Results of the CEDR* project *DISTANCE*

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*CEDR = Conférence Européenne des Directeurs des Routes

The DISTANCE project

- Developing Innovative Solutions for TrAffic Noise Control in Europe

- Goal of the project: *produce guidelines to allow National Road Administrations (NRA's) to optimize traffic noise abatement on main road networks*

The DISTANCE project as answer to the CEDR call

1. Improve quality of noise maps: which noise asset information should be gathered and to which precision?

2. Assessment of development of traffic

3. Novel noise abatement measures

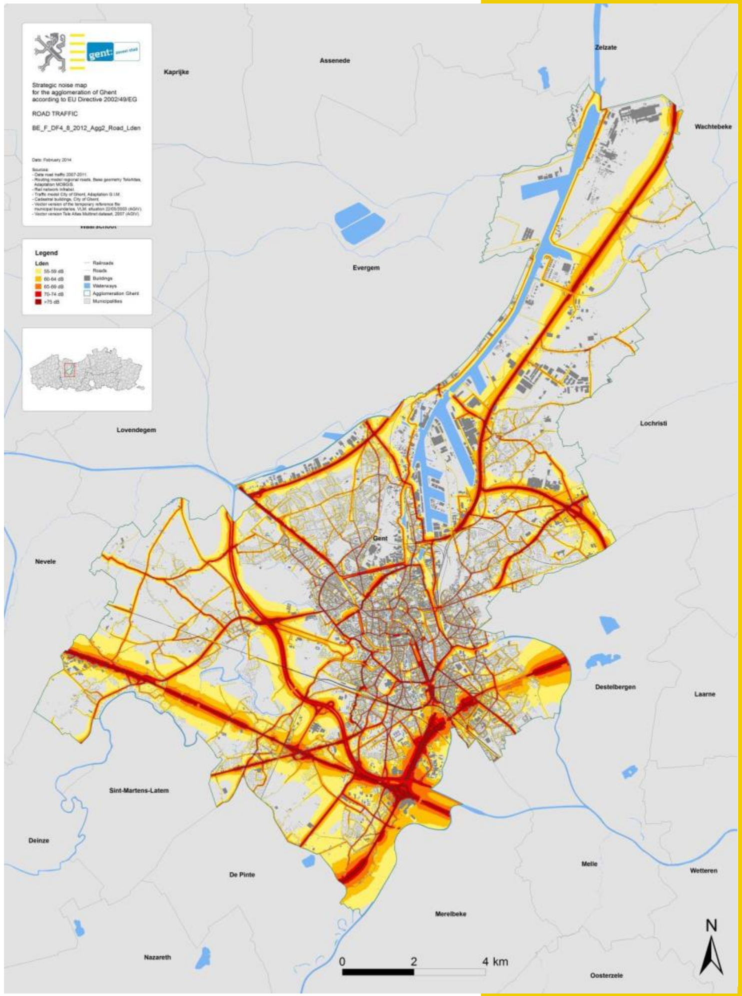
4. Additional functions for noise screens (and pavements)

5. Noise reduction ≠ nuisance reduction: what can be done with the psychological effects?

Methodology

- No own research
- Data mining in accessible sources
- Add own assessment and expert vision
- Present the information in guidelines in a practical, quickly accessible format

Data requirements for future noise mapping and action planning



Objectives

- list and evaluate data needed to produce more robust future strategic noise maps and action planning

Harmonized EU calculation model

= CNOSSOS-EU

Data types in the study

Group of data	Data type
Road Surfaces	Pavement Type
	Pavement Degeneration
Noise Barriers	Barrier Type
	Barrier Dimension
	Barrier Position
	Barrier Absorption
	Barrier Top
	Barrier Transmission
	Barrier Degeneration
Traffic Data	Vehicle Category
	Speed
	Quantity
Geospatial Data	Topography
	Building Height
	Road Information
	Building Type
	Ground Surface

Road surfaces

Data type	Are the NRAs prepared for new requirements?	What needs to be done by the NRAs	Co-oper. across NRAs
Pavement Type	Yes. Categories are based on physical parameters. But some have low coverage.		Yes
Pavement Degeneration	No. Except for a few countries.	National investigations to establish average effects, or to underline other conclusions.	Yes

