

## **Asset management and maintenance planning** an example in the road sector

Brussels · 16<sup>th</sup> November 2016

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**Asset Management** Review and Monitoring



1<sup>st</sup> Open Workshop

# AGENDA

01

INFRAESTRUTURAS DE PORTUGAL

02

ASSETS UNDER IP's JURISDICTION

03

PAVEMENT MANAGEMENT SYSTEM

04

SUPPORT TO DECISION-MAKING

05

FINAL REMARKS AND OPEN CHALLENGES

# Profile

*As per Decree-Law n. 91/2015 dated 29 May, and taking effects as of 1<sup>st</sup> June 2015, Rede Ferroviária Nacional - Refer, E.P.E. (REFER, E.P.E.) hereby incorporates by merger EP – Estradas de Portugal, S.A. (EP, S.A.) and becomes a public limited company named **Infraestruturas de Portugal, S.A. (IP, S.A.)**. The merger by incorporation extincts EP, S.A. and its duties and competences are transferred to IP, S.A..*

## Company

National Road Network General Concessionaire

Long-term Concession Contract of 75 years (until 2082)

Shareholder Base: Portuguese State (100%)



## Mission

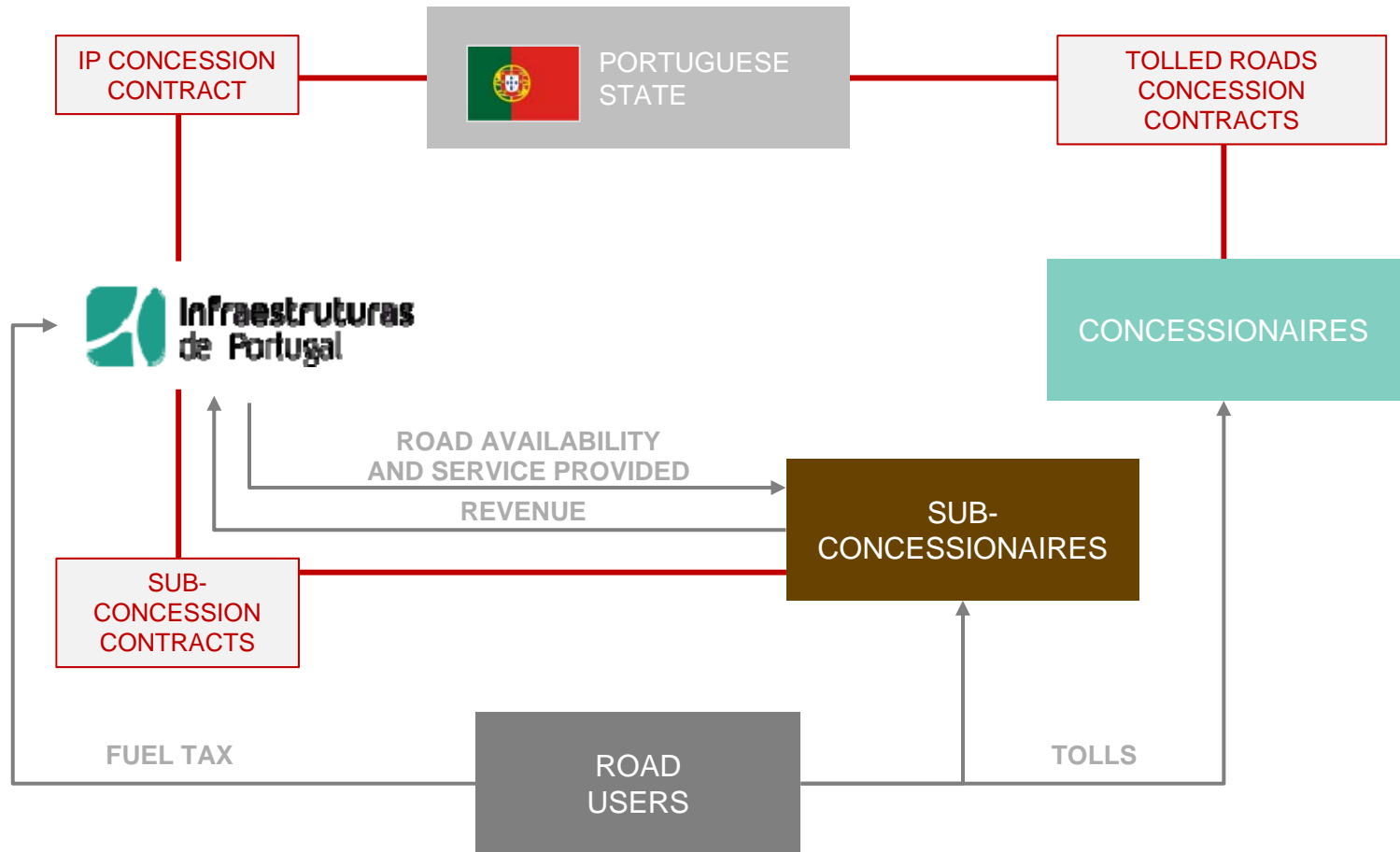
Financing, operation and development of the road network integrating the **National Road Plan** (except the network under private concession);

The design, construction, financing, maintenance, operation and development of the **future road network**.

