The Institute of Asphalt Technology
Irish Branch

FEHRL

How can we faced the upcoming challenges together?

Dr. Thierry Goger – FEHRL Secretary General

FEHRL

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FOREVER Open Road, Rail, River, Runway

Innovation areas of the 5th generation of roads and the necessary integrated approach

Infrastructure shapes mobility

FEHRL – the Forum of Europe's National Road Research Centers

Focus on Road Infrastructure

Dr. Thierry Goger

Secretary General of FEHRL

FEHRL Members and Associates

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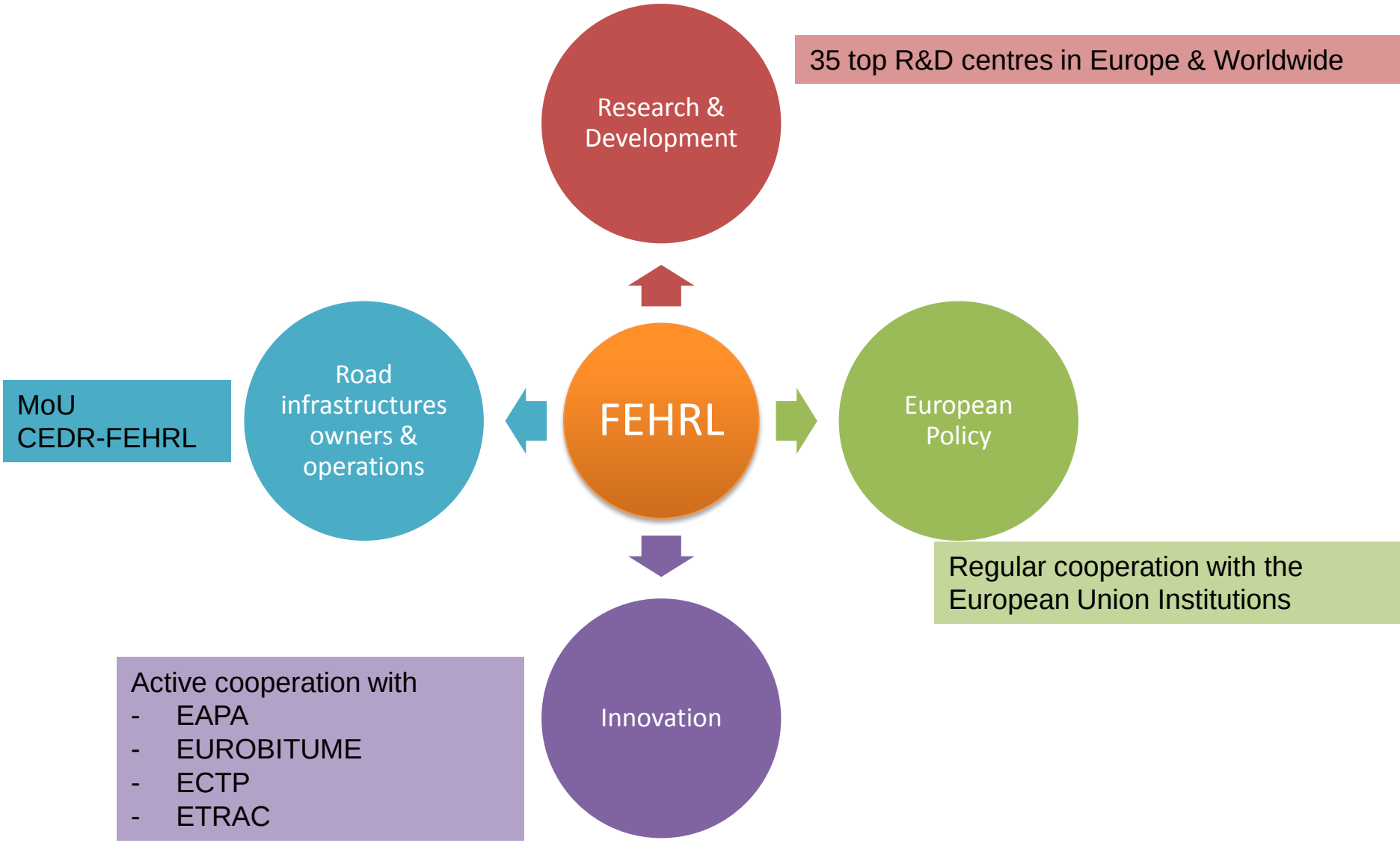
FEHRL: the cornerstone of research, innovation and implementation in Europe



