

## **CEDR Transnational Road Research Programme**

**Call 2012: Noise: Integrating strategic noise management into the operation and maintenance of national road networks**



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# **DISTANCE**

## **Perception and awareness of noise mitigation measures**

Deliverable 6.1, 07. 2015



**Developing Innovative Solutions for Traffic Noise Control in Europe**

Partners:



BRRC (Belgian Road Research Laboratory) [Belgium]



TRL (Transport Research Laboratory) [UK]



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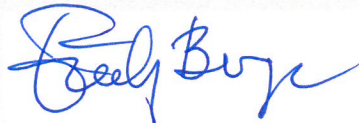
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## Executive summary

Road traffic noise is a major cause of annoyance. Reduction of traffic noise by source mitigation (quieter vehicles, tyres/road surfaces) has the benefit of being effective on most road corridors. However, there are some major drawbacks; the timeframe of implementation of low noise vehicles is long. The new EU limits for vehicles will not give a significant contribution to reductions of  $L_{den}$ -values within the next 10-15 years. More stringent noise limits for tyres may have a shorter timeframe for reduction, but there is a major concern about the effectiveness of the whole system, including the representativity of the ISO surface for many European countries (especially, the Nordic).

Thus, the National Road Authorities (NRAs) have to look for additional or alternative noise mitigation measures.

Regulations limit noise emissions from vehicles and tyres to maximum A-weighted sound levels, measured according to standardized procedures. Furthermore, regulations dictate energy-based sound levels ( $L_{den}$ ) and a maximum level during night time ( $L_{Anight}$ ) to limit road traffic noise emission levels. However, the noise **annoyance** from traffic noise is based on a subjective experience by the individual citizen.

This experience can be influenced by a range of non-acoustical factors such as:

- awareness of the noise,
- influence on the noise situation,
- sensitivity to noise,
- activity during exposure,
- and other socio-psychological and socio-demographic variables.

Several studies show that energy-based indices explain only about 30 % of experienced annoyance. It is therefore relevant to investigate how non-acoustical mitigation measures can contribute to a low-cost and easily implementable noise mitigation strategy for the NRAs.

This report describes the relationship between road traffic noise and public awareness and participation in noise mitigation measures. The study is based on a literature review of the most relevant publications and projects on this subject.

The study has been divided into four main areas:

- Communication
- Compensation
- Participation
- Other non-acoustical mitigation

Findings in the literature lead to the following conclusions:

### *Communication and participation:*

- Annoyance from traffic noise can increase if we perceive a lack of control of the nuisance.
- Being informed and being involved can enhance perceived control, and as such significantly reduce annoyance. The same holds for being treated fairly, even if people know their actual influence is limited.

- Organized events, like workshops and public meetings can be a great tool for informing and involving the public. It is important that the project is presented from different points of view and not only from the organizers' perspective. The public must feel capable of influencing the outcome of the project. Mistrust between the community and the decision makers/politicians can have a negative influence on the process.
- The use of websites and social media can be positive tools for communication with people not able to attend public events.
- Communication with noise experts at public events is strongly recommended.
- The use of descriptors more easily interpreted than  $L_{den}$  and  $L_{night}$  can assist communication with the general public. The Common Noise Index (CNI) developed in the HARMONICA project is an example of such a descriptor.

### *Compensation:*

- There are many examples of court rulings on the issue of economic compensation for people exposed to noise. However, it may be more advantageous to look at the opposite scenario: how much money are people willing to pay for reduced noise?
- Willingness to pay may vary with income, but also with a number of cultural and social factors and their influence may be greater than that of income alone. Different studies indicates a WTP per year per person in the range of 4 – 10 € to reduce noise by 1 dB.
- In 2003, EU proposed a value of hedonic pricing in € per household per dB annual reduction to be around 28-29 € (inflation corrected to 2015), which is in line with findings in Spain (2005). One example of economic compensation is a municipality in Norway that gives a 10 % reduction on annual property tax for households living in noisy areas.

### *Other non-acoustical mitigation:*

- Except for the two concepts of communication and participation, other non-acoustical mitigation measures can be somewhat difficult to define. They can be applied to the source, by influencing the driving behaviour (ITS, eco-driving, dialogue-display, etc.), during propagation (ground treatment, façade design) or at the receiver (soundscaping, quiet areas, quiet façade).
- Use of a dialogue-display (i.e. a speed limit with additional information to the driver) has proved to be effective in making motorcyclists keep to the speed limit in residential areas.
- Several studies show that the noise annoyance reduces when there is access to quiet areas (parks, zones) and quiet façades/backyards.

### *Some mitigation measures that directly or indirectly influence the noise level of the source:*

- Less aggressive or passive driving can reduce pass-by levels of cars and commercial vehicles by approximately 5 dB, while for motorcycles the reduction in noise can be as high as 7 dB.
- In Austria, a test of speed cameras with additional police control reduced the noise from motorcycles by 3-4 dB.

As part of WP6, a workshop on new ideas in non-acoustical mitigation measures was held in Trondheim in September 2014. In addition to representatives from the DISTANCE project consortium and the PEBs, other experts on subjective noise annoyance at SINTEF participated.



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The four above mentioned concepts were the basis for the workshop. The group discussed different concepts that are known to be of no effect on noise annoyance or concepts that have been proved effective. Then, new ideas for mitigation measures were proposed and briefly discussed. The most important of these ideas were:

- Active use of social media, including feedback from the NRAs
- Online information about noise levels (monitoring stations in line with what is available for air pollution today in the internet). Synergy between noise maps and air pollution may be a possibility
- Monetary compensation based on noise maps
- Active public participation in area and road maintenance/planning (on a level where different options are available).
- Presenting mitigation options with relative benefits and costs to aid choice
- Public listening possibilities

As a recommendation, different mitigation measures, both tested and new ideas are proposed for 3 road schemes; a new road scheme, upgrade of present road scheme and replacement of present road schemes:

- 1) A new road scheme will always need a legal process, including the presentation of noise maps and mitigation measures to ensure noise limits are preserved.
- 2) Upgrade of present road scheme is defined as minor changes, which normally do not involve any legal or public processes, including new calculation of noise maps. Such changes can be upgrade to include bicycle lane, redefinition of a lane to taxi/bus lane, etc.
- 3) Replacement of present road scheme is defined as major changes of the road, such as increase of number of lanes, increase in posted speed, changes in the location of the road. Normally will such major changes always trigger a legal process and new noise maps.

The 3 road schemes with proposed measures are listed in tables 6.1 to 6.3.

# 1 Introduction

Work Package 6 is one out of seven parts of the DISTANCE project. The objective of the DISTANCE project is to provide the National Road Administrations (NRAs) with information and guidance on the "state-of-the-art" of practical mitigation measures, data requirements for future action noise mapping and action planning, future potential traffic scenarios and improving public perception, awareness and acceptance of noise mitigation.

The most common way to reduce traffic noise is either by measures along the propagation path (noise barriers/screens), at the receiver (façade insulation) or at the source itself (low noise vehicles, low noise road surfaces, etc.). The aim in all cases is to reduce the **annoyance** caused by road traffic noise.

It is important to investigate how non-acoustical mitigation measures along a road corridor can reduce the annoyance. The NRAs are facing reduced budgets due to the economic crises and therefore need to look for more efficient and cost-effective solutions to reduce the noise nuisance from road traffic. Such solutions can be achieved through increased public participation and awareness in the planning process, and general acceptance of the noise situation.

In general, the DISTANCE project aims to provide information/guidelines to the NRAs in order to improve the noise abatement along the national road network. The focus is therefore more on the suburban situation and on the highway network. In WP6, we have studied examples of projects that studied the effects of public participation, public awareness and non-acoustical measures on noise mitigation. These findings are independent on the type of road network and in the literature review we have not discriminated between projects related to urban or suburban situation.

From this study, it is clear that there is a great potential to reduce annoyance from road traffic noise by means of non-acoustical measures. This potential has not yet been utilized in the many action plans to reduce the nuisance from road traffic noise.

## 1.1 Objectives of the deliverable

The objective of this work package is to describe how different non-acoustical features of the road or its surroundings may be used to reduce the actual annoyance, and to suggest new concepts for incentives to drive public awareness and public participation regarding noise mitigation and action plans.

The annoyance expressed by a person or a community in a certain noise situation depends on three main factors:

- **The noise exposure**, which can be described in objective physical terms (noise level, frequency content, time pattern, etc.).
- **Context**, which can be described in partly objective and partly subjective terms.
- **The individual sensitivity of road traffic noise**, which can be huge (a dynamic range of 40-45 dB at a certain percentage of people highly annoyed (Gjestland et al. 2011)).

WP6 of the DISTANCE project deals mainly with contextual issues. A change in the context can either change (increase or decrease) the annoyance response directly or cause an indirect change in the noise exposure which in turn will change the annoyance.

Examples of change are:

- A "feeling of control" (e.g. by access to a complaint contact point) reduces the annoyance even if "control" is not exercised and the actual noise exposure remains the same
- The concept of quiet areas/quiet façade

## ***1.2 Strategy and description of techniques used***

The work has been divided into 2 main parts:

### **1) Literature review**

The focus has been on projects/papers on how non-acoustical features of the road corridor may influence the annoyance of road traffic noise.

### **2) Workshop to elaborate new ideas**

A workshop was organized by SINTEF in September 2014. The workshop included participants from all of the project partners. In addition, experts on psycho-acoustics from SINTEF participated.

We have chosen to organize WP6 in four main areas, all related to non-acoustical noise mitigation:

- **Communication and participation**
- **Compensation**
- **Other non-acoustical mitigation**

#### *Methods and means of communication:*

The way in which a source owner (e.g. the road authorities) communicates with the affected community is of vital importance with respect to expressed annoyance. People that have a feeling of control, people that have a feeling of being treated fairly, and people that have a feeling of being fully informed (no hidden agendas) are less annoyed.

#### *Platforms for active participation by the general public:*

People that are given the opportunity to participate in the planning and implementation of a new development are less annoyed. People may not necessarily exercise the right to participate; just having the opportunity to do so, reduces the annoyance. Even if their actual influence on the process is limited or non-existent; just the feeling of participation can be enough.

#### *Compensation schemes:*

People that receive some sort of compensation for being exposed to noise are less annoyed. The compensation can be a lump sum of money or annual payments, but the compensation can also be on a community level: new pavement of local roads, improvement of public facilities, etc.

*Other concepts of non-acoustical mitigation measures along the road corridor:*

Such measures comprise for instance re-arranging the interior of a residence to locate noise sensitive rooms away from the noise exposed facades, providing access to local quiet areas, providing visual shielding of the noise source, and providing masking of the noise by agreeable sounds ("water fountains"), etc. The concept of *Soundscaping* is one example where masking of noise sources have been used to reduce annoyance.

## 2 Psycho-acoustics - concept

Psycho-acoustics is the scientific study of sound perception. It concerns the psychological and physiological human responses to sound. It often relates to speech and music, but has been proven to also be relevant to the perception of unwanted sound; e.g. noise.

