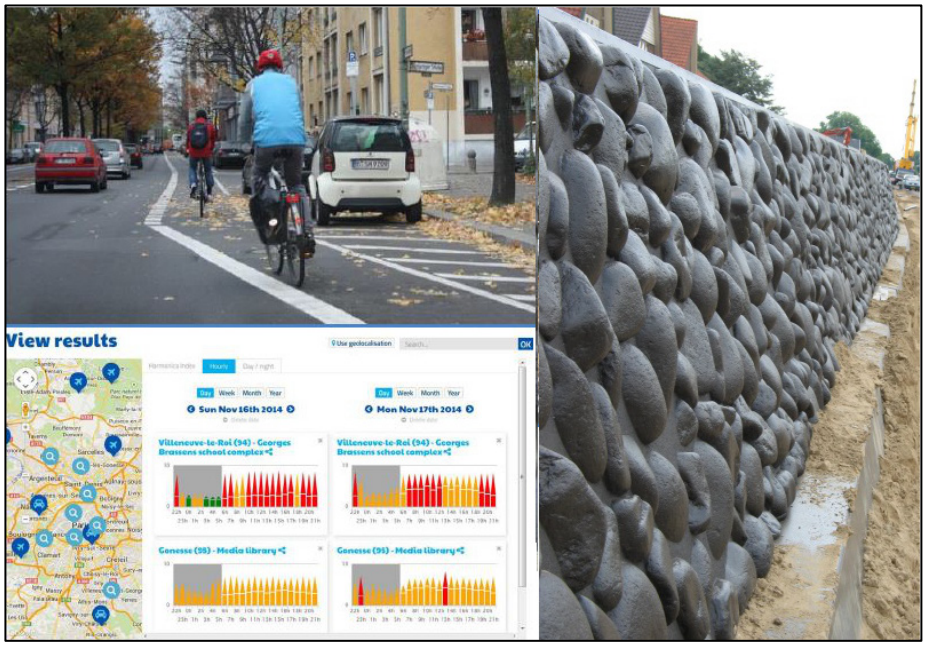
Noise assessment activities

Interesting stories in Europe



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European Topic Centre
on Air Pollution and
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Front page picture:
Composite that includes: photo of a street in Berlin redesigned with markings on the asphalt (from SSU, 2014); view of a noise barrier in Alverna (The Netherlands)(from http://www.eea.europa.eu/highlights/cutting-noise-with-quiet-asphalt), a page of the website http://rumeur.bruitparif.fr for informing the public about environmental noise in the region of Paris.

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1 Introduction

Environmental noise is *unwanted or harmful outdoor sound created by human activities, including noise emitted by means of transport, road traffic, rail traffic, air traffic, and from sites of industrial activity (...)* in Environmental Noise Directive 2002, page 13.

In the 1990s, it started to exist awareness on the European level of the detrimental effects on health of environmental noise, which meant its inclusion in policy instruments (EC, 1993; WHO, 1999, 2011). According to epidemiological evidence environmental noise is linked to sleep disturbance, cardiovascular disease and annoyance. Moreover, according to the evidence we can assume the relationship of environmental noise to cognitive impairment and tinnitus (WHO, 2011).

The European legislative milestone is from 2002: the Environmental Noise Directive (END) (3), which by defining an approach aims firstly to induce action at local level, and secondly a common approach at the European level. The main objectives are to improve/manage the environmental quality, protect human health, and produce knowledge at the European scale. The latter can then be used for strategic purposes in terms of policy evolution. The objectives of the END are accomplished by defining universal noise indicators, establishing the necessity of realizing strategic noise maps for agglomerations larger than 100,000 persons (by 2012. In 2007, the number was 250,000 persons), for major roads, major railways and major airports, and from these, action plans for the improvement of environment acoustic quality that could then be evaluated through updated noise maps, and prediction methodologies. It also defines the necessity along this process of the communication of actions and results to the public.

END inserted a first step in standardization, but still with important gaps. The necessity of standardization is clear in the difficulties in our report in defining quantitative impacts. Moreover, along the years there have been methodological improvements and a better quality and more detailed input data used to run the different noise models. In this way, noise maps even for the same location are hardly comparable. Even without what was already stated previously, local procedures and national methods are another obstacle. But work is in progress to make results already reported comparable through the standardisation of the assessment methods developed in CNOSSOS-EU (Common Noise aSSessment MethOdS). This was a process that elapsed from 2010 to 2012 when it was made public the report (Kephalopoulos *et al*., 2012) defining a common methodological framework for strategic noise mapping of road traffic, railway traffic, aircraft, and industrial noise. After several consultations with Member States, CNOSSOS-EU has become part of the EU legislative framework in the form of a revised Annex II of the END. The use of CNOSSOS-EU will be mandatory for all Member States after 31st December 2018, although Member States will have the possibility to transpose and start using the revised Annex II even before this date. This means that for the third round of noise maps, CNOSSOS-EU will still not be obligatory, and we will need to wait until 2022 to have the common methodology implemented and presumably more comparable results will be obtained throughout all Europe.

Additional work in the future concerns the input data for the models and the population attribution to the dwellings. In this light, several initiatives of harmonisation have emerged,

and among those, the work developed by Licitra and Ascari (2014). Licitra and Ascari try to define a method that uses the information already reported to calculate indicators which can be used to compare regions. Additionally, they propose to use the same indicators in an objective method to define "HotSpots". This goes further in closing other missing provisions in END: the too broad definition of concepts like "Hot Spots" and "Quiet Areas".

Our work showed that actions not prescribed in noise actions plans have a large positive impact on the environmental noise quality. Examples of this are cases in Madrid and Dublin. Madrid is crossed by the river Manzanares, and parallel to it runs the M-30 motorway. This meant the river was unavailable for public usufruct for 40 years. Moreover M-30 meant the physical division of the city. In 2004, large projects of urban requalification were launched, being one of them Madrid-Rio. Within this project the M-30 tunnelling was accomplished. This released the area adjacent to the river for intervention. The regeneration of the surface area lead to the creation of a corridor of green areas along the river. In this way, this area quality in terms of environmental noise increased immensely even if that was not the primary intention. In Dublin, the policies encouraging modal shift to cycling, walking, and the use of transport had a direct positive acoustical benefit by reducing the growth in traffic noise sources, but again this was not a point included in the Noise Action Planning. So, these two examples, among others, exemplify that improvements in environmental noise quality cannot be solely attributable to the END while common efforts among different policy departments dealing with similar or highly related problems demonstrates the co-benefit that can be obtained when addressing the problems with the same final objective: the protection of human health and the environmental quality.

For this document, we looked around the European landscape and document interesting cases of action taken in the area of environmental noise. We found that the European Union institutions and END have fuelled the action in the area of environmental noise, especially in those countries where no legislation concerning environmental noise had been developed before the END entered into force. This has happened in two levels: by following the prescriptions in END and what this entails regarding the application at the local level, and by working in improving the scope and objectives in END. The former is taken upon in Chapter 2 in which we analyse the action plans for Berlin (SSU, 2014), Dublin (Dún Laoghaire – Rathdown County Council, 2013), and Bilbao (Ayuntamento de Bilbao, 2014). The latter aspect can be seen in Chapter 3.1. In this chapter, we look into the results of the QUADMAP project which intended primarily to standardize the definition of Quiet Urban Areas as in END and experiment on specific actions to protect and improve these areas, prescriptions absent in END. In Chapter 3.1, we also report on the definition of the indicators of G_{den} and G_{night} calculable from the indicators L_{den} and L_{night} as defined in END, with which could be possible to compare between different regions in Europe. In Chapter 3.2, we report on projects that include an important effort to include the public. In this way, we report on initiatives by BruitParif that intend to make information about environmental noise levels and actions easily accessible and understood by the general public; we then report on two winners of the soundscape awards, one in Alverna, a Dutch village where all stakeholders had a feedback in the design of a minimization project of the impact of traffic noise, which then lead to a very well accepted solution by all involved. The second soundscape award winner was a campaign born in Switzerland to inform drivers of the benefits of buying low-noise tyres. This campaign has been imported by The Netherlands, which is making a further effort to promote it within the Eurocities Network. Finally, in Chapter 3.3 we report in a new way to further develop by using low price sensors and crowdsourcing.

2 Noise Action Plans

The Environmental noise directive END has four main objectives: the determination of the level of exposure to noise, the management of environmental noise, the development of knowledge and tools that will allow European wide measures to reduce noise at source, and to involve the public in this topic. Noise Action Plans are means to achieve the second and fourth objective. Noise Actions Plans are mandatory for major roads, railways, airports, and agglomerations every 5 years. 2009 was the year for the delivery of the first Action Plan. In this way, at this moment, several agglomerations have evaluated their first action plan and a second action plan has been prepared and already sent to the Environment Directorate-General.

According to END, quantitative evaluation was supposed to be accomplished by updating noise maps and evaluating the results obtained after the first noise action plan implementation. However, this has been difficult due not only to lack of standardization as mentioned before, but also due to methodological advances and an improvement of the quality of the measured data. Moreover, the timelines defined in END do not take into account that measures may take longer than three-four years to have an effect (e.g. modal shifting). In this way, an overall assessment of actions plans from 2009 may only be properly assessed in the noise maps for 2017 or even in 2022.

The main source of noise in the cities analysed is traffic. In this way, the Noise Action Plans analysed in this work focus their action on traffic, as e.g. by studying management of traffic and parking, connecting the Noise Action Plan with other Plans under municipality responsibility like Mobility Plans, and the redesign of the road net in order to diverge traffic from the city. It is obvious in the Action Plans of the financial constrains the municipalities face, because these Plans have no associated budget. This is also a major motivation for the integration efforts in the planning level and focus on prioritization, besides action efficiency.

2.1 Berlin[1]

Berlin is the largest city of Germany and its capital since 1990. It has 3.5 million inhabitants and an average density of 4,000/km2.

A big effort is evident in the Noise Action Plan 2013-2018 (SSU, 2014) for Berlin to comprehensively integrate noise measures into other planning tools. In this way, the Noise Action plan is part of several municipal plans: land use planning, urban and transport planning, and air quality plans crossover with the noise action plans. Particular relevance are the plans regarding road traffic, especially the urban development plan for the roads network which includes the Mobility Scheme for 2016. This integrative approach leads to higher efficiency in implementing the actions, in avoiding the emergence of new noise hotspots and in cutting costs. Finding financing for implementing the noise actions is very explicit in the Noise Action Plan 2013-2018 for Berlin as follows.

[1] Main source for this chapter is SSU, 2014.

END lead to the amendment of article § 47a-f BImSchG which then lead the transfer of the responsibilities to local authorities without the respective transfer of financial resources. To overcome this, it was defined the Konjunkturprogramm II8, which from 2009 to 2011 invested 15 million of Euros in noise abatement measures in Berlin streets. In 2012, an additional fund of 25 million of Euros was defined for road rehabilitation. In the fiscal years of 2014/2015 800,000 Euros/year was made available for additional measures at street level plus installation of sound proof windows. The latter in addition to individual projects with the aim to promote sound proofing of windows around especially noisy roads. It was also tried to take advantage of federal funds dedicated to improve the general environmental situation.

Because noise is a country wide problem, the regions have pressed the federal powers. This produced a federal council resolution by July 2013 that created a national program aimed at noise abatement in municipal roads. Moreover, the German Association of Cities has recognized the problem and assured that they would demand the necessary financial framework from the federal government. On the 14-15 November 2013 it took place a federal conference of environment ministers. It was recognized that the objectives set Europe wide in terms of the decrease in noise pollution had not been achieved in Germany. Consequently, a final paper defined that for Germany the key issues to implement were: (1) the inclusion of the limits 65 dB(A) during the day and 55 dB(A) during the night in the legislation relative to emission limits in roads; (2) the establishment of a stable financing instrument for federal, state and local governments for the implementation of measures in the Noise Action Plans; (3) Integrate the Noise Action plans, the Road Traffic Law and the General Rail Act (Allgemeine Eisenbahngesetz - AEG).

In sum, the costs declared for the implementation of the Noise Action Plan 2009 were:

- 2009-2011 - Konjunkturprogramm II8 – 15 million Euros
- 2012 – rehabilitation of roads – 25 million Euros
- 2014/2015 – further measures at street level plus sound proof windows – 800,000 Euros/year

The actions implemented focused on the reduction of noise from road traffic, but it also included recommendations for train and air traffic sources. It included areal plans for 12 neighbourhoods and for 8 major roads. There is an emphasis on urban design as a way to avoid and manage noise. This is integrated in the land planning.

The actions were divided in type A) implementation within 4 years of the action plan, and type B) implementation from 4-10 years of the action plan.
Major actions of type A:

- Redesign of roads.
- Analyse traffic around buildings with high traffic demand in order to minimize effects of additional traffic.
- Identify and protect quiet areas.
- Regulation of maximum speed at night to 30 km/h.
- Restrictions on lorries.
- Changes in controls of traffic lights.
- Increase in parking and changes in parking management. Parking management may contribute to reduce noise exposure through the reduction of passenger cars target traffic (e.g., by commuters) and reduction of local traffic dedicated to the search for parking spaces. Parking management includes the control of offenders. Creation of parking spaces

for delivery make it possible to prevent parking in second row and therefore interference with traffic flow.

- Major actions of type B:
- Construction of bicycle facilities.
- Modal shifting. Through operational mobility management, and promotion of pedestrian traffic, bicycling and of public transport.
- Pavement rehabilitation.