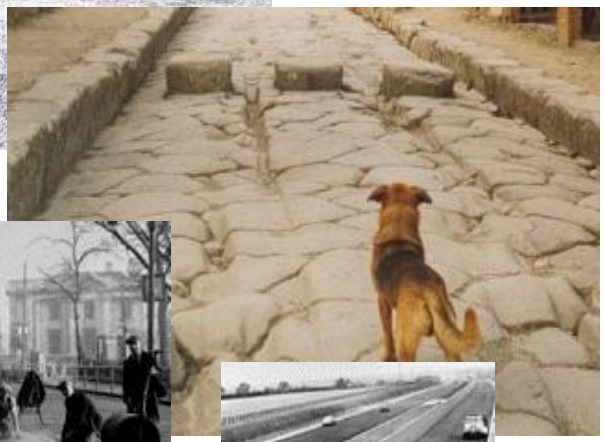
FEHRL‘s activities and added value

- Developing strategic R&D&I visions
- Voice for Transport Infrastructure Research
- Supporting cooperative research
- Improving awareness and exploitation of research outcomes

Trends and disruptions in transport by 2030-2050

Once upon a time… roads were good and a symbol of power, wealth and freedom!

- **1st generation** – the bridge
- **2nd generation** - the paved road
- **3rd generation** - the smooth road
- **4th generation** - the continuous road/motorways



Roads and transport infrastructure are backbone of economy and social cohesion!

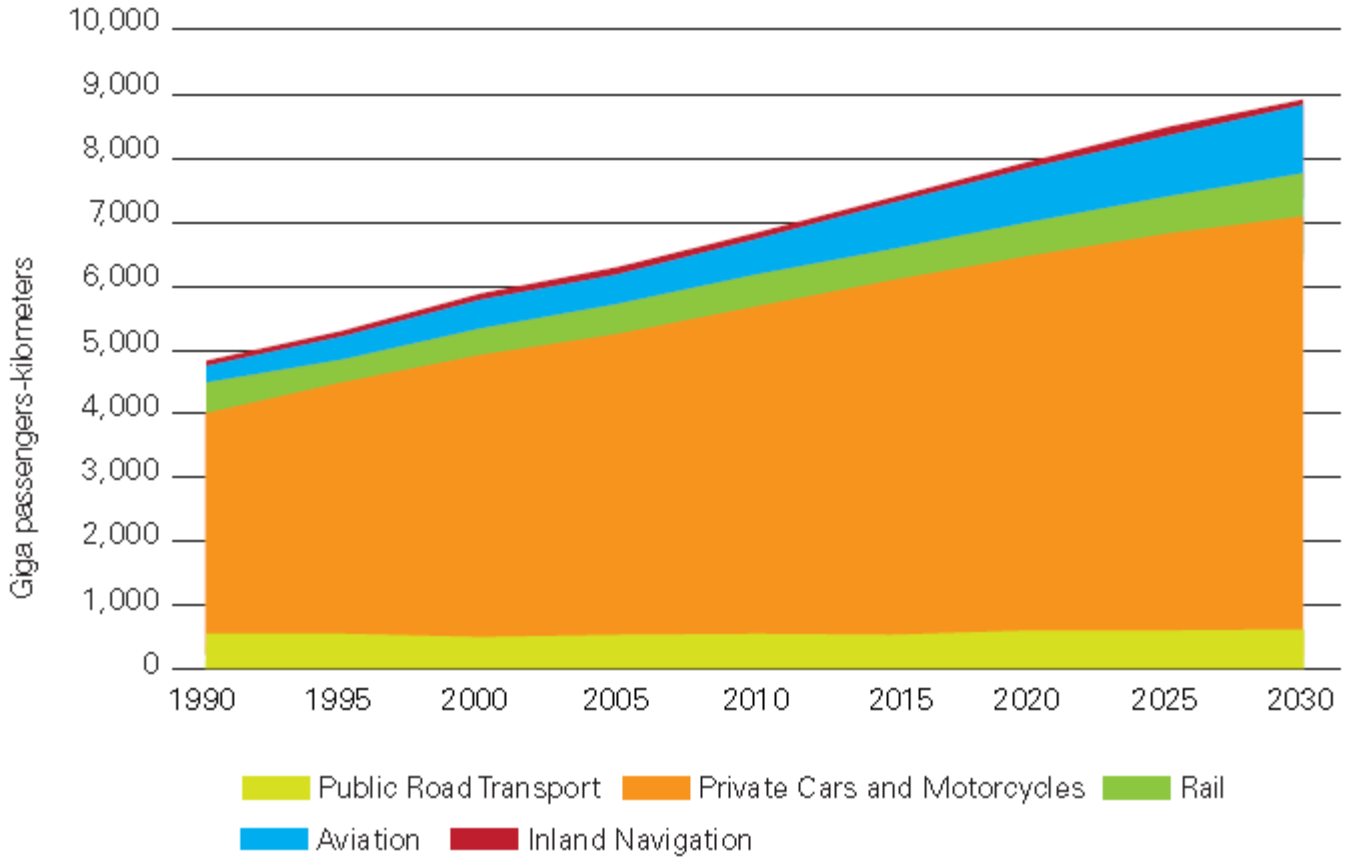
- 40% of every Member State assets are invested in the field of transport infrastructures.
- +/- 5,5 million kms of roads in Europe which represent 8 000 billion € estimated value of road asset
- Direct employment: 5 million jobs
- Indirect employment: 14 million jobs
- European competitiveness (1 % increase of GDP is underpinned by 1.5 % increase for transport infrastructure)

