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QUADMAP QUiet Areas Definition & Management in Action Plans

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Coordinating beneficiary

UNIVERSITY OF FLORENCE, Department of Industrial Engineering (Italy)

Associated beneficiaries

DCMR Environmental Protection Agency (The Netherlands)

TECNALIA (Spain)

VIE EN.RO.SE. Ingegneria S.r.l. (Italy)

BRUITPARIF (France)

COMUNE DI FIRENZE (Italy)

AYUNTAMIENTO DE BILBAO, Area de Obras y Servicios (Spain)

Supporter

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QUIET AREAS IN AN AGGLOMERATION

The European Directive 2002/49/EC on the Assessment and Management of Environmental Noise (abbreviated as END) defines *"Quiet Area in an agglomeration"* (in the following "Quiet Urban Areas", "QUAs") as *"an area, delimited by the competent authority, which is not exposed, for instance, to a value of Lden or of another appropriate noise indicator greater of a certain threshold (set by the Member State) from any noise source".*

CURRENT PROBLEMS RELATED TO QUIET URBAN AREAS

- The need to improve the very general definition of QUA provided by the END.

- As well as the need to recognize and protect areas that actually are quiet, the need to understand how to identify and manage areas that have a social role (gardens, parks, green path, etc.) but are not actually quiet, and what action is needed to ensure that they effectively pursue the role for which they are designed.

- A procedure for selecting QUAs doesn't exist in most Member States yet.

- In the Countries or cities where some criteria to deal with QUAs have been adopted, different approaches (qualitative and quantitative) have been used until now to analyse and evaluate these areas. As a consequence, current practices about selection, assessment and management of Quiet Areas in EU Countries, though regulated by the END, are extremely fragmented and inhomogeneous.

QUADMAP OBJECTIVES

The main objective of QUADMAP project is **to develop a harmonized methodology for selection, assessment** (combining quantitative and qualitative parameters) **and management** (noise mitigation, increasing of usability of areas and user's satisfaction) **of QUAs**, the aim being to overcome the current impasse. The project is focused on the problem of quiet in urban areas, where not only noise limits have to be considered and where noise is only one of the sources of pollution causing discomfort. One significant part of the project has been devoted to develop and test methods for the determination of relative weight of concurrent sources of discomfort, considering different acoustic factors and indicators and, at the same time, the opinion of citizens who usually attend those areas.
The validated results of the project will facilitate urban planners to apply standard procedures for identification, delimitation and prioritization of QUAs.

QUADMAP EXPECTED RESULTS

1) A **guideline** about the proposed harmonized and tested methodology for selection, assessment and management of QUAs. This result will overcome the current impasse related to the fragmentation of current practices. It will increase the success of QUAs management with respect to current procedures and it will provide a contribution in the END review process referring to QUAs.

2) The **implementation of acoustical and non acoustical interventions in the pilot areas** selected by the project in order to turn these areas from potential to actual QUAs.

METHODOLOGY IMPLEMENTED AND RESULTS ACHIEVED

1-ANALYSIS OF THE STATE OF THE ART: a research about methodologies adopted by Member States was carried out and a questionnaire addressed to stakeholders was submitted in several European countries, asking the competent authorities involved in the implementation of the END about the methods used to deal with QUAs.

→ **2a-PROPOSAL FOR A NEW GENERAL DEFINITION OF A QUA:** *'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'.*

↓

2b-DEFINITION OF A METHODOLOGY for the selection, analysis and management of QUAs.

↓

3-Application and testing of the methodology in 10 pilot areas located in Florence, Bilbao and Rotterdam.

↓

4-Collection of ante-operam data in order to:
- update the methodology and, in particular, the selection and analysis phases;
- carry out indications for the designing of interventions.

→ **5a- METHODOLOGY (selection and analysis phases) UPDATING.**

↓

5b-Designing and implementation of interventions.