## Responsibilities

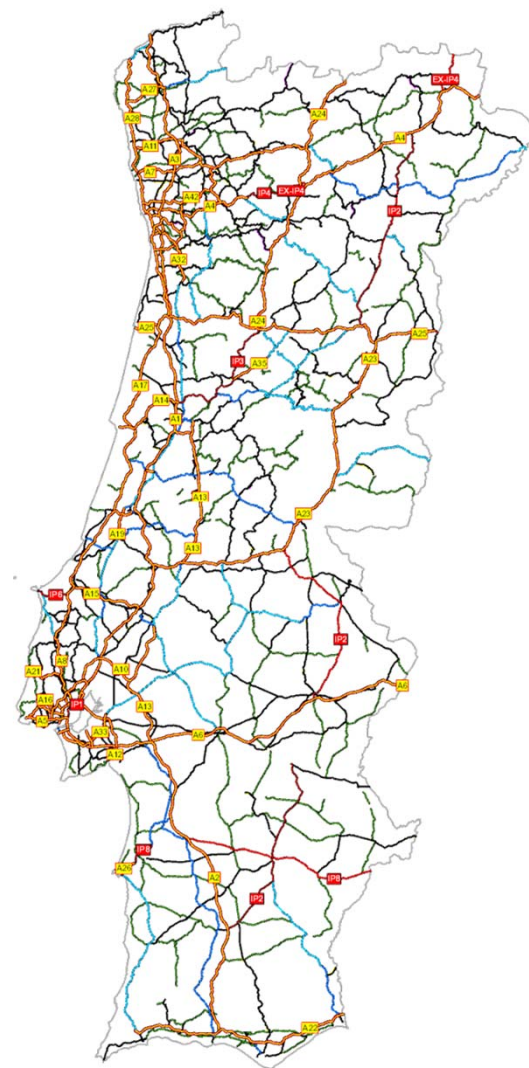
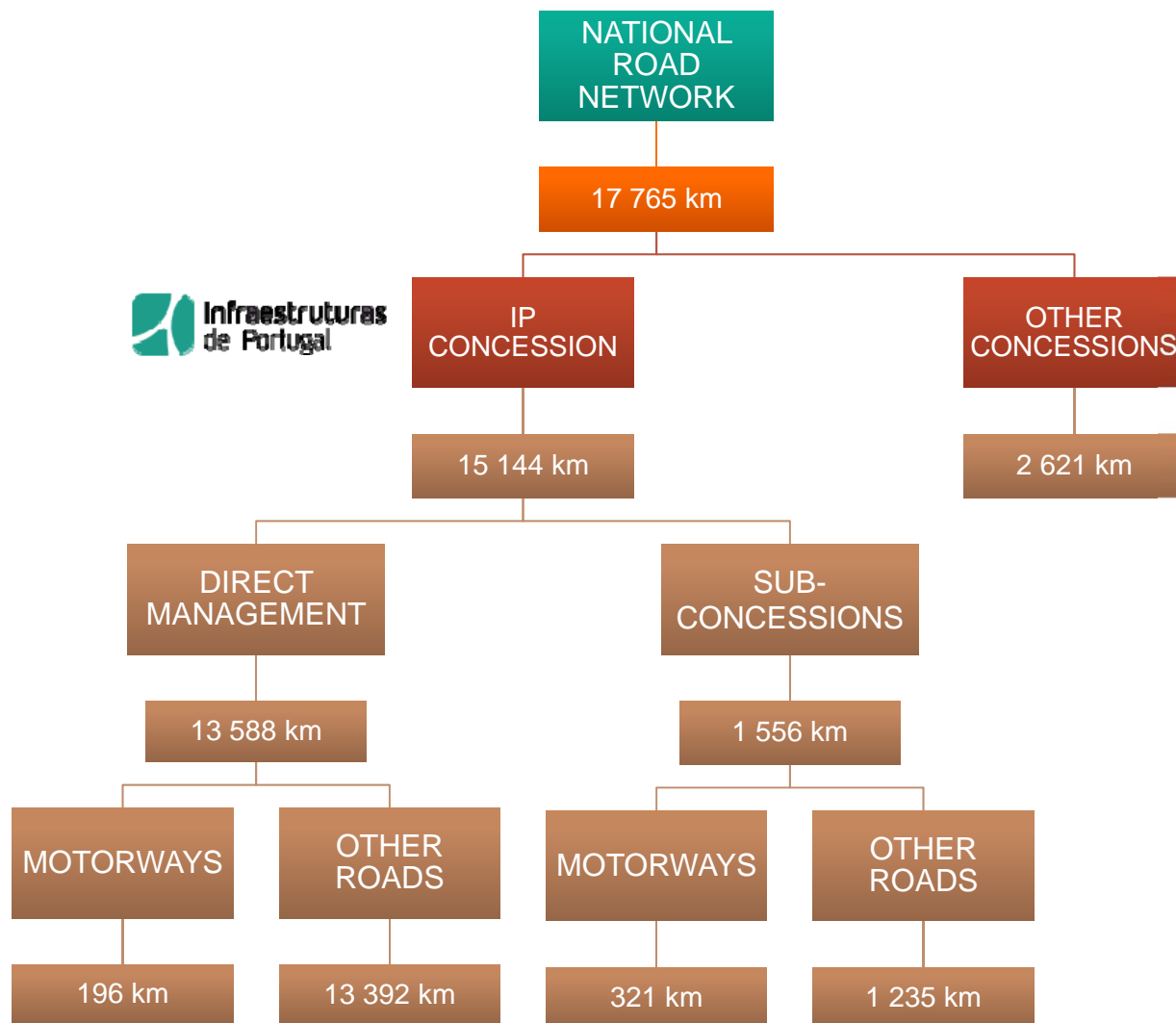
Fulfilment of performance indicators: Level of Service, Road Safety and Environmental Sustainability