Competitiveness

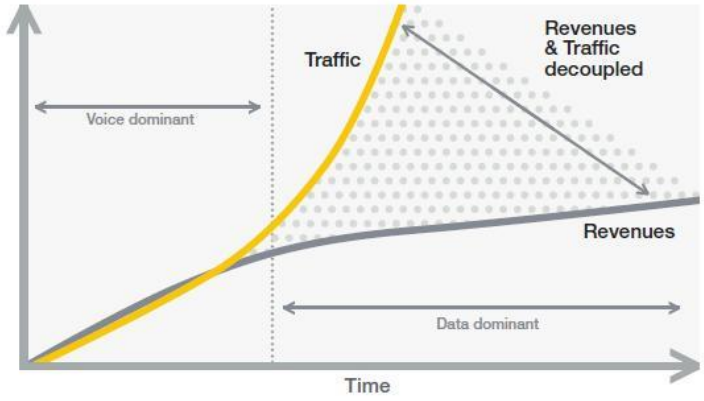
Societal cohesion

And will remain so in the future…

Trends and outlooks in passanger transport demand for the different modes of transport in EU-25 - 1990-2030 – Source ERF European Road Statistics 2013



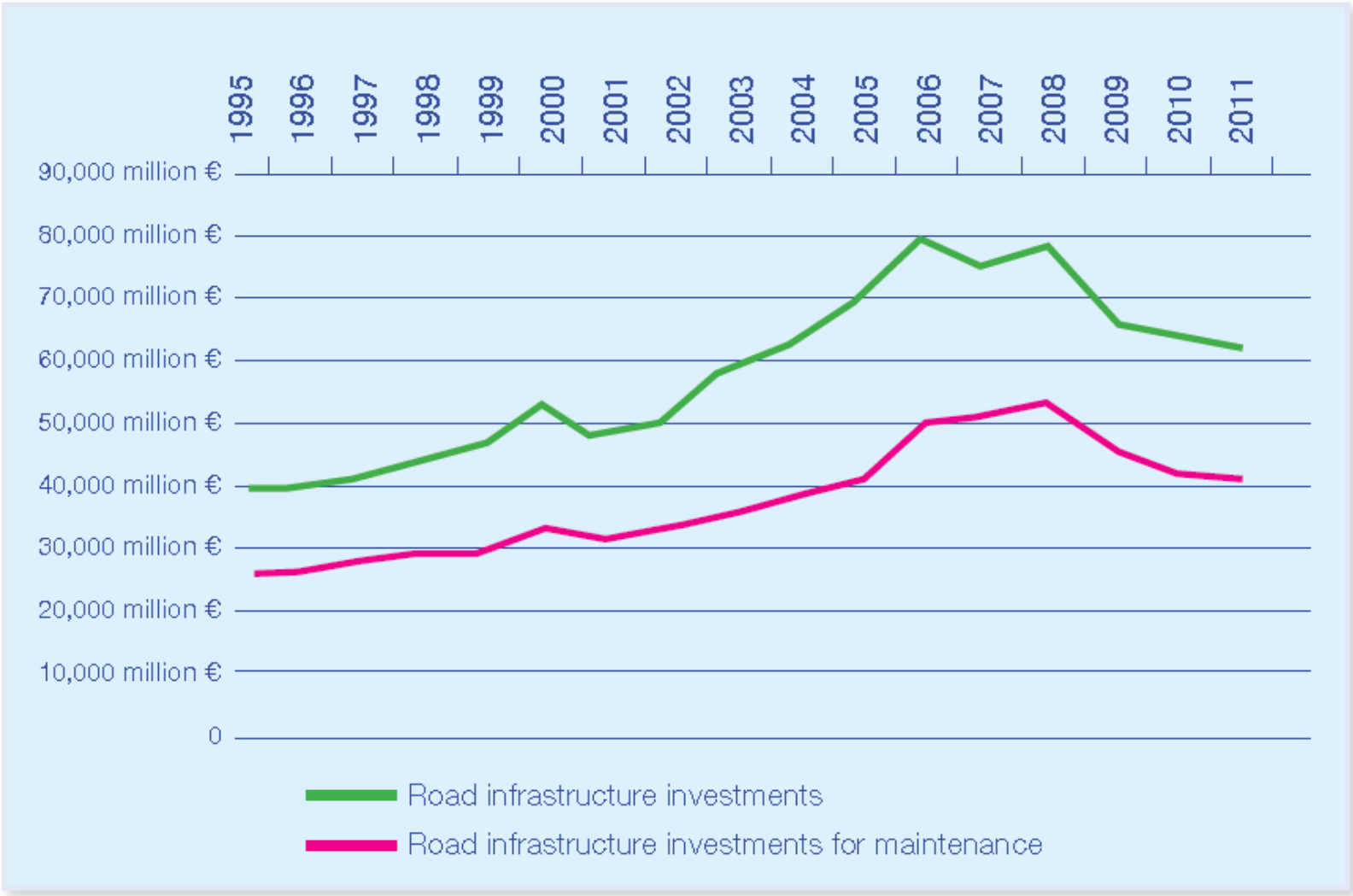
But … roads have become a symbol of evil, pollution, congestion, cost and fatalities!