It is well established that a characterization of road traffic noise (and environmental noise in general) based only on a single A-weighted energy-equivalent sound pressure level is often insufficient. Noise can be perceived as annoying, even if its sound level is relatively low.

In-situ studies (Marquis-Favre et al, 2005) have shown that only one third of the noise annoyance can be explained by energy-based indices. The loudness indicator has been found to have a higher correlation with annoyance than these energy-based indices.

Further properties of noise can also significantly influence the noise annoyance. Examples of such properties are: the number and frequency of noise events, the spectral content, tonal components, masking, etc. Apart from this, there are other non-physical annoyance factors: attitude, personality and other socio-psychological and socio-demographic variables.

In this work package, we are focusing on selected non-acoustical features, which are relevant for the noise annoyance.

Such non-acoustical features that can have a positive effect on the annoyance can be:

- Access to a quiet area
- Access to a quiet facade
- Economical compensation of noise exposure
- Public participation in action planning (e.g. road-side citizens involved in a planning process) in order to raise public awareness
- Measures that indirectly influence the noise emission levels of vehicles (ITS, speed control, eco-driving, etc.)
- The use of other means of design features e.g. colours, vegetation etc. that not necessarily reduce noise levels, but can influence the noise nuisance.

There are several non-acoustical annoyance parameters related to the attitude factors such as fear, attitude against the noise source, sensitivity to noise, activity during exposure and perception of the neighbourhood.

These factors will not be discussed in this report, but it is important to have these in mind, because they can influence the public awareness of road traffic noise.

## 3 Literature review

### 3.1 General outline of review

The literature review is primarily based on recent scientific journals and conference papers (Inter-Noise, Euronoise, ICA, etc.), as well as major international research projects.

The main projects reviewed are categorized according to the four themes listed in Chapter 1.2.

Besides the articles in journals and conference papers, the most important projects reviewed are:

- The Netherlands: a working group within EUROCITIES (Witteween & Wolfert, 2010) studied how to gain political and public interest for noise. The work consisted of literature review and a series of interviews with noise experts, policy makers, as well as European lobby organisations.
- A Canadian project (2000 and earlier) (Sinclair & Diduck, 2001; Doelle & Sinclair, 2006): An evaluation of Canadian Environmental Assessment (EA) processes (including other issues than noise). The aim was to establish a mutual learning process for both project owners and those affected by the decisions.
- A Swedish project on a runway extension at Örebro Airport (1997-2000) (Soneryd, 2004; Soneryd & Weldon, 2003): Even if this is about aircraft noise, the evaluation of the EA process showed that the people near the airport were very dissatisfied with the way they were involved in the project and the information provided.
- A Czech Republic project on widening of a street in the historic city centre of Prerov (1995-1998) (Richardson et al, 1998): The citizens felt there were no opportunities to voice their opinions on the project. Politicians made decisions without consulting the public. A protest foundation was established to organize a demonstration.
- A thesis from the University of Leiden, Netherlands (Moris, 2008): This study showed that in an experiment test persons that were allowed to voice their preferences in a choice within three noise samples, experienced reduced annoyance when the noise levels were relatively high (70 dB), while there was no difference at lower levels (50 dB).
- HUSH PROJECT: (Curcuruto, 2012) Co-funded by European program LIFE and Italian National Regulation. The main objective was to increase the guaranteed forms of citizen's participation through a law. A proposal to establish a National Commission for Public debate, designed to protect the citizens in case of violations of rules, to provide access to information, and to guarantee the right of public access to relevant decisions.
- HARMONICA PROJECT: A three year project (2011-2014) (Mietlicki et al, 2012) to improve the harmonisation and communication with the public and authorities through a new approach with effective and simple tools. Within this project a new simple common noise index, CNI, was developed.

- **QUADMAP PROJECT:** A three year project (2011-2014) (Wolfert, 2014) within the European program LIFE. Primarily, the project has aimed to give the owners of Quiet Urban Areas a tool to manage such areas.

A more comprehensive presentation of the projects is presented in Annex A, in a form of standardised fact sheets.

### ***3.2 Public awareness and participation, including communication***

#### **General observations**

Our annoyance increases when we perceive a lack of control over the nuisance. This applies directly to annoyance from traffic noise. Therefore, noise is more annoying when we cannot influence the noise exposure, for example by closing a window, or going to another room, etc. Being informed and being involved can enhance perceived control, and as such significantly reduce annoyance. The same holds for being treated fairly, even if people know their actual influence is limited (Maris, 2008).

These observations become especially relevant when a traffic noise situation is about to change. When there are plans for road network expansion, the public involvement process itself, can be a powerful tool to reduce noise annoyance.

When there are plans for noise abatements, like barriers, façade insulation, etc., the feeling of being involved can reduce the annoyance, in addition to what the noise mitigation measure provides.

While public participation is generally recognized as important and beneficial, experience shows that many public participation processes are ineffective. A review of literature on the topic has resulted in the following guidelines concerning the inclusion, communication and power aspects of public involvement.

#### **Timing of involvement**

Early, broad and non-exclusive involvement of the public avoids conflict and increases the likelihood for valuable project contributions, and realistic expectations of those involved. In general, a fair and open process can significantly reduce the noise annoyance experienced by residents.

It is important that all those who wish to participate in projects know that there are possibilities for them being involved. Notifications only in the local press may not be sufficient to reach everyone, and have been interpreted as attempts to adhere to legislative requirements, without actually trying to involve the public (Soneryd & Weldon, 2003). Other opportunities to notify the public are plentiful and ever changing, such as TV, radio and, increasingly, social media. Many of these can be suitable for this purpose; the importance lies in making sure that the targeted community receives the notification and that no one feels excluded (Rutherford & Campell, 2004). This also means that there has to be sufficient amount of time between the notification and the actual event or deadline.

The public needs to be involved as early in the process as possible (Doelle & Sinclair, 2006; Soneryd, 2004; Richardson et al, 1998). Early involvement enhances the public's power and increases the likelihood for an effective participation process that is beneficial for all parties. After large investments, the opportunity for considering or implementing viable alternatives is extremely limited.

## Ensuring participation

Organised events, such as workshops and public meetings can be great tools for informing and involving the public. Informal meetings are preferred over (quasi-)judicial processes (Rutherford & Campell, 2004). Care needs to be taken that the projects are presented from different points of view, and not only from one perspective, e.g. "the developer", "the planner", "the NRA", etc. (Sinclair & Diduck, 2001). The feeling of exclusion can be reduced by choosing easily accessible locations and appropriate times (such as outside of working hours) to ensure the best possible opportunity for involvement (Rutherford & Campell, 2004). While project owners have at times made changes because of public input, they have surprisingly often failed in reporting back to the residents (Sinclair & Diduck, 2001). These are missed opportunities when it comes to providing residents with a sense of control and thus reducing noise annoyance.

The public usually lacks the funding needed to meet on equal grounds with project owners. (Sinclair & Diduck, 2001; Soneryd & Weldon, 2003; Rutherford & Campell, 2004). This is especially problematic when a non-neutral party provides the scientific data. If the project owner owns the noise calculations and there is no funding for independent calculations or measurements, this data becomes untouchable (Soneryd & Weldon, 2003). To avoid distrust, an unbiased third party should provide the scientific data and make it freely available to all.

Ignoring the public increases their annoyance. Adopting confrontational positions can cause extra delay and should therefore be avoided wherever possible (Richardson et al, 1998).

A Working Group Noise of Eurocities commissioned the Radboud University Nijmegen to study how political interest for noise can be increased (Witteween & Wolfert, 2010). The work consisted of a literature review and series of interviews with noise experts, policy makers (local, members of European Parliament, etc.), as well as European lobby organizations.

The main factors for a low priority for environmental noise can be classified into two main groups:

- A lack of willingness among policy makers to take action against noise. The main reason being that other issues, such as air pollution seem to have a priority.
- Doubt of the effectiveness of measures against noise annoyance. The annoyance is not directly linked to technical measures to reduce traffic noise, as can also be affected by different non-acoustical factors such as emotional reactions. Such non-acoustical measures can be difficult to quantify for policy makers.

The group proposes to make a number of connections between different aspects of noise, between different agendas and between different levels of policy.

Such connections can be:

- Between noise annoyance and health
- Between noise and other environmental issues, such as air pollution
- Between different levels of policy
- Between the public and policy
- With the media

See Annex A, p. 31 for a more detailed review.



### **Keep it simple**

To attend public meetings which require physical attendance may be a too high threshold for some people. The feeling of no influence on the development of a project may cause people to stay home. The use of websites to make sure that all information and opportunities to get involved (like complaint and suggestion forms) are also available to those unable to attend, has been found to be beneficial to the participation process (Rutherford & Campell, 2004). *Information should be free and easy to obtain. Large amounts of documentation can quickly become overwhelming if not properly organised (Sinclair & Diduck, 2001).*

The scope of the topics discussed should not be restricted if this is not natural from the public's point of view. If a new highway is built because of an airport runway expansion, separating the two can be perceived as an attempt to exclude neighbours (Soneryd, 2004).

Noise is a difficult concept to communicate. Noise units, as used by experts and legislative documents, are easily misinterpreted, frequently wrongly used, and often inadequate in discriminating between two noise situations. Noise maps depend on these units and as such suffer from the same issues. Several recent initiatives attempt to demonstrate the actual differences between noise situation using audio samples, sometimes in parallel with video imaging (HS2 Ltd, 2011; Brekke & Strand, 2014). Such tools improve communication between experts and locals.

Expert information concerning noise, its effects and possible mitigation strategies should be shared before discussions are initiated (Bonacker, 2010; Bonacker et al, 2010). However, at all times the focus should be on the residents concern. When neighbours are concerned about noise, they should not feel the need to use an endangered species as their argument (Soneryd & Weldon, 2003).

Public participation requires two-way communication. This means that the expert needs to provide scientific information in an understandable manner, and make an effort to be less illiterate about public understanding (Soneryd, 2004). Using publications and regulations to show people that they are not annoyed will almost definitely increase their annoyance (not treated "fairly").

Dubbink (2014) claims that there is a shift in community noise management, due to the explosion of mobile and web technologies. The use of mobile phones with sound level meters can enable individuals to record their audio experience, replicating the "soundwalk" (a much used tool of Soundscape analysis).

Dubbink (2014) has developed an "Interactive Sound Information System", designed to produce shared aural experiences and a way of collectively imaging future sound environments. The tool enables users to build noise models and noise maps into the presentations and makes that the user can reposition or walk around on a map to experience different sound environments from different sources at different locations.

### **Examples of good practice**

Participation procedures generally involve those directly affected by the project. Positive experiences were obtained in Hamburg, where residents of the city discussed noise issues per topic ('road noise', 'quiet areas', etc.) and not per geographical location (Bonacker, 2010; Highways Agency, 2014). In the Czech Republic and Canada, Non-Governmental Organizations have in some cases given structure to public involvement that also avoided 'not-in-my-backyard' discussions (Sinclair & Diduck, 2001; Richardson et al, 1998).



