Work Area *3.1 Safety*
Closure Presentation

@Shift2Rail_JU
#Horizon2020

Work Area Information

Title	Safety
Total Cost	1 448 750 €
Funding	1 365 410 €
Participants Contribution	83 340k€
Timescales	Sep 16 to Sep 19
WA leader	SNCF
Participants	PLASA (CFM) 1. ASTS 2. SNCF GoSafeRail (OC) 1. Gavin & Doherty GeoSolutions Ltd 2. Irish Rail 3. Roughan and O'Donovan Consulting Engineers 4. University of Zagreb 5. Croatian Rail 6. Norwegian Geotechnical Institute 7. Contecht 8. Virtus IT 9. Infra Plan Konzalting 10. OpenTrack Railway Technologies 11. InGEO Consulting

Title	Budget	Timeline	Objective	Outputs / demonstration
PLASA*	150 000 €	Sep 16 - Aug 18 (24months)	• Increase knowledge about risk assessment methods • provide a usable methodology to manage the safety in operation	Decision Support model including an assessment of human reliability
GoSafeRail	1 298 750 €	Oct 16 – Sep 19 (36 months)	• develop a Global Safety Management Framework (GSMF) • develop Safety Monitoring Systems	• Identification of Global Safety KPIs • Design of a Decision Support Tool to implement the GSMF • Object detection system based on pattern recognition • Lanslide detection system

* Figures related to the Safety related Part of the project only

Work Area

Objective of Work Area	MAAP Tasks	Projects
Overall Objective • Develop a global approach of the safety of the railway system **Technical Objectives** • Increase knowledge about risk assessment methods • Improve the day to day management of the railway safety • Use risk assessment for the safety management	(1) State of the art of risk assessment methods	GosafeRail & PLASA
	(2) Requirements to conduct a risk assessment study on the overall railway system → Global Safety Approach	GosafeRail & PLASA
	(3) Requirements to apply the risk assessment method to manage the safety in operation → Decision support tool	GosafeRail & PLASA
	(4) Development of Safety monitoring Systems	GoSafeRail

Collaboration Activities

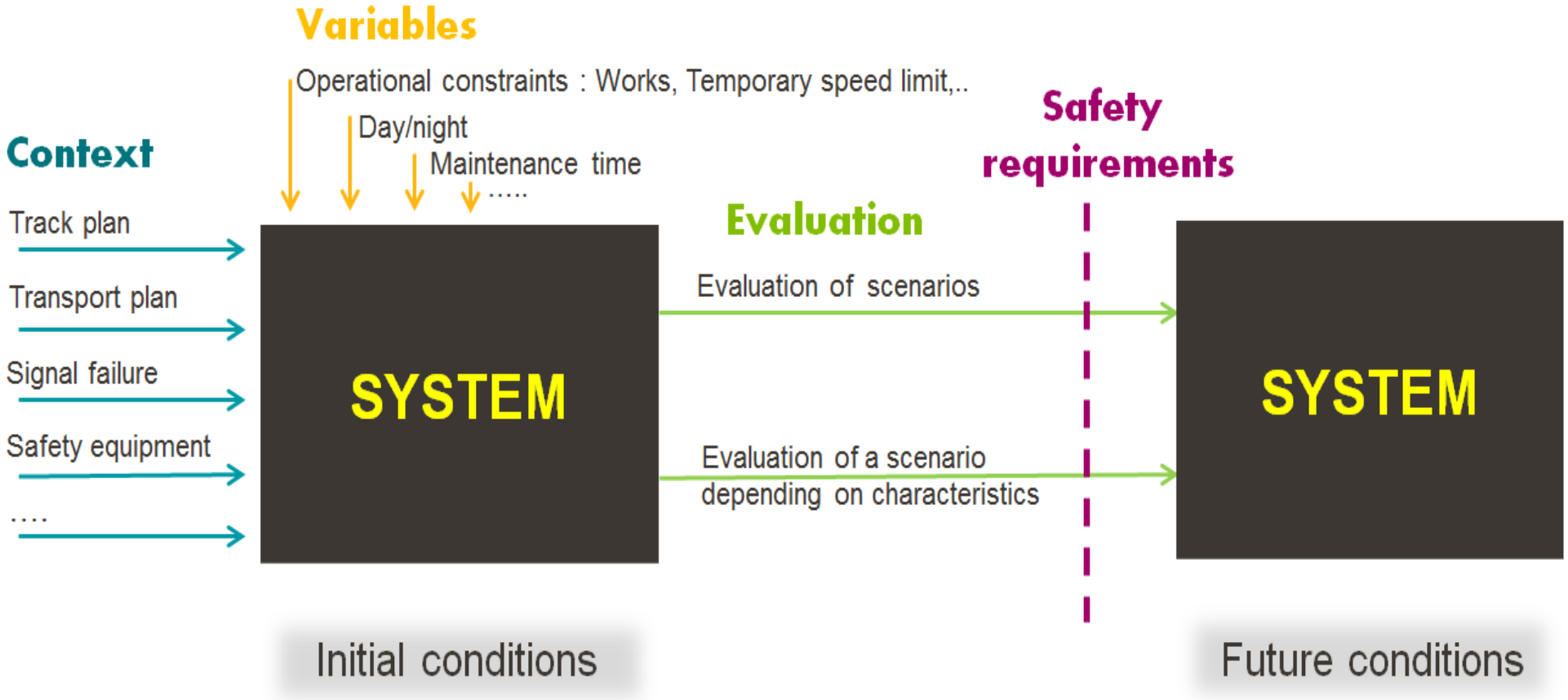
- While Plasa focused on the human centric aspect of safety, Gosaferail was tasked to put the attention to the data aspect
- due to the different scope of the projects, the projects didn't have collaboration on the activities during the project's lifetime

