PROPOSAL OF A HARMONIZED METHOD FOR SELECTION/ANALYSIS/MANAGEMENT OF QUIET URBAN AREAS AND APPLICATIVE TOOLS

Abbreviation list

QUA: Quiet Urban Area.

rQUA: relative Quiet Urban Area.

END: Environmental Noise Directive (European Directive 2002/49/EC, 25th June 2002).

GIS: Geographical Information System.

HUA: Homogeneous Urban Area.

Definitions

Lden: Lden (day-evening-night noise indicator) noise indicator for overall annoyance, as further defined in Annex I of Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002.

LAeq: Equivalent continuous A-weighted sound pressure level.

L10: Level statistically exceeded for 10% of measurements time.

L90: Level statistically exceeded for 90% of measurements time.

Candidate QUAs: areas that, after the pre-selection phase, are potentially considered as QUAs.

Introduction

The aim of the current report is to show and explain results of Action B.6, whose objective is to propose a methodology for QUAs selection, analysis and definition, both strategic and operative actions. The coordination and responsible of this Action is UNIFI.

The proposed methods are chosen according to the State of the Art concerning EU strategies for selection and analysis of QUAs and also to stakeholders questionnaires results.

With the further explained methodology an effort has been made in order to define a set rules which can be accustomed in a general steering document. Methodologies will be developed in order to leave each Country free to adapt on-the-fields activities. The aim is not to provide rigid sequence of operations, but an effective procedural, logic to be implementable despite of peculiarities of each Member state.

The development of the methodology will be the following:

- candidate QUAs selection;

- candidate QUAs analysis by using both quantitative and qualitative approaches;

- definition of strategic and operative actions devoted to the managing of QUAs.

Unfortunately, indications for the managing phase are still missing because incomplete. For this reason conclusions and/or proposals concerning the managing phase haven't been delivered yet; although the analysis phase includes many activities which are dedicated to obtain useful indications for possible interventions. The formal proposal for the managing phase will be developed during next months, considering also results from the analysis of the ante-opera data collected in the pilot areas. The possibility of providing another report or updating the present one will be discussed.

From the analysis of the State of the Art, concerning the QUAs procedures for selection and analysis, many interesting techniques occurred, although most significant parameters to be used aren't clearly defined yet. All considered, it has been decided to maintain an open-minded approach, taking into consideration almost all of different parameters proposed by each Country. This decision has been taken in order to evaluate the several proposed variables, also according to the analysis of results that will be collected in pilot areas during next months.

In the present report first paragraphs will deal with the QUAs definition and significance and the results coming both from the State of the Art and the stakeholders questionnaires. Following paragraphs will be dedicated to the description of the proposed methodologies for QUAs pre-selection and analysis.

As already said, the suggested methodologies should be intended as a first proposal, to be tested in pilot cases thanks to which we will try to give a summary of the results, bringing out the most

significant variables for the analysis phase. At the same time indications are expected, from the analysis of ante-opera data, for the completion of the proposal, relating to the management phase.

The testing methodology will consist in:

- data collection, according to procedures suggested in the present report;

- a first analysis to be carried on by partners involved in data collection;

- the data uploading on the on line database (in this phase the definition of a new questionnaires is foreseen);

- the transmission of correlated data (long-term measurements, short term measurements, wave file) to the project coordinator, in order to develop an overall analysis.

Expected results from the analysis of ante-opera data in pilot areas are the following:

- to verify which of the tested variables are the most significant and important for the analysis of pilot areas;

- to define appropriate basis for the definition of managing procedures;

- to confirm or modify previously suggested methodologies for data acquisition, to be used for post-opera data collection. The comparison between analysis of ante and post-opera results will be an important point for the evaluation of interventions and, more in general, for the evaluation of management procedures.

QUA definition

In this paragraph procedures to define a QUA and to analyse its quality are described, proposing methods to be applied by competent authorities. The issues linked to management activities will be addressed in further documents produced by QUADMAP project, also according to results obtained in the pilot areas.

The process to be implemented by each municipality, or agglomeration administration body, starts with the clarification and specification of the definition of a QUA.

Considering the END approach, *'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.*

This definition presents a general framework but, considering the results derived from the analysis of the state of art, additional aspects must be taken into account.

These aspects are mainly affected by political decisions regarding noise, sounds and environmental policies and are in connection with other aspects that condition the management of quiet areas from different points of view:

- uses and functions that are supposed to be important for the designation of an area as QUA;
- preservation of already QUAs and/or definition of new potential QUAs;
- other variables included in the concept of quietness (or somehow related to it): security, landscape, accessibility, environmental conditions, etc.

Therefore QUADMAP proposes, the following as the new, general definition of a QUA:

an urban area whose current or future use and function require a specific acoustic environment, which contributes to the well-being of the population.

