

QCITY: PROVIDING CITIES A GUIDE FOR NOISE ACTION PLANS

Ir. Tom Vanhonacker^a
Dr.Ir. Geert Desanghere^b
D2S International
J. Vandenbemptlaan 71
3001 – Heverlee
BELGIUM

1 INTRODUCTION

QCITY (Quiet City Transport) is an integrated research project sponsored by the EC-sixth research framework, currently in progress: February 2005 - January 2009. Twenty seven partners are working to develop an integrated technology infrastructure for the efficient control of road and rail ambient noise in urban areas.

A major objective is to provide municipalities with tools to establish noise maps and action plans and to provide them with a broad range of validated technical solutions for specific hot-spot problems they may encounter in their specific city.

This document describes the first results of the part of the study that aims at establishing a library of validated technical mitigation measures. Further in the research project, a decision making tool will be designed to assist the selection of noise measures in a specific city. Also the results of 15 validation projects as well as other types of measures such as economic incentives, will be added to the library.

2 CITY ACTION DRIVEN

As a starting point, a list of complaints made by the citizens of Stockholm has been taken and the types of required mitigation measures were identified.

For example, below the list of complaints for urban rail transport is given for the city of Stockholm, differentiated in different types of actions needed:

- GM: Global Mitigation measures;
- LC: Local Complaint handling;
- TC: Temporary Construction work.
- VH: Vehicle Noise

^a Email address: tom.vanhonacker@d2sint.com

^b Email address: geert.desanghere@d2sint.com
www.d2sint.com

complaint	required action
High equivalent noise levels	GM
	GM
High maximum noise levels	GM
Squealing	LC
Rattling from the trains and rails	LC
Breaking at stations	LC
Announcements from loud speakers at stations	LC
Fans and other equipment on stationary trains	VH
Squealing in curves	LC
Signal sounds from railway crossings	LC
Noise from the depots	LC/GM
Vehicles that grind the rails	TC
Work on and around the rails	TC
Heater construction on new commuter trains	VH
Noise reflection from new buildings	LC/GM
Whining sound around lone tall building	GM
Point effects	GM
Worn rail	LC
Construction, maintenance and repairing of the rail	TC
High noise levels from bridges, particularly steel constructions	LC
High noise levels where "sensitive" groups reside, e.g. schools, nursing homes etc	GM

Analysis of the complaints led to a wide spread of required actions: both local actions for a small number of annoyed people as well as global measures for major parts of the network are needed. Also (temporary) construction work causes major complaints, but those are outside the scope of the project as well as pure vehicle noise. Later on, vehicle noise will be included but only as far as it can be influenced by the cities. Cities cannot carry out technical modifications on vehicles but only influence the use of vehicles and the road network by local regulations and/or economic incentives.

Therefore, in the first part of the project the QCITY project mainly deals with:

1. noise maps and action plans, according to Directive 2002/49/EC and
2. complaint identification and solution.

3 GLOBAL MITIGATION PLANS AND LOCAL COMPLAINT ACTIONS

Difference between global and local complaints is needed because there is not always a relation between hot-spots identified in the noise maps and complaints identified by the inhabitants. This can be due to various reasons:

- the complaint is local, affecting a too small number of citizens to yield a high noise score in the hot-spot detection methods
- the L_{den} and L_{night} descriptors as used in global noise maps are not sensitive to noise sources that may locally cause considerable annoyance such as squealing, ...
- the methods used for the noise mapping do not always correctly include the local high noise generators.

Some of the work reported in this project gives a good illustration of this duality. This is illustrated underneath for a small part of the city of Brussels: 0,5 km², 6600 inhabitants, 1100 houses. The effect of both a local mitigation method (elimination of squeal noise) as well as a global mitigation method (rail grinding) is evaluated.

Squeal noise (tramways in curve) requires a local complaint handling measure. It modifies the rail noise reception for, e.g., ±100 inhabitants, but no effect can be seen in the global noise maps and tables of annoyed. Only when analysing the rail noise alone, some small differences can be observed.