There were 92 proposed actions of type A that by 2008 had already gone through different planning processes and were financially covered. The implementation was expected until the end of 2012. The status of completion by July 2013 was: 71% of the measures completed (as e.g. the regulation of maximum speed at night of 30 km/h and the redesign of the 4 exemplary roads) 15% of the measures had their implementation in question (related with traffic restrictions on lorries, changes in the controls of traffic lights and changes in parking management) 6% would be finalized by 2013, 5% were expected to be finalized later (these latter two mostly included measures related with road redesign and renovation), 3%, that is 3 measures would not be implemented. The barriers for not implementing these three measures were also three: one was financial restrictions because the costs amounted to higher than expected, a second measure clashed with already on-going projects and a third measure was revealed, after a detailed examination, to pose traffic safety issues.

For measures of type B (bicycle facilities, measures to promote pedestrian traffic and public transport, pavement rehabilitation) it was expected for them to be dealt by the local authorities directly responsible for the work. However, through a survey it was realized that they lacked the financial and human resources. Moreover, the survey also showed the fear by the local technicians of non-acceptance of the measures by the public. It is mandatory to follow-up these measures, because high noise levels are still present with noise exposures above 70 dB(A) during the day and 60 dB(A) at night.

In more detail, we describe a pilot project related with road traffic management. It was a study in redesigning roads to promote a fluid traffic flow. The pilot project was set in roads which accommodated less motor vehicle traffic than their actual capacity in case the experiment lead to an increase of traffic. The chosen roads were: Brandenburg street, Dudenstrasse street, and Prinzenallee avenue. The different measures taken were (see Figure 1):

1. for roads with 4 lanes, two lanes in each direction were transformed into bicycle lanes and a larger width for the remaining two lanes. For roads with two lanes, the width of the lanes was decreased to give space for the bicycle lanes. These measures had the objective of stabilizing the traffic and diminish its volume, and promote bicycling.
2. Create islands in-between the lanes, which facilitate the crossing of pedestrians and has a positive impact on speed level and traffic flow.
3. The turn lanes were kept at the crossroads.

This pilot project was financed through the Environmental Relief Programme II funded by the European Regional Development Fund and Berlin's budget.

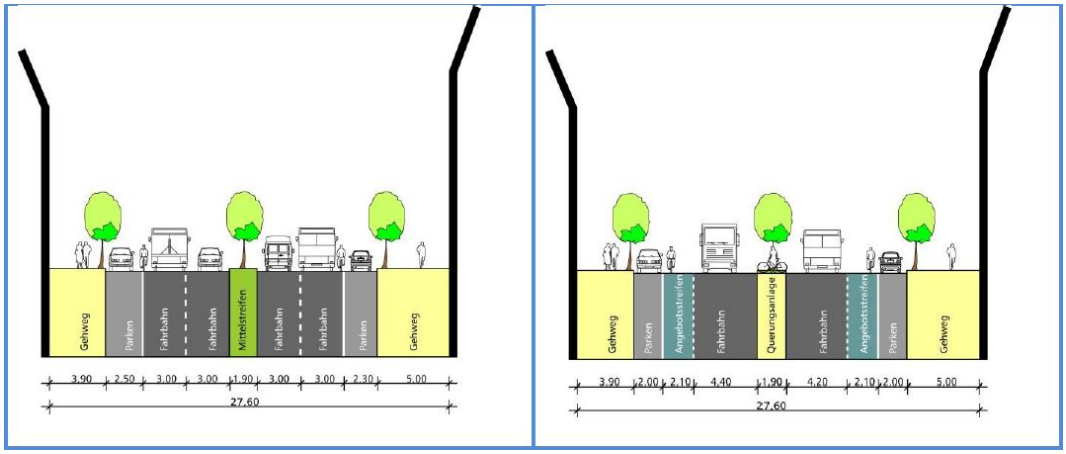


Figure 1 – Redesign of the Brandenburg street. On the left before and on the right after the implementation of the measures.

The implementation of the changes was done mainly through road markings, because these are inexpensive and easily to reverse in case of detection of adverse effects.

The implementation has been accompanied by extensive before/after studies and resident surveys. Before and after setting up the measures two surveys were carried out in Brandenburg street. In the before survey, 70% of the respondents (405) said they felt burdened by the noise in the street. The measures they pointed out for diminishing noise was road rehabilitation and lower speed limits. After the measures were implemented, 60% of the respondents rated the measures as useful and very useful. They considered that noise reduction was achieved, but did not consider it sufficient.

It was evaluated how the measures have affected the traffic behaviour and the experience on the road of motorists, cyclists, pedestrians and public transport users. For this purpose traffic counts were done in Brandenburg street, but also in alternative routes (see Figure 2) in order to evaluate possible unwanted effects. Along the Brandenburg street a GPS-based measure of the vehicles ride accurate to seconds gave the traffic flow and speed of passenger cars. It was concluded that the flow along the street from 2009 and 2011 (before and after the implementation of the measures) had improved. Other traffic investigations lead to the conclusions:

- For traffic volumes around 20,000 vehicles/day the disappearance of a turning lane did not affect the quality of traffic. It is possible to omit a second lane in favour of a bicycle lane.
- The new conditions lead to less impairment of traffic due to delivery operations.
- The traffic flow and travel speeds are as minimally affected in public transport as in passenger cars.
- In the pilot streets there was a decrease of 10% in traffic volume between 2009 and 2011 and no difference was detected in the potentially alternative routes.
- There was the increase of waiting times for pedestrians to cross the road. Maybe this kind of measures demand additional crossing facilities.
- For the pilot streets of Dudenstrasse and Brandenburg street the road safety increased, especially regarding interactions between pedestrians and cyclists. No statistically relevant trend was captured in Prinzenallee.
- The decrease in noise levels was up to 1.5 dB(A). This is the decrease expected from the imposition of new rolling noise requirements to new registered vehicles in the next 15

years (Annex II of the Regulation EC 661/2009 of the European Parliament and of the Council, 13 July 2009).

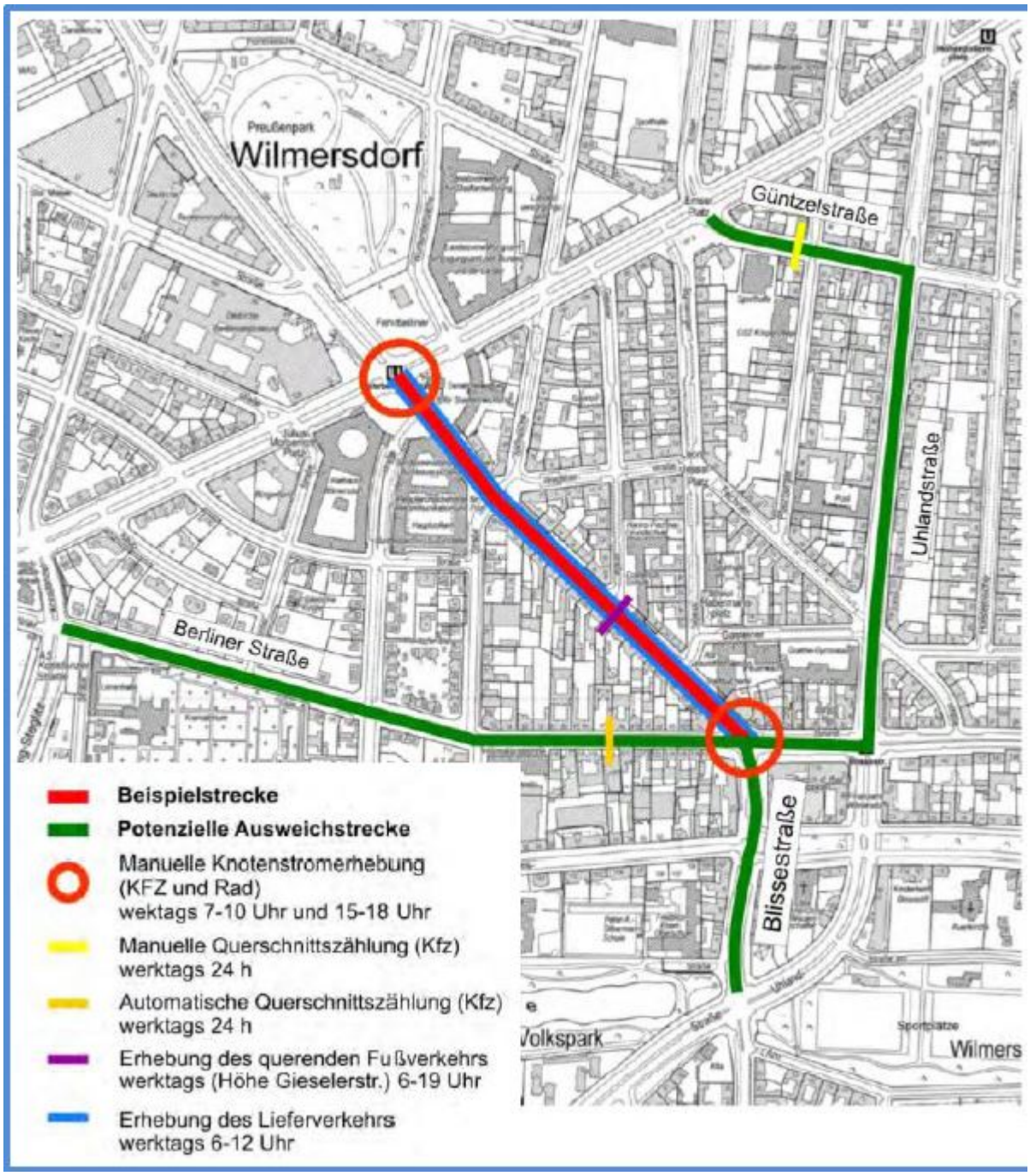


Figure 2 – Scheme showing the location of the measuring points in the case of the Brandenburg street: red segment: the stretch where the measures were implemented; green segment: potentially alternative routes; red circles: crossroad location for the manual counting of passenger cars and bikes (workdays 7am-10am and 3pm-6pm); yellow segment: manual counting of passenger cars 24h; purple segment: survey of pedestrians at workdays 6am-7pm; blue segment: survey of passenger cars at workdays 6am-12pm.

The costs of this pilot project were between 5,000 to 15,000 Euros per 100m of road. The quite high difference between both values is due to the very different conditions in the test roads.

The public participation in the context of the Noise Action Plan was very comprehensive and in-depth. As expressed in the Noise Action Plan report, there is no binding framework for public consultation in END, therefore who implements the Noise Action Plan has the opportunity to make their own mark.

On January 24, 2013 the contents of the Noise Action Plan was presented in a Press Conference by the competent State Secretary, who also introduced the public to a website with the campaign "Berlin becomes quieter – working against traffic noise" – leises.berlin.de. It contained information on the current activities, the intended measures and planned steps. The main intent was to promote an internet based discussion, so there was a connection to other internet platforms like Facebook, Twitter, and Google+. On the website, the content of the Noise Action Plan was presented and the users were offered the opportunity to nominate their noise problems and mitigation options, and comment and recommend other users additions.

The Public Outreach in the first trimester of 2013, included besides the website and the press conference:

- the media (television, radio, print) with the cooperation of the Department of Communication and the Press Office of the Senatorial Department for Urban Development and Environment (the latter included in its website the links to the internet sites where the online discussion was being promoted);
- posters and postcards (in Germany it is usual to publicize on postcards that are distributed around cafes and bars);
- Advertising on traffic information boards along the city main roads;
- Noise workshops, where the Noise Action Plan was presented and specific noise related topics were discussed. Moreover, a space was open to let sufferers bring their noise problems and discuss concrete solutions with experts;
- Several institutions set up 150 offices to communicate with the public by email: departments of the city districts, the Berlin public transport, neighbourhood managers, civil organizations, teachers/students from relevant environmental disciplines, etc.

Moreover between January 2013 and May 2014 three noise forums took place between public and civil institutions, and NGOs where besides discussing the Noise Action Plan, agreements and trade-offs were set. Involved institutions were the public administration, ADAC (General German Automobile Club), ADFC (General German Bicycle Club), Carrying Trade Guild, Chamber of Crafts, Chamber of Commerce, real estate companies, health groups, and environmental organizations.

The internet-based campaign led to 3000 suggestions for improvement, circa 1900 comments, and 10,000 reviews. These material was summarized and evaluated within the districts departments. 70% of the material was about noise in the streets, 15% was related to railway, and 10% to aircraft. An assessment of the technical advice and suggestions that sprout from this initiative was made and incorporated in the Action Noise Plan when possible or referenced for the future. The users that posted the ideas most reviewed were invited to a noise workshop and were given the opportunity to discuss their concerns with experts. All of the results of the online conversation were put online.

From 17 February to 17 March 2014 the Noise Action Plan with its annexes was put to public inspection in the Senatorial Department for Urban Development and Environment. Moreover, it was posted in the internet, and it was possible to submit a requisition to receive it through mail, fax, or electronically. The deadline for submitting comments was March, 28 2014. Most of the comments (275) were about traffic noise. The main topics were:

- Speed: call for restrictions in the main road network, especially at night; call for speed limits in the motorways within the urban area, especially at night and for trucks; call for monitoring of speed; a few comments were against the proposed restriction of 30 km/h speed limit in residential areas.
- Traffic management.
- Lack of noise control in the motorways.
- Sustainable road rehabilitation and noise-reducing surfaces.
- Improve traffic flow.
- Call for road design in the residential areas that would force adherence to the 30 km/h speed limit and avoid its use as "rat-runs".