The European LIFE-project HUSH (Curcuruto, 2012), besides harmonization between European and Italian National legislation, proposes suitable public information and consultation tools. The project recommends establishing a National Commission for Public debate. The new commission should be designed to protect the citizens (by law) and to guarantee the public access to decisions that affect the environment (see Annex A, p. 35).

In another LIFE project in Europe, HARMONICA, a common noise index (CNI) has been developed to simplify the communication between the general public and the stakeholders (Mietlicki et al, 2012). The index is based on the background noise at a certain site, the dynamics of the noise and the number of single noise events disturbing a quiet period. Based on this index, an area is given a rating between 0 and 10, where 0 is for an area of excellent quality, while 10 indicates a very noisy area (see Annex A, p. 37).

Brazil has participated in the International Noise Awareness Day (INAD) since 2008. However, to improve the public participation and awareness, a new website was released in 2011, together with massive presence in social media. The results were very positive, with a higher rate of visitors, especially from states/cities that actively took part in the INAD. It was concluded that maintaining the website and social media with up-to-date automatic posting was of fundamental importance.

### **3.3 Compensation**

Financial compensation is a common method for increased acceptance of a noisy environment. There are numerous examples (e.g. court decisions) where a source owner has been sentenced to pay compensation to citizens that have been exposed to increased noise levels.

But what is "the value" of noise annoyance? What constitutes fair compensation?

It may be advantageous to look at the opposite scenario: How much money are people willing to pay for reduced noise? In willingness to pay studies, respondents are asked whether they would accept a decrease in noise levels, or whether they would prefer financial compensation for their household instead.

Willingness to pay may vary with income, but also with a number of cultural and social factors and their influence may be greater than that of income alone. The number of protest votes (people unwilling to put monetary value on the concept) and 'don't know' answers tend to be very high in these kind of studies. One study found much lower rates of protest votes with a willingness to accept approach (Máca & Urban, 2010), but other studies did not, or experienced the opposite.

Barreiro (2005) have studied how much people are willing to pay (WTP) for silence in a Spanish city, (telephone interviews in Pamplona). A surprising result was that here personal income was not a significant factor regarding WTP. The average Spanish household would pay about 4 € per year for a reduction of 1 dB. The total mean WTP varied between €26 and €29 per household per year.

Nellthorp et al. (2007) from the Institute of Transport Studies, University of Leeds, have presented a comprehensive overview of results from different WTP studies. They quote a presentation by Navrud from the 4<sup>th</sup> Ibero-American Congress on Environmental Acoustics. The WTP per household per year for a 1 dB change varies substantially as shown in

Table 3.1. The paper by Nellthorp et al. (2007) also includes a comprehensive list of references.

Table 3.1: Road traffic noise: willingness-to-pay per dB(A) per household per annum, in EUR (2005). Source: (Martin, M A et al, 2006).

Location, study year, scenario	Method	€/dB	Reference
Basel, Switzerland, 1988, percentage change	CVM	103	Pommerehne (1988)
Neuchâtel, Switzerland, 1993, percentage change	CVM	62-74	Soguel (1994)
Helsinki, Finland, 1993, elimination of annoyance	CVM	6-9	Vainio (1995,2001)
Oslo and Ullensaker, Norway, 1994, percentage change	CVM	20	Thune-Larsen (1995)
Sweden (national study), elimination of annoyance	CVM	29	Wibe (1997)
Norway (national study), 1996, elimination of annoyance	CVM	2	Navrud (1997)
Oslo and Akershus, Norway, 1993, percentage change	CE	50-100	Sælensminde (1999)
Oslo, Norway, 1999, elimination of annoyance	CVM	24-33	Navrud (2000)
Pamplona, Spain, 1999, elimination of annoyance	CVM	2-3	Barreiro et al. (2000)
Rhône-Alpes Region, France, 1999, elimination of annoyance	CVM	7	Lambert et al. (2001)
Copenhagen, Denmark, 2002, elimination of annoyance	CVM	11	Bjørner et al. (2003)
Edinburgh, UK, 1996, percentage change	CE	38-57	Wardman and Bristow (2004)
Lisbon, Portugal, 2001, change to level in a known location	CE	57	Arsenio et al. (2006)

Note: The change in noise levels builds upon Navrud, who assumes that 50% reduction is best represented by an 8 dB change while the elimination of annoyance is best reflected by a 10 dB change.

In 2003, EU in a position paper (van Zyl et al, 2014) recommended a value of hedonic pricing in Euros per household per dB annual reduction of €25. Corrected for inflation this value is around €28-29, which is in the range of the Spanish study from 2005 (Barreiro et al, 2005).

Compensation on an individual level is usually direct (a certain sum of money), but there are also examples of "compensation to the community". A new motorway will be accepted provided that adequate roads for bicycles and pedestrians are also being built, or the local park and playground are refurbished as part of the deal.

The municipality of Malvik, just east of Trondheim, Norway, provides an example of economic compensation for noise to households. This municipality has made noise maps available on their website for the busiest road (E6). On these maps, certain areas are marked. Within these areas, the householders receive a 10 % reduction to the annual property tax.

### 3.4 Other non-acoustical mitigation measures

All the above concepts can be defined as "non-acoustical" measures. In this chapter, we will look at other types of so-called "non-acoustical" mitigation measures.

Non-acoustical mitigation measures can be somewhat difficult to define. The concept of "soundscaping", for example, may include use of other sound sources (like fountains, bird recordings, or music) to mask traffic noise in a recreational area. The question is then whether such measures really qualify as "non-acoustical".

In general, non-acoustical mitigation measures can influence the noise at three different locations:

- **At the source itself:** Normally this is done mainly by influencing the driver's behaviour. Typical means are ITS systems that keep the speed down or re-route traffic, or dialog-display that influence speed and driving behaviour (by means of either an in-vehicle systems, or special roadside signs).
- **Along the propagation path:** Examples are: façade design, vegetation that blocks direct view, etc.
- **At the receiver:** It is well established that access to quiet façades and quiet areas can influence the annoyance level caused by traffic noise (QSIDE, 2015; Bonacker et al, 2010).

All of these factors were considered relevant during the workshop.

Some papers related to the influence of the source (driving behaviour) and the receiver (quiet façades/quiet areas).

#### How driving behaviour can be influenced

The following statement was presented by the EU-funded SILENCE project (SILENCE, 2002):

*"Driving styles have a high impact on the noise that is generated. Using low engine speeds and avoiding unnecessary high acceleration and vehicle speed values achieve a significant reduction of the propulsion noise of a vehicle. There is a correlation between acceleration and noise for passenger cars. For low speeds of around 30 km/h, the average noise increase due to acceleration is 2 dB. For speeds around 50 to 60 km/h, the increase is 1 to 1.5 dB. It is possible to drive with very low engine speeds, if one does not use the full acceleration potential of the vehicle. The acceleration values that are necessary to follow the traffic flow are normally much lower than the full acceleration potential of the vehicle."*

Other sources mention even higher noise reduction potentials. Less aggressive or passive driving styles reduce the noise on average by approximately 5 dB for cars and commercial vehicles, and 7 dB for motorcycles. Furthermore, they result in considerable fuel savings, improve traffic safety and reduced gas exhaust emissions (European Commission, WG5, 2002)

New ways of affecting driving behavior to reduce aggressive driving should be pursued.

Examples on how driving behavior can be influenced by *active road signs* are presented in a guidebook published by Scottish authorities (Highways Agency, 2014). Examples of such signs are:

- Lane divert, closure;
- Speed reduction
- Congestion: stay in-line, re-routing, etc.

The main objective is to manage accidents/safety, congestions, improve performance of road network and timely information to the driver.

In Germany, the use of a dialogue-display sign have been tested to reduce speed of motorcycles driving through a small village (to adopt to posted speed) in order to reduce the noise annoyance from such vehicles. With the dialogue-display, the number of motorcycles observing the speed limit increased from about 48 % to nearly 70 %. (RTB\_Traffic\_Light\_Report\_66.pdf, fall 2013, downloaded from: <http://www.rtb-bl.de/RTB/cat/traffic-light-report/?lang=en>).

In Austria, an action plan against motorbike noise was conducted in 2009 (Lechner & Lercher, 2010). This was mainly done by imposing a speed limit of 30 km/h in a certain area for a whole season. With just the 30 km/h zone, the effect of reduced speed gave only 1-2 dB(A) reduction in noise levels from the motor bikes. However, with additional police control of the speed, the noise levels decreased by up to 4 dB on weekends and 3 dB on weekdays.

### Quiet façades

There is no acoustical definition of a quiet façade (e.g. relating to a certain maximum noise level at the façade). Normally, it is the façade of the house that is NOT facing the traffic, as shown in figure 3.1.



*Quiet façades and quiet areas are good for inhabitants.  
The general term 'quiet places' is used for quiet façades and quiet areas.*

Figure 3.1: Quiet façade and quiet area (Galbrun & Ali, 2013).

An investigation by TNO (de Kluizenaar et al, 2011) on the effect of a quiet façade concludes that there are only a limited number of studies on the subject and that further quantification is needed. In their project, two groups were studied; one with a façade with relatively large difference between most and least exposed façade ( $Q > 10$  dB) and one group with less difference ( $Q < 10$  dB). Annoyance was less in the subgroup with a relatively quiet façade than in the other subgroup. Other results indicate that residents may benefit from a quiet façade (Gjestland et al, 2001).

### Sound masking

Unwanted sounds (traffic noise) can be masked by pleasant or agreeable sounds. Several studies of the masking properties of other sounds, especially from water, have been

published (Galbrun & Ali, 2013; Al-Musaw, 2012; De Coensel et al, 2011; Nilsson et al, 2010). This technique seems to be useful for masking noise from roads with low temporal variability.

### Quiet areas

In the European Noise Directive (END), Article 3 "Definitions", there are two definitions of a quiet area:

- Quiet area in an agglomeration shall mean an area, defined by the competent authority, for instance which is not exposed to a value of  $L_{den}$  or of another appropriate noise indicator greater than a certain value set by the Member State, from any noise source.
- Quiet area in open country shall mean an area, delimited by the competent authority, that is undisturbed by noise from traffic, industry or recreational activities.

For agglomerations, this means that it is up to the individual Member State to actually define the criteria for a quiet area. In Article 8 "Action plans 1(b)", it is stated that agglomerations with more than 250 000 inhabitants shall also aim to protect quiet areas against an increase in noise.

In the project QUADMAP (Wolfert, 2014), financed through the European LIFE+ program, the objective is to develop a methodology for the identification, selection, and management of quiet areas. QUADMAP aims to give more insight in effects of various interventions such as noise barriers, low noise pavements and nature features on both acoustic and perception factors.

The methodology has been developed through several steps, the first being an inventory of existing legislation, policies and approaches already in place in the EU Member states. Furthermore, to make use of existing noise maps produced according to END, because these maps could identify quiet or relative quiet areas. Finally, noise measurements have been conducted in selected areas, and questionnaires completed by residents and users of these areas were collected.

A list of proposals to owners of quiet areas for management of these areas has been proposed (see Annex A, p. 39).