# Road sector model

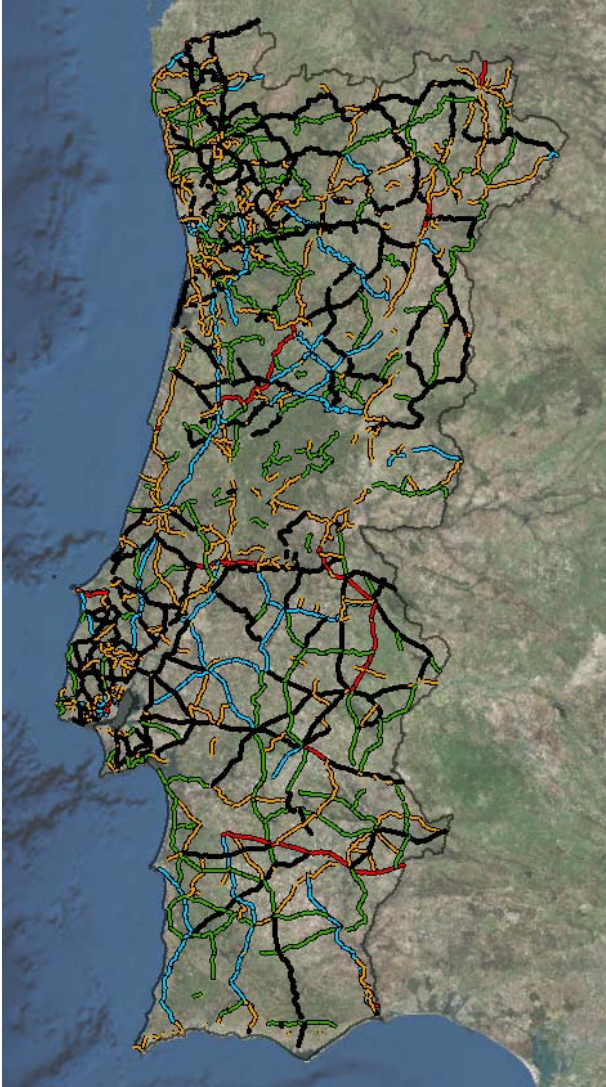




# Road network extent



# Road assets under IP jurisdiction

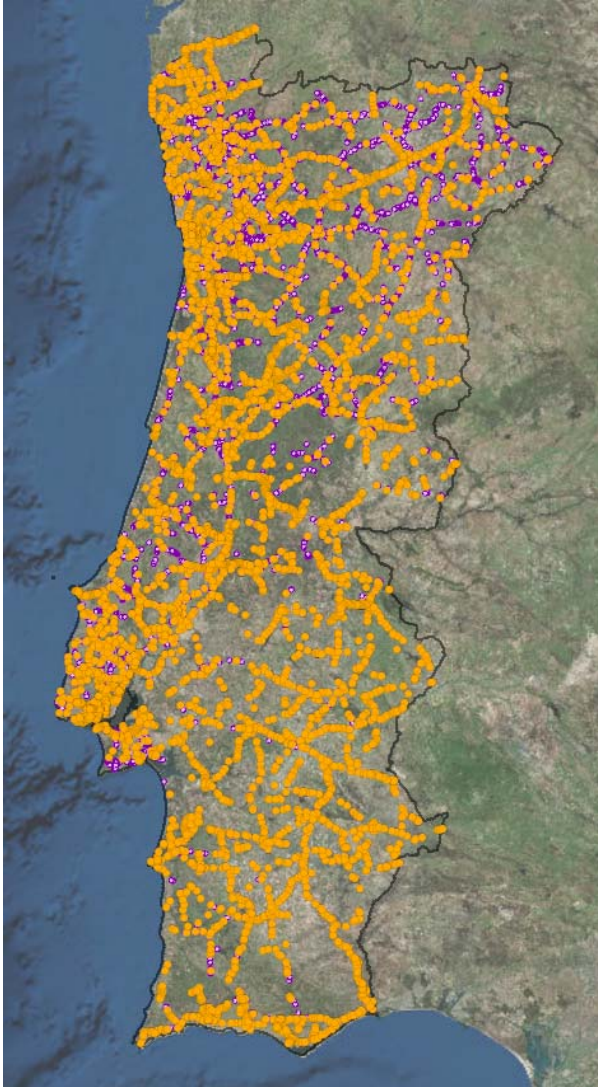


## Classified Roads (9 774 km)

- Principal Itineraries (443 km)
- Complementary Itineraries (1 579 km)
- National Roads (4 465 km)
- Regional Roads (3 287 km)

## Declassified Roads (3 814 km)

# Road assets under IP jurisdiction



## Bridges and similar structures (5 211)

- Water ducts prevail over other types of structures (40%)

## Earth Retaining Structures (23 551)

## Other types of road furniture

- Signalling, drainage, lighting, safety barriers, etc. (complete inventory)