2.2 Dublin[2]

Dublin is the capital of Ireland with circa 528,000 inhabitants (density 4,588/km^2)

The administration of the Dublin Agglomeration is fractured in four local authorities:

- Dublin City Council (includes Comhairle, Cathrach, Bhaile, Atha, and Cliath).
- South Dublin County Council.
- Dun-Laoghaire-Rathdown County Council.
- Fingal County Council.

This fracture is obvious when:

- noise monitoring, reduction and management are included in each's city councils Development Plans.
- Each city council produces its own annual reports for their own monitoring net.
- In the Noise Action Plan structure in which we find a long list of responsible bodies.

They try to overcome this by defining in the Noise Action Plan areas of responsibility in detail and clearly. Another difficulty is the financing of the measures to implement. This is shown by the fact that specific complains of the public regarding annoying noise levels from roads are answered by the standard sentence: "(…) noise abatement works that require expensive structural work are only carried out as part of the upgrading of existing roads or the building of new roads. The cost of such mitigation measures may then be included in the overall budget of these projects." Nowadays the budget is limited and in this way there is a strenuous evaluation process in order to assure that the action is a necessity, a priority and will achieve the goal. They take on the risk that by focusing on the areas with more noise exposed inhabitants and the preservation of the "quiet areas", the areas in-between are in risk of negligence.

[2] Main source for this chapter is Dún Laoghaire – Rathdown County Council, 2013.

The timeline of noise activities in Dublin are as follows:
2007 - First round of noise mapping from the responsible bodies for mapping each agglomeration and sources according to references set in END (agglomerations with more than 250,000 inhabitants; roads with more than 6 million vehicle passages per year; railways with more than 30,000 train passages per year; airports with more than 60,000 aircraft take-off or landing movements per year).
2008-2013 – Actions carried out by responsible bodies for Noise Action Planning.
2009 – Commencement of the installation of the permanent noise monitoring network
2012 – Second round of strategic noise mapping (agglomerations with more than 100,000 inhabitants; roads with more than 3 million vehicle passages per year; railways with more than 30,000 train passages per year; airports with more than 50,000 aircraft take-off or landing movements per year).

The 2007 noise maps showed that the dominant source of noise in the Greater Dublin Area was road noise traffic. The Noise Action Plan was constructed based on this, on the necessity from END to include also railway and aircraft and on the EU Green Paper on "Future Noise Policy" in which was highlighted the need for high level of health and environment protection from noise.

The actions implemented were:

- Protecting quiet areas
- It was established a permanent noise monitoring network designed to operate continuously. Its units record sound levels and statistical information to allow analysis of trends in noise emissions. The devices are installed in areas affected by traffic and rail noise. By 2012 it included 26 sites in total. Annual reports are produced and made available to everyone at www.dublincity.ie (by searching for "Noise").
- Implementation of the national transport policy 2009-2020, which included the following:
    - Development of Cycle Greenways and shared pedestrian/cycle routes.
    - Implementation of bus priority measures.
    - Expansion of the Light Rail Tram System.
    - Introduction of 30 km/h zones and traffic calmed areas.
    - Improved Urban Road network through improved traffic signal efficiency allowing a smoothing of traffic flows on key strategic routes.
    - Removal of HGV's (Heavy Good Vehicles) from non-strategic routes and a greater focus on the delivery of goods during certain hours and restrictions at certain times (night time delivery restrictions or limits).

Besides work done in each previously listed point, some other specific measures carried out in each district of the Great Dublin Area were:

- Dublin: for new roads schemes and major resurfacing projects, low noise surfaces were considered and applied where considered to be appropriate; a greater focus was placed on parking control and management in the City which in turn alleviated traffic congestion and thus noise.
- Dún Laoghaire-Rathdown: Installation of a network of electric charge points around the County in conjunction with Electricity Supply Board.
- South Dublin: Opening of Bothar Katherine Tynan (Embankment Road Extension) linking Belgard Road with Citywest, removing 'rat runs' from housing estates.
- Fingal: For new roads schemes and a small number of major resurfacing projects low noise surfaces were considered and applied where appropriate.

Into the future, the action plan for 2013-2018 highlights the sustainability factor.

Besides noise maps, the Dublin councils also produce quantitative data based on number of complains as shown in Figure 3. The Figure clearly indicates that the majority of complaints in Dublin are not related to environmental noise as addressed by the END. In this way, we can conclude that a city may be dealing with noise and annoyance, and the public is aware and concerned about noise, just not in the framework of END.

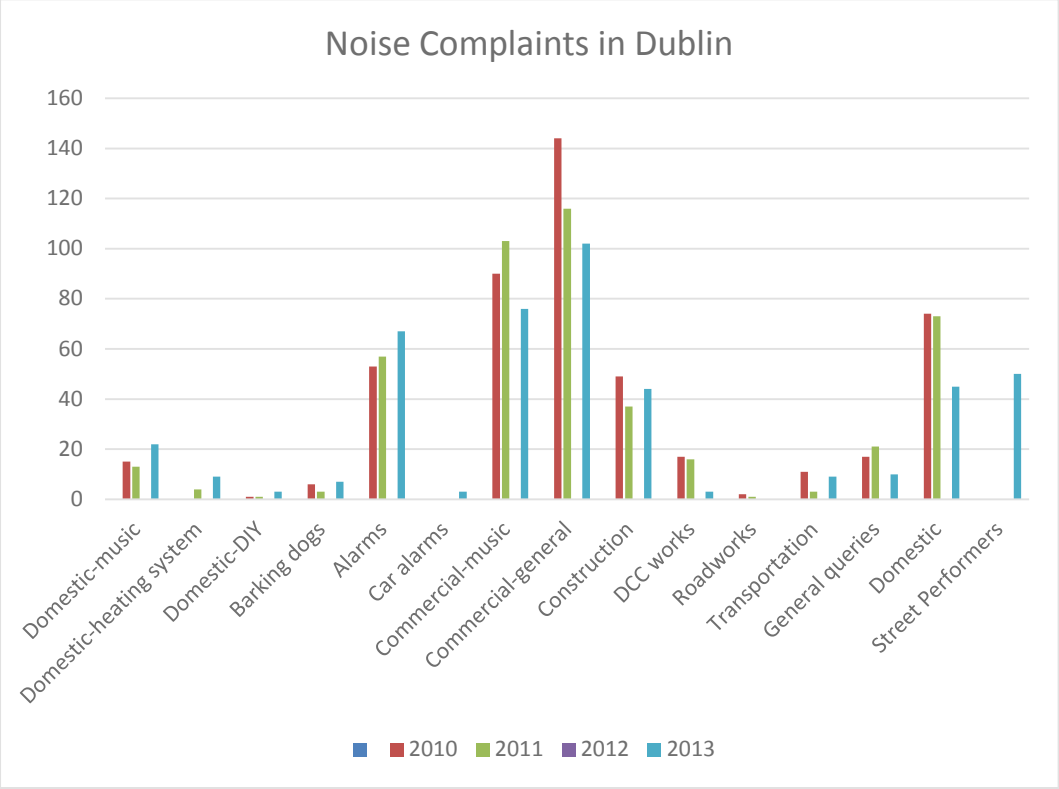


Figure 3 - Number of complains per activity in the Dublin area reported for the years of 2010, 2011, 2012, and 2013 (information retrieved from the Air Quality Monitoring and Noise Control Annual Reports: http://www.dublincity.ie/main-menu-services-water-waste-and-environment-air-quality-monitoring-and-noise-control-air/annual. Last accessed December 9, 2015).

Regarding public involvement in the Dublin Noise Action Plan, it is reported that the Dublin councils followed the END demands in what concerns public need of consultation and information. As information channels they chose newspapers. Annual reports, Action Plans, and Noise Maps are uploaded on the website of each Local Authority (note: the user has to know what one wants to find when searching the websites).

2.3 Bilbao[3]

Bilbao is a city in the autonomous community of the Basque Country in the North of Spain. It contains a population of 352 402 inhabitants and an average density of 8,400/km2.

END was transposed into nation law in Spain first by 2003, with further developments in 2005 and 2007. In the Basque country, the previous laws were transposed into autonomic law in 2012. The Noise Action Plan for Bilbao is from 2014. However, in Bilbao like in Madrid, work in noise started decades ago:

1985 – First noise map for the Basque country.
2000 – Update of the noise map for the Basque country.
2007, 2012 – Strategic noise map for Bilbao.

The long-standing noise actions in Bilbao are in the field of assessment for which Bilbao's municipality manages a noise monitoring network with 17 fixed stations and additionally a mobile unit for "in situ" measurements. For the construction and update of noise maps they also use the numerical model SoundPlan.

Actions in the management of noise were taken before 2012, that is, the year in which there was the transposition of END into autonomic law. Actions like:

- Noise screens in the major roads.
- Turning streets into pedestrian circulation areas.
- Restrict the circulation of lorries with mass above 9.5 tonnes within the city.
- Pilot project for studying the calming of traffic circulation.
- Reintroduction of tramways in the city. The construction started in the year 2002 and lasted 3 years. Since then new extensions have been installed. The last one in 2010, from Hospital to La Casilla (passing Basurto). The extension from Basurto to La Casilla was supposed to cost 5 million Euros, 65% bared by the regional government and the rest by the municipality[4]
- Promotion of biking by constructing bicycle paths (today 27 km constructed, planning for a 80 km extension.), a system for borrowing bicycles (today 25 loan points with a total of 170 bicycles, planning for 27 loan points and 200 bicycles).
- Promotion and support of private initiatives for car-sharing: Compartir Coche-Carpooling (making it easier for people to get into contact) and car sharing services like the company ClickCar and the association Eusko CarSharing (sharing of rented vehicles).
- Tunnelling of the train track FEVE-ADIF at Basurto (135 m extension).

These actions are not only directed to noise reduction, but a more transversal approach which entails the redesign of the city and changing of transportation habits within the urban area.

[3] Main source for this chapter is Ayuntamento de Bilbao, 2014.
[4] Web page (last accessed on July 6th, 2015)
http://www.euskalyvasca.com/en/ac_detalle.html?contentName=cont_evolucion.alta_velocidad.2010.07.07%20&section=ALTA_VELOCIDAD

Moreover, the initiatives in action in Bilbao show a concerted effort in bringing together legislative ordinances and different municipal plans and levels of responsibility that can impact effects on noise. In this way, in the municipal ordinance for the protection of the environment:

- It is taken into account the control of noise emission from municipal vehicles and the acoustic isolation of municipal activities.
- It is considered the education of policemen and municipal technicians in noise management.
- It is considered the request for the collaboration of the managers of the activities that constitute noise sources.
- Issuing activity licenses takes into account their compliance with the specifications of the municipal ordinance for the protection of the environment, which includes noise emission prevention.
- The location of activities, which will probably generate high noise emissions (like malls, discos) is limited in terms of being set in residential areas and in terms of distances between each other.

After the year 2012, Bilbao joined a system promoted by the Basque region for car sharing of electric cars. Otherwise, the main initiative with effect in terms of changing the noise impacts over the population were the new accessibilities to the city of Bilbao from the highway A-8. This highway connects the regions along the Northern Coast of Spain and continues into France. A-8 is the main beltway in the metropolitan area. Due to chronic problems of traffic congestion in the exits of A-8 to Bilbao, a new solution has been under construction as follows. The accessibilities were moved to a northerner location (around San Mames). The old accessibilities disappeared with the demolition of the viaduct Sabino Arana (close to Basurto) (the dismantling of this structure was supposed to cost 4 000 000Euros, IVA included). To protect the population living around the A-8 it was implemented:

- Tunnelling of the A-8 close to Basurto in an extension of circa 350m. The new surface area created will be a park that will connect the two sides now apart: Lezeaga and Bentazarra.
- Tunneling of the new accessibilities close to the neighbourhood of Santa Ana. Covering of surfaces with absorbing material.
- Around the viaduct of Olabeaga it was installed curved noise screens.

At the moment of the writing of the "Plan de *acción* contra el ruido de Bilbao" (October 2014) the move of the exit from the A-8 has meant less noise in the Sabino Arana area, that is, the area into which flowed the traffic. However, the area surrounding the old exit was deprived of barriers that would block the noise from the A-8. A study is being done for new noise measures in this particular area.

The "Plan de *acción* contra el ruido de Bilbao" (October 2014) shows for the actions intended for the future a continuation from what has been already accomplished and learned, and an intention to continue learning and innovating. In terms of innovation and learning we point, e.g., to:

- the involvement of the municipality of Bilbao municipality in the QUADMAP project (see chapter 3.1.1). This project was intended in clarifying the concept of quiet areas in the urban context and define methodologies and guidelines to define quiet areas, and improve and manage them. The practical result of this project in Bilbao was the creation of an acoustic island at Plaza General Latorre (it costed 720, 000 Euros). The experience will continue to be used in Bilbao for improving other areas and for better managing quiet areas.

- The plan to collect traffic data with the specific intention of better understanding noise maps, like, traffic intensity, vehicle composition, and speed.
- The definition of new noise indicators that give a better representation of the impact of noise.

We will not present quantitative comparisons, because of the methodological differences and higher quality of the measurements of the noise map for 2012 and for 2007. This does not mean that the assessment of noise conditions is irrelevant as it informs the technicians of the acoustic reality in the area of their responsibility.

In the framework of the action plan the process of public information has not been completed.

3 Innovative Stories

3.1 Improving the Environmental Noise Directive

3.1.1 The European Project QUADMAP

The Environmental Noise Directive (END) states the need to preserve and improve quiet areas in urban areas and in open country. It leaves to the member state the task of setting the criteria for the definition and delineation of the quiet areas. In the European Project QUADMAP (QUiet Areas Definition and Management in Action Plans), it was intended to improve END by delivering a method and guidelines for the identification, delineation, characterisation, improvement and management of Quiet Areas in urban areas. That is, a standardized way of defining quiet urban areas and of improving and managing them. The protection of quiet areas around Europe has diverse degrees of diligence and efficacy. The setting of guidelines can hopefully help in protecting and renovating quiet areas.

