Life-cycle performance of noise mitigation measures

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QUESTIM project

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Mitigating traffic noise

The environmental noise exposure of road traffic is often mitigated through:

- Noise barriers, and
- Noise reducing pavements

Apart from other measures such as façade insulation or traffic calming.

Initial performance versus life-cycle performance of noise reducing road surfaces

- Frequently observed that the excellent reduction effects disappear after a few years
- Loss of acoustic performance varies significant
  - After 2 years effect is gone
  - After 10 years still performing excellent
- Understanding of aging fails
  - Unclear what material improvements are needed
  - Unclear where to put which surface type
  - Unclear how to plan maintenance and repaving

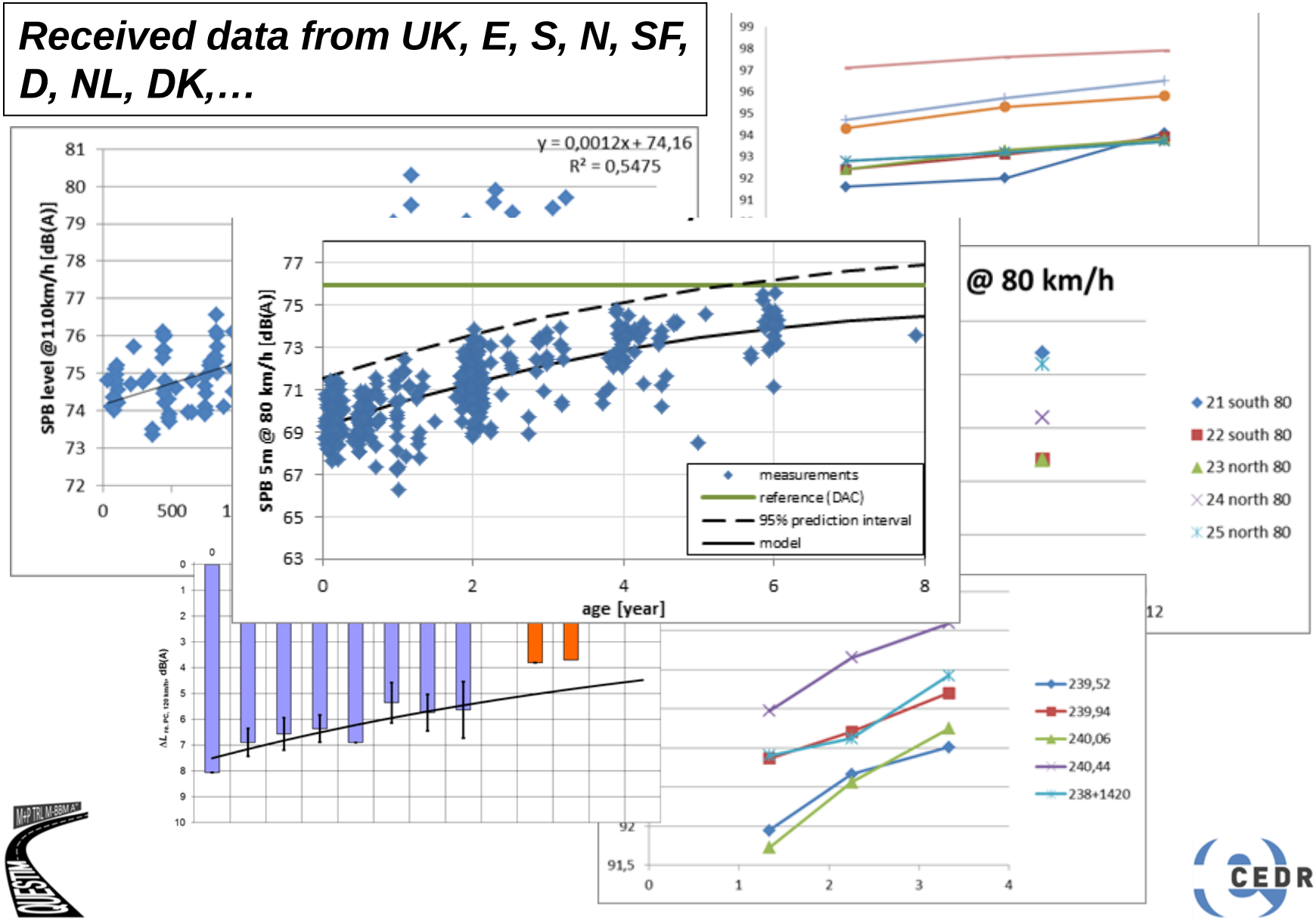
Objective of QUESTIM

1. To collect and analyze age related performance data from surfaces all over Europe
2. To understand the aging process of noise reducing surfaces and model it as a function of;
   - Surface type
   - Traffic condition
   - Environmental condition
   - Specific conditions (e.g. studded tyres)
3. To develop a monitoring practice to follow performance
4. To propose a scheme to implement this in a pavement Management System (PMS)