Exploitation of Results

Work Area Task	Outputs	Next steps
WA 3.1.2 Global safety Approach	Decision Support model for safety for day-to day operation including an assessment of human reliability	Develop a POC (Proof of concept) based on the method to prove the usefulness Extension to other use cases (in particular fire in tunnels)
WA 3.1.2 Global safety Approach	Identification of Global Safety Key Performance Indicators	Make sure that these results are disseminated to IMs and Operators to ensure they are implementation in their asset management framework (stakeholders outside the project)
WA3.1.3 Development of a Decision Making tool	Global Safety Management Framework that integrates risk assessment across asset categories including; slopes and retaining walls, level crossings and bridges, tracks and tunnels and network flow model outputs	Determine the best way to implement this framework into the procedures and software systems
WA 3.1.4 Development of a safety monitoring system	Object detection system based on pattern recognition → deployed on the Croatian Rail network	Continue to develop and improve this new obstacle detection system with particular focus on increasing the detection distance.
WA 3.1.4 Development of a safety monitoring system	Landslide detection system based on micro-seismic sensors (early warning system) → Deployed on a section of the Norwegian Rail network	The development of the rock-fall detection system developed has continued at the Norwegian Railway Agency Bane NOR, The prototype detection system installed as part of the GoSafe Rail project is set to be followed up at a large scale