Since a positive evaluation of an areas acoustic and overall environment depends on other than - only acoustic - variables, several approaches must be included in the selection and analysis methodology for QUAs.

The final objective of providing QUAs is to define areas where people can find some refuge from urban environmental stress factors. In the end this might contribute to reduced stress and improved well-being. This issue should be also taken into account when defining the process of QUA management.

Outcomes of desk study and stakeholders' questionnaires

Although this document proposes a general definition and suggests which variables should be considered for the analysis of QUAs, many issues (the definition of the public participation, the creation of a network of QUAs in the territory, etc…) remain open to political decision in each administration. These issues include both the variables themselves (a selection of the proposed ones and/or other complementary ones) and the general policy framework to implement the management strategy of QUAs.

The provisional procedure described below to select and analyse QUAs is based on the analysis of the results of the State of the Art, developed in the QUADMAP project. In addition to this, a stakeholders' questionnaire was submitted in several European countries[1], asking the competent authorities involved in the implementation of the END about the methods used for selecting/analysing/managing QUAs. 36 stakeholders filled in the questionnaire (9 questionnaires from Italy, 11 from Germany, 4 from Spain/Portugal, 5 from UK, 1 from Norway, 4 from The Netherlands, 1 from Belgium and 1 from France).

In the stakeholders' questionnaire 26 questions are proposed, but only answers n° 9 and 10 have been firstly analysed, in order to gain the immediately usable information for the draft proposal. The number of answers to question n° 9 and 10 are respectively 30 and 31.
The following Figures show a summary of the identified indicators.

[1] The Netherlands, Belgium, Norway, United Kingdom, Italy, Germany, Spain, Portugal and France.

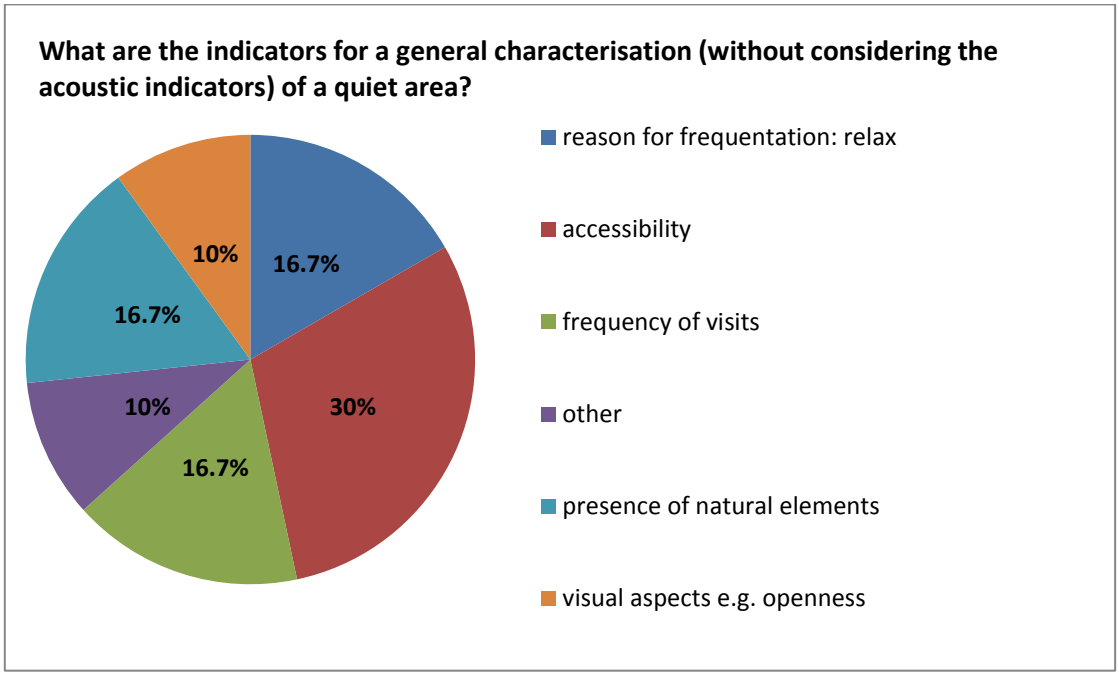

Figure 1: Analysis of answers to question n° 9 - percentage of answers to each choice (note that "other" includes as answers "presence of relevant urban elements", "dedicated use", etc…)

From previous chart it can be seen that the most common parameters for a general non acoustic characterization of QUAs are the accessibility, the reason for frequentation, the presence of natural elements and the frequency of visits. The analysis of each variable has been made in a specific section of the report respectively, as shown in the following table:

VARIABLE	SECTION (REPORT APPENDIX)
Accessibility	▪ Expert analysis for the characterization of pre-selected areas ▪ Expert analysis for the non-acoustic data collection (Appendix 3 Tool 1) ▪ In situ questionnaires (Appendix 3 Tool 2)
Reason for frequentation	▪ In situ questionnaires (Appendix 3 Tool 2)
Presence of natural elements	▪ In situ questionnaires (Appendix 3 Tool 2)
Frequency of visits	▪ In situ questionnaires (Appendix 3 Tool 2)

Table 1: main non acoustic variables from Stakeholder questionnaire and their inclusion in the methodology

The next chart shows the same information, as answers in percentage for each option given from single Countries.