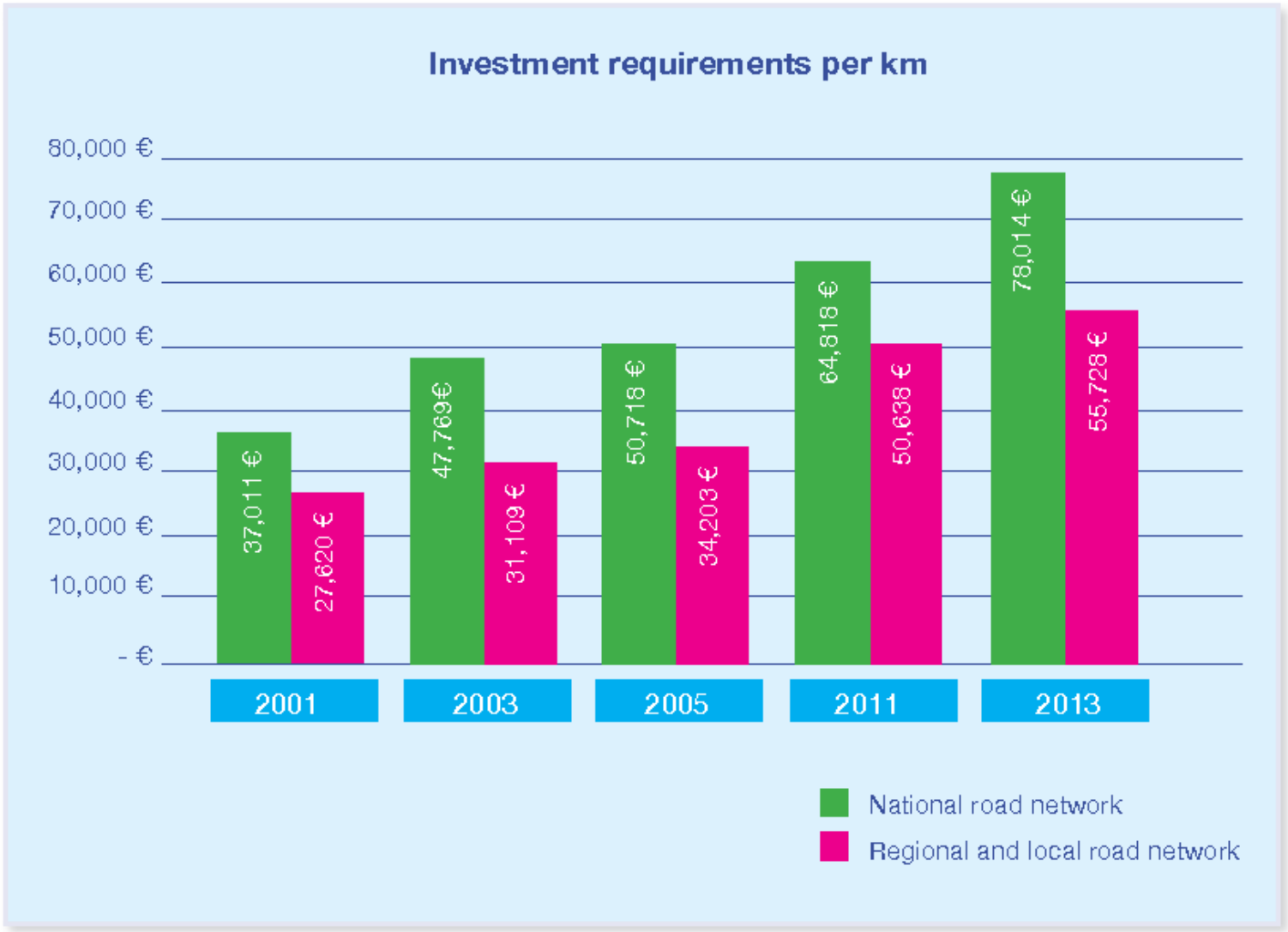
Trends and disruptions in transport by 2030-2050

Investment in road assets has dropped…

Evolution of Road Infrastructure Investments and Road Maintenance Investments in a selection of Western European Countries*



…to the point that maintenance costs are increasing and operations even moving to much more expensive rehabilitation



INFORME-NECESIDADES-DE-INVERSION-EN-CONSERVACION-ABRIL-_2014.pdf - Source A.E.C.

