Background and motivation -
Ontology based data integration approach for linear network infrastructures

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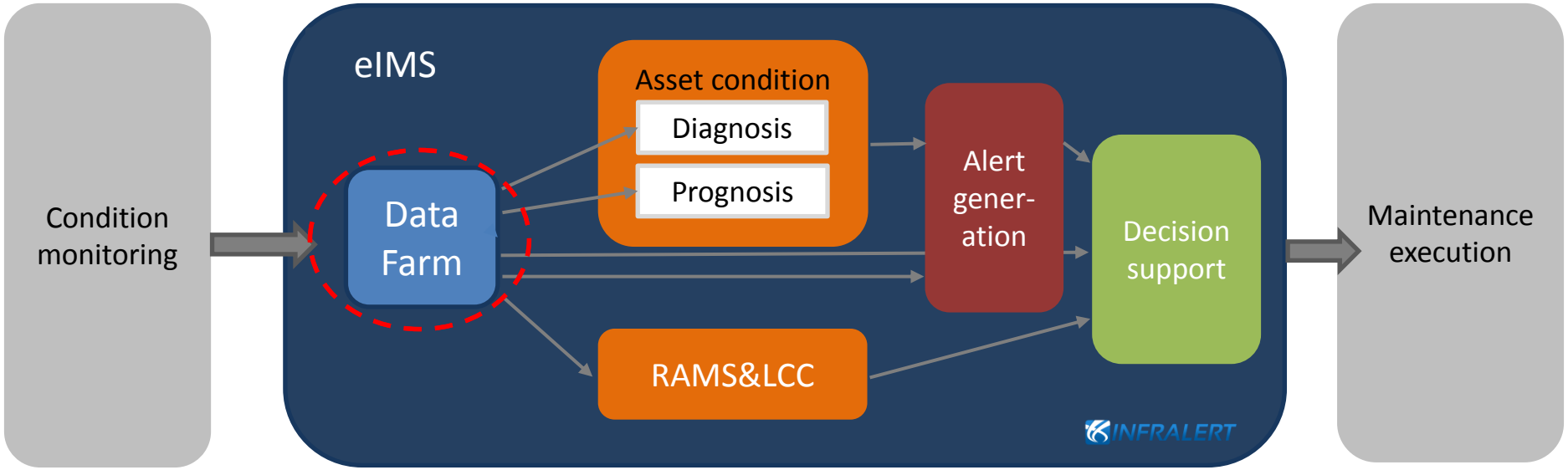
Agenda

- General Overbiew & Objectives
- Project in Brief: Data Management
- State of Art
- Data Farm
- Linear Infrastructures
- Network Modeling
- Data Ontology
- Data Management
- The TKN platform
- Results and Conclusions