### Influence of colours

There are few examples of studies of the influence of colours on traffic noise annoyance. In a Chinese laboratory experiment (Song et al, 2011) with 30 test persons, 6 different colours were presented on a computer screen, together with different recorded levels of traffic noise. The six colours were red, yellow, green, blue, cyan and purple. The combination of colours (with 3 different brightness levels) and noise levels were presented randomly to the test panel. The conclusions were that colour was proven to be a significant factor of noise annoyance evaluation, while the brightness was not. Figure 3.2 shows the annoyance score for the six colours, with different levels. For the highest sound levels 75 dB, the colour *green* seems to give the lowest annoyance score. For levels around 45 dB, the colour *blue* seems to be preferred. The paper does not discuss how "colour" could be implemented in any mitigation measure scheme.

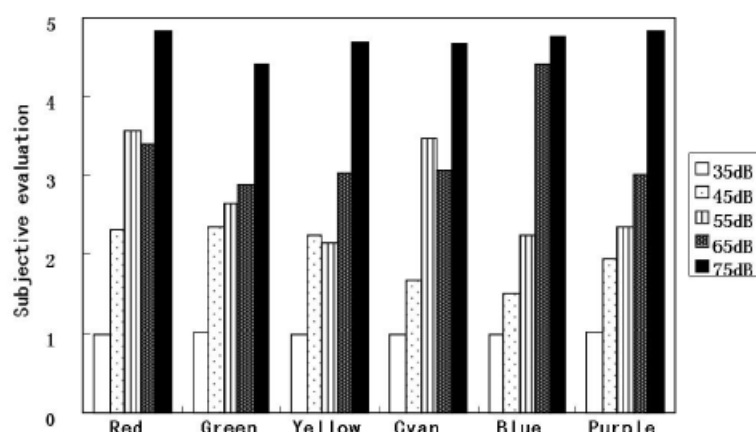


Fig. 3.2: The annoyance evaluation of audio-visual stimuli (Song et al, 2011)

The road surface colour may also have a psychological effect on the perception of road traffic noise. In the Tyre/road noise reference book (Sandberg & Ejsmont, 2002) the authors discuss the fact that cement concrete road surfaces (bright colour) often is perceived as noisier than more dark surfaces, even if the surface is quite new. This is believed to be related to a general idea that cement concrete surfaces are more noisy due to the fact that old cement concrete surfaces often has joints in poor condition.

The authors also refer to a case in Denmark (mid-nineties), where noise complaints were received when a motorway was constructed with a new cement concrete surface. To reduce the annoyance, a top layer of asphalt emulsion was put on the surface before the traffic was admitted on the road. This gave the surface a black colour, giving the public the impression that the surface was asphalt. No complaints were received, even if no noise reduction measures were involved.

### Influence of climate area

In the work description of WP6, we are asked to evaluate if there are some regional differences in how noise is perceived, like differences between Northern and Southern Europe. We have not found any studies on road traffic noise annoyance directing this issue within Europe. However, there is a Japanese study (Moriwaka et al, 2003; Yano et al, 2003) on the response on community noise in two different climate areas (cold/warm) in Japan. Both railway noise and road traffic noise was part of the study. The cold area was on the island of Hokkaido, while the city of Kyushu was the warmer area. As figure 3.3 shows, there was no difference in the annoyance score between these two regions.



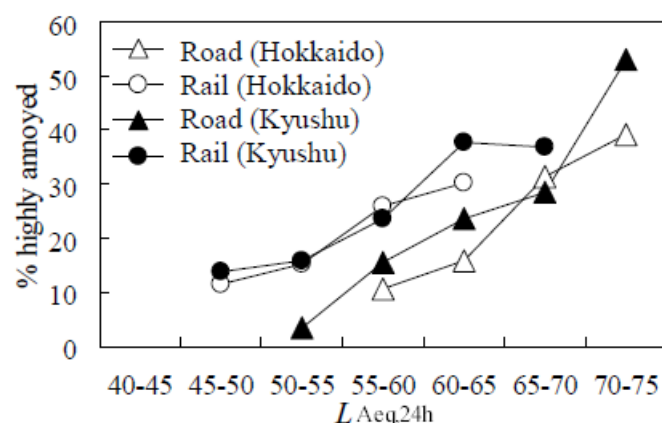


Fig. 3.3: Dose-response relationships for general annoyance (Moriyama et al, 2003).

In a new study about subjective reactions on aircraft noise within different European countries, there seems to be large variations, depending on region/country. Noise annoyance near two airports in Norway was studied; one with civilian air traffic only and one with mixed civilian and military traffic (Gelderblom et al, 2014). The annoyance was found to be significantly lower than as predicted by the "standardised" curves established by Midema. This may be the result of regional differences (people in the northern countries spending more time indoor due to climate conditions). One of the findings was that the people were more annoyed during the summer period.

It has not been verified whether these results are applicable for road traffic noise.

### Influence of vegetation - aesthetics

In this context, the effect of vegetation on the propagation of sound is excluded. It is only the aesthetical influence on the annoyance which is evaluated.

In Lyon, France (Rådsten-Ekman et al, 2011), a low vegetated noise barrier, erected in the central of the city to protect a popular esplanade from road traffic noise, was studied. The barrier was 1 m high, 14 m long and 40 cm thick. The barrier was filled with a substrate on which 40 plants per square meter were grown on both sides, see figure 3.4.



Fig. 3.4: Evaluation of road traffic noise annoyance in Lyon with and without a low, vegetated barrier (Questionnaire respondent at the tables next to the road) (Rådsten-Ekman et al, 2011).

The noise reduction ( $L_{Aeq}$ ) of the barrier itself was measured to be around 5 dB(A). The questionnaire responses showed that the barrier reduced traffic noise annoyance, and increased the overall quality of the sound environment. However, the effects were found to be fairly small and further studies were recommended.

### **Influence of barrier design including colour change**

In addition to the physical attenuation of traffic noise level, it has been shown that the design of the barrier can influence how the noise is perceived. Watts et al (1999) found that human sensitivity to noise appeared to be greater when the source was not visible. A transparent barrier can reduce the noise annoyance in addition to the reduction of noise levels. In addition, the barrier may subjectively feel lower than an opaque barrier, if it is partly or totally transparent. The topic of transparent barriers is also presented in Deliverable D4.1.

In this report, there is also one example of public/residents participation in the architectural design of a barrier (Barcode A40, 2008). In a German project on the A40 at Bochum a competition was launched where more than 1200 people participating with design proposals. The result was a "barcode" noise barrier, as shown in figure 3.5.



Fig.3.5: "Barcode" noise barrier on A40, Bochum, Germany (Barcode A40, 2008)

As seen on the figure, it seems that it is the outer side of the barrier that have this colour scheme. It is not likely that the colour scheme is the same on the resident's side. It may be that the concept of participation in the design itself can reduce the annoyance. However, this is not reported on the projects website.

## **4 Workshop on new ideas**

### **4.1 Lay-out of the workshop program**

The workshop was organized by SINTEF on September 4<sup>th</sup> 2014. The participants are listed below:

Phil Morgan, TRL, UK

Massimo Losa, ANAS/Univ. of Pisa, Italy

Johan Maeck, BRRC, Belgium

Luc Goubert, BRRC, Belgium



Helena Axelsson, NPRA (PEB), Norway

Herold Olsen, SINTEF, Norway

Femke Gelderblom, SINTEF, Norway

Truls Gjestland, SINTEF, Norway

Truls Berge, SINTEF, Norway

The workshop was coached by Terje Østlyng, STYRKAR (external consultant).

Each participant was asked to write down short ideas and subjects on post-it notes, to be discussed within the 4 themes:

**1) Communication:**

How do we communicate with stakeholders and the general public? Public hearings, social media, etc.

**2) Compensation:**

How can compensation (economical or non-economical?) work to reduce annoyance?

**3) Active participation of the public:**

How to achieve a "feel of control"? What is the "action space" of the general public to influence mitigation measures in the project plan? What is feasible?

**4) Other non-acoustical mitigation measures**

New ideas of non-acoustical mitigation (other than 1-3) measures along the road corridor shall be developed. Examples of existing measures are quiet facades, quiet areas, soundscaping (e.g. masking).

All the notes were then classified into the following concepts:

- 1) Tested, non-working concepts
- 2) Tested, working concepts
- 3) New ideas, untested
- 4) Other concepts

## **4.2 Results from the workshop**

The main results from the workshop are summarized in tables 4.1- 4.4 ("Notes" are listed without any priority):

For the two first concepts (tested), references to literature have been made for some of the notes.

Table 4.1 Tested non-working concepts

Theme	Notes
<b>Communication</b>	<ol style="list-style-type: none"> <li>1) Public exhibitions – not publicised enough for people to know about</li> <li>2) Radio/TV/Newspaper adverts – risks not reaching audience</li> </ol>
<b>Other non-acoustical mitigation measures</b>	<ol style="list-style-type: none"> <li>1) Sound energy "harvest" for some area applications</li> </ol>

Comments to the table:

#### COMMUNICATION

- *Public exhibitions – not published enough for people to know about*

Projects relating a new road/or rebuilding of a road may only be published through an exhibition at a local council house. This means that many people in the local community may not be aware of the plans before approvals or before the work starts.

- *Radio/TV/Newspaper adverts – risks not reaching the audience*

Not everybody is using the "traditional" media on a daily basis. This may be elderly, disabled persons or others.

Table 4.2 Tested concepts, working

Theme	Notes
<b>Communication</b>	<ol style="list-style-type: none"> <li>1) Single points for noise complaints</li> <li>2) "Odd" magazines and TV commercial (quiet behaviour)</li> <li>3) Audio samples of situations with and without mitigation</li> <li>4) 3D drawing construction/presentation</li> <li>5) General NRA website with key topics common to all schemes</li> <li>6) Public information meetings/events</li> <li>7) Explain dB by using audio examples</li> <li>8) Guarantee of maximum noise levels (Lden, Lnight)</li> <li>9) Multi-expert planning (early in projects)</li> <li>10) New articles (education, events)</li> <li>11) Information web-sites and videos (events)</li> <li>12) Communications to people of monitoring actions by EA</li> <li>13) Multi-criteria assessment of alternatives in planning phase</li> <li>14) Live (?) experience of situation with and without noise barrier, comparing before and after</li> </ol>
<b>Compensation</b>	<ol style="list-style-type: none"> <li>1) Large scale testing, quiet facade</li> <li>2) Adoption of visible mitigation measures</li> <li>3) Compensation to the community by re-surfing roads</li> <li>4) Non-monetary compensation, sound insulation of properties</li> </ol>
<b>Active participation of the public</b>	<ol style="list-style-type: none"> <li>1) Personal compensation for mitigation measures</li> <li>2) Somewhere to send complaints (continuously access)</li> <li>3) Forum showing complaints + feedback</li> <li>4) Involvement of non-implicated residents (community feeling)</li> <li>5) Involvement of the public in early planning stage</li> <li>6) Jargon-free explanations – use terms to be understood by</li> </ol>

	target audience
Other non-acoustical mitigation measures	1) <i>Esthetics</i> 2) <i>Quiet area/park nearby</i> 3) <i>Photo-printing on noise barriers – pictures of countryside</i>

Comments to the table:

## COMMUNICATION

- *Single points for noise complaints*

This summer, a single phone number was established by the municipality for noise complaints in Copenhagen, Denmark. This phone number was meant to be a possibility for the public to complain about "neighbour" noise, like noise from outdoor arrangements, cafés, discotheques, etc. The telephone line was open from Thursday evening until late Sunday night. When someone called, a "noise" unit went out to check the cause of complaint and if there was some simple solution to reduce the annoyance. About 200 phone calls were registrated during the summer period (<http://www.kk.dk/da/borger/bolig/miljoe/hvis-du-vil-klage>) (Link is in Danish language) [Accessed February 2015].