# IP Asset Management Systems

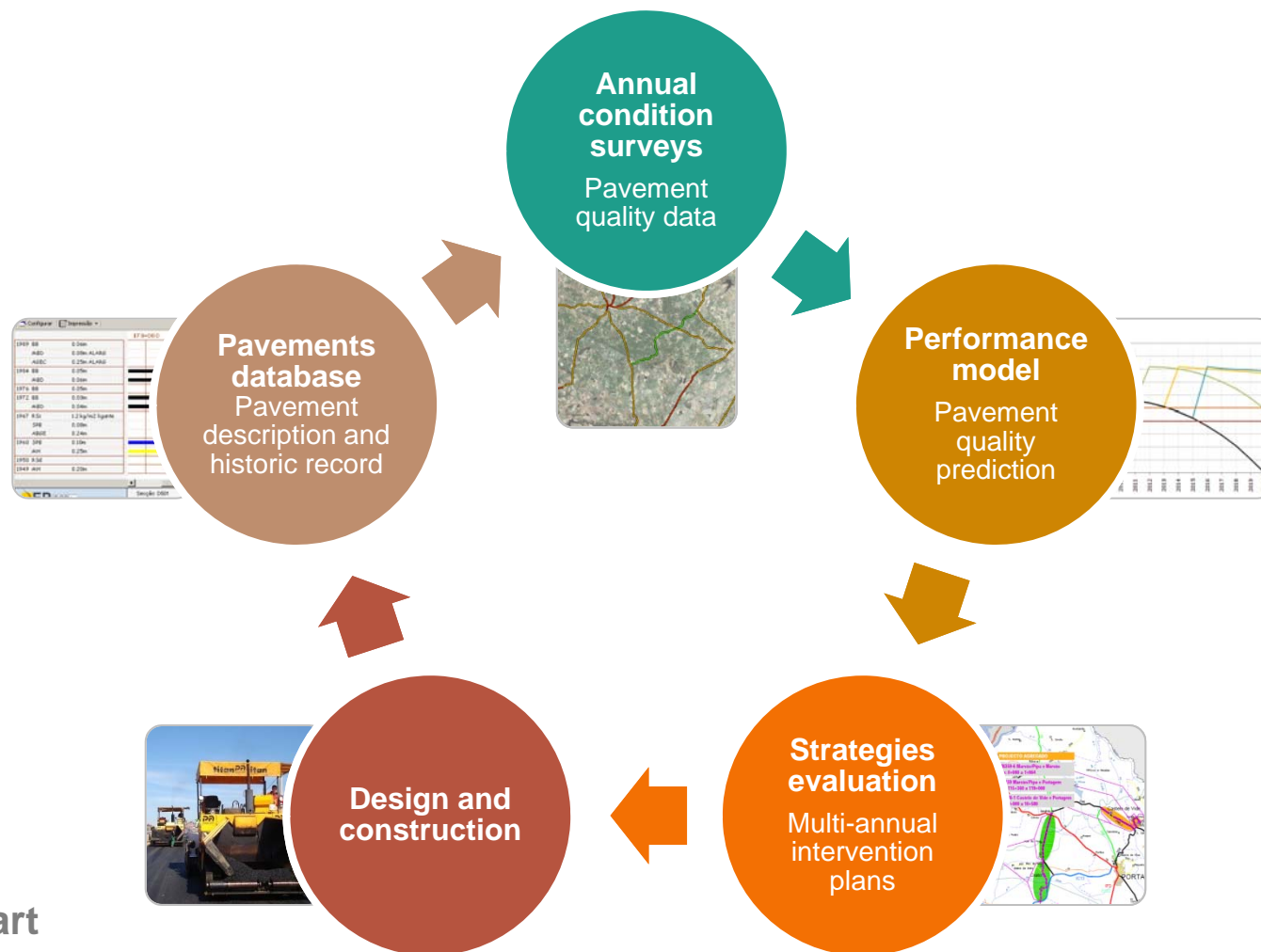


**SGPav**

**Pavement  
Management  
System**



# Pavement Management System overview



2003 | Project start

2007 | Production start

# Database structure

## Node

Object defining start and end points of each section, placed on junctions, district limits, change in road classification or change in cross section type.

## Section

Basic road network object, serving as minimum unit for a network stretch and used for survey and analysis purposes



# Database contents

- **Road network features**

section id, location data, geometric data (*per section*)

- **Traffic data**

AADT, heavy vehicle rate, growth rate, axle aggressiveness (*per section*)

- **Pavement condition data** (global and parametric)

Quality Index (global) (*per section/1000 m/100 m per year*)

Condition parameters (longitudinal unevenness, transverse unevenness, area with cracking, macrotexture, friction) (*per section/1000 m/100 m/10 m per year*)

- **Pavement subgrade bearing capacity** (*per section*)

- **Historic record of all pavement interventions**, allowing the assessment of the structural capacity (*start and end km, materials, layer thicknesses, etc.*)

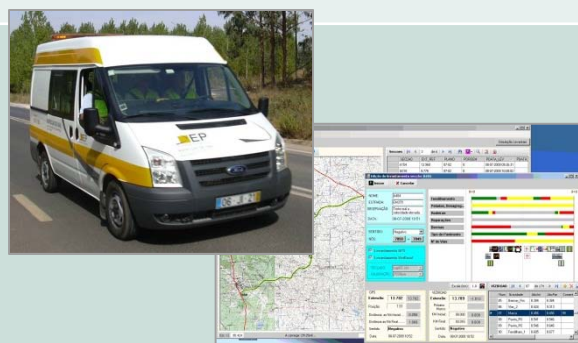
- **Front and rear images** (*per 10 m per year*)

## Survey methods and annual coverage

### Visual inspection

VIZIROAD equipment (visual surface defects identification with linear and GPS referencing)

Used for project level surveys



### Laser RST

Laser vehicle collecting unevenness (longitudinal and transverse), macrotexture, geometry and front and rear images

Used for network surveys  
(**over 90% per year**) since 2011



### SCRIM

SCRIM vehicle collecting wet skid resistance and macrotexture

Used for network surveys  
(**partial extent**) since 2012





Besides each individual condition parameter, a global quality index is used:

## PAVEMENT QUALITY INDEX

automatic evaluation

automatic evaluation

assessed by the  
operator

$IQ = f$  (longitudinal unevenness, transverse unevenness and cracking)

$$IQ_t = 5 \times e^{-0.0002030 \times IRI_t} - 0.002139 \times R_t^2 - 0.03 \times (C_t)^{0.5}$$

## PAVEMENT QUALITY RANK

**Good:  $IQ > 3.5$**

**Fair:  $2.5 < IQ < 3.5$**

**Poor:  $1.5 < IQ < 2.5$**

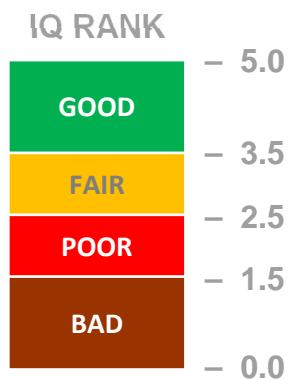
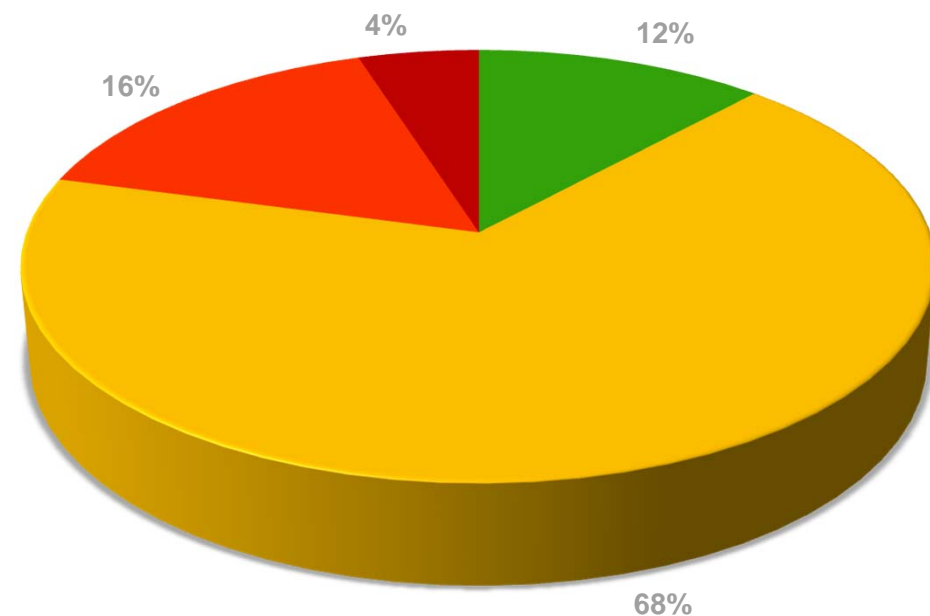
**Bad:  $IQ < 1.5$**