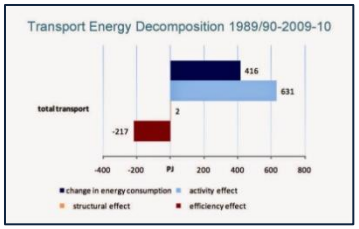
European road assets are in danger…

Knowledge gaps and game-changers

future trends in key external variables

utilisation of transport capacity

poor understanding of rebound effects

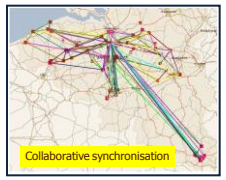


prospects for autonomous vehicles

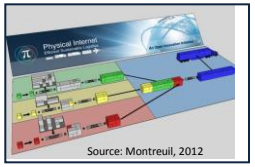
effects of full internalisation of environmental costs

crowd-sourcing vehicle-based traffic data

digitalisation



development of the 'physical internet'



shift from owning to sharing transport assets

Electrification of road transport

insurance pricing catalysing good safety practices

Source: Horizon 2020: Transport Advisory Group

FOREVER Open Road, Rail, River, Runway

Innovation areas of the 5th generation of roads and the necessary integrated approach

Infrastructure shapes mobility

The 7 golden areas

Governance for implementation

Customer focussed Governance
Governance based on performance criteria
Procurement for innovation
Innovative financing approaches
Green procurement

Cross & Multi-modal integration

Road network as part of integrated transport system
Transfer of solutions (technologies, methodologies, standards etc.)
Safety for vulnerable road users
Infrastructure response to future mobility scenarios

Safety & Security

Carbon and Environment

CO_2 reduction (embedded and operational)
Supporting electrification
Energy Harvesting
Decarbonisation
Reduce rolling resistance
Reuse and recycling
Circular Economy
Noise and air quality

Maintenance & upgrading of ageing infrastructure

Upgrading
Life Extension
Self explaining and forgiving road
Safety for road users and operatives
Prefabrication
Maintenance
Robotics

Digitalisation

Adaptation of infrastructure to automated vehicles
Infrastructure investment decisions
Big Data, BIM, Internet of things
Cyber security (threat from BIM & data)
Traffic management
Safety improvement due to digital environment
Smart, connected cities

Resilience

Adaptation of infrastructure to extreme weather, climate change & man made hazards
Extreme short term variations in temperature
Improved safety in extreme weather conditions

Impacts

Governance for implementation

-25% whole life costs for construction and maintenance
+50% green procurement around EU
≥ 95% customer satisfaction

Cross & Multi-modal integration

Matching mobility demand to use of transport infrastructure
+15% improvement of local air quality
+15% improvement of public health
+30% freight transport efficiency.
-40% KSI of vulnerable road users
Adapt infrastructure to new users.
+20% reduction of congestion
2 way technology transfer

Carbon & Environment

-20% carbon intensity of road construction, maintenance & operation
-40% CO2 emissions and air pollutants
100% recycling rate for concrete
+20% recycling rates for asphalt and lower energy requirements
+20% financial savings for operators
-10% of rolling resistance
-10 dB road noise