A general complaints phone number for traffic noise annoyance may be a more challenging. It would depend on what degree of feedback one could give to the public. If it is during construction of a road, it may be related to "construction" noise, which could be everything from machinery noise, blasting (impulsive) noise and transportation noise from heavy trucks. Such noise is normally regulated according to "industrial" noise, rather than road traffic noise. For general complaints concerning traffic noise, we do not know if such "single" point for complaints exists. Today, it would probably be local health authorities, the municipality or the police that is receiving most noise complaints.

- *"Odd" magazines and TV commercials (quiet behaviour)*

An example of "odd" magazines: A story about the human effects of traffic noise was published in a Swedish Woman's magazine and was quite successful, in terms of increased visibility of noise experts (Witteween & Wolfert, 2010). Their conclusions are that it is quite easy to find different media to inform the general public about noise issues. However, it has been proven that about 40 % of public campaigns to change behaviour fail. The reason can be mistrust to authorities and politicians. One such campaign that worked well was the BOB campaign on TV in the Netherlands (BOB stands for people who do not drink alcohol on a night out and drive safely home – the concept was first launched in Belgium and then copied by the Netherlands). The reason of the success was mainly due to:

- nice and funny commercials
- easy to understand message
- rather positive context
- believable situation/recognizable
- sympathetic actors casted

- *Audio samples of situations with and without mitigation (see also point 14 in table 4.2)*

The Norwegian consultancy company, Brekke & Strand Acoustics AS (Brekke & Strand, 2014) has designed a "Sound Lab" that enables non-experts to listen to for example the current noise situation and a future scenario with different traffic load, effect of screening, etc. This lab was developed on behalf of the Norwegian Public Roads Administration. See:

<http://www.brekkestrand.no/index.php/nb/lyttelab> (presentation in English) [Accessed February 2015].

### *3D drawing construction/presentation*

Many of the commercially available traffic noise calculation programs do present the results in 3D drawings. An example from SoundPLAN is shown in figure 4.1.

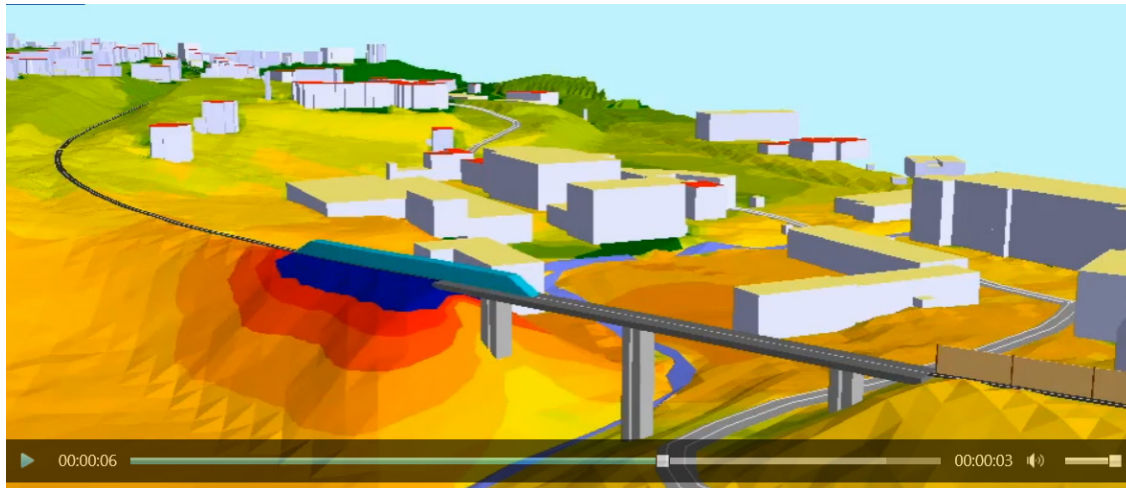


Fig. 4.1: Presentation of noise levels from a passing train in 3D (SoundPLAN)

- *General NRA website with key topics common to all schemes*

The use of internet as a mean of communication is the most obvious tool today. To make it easy for the general public to access information about topics related to road traffic noise should be a simple solution

The NRAs websites in the following countries were investigated: Norway, Sweden, Denmark, UK, Germany, Netherlands, Belgium/Flanders and Italy. These are countries which may have a national strategy to reduce road traffic noise, or at least have some activity related to the END/Action plans.

However, a search on the NRA websites for information about traffic noise was found to be a disappointing exercise.

Information about traffic noise was not easy available. In general, one had to use the "search tool". Then in most cases, a list of documents/reports which may not give the relevant information was the result of a search.

The topic of noise (in general) was found to be more present and more informative on the websites of Environmental Agencies or Ministry.

These are some examples on the information to the public given by governmental agencies in the selected countries:

#### Norway:

The National Public Roads Administration:

<http://www.vegvesen.no/en/Professional/Environment/Noise>

Very little useful information is published.

The Norwegian Environment Agency: <http://www.miljodirektoratet.no/no/Tema/Stoy/>

This webpage is in Norwegian only. If "English" language is chosen, the information disappears.

UK:

UK: <https://www.gov.uk/noise-pollution-road-train-plane/noise-from-roads>

Denmark:

The Danish Road Directorate:

<http://www.vejdirektoratet.dk/EN/Pages/default.aspx#.VPgvPkZ0ypo>

If "Støj" (Danish for "Noise") is used for a search, only a list of documents/reports is listed. No information about regulation, mitigation measures, etc.

However, the website of the Danish Ministry of Environment is more useful and informative:

<http://eng.mst.dk/topics/noise/traffic-noise/>

Germany:

There seems to be no general website from the Government about road traffic noise. The most informative seems to be the site informing about the project "Leistra3":

BASt, Germany: <http://www.bast.de/EN/FB-S/Subjects/e-leiser-verkehr/leiser-verkehr.html>

The Netherlands:

Very little information is available from the Government:

[http://www.rijkswaterstaat.nl/en/about\\_us/rijkswaterstaat\\_and\\_the\\_environment/index.aspx](http://www.rijkswaterstaat.nl/en/about_us/rijkswaterstaat_and_the_environment/index.aspx)

A more useful website can be found on the non-commercial/non-governmental website of "Silent Roads": <http://www.silentroads.nl/index.php?page=home>

The independent organization "Crow" has some information about road traffic noise (in Dutch only):

<http://www.crow.nl>

Belgium:

The website of the Flemish road administration has information about road traffic noise, including results of END mapping (in Flemish):

<http://www.wegenenverkeer.be/geluid-trillingen>

Italy:

ANAS doesn't have a website dedicated to noise activities, but they are coordinating the LIFE DYNAMAP project. The objective of this project is the provision of noise maps in real

time. The project includes the development of software to inform the public on noise issues, provide noise maps and ease the participation of the public in the action plan. Details of the project can be found at: <http://www.life-dynamap-eu>

- *Quiet area/park nearby*

Good examples are shown in this video on YouTube: Traffic noise and quiet areas: <https://www.youtube.com/watch?v=M-frV0IOxxA> [Accessed February 2015].

The website gives examples of busy roads and quiet parks in large cities like Amsterdam, Paris, Rome and New York.

Table 4.3 New ideas, not tested

Theme	Notes
<b>Communication</b>	<ol style="list-style-type: none"> <li>1) Website explaining why and how long a road will be busier</li> <li>2) Online info: peaks, average levels of actual position + other positions, airport, trains, point to give perspective</li> <li>3) Social media must include feedback to NRAs</li> <li>4) Virtual sound experience</li> <li>5) Carefully identifying target audience</li> <li>6) Synergy of noise levels (maps?) and air pollution</li> <li>7) Quiz competition (online): How to make the place more quiet</li> <li>8) Sign saying: "The last hour has been relatively quiet", etc.</li> <li>9) A "Noise" app</li> </ol>
<b>Compensation</b>	<ol style="list-style-type: none"> <li>1) Reduction of property taxes for more noise exposure</li> <li>2) Visual indication of noise levels – monetary compensation</li> <li>3) Bonus eg. at toll roads for people living in noisy areas</li> <li>4) Noise levels to "earn" abatement measures</li> <li>5) Free dinner every time noise level exceeds x dB</li> <li>6) Public contest to seek the best compensation for the area</li> </ol>
<b>Active participation of the public</b>	<ol style="list-style-type: none"> <li>1) Electric MCs and mopeds, being trendy by young people</li> <li>2) Give people control of traffic speed in the neighbourhood</li> <li>3) Active participation in area/road maintenance, Somewhere to post ideas and forum for (continuously) discussions</li> <li>4) Up-voting/down-voting system of ideas from public input</li> <li>5) Presenting mitigation options with relative benefits and costs to aid choice</li> <li>6) People planning themselves with expert help</li> <li>7) Public listening possibilities ("acoustic manager")</li> </ol>
<b>Other non-acoustical mitigation measures</b>	<ol style="list-style-type: none"> <li>1) Mask traffic noise with bird song</li> <li>2) OBD2 (Vehicle On Board Diagnostic) plug + app for own noise "footprint"</li> </ol>

Comments to the table:

Since the date of the workshop, a "noise app" has been launched in England (Institute of Acoustics, 2015). Residents in the London Borough of Croydon can report any noise nuisance to their local authority via an app, called "My Croydon". The current version of the app includes a decibel meter which measures noise and tells the user whether it is loud enough to be classified as nuisance. If it is, the app request some more information, such as category of noise, as well as location of the noise. Currently, the app is being tested out and

users are being asked to provide any feedback on any technical issues they may experience. So far, more than 6000 people have downloaded the app.

## 5 Conclusions and recommendations

### Communication and participation:

- Annoyance can increase if we lack control over the nuisance
- Organized events, like workshops and public meetings can be a great tool for informing and involving the public. Care needs to be taken that the projects are presented from different perspectives
- To attend public meetings can be a too big threshold for some. Websites can be a good supplement
- It is important that the participants know the possibilities to be involved
- Noise is a difficult concept to communicate. Noise units, as used by experts and legislative documents, are easily misinterpreted, frequently wrongly used, and can be inadequate in discriminating between two noise situations
- The public needs to be involved as early in the process as possible

### Awareness of environmental noise:

Main factors for low priority:

- ***A lack of willingness among politicians to take action against noise***

This can be related to:

- Noise annoyance is difficult to quantify
- Uncertainty in the effect of noise on human beings (lack of "scientific" evidence)
- Air pollution is considered more important (more easily described and more easily related to health effects)

- ***Doubt of the effectiveness of measures against noise annoyance***

This can be related to:

- Lack of clarity on the suitable units for the effects of noise
- Lack of a clear limit value
- Noise sources in the END do not include noise sources like neighbours, recreation noise, etc.