General Overview

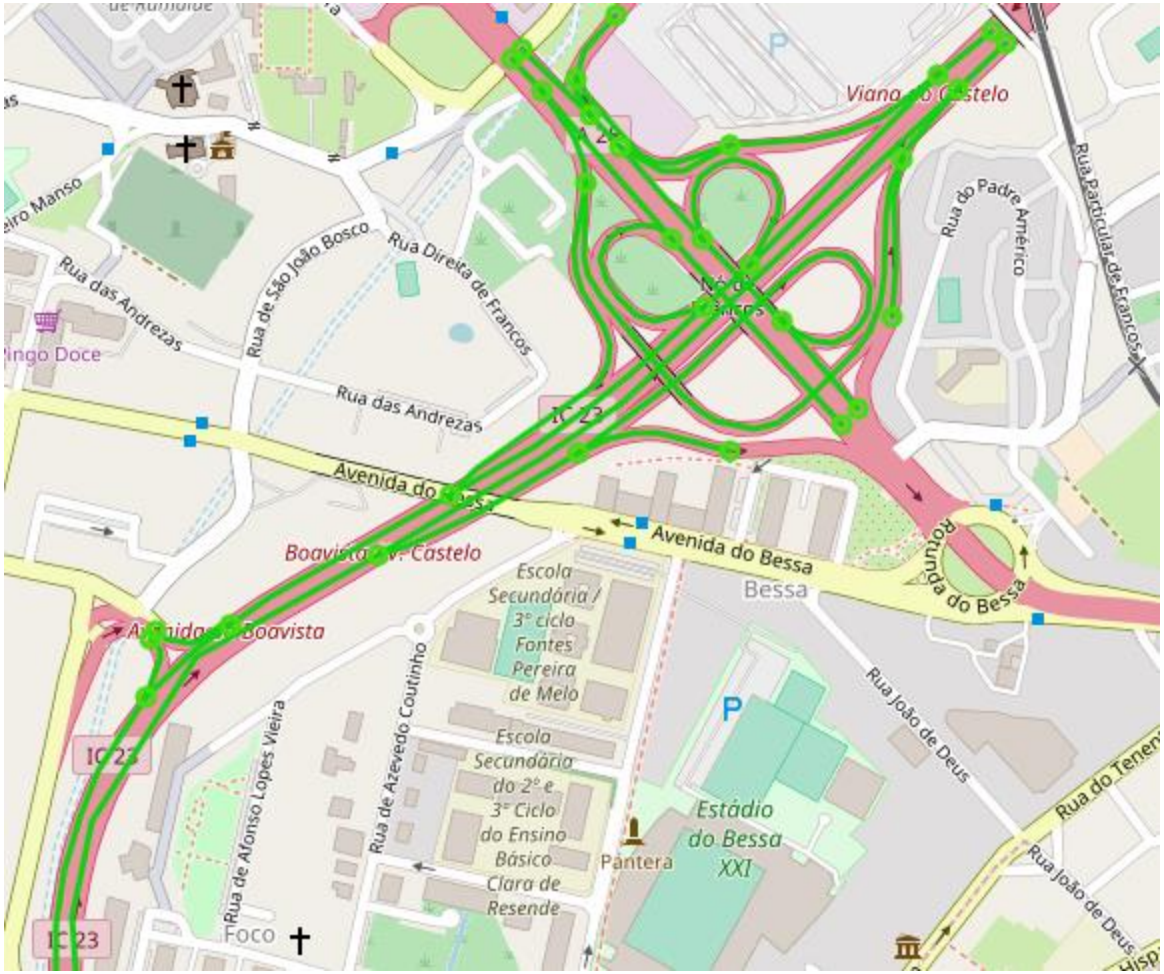


LINEAR INFRASTRUCTURE

- The concept of linear infrastructure comes to help and it is the starting point of the INFRALERT Data Farm development.
- In fact, it makes possible to build an efficient and generic Data Farm based on two crucial assumpions:

1. The infrastructure is linear
2. The topology is described with a graph of nodes and edges for all linear infrastructures.

