



CALM Workshop

Quiet City Transport Project Presentation

Brussels, June 16, 2005
presented by Geert Desanghere, Akron
On behalf of Mr. Nilsson, Acoustic Control





Figures and Facts :

- ✓ FP6 - Integrated project
- ✓ 01-02-2005 - 30-01-2008
- ✓ Turn on: 13.5 milj. Euros
- ✓ EC Contribution: 7.4 milj. Euros
- ✓ 31 partners
- ✓ link: www.aptserver.com/qcitystart.php





General AIMS

- ✓ to develop an integrated technology infrastructure for the efficient control of road & rail ambient noise by considering the attenuation of noise creation at source at both vehicle/infrastructure levels.
- ✓ to support European noise policy to eliminate harmful effects of noise exposure & decrease levels of transport noise creation, especially in urban areas,
- ✓ to provide municipalities with tools to establish noise maps and actions plans (Directive 2002/49/EC) and to provide them with a broad range of validated technical solutions for the specific hot-spot problems they encounter in their specific city.





Key points:

General applicability means that a specific measure for vehicles should be applicable to all vehicles and not to one specific component or one specific vehicle.

At the 18 months interval, **a selection** will be made of those measures which will be further developed in SP5: detailed design, prototype building and testing, validation in situ.





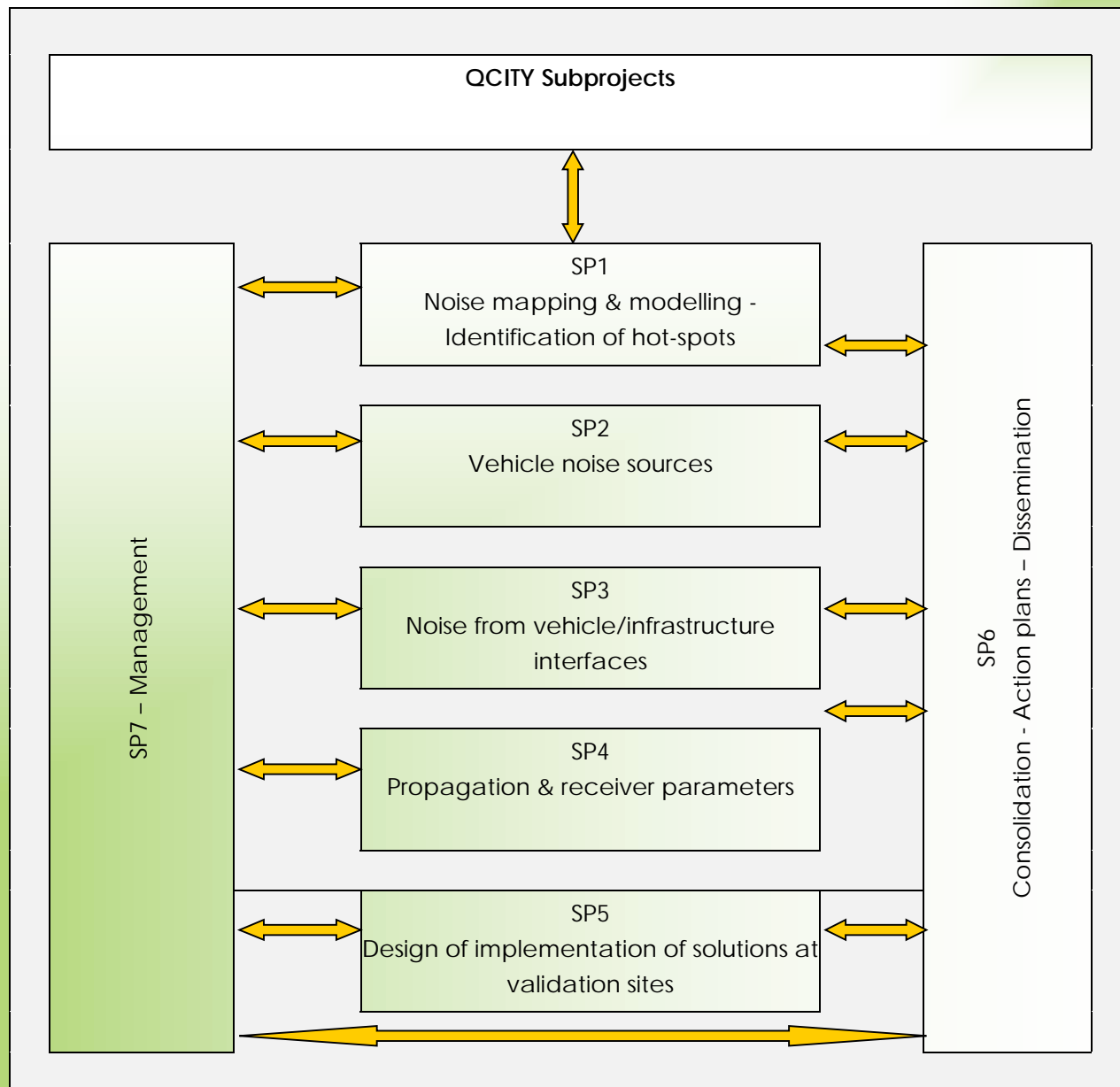
- ✓ direct extension of the EC policy of Quieter Surface Transport holistic approach towards noise reduction
- ✓ to provide **practical solutions**
- ✓ that can be **realistically implemented** both from an economic as well as from a practical point of view.
- ✓ driven **by stakeholders** in the noise reduction process (cities, urban transportation authorities and their consultants in co-operation with specialised manufacturers).