### ***Proposals to improve awareness of noise, including new ideas:***

- Establish links between noise and different health outcomes (with reference to reports from the World Health Organization)



- Establish a link between noise and air pollution (same source)
- Clarify different levels of policy: END/Action plans put the responsibility on local level. assistance from higher levels would be helpful
- Make people aware of the fact that noise maps and action plans do exist
- Scientists and experts need to increase their visibility for noise in the media, by also publishing outside of scientific journals
- Make use of social media to communicate with citizens
- The use of a listening possibility to inform about effectiveness of mitigation measures

As a recommendation, a list of proposed actions has been made for 3 different "road schemes":

- 1) New road scheme: *This scheme will always need a legal process, including the presentation of noise maps and mitigation measures to ensure noise limits are preserved;*
- 2) Upgrade of present road scheme: *Defined as minor changes, which normally do not involve any legal or public processes, including new calculation of noise maps. Such changes can be upgrade to include bicycle lane, redefinition of a lane to taxi/bus lane, etc.. This scheme is not expected to induce any changes in noise levels. However, it may be worthwhile to produce documentation of this to the public;*
- 3) Replacement of present road scheme: *Defined as major changes of the road, such as increase of number of lanes, increase in posted speed, changes in the location of the road. Such major changes will always trigger a legal process and the creation of new noise maps.*

For each road scheme, mitigation measures that have been tested and proved working are listed, together with some of the proposed new ideas, which may prove worthwhile testing out.

Some of the proposals would be suitable for more than one of these 3 road schemes.

The 3 road schemes with proposed measures are listed in tables 6.1 to 6.3.



Table 6.1 New road scheme

<i>Tested ideas, working</i>	<i>Examples/comments</i>
<b>3D drawings/presentations</b>	Commercial noise calculation programs; CadnaA, SoundPLAN, etc.
<b>Audio samples of new road with and without mitigation measures, different scenarios. Can also explain/demonstrate dB differences</b>	"Sound Lab", Brekke & Strand (Norway)
<b>Monetary compensation</b>	Reduced property tax
<b>Low noise surface as a compensation</b>	Limited acoustical lifetime in some Nordic countries
<b>Transparent/partly transparent barrier</b>	The height of barrier feels subjectively lower
<b>Public meetings/events</b>	Participants must experience the possibility to influence the planning process
<b>Web site for information and communication</b>	
<i>New ideas, not tested</i>	<i>Comments</i>
<b>Colour of road surface</b>	Only limited lab tests (China) of human reaction to traffic noise levels, combined with different colours. Needs to be verified for road surfaces
<b>In-situ sound experience</b>	Different from the "Sound Lab" example, as you are placed at your home site and can listen to different noise mitigation alternatives here
<b>Planning participation together with noise experts</b>	Include benefit and cost analysis
<b>Social media</b>	Twitter, Facebook etc.

Table 6.2 Upgrade of present road scheme

<i>Tested ideas, working</i>	<i>Examples/comments</i>
Documentation of noise situation before and after (if requested)	Commercial noise calculation programs; CadnaA, SoundPLAN, etc.
<i>New ideas, not tested</i>	<i>Comments</i>
A "noise" app	Information of sound levels of "before" and "after" situations

Table 6.3 Replacement of present road scheme

<i>Tested ideas, working</i>	<i>Examples/comments</i>
Quiet areas/quiet façades	Mostly related to urban situations
Web-sites of NRAs/NGOs	Differences in quality and usefulness
3D drawings/presentations	Commercial noise calculation programs; CadnaA, SoundPLAN, etc.
Audio samples of options for upgrade alternatives with mitigation measures. Can also explain/demonstrate dB differences	"Sound Lab", Brekke & Strand (Norway)
Monetary compensation	Reduced property tax
Low noise surface as a compensation	Limited acoustical lifetime in some Nordic countries
Transparent/partly transparent barrier	The height of barrier feels subjectively lower
Public meetings/events	Participants must feel the possibility to influence the planning process, different options for replacement schemes must be available
<i>New ideas, not tested</i>	<i>Comments</i>
Make "pollution" maps, for both air pollution and noise	These maps can indicate an improvement of the environment for the inhabitants
In-situ sound experience	Give residents listening examples of changes in upgrade situation. In-door or out-door possibilities

## 6 References

Al-Musawi T T A (2012). Acoustical design of water features and their use for road traffic noise masking. Heriot-Watt University, PhD Thesis, <http://hdl.handle.net/10399/2603> [Accessed January 2015].

Barcode A40 (2009). *Projekt Barcode A40* (in German) [online]. Available from World Wide Web: [www.barcode-a40.de](http://www.barcode-a40.de) [Accessed March 2015].

Barreiro J et al. (2005). How much are people willing to pay for silence? *Applied Economics*, vol.37 (11), 2005.

van den Berg F, Shoonebeek C, Hilleberg T (2012). M. An overview of proposed and actual limit values for quiet façades/areas: On the definitions of quiet façades and quiet urban areas. *Proceedings of Euronoise 2012*, Prague.

Bonacker M (2010). Quiet Area: What People Think Or Say In The Participation Process. *Proceedings of INTER-NOISE 2010*, Lisbon.

Bonacker M, Hintzsche M, Popp C (2010). Action planning in Hamburg – a communicative approach for large agglomerations. *Proceedings of INTER-NOISE 2010*, Lisbon.

Brekke&Strand (2014). Sound Laboratory. Leaflet: Experience noise- traffic noise auralization. <http://www.brekkestrand.no/index.php/nb/lyttelab> [Accessed April 2015].

Curcuruto S (2012). HUSH project contribution to Environmental Noise Directive implementation and revision, focusing on noise management and public information tools. *Proceedings of INTER-NOISE 2012*, New York.

De Coensel B, Vanwetswinkel S, Botteldooren D (2011). Effects of natural sounds on the perception of road traffic noise, *J Acoust Soc Am*, 129 (4), 2011.

Doelle M & Sinclair A J (2006). Time for a new approach to public participation in EA: Promoting cooperation and consensus for sustainability. *Environmental Impact Assessment Review*, 26, pp.185–205.

Dubbink D (2014). Sharing ideas about noise management and community design. *Proceedings of INTER-NOISE 2014*, Melbourne.

European Commission (2002). Working Group 5, Abatement. Inventory of noise mitigation measures, 2002.

Fonesca W & Paul S (2012). Using a website, social media and microblogs to encourage people to low noise behavior. *Proceedings of INTER-NOISE 2012*, New York.

Galbrun L, Ali T (2013). Acoustical and perceptual assessment of water sounds and their use for road traffic noise, J Acoust Soc Am, 133(1), pp227-237, 2013.

Gelderblom F, Gjestland T, Granøien I L N, Taraldsen G (2014). The impact between civil versus military aircraft noise on annoyance. Proceedings of INTER-NOISE 2014, Melbourne.

Gjestland T, Støfringsdal B (2001). The influence of a quiet facade on road traffic annoyance. J Acoust Soc Am, 110 (5), 2732, 2001 [<http://dx.doi.org/10.1121/1.4777470>] [Accessed February 2015].

Gjestland T, Fidell S, Mestre V, Schomer P (2011). A theory-based approach to predict the prevalence of annoyance due to transportation noise. Proceedings of INTER-NOISE 2011. Osaka.

Highways Agency (2014). Smart motorways – Driver information [online]. Available from World Wide Web: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/373070/S140389\\_Smart\\_motorways\\_ezine.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/373070/S140389_Smart_motorways_ezine.pdf) [Accessed February 2015].

HS2 Ltd (2011). Consultation blog: HS2 sound demonstrations [online].. Available from World Wide Web: <https://hs2ltd.wordpress.com/2011/07/22/hs2-sound-demonstrations/> [Accessed January 2015].

Institute of Acoustics (2015), Acoustic Bulletin, Vol.40, No.2 March/April 2015, p.18.

de Kluizenaar Y, Salomons E M, Janssen S, van Lenthe F J, Vos H (2011). Urban road traffic noise and annoyance: the effect of a quiet façade. The Journal of the Acoustical Society of America.10/2011, 130(4):1936-42.

Lechner C, Lercher P (2010). Action plan against motor bike noise – an Alpine case study. Proceedings of INTER-NOISE 2010. Lisbon.

Máca V, Urban J (2010). Transportation noise annoyance: a willingness-to-accept scenario [Internet]. Fourth World Congress of Environmental and Resource Economists. 2010. p. 1–18.

Maris E (2008). The Social Side of Noise Annoyance (De Sociale Kant van Geluidhinder). Universiteit Leiden.

Marquis-Favre C, Aubrée D, Vallet M (2005). Noise and its Effects – A Review on Qualitative Aspects of Sound. Part 1; Notions and Acoustic Ratings. Acta Acoustica united with Acoustica. Vol.91 (2005) pp 613-625.

Martin M A et al. (2006). Exposure-effect relationships between road traffic noise annoyance and cost valuation in Valladolid, Spain. Applied Acoustics 67, 2006, pp945-958.

Mietlicki F, Gaudibert P & Vincent B (2012). HARMONICA project (HARMonised Noise Information for Citizen and Authorities). Proceedings of INTER-NOISE 2012, New York.

Morihara T, Yano T, Sato T (2003). Effect of distance on road traffic annoyance and railway noise annoyance. Proceedings of 8<sup>th</sup> ICBEN Conference, Rotterdam, 2003.

Neilthorp J et al. (2007). Introducing willingness-to-pay for noise changes into transport appraisal: an application of benefit transfer. *Transport Reviews*, 27 (3), pp 327-353, 2007.

Nilsson M, et al. (2010). Auditory masking of wanted and unwanted sounds in a city park, *Noise Control Engineering Journal*, vol 58 (5), pp 524-31, 2010.

QSIDE webpage (2015): <http://www.qside.eu/index.html> [Accessed January 2015].

Richardson T, Dusik J & Jindrova P (1998). Parallel public participation: an answer to inertia in decision-making. *Environmental Impact Assessment Review*, 9255(98), pp.201–216.

Rutherford S & Campbell, K (2004). Time Well Spent? A Survey of Public Participation in Federal Environmental Assessment Panels, *West Coast Environmental Law*, 2004.

Rådsten-Ekman et al. (2011). Case-study evaluation of a low and vegetated noise barrier in an urban public space. Proceedings of INTER-NOISE 2011, Osaka.

Sandberg U, Ejsmont J A (2002). Tyre/road noise reference book. Informex, 2002.

SILENCE project (2002): <http://www.silence-ip.org/site/> [Accessed January 2015].