To a lesser degree also noise barriers

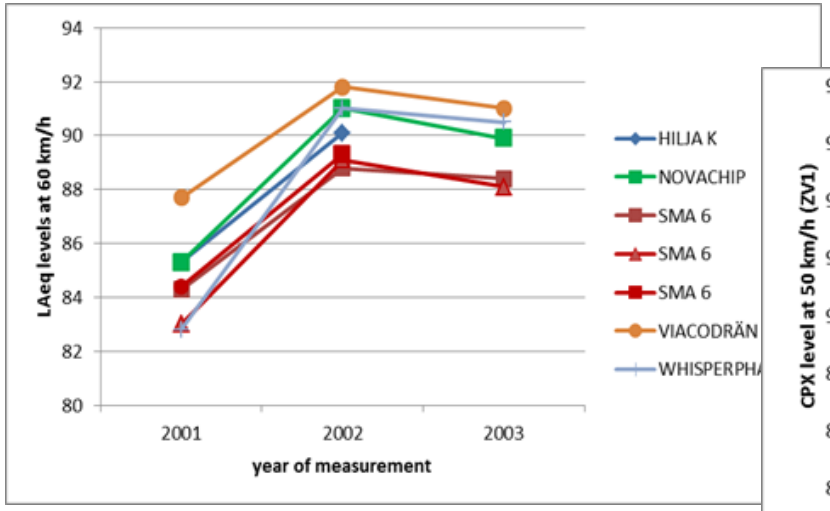
1. Collect data

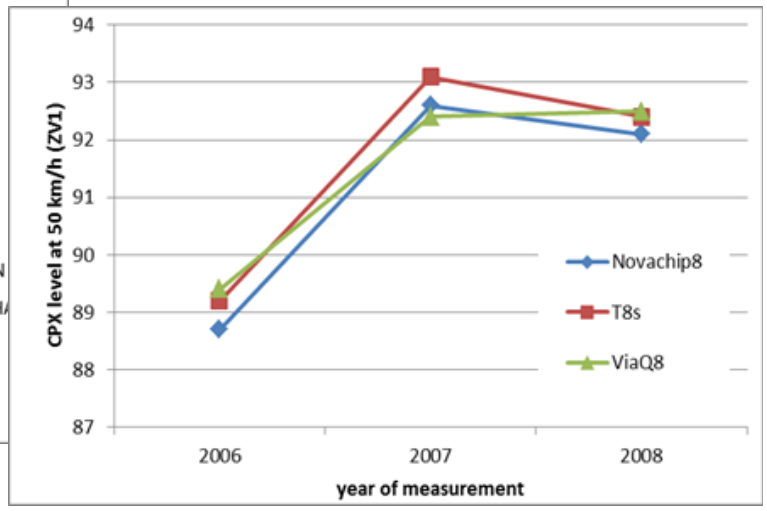
Received data from UK, E, S, N, SF, D, NL, DK,…



General observation

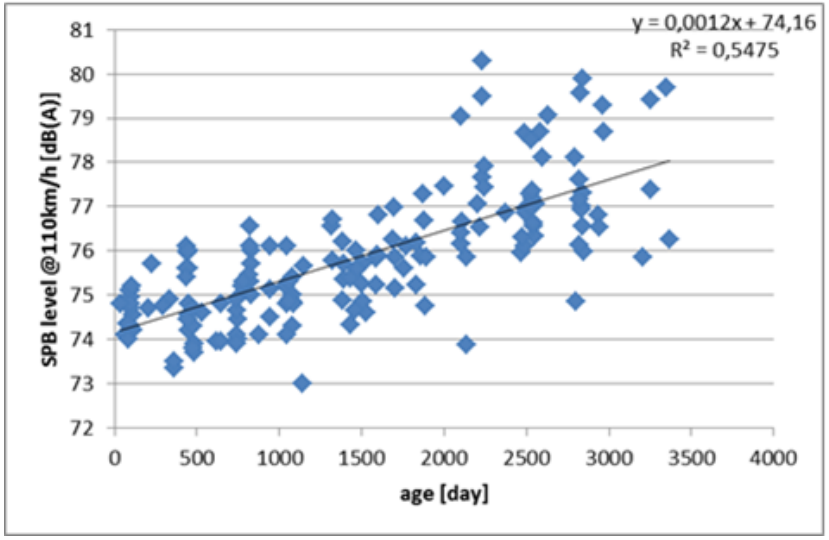
1. All data indicate loss of performance over time
2. Sound level increases between 0,3 and 2 dB/year
3. Trends are similar over Europe with the exception of Scandinavia where 4 to 6 dB increase after one year were reported (see graphs from N and SF)