NON-STRUCTURAL MAINTENANCE



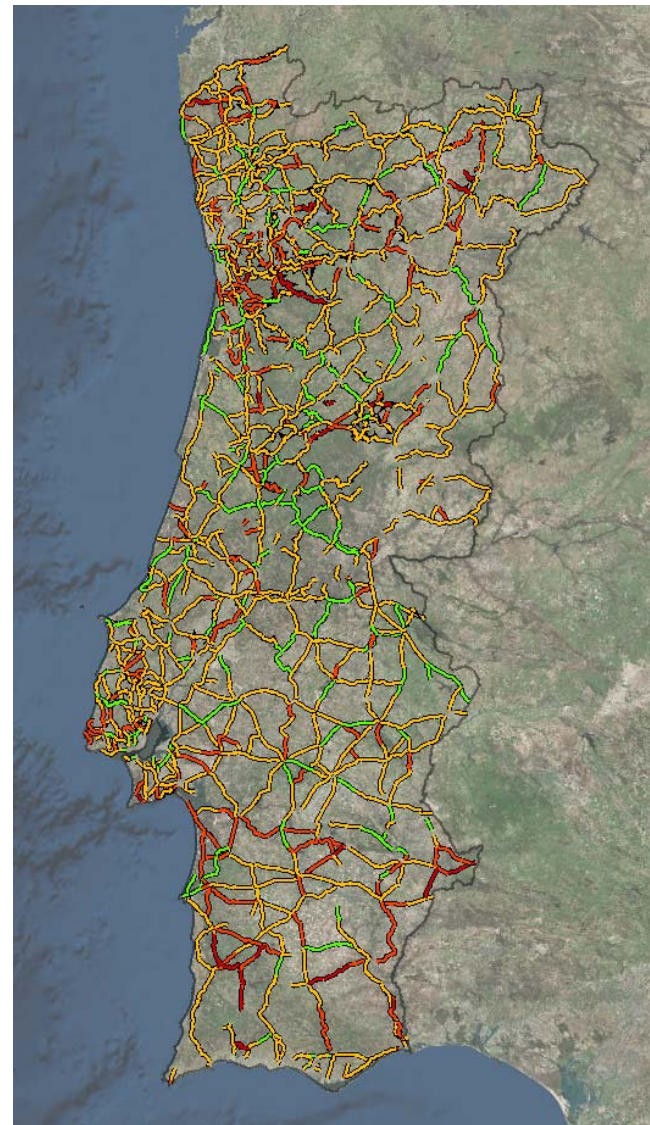
STRUCTURAL MAINTENANCE

## Pavement quality

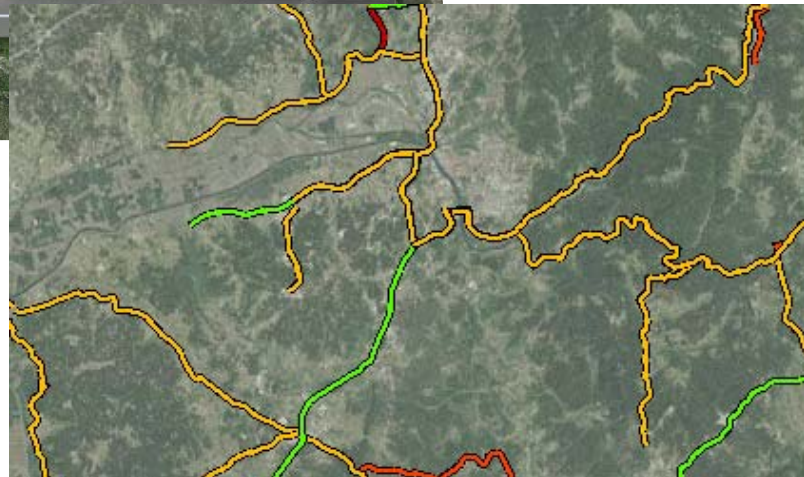
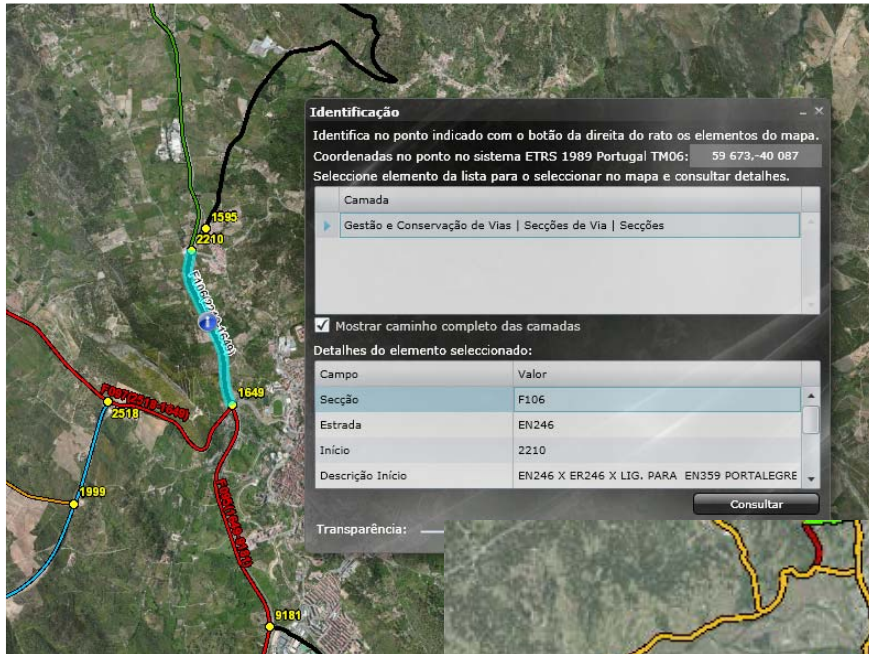