Three cities developed pilot studies in applying the new methodology and then projects of improvement of the acoustic quality of quiet urban areas: Bilbao, Florence, and Rotterdam. We will expound on the first two, considered more interesting. In Florence the work was done in six school courtyards. In Bilbao, the work was done at a square affected heavily by traffic noise and a suburban green area.

3.1.1.1 The guidelines

In END, quiet areas are considered in terms of their role in the city as is shown by "This Directive shall apply to environmental noise to which humans are exposed in particular in built-up areas, in public parks or other quiet areas in an agglomeration, in quiet areas in open country, near schools, hospitals and other noise sensitive buildings and areas." (END 2002, article 2.1). Then it is suggested to use a noise indicator to delineate them: "quiet area in an agglomeration' shall mean an area, delimited by the competent authority, for instance which is not exposed to a value of Lden or of another appropriate noise indicator greater than a certain value set by the Member State, from any noise source;" (END 2002, article 3).

In QUADMAP, they explicitly focus on the role of a quiet urban area (QUA) within the urban environment: "a QUA is an urban area whose current or future use and function require a specific acoustic environment, which contributes to the well-being of the population" (Bartalucci *et al*., 2015 - page 7). However, in a case study in Bilbao, they tried to apply the developed methodology to a QUA in an open country setting, but the outcome was unsuccessful.

In addition to using the objective approach suggested in END, the QUADMAP team used several subjective strategies. This included the involvement of the public in the planning and designing of the abatement interventions.

The information used in the process has the following origins:

1. Environmental noise maps constructed using L_{den} as prescribed in END.
2. Input from experts with knowledge of the local conditions (like the staff from the municipalities).
3. Questionnaires to the public.
4. Sound measurements in the selected QUAs.

The methodology included in the QUADMAP guidelines is organized in three working phases: the selection of the QUAs, evaluation of the QUAs, and their management.

Selection of the QUAs

For the selection of the QUAs they set two main variables to be considered:

- noise levels in the environmental noise maps (they suggest the threshold value L_{den}<55dB);
- use and function of the areas.

They propose a method (the rQUA method) which based solely on the information from noise maps can help identify QUAs and then indicate the necessity and type of acoustic measures to improve the space (more in the Management of QUAs phase explanation later on in this report). The minimum requirements to apply this method is a GIS platform software with the spatial analyst extension and data from the noise calculation software: noise levels (L_{den} and L_n according to END requirements) available in a grid format with a resolution of circa 10m x 10 m. For each grid point an absolute L_{den} is calculated, that is, a L_{den} that includes all sources. Secondly, for each grid point it is defined an area with a radius of 250 m and an arithmetic average L_{den} is calculated for the area within the circle. In this way, the quietness is appraised not only by considering the absolute noise levels, but also how the noise level in the QUAs compares to the immediate neighbourhood. Using results from the rQUA method it is possible to define coloured areas as set in Figure 4. Δ is the subtraction to L_{den} arithmetic average (R = 250m) of the absolute L_{den} in the respective grid. Green and yellow areas are already quiet areas considering the absolute noise levels in the area. Orange areas are not quiet when looking at absolute noise levels, but considering the comparison with the surrounding neighbourhood, they could be very relevant as havens in a noisy neighbourhood. White areas area also not quiet, but are potentially quiet when looking at Δ. The definition of measures in the white area is therefore relevant.

Colour	$Lden_{absolute}$ dB(A)	Δ dB(A)
Green	≤ 55	> 10
Yellow	≤ 55	≤ 10
Orange	> 55	> 10
White	> 55	≤ 10

Figure 4 – Categories established in the rQUA method.

Concerning the second main variable to consider in selecting QUAs, the uses and functions is evaluated based on the knowledge of key experts and municipal staff. The QUADMAP team also suggest additional criteria for this phase as e.g., public opinion and the consideration of

areas accessible to the general public (the objective is that everyone has access to an outdoor quiet area in their urban setting). For a first selection they suggest two approaches:

- brainstorm-type meetings with elected officials and local technicians (that then could e followed by a public consultation);
- pre-selection by elected officials and then re-evaluation by the local technicians using the variables proposed by the QUADMAP team.

Evaluation of the QUAs

The evaluation of the QUAs is accomplished through the consideration of acoustic and non-acoustic criteria in three phases:

- grouping of the QUAs into type areas (called Homogeneous Units of Analysis - HUA).
- Collection of non-acoustic information.
- In-situ questionnaires.

The definition of HUAs is necessary because a large QUA may have areas affected by different sources, have diverse uses and functions, populations may have different expectations and in this way different acoustic requirements may present themselves. Therefore in order to apply a harmonized methodology the QUA needs to be divided in its homogeneous parts. The grouping into HUAs should be accomplished by experts considering:

- Landscape – the area must be characterized by uniform visual elements and landmarks.
- Use or function - The area must have only one main and specific use or function. This is related to the facilities and furniture in the area. For instance, in a park, many different activities can be carried out in different areas depending on the facilities: sports areas, recreational areas, resting and relaxing areas.
- Presence and distance to sound sources - The influence of environmental noise sources (road, rail, and air traffic or industrial activities) or other sound elements must be homogeneous in the area.

The two next phases have the objective to create information on which to base the evaluation process and the definition of strategies for improvement and management. The collection of data suggested includes: visual context (landscape), cleanliness and maintenance, safety, urban environment, proximity to residential areas, accessibility, proximity to noise sources, presence of a multi-source scenario, noise reduction measures, number of users and its distribution in the HUA, and activities performed. The questionnaires should address the following aspects: dominant sound sources and their perception, perception of calmness, perception of pleasantness, perception of congruence, general perception of the area, overall satisfaction, visual context, cleanliness and maintenance, safety, urban environment, accessibility, duration of the stay in the area, activities performed.

Sound measurements in the selected QUAs

Besides the overall sound level it is advised the measurement of the density of negative sound events.

Management of QUAs

In the case of an only potentially quiet QUAs there will be the need for a first intervention to reach the level of actually quiet. The rQUA method can be used to indicate the necessity and type of acoustic measures. Figure 4 shows the areas established in the rQUA method. The green and yellow areas are actually quiet areas and the orange and white are potential quiet areas (see Selection of the QUAs previously in this chapter). The orange area may play an

important role as a haven in a noisy larger area and its context signals to difficulties in improving its character without a comprehensive approach to the neighbourhood. The white area is in absolute terms noisy, but the Δ does not allow to understand if and which kind of intervention could take place in order to improve the acoustical conditions. In this way, the white area should be further divided into a blue and red area (see Figure 5). The blue area similarly to the orange area is predominantly affected by a non-localized source and only strategical measures at block level can be performed (e.g., reduced speed, vehicle-free zones). In the red area, the sources of noise are localized and therefore it is possible to implement a limited number of measures at the edges of the QUAs (e.g., noise screens, low-noise road surfaces). The type of measures pointed by the rQUA method should be matched with the measures proposed by technicians after the on-site recognition and with the responses to interviews with the end-users. Also, these measures should integrate an expert analysis considering the effectiveness of noise abatement measures, also when considering non-acoustic indicators.

Colour	*Lden_absolute* dB(A)	Δ dB(A)
Green	≤ 55	> 10
Yellow	≤ 55	≤ 10
Orange	> 55	> 10
Blue	> 55	>-5* and ≤10
Red	> 55	≤ -5*

Figure 5 – Categories established in modified rQUA method.

In the case of an actually quiet area a plan should be devised in order to preserve the area and increase its value. One sure way to achieve the former is by including it in other management plans as city's maintenance operations and in renovation strategies. The latter is accomplished by including the quiet area in biking and walking routes, signage directing the public to it, and informing the public of the benefits of quiet areas.

3.1.1.2 Case studies

The guidelines were tested and improved through the case studies in Rotterdam, Florence, and Bilbao. We will address the latter two.

Bilbao

Two areas were chosen in Bilbao for the study of the improvement of environmental acoustic quality. One area was a green area in the suburbs of Bilbao: Santa Marina. This area was not chosen for the existence of noise pollution, but the opposite. It is an area relatively distant from noise sources and used for resting. The aim was to study the QUADMAP methodology for quiet areas in a rural setting and the creation of a positive soundscape by incorporating pleasant sounds like birds singing. From this experience it was concluded that changes were needed in the methodology for it to be valid in open country (Bartalucci *et al.*, 2015).

The other chosen area was highly affected by noise: Square General Latorre. It is within the city in the neighbourhood of Basurto. This neighbourhood contains 5% of the people affected by L_n>55 dB(A) relative to the total Bilbao population. This makes it the fourth most problematic neighbourhood in Bilbao. The Square General Latorre has become an "acoustic

island". An acoustic island means not only that noise levels are lower, but that positive sounds have been introduced. The actions taken in the area were the following:

- A fountain with 12 jets of a closed water circuit with artificial illumination. The jets and LED lamps are computer controlled in order to create water plays intended as "music".
- Vegetal isolation: green areas surround the Square separating it from the streets visually and acoustically.
- Renovated pedestrian crossings adapting to the rules of accessibility and better street asphalting with leveling of the road with the sidewalk. Both measures had the intention of reducing road traffic and deterring vehicles circulating around the square of reaching high speeds.

The case study in General Latorre Square was used in the report to exemplify the use of questionnaires. Two questionnaires were given to users of the Square General Latorre before and after the intervention. The duration of the users reported stays in the area had gone from less than 15 minutes to 30-60 minutes. The global pleasantness perceived had gone from 28% to 98%. Indicators had improved remarkably between questionnaires: calmness, safeness, cleanness, visual pleasantness, and accessibility (Bartalucci *et al*., 2015 – pages 32 and 33).

This work has been extended by the institution (Tecnalia[5]) responsible for the case studies in Bilbao into the concept of Comfort Urban Place (CUP). This is a methodology that evaluates QUAs in terms of sensorial human experience. It considers acoustics, light, and thermal sensation. It includes measurements and numerical models and the end product are maps describing environmental comfort. It describes the area and it helps in decision-making. Moreover, it helps comparing between different design options. Tecnalia is applying this concept in projects that produce an inventory of public spaces tagged with their CUP level, and that of collaboration with urban designers. It is their ambition to also collaborate with designers of furniture and equipment for outdoor leisure spaces.

A final remark: there is contention regarding soundscape. There is the view that the creation of a sound (even if pleasant) adds to the physical acoustic effect and moreover that it is not a solution to noise pollution. The opposite view bases itself in the psychological effect of noise in the subjective sense of wellbeing.

Florence

In Florence the criteria used to choose QUAs was to act on a special type of QUAs: the noise sensitive areas, that is, areas that demand care in maintaining low noise levels due to their use. These are areas that surround schools, hospitals, etc. Six schools were chosen in Florence: E. de Filippo school (A), Secondary school P. Uccello (B), Secondary school A. Manzoni (C), Nursery school Montessory-Vamba (D), Nursery school P. Fedi (E), and Nursery school F. Dionisi (F) – see Figure 6 for the location of each school.

The areas around schools were expected to be quiet, but quantitatively presented high noise levels.

[5] Personal communication with Itziar Aspuru Soloaga from Tecnalia

In QUADMAP's reporting two of the case studies in Florence were used to exemplify the selection of HUAs, the analysis of these areas and suggestion of measures for improvement and management: the Nursery school Montessory-Vamba (D), and Nursery school F. Dionisi (F).

The first step was a desk-study and preliminary in-situ visit by municipality staff in order to identify within each QUA HUAs. The criteria used in this phase were landscape, use or function, and presence and distance from sound sources. In the Nursery school Montessory-Vamba schoolyard they identified two HUAs. The differentiation was based on different student classes using two areas of the garden and one area being affected by road traffic noise from two streets and the other from one street. Next, each HUA was analysed considering a set of criteria (see the previous section regarding evaluation of QUAs). Tables were produced listing positive and negative aspects for each criteria and if necessary/impossible to recommend interventions, and for some, specific solutions to implement.

The actions reported as already implemented by the time of writing the report were the redesign with traditional noise reduction systems: natural noise barriers like planting trees and traffic management in the adjacent roads. It had been intended also the implementation of innovative solutions of the holistic kind. The actions on the exterior have an effect inside the building and a better soundscape for children in the courtyard.

3.1.1.3 ***Lessons learned in the QUADMAP project***

- The analysis of the measurements highlighted that long-term measurements should be carried out as a tool for having further detail of the L_{den} values, including sound sources that are not considered in noise mapping.
- Based on the short-term measurements, L_{A50} seems the most appropriate indicator to describe appreciation of users. Other acoustic indicators, i.e., L_{Aeq}, L_{A10}, L_{A90} and psycho-acoustic parameters were not statistically relevant.
- Based on the results from the pilot cases of Florence and Rotterdam, the psycho-acoustic parameters obtained by processing the audio recording do not seem to add essential information to the end user questionnaires. Consequently, it is confirmed that the WAVE recordings should be maintained as a non-compulsory procedure.
- Based on the pilot cases in Florence a new qualitative classification for quiet areas was defined (see Figure 5).