This measure is being tested in practice (by lubrication device). When the device has been put out of work for one week, the city/operator reported immediate complaints and threats with legal actions.

Although the number of people affected is small and its appearance in global noise maps is nihil, squeal noise mitigation measures are an important contribution to the sustainability of urban transport.

Squeal noise – number of inhabitants exposed

	Inhabitants of a building with a value at the most exposed façades inside the specified range	
	Original	Squeal noise difference
Road & Rail		
... < L _{den} < 55 dB	1092	0
55 ≤ L _{den} < 60 dB	233	0
60 ≤ L _{den} < 65 dB	1572	0
65 ≤ L _{den} < 70 dB	885	0
70 ≤ L _{den} < 75 dB	625	0
75 ≤ L _{den} < ...	1977	0
sum	6381	0
Rail only		
... < L _{den} < 55 dB	4337	0
55 ≤ L _{den} < 60 dB	574	81
60 ≤ L _{den} < 65 dB	526	76
65 ≤ L _{den} < 70 dB	887	-97
70 ≤ L _{den} < 75 dB	39	-39
75 ≤ L _{den} < ...	21	21
sum	6384	0

Rail grinding is a global mitigation measure. It has a noticeable important impact on ±10% of all inhabitants (along the track) with at least 5 dB(A) reduction, when regarding rail noise only.

But rail noise is only a minor part of the total noise (definitely when it is expressed as LAeq). So in the global evaluation, only 0.5% of the inhabitants are influenced on category.

Rail grinding – number of inhabitants exposed

	Inhabitants of a building with a value at the most exposed façades inside the specified range	
	Original	Rail grinding difference
Road & Rail		
... < L _{den} < 55 dB	1092	0
55 ≤ L _{den} < 60 dB	233	0
60 ≤ L _{den} < 65 dB	1572	0
65 ≤ L _{den} < 70 dB	885	0
70 ≤ L _{den} < 75 dB	625	32
75 ≤ L _{den} < ...	1977	-11
sum	6381	-21
Rail only		
... < L _{den} < 55 dB	4337	686
55 ≤ L _{den} < 60 dB	574	562
60 ≤ L _{den} < 65 dB	526	-342
65 ≤ L _{den} < 70 dB	887	-843
70 ≤ L _{den} < 75 dB	39	-39
75 ≤ L _{den} < ...	21	-21
sum	6384	-

4 LIST OF MITIGATION MEASURES

Based on contributions from the partners involved in this part of the QCITY project, a list of ±100 validated mitigation measures was retained. They were grouped in five sub-lists:

- Global Mitigation Measures (GM):
 - Traffic flow;
 - Road traffic;
 - Rail transport;
 - Noise propagation;
- Local Complaint Handling (LC):
 - Rail.

Each list consists of:

- a table with information on potential noise reduction and a first cost estimate for each mitigation measure;
- for each mitigation measure, a datasheet giving additional information, examples, and links for further information

A few examples are given hereafter:

4.1 Traffic flow – Table of mitigation measures (partial)

Ref. - GM	Location	Action	Noise reduction at site [dB(A)]	Cost [€]
GM-TRAF-1	Link specific road traffic noise	Close off road for car through traffic	Can give substantial noise reduction of 3-14 dB(A) (L_{DAY})	Low implementation cost
GM-TRAF-2	Link specific road traffic noise	Decrease speed limit	Can give noise a reduction of 3 - 4 dB(A) (L_{DAY})	Low implementation cost
GM-TRAF-3	Area wide road traffic noise	Create quiet areas by restricting noisy vehicles by charges or road barriers	Has a potential to give substantial noise reduction of 3 - 14 dB(A) (L_{DAY})	High implementation cost
GM-TRAF-4	Area wide road traffic noise	Increased frequency of public transport services	Generally small noise reductions	High implementation cost
GM-TRAF-5	Area wide road traffic noise	Decreased ticket price for public transport	Generally small noise reductions	High revenue loss
GM-TRAF-6	Area wide road traffic noise	Area wide congestion charging schemes	Generally small noise reductions of 1 - 2 dB(A)	High implementation cost (should be exceeded by revenues)
GM-TRAF-7	Road traffic noise	Make people drive less aggressive	About 1 dB(A)	Situation specific
GM-TRAF-8	Truck	truck routing/road restrictions	1 – 3 dB(A)	±400 000

4.2 Road traffic

Road traffic includes mitigation measures for both road surface (partial table) and road-tyre interaction.