Safety & Security

≥40% improvement

Maintenance & upgrading of ageing infrastructure

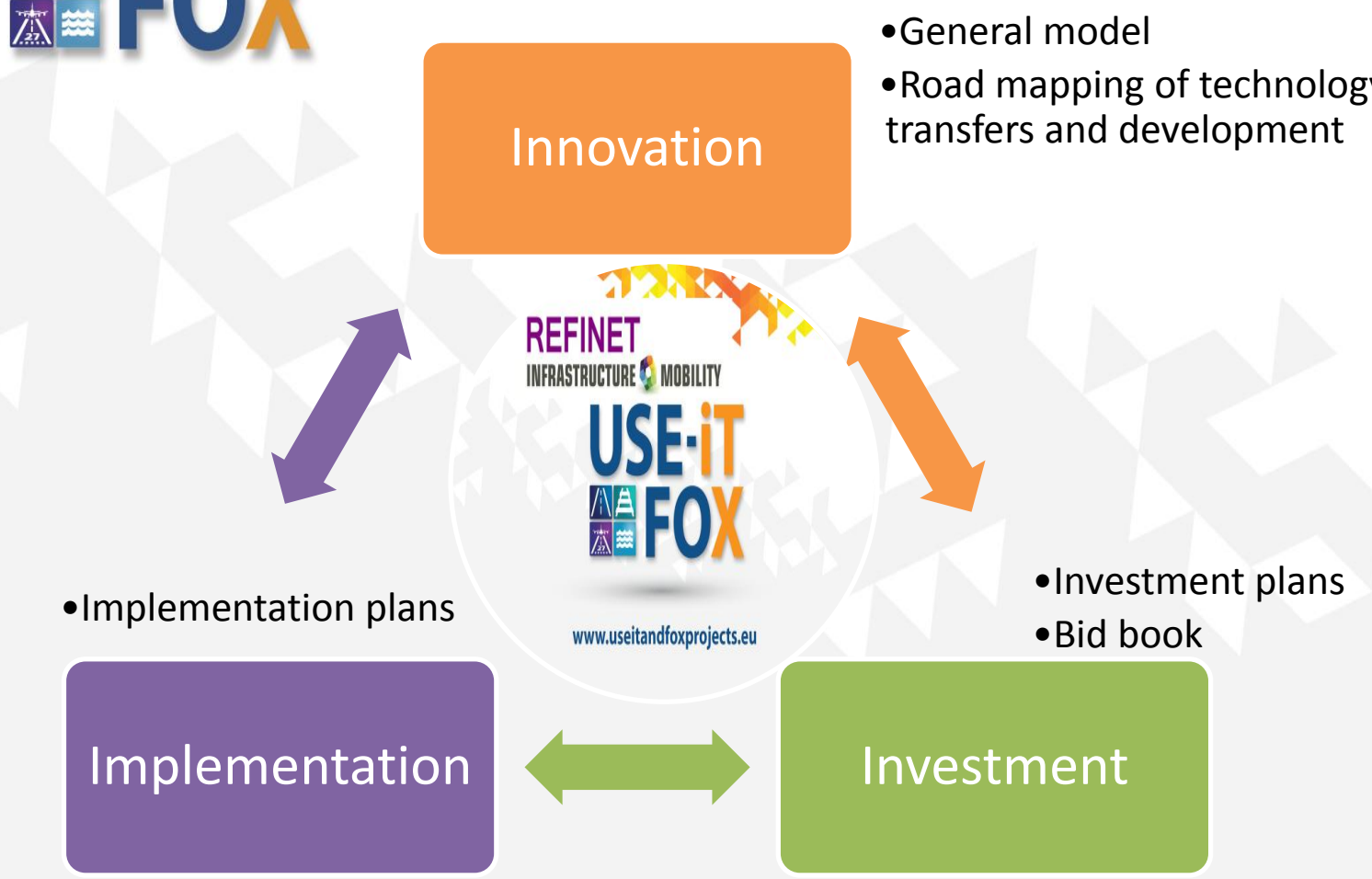
+20% increase in off-site construction
-50% time lost to upgrades
+20% extension of infrastructure life
-30% exposure of workers to live traffic
+40% reduction in KSIs
-25% lane closure time

Digitalisation

Increase capacity of infrastructure for mobility by optimisation of space sharing (+20%)
-30% total cost of road ownership
Production of document detailing potential traffic scenarios as a result of mobility changes
+20% reduction of congestion
+40% reduction in KSIs

Resilience

+50% reduction in downtime
+10 improvement in service levels
+40% improvement

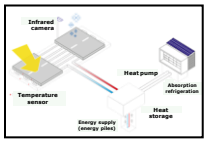

Innovation
•General model
•Road mapping of technology transfers and development
REFINET
INFRASTRUCTURE MOBILITY
USE-iT FOX
www.useitandfoxprojects.eu
•Implementation plans
Implementation
Investment
•Investment plans
•Bid book

FOX WP3 – Maintenance

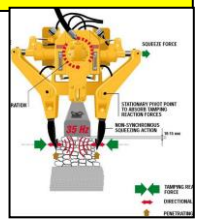
Area 1: Preventative Maintenance

Ballast preventive maintenance
This technique consists of restoring the geometry of the infrastructure by tamping the ballast. It also consists of replacing and/or cleaning of the ballast.
Ballast profiling machine: Restoration of the ballast geometrie.
Tamper machine: Expulsion of the ballast under the sleepers; restoration of the initial sleeper's position, the rail geometry and the vertical rail deviation.
Ballast cleaning machines: Replacement of the sleepers.
- **Benefits**
  - Machines can work in line and are subject to work as modules.
  - Maintenance operations can be synchronized.
- **Barriers**
  - Frequency of the operations is different:
    - ❖ Ballast profiling: every 1-2 years
    - ❖ Tampering: every 5-6 years
    - ❖ Ballast cleaning: every 12-15 years

Rejuvenation of asphalt pavements
By employing a special bitumen rejuvenator emulsion or other chemicals on the top of the surface the asphalt recovers part of its original ductility and pliability.
- **Benefits**
  - Prevention of further damage tied to aging (cracking, raveling, etc.).
  - Minimum disruption of traffic by the short road work timeframe.
  - Extension of the lifetime of the pavement.
- **Barriers**
  - After application of the rejuvenator, surface gritting is needed.
  - Skid-resistance may suffer.