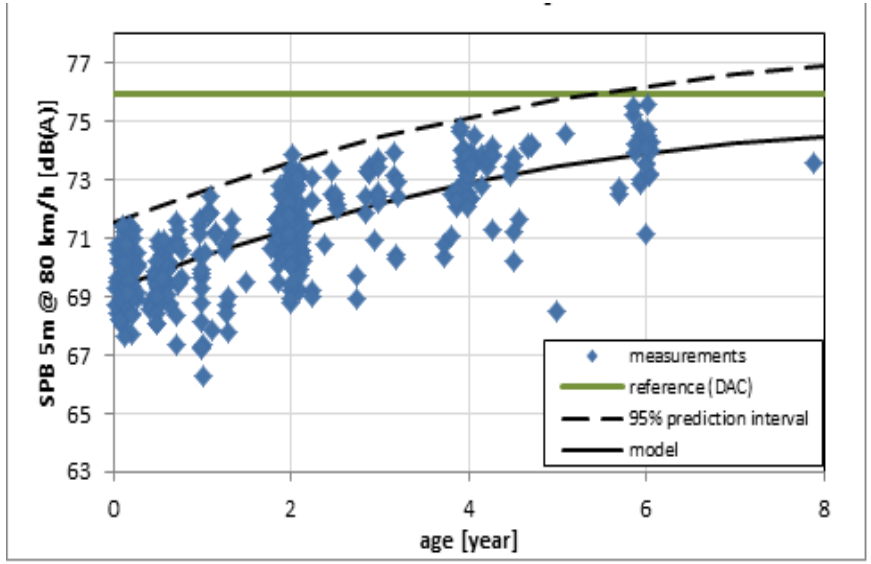




2. Understand aging and model it

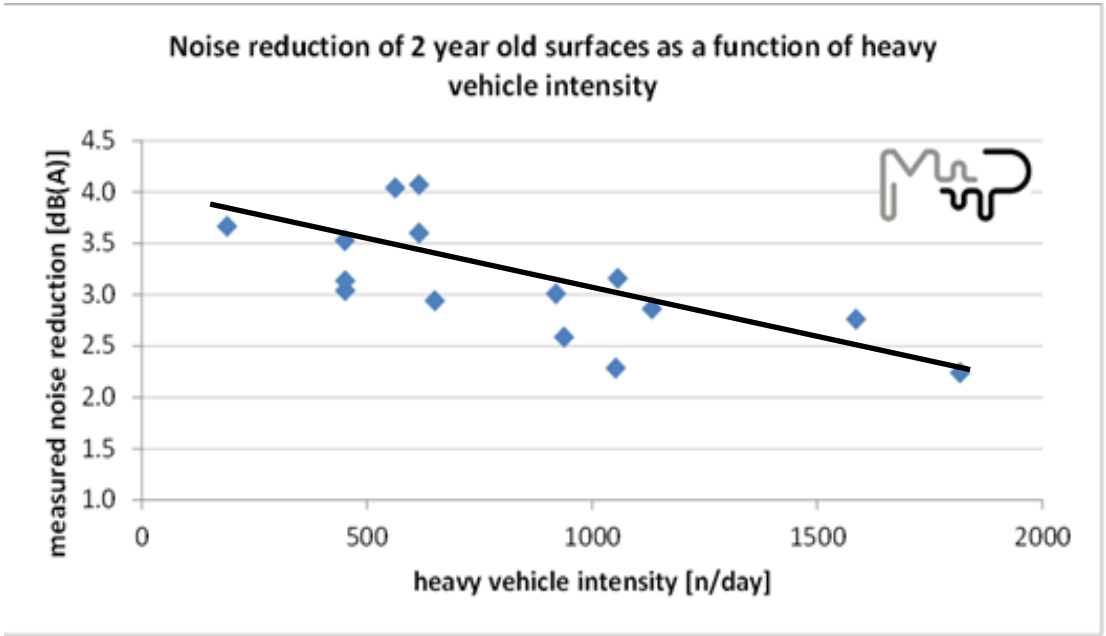
- Both linear and exponential relations are reported
  - preference for exponential decay of reduction effect