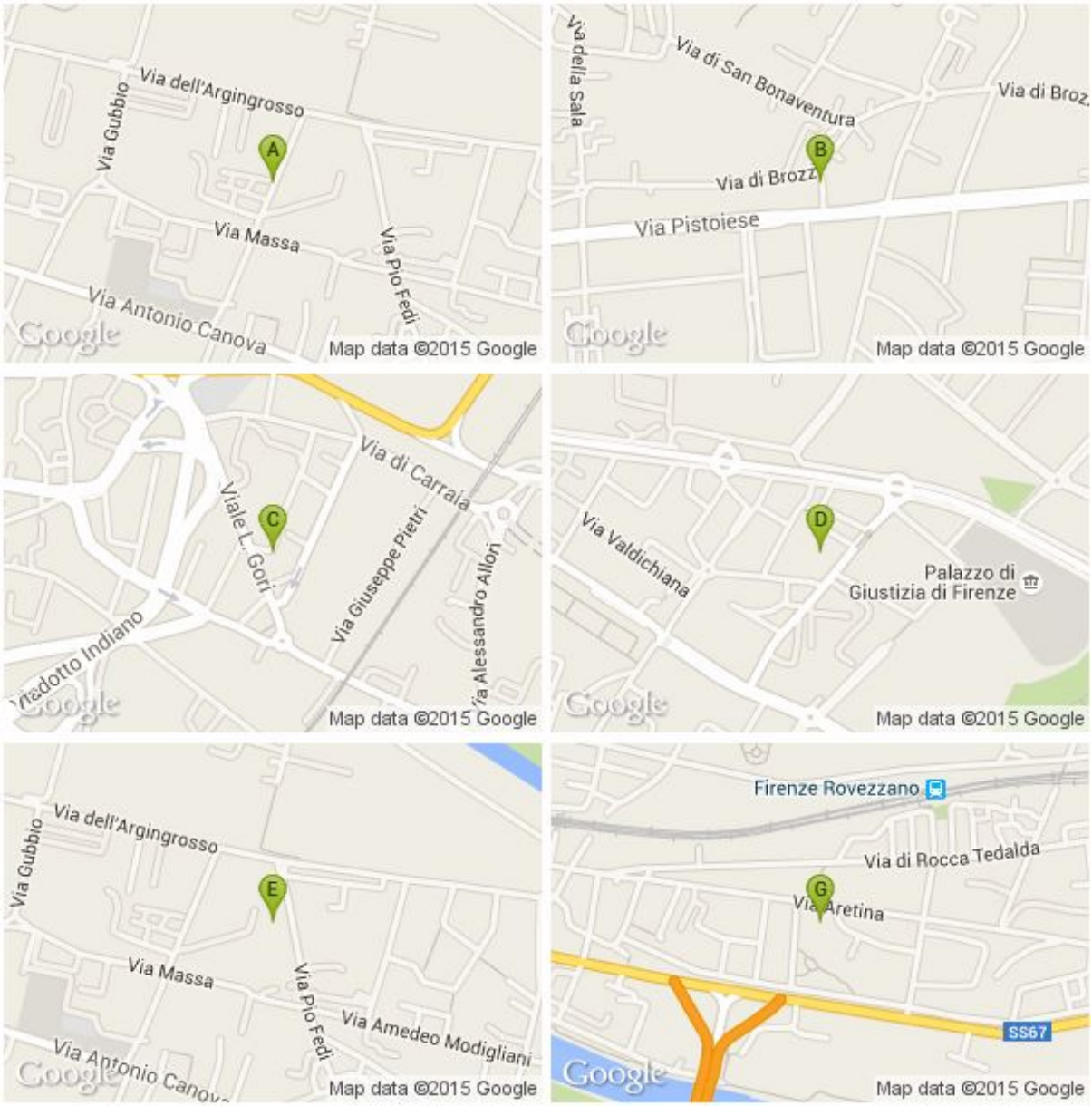


Figure 6 – Location of the schools used as pilot areas in Florence for QUADMAP
(taken from http://www.quadmap.eu/welcome/pilot-areas/)

3.1.2 The G_{den} and G_{night} indicators

The Gden and Gnight indicators: They are an integration of L_{den} and L_{night} from different sources and they take into account the number of exposed people. These two indicators are normally used to compare zones of the same city or the time evolution of a single zone (Licitra and Ascari, 2014). In order to use the indicators to compare different areas, Licitra and Ascari normalize G_{den} and G_{night} with the respective total population. However, it can only be used to make a comparison between homogeneous samples, that is, samples produced with the same methodology. Moreover, the reported data in terms of population exposed does not cover the total number of inhabitants in a urban agglomeration and therefore it is not clear if not reported population could be exposed to values lower than 55 dB or if they have been neglected without knowing their exposure levels.

Licitra and Ascari (2014) describe the analysis of the noise map reported by the different European cities in order to analyze their distribution of exposed population over classes of L_{den}. Differences were found which point to the different methodologies used in the production of the noise maps. Two large groups of more homogeneous data was identified: one is constituted by German data that is based on a national method of people distribution and the latter by English data produced by the same institute (DEBRA). In this way, by using these data, errors are made, but they allow higher possibilities of comparison of the data already delivered by the Member States.

Data homogeneity should increase with the implementation of the CNOSSOS-EU method, which then allows for noise indicators including G_{den} and G_{night} to have more quality.

Pisa was the stage of a study in which was intended the application of G_{den} to the identification of hotspots in agglomerations. The results were compared with another methodology developed during the European Project Qcity (www.qcity.org). Gden methodology provided lower geographical resolution, but it was faster to calculate. It was also remarked that the measure unit Gden score would be easier to understand by the public than a score in standard deviation.

The G_{den} and G_{night} indicators are being used in a project at the national level in Turkey that intends to lie the basis for developing measures to reduce the environmental noise impact in accordance to END.

3.2 Public outreach

3.2.1 Bruitparif (Paris region)

The Paris region (Île-de-France) is one of the twenty seven regions of France and includes the city of Paris. It has a population of 12 million. An institution has the responsibility of overviewing matters regarding noise in this region: Bruitparif.

Bruitparif is a non-profit institution established in 2004 by the Regional council as requested by environmental associations[6] . It brings together the stakeholders in noise control in the Île-de-France (government agencies, local authorities, managers of infrastructures and economical activities, environmental associations and associations for the protection of consumers). Among its responsibilities stands the implementation of END. They go further in terms of measurements and research, and public awareness and education. In terms of Noise Action Plans, their responsibilities is to provide support. They inform the concerned stakeholders (the local authorities and managers of infrastructures) of deadlines, necessary contents (updated with the new information accrued since 2002), methodologies, noise levels limits, and even how to fund the planning and afterwards the implementation of the actions. They also support the implementation by delivering the strategic noise plans, by offering a forum for exchange of experiences, by working as mediators between the stakeholders, and providing tools like a portal to exchange data.

[6] http://www.bruitparif.fr/en/bruitparif/about-bruitparif/bruitparif#.VfFgupcXfVI

The work done by Bruitparif in public reaching is extraordinary, which correlates with the main idea when creating Bruitparif: to give reliable information about noise levels to the inhabitants of Île-de-France. In this way, Bruitparif goes further from informing to educating. The education concerns what is sound physically, what means the quantified values of sound, the limits in legislation, how sound is detected by the human ear, awareness of effects of sound on the ear and human health, and advice in how to protect yourself from noise harm (see webpage: http://www.bruitparif.fr/en/).

Moreover, Bruitparif has worked in two projects, RUMEUR and HARMONICA, which leads to the easier access to information about the noise status in Île-de-France and in a format easier to understand by everyone.

Bruitparif is setting up a noise monitoring network covering an area of 12,000 km^2 that feeds a web platform called RUMEUR (http://rumeur.bruitparif.fr). This system will help assess the effects of the Noise Action Noise Plans, but they will also focus in its value to the general public. The innovation of RUMEUR rests on its pragmatism. It endeavours to create a platform that informs in an integrated and easily understandable way, and can be expanded to other European cities creating a harmonized source of information.

Established in 2008, the noise monitoring network contains at the moment 45 long-term stations and 350 short-term terminals with a special focus on aircraft noise. There is also the tools (measurement devices, laboratory vehicles) for short-term campaigns. The design of the network was based on the analysis of the strategic noise maps prompted by END, a measurement campaign of more than 350 points in the area of Île-de-France, on-site visits, and consultations with local authorities and resident's associations. The objective was to select representative sites of the diverse noise sources (air, railway, road traffic, leisure activities, etc.) and situations that are most in need of observation like the effects of major urban projects, modifications in flight paths, assess noise mitigation actions, etc. Managing the monitoring network demands cooperation with other institutions that can share data and expertise in road, rail, and air traffic counts, aircraft flight paths, weather data, land use and population data, etc.

The data retrieved by the monitoring stations is transferred near real time to a central server and stored in a database (The raw data stored is values in dB(A), dB(C), dB(Z), and one-third octave bands. For terminals in airports they also store digital audio recordings). The transference is done through cellular networks, because they provide wide coverage at ever-increasing transmission speeds and at steadily declining prices. In addition, it is by far the most reliable method because operators have to ensure the operation of their mobile networks. The apparent cost of data connections is largely offset by the savings in working time needed to maintain an alternative telecom infrastructure based on connecting to WIFI or ADSL networks within private households or public buildings, for example (Mietlicki *et al*., 2015b). The quality control of the raw data is done in a daily basis.

The measured data and the data provided by other institutions and previously referred are brought together, validated and processed in order to create the indicators presented in the web platform RUMEUR. In Figure 7, we show a snapshot of the initial page of the web application, which shows the monitoring sites on the map. In blue are temporary monitoring sites that have been terminated. For the ones in light blue a report has been produced. In green are monitoring stations in operation. The user can click on these geopoints and arrive to further information (see Figure 8) like the exact location of the site, the objective for the

monitoring, the characteristics of the noise event, and the noise levels in different time-scales (noise fluctuations per second, averaged values, and long-term trends).

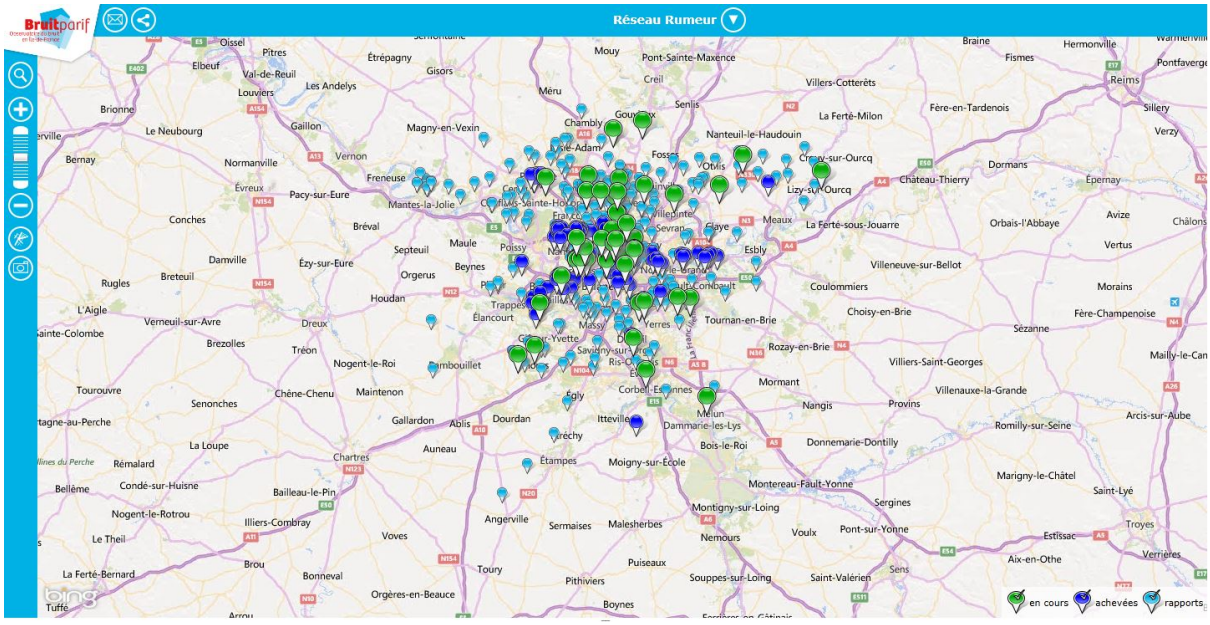


Figure 7 – Snapshot of the initial page of the RUMEUR web application.

The graphic in the below left corner in Figure 8 shows daily averages in dB(A). This graphic will be substituted by a visual representation of a new index called HARMONICA that intends to be closer to a person's perception of noise (see Figure 9). In this way, in the Y-axis the scale is linear and scores the noise environment quality (the higher the score the poorer the noise quality). The index contains two noise components which were found to be the most relevant in terms of public perception: background noise (represented in Figure 9 by the rectangle) and noise peaks (the triangle). The colours are referent to values recognized as critical in the WHO environmental quality objectives. These colours take into account that during the night people are more sensitive to noise.