NETWORK MODELLING

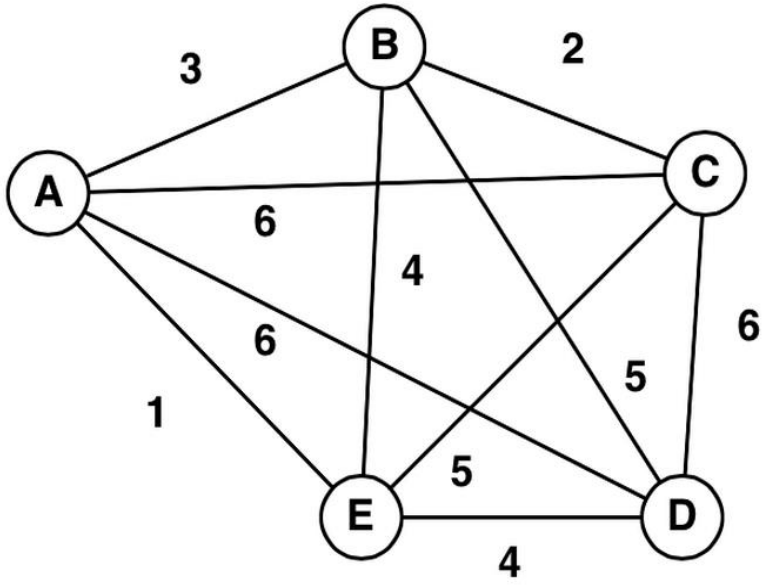


DATA ONTOLOGY

- Working with linear infrastructures makes possible the creation of a data ontology and abstract data types definition based on this assumption.
- As a consequence, data coming from different infrastractures as rails and roads can be integrated really well, stored in the same data repository and in some cases even in the same database tables, because they belong to the same ‘abstract data type’ (ADT).
- A good example of ADT is the concept of node and edge.

NODES AND EDGES

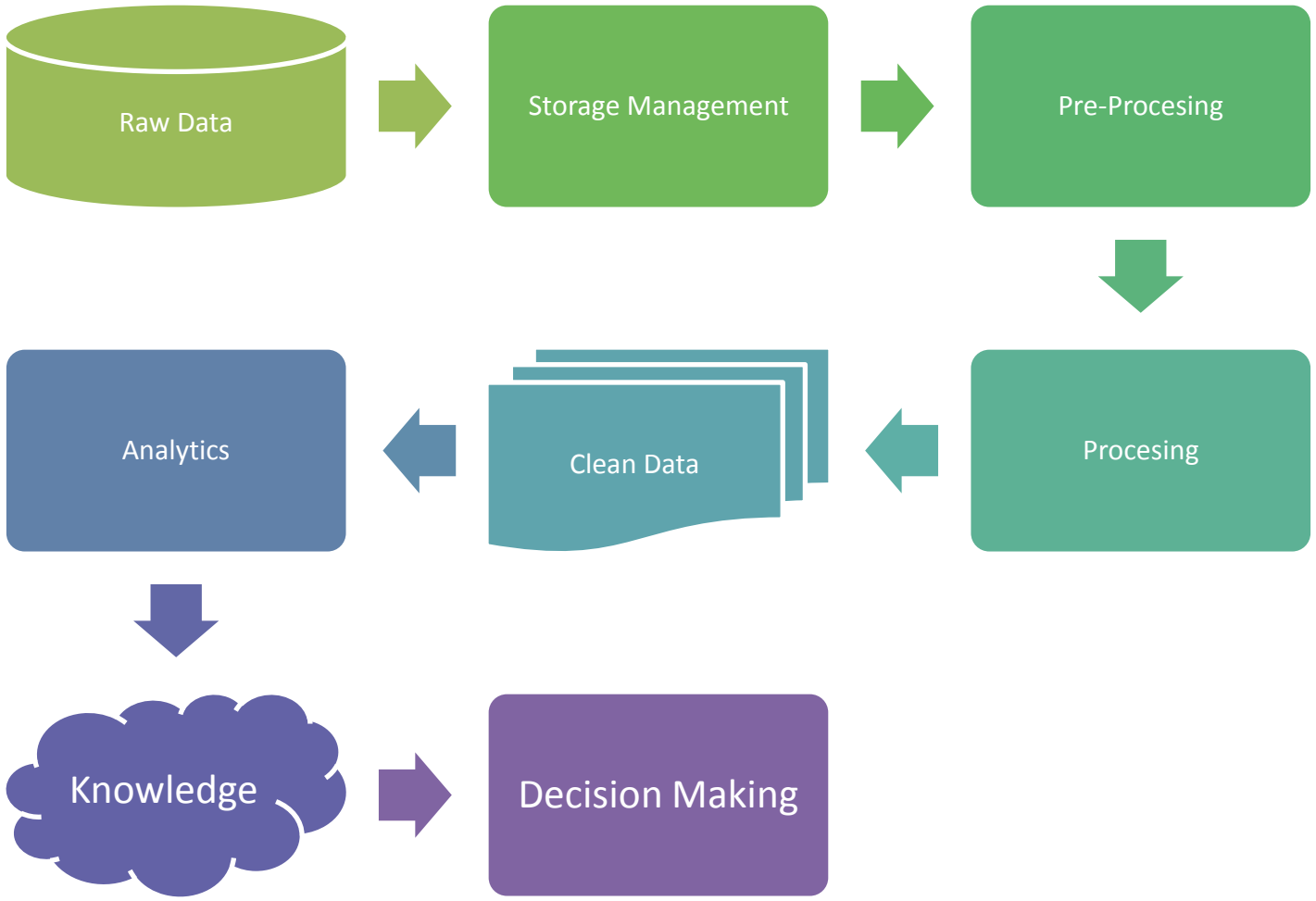
- Nodes and edges, the core of networks representation, are the same graphic objects used to represent a linear infrastructure, but the real meaning depends on the particular network they belong to.