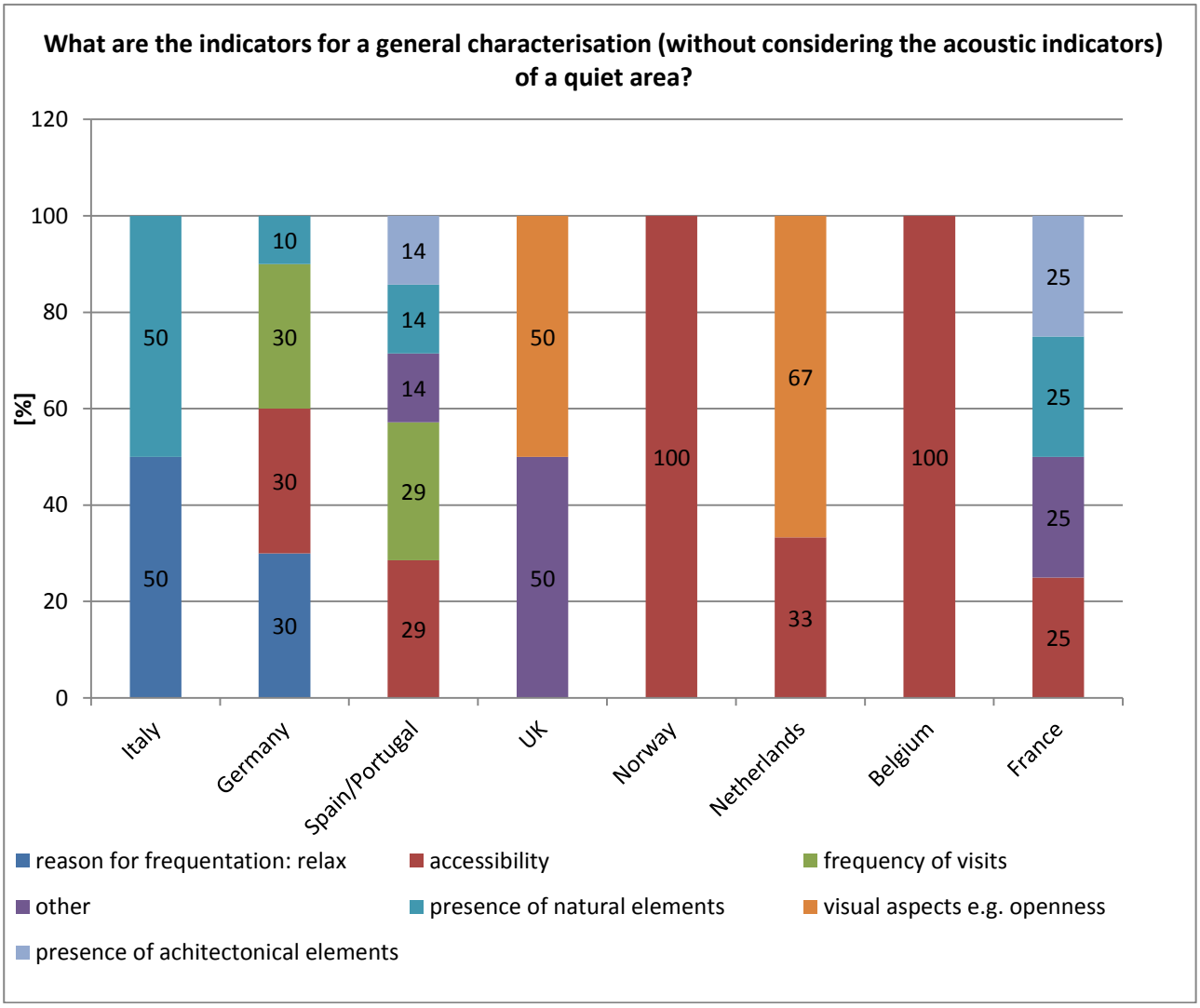

Figure 2: Analysis of answers to question n° 9 - percentage of answers from each country