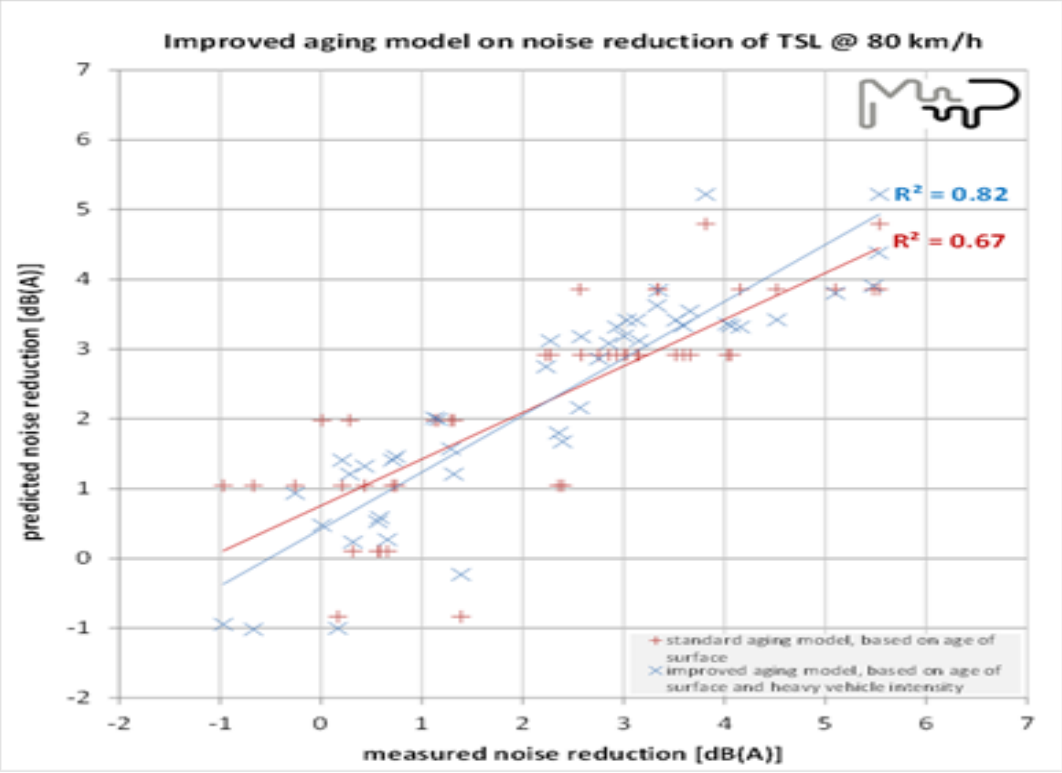
2. Understand aging and model it (2)

- Identifying relevant parameters
  - Intensity of heavy vehicles affects performance loss



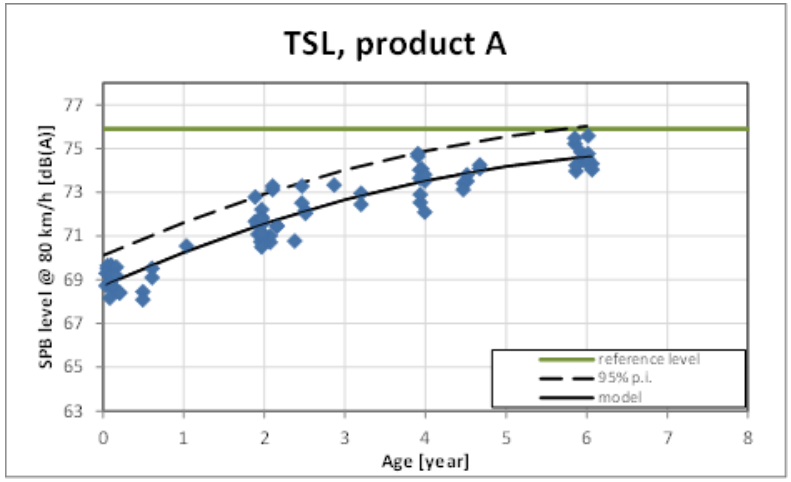
2. Understand aging and model it (3)

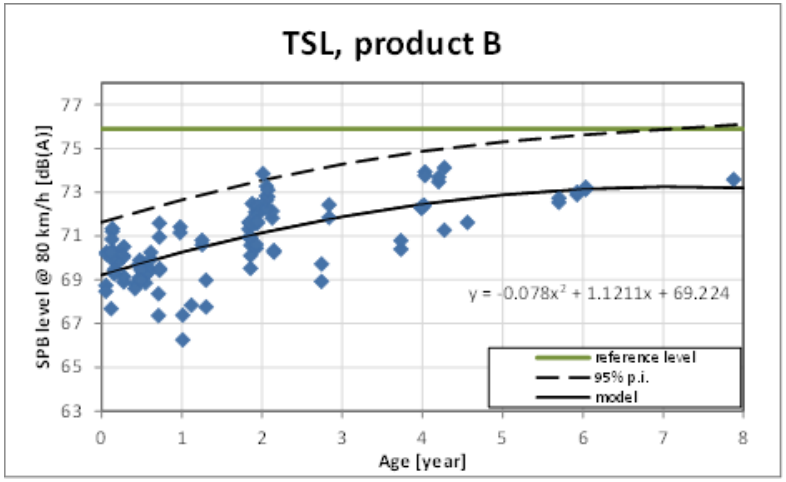
- Adding HDV Intensity improves prediction quality
- Formula for Thin Surface Layers (TSL) on regional roads:
  - using only age: r2=0,67
  - Using also HDV intensity: r2=0,82



