2.1) enough to clasiffy all the assets in the model and address defects (defined in D2.1) to components?

NOTE: Highlighted are the assets relevant to the use cases defined in D2.1.

Service	System	Subsystem
iCatMon	Wires	Contact wire
		Catenary
		Feeder
	Support and sustentation	Masts and frames
		Registration Arms
		Droppers
		Rigid catenary guides
	PREQ - Protection equipment	Insulators
		Disconnectors
		Sections
		Earth wire
		Lighting conductor
		Hoods

[…]

Service	System	Subsystem
iPantMon	Pantograph head	Contact strip
		Horn
		Pantograph head support unit
		Other Components
	Frame and base frame	Insulators
		Junctions
		Operating positions
		Copper braids
		Other Components
	Drive System	Automatic dropping device
		Contact force regulation
		Electrical connections
		Other Components

[…]

Service	System	Subsystem
iWheelMon	Wheels	All types of wheels
		Monobloc wheels
		Axle
		Axle Box
		Wheelset

[…]

Service	System	Subsystem
iRailMon	Rail ends	Full section
		Head
		Web
		Foot
	Not rail ends	Full section
		Head
		Web
		Foot

	Defects caused by damages to the rail	Full section
	Welding and resurfacing	Electric flash-butt welding
		Thermite welding
		Electric arc welding
		Oxyacetylene welding
		Pressurised gas welding
		Induction welding
		Resurfacing
		Other welding methods

[…]

7. Which relevant information systems for assets management (ERP, excel files…) do you use? Are they commercial or tailor made?

[…] From our side as maintainers there is no mandatory to have an asset register, EXCEL FILE.

8. How do you plan to load in SIA the model data required for testing (components, inventory, location…) from those external applications?

SIA interfaces	☐
Export/import files	X
Automated communication (webservices…)	☐

Please, provide additional information:

[…]

9. Could you provide technical documentation of these information systems and contact persons (if different from the one filling in this form)?

[…]

6 Auscultation/monitoring data

10. Do you have auscultation reports that could be relevant/helpful to upload to SIA platform? Could you describe them and provide sample data?

[…] Dynamic auscultation reports (no row data, only the points that don't meet the thresholds).

11. Do you already have onboard monitoring sensors apart from those developed in SIA that could be interesting to upload to SIA platform? Could you describe them (hardware, parameters, sampling rate…) and provide sample data?

[…] No

12. Could you provide technical documentation of these auscultation systems and monitoring sensors and contact persons (if different from the one filling in this form)?

[…]……

7 Maintenance data

13. Which relevant information systems for maintenance management (CMMS, ERP, excel files…) do you use? Are they commercial or tailor made?

[…] excel

14. How do you plan to load in SIA the maintenance data required for testing (configuratioon, defects, maintance operations…) from those external applications?

SIA interfaces	☐
Export/import files	X
Automated communication (webservices…)	☐

Please, provide additional information:

[…]

15. Could you provide technical documentation of these information systems and contact persons (if different from the one filling in this form)?

[…]

8 Other information

16. Will there be any third parties involved in the systems integration process such as software vendors, maintenance operators, manufacturers, installers....? Could you please list them and describe their role.

[…] In the maintenance task there are two " programs", managed by Adif called **SIOS (made by INECO)** (https://www.ineco.com/webineco/soluciones/idi/sios-0) and **PIDAME**, is the system where you ask/request the permissions to get inside the track for a maintenance action.

They are close system with no integration possibilities from our side.

17. Is there any approved investment to be executed during 2020 that could be relevant to the SIA project end users' IS integration and testing? Ej: new or deprecated software or software upgrades, new sensors, new contractors... Could you provide a schedule and deadlines?

[…] Unknown

18. Is there anything else you would like to add regarding the existing information systems integration in SIA platform to carry out the tests you will perform?

[…]

11.3 TELICE Data Collection Template

4 General information

1. **Company name:** Teléfonos, Líneas y Centrales, SA (TELICE)

2. **Contact person and position:** Iván Rivera Rodríguez – Innovation Manager.