↓

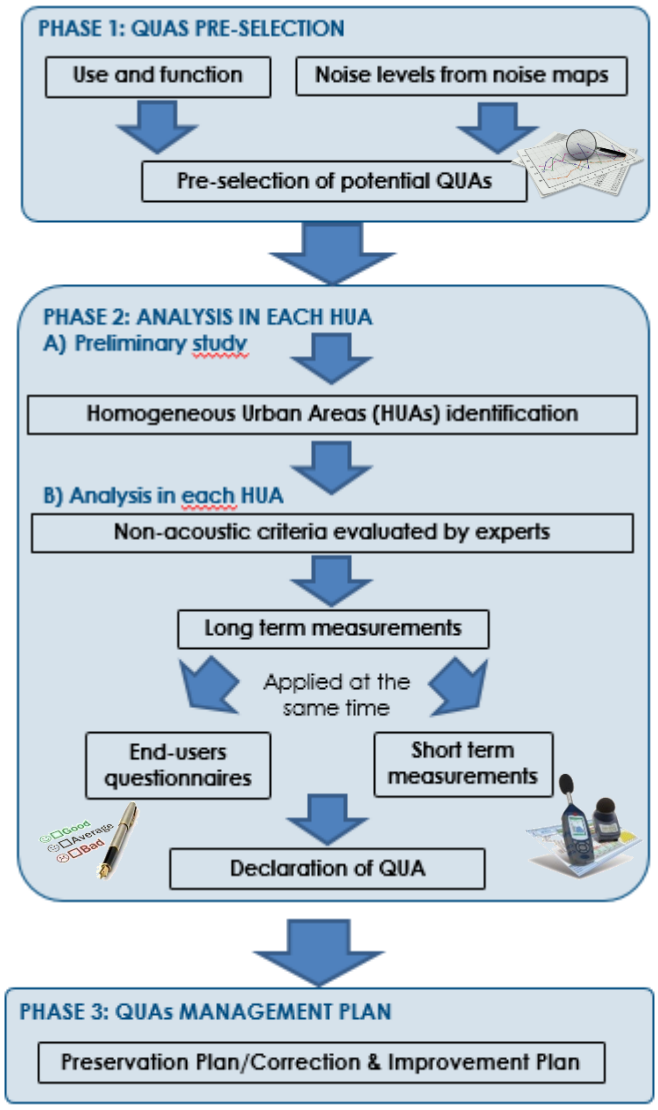
6-Collection of post-operam data in order to:
-update the methodology and, in particular, the management phase and definitively optimize it;
-verify the effectiveness of the implemented interventions.

→ **6b-METHODOLOGY (management phase) UPDATING AND DEFINITIVE OPTIMIZATION.**

↓

7-Implementation of **GUIDELINES** about the proposed methodology.

DESCRIPTION OF THE METHODOLOGY FOR SELECTION, ANALYSIS AND MANAGEMENT OF QUAs



PHASE 1: QUAs SELECTION

Two main variables are indicated for the selection phase: **use and function** of the area (variable 1) and **noise levels** (variable 2) provided by the Noise Maps required by the END, to be compared to a threshold established by each Member State (a suggestion for this threshold is provided by the methodology according to the State of the Art).

PHASE 2: QUAs ANALYSIS

Firstly, a preliminary study is carried out in order to understand if the area should be divided in **Homogeneous Urban Area (HUAs)**: smaller areas evaluated as uniform according to the landscape, the use and the distance from noise sources.
Then in each HUA some **non-acoustic factors** (e.g. natural elements, cleanliness, safety, etc.) are **examined and evaluated by experts** (e.g. technicians of municipality).
Long-term measurements (minimal duration 1 week) should be carried out in each QUA to detail the noise maps in the specific studied areas, to collect acoustic information about the variability of sound levels over time in the area and to assess the impact of the acoustical interventions. Then, at the same time a **questionnaire** is submitted to the users of the area, in order to collect information about their general and specifically acoustic perception of the area, and **short term measurements** (same duration of interviews) are performed.
As a conclusion for the analysis phase, the area is evaluated as already quiet (no criticalities are detected) or only potentially quiet (some criticalities are present at least in one of the performed analysis: expert analysis, long term measurements, end-users questionnaire results and short term measurements).

PHASE 3: QUAs MANAGEMENT

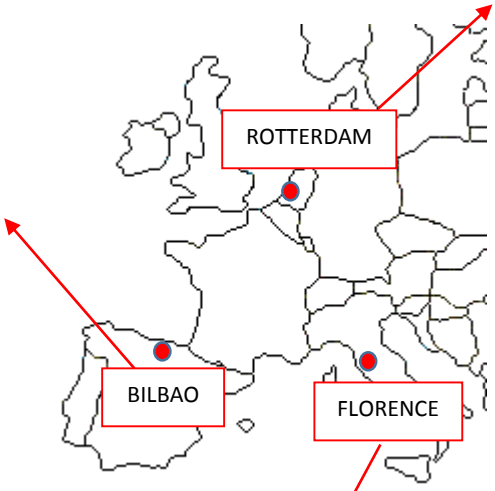
Different management goals are proposed, depending on whether the selected areas are defined as actually quiet (in order to preserve the area, to increase its value or to promote its use) or only potentially quiet from the analysis phase (the interventions are designed in order to improve the quality in the QUAs and possibly to solve all the criticalities highlighted during the analysis phase).