DATA MANAGEMENT

- Data management techniques are the ones involved in the process of transforming (big) data from original format (raw data) to computer formats and it progresses with applying (big) data operations towards achieving decision-making. The goal is usually to obtain a clean data repository to which data analytic techniques are applied in order to extract knowledge for decision making. This process is schematized in the following figure.

DATA MANAGEMENT



INNOVATIONS

- The INFRALERT Data Farm, in contrast to conventional databases, stores big volume data and is still open, portable and scalable.
- SQL is an abstraction layer making the applications portable: everything has been done in order to make it easily installable on a number of popular databases, from MySQL to Oracle.



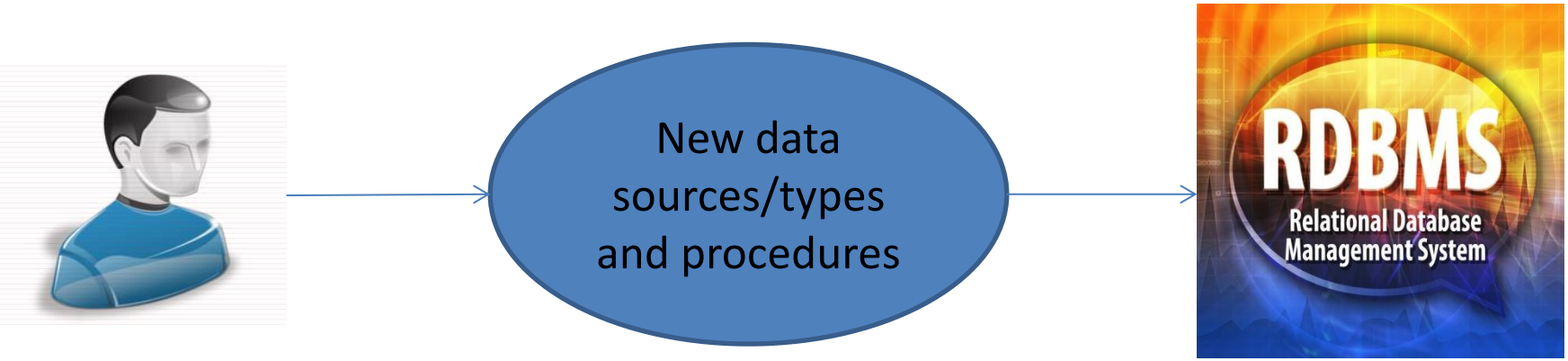


KEY FEATURES

- User expandable.
- Direct access to the data possible for the competent user.
- Compliant with the standards.
- Data access speed.

USER EXPANDABLE

- The users can add data sources and data types. Every user/organization shall be able to use a manual to update the system.
- Once new data are added, they must be used. Thus a programmer shall be able to add procedures using the newly added and the previously existing data: it will not be necessary to call the system manufacturer for every change/upgrade.



DIRECT ACCESS

- Direct access to data is possible for the competent user.
- The users can interrogate the data base by building their own queries.
- The architecture allows the competent user many ways to add his own algorithms. The main ones are: a plug-in on the server, a brand new client, seeking the data on the server via any of the available methods.