Sinclair A J & Diduck A (2001). Public involvement in EA in Canada: a transformative learning perspective. *Environmental Impact Assessment Review*, 21, pp.113–136.

Soneryd L (2004). Public involvement in the planning process: EIA and lessons from the Örebro airport extension, Sweden. *Environmental Science & Policy*, 7, pp.59–68.

Soneryd L & Weldon, S (2003). Noise and newts: public engagement in the UK and Sweden. *Environmental Impact Assessment Review*, 23, pp.17–37.

Song J, Ma H, Yang Q, Zhang S (2011). Interaction of color perception and annoyance of road traffic noise. Proceedings of INTER-NOISE 2011, Osaka.

Watts G R, Chinn L, Godfrey N (1999). The effects of vegetation on the preception of traffic noise. *Applied Acoustics* **56**, 34-56.

Witteween W & Wolfert H (2010). How to gain political and public interest for noise. Proceedings of INTER-NOISE 2010, Lisbon.

Wolfert H (2014). QUADMAP, three pilots and a methodology. Proceedings of INTER-NOISE 2014, Melbourne.

Yano T, Morihara T, Sato T (2003). Comparison of community responses to railway and road traffic noises in Kyushu area of Japan, and Hokkaido, a colder area. Proceedings of Forum Acousticum, Sevilla, 2003.

van Zyl S et al. (2014). Potential benefits of Trips A-tyres in the Netherlands. TNO Report TNO 2014 R10753, 12<sup>th</sup> June 2014.

## *Annex A - LITERATURE FACT SHEETS*

**Selected projects/publications on public awareness and participation, including communication and compensation**

## CEDR Call 2012: Noise

Case	How to gain political and public interest for noise			
Year	2010			
Location	The Netherlands			
Noise type	<input checked="" type="checkbox"/> Road	<input type="checkbox"/> Air	<input type="checkbox"/> Train	<input type="checkbox"/> Other
Review Type	<input checked="" type="checkbox"/> Single Project		<input type="checkbox"/> Multiple Project Overview	

### Summary

A Working Group Noise of Eurocities commissioned the Radboud University Nijmegen to study how political interest for noise can be gained. The work consisted of literature review and series of interviews with noise experts, policy makers (local, members of European Parliaments, etc.), as well as European lobby organizations.

### Results

The main factors for a low priority for environmental noise could be classified into two main groups, which both contains a number of subfactors:

- A lack of willingness among policy makers to take action against noise
- Doubt of the effectiveness of measures against noise (annoyance).

Lack of willingness can be related to:

- Noise annoyance is difficult to quantify
- Uncertainty in the effect of noise on human beings (lack of "scientific" evidence)
- Air pollution is more important (and more easy to relate to regarding the health impact)

Lack of effectiveness can be related to:

- Lack of clarity on a suitable unit for the effects of noise
- Lack of a clear limit value
- Noise sources in END do not include noise sources like neighbors, recreation noise, etc.

The group suggests a "three dimensional" approach to improve the connection between different aspects of noise: 1) Stakeholders 2) Noise relating to other environmental issues 3) Different levels of policy.

The main connections are:

- Link between noise and health
- Link between noise and air pollution (same source)
- Levels of policy: END/Action plans put the responsibilities on local level. Assistance from higher levels would be helpful
- Make people aware that noise maps and action plans exist
- Scientists and experts need to increase their visibility and attention for noise in the media by also publishing outside of scientific journals

### List of main references

1. Witteveen W, Wolfert H. How to gain political and public interest for noise. Proc INTER-NOISE Lisbon, 2010.



## CEDR Call 2012: Noise

Case	Runway extension at Örebro Airport			
Year	1997-2000			
Location	Sweden			
Noise type	<input type="checkbox"/> Road	<input checked="" type="checkbox"/> Air	<input type="checkbox"/> Train	<input type="checkbox"/> Other
Review Type	<input checked="" type="checkbox"/> Single Project		<input type="checkbox"/> Multiple Project Overview	

### Summary

Evaluation of the EIA process for the runway extension at a Swedish airport that would lead to >40% increase in air traffic. The people living near the airport protested and took action, but felt excluded from the process.

### Results

Voiced concerns were:

- Notification for the consultation meeting (a note in the newspaper) was insufficient for all those who wanted to be involved to know about the meeting.
- The consultation meeting was informative and engaging, but afterwards there was no clear indication that raised concerns affected decisions. It was felt that the meeting was only held because of legislation demands, not because of interest in the local opinion.
- Decisions were taken based on calculations provided by the airport company. The local public did not have the funding for proper noise measurements or other noise expert support and so could not dispute the calculations.
- The greater part of the extension was already carried through before the Swedish Government had given the final decision to allow it.
- The administrative separation of the runway extension project and a project for a new highway (if the road was not changed the runway could not be expanded) was easily interpreted as a mechanism for excluding the public.

### List of main references

1. Soneryd L, Weldon S. Noise and newts: public engagement in the UK and Sweden. *Environ Impact Assess Rev.* 2003;23:17–37.
2. Soneryd L. Public involvement in the planning process: EIA and lessons from the Örebro airport extension, Sweden. *Environ Sci Policy.* 2004;7:59–68.

## CEDR Call 2012: Noise

Case	Widening of one-way street in historic city centre of Prerov			
Year	1995-1998			
Location	Czech republic			
Noise type	<input checked="" type="checkbox"/> Road	<input type="checkbox"/> Air	<input type="checkbox"/> Train	<input type="checkbox"/> Other
Review Type	<input checked="" type="checkbox"/> Single Project		<input type="checkbox"/> Multiple Project Overview	

### Summary

Evaluation of EIA process concerning widening of a one-way street in the historic city centre of Prerov (20 000 inhabitants), to increase the road network's capacity. From the very moment of project proposal, the department of local police responsible for traffic safety and 80 % of citizens opposed to the plans.

Several independent civic initiatives gradually merged to form a working group of citizens and NGOs. The resulting foundation organized a demonstration. The foundation was attacked for complaining without providing a solution, and decided to develop alternative solutions. However, the city council executive approved the widening of the street one day after the demonstration, clearly attempting to avoid the delay that discussion of alternatives could cause.

Three months later the regional Hygiene Authority requested an EIA and the Regional Office of the Ministry for Environment decided this was indeed required. A meeting was held giving citizens the opportunity to voice their concerns directly for the first time.

When the EIS was publicized, the Foundation made copies and distributed it to interested citizens. They found the EIS inadequate and attempted to set up a Citizen's Advisory Panel to address the traffic problem, but city representatives refused to participate.

The Foundation organised a public debate, an art competition for young school-children, and a survey. The City Council approved the widening of the street, circa half a year before the revised EIA documentation was to be published.

### Results

- Citizens did not have the opportunity to voice their opinion early in the process, so by the time a meeting was organized the result was a heated discussion, and it was found difficult to keep the meeting focused. The fact that public involvement was late in the process exacerbated rather than resolved potential conflicts.
- The councillors' attitude was that, as elected politicians, they had a mandate to act on behalf of the citizens and as such did not need to involve them. Their attempt to speed up the process by quickly approving plans after a demonstration was unsuccessful. Adopting confrontational positions can increase the possibility of costly delays.
- NGOs can take the initiative and create opportunities for citizens' involvement in decisions affecting them. They did this by distributing information and structured attempts to contribute constructively to the proposal. The Foundation was also able to avoid not-in-my-backyard positions, by seeking to build dialog and introducing alternatives.

### List of main references

1. Richardson T, Dusik J, Jindrova P. Parallel public participation: an answer to inertia in decision-making. Environ Impact Assess Rev. 1998;9255(98):201–16.

## CEDR Call 2012: Noise

Case	Hamburg Action Planning for noise reduction concepts			
Year	2008-2010			
Location	Germany			
Noise type	<input checked="" type="checkbox"/> Road	<input checked="" type="checkbox"/> Air	<input checked="" type="checkbox"/> Train	<input type="checkbox"/> Other
Review Type	<input type="checkbox"/> Single Project		<input checked="" type="checkbox"/> Multiple Project Overview	

### Summary

The Strategic Action Plan Hamburg was the first planning stage for detailed noise reduction concepts for the Federal State of Hamburg. "Strategic" in this context means that only measures of city-wide importance (such as city-wide road surface or speed reduction conceptions) have been taken into account in the first phase of action planning (2008). In the second phase (2009) the public has been involved. In this phase got the public the possibility to present hot spots and possible noise reduction measures from their point of view.

### Results

Overall more than 800 citizens participated and more than a thousand proposals for noise mitigation were given. These proposals were to be checked by a noise expert team for their relevance and chance for realization. No English documentation of the continuation of this process was found.

It was found to be of great importance to present information on noise, its effect and possible noise mitigation strategies before starting the discussion.

### List of main references

1. Bonacker M. Action planning in Hamburg-A communicative approach for large agglomerations. Proceedings of INTER-NOISE 2010, Lisbon.
2. Bonacker M. Quiet area: What people think of say in the participation process? Proceedings of INTER-NOISE 2010, Lisbon.

## CEDR Call 2012: Noise

Case	HUSH project contribution focussing on public information tools			
Year	2012			
Location	Italy			
Noise type	<input checked="" type="checkbox"/> Road	<input checked="" type="checkbox"/> Air	<input checked="" type="checkbox"/> Train	<input type="checkbox"/> Other
Review Type	<input type="checkbox"/> Single Project		<input checked="" type="checkbox"/> Multiple Project Overview	

### Summary

HUSH “Harmonization of Urban Noise reduction Strategies for Homogeneous action plans” is a project, co-funded by European Community’s Life+Program, having the purpose to give a contribution to the harmonization of European and Italian National legislations. Proposals on public information and consultation tools are described.

### Results

HUSH project members propose to increase the guaranteed forms of participation through a law addressing:

- the establishment of representative democracy through the right to active participation of citizens;
- the application of the principle of equality in order to facilitate access to the construction of public choice of all people and their organizations, recognizing the rights of persons;
- establishing and defining the framework of subjects and procedures to implement processes of comparison quote, concerted, negotiated planning and participation;
- the availability of resources, tools and skills to enable processes of participatory democracy, through methods that ensure equal opportunities to organizations of citizens;
- the implementation of a participatory system coherent and homogeneous on the field, which contains the best practices and experiences.

The proper instrument to ensure participation may take form of a Public debate, consisting in a debate based on specific rules, organized and conducted under the responsibility of a body independent "third party", established by the law itself.

HUSH project team members also propose the establishment of a National Commission for Public debate, designed to protect the citizens by accepting claims in case of violation of rules on information and access to the environmental information, and to guarantee the right to have public access to decisions that affect the environment in the proceedings of environmental projects at national or local level. In addition, the National Commission for Public debate could advise the authorities regarding consultation with the public throughout the project.

A national registry of noise sources can be used for:

- reporting of the information and the data updating which are already available by ISPRA;
- assisting of the investigation activities relating to the Environmental Integrated Authorization (EIA), allowing the detection, in specific interested areas, of the existing interfering sources with the new infrastructure under examination;
- providing a transparent and quality environmental information.