2. Understand aging and model it (4)

- Manufacturers quality is relevant
  - Example: TSL from producer A and producer B
  - Same initial value: 6 dB reduction
  - After 6 years:
    - Product A: 1 dB reduction
    - Product B: 3 dB reduction

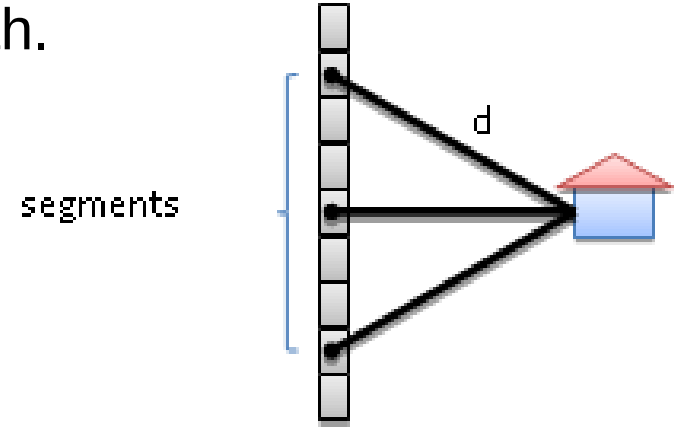




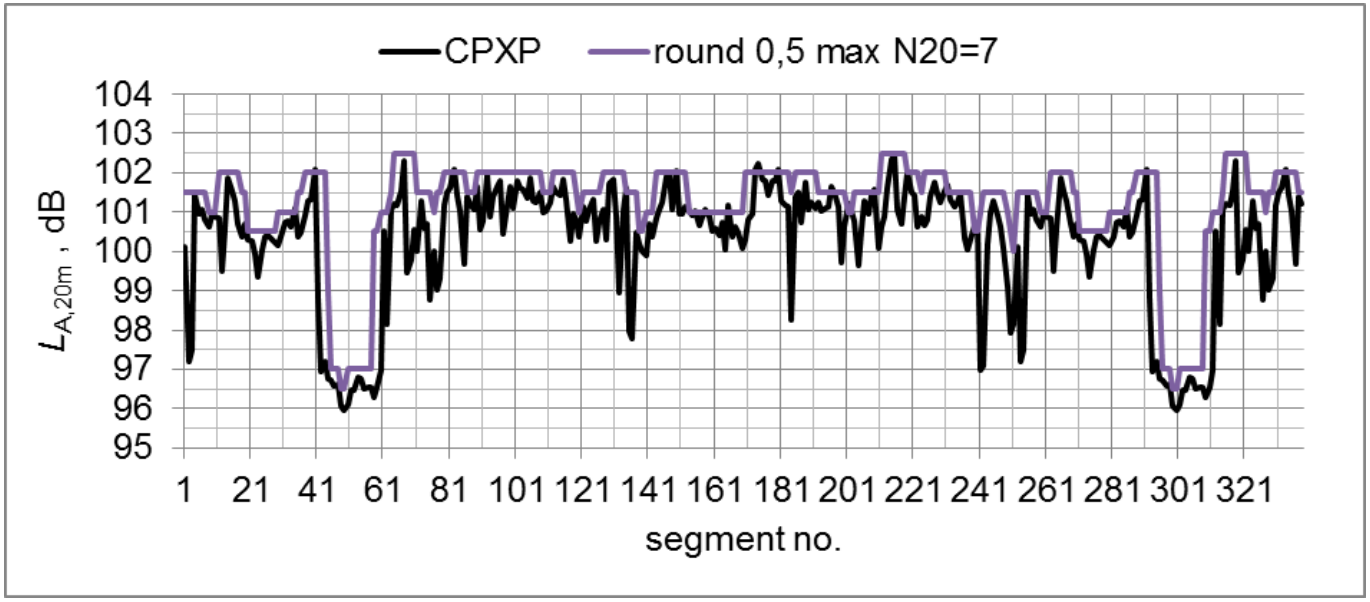
Develop scheme for lifetime monitoring