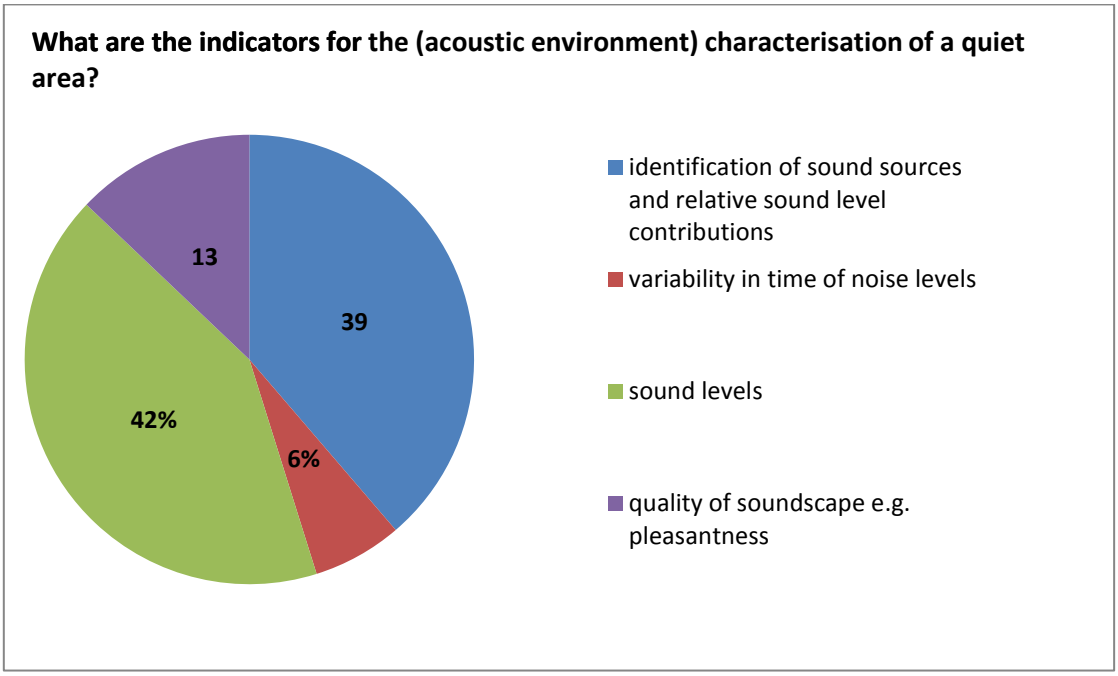

Figure 3: Analysis of answers to question n° 10 - percentage of answers to each choice

From previous chart it can be seen that the most common parameters for the acoustic environment characterization of QUAs are sound levels and the identification of sound sources and relative sound level. Each of the relevant variables has been introduced in a specific section of the report, as shown in the following table:

VARIABLE	SECTION (REPORT APPENDIX)
Sound level	▪ In situ sound measurements (Appendix 3 Tool 3)
Identification of sound sources and relative sound level	▪ In situ sound measurements (Appendix 3 Tool 3)

Table 2: main acoustic variables from Stakeholder questionnaire and their inclusion in the methodology