MY PROCEDURES

COMPLIANT WITH THE STANDARD

- Some formal or de facto standards exist (especially for railways) .
- It is important to incorporate these standards and expand them consistently where the standards are not enough to model the infrastructure to the desired detail level.

INTERNATIONAL UNION OF RAILWAYS

RTM® railTOPOMODEL

railML®

DATA ACCESS SPEED

A very important point allowing us to think our ambitious goals are atteinable is also:

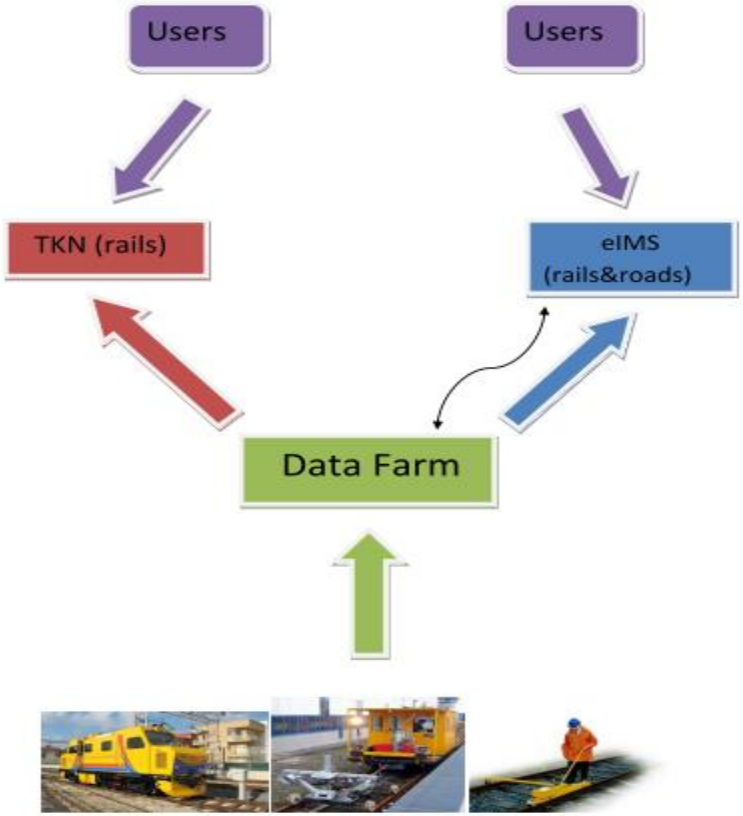
- The very nature of the data coming from the measurements on linear infrastructures. These data are intrinsically ordered sequentially, along the space coordinate.
- This "a priori" knowledge can be incorporated into the system architecture, to create an access engine very efficient both in terms of speed of access and in terms of storage volume.

INFRALERT RESULTS AND 'PRODUCTS'