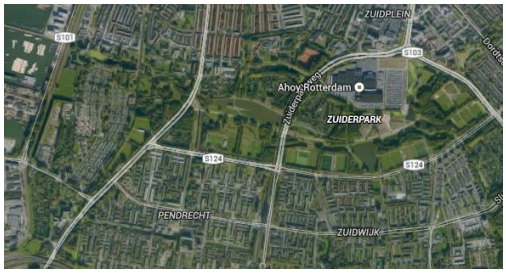
PILOT AREAS

The developed methodology has been tested in **10 pilot areas**: 6 schoolyards in Florence (Italy), a square and a peri-urban green ring in Bilbao (Spain) and 2 public parks in Rotterdam (The Netherlands).

General La Torre square

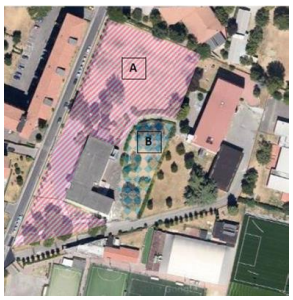
S. Marina green ring





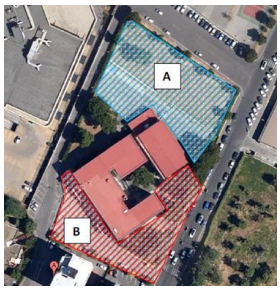
Southern park

Spinoza park



E. De Filippo schoolyard
Bassi street

P. Uccello schoolyard
Golubovich street



A. Manzoni schoolyard
Sgambati street

F. Dionisi schoolyard
Aretina street

Vamba-Montessori schoolyard
Giardini della Bizzarria street

P. Fedi schoolyard
Pio Fedi street

BENEFITS AND IMPACTS

1) A GUIDELINE FOR SELECTION, ANALYSIS AND MANAGEMENT OF QUAs

The main benefit of the project consists of the guideline, available on the project website.

It provides applicative examples and practical tuition tools, which will reduce the learning curve, minimizing the time required for the adoption of the new methodology, mainly in those countries where a methodology is still factually lacking.

The spreading of a harmonized approach will lead to a completely new monitoring tool, currently missing due to the fragmented state of existent methodologies. In other terms, it will be possible for EU to monitor the QUAs management among the different Member States, on the basis of common QUAs tools and indicators proposed in the guideline.

2) COLLECTED DATA

Another important benefit comes out from the data collected during the project, which are publicly available on the website in the following documents:

- ✓ "*Proposal of a harmonized method for selection/analysis/management of quiet urban areas and applicative tools*", in this document data collected from stakeholders are presented and analysed in the under the section "Results and deliverables";

- ✓ presentations during the Internoise 2013 congress and the 2013 European Symposium on Acoustic Comfort in Urban Design, in these documents data collected in the pilot areas from end-users questionnaire and noise measurements in the ante-operam scenario are presented and analysed;

- ✓ presentations during the final conference in Rotterdam, in these documents data collected in the pilot areas from end-users questionnaire and noise measurements in the post-operam scenario, are presented and analysed;

- ✓ "*Report on final optimized methodologies and their applications limits*", in this document all data collected, analysis and developed optimized method are presented.