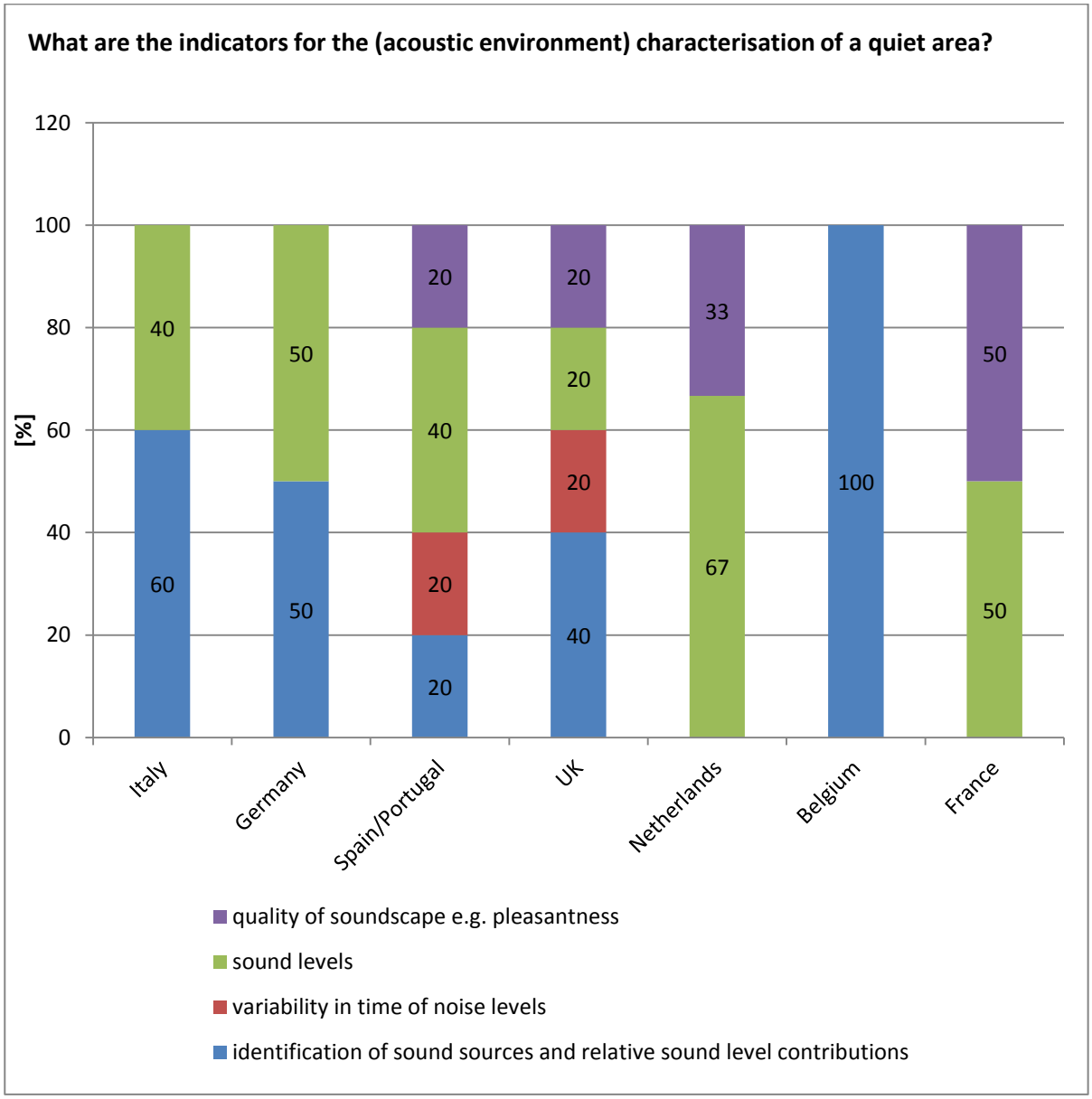

Figure 4: Analysis of answers to question n° 10 - percentage of answers from each country

As a general conclusion for this paragraph it can be said that the most important parameters emerged from the analysis of the stakeholders questionnaires have been considered in the draft proposal of the analysis phase. All considered, as the number of the collected questionnaires isn't extremely significant (36 stakeholders), it has been chosen to maintain a higher number of variables, to be eventually reduced in the next analysis phase.

Proposed method

The set of variables to be considered in each phase (selection and analysis of QUAs) and the procedures to be used are described in the next sections. In general, the proposed methodology is based on four approaches:

- noise maps of the environmental noise levels (noise emitted by means of transport, road traffic, rail traffic, airports and sites of industrial activity) in the municipality/agglomeration, developed applying the methodology defined by the END;

- expert analysis of municipality/agglomeration staff, based on the knowledge of the area or on the analysis of official documents;

- questionnaires submitted to the users (citizens) about their perception of the selected areas

- sound measurements in the selected areas.

The tools mentioned above are needed to implement the proposed method which is based on the state of the art, on stakeholder questionnaires, on the networking activity. The method has been developed also according to the suggestions provided by the COST Action on Soundscape, the ISO Working Group on Soundscape and the Expert Panel on Noise (EPoN), chaired by EEA. These groups of scholars, academics and experts provide advice and expertise to many relevant stakeholders from European, national and local authorities. A first EU draft guidance document on quiet areas according to the END is currently prepared by the EPoN and might in due time incorporate insights from the QUADMAP project.

The following Table 3 lists all the variables considered in the selection and/or analysis phases and the tools proposed for each one.

Variables	Tools					
	Noise Map	**Expert analysis for the characterization of pre-selected areas**	**Expert analysis for the delimitation of HUAs (Appendix 2 Tool 1)**	**Expert analysis for the non-acoustic data collection (Appendix 3 Tool 1)**	**In situ questionnaires (Appendix 3 Tool 2)**	**In situ sound measurements (Appendix 3 Tool 3)**
Selection Variables						
Use and Function		√				
Environmental Noise Levels	√					
Analysis Variables						
Acoustic factor						
Global Sound Level						√
Density of negative sound events						√
Dominant sound sources and their perception and valuation					√	
Perception of calmness					√	
Perception of pleasantness					√	
Perception of congruency					√	
Non acoustic factor						
Landscape (for the delimitation of HUAs)			√	√	√	
Use (for the delimitation of HUAs)			√			
Distance and presence of sound sources (for the delimitation of HUAs)			√			
Cleanliness and Maintenance				√	√	
Safety				√	√	
General analysis						
Urban context				√	√	