- Most adequate system: CPX

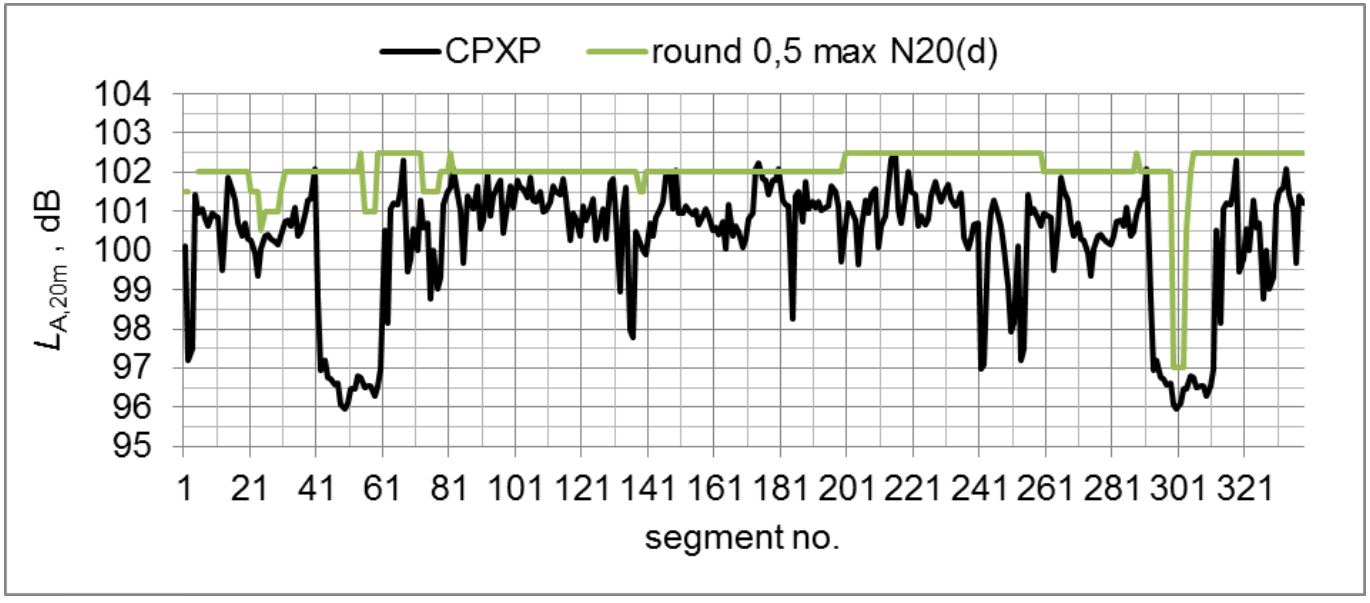
- Challenge: choice of evaluation length.
  - Proposed: 7 times distance road-receiver:
    - 20 m →140 m
    - 50 m → 350 m



Aggregation of segments for evaluation length



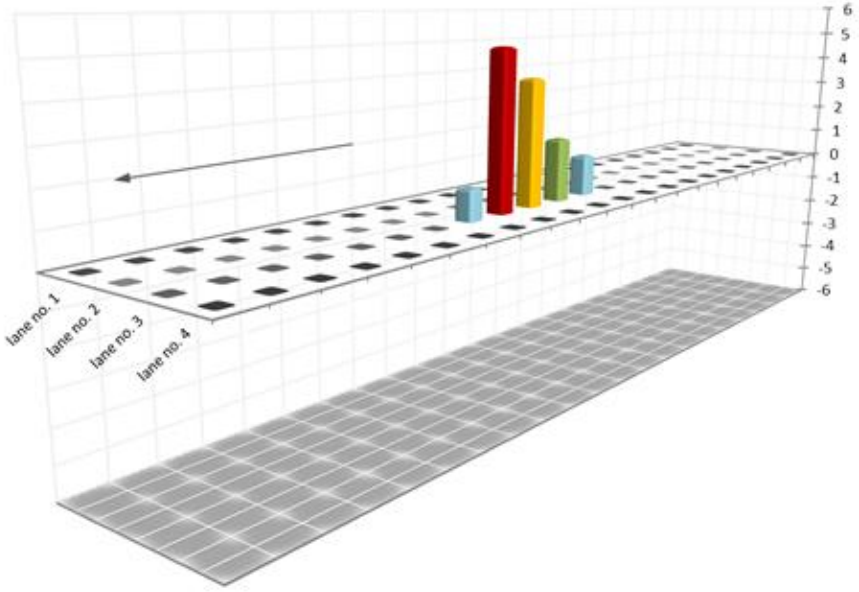
- Max value over 7 20m segments, rounded to 0.5 dB (independent of receiver distance