3. **Contact details (email and phone number):** irivera.rodriguez@telice.es +34 653965812

4. **Which SIA services are you going to test as end user within WP8? (mostly based on DoA)**

iCatMon	x
iPantMon	☐
iRailMon	☐
iWheelMon	☐

5 Assets data

5. Which infrastructure/vehicle are you going to use to test SIA services?

Please, describe the infrastructure (for Rail/Catenary) or vehicles (for Pantograph/wheels) where you plan to test SIA services. Give us as many details as possible -> Location, from-to, length, installer/manufacturer, year of installation/manufacturing…

a) Infrastructures:

Several railway lines where TELICE performs maintenance works.

b) Vehicles:

N/A.

6. For the SIA Services you plan to test, is the following 2-levels ontology (defined in D2.1) enough to clasiffy all the assets in the model and address defects (defined in D2.1) to components?

NOTE: Highlighted are the assets relevant to the use cases defined in D2.1.

YES

Service	System	Subsystem
iCatMon	Wires	Contact wire
		Catenary
		Feeder
	Support and sustentation	Masts and frames
		Registration Arms
		Droppers
		Rigid catenary guides
	PREQ - Protection equipment	Insulators
		Disconnectors
		Sections
		Earth wire
		Lighting conductor
		Hoods

[…]

Service	System	Subsystem
iPantMon	Pantograph head	Contact strip
		Horn
		Pantograph head support unit
		Other Components
	Frame and base frame	Insulators
		Junctions
		Operating positions
		Copper braids
		Other Components
	Drive System	Automatic dropping device
		Contact force regulation
		Electrical connections
		Other Components

[…]

Service	System	Subsystem
iWheelMon	Wheels	All types of wheels
		Monobloc wheels
		Axle
		Axle Box
		Wheelset

[…]

Service	System	Subsystem
iRailMon	Rail ends	Full section
		Head
		Web
		Foot
	Not rail ends	Full section
		Head
		Web

		Foot
	Defects caused by damages to the rail	Full section
	Welding and resurfacing	Electric flash-butt welding
		Thermite welding
		Electric arc welding
		Oxyacetylene welding
		Pressurised gas welding
		Induction welding
		Resurfacing
		Other welding methods

[…]

7. **Which relevant information systems for assets management (ERP, excel files…) do you use? Are they commercial or tailor made?**

Catenary: tCat® Overhead Line Equipment software, developed in-house.

8. **How do you plan to load in SIA the model data required for testing (components, inventory, location…) from those external applications?**

SIA interfaces	☐
Export/import files	X
Automated communication (webservices…)	☐

Please, provide additional information:

Other formats or communication protocols may be considered.

9. **Could you provide technical documentation of these information systems and contact persons (if different from the one filling in this form)?**

6 Auscultation/monitoring data

10. Do you have auscultation reports that could be relevant/helpful to upload to SIA platform? Could you describe them and provide sample data?

We have tCat® measurement campaigns available for testing and integration purposes.

11. Do you already have onboard monitoring sensors apart from those developed in SIA that could be interesting to upload to SIA platform? Could you describe them (hardware, parameters, sampling rate...) and provide sample data?

No.

12. Could you provide technical documentation of these auscultation systems and monitoring sensors and contact persons (if different from the one filling in this form)?

7 Maintenance data

13. Which relevant information systems for maintenance management (CMMS, ERP, excel files…) do you use? Are they commercial or tailor made?

Excel files.

14. How do you plan to load in SIA the maintenance data required for testing (configuratioon, defects, maintance operations…) from those external applications?

SIA interfaces	☐
Export/import files	X
Automated communication (webservices…)	☐

Please, provide additional information:

[…]

15. Could you provide technical documentation of these information systems and contact persons (if different from the one filling in this form)?

8 Other information

16. Will there be any third parties involved in the systems integration process such as software vendors, maintenance operators, manufacturers, installers....? Could you please list them and describe their role.

NO.

17. Is there any approved investment to be executed during 2020 that could be relevant to the SIA project end users' IS integration and testing? Ej: new or deprecated software or software upgrades, new sensors, new contractors... Could you provide a schedule and deadlines?

NO.

18. Is there anything else you would like to add regarding the existing information systems integration in SIA platform to carry out the tests you will perform?

NO.