Proximity from/to residential areas	√			√		
Accessibility		√		√	√	
Proximity from/to noise sources				√		
Presence of a multi-sources scenario				√		
Noise reduction interventions				√		
Perception of the area as beautiful, pleasant or/and natural					√	
Perception of global satisfaction					√	
Behaviour factor						
Number of users				√		
Distribution of users in the sub-area				√		
Time (duration of stay in the area)					√	
Activities performed				√	√	

Table 3: variables and related Tools

QUAs PRE-SELECTION

The variables proposed for the selection of the areas as candidate QUAs are defined in this chapter, as well as the indexes for their description and the methods for their use. These variables should be analysed in sequence, since the pre-selection could identify areas that at present time do not fulfil the requirements, but could be part of an action plan for their improvement (either reducing noise levels or changing their use). A scheme at the end of this chapter illustrates the process of pre-selection (Figure 4).

On the other hand, there could be complementary approaches to perform the pre-selection of QUAs in a municipality or agglomeration, depending on the policies of the competent body (for instance in case the municipality wants to characterize the QUAs based on additional, specific information). An exemplifying complementary approach, referring to the municipality of Paris, is presented in Appendix 1.

Pre-selection according to Use and Function (Principal Variable 1)

There are some uses and functions of urban areas that can require an acoustic environment and/or quietness and are compatible with the QUA selection.

Indexes:

- category of land use in the general urban planning: residential, green areas, commercial areas, school areas, historic centre, cultural areas, etc.;
- (current) function of the space: social relationship, conversation, resting, reading, playground, sport activities, leisure activities, etc.

Method of Analysis:

- category of land use in the general urban planning: official documents of urban planning;
- current or future function of the space: interview and/or observation of key experts and municipality technical staff.

Pre-selection according to Noise Levels (Principal Variable 2)

It refers to the definition of a noise limit or threshold according to the END definition of environmental noise: “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 such as those defined in Annex I to Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control”.

Index:

- Yearly averaged L_{den} values related to noise emitted by means of transport, road traffic, rail traffic, air traffic, and from sites of industrial activity.

A complementary approach could be the comparison of the L_{den} values in the area with the surrounding noise levels (rQUA, see Appendix 1).

Method of Analysis:

- Comparison of Noise Mapping (provided by the END requirements or national legislation) with a threshold level defined below.

In the case of the relative quiet urban area (rQUA) see Appendix 1.

Threshold value:

- L_{den} < 55 dB(A) or other defined by national legislations for example according to use and function of the area.

  The threshold level of 55 dB(A), despite not being the most used considering the State of the Art (where the threshold level of 50 dB(A) is the most recurrent), has been proposed in this phase for two reasons:.

  - it is not too restrictive (in order to be not too exigent in stating an area as already quiet);

  - in any case it is used among several member states.

After this step it will be possible to assess whether an area, selected because its use and function, can be considered as already quiet or only potentially quiet. This aspect will be confirmed or changed only after the analysis phase, when “in situ” evaluations will have been made.

STEP 1:

DATA-COLLECTION

USE AND FUNCTION:

1- Use Category of the General Urban Planning, as cartographic information of uses (residential, green areas, school areas, historic centre, cultural areas, etc.).

2- Use and function, interviews with technical staff with knowledge of the areas (resting, reading, playground, social activities, sport activities, leisure activities, etc.).

ENVIRONMENTAL NOISE LEVEL (2002/49/CE):

1- Lden - Noise Mapping (strategic methodology or more detailed).

2- Local knowledge - interviews with technical staff with knowledge of the areas and previous studies.

3- relative Lden approach.

STEP 2:

PRESELECTION

An area can be pre-selected as potential or already quiet (this aspect will be clarified in the following phase of characterization) because:

- its use or function respect the established requirements

and/or

- it has been identified from the noise map according to the established threshold value

Figure 1: QUAs pre-selection

candidate QUAs PRE-SELECTED

Complementary approaches to select QUAs in a municipality/agglomeration

Equity Distribution

By some competent authorities the possibility for citizens to live close to a QUA is considered as a priority. In these situations different indexes can be used to consider this parameter, all of them with the purpose of having equity in the distribution of quiet areas.

Index:

- QUA's size in relation to districts' size

- QUA's size in relation to residential areas or n° of inhabitants inside the district

- (walking) distance from dwelling to QUA

- Number of quiet areas in each urban district

- others.

Methodology:

- use of G.I.S. tools for the spatial analysis.

Threshold:

- to be decided by each competent authority

Citizens' opinions

Citizens' opinions regarding which areas must be or are perceived as quiet is an aspect that should be integrated in the pre selection process of QUAs. With respect to this aspect, the challenge is to obtain as many opinions as possible to have representative information on the citizens' point of view.