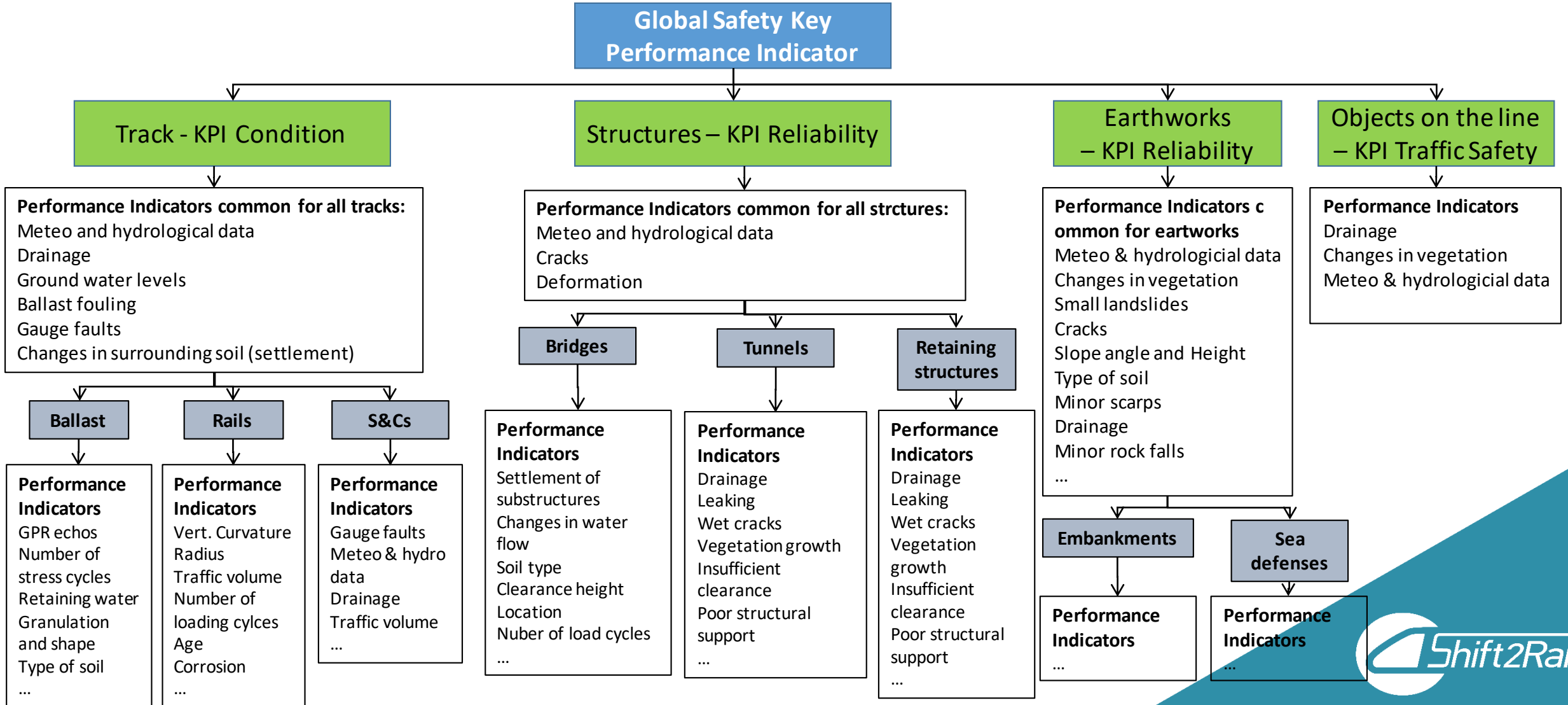
Exploitation of Results

Decision Support model : principle (project PLASA)



Exploitation of Results

Identification of Global Key Performance Indicators → Inputs for the Global Safety Management Framework