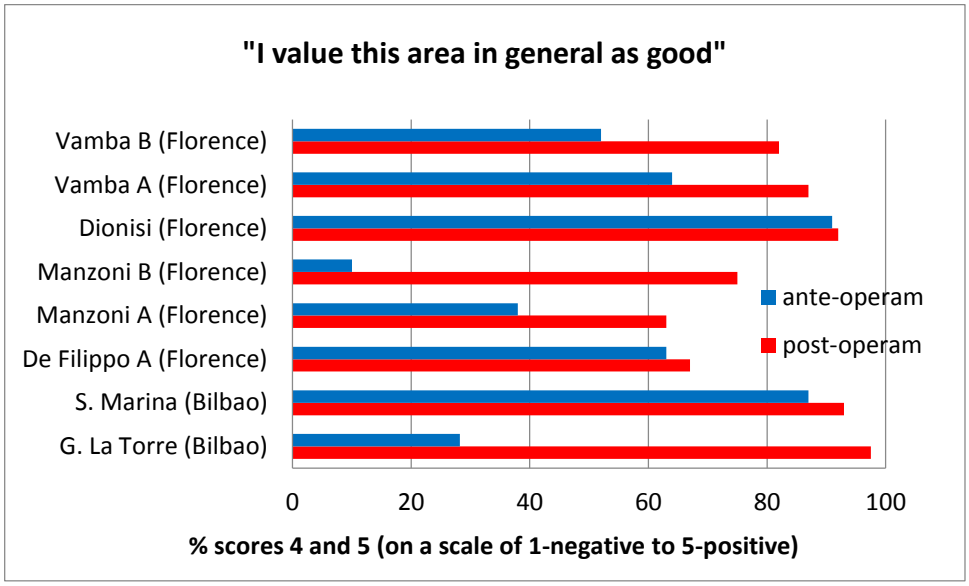
3) INTERVENTIONS IN THE PILOT AREAS

The project has obtained specific important benefits referring to the pilot areas. After the application of QUADMAP method, in most of pilot areas acoustic and non acoustic interventions were defined and actually implemented as reported in the following table and shown in the pictures below.

Pilot area	Acoustic interventions implemented	Non Acoustic interventions implemented
Vamba/Montessori schoolyard (Florence)	Noise barrier.	A part of the barrier is green type. A wooden platform in the garden area protected by the barrier has been designed.
Dionisi Schoolyard (Florence)	Noise barrier.	Blackboards integrated into the internal side of the barrier.
Manzoni Schoolyard (Florence)	Noise barrier.	5 trees, 30 concrete cube seats.
De Filippo Schoolyard (Florence)	Noise barrier.	4 trees, 20 concrete cube seats; 2 sound games.
P. Fedi schoolyard (Florence)	Additional road signs containing the prescribed speed limit of 30 km/h (minor intervention).	/
P. Uccello schoolyard (Florence)	Noise barrier.	Seats made up of concrete cubes of size 45x45x45 cm with anti-graffiti treatment.
S. Marina green corridor (Bilbao)	/	Selective tree thinning of non-autochthonous plants (*Pinus Pinaste*).
G. La Torre square (Bilbao)	Urban barrier for traffic noise combined with a fountain (that creates background water sound and water sound events related with jets), improvement of traffic flow, give priority to pedestrian, increasing greenery (developing small hills)	Increasing the pedestrian accessibility, creating visual permeability, improving the construction quality in materials and services (putting 43 trees in the area and increasing the presence of benches), increasing the resting areas in the square and the area for greenery, increasing the acoustic comfort in the area (pleasant sounds coming from urban furniture with vertical water dispensers).
Southern park (Rotterdam)	Low noise paving.	/
Spinoza park (Rotterdam)	Low noise paving.	/

3.1 REDUCTION OF NOISE LEVELS/INCREASE OF POSITIVE EVENTS/RESOLUTION OF CRITICALITIES

In general, in all cases the benefits consist in an improvement in the evaluation from experts after the intervention and in the increasing of citizens satisfaction, as shown in the following figure related to pilot cases in Florence and Bilbao.



Citizens perception immediately after the interventions realization in Florence (for each area the letter A or B refers to the identified HUAs) and Bilbao

Referring to the acoustic benefits, the implemented interventions permit to hardly reduce noise levels in some cases where noise barriers take place. In other cases the noise levels have been only slightly reduced or not reduced. For example, in the pilot cases located in Florence, according to short term measurements associated to questionnaires, average noise levels have proved to be lower during the post-operam surveys, with benefits **up to 8 dBA** in terms of LAeq in the shadow zone behind the barrier.
Referring to the possibility of reducing the negative events (e.g. due to road traffic noise) in the pilot case of General la Torre selected in Bilbao, after the realization of interventions, the higher presence of people and children (and the sound of water) have increased the background sound (LAeq) and the **number of positive events**. At the same time, the urban barrier has masked the traffic noise (reducing the presence of negative events).

	Morning		Evening	
	11:00-11:30	11:30-12:00	18:00-18:30	18:30-19:00
LAeq	64 dBA (-3)	66 dBA (+4)	64 dBA (0)	66 dBA (+4)
Events (negative)	2 (-4)	2 (-4)	2 (-7)	0 (-2)
Events (positive)	0	0	0	4 (+4)

Noise levels (LAeq) and noise events evaluated in general la Torre square for the post-operam phase (in brackets the difference between the post and the ante-operam scenario)

In General La Torre square, referring to the periods in which ante and post-operam questionnaires have been submitted, noise levels (LAeq) are even slightly increased (2-3 dBA) after the realization of interventions. This fact in general can be explained according to the typologies of interventions realized in General La Torre

square where they were not specifically aimed to reduce noise levels as to modify dominant sound sources and increase positive events.
Finally, regarding the analysis carried out by experts, depicted criticalities have been solved by the end of the project. As an example, from the comparison of results concerning non acoustic principal factors and respectively achieved during the ante and the post-operam phase, it can be seen that the criticality emerged for the Dionisi school (Florence) concerning **safety** was solved during the post-operam phase.