Interseasonal heat transfer
Source: BASt



Tamping procedure
Source: Plasser & Theurer

Temperature controlled pavements
Pavements can be heated in winter and cooled in summer. Temperature can be controlled using electric energy or renewable energy sources (e. g. geothermal energy). Electric energy pavements are heated via electric wires installed under or between pavement layers. For geothermal energy, pavements are heated or cooled by circulating geothermal water.
- **Benefits**
  - Reduced negative impact on environment comparing with traditional deicing materials.
  - Less damage on infrastructure comparing with traditional snow removal techniques.
  - Increased safety due to better driving/operation conditions.
  - Prevention of traffic disruption due to maintenance measures.
- **Barriers**
  - Costs.
  - Construction barriers due to specifics of the road construction, e. g. pipes.

Area 2: Rehabilitation

Diamond grinding
Diamond covered discs are used to cut grooves on concrete surfaces with a typical distance of 3 mm, a typical depth of 1 to 3 mm and a width of 3 mm.
- **Benefits**
  - Increase in skid resistance and safety.
  - Reduction of noise.
- **Barriers**
  - Diamond covered discs are costly.
  - The infrastructure is slightly weakened, due to the removal of a thin surface layer.
  - Improvements (skid resistance, noise) are temporally limited.

Machines for track renewal and track laying
Continuous-action, assembly-line method: Mechanised operation of the entire supply of new/renewed sleepers, rails and ballast within the track.
- **Benefits**
  - Accuracy and high working speed.
  - Automation of construction work resulting in a reduction of the (re-)construction time.
- **Barriers**
  - Track needs to be prepared prior to the works of the machine, e. g. removal of signals, beacons, catenaries, loose of fasteners, new rail have to be laid beside the track.

Installation of modular pavement
Source: Modi Slab

Track laying machine
Source: Plasser & Theurer

Fine milling of the pavement surface
Adaptation of the classical milling technique to create more fine texture of a pavement surface. For this reason, the milling drum is fitted with a dense net of rotating picks.
- **Benefits**
  - Cheap; Large areas can be improved.
  - Improved evenness and skid resistance (safety!).
- **Barriers**
  - Missing rules.
  - Technology can cause problems in the vicinity of joints of cement concrete pavements.

Fibre reinforced polymer (FRP) grease free bearing for lock gates
Rehabilitation measure to replace the commonly used bearings, also relevant to the area of reconstruction.
- **Benefits**
  - Environmental and a maintenance advantage due to less requirements for lubricants as grease or oil,
  - System needs less maintenance.
  - FRP/metal systems have a longer lifetime because they are more robust.
  - High risks due to a failure of the bearings are reduced.
- **Barriers**
  - ./.

Area 3: Reconstruction

Modular pavement based on porous concrete
Short length panels supported by precast concrete beams are placed over precast foundation piles. A fine grained top porous layer is used to reduce the amount of tire/pavement noise.
- **Benefits**
  - Simple and rapid rehabilitation is possible, road closure is minimized.
  - Increased water permeability.
  - Better water drainage at airports.
  - Noise reduction.
- **Barriers**
  - High construction costs.
  - Lower strength and durability compared to traditional concrete pavements.
  - Additional drainage necessary.

Ultrafast concrete
Fast repairs (< 6 hours) of small areas of cement concrete pavements of construction segments.
- **Benefits**
  - Very fast exchange of distressed parts of concrete pavements.
  - Reduction of user costs and time closure.
  - Increase in safety.
  - Technical regulations already exist.
- **Barriers**
  - High costs.
  - Highly skilled team of workers, tuned coordinated processes and reserved equipment/machinery in case of problems are necessary.
  - Regulations for the technical aspects differ in each country.

Cold in-place recycling on the state road L 114 in Weibern, Rhineland-Palatinate, Germany
Source: Wirtgen Company

Cold in place recycling on the motorway A4 Turin-Trieste, Italy
Source: Wirtgen Company

Cold in-place recycling
Part of the asphalt layers and the unbound layer are recycled in-place. Asphalt emulsion and cement are used as binders. The new recycled base layer is finally overlaid by new asphalt layers.
- **Benefits**
  - Fast reconstruction method, limitation of the amount of transported material and need of raw material.
  - Increased lifespan of pavement structures at reasonable costs with minimum impact on environment.
  - Suitable solution for tar contaminated material
  - Correction of longitudinal/transversal profile.
  - Possibility to improve the homogeneity of pavement conditions along its length.
- **Barriers**
  - Current regulations and practices differ in each country.
  - Limitation of D to 63 mm, method is therefore not applicable on rigid pavements (concrete) or paved roads.