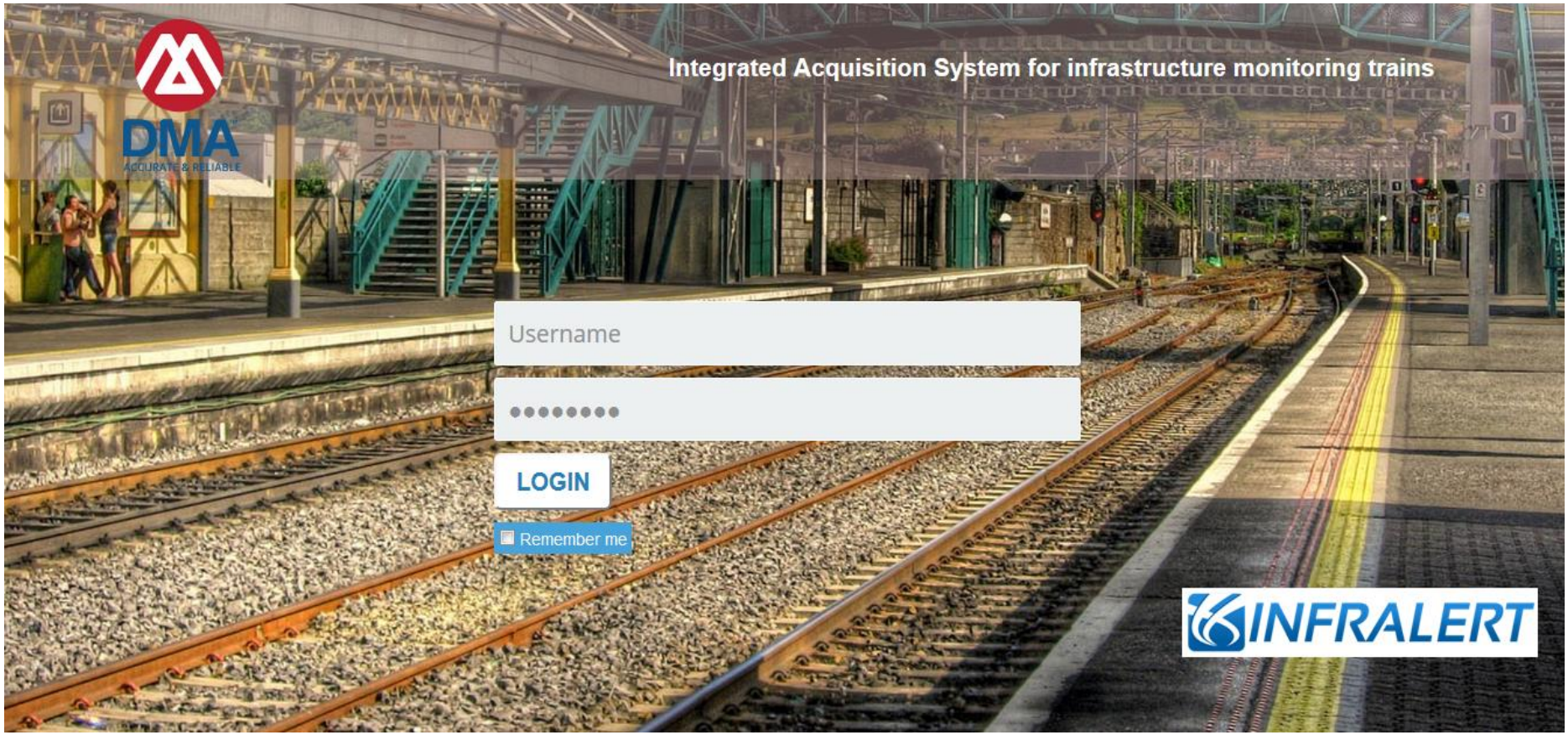
- The result of this project is a set of tools and methodologies able to be implemented and integrated with existing information systems in order to fulfil INFRALERT's aims.
- INFRALERT developed an eIMS (expert-based Infrastructure managament System) able to manage all maintenance aspects and tasks.
- It is an open tool that can be easily used by different existing management systems that different Infrastructure Managers may have.

INFRALERT PLATFORM

- The INFRALERT platform is a system which starts from the collection of data on the field, the storage in the Data Farm and through its eIMS, the developed toolkits and the specialized TracksNet rail tool makes analysis results available and easily retrievable for the final user.