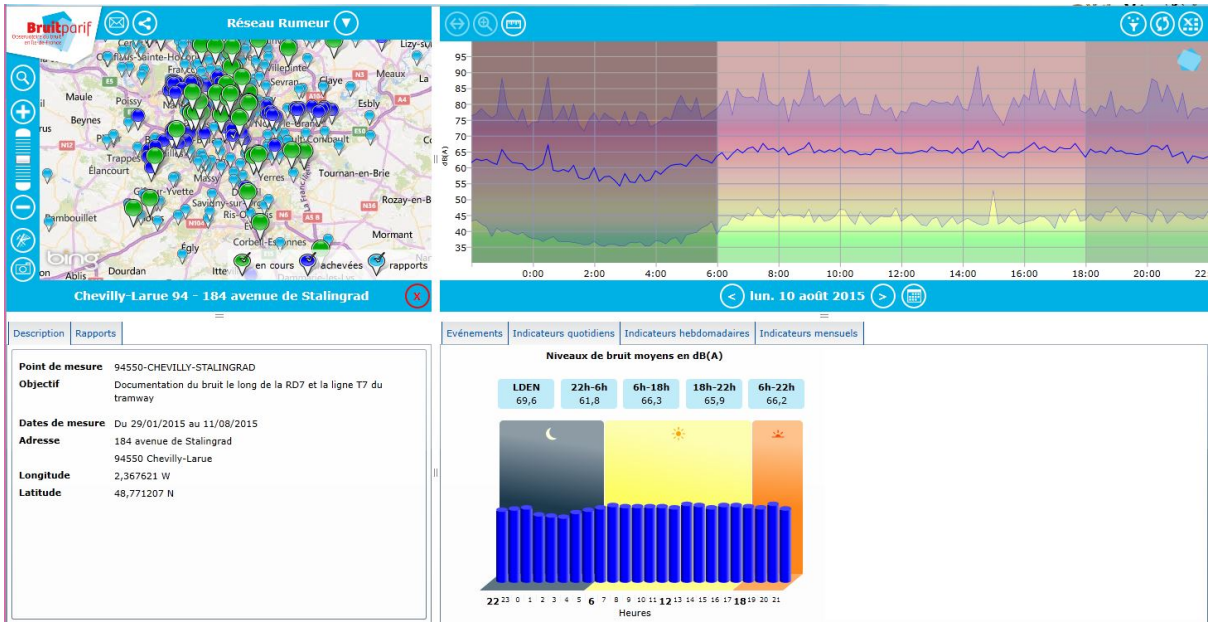


Figure 8 – Snapshot of the RUMEUR web application. Zoom into information relative to the monitoring site 94550-Chevilly-Stalingrad.

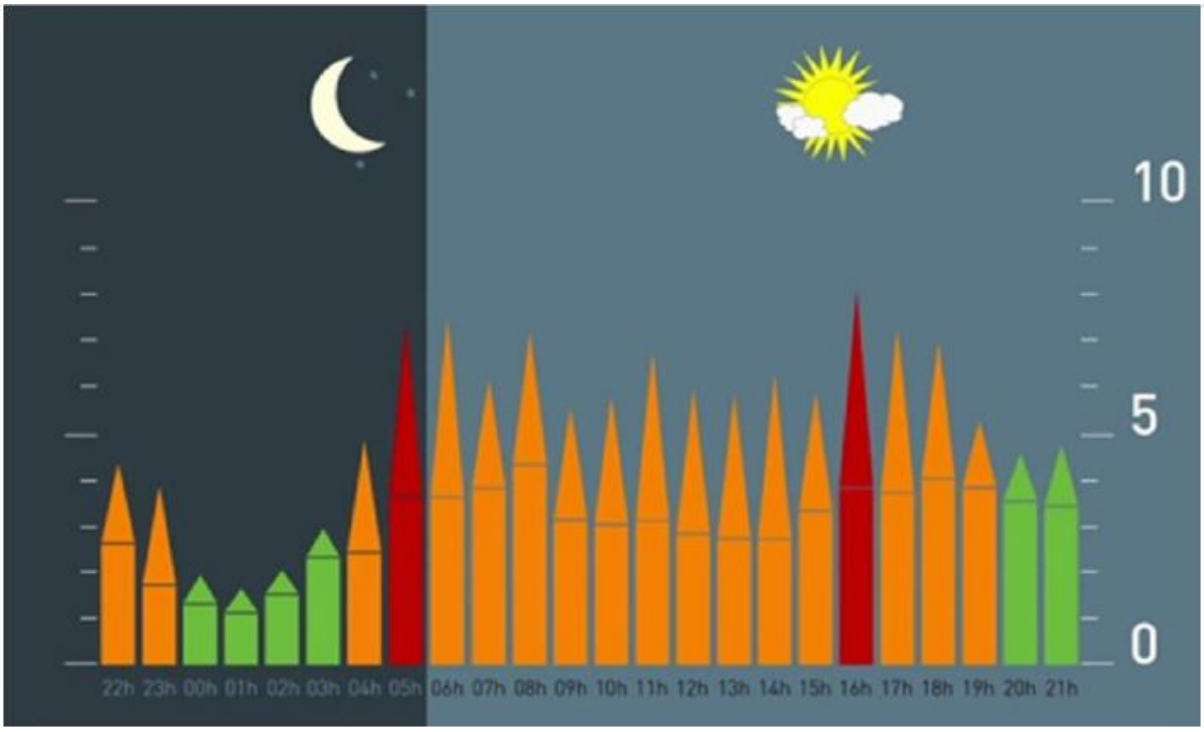


Figure 9 – Example of hourly variation of the HARMONICA index over a 24h period (Mietlicki *et al.*, 2015a).

3.2.2 Alverna

Original situation and initial planned measures

Since Roman ages the 'Graafseweg' has provided a major connection between the historic city of Nijmegen in The Netherlands and its southern regional towns and villages. Nowadays,

it runs as a busy main road, the N324, with a local parallel road at each side, through the middle of the village of Alverna in the municipality of Wijchen.

Over the past few decades, Nijmegen, Wijchen and surrounding villages experienced major growth with extensions of several new residential areas. This led to significant increases in traffic intensities on local and regional roads. In 2010, daily traffic intensity of the Graafseweg was some 25,000 vehicles against 15,000 ten years earlier. With this increased levels of traffic, noise levels increased as well and, not unexpectedly, the number of complaints from local residents. Furthermore, it became more and more a barrier in the village, threatening the quality of life and the road safety.

A series of some 70 houses along the road were exposed to noise levels above the limit values and would need noise reduction measures. In efforts to tackle the high noise levels the province of Gelderland, owners of the road, developed in cooperation with the municipality of Wijchen a plan, which consisted of installing a relative cheap and little space consuming four meter high wall-shaped sound barriers at both sides along the main road through the whole village, as illustrated in Figure 10.

Figure 10 – The main road without the proposed noise reduction measure (left picture) and with the proposed 4 m high wall-shaped sound barriers (right picture).

Rejection of initial plan

This plan was first presented to the residents and business owners of Alverna in 2004. The proposal for this four meter high sound barrier was much criticized by its residents for several reasons. Such wall in front of the houses was considered a visual and physical obstacle. It would lower the market value of their house. Furthermore, it was also considered to both affect the typical identity and scenery of the village and its quality of life due to the split of the small community into two by such high wall. As a consequence, the initial plan ‘designed behind a desk’ was firmly rejected by the residents. A ring road around the village as alternative did not pass the municipality council as it would cut through a nature reserve.

Involvement of the residents in the planning

The firm rejection of the initial plan led to the awareness that an alternative for reconstructing Graafseweg should be reached in consensus with all involved stakeholders. A carefully coordinated, interactive process was launched between the authorities of the province, the

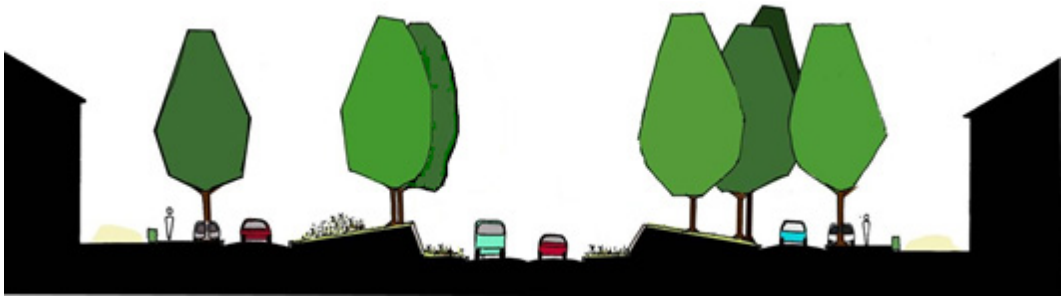
municipality, and the residents and businesses of Alverna. A set of essential boundary conditions for the reconstruction of the Graafseweg were defined through a series of open discussions with and consultations of the residents and business owners of Alverna. Based on their expertise and experience the following objectives were defined:

- Improve environmental aspects, in particular reduce traffic noise and improve air quality.
- Improve traffic flow, reduce congestion.
- Accentuate the 'green' character of the surrounding area.
- Preserve the characteristic village appearance of Alverna.
- Preserve or improve Alverna as an attractive place to live.

To meet with these boundary conditions a series of measures were included by the province and municipality authorities in a new main road design (Figure 11) achieving a traffic noise reduction of 10 dB:

- Reduce the number of lanes of the main road from 2x2 to 2x1, and move and join them.
- A sunken main road, 0.5 m deeper than its bordering parallel roads.
- Asymmetric low dike-shaped sound barriers of just one meter height at both sides of the main road, with a steep slope at the road side and a gentle slope facing the parallel road and houses.
- Sound barriers having a noise absorbing cobblestone-like surface at the steep road side, as an artistic and historical element as a hint to the Roman road that once traversed the region at this location.
- Sound barriers with a wide gentle earth slope with park-like greens such as lawns, trees and bushes creating a green landscape matching the character of the village.
- Energy-saving LED street lights providing a 'warm' ambience at both the regional main road and the local parallel road traffic passers.
- Apply special 'quiet' asphalt.
- Reduced speed limit from 80 to 50 km/h not only reducing the noise, but also improving road safety and air quality.

Figure 11 - The combined set of measures resulted in a new design of a narrowed and sunken main road with its two parallel local roads separated by asymmetric dike-shaped sound barriers.



The relocated and reduced number of main road lanes allowed to create additional pedestrian crossings, attractive pedestrian areas, squares, café and restaurants terraces attracting more recreational public and locals. It also allowed to include new and enhanced cycling routes linking neighbouring countryside with the village and beyond (note that cycling is a significant means of both transport and recreational activity in The Netherlands).

As an independent party, the Radboud University of Nijmegen investigated both the acoustic and air quality conditions of the original situation through measurements and the new situation through 3D-modelling. Model based analyses contributed to the selection of smart noise reduction solutions applied in the design. The air quality seemed not to be a limiting factor in the selected design elements. The ultimate package of measures appeared to be enough to reach the desired noise reduction, without the need for additional façade isolation of the houses along the road. The combination of the measures led to an estimated reduction in noise levels of more than 10 dB at a total of 90 homes and were as effective as the four meter high sound barriers in the original plan.

Innovative character and sustainability of the plan

The innovative character of this project lies in the fact that – at that time – it was the first traffic noise reduction plan in The Netherlands, and perhaps one of the first in Europe, that was designed through intensive and major involvement, consultation and participation of its residents and business owners. Even though such a busy major road runs through the village centre, the residents are extremely supportive and committed to the plan, as they have been so closely involved in its preparations.

The combination of implemented smart noise reduction measures meeting also other local predefined physical and social boundary conditions leads to set of additional co-benefits,

such as improved social and physical connection between the two sides of the village, accentuation of the historical background and scenery of the village, improved view from the dwellings along the road, higher social appreciation and perception by its residents and an overall reduction of health impacts (less noise, less air pollution, higher road safety). As a result the road reconstruction leads to a more attractive residential area to live.

Due to the high level of commitment from its residents and the co-benefits coming with the reconstruction, all stakeholders consider it as a long-term time resistant design. As such, it is justified that one qualifies this project as a sustainable traffic noise reduction measure.

The new design required additional budget compared to the initial proposal of 2004. This was, however, no problem as the new and innovative character of the plan generated considerable attention from both policy making authorities at different levels and the media. It served as a show case providing a potential for replication for traffic noise reduction measures in other regions and countries. This led to a willingness to invest. A consortium with local, provincial, national authorities provided the necessary funds, including funds from the European Regional Development Fund, to realise this innovative, attractive and sustainable 'soundscape' in the village of Alverna.

3.2.3 Campaigns for Better Tyres

In 2013, the European Soundscape Award winner[7] went for the communication campaign for better tyres in Switzerland. It was submitted by The Swiss Federal Office for the Environment (FOEN) as the leader of a consortium of private and public partners. The aim of the campaign was to help reduce road traffic noise at the source at little to no additional cost by promoting the use of low-noise tyres. The campaign focused on the – at that time – frequently-overlooked option of choosing quieter tyres. Low-noise tyres are already on the market, are not more expensive than regular tyres and do not show obvious trade-offs on other aspects such as fuel saving, durability and safety.

The tyre list

An analysis of the tyres market in Switzerland showed that a vast majority of people (> 90 %) buy tyres at their common car repair shop after being told that the mounted tyres are worn out. Car repair shops, tyre industry and mobility clubs confirmed that for car owners, the tyre usually is not a topic, even though it is one of the key products of a car and its performance. Moreover, nowadays clients are used to get all the information on the web and visit various information platforms to compare products of interest prior to the purchase. In terms of tyres, such mechanism did not exist at the time. This made FOEN decide, as a first step, to start developing an instrument to inform the car owner about tyres and their (acoustical)

[7]Web page Soundscape Award winner 2013 "Campaigning for the use of low-noise tyres" http://www.eea.europa.eu/highlights/campaigning-for-the-use-of (with article "Campaign for better tyres (Contribution FOEN)" http://forum.eionet.europa.eu/european-soundscape-award/library/campaign-better-tyres-foen/campaign-better-tyres/download/1/Contribution%20FOEN_European%20Soundscape%20Award%202013.pdf?action=view)

performances. FOEN developed together with the Swiss mobility club TCS (http://www.tcs.ch) the first, so called, "Tyre list" (http://www.reifenetikette.ch/#reifenliste; German: Reifenliste).