Noise Barriers

<table>
<tr><th>Data type</th><th>Are the NRAs prepared for new requirements?</th><th>What needs to be done by the NRAs</th><th>Co-oper. across NRAs</th></tr>
<tr><td>Barrier Type</td><td colspan="3" rowspan="4">These data types are not investigated specifically in this study because of lack of support in the calculation methods, including CNOSSOS-EU</td></tr>
<tr><td>Barrier Transmission</td></tr>
<tr><td>Barrier Degeneration</td></tr>
<tr><td>Barrier Top</td></tr>
<tr><td>Barrier Dimension</td><td rowspan="2">Yes, for most countries.</td><td rowspan="2">For some countries: Improve precision.</td><td rowspan="2">No</td></tr>
<tr><td>Barrier Position</td></tr>
</table>

Conclusions

- NRAs seem to be well prepared for the CNOSSOS-EU requirements
- But for some issues more work need to be made by many NRAs before the requirement is fulfilled, a.o.
  - pavement degradation
  - ground surfaces
  - …
- Should be addressed internationally

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Multi-function noise barriers and pavements

Multi-function noise barriers

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Multi-function noise barriers

Description of enhancement	Technical feasibility	Financial impact	Sustainability impact			Why	Why not	Potential for use by NRA
			Ecological ('planet')	Financial ('profit')	Social ('people')			
PVNB	*Now*	*= to +*	✓	✓		*Renewable energy generation*	*Maintenance and overall cost*	
Safety barriers	*Now*	*+*			✓	*2 functions in 1*	*Safety issues*	
Added devices	*Now to Near*	*= to +*			✓	*Additional reducing noise*	*Difficult to predict noise benefit*	
Enhanced visual characteristics	*Now*	*= to +*			✓	*Urban aesthetics*	*Cost?*	
Transparency	*Now*	*+*			✓	*Urban aesthetics*	*Cost, safety*	
Recycled materials	*Now to Future*	*= to +*	✓	✓		*Cost and ecology*	*None*	
Green barriers	*Now*	*= to +*			✓	*Urban aesthetics*	*Maintenance*	
TiO2 capture	*Near*	*++*	✓		✓	*Health issues*	*Efficiency*	
Electrostatic capture	*Future*	*++*	✓		✓	*Health issues*	*Efficiency*	
Lighting	*Future*	*Unknown*			✓	*2 functions in 1*	*Cost*	
Adverts/information	*Now-Future*	*Unknown*	✓		✓		*Distraction of drivers*	
Rainwater harvesting	*Future*	*Unknown*	✓				*Negative CBA*	

Multi-function pavements

Description of enhancement	Technical feasibility	Financial impact	Sustainability impact			Why	Why not	Potential for use by NRA
			Ecological ('planet')	Financial ('profit')	Social ('people')			
Dynamic markings (lane delineation)	*Future*	=			✓	*Improve safety*	*Insufficient light energy storage*	
Dynamic markings (lane control)	*Future*	*Unknown*			✓	*Improve traffic movement*	*Cost and technology*	
Inductive charging	*Near-Future*	++	✓			*Increased electric vehicle use?*	*Cost and technology*	
Heat capture/storage	*Near-Future*	**	✓	✓		*Renewable energy generation*	*Cost and technology*	
Modular pavements	*Near*	++			✓	*Less disruption to road users. Faster installation and maintenance*	*Cost*	
Self-healing surfaces	*Near*	=	✓			*Less maintenance*	*Limited surface types*	
Air pollutant capture	*Future*	=	✓		✓	*Health issues*	*Efficiency*	
Energy generation	*Near*							
Recycled materials (asphalt & concrete)	*Now - Near*	*- to =*	✓	✓		*Ecology*	*Durability concern*	
Recycled materials (tyres, etc.)	*Near*	++	✓			*Ecology*	*Durability concern*	

SILENT ROADS

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Potential future traffic scenarios

Objectives

- Model the impact(s) on roadside traffic noise of potential changes to national road networks & vehicle fleets
- Examples of such changes include
  - Changes in traffic composition (e.g. % HGVs)
  - Presence of electric vehicles within fleets
  - Introduction of quieter tyres
  - Use of different low-noise road surfaces
  - Use of ITS for traffic control & management

- Modelling undertaken using the harmonised EU noise prediction model CNOSSOS-EU

Review of vehicle fleets & road infrastructure data results

- An increase in motorways as a fraction of the road network
- An increase in the use of Intelligent Transport Systems, designed to smooth traffic flow
- An increase in LGVs as a fraction of the fleet
- An increase in the use of durable low-noise road surfaces
- An increase in the use of electric & hybrid electric cars