average quality = 2.9

2015 data



## Section general information



## Global quality overview

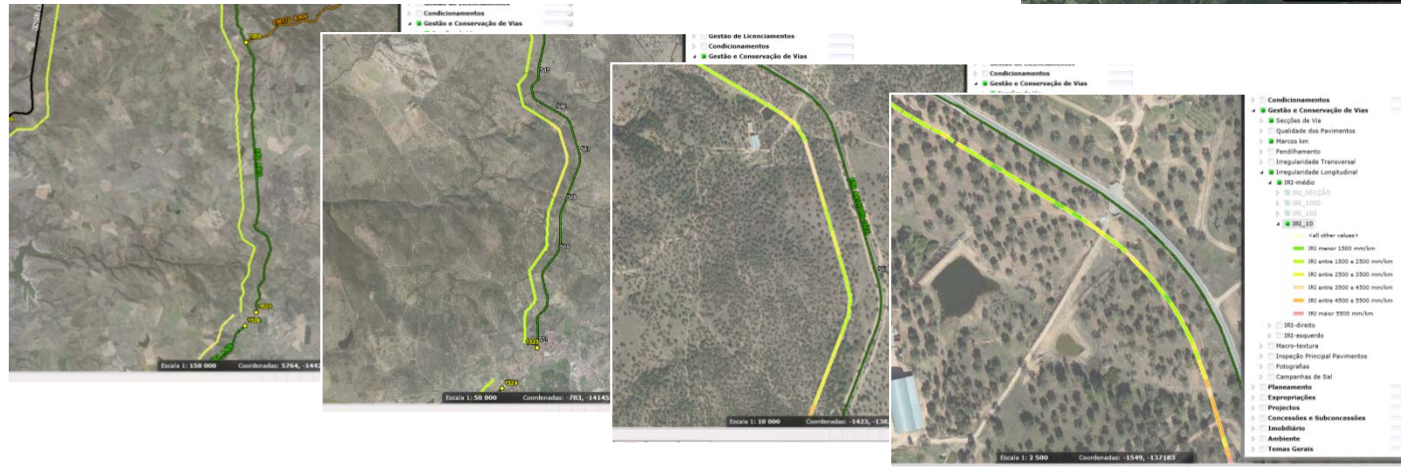


# Data visualisation



Condition parameters visualisation

Front and rear image visualisation  
(clickable location or per km selection)

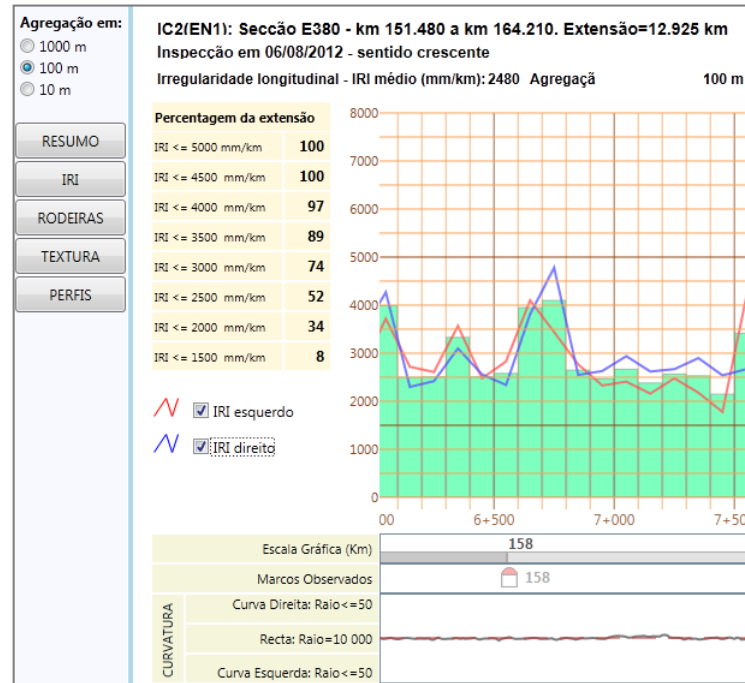


Dynamic  
segmentation  
according to  
visualisation scale  
(section, 1000 m, 100 m  
and 10 m for all  
parameters)