Area 4: Asset Management

Estimating end-of-service-life of hydraulic structures
Unified approach for estimating the remaining service life of hydraulic structures. The model for obtaining a timeframe for the technical 'lifetime' of a structure uses a simple univariate Bayesian model to make full use of the little information that is available about the remaining life of the structures.
- **Benefits**
  - Assessment of the service life of the structures.
  - Better cost-benefit-performance of infrastructure investments.
- **Barriers**
  - Missing and unreliable data.
  - Timing of investments.
  - Costs for information aquisition.

Risk based maintenance (probabilistic operation and maintenance, ProBO)
Concept is used to "guarantee" the protection against flooding with storm surge barriers that are normally opened and only closed in particular situations (high water levels) to keep the water outside specific areas. The concept is based on a required maximum probability of failure of the closing operation. This probability depends on operational issues and maintenance issues. Maintenance and inspection are related to the probability of failure by a quantitative fault tree analysis.
- **Benefits**
  - for complex, critical elements in the network the method saves money and increases the performance of the element and as a result of the network.
  - Clear control and quantified justification of maintenance decisions as well as a better performance of the network by better performance of complex and critical elements in the network.
- **Barriers**
  - Complicated and time consuming method which is not beneficial for most objects/assets
  - Method is not modified to specific objects.

Governance | Customer

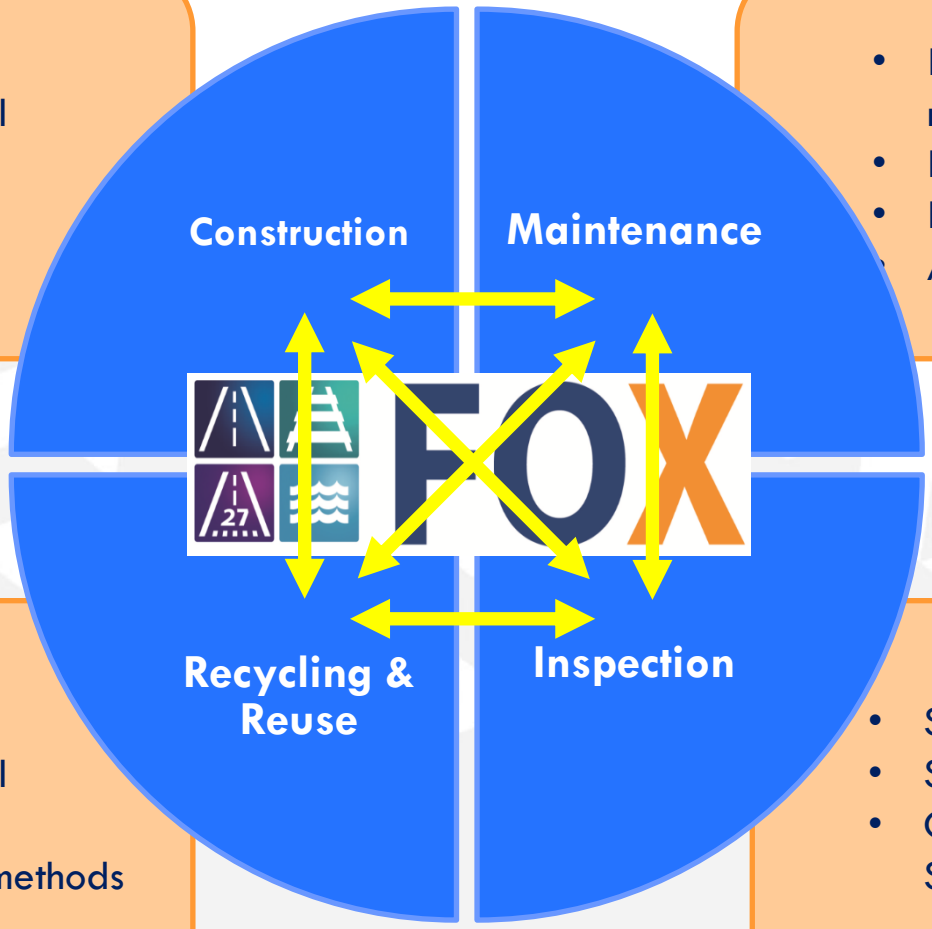
Mode: Road | Rail | Water | Air

Left hand side – current application
Right hand side – Potential for future application

USE-iT FOX

- Innovative material
- Innovative technical solutions
- Advanced design methods

- Preventive maintenance
- Rehabilitation
- Reconstruction
- Asset management



- Innovative material
- Innovative technical solutions
- Advanced design methods

- Surface Condition
- Structural Condition
- Condition of Structures

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