In 2009, while the campaign for quieter tyres was in its initial stages and the tyre list was in preparation, it became clear that the EU would opt for implementing a tyre labelling consisting of three elements: energy saving (fuel saving due to reduced rolling resistance), braking safety (wet grip) and external noise reduction (see Figure 12). FOEN recognised that this offered the opportunity to broaden its campaign by including also the fuel saving and braking safety elements. In this way, the campaigning strategy and tyre list moved from the exclusive noise aspect, i.e. "Quieter tyres", towards a broader information campaign promoting "Better tyres" as being quieter, fuel saving and safer.

The tyre list was at that time a unique databased internet tool. It allows easy queries and intercomparison of tyres. Query results can be sorted after different parameters (noise, rolling resistance, wet grip, TCS-tyre test and other characteristics). To assure actuality, the database is constantly maintained and updated by the TCS. With the functioning of the tyre-list it was assured, that interested people could easily compare parameters of tyres and hopefully choose a quieter tyre. A drawback, however, is that the database does not provide an indicative consumer price. Whereas, an important incentive in consumer's decision processes is – in general – the price.

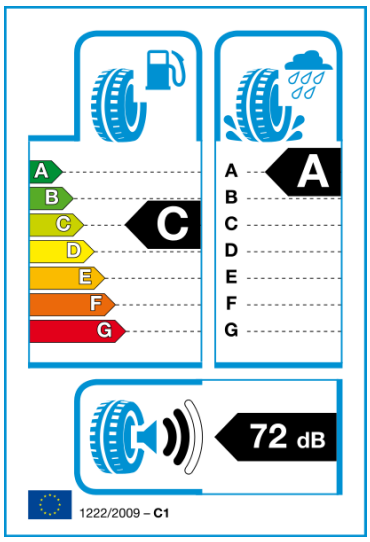


Figure 12 – An example of the European Union (EU) tyre labelling in force as November 1, 2012. It contains an indication of fuel consumption efficiency (rolling resistance), wet grip, and exterior noise[8].

The campaign

With a tyre list in place on the internet, the campaign itself was launched. The campaign was oriented to make the tyre a product of interest to car owners (message: "*choose better tyres*"), but sales people were also included in order to have a maximum coverage and achieve its potential impact. The sales people in the car repair branch were pre-informed and offered free instruction on providing balanced advice to consumers (message: "*recommend better tyres*").

[8] http://ec.europa.eu/energy/en/topics/energy-efficient-products-and-labels/tyres

Important principles of the campaign were that all three label parameters were to be treated equally, and that both the consumer and sales perspective were treated equally to assure no conflict of interest between both groups.

The campaign used a series of media support: internet landing page of campaign in the three Swiss languages, the tyre list, TV spots, online ads, Twitter, Billboard poster at highways, info poster for car repair shops, lottery of a series of sponsored quality tyres to draw the public's attention, counter leaflets and flyers. Each had its specific goals, such as sensitizing/ educate / inform / motivate public and consumers, advocate the consultation of the tyre list and support and instruct sales people.

Concluding remarks on the Swiss Campaign

The expected noise reduction from daily traffic was of 2 to 3 dB. This would lead to a reduction in Swiss people suffering from emission values above legal limits of 39 % to 51 % (FOEN, 2009). The campaigning costs were circa 750,000 Euro, which is negligible relatively to other noise reduction measures and its effectiveness.

There seems to have been no post-assessment of the effectiveness of the campaign. The private partners indicated that the number of shop owners participating was above expectation and that they were well motivated throughout the campaign.
However, that is not a proof of success.

Spin-offs

The Swiss campaign for better tyres has so far been adapted to other markets: The Netherlands and Belgium. Its reach has the potential to continue spreading through an initiative by the Municipality of Rotterdam (supported by the Dutch Ministry of Infrastructure and Environment I&M) to have the members of the Eurocities[9] network sign the "Declaration on Best Tyres".

The Netherlands[10]
Early April 2015, the ministry I&M launched a campaign in The Netherlands similar to the Swiss campaign, with:

- the same equal treatment of the three EU labelling parameters,
- a similar web site (http://kiesdebesteband.nl),
- participation of similar type of private and public national organisations,
- a similar slogan "Kies de Beste Band" (in English: "Chose the best tyre"), and
- a similar approach to both consumers and retailers.

[9] Eurocities network: Their objective is to reinforce the important role that local governments should play in a multilevel governance structure. They aim to shape the opinions of Brussels stakeholders and ultimately shift the focus of EU legislation in a way which allows city governments to tackle strategic challenges at local level. They influence and work with the EU institutions to respond to common issues that affect the day-to-day lives of Europeans. (http://www.eurocities.eu)

[10] 'Kies de beste band', Dutch Campaign for best tyres, http://kiesdebesteband.nl and personal communication with campaing leader of the Ministry I&M, NL, July and September 2015.

Observed differences are:

- No direct link to a prominent online interactive tyre list database on the web site http://kiesdebesteband.nl itself. Some of the downloadable flyers on this web site refer to a 'tyre' page of the Dutch national touring club (ANWB; http://www.anwb.nl/auto/banden) that contains, among others, tyre lists which include among other indicators price estimates. The tyre lists are organised jointly with several European national touring clubs, which share the results.
- Somewhat more emphasis on the cost savings when one choses triple-A[11] tyres and adequately maintains tyre pressure over time.
- More oriented on information transfer through the retailer sector (flyers, refer to retailer's advice) than direct promotion through public media (limited bill boards, no TV and radio advertising).

The Dutch campaign is slightly more ambitious than the Swiss campaign by:

- Emphasizing the principle of "Best Tyres" instead of "Better Tyres" with the Triple-A tyres concept.
- Including a fourth parameter: type pressure maintenance.
- Aiming for a closed recycling cycle in The Netherlands (slogan: "*an old one for every new one*").
- Strives to commit Dutch authorities to the principle of "Best Tyres" in their mobile fleet. The Dutch National Road Authority (RWS), owner of a large vehicle fleet, committed itself to such application. These initiatives should serve as good example cases to other public and private organisations, with the expectation that more and more cities, departments and companies will switch to the application of the best tyres as well. All together this may involve a considerable number of tyres. It is estimated that in case Rotterdam puts its 1097 vehicle fleet on triple-A tyres with the correct pressure the potential annual benefits would be a fuel saving of 245 thousands litre, a CO_2 reduction of 514 tons and a cost saving of 304 thousands Euros (TNO, 2015).

Eurocities Network

Eurocities, a network of major European cities (http://www.eurocities.eu), is close to sign a "Declaration on Best Tyres". This Declaration is largely based on the principle of the Dutch campaign of committing large parties to install best tyres on their car fleets. Eurocities members that sign the Declaration commit themselves to strive to have 50% of their fleet on best tyres by 2020, to equip their fleet with Tyre Pressure Monitoring Systems (TPMS), to include 'Best Tyres' into their Green Procurement policy, to evaluate the progress with the intention to report bi-annually on it, to consider EU benchmarking, and to promote and call upon fleet-owners to apply best tyres.

Belgium

ByAugust 2015, the Belgium's Federal Public Service (FPS) branches Health, Food Chain Safety and Environment (http://www.health.belgium.be/eportal/index.htm) and Mobility and

[11] Triple A-tyres: Tyres that meet all three label elements of the EU tyre labelling: fuel efficiency, wet braking and external noise. For some tyre sizes such types do exist already, for others the developments have not yet lead to this highest possible qualification. The terminology 'Triple A' is not used in the campaign itself; it is used explicitly in TNO studies (www.tno.nl) that formed the basis of the Dutch campaign.

Transport (http://mobilit.belgium.be) have launched a campaign, http://www.bandentips.be, very similar to the Swiss and Dutch concept, with its own interactive tyre listing and comparison web site. The Belgian campaign focuses somewhat more on knowledge of each of the three separate label elements and characteristics, instead of going for the "better" or "best" tyre.

3.3 Smart Cities: Santander

The Smart City is the concept of using information and communication technologies in order to increase the performance and customer outreach of urban services, like transportation, energetic needs, city-level administration, etc. The European Union has supported projects based on the smart city be it in its "Europe's Digital Agenda" or the latest call for financing with Horizon 2020.

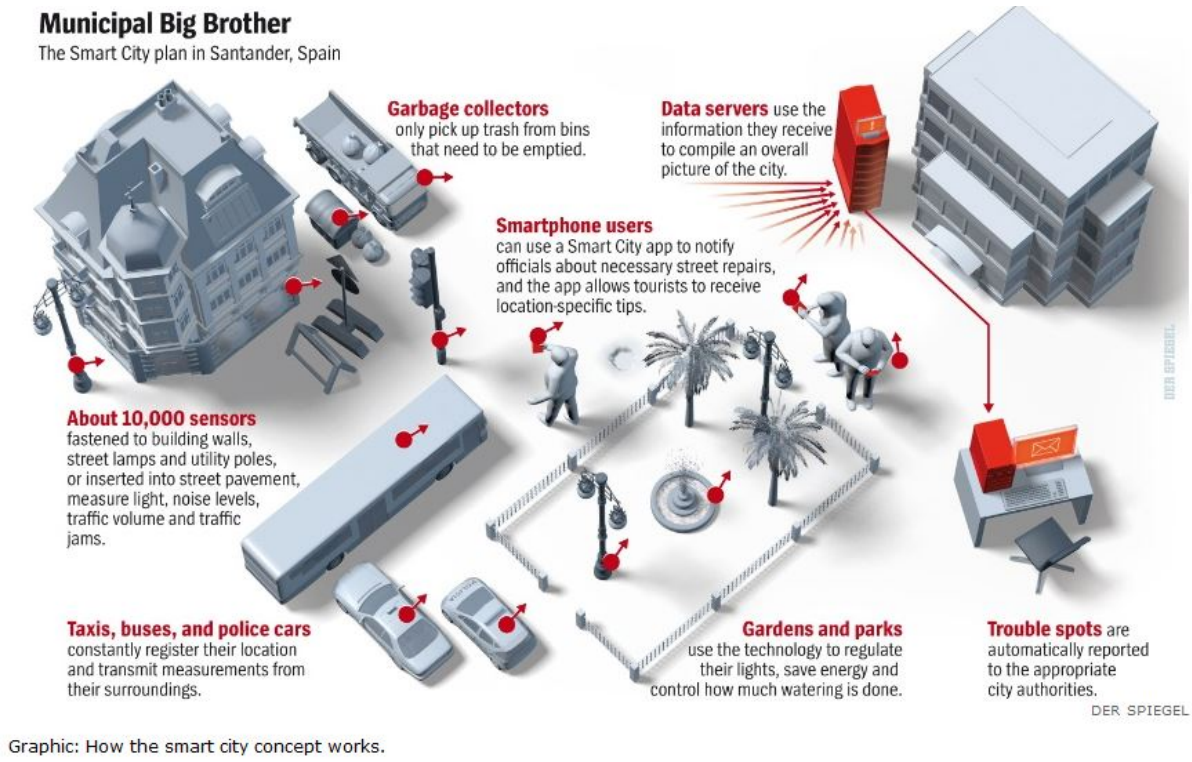


Figure 13 – Diagram of the smart city concept in Santander, Spain. (in Der Spiegel, 14/04/2013).

Within this context comes the experiment called SmartSantander. This project received around 8.67 million Euros (most from the European Union) in research money to implement a smart city experiment. Fifteen stakeholders in several countries from the private and university sectors participated, as e.g., the company Telefonica I+D (Spain), Commissariat a L'Energie Atomique (France), University of Reading (UK), Computer Technology Institute (Greece) (http://www.smartsantander.eu/wiki/index.php/Main/ProjectPartners[12] provides a

[12] Last accessed September 9, 2015

full list of project partners). Four million Euros was used by the Santander stakeholders, which included the municipality, the university and private companies. The project started in September 1, 2010 and lasted three years (for a diagram of the project in Santander see Figure 13). In this phase a net of static sensors were set across Santander (Figure 14), a small city of 180,000 inhabitants (density of 5,100/km^2). The sensors measure continuously a wealth of variables: related with traffic and parking, irrigation, and environmental components (temperature, relative humidity, speed, ozone, NO_2, particles, CO) including 60 sensors for noise levels. These sensors are of low cost and low accuracy, but they allowed the municipality to construct noise maps and know trends in their city for the first time. The quality and sophistication of the sensors has improved in the meanwhile. Moreover, sensors were embed in public vehicles (buses, taxis, municipality vehicles).

This project also has a crowdsourcing component mainly constructed through other European project: CITI-SENSE. The municipality approached the citizens of Santander through advertisements in, e.g., buses and newspapers for cooperation. In this way, the citizens can contribute with data just by downloading an app to their smartphones. In the first year of this initiative there were 10,000 downloads of the app from the CITI-SENSE website[13] .