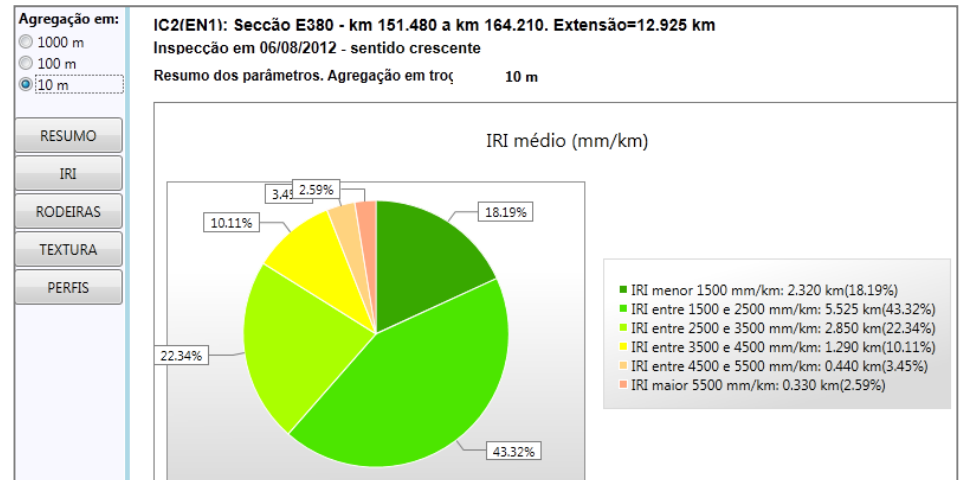


# Data visualisation and web apps

## Linear visualisation for condition parameters

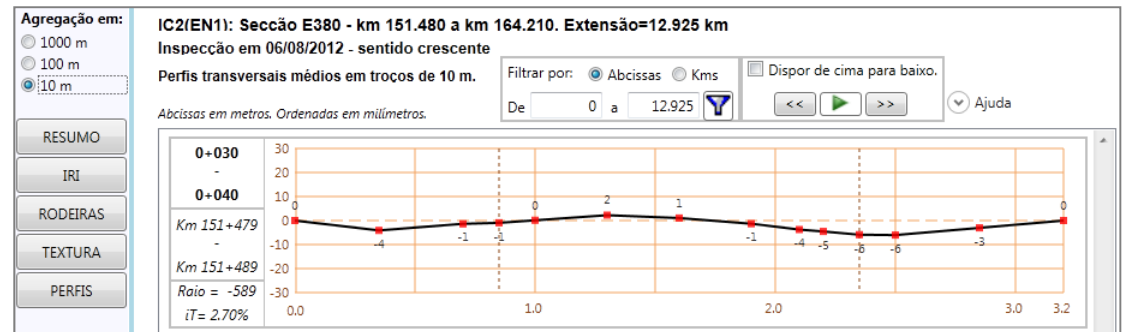


## Statistical analysis for condition parameters



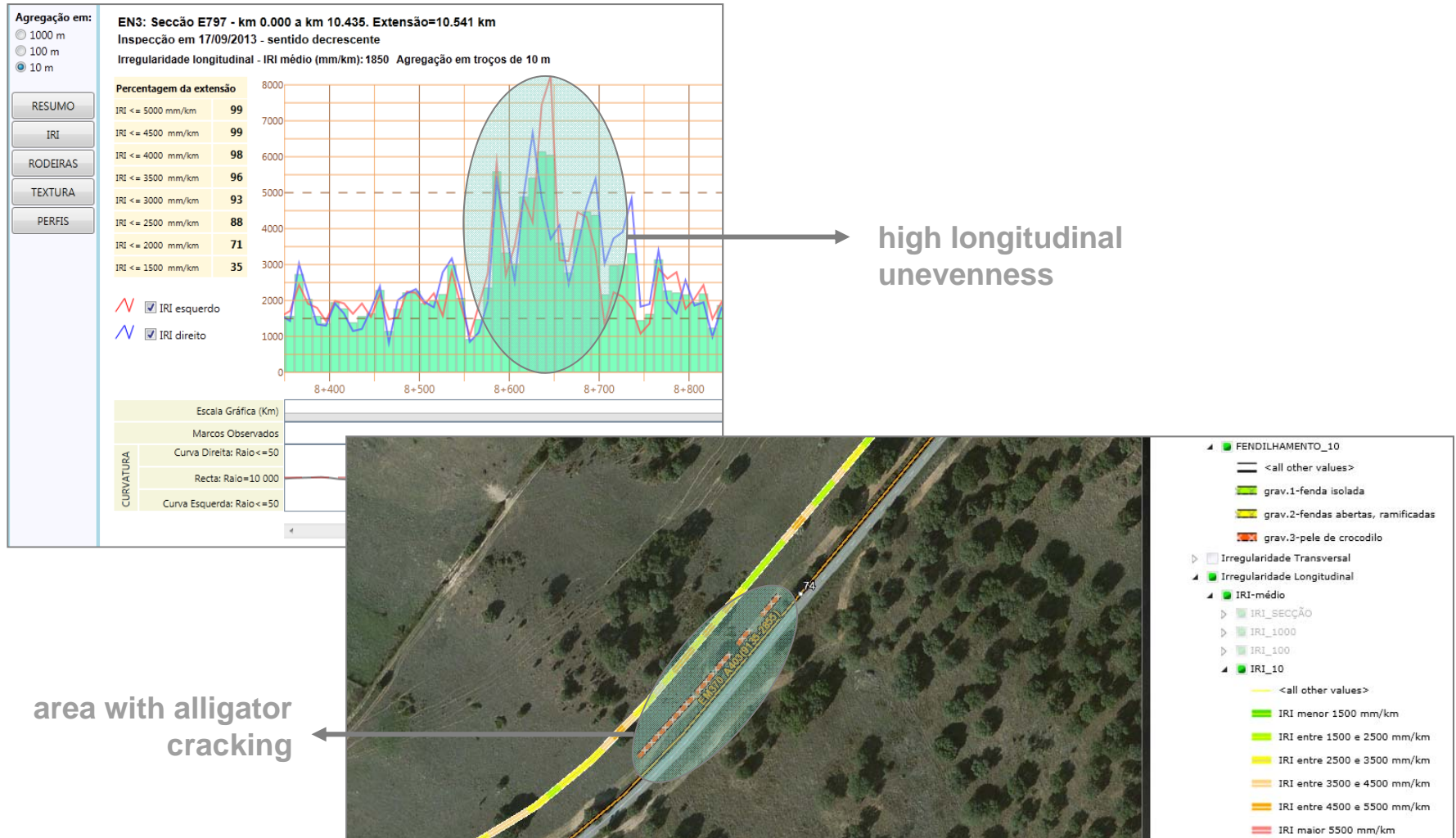
## Cross section visualisation for each 10 m

Information  
 automatically  
 provided by  
 SGPavGraf web app  
 (per section per year)



# Support to decision-making

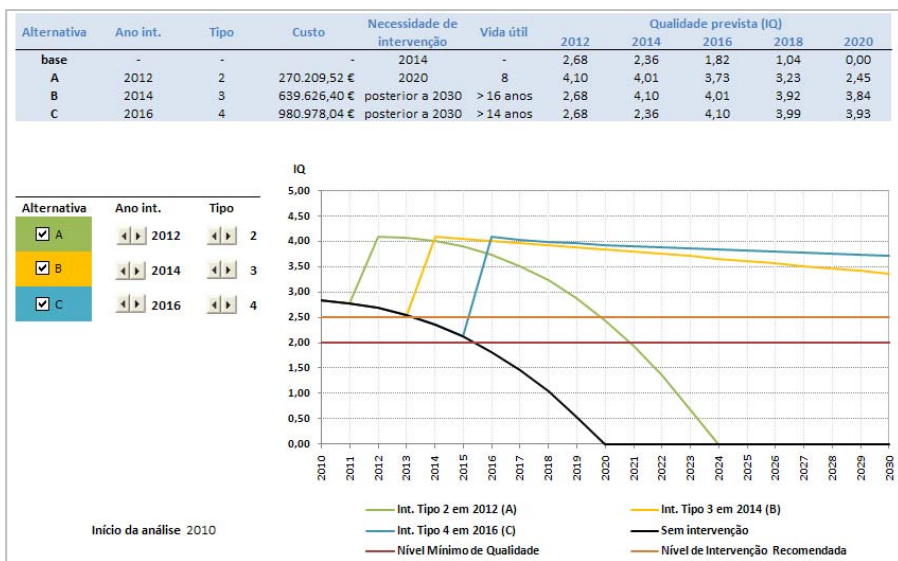
Aid to **routine maintenance planning** by identifying sites needing actions