The project therefore does not start from a supplier's viewpoint, but **from a buyer's point of view**: cities that require noise maps with indication of hotspots and action plans that will require new solutions to reduce the overall noise levels.



Partners

1	Acoustic Control	SE
2	Accon	DE
3	Akron	BE
4	Amec Spie Rail	FR
5	Alfa Products & Technologies	BE
6	Banverket	SE
7	Composite Damping Material	BE
8	Havenbedrijf Oostende	BE
9	Frateur de Pourcq	BE
10	Goodyear	LU
11	Head Acoustics	DE
12	Heijmans Infra	BE
13	Royal Institute of Technology	SE
14	Vlaamse Vervoersmaatschappij DE LIJN	BE
15	Lucchini	IT
16	NCC Roads	SE
18	Stockholm Environmental & Health Administration	SE
20	Société des Transports Intercommunaux de Bruxelles	BE
21	Netherlands Organisation for Applied Scientific Research	NL
23	Trafikkontoret Göteborg	SE
24	Tram SA	GR
25	TT&E Consultants	GR
27	University of Cambridge	UK
28	University of Thessaly	GR
29	Voestalpine Schienen	AU
30	Zbloc Norden	SE
31	Union of European Railway Industries	BE



SP1 – Noise maps & modelling	Analysis of hot spots in city noise-maps. Detailed analysis with aid of simulation task & measurements.
SP2 – Vehicle sources	Development & validation of pertinent tools for control of noise at the source from road & rail traffic, including traffic control.
SP3 – Vehicle/infrastructure interface	Development & validation of pertinent tools for control of noise by change of the vehicle/infrastructure interface for road & rail traffic (tyre/road & wheel/rail).
SP4 – Propagation & receiver parameters	Development & validation of tools that work on sound propagation and receiver parameters, including town planning.
SP5 - Design and implementation of solutions at validation sites	Final detailed design of all solutions retained. Implementation and validation of solutions in cities concerned. Validation sites for dissemination and promotion purposes.
SP6 - Consolidation - Action plans – Dissemination	
SP7 – Management	This subproject & its steering committee will link activities in SP1, SP2, SP3 & SP4 to a number of optimised noise control packages for use in city areas.

SP1 – Noise mapping & modelling - Identification of noise hot-spots

- update of the existing available noise maps for the cities and with the identification of hotspots and quiet areas on the noise maps.
- the sensitivity of the calculations in regards to traffic data and selected receptor points will be investigated.
- relevant figures on noise annoyance and sleep disturbance as well as their monetary effect will also be linked to the noise maps.
- the noise maps will later be recalculated with the inclusion of the proposed mitigation measures.
- software compatible with the EU-Directive will be used. No new software development is required.

Antwerp particular attention to validation of new combined tram/road noise concepts in large refurbishment project (Hoboken) and potential exploitation of results in maritime sector/harbour.