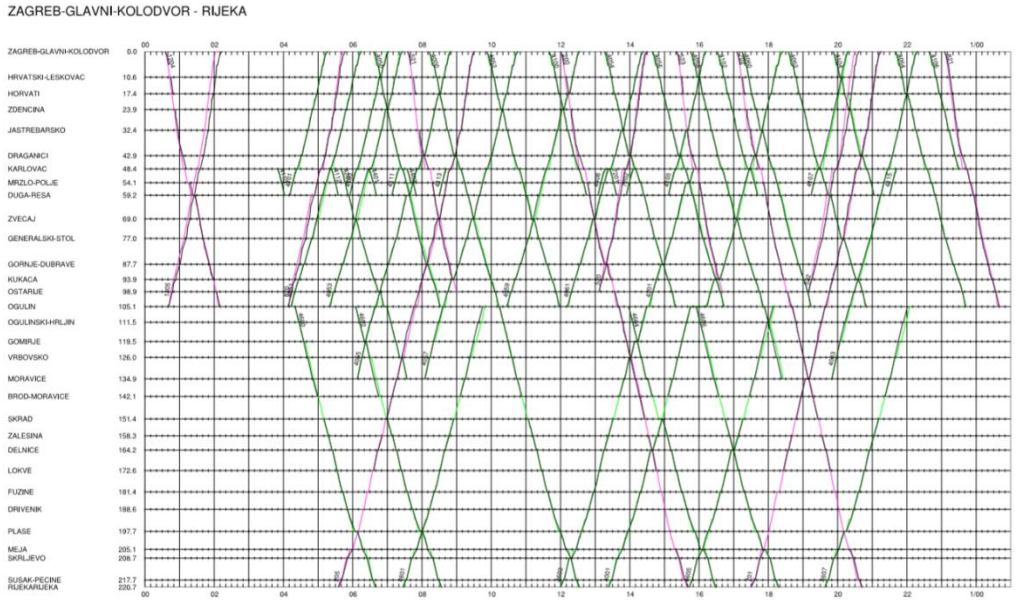


Exploitation of Results

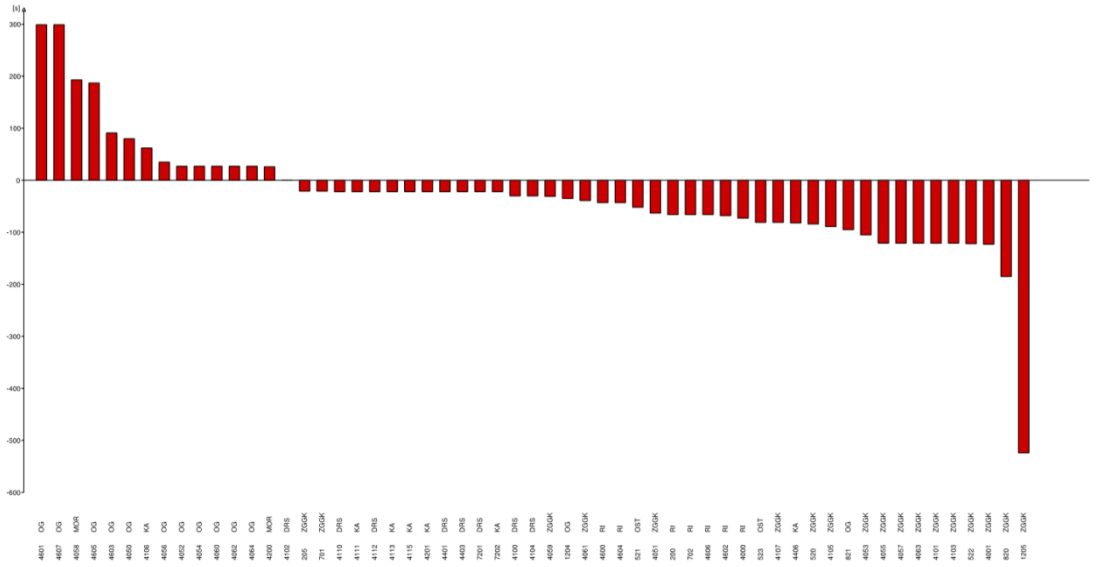
Prediction of delays from data converter + algorithm based on Kronecker algebra

A set of micro-planning simulations have been used to demonstrate via a series of case studies that a new scheduling algorithm based on Kronecker algebra enables infrastructure managers to optimise rail operations and produce deadlock-free timetables.

A data converter has also been developed to automatically generate from the OpenTrack infrastructure and timetable the input data required for this new algorithm.