# Support to decision-making

## Pavement performance modelling allowing the early identification of future maintenance needs

### Network-wide future pavement condition evaluation



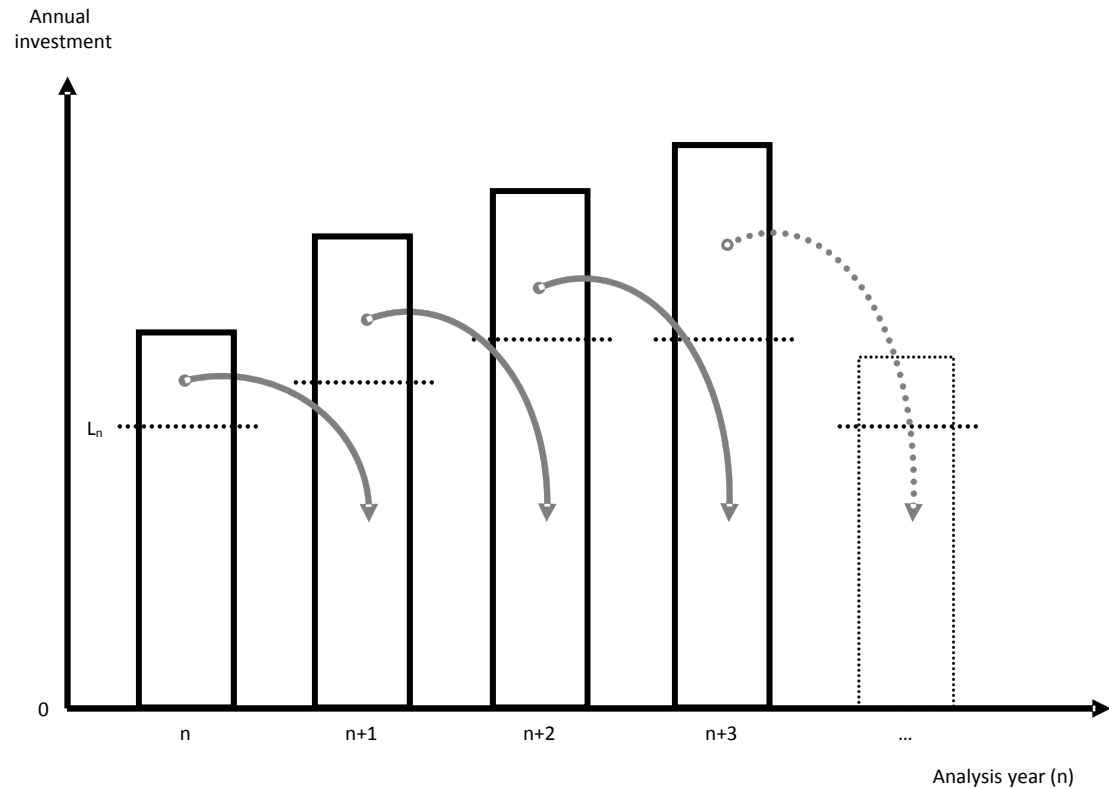
3.76	3.68	3.65	3.63	3.61	3.60	3.58	3.57	3.55	3.54	3.53
4.10	3.97	3.92	3.88	3.84	3.81	3.79	3.76	3.74	3.71	3.69
2.15	2.00	1.85	1.71	1.60	1.50	1.40	1.30	1.20	1.09	0.99
4.10	3.97	3.92	3.88	3.84	3.81	3.78	3.76	3.73	3.71	3.68
1.89	1.76	1.66	1.57	1.49	1.41	1.32	1.24	1.16	1.08	1.00
2.63	2.52	2.46	2.42	2.39	2.36	2.33	2.30	2.27	2.25	2.22
2.08	1.94	1.78	1.63	1.48	1.33	1.18	1.03	0.88	0.75	0.75
2.64	2.49	2.34	2.19	2.04	1.89	1.74	1.59	1.44	1.29	1.14
2.95	2.80	2.65	2.52	2.46	2.41	2.35	2.31	2.26	2.22	2.17
3.00	2.90	2.80	2.70	2.60	2.50	2.40	2.30	2.20	2.10	2.00
3.80	3.70	3.60	3.50	3.40	3.30	3.20	3.10	3.00	2.90	2.80
2.86	2.76	2.66	2.56	2.46	2.36	2.26	2.16	2.06	1.96	1.86
2.35	2.20	2.09	2.02	1.96	1.91	1.85	1.80	1.76	1.71	1.66
2.63	2.48	2.38	2.31	2.26	2.21	2.16	2.11	2.07	2.03	1.99
2.83	2.68	2.60	2.54	2.49	2.44	2.40	2.35	2.31	2.28	2.24
2.85	2.70	2.60	2.55	2.51	2.47	2.44	2.40	2.37	2.34	2.31
2.38	2.23	2.08	1.93	1.78	1.63	1.48	1.33	1.18	1.03	0.88

## Performance assessment of different maintenance alternatives

# Support to decision-making

## Budget **optimisation** and **prioritisation** of maintenance interventions

- Heuristic method to rank interventions and assign them to each analysis year according to the expected budget
- Ranking is made based on two criteria:  
**investment/traffic demand ratio (35%)**  
and the **road condition deterioration rate (65%)**
- The result is a **5-year maintenance plan**, designed to meet **strategic quality targets**





## Final remarks

The recent IP SGPav developments contributed decisively to its consolidation

- by **eliminating the subjectivity** in the collection of condition parameters
- by the **extent of the information available** (annual network coverage over 90%)

It resulted in a wider SGPav **recognition**, not only from its everyday users, but also from **top management**

## Open challenges

Given the **heterogeneity of the IP network** (hierarchy, traffic demand and attributes), several challenges arise

- **Forecasting** road condition efficiently
- **Performance indicators** enhancement
- **Decision-support** improvement

Common **asset management framework** for both road and rail



**Rodovia e Ferrovia**  
**Juntos encurtamos distâncias.**



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