Athens particular attention to tram infrastructure noise & motorbike noise

Brussels particular attention to tram vehicle noise

Caen particular attention to guided trambus (one rail) noise

Göteborg Particular attention to road noise

Augsburg particular attention to town planning

Ostend Particular attention to freight trains and exploitation of results in maritime sector

Stockholm particular attention to the airborne metro noise, train noise, cars and town planning

Stuttgart Particular attention to noise from trucks and traffic flow



Workpackage 1.1 Noise maps: initial situations

- 1.1.1 Automated hot-spot detection from noise maps: Noise Environment Rating Model
- 1.1.2 Noise Mapping of the selected cities..
 - Preliminary discussions on possible mitigation actions.
 - Analysis of hot spots with respect to the city's noise score rating model.
- 1.1.3 Linking outcomes of detailed mitigation studies in which dedicated specific noise calculation tools are used, to the global noise maps..
- 1.1.4 Intermediate evaluation of benefits from mitigation measures



Workpackage 1.2 Noise maps after integrating action plan measures

- 1.2.1 How to produce relevant figures on **noise annoyance, sleep disturbance, and monetary valuation** on the basis of noise maps, using the Position Papers of WG2 / WG HSEA, which have been founded by EU/DG Env on these subjects .
- 1.2.2 Linking in more detail outcomes of elaborated mitigation studies in which dedicated specific noise calculation tools are used, to the global noise maps.
- 1.2.3 **Final evaluation of benefits** from mitigation measures as proposed for the prototypical situation by recalculating noise maps after incorporating mitigation measures.



SP2 – Perception of vehicle noise sources: cars, trucks, busses, motorbikes, trams, surface metros, trains

Sub-Project 2 will **investigate the level of contribution for the various vehicle noise sources** using good quality road, rail and wheel surfaces. These noise sources will be further evaluated from a quantitative point of view to obtain an insight in why some noise is **perceived as more aggressive**. The project will consider a variety of mitigation options that are **not only limited to technical solutions**, but also include traffic control; measures and driver behaviour.



Workpackage 2.1 Identify/rank perception of noise sources under following conditions

- constant speed;
- acceleration/deceleration;
- standstill (loading/unloading).

2.1.1 **Qualitative identification** of relative importance of wheel, rail, traction, exhaust, tyre, road, ... for different transportation means based upon evaluation of existing data bases (considering good quality road surface and good quality wheel/rail surfaces)

2.1.2 **Evaluate evolution** of noise source intensities in future taking into account future requirements of pass-by noise tests

Workpackage 2.2 Subjective perception of noise sources

2.2.1 **Identification of modern vehicles** which comply with pass-by noise test requirements.

2.2.2 **Evaluation of noise perception** of these vehicles:

- Identify more "aggressive" sources;
- Define "penalty" or "premium" values for different noise sources according perception of noise.

Workpackage 2.3 Evaluate noise mitigation measures

2.3.1 **Retrofit measures** (shielding of sources, vehicle skirts, ...): analysis based on existing know-how

2.3.2 **Traffic control measures**

Noise reduction action plans need to take into account a wide range of different options to reduce noise. In order to relate technical improvements investigated in the QCITY project to other means of noise reduction, some effort will be put in calculation of such effects. This work package will look into the effects of traffic control measures in this respect.

Method

For global effects, the Sampers transportation modelling system (Transek, Sweden) will be used, which contains a multimodal travel demand model system.

For more detailed analysis (hot spots and quiet areas), a micro simulation system like Aimsun (TSS, Spain) or Vissim (PTV, Germany) will be used.

Different scenarios with respect to traffic control strategies will be analysed and compared.

Workpackage 2.3 Evaluate noise mitigation measures

2.3.3 Driver behavioural measures

to study impact of Intelligent Speed Adaptation systems, affecting individual acceleration and deceleration behaviour.

2.3.4 Car ownership effects (car type restrictions) and effects of market take-up of low-noise vehicles.

Scenarios

- no policy change;
- general car restriction policy (congestion charges, traffic control, improved public transport supply);
- car type differentiated restriction policy;
- car type promotion policy.

2.3.5 Interchange measures between different transportation means

The EU (Clean urban transport) is working to promote a more sustainable mobility by a number of measures. Many of these are directed towards changing to more sustainable modes:

- promoting market take-up of lower-consumption vehicles and new propulsion technologies to reduce emissions;
- promoting the use of Improved collective and non-motorised modes in conjunction with mobility management schemes;
- demand management schemes such as parking controls and access restrictions;
- information systems for better traffic management and improving traffic flow;
- integrated intermodal freight and passenger transport systems such as city logistics and improved terminals;
- fair and efficient pricing regimes;
- supporting integrated land-use and urban transport planning to minimise the need to travel and facilitate collective transport;
- promoting efficient public transport modes to people with reduced mobility;
- supporting and promoting cycling;
- possible contribution of Teleworking.