11.4 OBB Data Collection Template

4 General information

1. **Company name:**

ÖBB-Infrastruktur

2. **Contact person and position:**

Dr. Thomas Petraschek, Head of R&D

3. **Contact details (email and phone number):**

Thomas.petraschek@oebb.at, +43 664 2867963

4. **Which SIA services are you going to test as end user within WP8? (mostly based on DoA)**

iCatMon	☐
iPantMon	☐
iRailMon	x
iWheelMon	x

5 Assets data

5. Which infrastructure/vehicle are you going to use to test SIA services?

Please, describe the infrastructure (for Rail/Catenary) or vehicles (for Pantograph/wheels) where you plan to test SIA services. Give us as many details as possible -> Location, from-to, length, installer/manufacturer, year of installation/manufacturing…

a) Infrastructures:

Tbd mid of September, regular passenger train

b) Vehicles:

Tbd mid of September

6. For the SIA Services you plan to test, is the following 2-levels ontology (defined in D2.1) enough to clasiffy all the assets in the model and address defects (defined in D2.1) to components?

NOTE: Highlighted are the assets relevant to the use cases defined in D2.1.

Service	System	Subsystem
iCatMon	Wires	Contact wire
		Catenary
		Feeder
	Support and sustentation	Masts and frames
		Registration Arms
		Droppers
		Rigid catenary guides
	PREQ - Protection equipment	Insulators
		Disconnectors
		Sections
		Earth wire
		Lighting conductor
		Hoods

[…]

Service	System	Subsystem
iPantMon	Pantograph head	Contact strip
		Horn
		Pantograph head support unit
		Other Components
	Frame and base frame	Insulators
		Junctions
		Operating positions
		Copper braids
		Other Components
	Drive System	Automatic dropping device
		Contact force regulation
		Electrical connections
		Other Components

[...]

Service	System	Subsystem
iWheelMon	Wheels	All types of wheels
		Monobloc wheels
		Axle
		Axle Box
		Wheelset

[...]

Service	System	Subsystem
iRailMon	Rail ends	Full section
		Head
		Web
		Foot
	Not rail ends	Full section
		Head
		Web
		Foot

	Defects caused by damages to the rail	Full section
	Welding and resurfacing	Electric flash-butt welding
		Thermite welding
		Electric arc welding
		Oxyacetylene welding
		Pressurised gas welding
		Induction welding
		Resurfacing
		Other welding methods

[…]

7. **Which relevant information systems for assets management (ERP, excel files…) do you use? Are they commercial or tailor made?**

ESRI for GIS data.

8. **How do you plan to load in SIA the model data required for testing (components, inventory, location…) from those external applications?**

SIA interfaces	☐
Export/import files	x
Automated communication (webservices…)	☐

Please, provide additional information:

ESRI shapefile format of the track used for testing.

9. **Could you provide technical documentation of these information systems and contact persons (if different from the one filling in this form)?**

[…]

6 Auscultation/monitoring data

10. Do you have auscultation reports that could be relevant/helpful to upload to SIA platform? Could you describe them and provide sample data?

No. We see that our role in the project is to provide the infrastructure and the rolling stock for the test measurements. We are very much interested in comparing the SIA-measurement data with our own data, especially those of the positioning unit. The great benefit of SIA is of course the use of low-cost sensors…having our system as a reference, e.g. in positioning, can be a benefit for SIA as well, I think.

11. Do you already have onboard monitoring sensors apart from those developed in SIA that could be interesting to upload to SIA platform? Could you describe them (hardware, parameters, sampling rate…) and provide sample data?

Same answer as in question 10.

12. Could you provide technical documentation of these auscultation systems and monitoring sensors and contact persons (if different from the one filling in this form)?

Not applicable.

7 Maintenance data

13. Which relevant information systems for maintenance management (CMMS, ERP, excel files...) do you use? Are they commercial or tailor made?

14. How do you plan to load in SIA the maintenance data required for testing (configuratioon, defects, maintance operations...) from those external applications?

SIA interfaces	☐
Export/import files	☐
Automated communication (webservices...)	☐

Please, provide additional information:

[...]

15. Could you provide technical documentation of these information systems and contact persons (if different from the one filling in this form)?

[...]

8 Other information

16. Will there be any third parties involved in the systems integration process such as software vendors, maintenance operators, manufacturers, installers....? Could you please list them and describe their role.

No.

17. Is there any approved investment to be executed during 2020 that could be relevant to the SIA project end users' IS integration and testing? Ej: new or deprecated software or software upgrades, new sensors, new contractors... Could you provide a schedule and deadlines?

No.

18. Is there anything else you would like to add regarding the existing information systems integration in SIA platform to carry out the tests you will perform?

No.