Index:

- number/percentage of citizens considering an area as quiet or thinking that an area should become quiet.

Methodology:

- social survey: by telephone, by web, organizing a public event informing district's inhabitants, etc.

Public consultation on the district level or in the neighbourhood of the quiet area (a too big scale is not efficient in the Bruitparif point of view).

Website for the general public where it's possible to select a specific area and put a comment

Threshold:

- to be decided by each competent authority (as a support for the definition of the threshold values some interesting studies could be put in evidence, for example the study carried out in Sweden by Nilson et al. in which percentages higher than 50% were discussed as threshold).

Public use

The property of the area can be an aspect to consider in order to decide whether the area can be regarded as quiet.

Index:

- property: public, private, public with private maintenance

Methodology:

- municipality or agglomeration technical staff knowledge

- analysis of official documents regarding land property

Data could be collected by direct interviews to the agglomeration technical staff, with the aim of transfer them in the GIS platform.

Threshold:

- to be decided by each competent authority.

ANALYSIS PHASE

The analysis phase of the QUA requires two approaches or activities:

- a preliminary desk study (and a preliminary "in situ" evaluation, if considered necessary or even recommended), to be developed by the municipality/agglomeration staff, based on the knowledge of the area or on the analysis of official documents. The outcome of this work is the subdivision of candidate areas into **HUA** as defined in **Appendix 2, according to visual aspects, use, distance and presence of sound sources**.

- an "in situ" survey in each area to be carried out during the hours citizens are visiting the area.. The study comprises the simultaneous development of:

    - a further "in situ" study in each HUA to check general and non-acoustic criteria. **Appendix 3 - Tool 1** describes the tool to develop this further analysis;

    - questionnaires to the users of each HUA. **Appendix 3 - Tool 2** describes the questionnaire structure and submission strategy;

    - sound measurements in each HUA. **Appendix 3 - Tool 3** describes the minimal requirements for the measurements.

Frequently, when the candidate QUA is large, many HUAs could be identified. The sound quality requirements in each of them can be different, depending on the uses, functions and citizens' expectations.

In the tools mentioned before the analysis of a set of variables is proposed and minimal requirements for analysis of QUAs are defined. These requirements are expected to be of general validity; this assumption, however, will be validated/modified according to the outcome of the forthcoming analysis of the pilot cases.

At the end of this analysis phase it will be possible to:

- identify QUAs;

- suggest the actions to be implemented in each area in order for it to become a QUA or actions to preserve areas that are already quiet.

The second aspect (related to actions to be implemented) is more connected to the management process for QUAs and will be considered in future documents also according to results coming from pilot case experiences.

Figure n° 5 shows analysis activities to be implemented (activities are detailed in Appendix 3), and obtained results. These ones, in their turn, will be useful in the following phase of management of QUAs