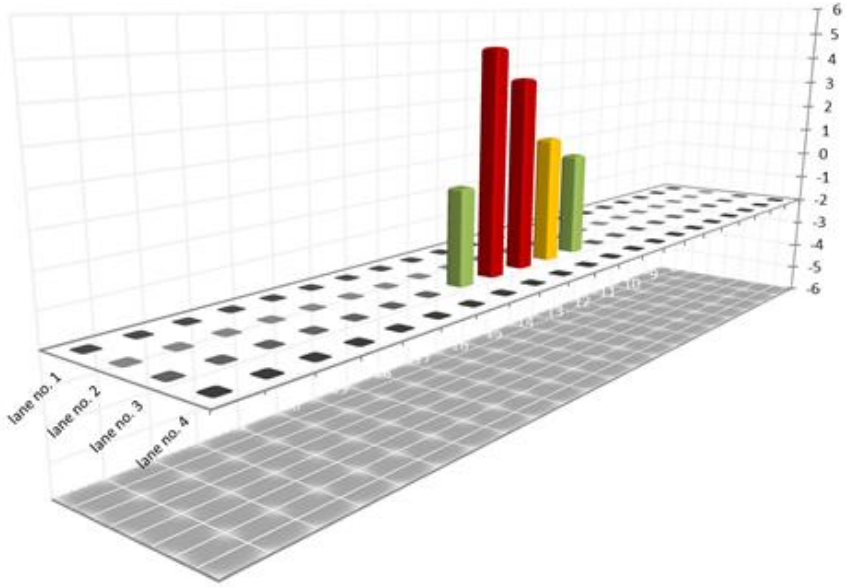
- Define segment length using receiver distance. Max value of the overlapping segments at one 20m segment

Zero Rating Niveau - Example

- *Zero Rating Niveau: Stipulated noise reduction value (or CPX level) of road surface or similar*
- *Determine acoustic condition based on five-stage scale*



