How can we faced the upcoming challenges together?

Dr. Thierry Goger – FEHRL Secretary General
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
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FEHRL Members and Associates

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

35 top R&D centres in Europe & Worldwide

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Road infrastructures owners & operations

Research & Development

Active cooperation with
- EAPA
- EUROBITUME
- ECTP
- ETRAC

Regular cooperation with the European Union Institutions

Innovation

European Policy
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)
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

- Public Road Transport
- Private Cars and Motorcycles
- Rail
- Aviation
- Inland Navigation
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.
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: Montreuil, 2012

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

**Carbon and Environment**
- CO₂ reduction (embedded and operational)
- Supporting electrification
- Energy Harvesting
- Decarbonisation
- Reduce rolling resistance
- Reuse and recycling
- Circular Economy
- Noise and air quality

**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

**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

**Safety & Security**

**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

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

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

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

Carbon & Environment
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+20% recycling rates for asphalt and lower energy requirements
+20% financial savings for operators
-10% of rolling resistance
-10 dB road noise
Innovation

- General model
- Road mapping of technology transfers and development

Investment

- Investment plans
- Bid book

Implementation

- Implementation plans

www.useitandfoxprojects.eu
Benefits

- Noise reduction.
- Increased water permeability.
- FRP/metal systems have a longer lifetime because they...
- Reduction of noise.
- Better water drainage at airports.
- Diamond covered discs are costly.
- Machines...
- Barriers
- Accuracy and high working speed.
- Method is not modified to specific objects.
- System needs less maintenance.
- Skid costs.
- Costs.
- Construction barriers due to specifics of the road construction, e.g. pipes.
- Final 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
  - /.

Modular pavement based on porous concrete

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

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 2 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 the asphalt surface layer.
  - Improvements (skid resistance, noise) are temporarily limited.

Machines for track renewal and track laying

Continuous-action, assembly-line method: Mechanised operation of the entire supply of new/renewedsleepers, 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, beacon, catenaries, loose of fasteners, new rail have to be laid beside the track.

Fine milling of the pavement surface

- Source: MWH

Temperature controlled pavements

Pavements can be heated in winter and cooled in summer. Temperature can be controlled using electricity 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/operaion conditions.
  - Prevention of traffic disruption due to maintenance measures.
- Barriers
  - Costs.
  - Construction barriers due to specifics of the road construction, e.g. pipes.

Unfused concrete

Fast repairs (4-6 hours) of small areas of cement concrete pavements of construction segments.

- Benefits
  - Very fast exchange of disressted 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 application.
  - Regulations for the specific aspects differ in each country.

Weighted paving

- Source: FOX WP3

Reconstruction

- Source: FOX WP3

Risk based maintenance (probabilistic operation and maintenance, ProDi)

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 also 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.

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  - Increased water permeability.
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  - Noise reduction.
- Barriers
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  - Additional drain necessary.
• Innovative material
• Innovative technical solutions
• Advanced design methods

• Preventive maintenance
• Rehabilitation
• Reconstruction
• Asset management

• Surface Condition
• Structural Condition
• Condition of Structures

TRA 2016
How can we faced the upcoming challenges together?

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