Workpackage 2.3 Evaluate noise mitigation measures

2.3.6 Rank all the above developed mitigation measures considering performance/cost, general applicability and general acceptance





SP3 – Vehicle/infrastructure interface related noise (wheel/rail and tyre/road)

Sub-Project 3 is focussed on addressing the noise problem caused at the **vehicle/infrastructure interface**.

- For rail transport systems we start with a state of the art system and investigate the effects on noise for a number of fundamental variables that affect the **wheel/rail interface**: quality, geometry, and material properties. We will also study the indirect effects from the rail infrastructure: rail fastening systems, track sub-base, special trackwork, and track layout, as well as special issues such as wheel squeal and corrugation.
- On the road site, we also start with a state of the art **tyre/road system** and the effect of potential measures such as optimisation of the **thread pattern**, near field shielding, porous and wave bearing road surfaces. Indeed, it is the roughness of the road surface that is responsible for exciting the tyre. Since it is not realistic to expect smooth roads in the urban environment, road surface solutions will have to come from sound absorbing roads that are created by **poroelastic road surfaces**.

Based on the rankings of the above discussed technologies, a selection will be made that will be validated in various cities, and their performance will be measured (SP5).



Workpackage 3.1 *Quantification of effect of contributing parameters to wheel/rail noise*

- 3.1.1 Definition of a reference system for tram, surface metro & freight train to compare against in quantification analyses
- 3.1.2 Evaluation of effect of wheel & rail quality
- 3.1.3 Evaluation of effect of wheel & rail geometry (New shapes – profile grinding, ...)
- 3.1.4 Evaluation of effect of material properties (hardness, steel type, ...)
- 3.1.5 Evaluation of effect of rail fastening system (discrete, continuous, ...)
- 3.1.6 Evaluation of effect of track system (Surface – sub-base) (ballast, concrete, road surface type)
- 3.1.7 Evaluation of effect of contributing parameters to wheel/rail noise in special trackwork
- 3.1.8 Evaluation of effect of track lay-out (e.g. curves) on wheel/rail noise, including effects such as squeal/corrugation



Workpackage 3.2 *Quantification of effect of mitigation measures for wheel/rail noise*

- 3.2.1 Mitigation measures for wheels such as dampers, resilient wheels, wheel turning, ...
- 3.2.2 Mitigation measures for rail such as:
 - Fastening system – grinding – rail dampers – special trackwork treatment – geometrical changes - special rail designs such as rail with increased web thickness – saddle profile rail – full profile rail.
- 3.2.3 Ranking of mitigation measures and contributing parameters considering performance/costs/ general applicability/general acceptance.

Most of the work to be carried out in this WP will be based on existing technology and available studies.





Workpackage 3.3 Quantification of noise emission of existing different tyres and road surfaces

3.3.1 Develop and build a **new suitable trailer for CPX** measurements of tyre/road noise from passenger car tyres.

Definition of a **reference testing system for tyre/road interaction** to compare against in quantification analysis

3.3.2 Measure noise emission from 10-15 currently used **passenger car tyres** and 5-8 types of truck tyres using CPX, drum and pass-by techniques.

3.3.3 Evaluation of **effect of road surface**

Perform measurements of typical source heights for modern passenger car tyres

Evaluation of effect of **tread design**

Perform measurements of noise generation from **road joints, road markings and rail crossings** for 4-5 different tyre brands.

Evaluation of effect of **tyre geometry**



Workpackage 3.4 Parametric studies of tires and road parameters

Try to understand the physics of certain parameter changes that earlier have proven to result in noise reduction but never been fully understood. Examples of such parameter changes are :

- filling tyres with solid polyurethan rubber instead of air, changing the tyre gross dimensions from wide and low to high and narrow (10 dB reductions have been found).
- mobility measurements near the contact edges, modal analysis, wave number decomposition, contact pressure distribution measurements, ... will be used in order to find the mechanisms of the found noise reductions.

The gained knowledge on what underlying parameters that governs the reduced sound emission will be used in an attempt to apply them in order to quiet current tyre constructions.