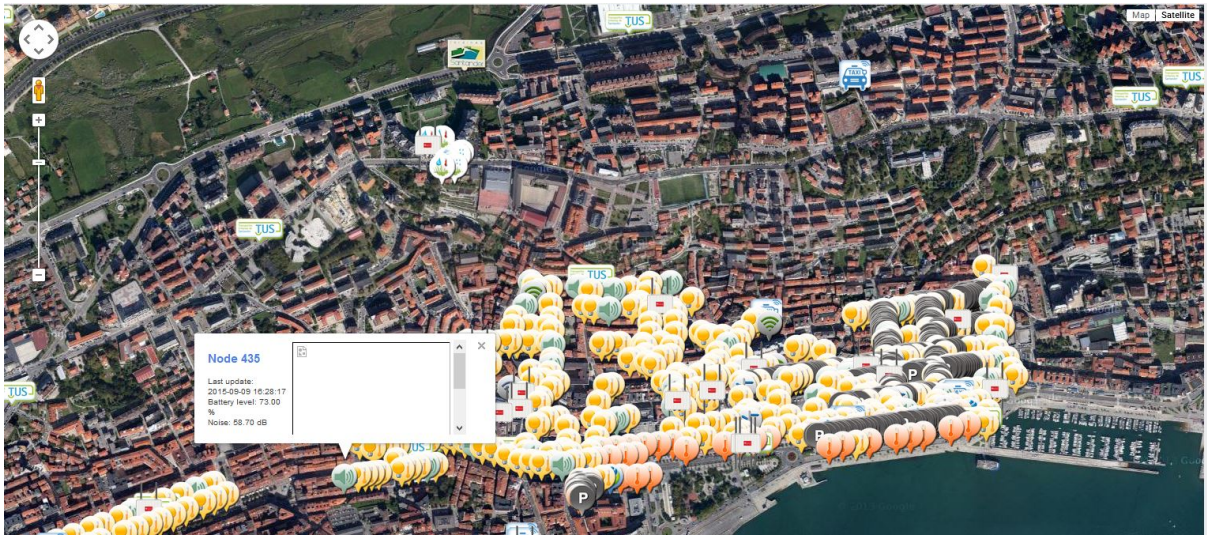


Figure 14 – View of the static sensors location in Santander from the open website http://maps.smartsantander.eu/ and example of pop-up window with information for a specific sensor.

These data are collected in a central computer at the University of Cantabria, which then gives an integrated view of the city: traffic conditions, air quality, noise levels, street lamps out of order, etc. This means that there is the potential to act in real time on the conditions reported in order to manage good liveable conditions, as e.g., manipulate traffic conditions through controllers (as traffic lights). It is possible for a user to verify the response of the responsible services for fixing a problem and suggest solutions. Moreover, not only the public can participate by sending data to the central computer, but applications and services are created specifically for the public. An example of this is the Smarter Travel Map (Figure

[13] Personal communication with the project coordinator Luis Muñoz.

14). The aim behind this initiative is to deliver reliable, real-time information on the traffic situation throughout the city. The users can then reach their destinations in a more efficient way, reducing the time spent driving through the streets and avoiding, as much as possible, congestion and occasional incidents on the streets. To produce the map in Figure 14 it is necessary a set of models (traffic assignment models and a flow estimation model) that use historical data in the database and real-time measurements. It was also necessary to develop web and mobile applications. (in webpage: http://smartsantander.eu/index.php/smart-travel).

One of the challenges during the first phase of the project was the fact that the technology was still not mature. Nowadays, this has been substituted by security concerns. The other main challenge relates to public procurement of municipal services. Tenders do not take into consideration new technology and the integration of demands on this level means the reconsideration of procedures and extra costs for the municipality.

At the moment, the project in Santander is in its second stage, which is to create additional value from all the data acquired and being acquired. The setup and know-how exists and can easily be used for environment noise management. As an example of this capacity is one pilot study within the framework of the project EAR-IT, in which noise patterns are analysed for automatic (re)action. The area around the hospital of Santander is considered risky in terms of traffic. Therefore, noise sensors connected to CPUs were installed that detect the sound patterns of sirens from police cars and ambulances and act on it controlling the traffic lights in the area in order that the vehicles reach the hospital the most efficiently possible. As an amusing side note, we mention the second pilot study in EAR-IT: dispositive with noise sensors were installed around the train station area. They detect the specific sound the cans used in graffiti make and react to it by making an alert noise. The objective is to scare the graffiter and avoid visual vandalism.

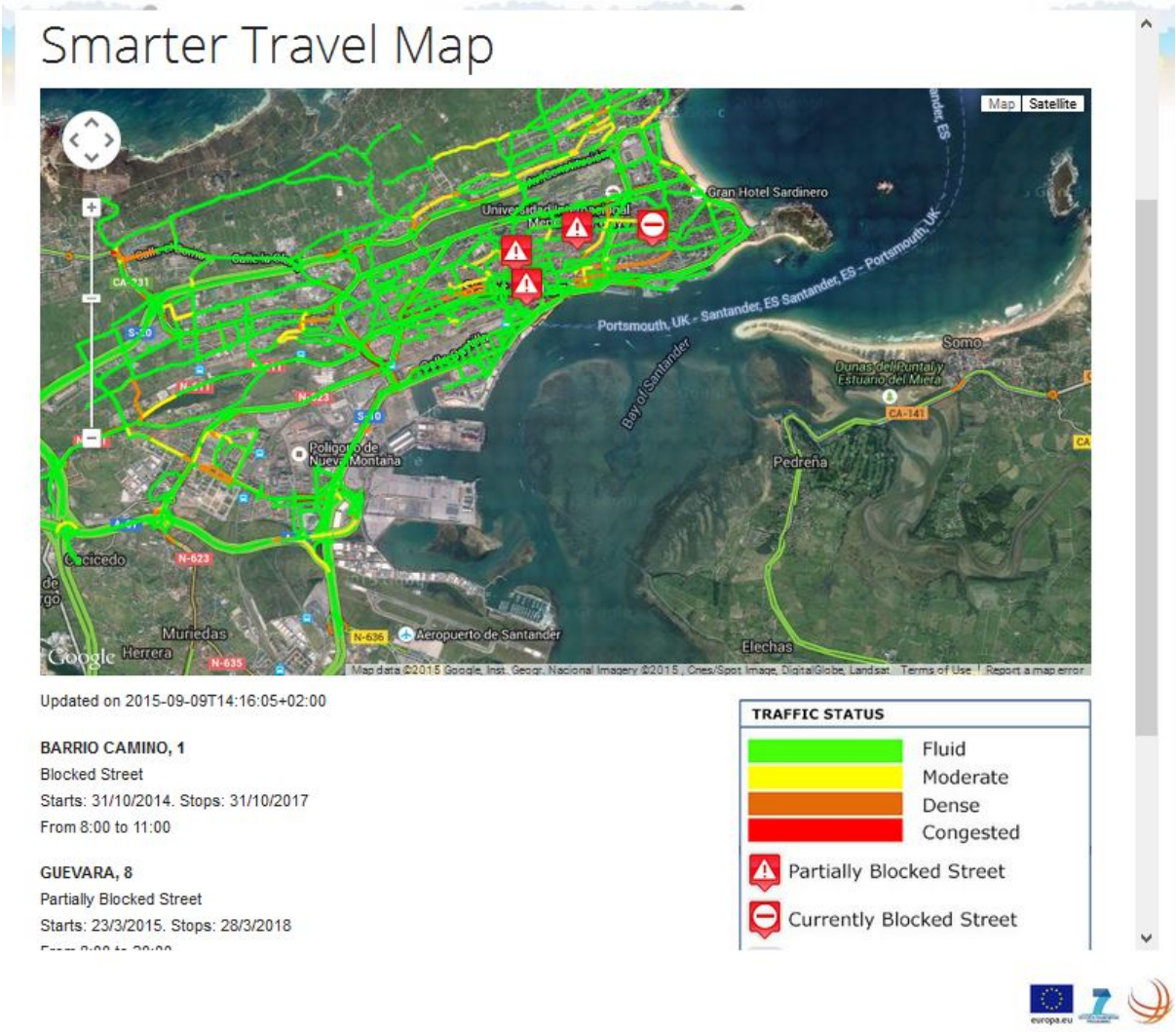


Figure 15 – Snapshot of the Smarter Travel Map website http://smartsantander.eu/index.php/smart-travel (it offers the possibility to zoom).

However, the main purpose of SmartSantander is as a platform for experimentation and creation of new applications and services for a smart city. It already led to other testbeds in Belgrade, Guildford and Luebeck. In these cities theories and ideas in the area of computation, environmental sensors and internet of things (IoT) technologies are experimented in a place and scale that is considered ideal, because (in SmartSantander tutorial):

- The dense social ecosystems heavily rely on technology.
- It contains the necessary critical mass of experimental businesses, local governments and citizens as end-users.
- Initial impact of the IoT will be most visible to European citizens.

Moreover, crosscutting applications are possible to test by tying economy, architecture and urbanism, social, governance, transport, natural resources, environment, etc.

4 Conclusions

The Environmental Noise Directive (END) was promulgated by 2002, in which were defined the minimum requirements for a quantitative evaluation that should be accomplished by cycles of updating noise maps, implementing noise actions plans and evaluating its results. At the moment of the writing a cycle has been accomplished and a second set of noise action plans are in the process of being implemented. In this way, the objective of this study was to report success stories from the noise assessment process set by END. At first the intention was to base the success on quantitative information, however this was impossible due to a lack of standardization, due to methodological advances, and the improvement of the quality of the measured data. Moreover, the timelines defined in END do not take into account that measures may take longer than three-four years to have an effect (e.g., modal shifting). In this way, for example, an overall assessment of actions plans from 2009 may only be properly assessed in the noise maps developed by 2017 or even by 2022. The objective set then was to look for actions that could be characterized by its innovation, pragmatism, and replicability.

We analysed Noise Action Plans and more specifically the ones for Berlin, Dublin, and Bilbao. We also analysed projects, some of which integrated in Noise Action Plans. These projects were innovative in the areas of improving END, including the general public, and the use of cheap noise sensors, which allows for tight-budget municipalities to still gather a good view of trends in noise levels.

Noise Action Plans can include major urban redesign work in order to change the road network constructed for an automotive city, shifting the focus to the pedestrian. This can be a very effective noise action plan, because traffic is the major source of environmental noise in cities. In Bilbao, the traffic from a major highway which was flowing into the centre of the city was deviated to a northerner entrance. But successful action plans can operate in a smaller scale, working, e.g., on modal shifting and behavioural shifting. Moreover, effective measures can be taken by acting on the municipal fleet of vehicles and in the education of policemen and technicians. We could detect the economical strains the cities go through to implement their noise action plans as in most cases there is no extra financing attached to their implementation. The cities analysed overcame somewhat this by integrating the noise action measures with other planning tools at municipal level like land use planning, urban and transport planning, and air quality plans. Moreover, the cities design pilot projects that they finance through European funds that not only help in the problem at hand but have innovative output. Berlin implemented a study in how the design of streets can affect the traffic flow, which was funded through European funds for Regional development; Bilbao participated with two pilot projects in the LIFE+2010 QUADMAP project that aimed in improving END in the matter of quiet areas definition, protection and improvement. In terms of public outreach as intended in END, Berlin is a very salient case to look upon by its comprehensive efforts. Municipalities have work in the area of noise actions that fall outside the scope of END. In Dublin, the complaints dealt by the municipalities from the public relatively to noise was majorly related to the neighbourhood and leisure noise. Therefore, this work matters in terms of educating the public and ameliorate their well-being in the area of environmental noise. We think that the evaluation of the success of the work implemented by a municipality in the area of environmental noise should also consider the evolution of public complaints including the urban noise sources not included in END.

END has high potential for improvement and projects we present like QUADMAP and the devise of noise indicators like G_{den} and G_{night} intend to add to the basic legislation. The QUADMAP contributors offered a methodology to define, and then protect and improve quiet areas. Most of the pilot projects within the QUADMAP were set in urban areas that because of their use should be quiet, like schools, parks, and squares. The new methodology includes objective parameters as noise indicators, but preeminent is the work of experts and the public contribution. In Bilbao, besides the use of traditional strategies of noise control they used sound masking, that is, the addition of the noise from a fountain to improve the acoustic quality of the area. Moreover, the concept in Bilbao has been extended to the concept of "comfort urban place", which entails the evaluation of a space in terms of the sensorial human experience by considering acoustics, light and thermal sensation. The work by Licitra and Ascari (2014) intends to help in the comparability of data already delivered by the different Member States in the framework of END. The results show that both indicators can be used to evaluate differences between cities inside a country, but cannot be used as a single reliable indicator to compare cities all over Europe.

Public outreach is an important part of the intentions in END. Several projects related in this report deal with this thematic. The work of Bruitparif is aimed in informing the public on environmental noise matters in the Paris region (Île-de-France). Bruitparif has established a noise monitoring network called RUMEUR that has the fundamental objective of informing the public of the noise levels in the region. To make the information easier to understand they devised an index named HARMONICA that takes into account how the noise is perceived by a person. The soundscape award cases we present were both interested in the public participation in noise actions. In Alverna (The Netherlands), there was the necessity to protect a set of 70 habitations from the traffic noise of the main road traversing the village. A first project without the input of the local population was deemed by the population as unacceptable because it entailed a 4 m barrier between the habitations and the road, which would be an ugly physical separation within the agglomeration. The new plan included the interaction with the stakeholders including the public and the new solution was a success by introducing a noise barrier that was accepted by the public and had in attention the preservation of the use of the exterior of the habitations in an agreeable design. The second project coming from the soundscape awards intended to inform the general drivers of the existence and positive aspects of buying low noise tires. This is a basic, but normally neglected aspect of solving noise problems: act on the source and include the public in the solution. The project started in Switzerland and has expanded to The Netherlands.

Finally, we present the example in Santander where a project within the concept of smartcities, spread around the city sensors of low accuracy and low cost for several environmental parameters including noise. These system allowed the construction of the first noise maps and know trends in the city for the first time. Moreover, it should be considered that the analysis of the measurements highlighted that long-term measurements could be carried out as a tool for having further detail of the L_{den} values and the inclusion in the city maps of sound sources not considered in the strategic noise mapping developed for the END.

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