Modelling scenarios (What if…)

(Baseline: 5000 vehicles/h; DAC 0/11 road)

- **Road type (by speed)**: Motorways (free-flowing & congested), national trunk roads, principal local roads, minor local roads
- **Traffic volume**: 50% increase in volume; 50% increase in HGVs; 50% decrease in HGVs
- **Motorway regulations**: 10 km/h speed limit increase for free-flowing; ITS for congested traffic
- **Other road surfaces**: SMA 0/6, two-layer porous asphalt, EACC
- **Impact of studded tyres**: Apply to 100% cars only
- **Increased use of electric vehicles**: Apply to 100% cars only

Modelling results (across road types)

	Difference in $L_{Aeq,1h}$ relative to baseline
Increase in traffic volume	+ 1.8 dB
Changes in %HGV (exc. congested motorways)	-0.4 dB to +0.4 dB
Changes in %HGV (congested motorways only)	-2.2 dB to +1.5 dB
Increased motorway speed limits (free-flowing motorways only)	+ 1.1 dB
ITS systems (congested motorways only)	-3.1 dB
Road surfaces (exc. congested motorways)	-5.9 dB to +1.2 dB
Studded tyres (exc. congested motorways)	1.2 dB to 3.0 dB
Electric vehicles	-0.8 dB to -0.3 dB
Vehicle regulations	-1.6 dB to -0.2 dB
Future scenario (low-noise thin surface, some ITS, quieter cars with quieter tyres, 25% EVs)	-4.6 dB to +2.4 dB

Interpretation of modelling results

- Not a huge noise benefit from future vehicle(s)
- Real benefits require infrastructure changes
- ITS and road surface types can help
- Overall trend is to quieter traffic even if noise is not the driver
- No ‘silver bullet’ for traffic noise but...
- ... lower noise levels can be achieved!

Smart noise mitigation measures

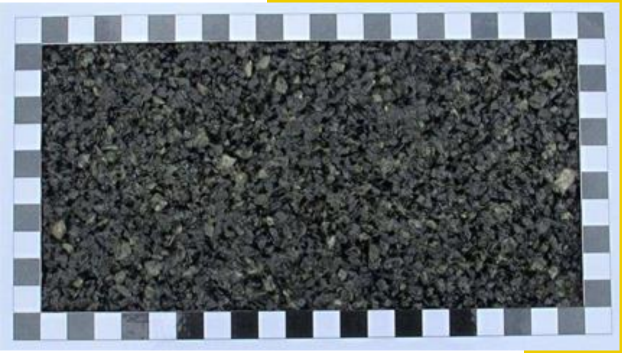
MEASURES SELECTED FOR THE SPECIFIC INTEREST OF NRAs

- Traffic flow measures: diversion of traffic volumes
- Traffic speed measures
- future ITS applications
- Junction design
- Traffic tolls
- Tyre noise limits
- New EU vehicle noise limits
- Diffractors
- Helmholtz resonators in pavements
- Poroelastic road surfaces (PERS)
- Soft ground along the road
- Artificial surfaces
- Sonic crystals

For higher levels of noise mitigation (IL≥7 dB(A))

- Poroelastic Road Surfaces (PERS)
  - Constraints: None
  - Cost band: more expensive
  - Unequalled noise reducing potential

- Sonic crystals
  - Constraints: space
  - Cost band: more expensive



For medium levels of noise mitigation (3 dB(A)≤IL<7 dB(A))

- Diffractors
  - Constraints: safety barriers
  - Cost band: less expensive
  - Context: highways in sub-urban

- Replacing hard ground with soft ground
  - Constraints: space
  - Cost band: less expensive
  - Context: rural areas

Perception of noise and noise mitigation measures

Perception of noise and noise mitigation measures

- Annoyance from road traffic is very much influenced by the context of the situation (psycho-acoustics)

- Aim: reducing the actual annoyance rather than noise by influencing perception with non acoustical measures

Perception and awareness of noise mitigation measures

- Communication & participation
  - Annoyance can increase by lack of control of the nuisance
  - Being informed & involved & treated fairly can enhance perceived control as such reduce annoyance
  - Organized events can be a great tool
  - Use of websites & social media can be positive tools
- Compensation
- Little or no data about influencing nuisance with e.g. visual aspects of noise barriers

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