Workpackage 3.5 Refine & optimise the road surface

- road surfaces which are poroelastic (i.e. both display permeable communicating pores in the surface and substantially increased elasticity) can be very quiet. 12-14 dB(A)
- but problems with wear still have to be tackled. A new technique for pre-coating the rubber with bitumen has though shown promising characteristics.
- Other means for creating poroelastic road surface characteristics will also be tested such as using a twin layer technique where the upper layer is made as a rather conventional open graded asphalt mix, while the lower layer is designed to display a high compliance.
- Another challenge is to achieve acceptable wear characteristics with as small stone sizes in the mix as possible. It has e.g. been found that 5-mm typical max. stone size will give 2-4 dB(A) units more noise reduction as compared to a mix with 8-mm typical max. stone size.



SP4 – Noise propagation & receiver perception

Sub-Project 4 explores **new ways to reduce noise propagation** and alter the receiver perception. The task of town planning is explored to engage in new possibilities of using new buildings in a variety of ways to help reduce noise an/or make it more acceptable to residents.

The benefits of following scenario's will be explored:

- traditional sound walls,
- using continuous buildings as a sound wall,
- taking advantage of the orientation of the building, in combination with the internal layout of the building.
- changes in perception of noise from the way buildings are designed with features that provide for a better, more acceptable perception of noise, The question of limiting noise in urban areas can no longer be restricted to transport noise sources. It's also an essential part of present town planning and development of sustainable and attractive living environments.



Workpackage 4.1 Quantify influence of propagation media and of screening effects

4.1.1 Quantify influence of propagation media:

- absorbing or reflective surfaces
- urban typical formation, walkpaths
- open spaces, squares, green areas, vegetation

4.1.2 Quantify influence of screening effects :

- earth formations
- noise barriers

Workpackage 4.2 Quantify influence of local town planning

Quantify influence of local town planning involving:

- land use planning;
- type of building;
- location of the building in propagation area ;
- building orientation in function of the source;
- internal lay-out;
- type external structure (walls, glazing, ...);
- climatic conditions.



Workpackage 4.3 Define adequate performance evaluation tool

Definition of an adequate performance evaluation tool from receiver point of view including both physical descriptor, cost ratio and population opinion assessment procedures

Workpackage 4.4 Propose solutions after preliminary theoretical assessment

Propose solutions in the area of noise propagation and receiver perception after preliminary theoretical assessment to be retained for further development after the 18 months initial period





SP5 - Design & implementation of solutions at validation sites (after month 18)

Detailed design of the selected mitigation measures for the hot spots to be studied in the cities concerned:

- Workpackage 5.1* *Antwerp validation site – Quiet road for busses combined with trams*
- Workpackage 5.2* *Athens validation site – Quiet tram tracks*
- Workpackage 5.3* *Brussels validation site – Quiet tram vehicles on quiet tracks*
- Workpackage 5.4* *Caen validation site – Guided trambus vehicle*
- Workpackage 5.5* *Göteborg validation site – Poroelastic road*
- Workpackage 5.6* *Augsburg – Town planning*
- Workpackage 5.7* *Ostend validation site – (freight operations in urban maritime environment)*
- Workpackage 5.8* *Stockholm validation site 1 (traffic control)*
- Workpackage 5.9* *Stockholm validation site 2 (Suburban rail)*
- Workpackage 5.10* *Stuttgart validation site – Town planning(trucks)*
- Workpackage 5.11* *Test of new quiet passenger tyre designs*
- Workpackage 5.12* *Design & implement source related measures for validation purposes*
- Workpackage 5.13* *City areas with quiet vehicles*
- Workpackage 5.14* *Case study on receiver perception tests*





SP6 – Consolidation – Action Plans - Dissemination

Workpackage 6.1 Consolidation of technical project results

WP6 will **consolidate the knowledge** gained into a practical guide on how to tackle the complex issue of noise reduction in an urban environment. The document will comprise only **realistically applicable and affordable** solutions with estimates of their benefits in absolute and perceived terms.

In this SP, the ranking of the measures obtained in SP2 (sources), SP3 (interfaces) and SP4 (propagation and receiver) will be evaluated.

For **each test site** (each city), a specific measure will be selected to be implemented (in function of the problem to be addressed in that city). This specific measures will be designed (detailed design), implemented and validated (SP5). The knowledge gained after validation will be consolidated.

Workpackage 6.2 Action Plans

The **tentative contents of the action** plans will be determined.

Action plans will be produced for all the cities involved (related to the hot-spot section studied).

Workpackage 6.3 Dissemination

International organisation such as UITP, and UNIFE will be asked to **disseminate** the results to their members. A particular amount of money is reserved to pay these organisations for this dissemination work.