Road traffic - Table of road surface mitigation measures (partial)

ref. GM-	location	action	noise reduction dB(A)	cost
GM-ROAD-4	road surface	Poroelastic road surface	8-10	€20,00/m ² €2,00/m ² in increased maintenance cost
GM-ROAD-5	road surface	Dense and smooth road surface in combination with tread pattern optimized tyres	3-5	€14,00/m ² Possibly €1,00/m ² in increased maintenance cost
GM-ROAD-6	road surface	Road markings	3-4 dB(A) relative to normal road markings. The reduction is concentrated to 250 Hz.	€7,00/m ² machining cost for the road marking in-fill

4.3 Rail traffic – Table of normal rolling noise mitigation measures (partial)

Rail traffic mitigation measures include normal rolling noise, excessive rolling noise, impact noise and corrugated rail noise.

ref. GM-	location	action	noise reduction [dB(A)]	cost [€]
GM-RAIL-1	vehicle	resilient wheels	1 to 2	2 000,00 to 3 000,00 per wheel
GM-RAIL-2	trackwork	trackbed absorption	5	100,00 per m ²
GM-RAIL-3		tuned rail dampers	1 to 3	500,00 per m
GM-RAIL-4		global rail dampers	2 to 3	100,00 to 200,00 per m-rail
GM-RAIL-5		global rail dampers & wheel dampers	5 to 7	+500,00 per wheel
GM-RAIL-6		embedded rail with absorbent trackbed	1 to 3(*)	500,00 to 800,00 per m-rail
GM-RAIL-7		new rail type with/without adapted pad stiffness	2 to 5	20,00 per m-rail
GM-RAIL-8		special rail profiles	5	100,00 to 1 000,00 per m-rail

4.4 Noise propagation

Noise propagation includes:

- building isolation;
- facade isolation;
- city planning (partial table underneath, as example);
- road construction;
- barrier design.

4.5 Rail traffic – local complaint handling

For local mitigation measures, treatments are segregated according to curving noise (squeal, wheel howl), special trackwork (frogs, crossovers...) and open deck steel bridges.

Each of these mitigation measures is complemented with a datasheet with further information. The full document will become available on the website.

City planning – Table of mitigation measures (partial)

ref. GM-	location	action		effect dB(A)
		measure	options/examples	
GM-PROP-11	normal urban area medium / high population density	noise screening building block(s)		
		unbroken block or connected blocks over substantial length (100 – 1000 m), close to road		
		close standing building blocks with long side facing road, close to road		
		close standing building blocks close to road, with zigzag access		
		close standing building blocks close to road, 'normal' access		
		close standing building blocks with short side facing road (not recommended)		

5 CONCLUSIONS

This paper describes the first steps towards one objective of the QCITY project: providing a well documented guide for cities of validated mitigation measures to solve all kind of complaints related to urban traffic.

Further work is in progress to further extend the library and to transform it to a real selection guide.

6 ACKNOWLEDGEMENTS

This publication reports on work done in the integrated research project QCITY, sponsored by the EC sixth research framework – priority: sustainable surface transport.

This project involves 26 partners, of which further information can be found on www.qcity.org and www.d2sint.com/Qcity

Specific partners participating in this part of the project are Acoustic Control AB, Sweden; Accon GmbH, Germany; Royal Institute of Technology, Sweden; Stockholm Environmental & Health Administration and TNO, Built Environment & Geosciences, The Netherlands.