### List of main references

1. Curcuruto S. HUSH project contribution to Environmental Noise Directive implementation and revision, focusing on noise management and public information tools. Proceedings of INTER-NOISE 2012, New York.

## CEDR Call 2012: Noise

Case	The Social Side Of Noise Annoyance			
Year	2008			
Location	The Netherlands			
Noise type	<input type="checkbox"/> Road	<input checked="" type="checkbox"/> Air	<input type="checkbox"/> Train	<input type="checkbox"/> Other
Review Type	<input checked="" type="checkbox"/> Single Project		<input type="checkbox"/> Multiple Project Overview	

### Summary

This thesis discusses two lab experiments that study the social side of noise annoyance. Each experiment involves three noise samples. In the 'fair treatment' experiment, test persons are allowed to voice their preference and told this will be taken into account as much as possible (in reality their preference is ignored). In the 'neutral treatment' experiment, test persons know there are three different samples, but they are simply assigned one without being allowed to state a preference. In the 'unfair treatment' experiment, test persons are promised they get to choose, but then the experimenter overrides this choice.

### Results

Fair treatment (even if 'fair' means that the test person only gets to voice a preference) reduces noise annoyance at relatively loud levels of noise (70 dB), but has no effect when noise levels are lower (50 dB). Unfair treatment increases the noise annoyance at both sound pressure levels. The observed loudness of the noise is unaffected by the treatment.

### List of main references

1. Maris E. The Social Side of Noise Annoyance (De Sociale Kant van Geluidhinder). Universiteit Leiden; 2008. p. 1–72.
2. Maris E, Stallen PJ, Vermunt R, Steensma H. Evaluating noise in social context: the effect of procedural unfairness on noise annoyance judgments. J Acoust Soc Am. 2007;122(6):3483–94.
3. Maris E, Stallen P, Steensma H, Vermunt R. The influence of procedural fairness on evaluations of noise. Proceedings of INTER-NOISE 2004, Prague.
4. Maris E, Stallen PJ, Vermunt R, Steensma H. Noise within the social context: annoyance reduction through fair procedures. J Acoust Soc Am. 2007;121(4):2000–10.

Case	HARMONICA project (European program LIFE+2010)			
Year	2011-2014			
Location	France			
Noise type	<input checked="" type="checkbox"/> Road	<input type="checkbox"/> Air	<input type="checkbox"/> Train	<input type="checkbox"/> Other
Review Type	<input checked="" type="checkbox"/> Single Project		<input type="checkbox"/> Multiple Project Overview	

### Summary

The HARMONICA project was founded on the following observation: the general public and public authorities are insufficiently aware of noise pollution and its consequences. The objectives of the project were:

- To **harmonise** the technical aspects of the use of noise monitoring systems and to prepare the transfer of information to other European agglomerations
- To build **innovative** tools to publish information on environmental noise in an **easy-to-understand** way and to access:
  - a common noise index, CNI
  - an interactive platform to display the index
  - a database on noise abatements actions
- To **implement** these tools and to **assess** them by the general public and public authorities on the two territories
- To **disseminate** this new approach and tools and to share experiences with other European agglomerations

### Results

A new common index, CNI, has been developed. The index is based on 3 simple parameters describing the noise:

1. Parameter 1: Background noise
2. Parameter 2: Noise dynamics
3. Parameter 3: Noise events disturbing the quiet periods

The final CNI is a score between 0 and 10, where 0 is an area with excellent quality and 10 is a horrendous area.

The method has been tested and evaluated based on 8 territories chosen for their frequently encountered typology noise exposure.

### List of main references

1. Mietlicki F, Gaudibert P, Vincent B. HARMONICA project (HARMonised Noise Information for Citizen and Authorities). Proc INTER-NOISE, New York 2012.
2. HARMONICA website: [www.harmonica-project.eu/en](http://www.harmonica-project.eu/en)

## CEDR Call 2012: Noise

Case	Willingness to Pay & Willingness to Accept			
Year	2002-2013			
Location	Several			
Noise type	<input checked="" type="checkbox"/> Road	<input type="checkbox"/> Air	<input type="checkbox"/> Train	<input type="checkbox"/> Other
Review Type	<input type="checkbox"/> Single Project		<input checked="" type="checkbox"/> Multiple Project Overview	

### Summary

Several studies have attempted to find out how much people are willing-to-pay for reduced noise. In willingness to accept studies, respondents are asked whether they would accept a decrease in noise level, or whether they would prefer financial compensation for their household instead.

### Results

Willingness to pay varies with income, but also with a number of cultural and social factors and their influence may be greater than that of income alone. The number of protest votes (people unwilling to put monetary value on the concept) and 'don't know' answers tend to be very high in these kind of studies. One study found much lower rates of protest votes with a willingness to accept approach, but other studies did not, or experienced the opposite.

### List of main references

1. Istamto T, Houthuijs D, Lebrete E. Multi-country willingness to pay study on road-traffic environmental health effects: are people willing and able to provide a number? Environ Heal. 2014;13(35):1–13.
2. Navrud S. The State-Of-The-Art on Economic Valuation of Noise. 2002 p. 68.
3. Lera F, Faulín J, Sánchez M, Calleja-blanco J. Willingness to Pay to Reduce Environmental Impacts from Road Transportation : a case study from the Spanish Pyrenees. J Appl Oper Res. 2013;5(4):135–52.
4. El Idrissi A. Valuing the Environment: An analysis of the environmental costs of raising the speed limit on Dutch motorways. 2011.
5. Urban J. Willingness-to-accept compensation for road and rail noise annoyance. Proceedings of INTER-NOISE 2010, Lisbon.

## CEDR Call 2012: Noise

Case	QUADMAP project (European program LIFE+)			
Year	2011-2014			
Location	Italy			
Noise type	<input checked="" type="checkbox"/> Road	<input type="checkbox"/> Air	<input type="checkbox"/> Train	<input type="checkbox"/> Other
Review Type	<input checked="" type="checkbox"/> Single Project		<input type="checkbox"/> Multiple Project Overview	

### Summary

The QUADMAP project has been running in three European cities; Bilbao, Florence and Rotterdam. The main objectives has been to define a harmonized method to select, evaluate and manage "quiet areas", defined in the END and adopted by Italian law.

### Results

Based on the findings of the project (measurements, interviews and expert analysis), they have presented a list to the owners of Quiet Urban Areas, how to manage such areas. Among these recommendations are:

- Frequently repeat the interviews among visitors, to observe trends in perception
- Provide Quiet areas with provisions to prevent access of motorized vehicles, such as mopeds, motorcycles, scooters, etc.
- Make sure that the quiet areas are dominated by natural sounds and if not, add such sounds (e.g. fountains, play grounds, etc.)
- Quiet areas should be recognized by sign and shields
- Municipalities should promote the use of Quiet areas by means of campaign and inform people about their benefits

### List of main references

1. Garcia, I et al. Application of the methodology to assess quiet urban areas in Bilbao: case pilot of Quadmap. Proc INTER-NOISE, New York 2012.
2. Wolfert, H. QUADMAP, three pilots and methodology. Proc. INTER-NOISE, Melbourne 2014.
3. QUADMAP website: [www.quadmap.eu](http://www.quadmap.eu)



## CEDR Call 2012: Noise

Case	Evaluation of Canadian EA processes			
Year	2000 and earlier			
Location	Canada			
Noise type	<input type="checkbox"/> Road	<input type="checkbox"/> Air	<input type="checkbox"/> Train	<input checked="" type="checkbox"/> Other
Review Type	<input type="checkbox"/> Single Project		<input checked="" type="checkbox"/> Multiple Project Overview	

### Summary

This study evaluated selected Canadian environmental assessment (EA) processes to reveal the extent to which they facilitate mutual learning by EA participants. Their criteria were:

- Accurate and complete information
- Freedom from coercion
- Openness to alternative perspectives
- Ability to reflect critically upon presuppositions
- Equal opportunity to participate
- Ability to assess arguments in a systematic manner and accept a rational consensus as valid

The studied projects did not necessarily concern noise.

### Results

There is regularly *too much* information provided, and relevant information may be hard to find due to limited search options. Guidance on how the public can get involved and legislation documents were often missing. Notices do not always reach all those interested. Documentation is often too long and complex to be user-friendly.

Proponents generally control how the public is consulted, and how the information is assessed and utilized. They receive no guidance, and how well they have involved the public is rarely assessed. Organized meetings do not sufficiently engage the public.

Most projects owners were required to consider the need of the project, and possible alternatives. Involvement of the public in early stages was sporadic at best. Earlier involvement would increase the influence of the public, because project owners are less open to alternatives after substantial investments of time and money.

Information feedback to the participating public is missing, so the public doesn't know if their involvement has had any effect. This discourages them from further participation. The decision-making process lacks in transparency.

Funding for effective participation by the public is lacking, which create a disproportion of resources between proponents and the public.

Those involved in participation processes are generally the ones that will be most directly affected. These may either be the ones that reap the benefits (like job opportunities) while the cost is shared by the entire society (pollution), or oppositely, the ones that will be most negatively affected (noise), while the rest of society benefits (better transport system). Such a bias towards directly affected publics affects the depth of issues considered (the bigger picture may go missing).

While there was substantial government supports for proponents (like assistance in proposal development), but little to no help is provided to the public (guidance for writing submissions).

Policies and ideologies of the government of the day likely affect the decisions taken.

List of main references

1. Sinclair A, Diduck A. Public involvement in EA in Canada: a transformative learning perspective. *Environ Impact Assess Rev.* 2001;21:113–36.
2. Doelle M, Sinclair AJ. Time for a new approach to public participation in EA: Promoting cooperation and consensus for sustainability. *Environ Impact Assess Rev.* 2006;26:185–205.

## *Annex B – OTHER RELEVANT LITERATURE*

Aigner G, 2003. Alternatives in Modern Noise Protection. Lärmschutz symposium, Asfinag, Krems, Austria, 2003.

El Idrissi A, 2011. Valuing the Environment: An analysis of the environmental costs of raising the speed limit on Dutch motorways. 2011.

Hong J Y, Jeon J Y, 2013. Designing sound and visual components for enhancement of urban soundscapes. J Acoust Soc Am, 134 (3), pp 2026-36, 2013.

Istamto T, Houthuijs D, Lebrete E, 2014. Multi-country willingness to pay study on road-traffic environmental health effects: are people willing and able to provide a number? Environmental Health. 2014;13(35):1–13.

Lera-Lopez F, Faulín J, Sánchez M, Calleja-blanco J, 2013. Willingness to Pay to Reduce Environmental Impacts from Road Transportation: a case study from the Spanish Pyrenees. J Appl Oper Res. 2013;5(4):135–52.

Navrud S, 2002. The State-Of-The-Art on Economic Valuation of Noise. 2002 p. 68.

Urban J, 2010. Willingness-to-accept compensation for road and rail noise annoyance. Proceedings of INTER-NOISE 2010, Lisbon.

Wolfert H, 2014. Towards new less noisy mobility patterns in cities. Proceedings of INTER-NOISE 2014, Melbourne.