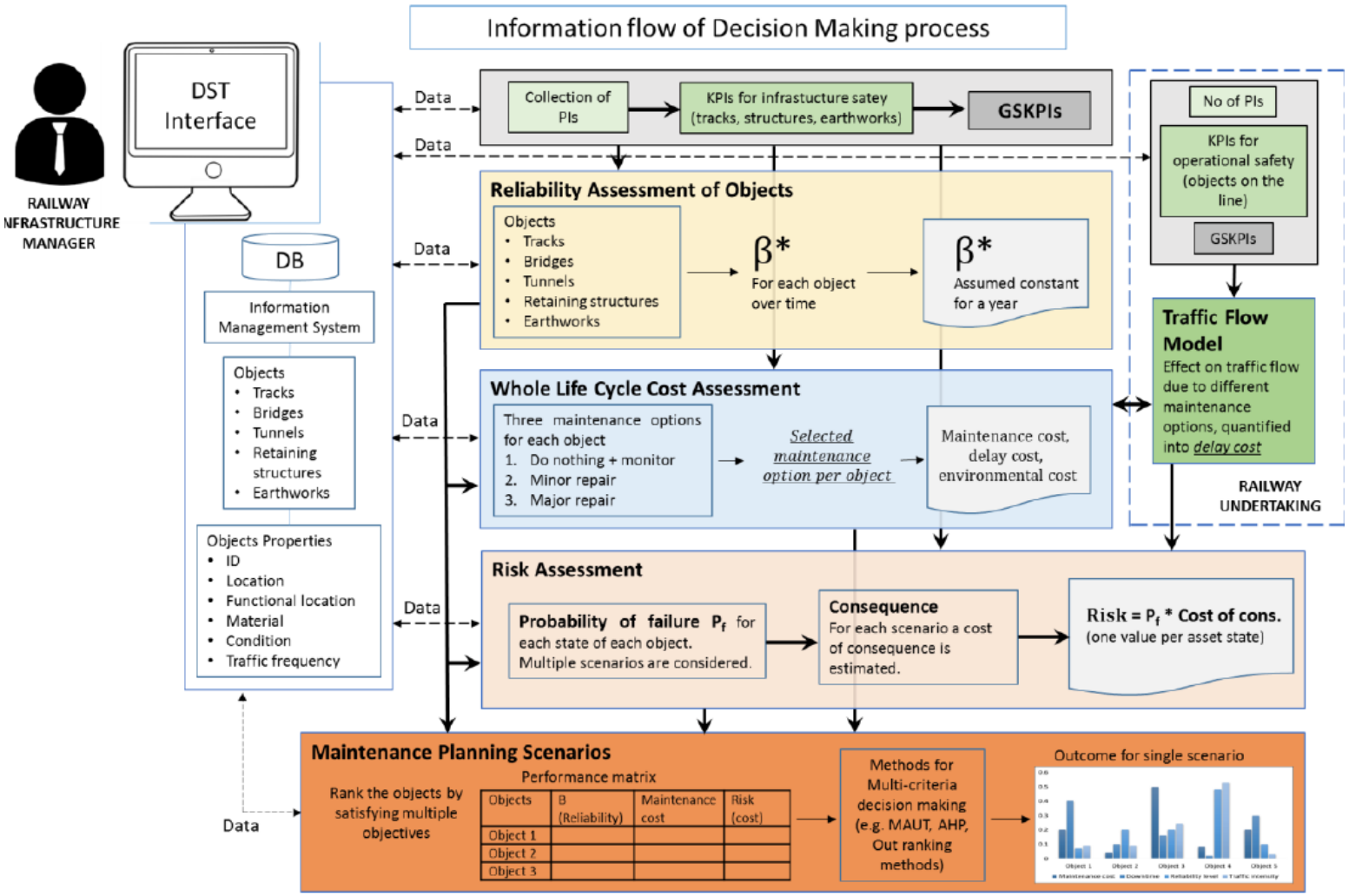
train graph of the Zagreb - Rijeka line in Croatia for all passenger trains



delays in seconds of all passenger trains at their final station.