TRACKSNET RAIL TOOL



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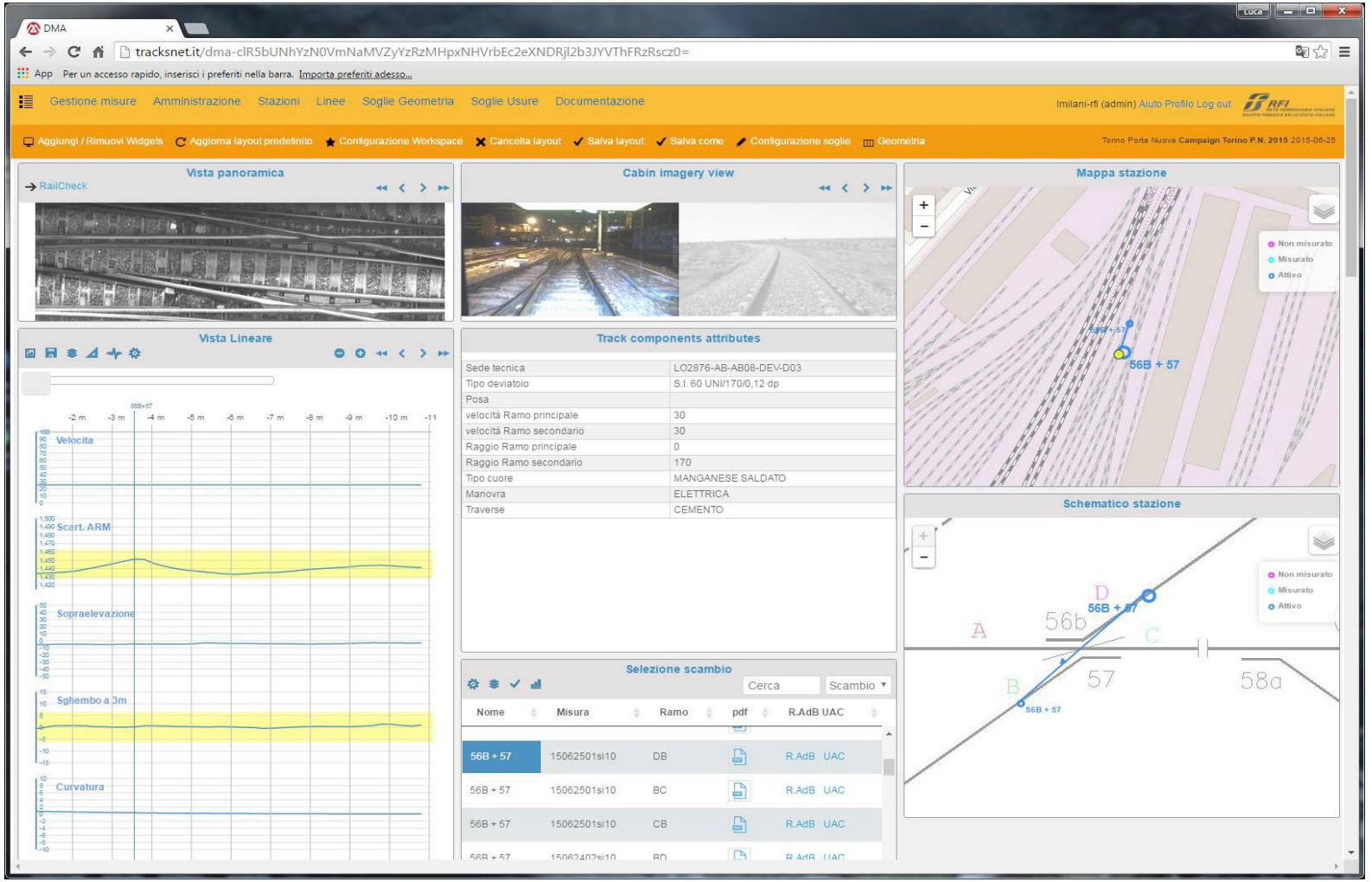

INFRALERT RESULTS AND 'PRODUCTS'

- INFRALERT exploits the existing similarities among different linear infrastructures to standardise and unify concepts for data management, data analytics and decision support.

- INFRALERT research activities and results is being tested on two real pilots cases: road infrastractures in Portugal and railway lines in Sweden.

CONCLUSIONS

- Summing up, the overall goal of INFRALERT is to improve the operability and functionality of linear asset transport infrastructures based on automating predicting, determining, and planning of maintenance and renewal interventions. The holistic view the infrastructure is the key starting point; easy data access is what makes the holistic view possible.
- Ensure infrastructure service reliability and safety by minimising incidents and failures.
- Enancing the reliability of infrastructure assets in total.
- Improving safety and comfort levels for travellers and maintenance workers.
- Enhancing the flexibility and quality of interventions planning process.

INFRALERT

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