CRITERIA	DESCRIPTION	PARAMETERS	RATING	DIONISI SCHOOLYARD	INPUT TO DEFINE POSSIBLE SOLUTIONS
Safety	Evaluation of safety by observation from experts	Dangerous zone (robberies, attacks or accidents from official statistics in the area)			Propose interventions to improve safety. **04: TO CLOSE THE GARDEN WITH A BARRIER**
		Not guarded spaces or dark zones without lighting			
		Guarded and lighted spaces			

Expert analysis-ante operam scenario for the pilot cases selected in Florence (Dionisi schoolyard)

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Safety	Evaluation of safety by observation from experts	Dangerous zone (robberies, attacks or accidents from official statistics in the area)			/
		Not guarded spaces or dark zones without lighting			
		Guarded and lighted spaces			

Expert analysis-post operam scenario for the pilot cases selected in Florence (Dionisi schoolyard)

4) COST-BENEFIT INDEX

In those pilot areas located in Florence, in which a noise levels reduction was obtained, a cost-benefit index has been evaluated. In particular, a Cost Benefit Index (CBI), similar to the one proposed by the LIFE+NADIA project, has been developed. Variables considered by this Index are the interventions' costs and the Priority Index (IP) evaluated both for the ante and the post-operam phase.

$$CBI = \frac{intervention's\ cost}{(IP_{ante-operam} - IP_{post-operam})}$$

$IP = R \cdot k \cdot (L_{obs} - L_{im})$ where:

L_{obs}= average noise level in the QUA, ante-operam/post-operam scenario

L_{im} = 55 dBA

$IP = 0$ if $(L_{obs} - L_{im}) < 0$

R = number of users

k = 1 or 3 (3 when QUA is a school yard)

As shown from the previous equation, low CBI values mean a very good cost/benefit compromise.

Pilot case	Interventions' cost [€]	IP ante-IP post	C-B INDEX
De Filippo	60.110,78	3276,3	**18,3**
Manzoni	127.248,91	5194,3	**24,5**
Dionisi	81.474,49	831,6	**98**
Montessori-Vamba	141.354,17	3174	**44,5**

Evaluation of the CBI in the pilot areas located in Florence

From results obtained, it can be noticed that values of the C-B Index obtained for De Filippo, Manzoni and Montessori-Vamba schools are quite similar and low. Regarding the Dionisi school, a higher value of the C-B Index has been found, but this is reasonably due to the lower number of users and to the lower efficacy requested to the intervention. In fact, in this pilot case the main reason to build up the barrier was safety instead of noise.

TRANSFERABILITY OF PROJECT RESULTS

In current applications, the method is certainly applicable at European level since it was established taking into account several experiences at European level and it has been tested on pilot cases in three different Member States.

Moreover, the partner Bruitparif performed internal harmonization among the different proposed solution with special regard to the possibility of generalizing them at EU and international level. In particular, France was chosen as additional test country for the applicability and adaptability of the proposed methodology. As a consequence, the analysis phase of the optimized methodology, together with finalized tools, was further tested on the area of «bassin de la Villette" in Paris. From results obtained in this application, the possibility of transferring the methodology to other countries has been confirmed, bearing in mind that all the pilot cases selected by the project should be considered as good examples and not as templates to reuse systematically.

To facilitate the transferability, **appropriate guidelines** were prepared, together with **tools and application examples** derived from the pilot cases, and they have been **translated in the languages of project partners**.

The transferability of the method is also encouraged and strengthened by the following **actions of dissemination**:

- ✓ Development of a website www.quadmap.eu.
- ✓ Dissemination at European level by:
  - ➢ the connection with OTHER EUROPEAN PROJECTS;
  - ➢ the knowledge sharing with EUROCITIES, the network of major European cities, operating in 33 European countries and representing the interests of its members in dialogue with the European institutions across a wide range of policy areas affecting cities. EUROCITIES will allow the diffusion of results and will lead to support other countries willing to apply the proposed methodology. The periodic meetings carried out by the network itself define some of the QUADMAP partners being also EUROCITIES members, the way for the reaching of the 130 EUROCITIES members. The project's guidelines have been sent to EUROCITIES office and they will distribute this to all European cities being member of EUROCITIES.

In this way, a continuous action of dissemination and demonstration of gained results can be an incitement to adopt the QUADMAP methodology in the cities, in order to improve the metropolitan quality of life year after year.