Exploitation of Results

Global safety Management Framework → Decision Support Tool



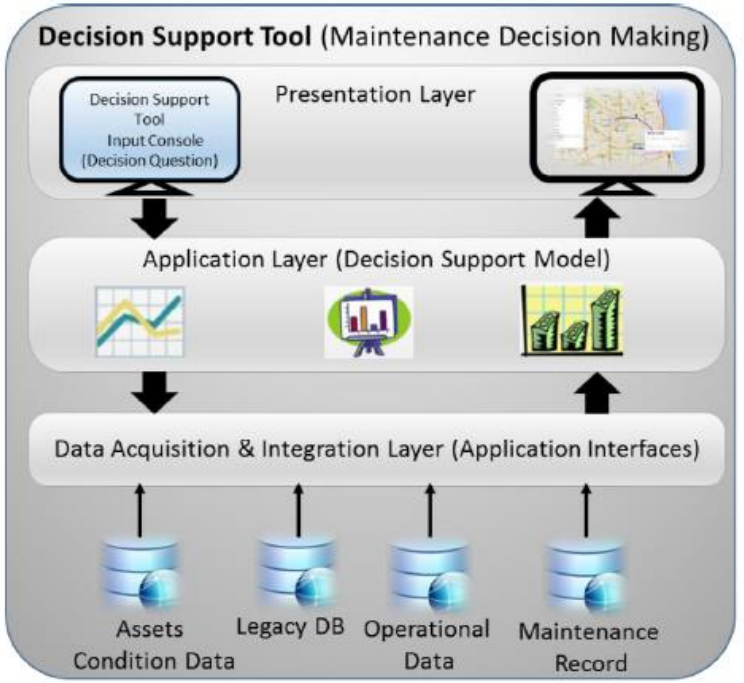
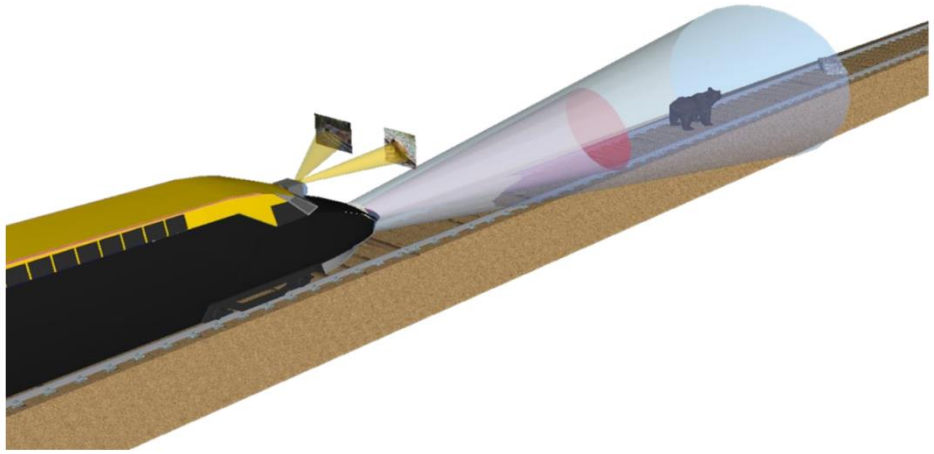


Figure 9: DST System Architecture

Exploitation of Results

Safety Monitoring System : Vehicle-mounted obstacle detection system (pattern recognition)

A new sensor system, which combines train-mounted high-resolution cameras, image processing equipment, and LIDAR scanners with static cameras mounted along tracks, has been developed to provide engineers and infrastructure managers with greater ab ility to detect vehicles, humans, and large animals on railway tracks, and specifically on safety-critical sectors of infrastructure such as level crossings, bridges, and tunnels.
The object detection system, comprising cameras and radar, was demonstrated on an active railway in Croatia.



train mounted with image processing equipment including a high-resolution camera

Illustration of the most effective obstruction detection algorithm used in the case study

Exploitation of Results

Safety monitoring system : Rockfall and Landslide detection systems uses geophones and magnetometers to identify vibrations in the railway line

The prototype uses geophones and magnetometers to identify vibrations in the railway line, has been installed for testing at a site in north-west Norway with frequent rock falls. There have not been any registered rock falls since the detection system was installed but drop and sledgehammer tests have shown that the sensors and algorithms are working well.

warning system test site, showing an electronics cabinet housing two relay radio units with directional yagi antennas

self-contained sensor units, which contains the sensors, data acquisition unit, radio module, antenna, and battery.

Work Area Roadmap

Work Area	TRL	2016				2017				2018				2019				2020			
WA 3.1.1 - State of the art of risk assessment methods																					
WA 3.1.2 - Requirements to conduct a risk assessment study																					
WA 3.1.3 - Requirements to apply the risk assessment method																					
WA 3.1.4 Development of a safety monitoring system																					

Project	TRL	2016				2017				2018				2019				2020			
PLASA																					
GoSAfeRail																					

	Work area active
	Complete project
	On going project
	Planned project

Project	Summary of Output
PLASA	A specific method has been developed relying on a decision model that allows to identify the main parameters impacting the risk assessment and to use them to optimize cost, functionalities and safety of a system
GoSAfeRail	Development of a Global Safety Management Framework for rail infrastructure managers is addressed