ZRN = 0 dB



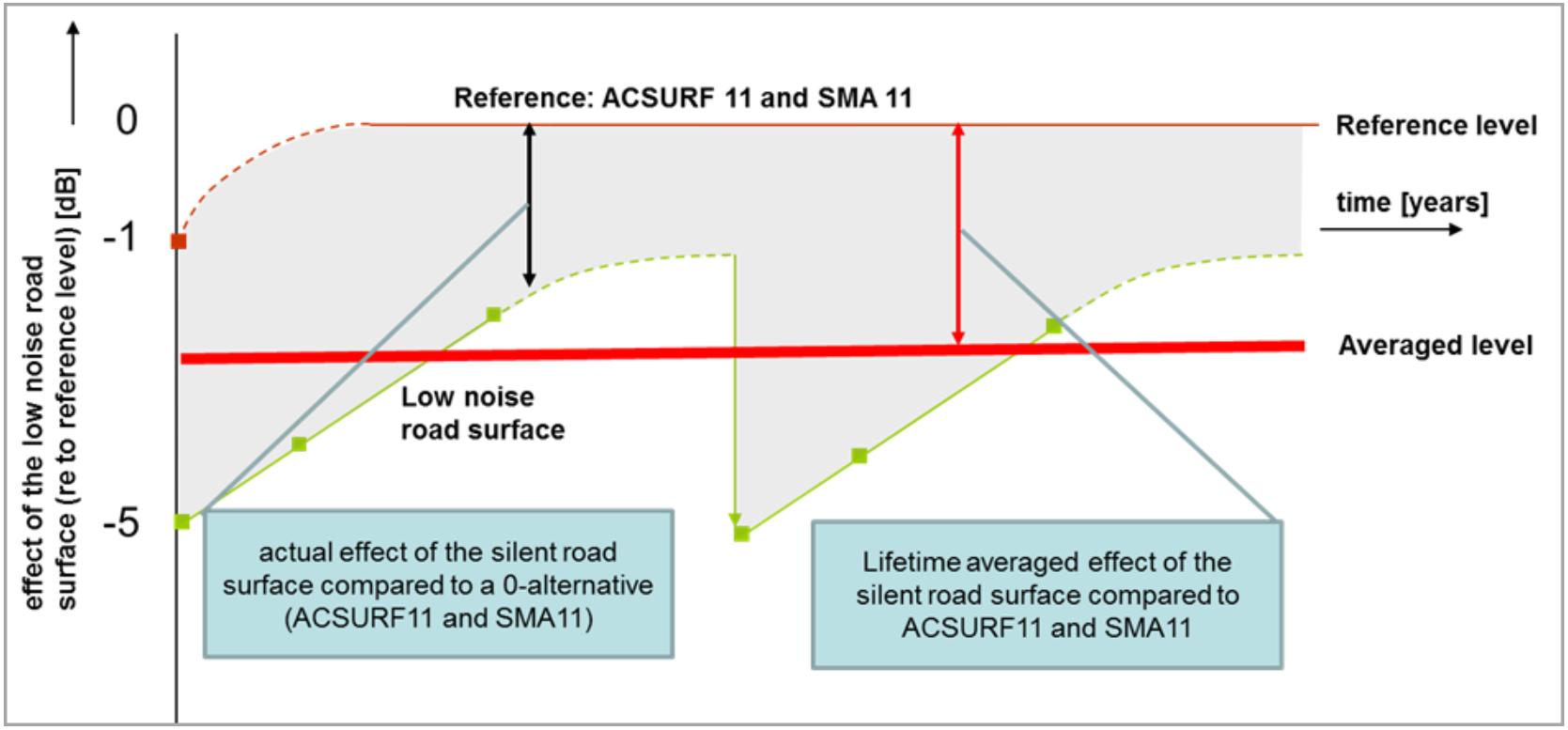
ZRN = -2 dB

Life-cycle performance

- First impression
  - Low noise surfaces perform excellent when new, but quickly loose their noise suppressing effect
  - Why bother to spend this extra money?

- Second thought
  - You should compare them to a fair reference, namely a “normal” surface of the same age
  - Accept a more frequent renewal
  - Discuss the total life averaged affect against the costs

Reduction in comparison to standard dense asphalt concrete reference surface type.



Initial effect : -4 dB, assumed final effect: -0,5 dB, actual final effect -1,5 dB, lifetime averaged effect -3,0 dB.

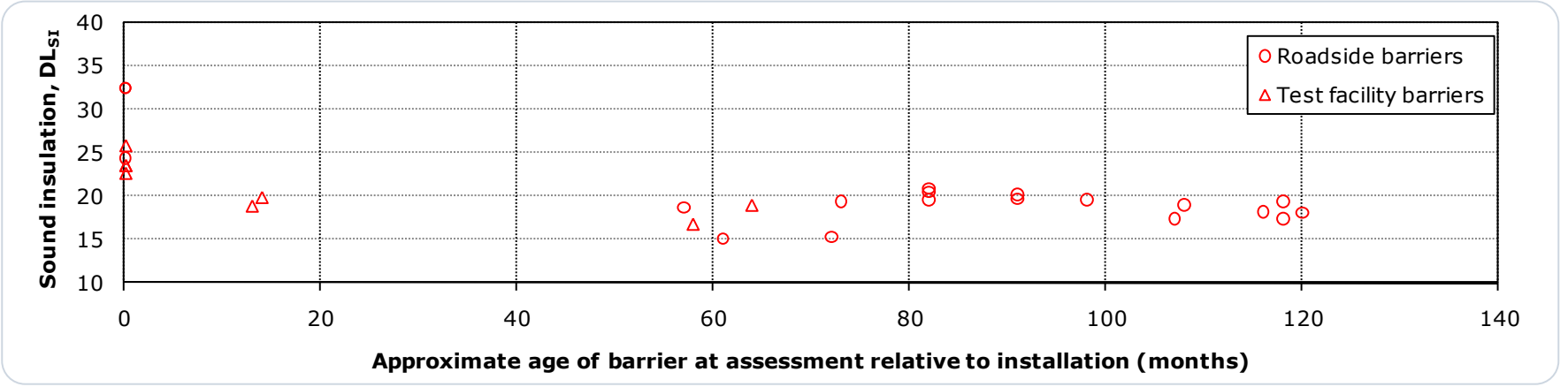
Life-cycle costs compared to benefits

- The financial benefits of low noise surfaces are :
  - hedonic pricing (2003 figure 25 €/household/dB/yr.)
  - the effect on house prices and the increased availability of building areas close to road
  - the direct savings in treatment of health problems and valuation of extra healthy life years
  - the savings on abatement measures
- The costs lie in the initial plus more frequent renewal costs of the surface.

- Several studies show that in populated areas benefit to cost ratio's for noise reducing surfaces exceed 1.

Noise barrier durability

- Limited data is available on acoustic durability
  - Not always a mandatory requirement to report this data
  - Appropriate test methods only recently developed (EN/1793-6)
  - Any data largely based on manufacturer expert judgement
  - Measurement data primarily for timber barriers (TRL, 2010) – insufficient data to draw robust conclusions



Causes of degradation/poor performance

- Acoustic degradation primarily affects timber barriers and poorly protected/fitted sound absorptive materials
- Impact of effects on noise levels at residences will vary
- Regular inspection/monitoring allows better control/maintenance

Do You Have Any Questions?