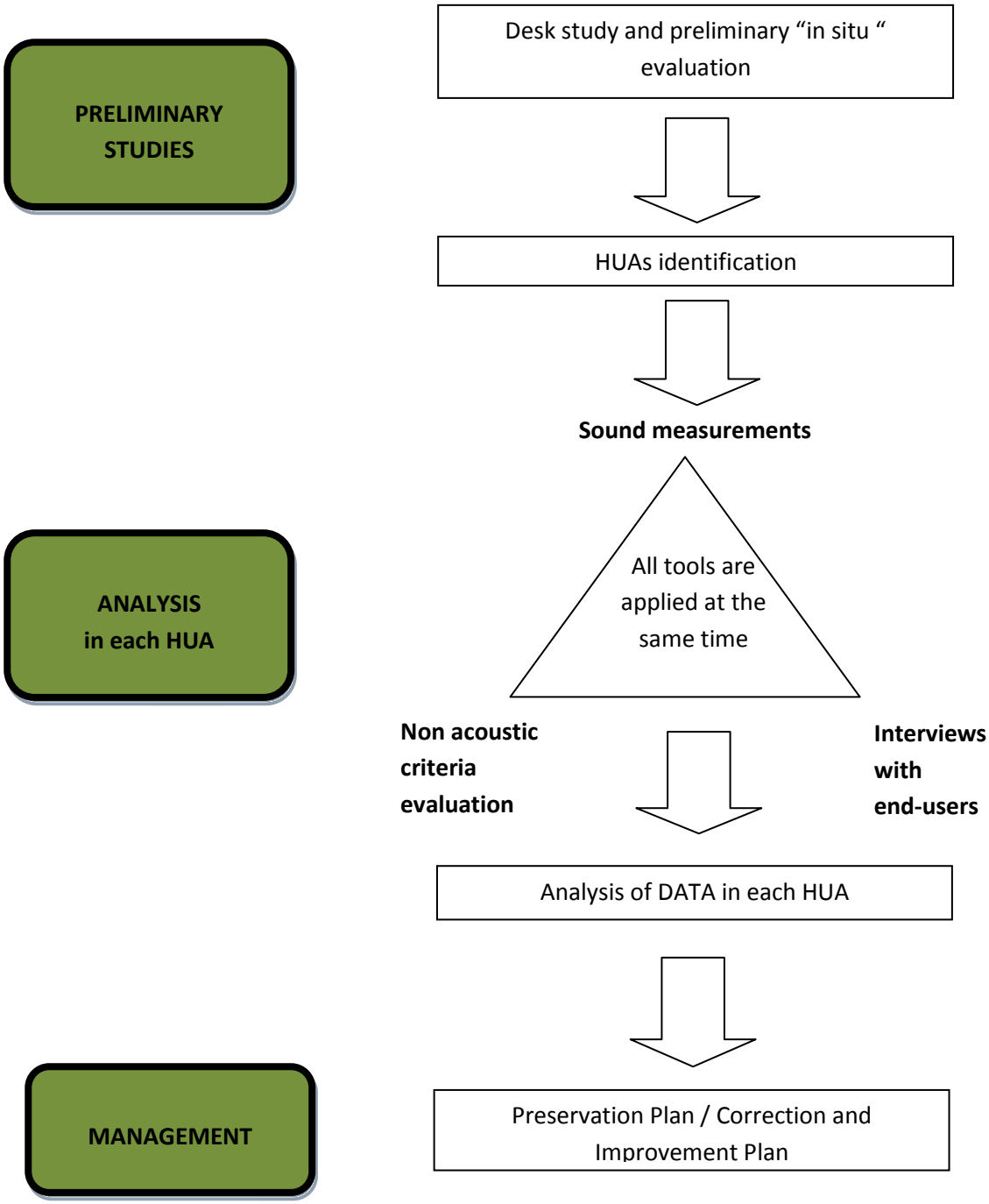

Figure 5: QUAs analysis

Appendix 1: description of the rQUA method

The rQUA criterion is only one step of the potential QUAs selection phase introduced in Paris.

The global methodology needs:

- the pre-selection of potential quiet areas from the noise maps (only acoustic criterion)
- the local consultation with the inhabitants or with stakeholders as technical staff of the city
- to cross and to filter with items available in the GIS software (Data collection based on use and function requirements):
    - Subjective and perceptual available (cleanliness, security, presence of other sources of pollution, ...).
    - more factual data (presence of vegetation, water, biodiversity, urban furniture, landscape and heritage value, sensitive establishment, ...).

First step - The step of pre-selection of potential quiet areas from the noise maps consists in locating the sites that can considered as quiet areas, thanks to an exclusively acoustic criterion. The processing of the maps with a GIS avoids any bias on the nature and the location of the results. The basic principle chosen is that any space open to the public is a potential quiet area. The predominance of green spaces in the results of the GIS filters can be guessed, but what is important is identifying all interesting spaces, even if they are not parks and gardens. To do so, the chosen approach is based at first on the updated results of the strategic noise maps and after to cross and to filter with the other georeferenced data available (public property, parks, city facilities).

Second step - Once the potential quiet area are pre-selected, it is necessary to start a consultation in the field with the population or technical staff of the city (link with current function of the space: interview and/or observation of key experts and municipality technical staff). Indeed, whatever the quality of the data used in the pre-selection step, it cannot take into account all noise sources, such as the emergences of powered two-wheelers, the sirens of emergency vehicles, the noise nuisances related to shops and small businesses and simply the sound reality of the different neighborhoods. The objective is to confront the local feelings with the acoustic selection from noise maps.

This method relies on a noise mapping approach, it is elaborated starting from the method used in the municipality of Paris, but compared to it, it is simpler since it is based on the strategic noise maps data, which are usually available. Maps are usually provided in a form compliant to the END requirements (i.e. *Lden* as acoustic parameter and a map grid resolution of 10x10 m).
The rQUA requires the use of a GIS that can apply several levels of filters on the existing data.
Minimum requirements :
- data from the noise calculation software: noise levels on grid of receiver points, indicators Lden, Ln according to the END requirements;

- GIS platform software.

For an easy use of the GIS software, it is necessary to collect END noise maps as a grid of points (e.g. 10m x 10m grid resolution). In particular, as minimal requirements according to the method proposed in Paris, noise maps for road and railway are needed on the same grid points to perform the evaluation.
In the cases noise maps are not available as grid of points, it is necessary to convert them into a grid of points with resolution of 10m x 10m.

At first, it provides the superimposition of the noise map of Lden. (maps built with GIS software representing the energetic combination of the road and rail noise Lden maps of the Lden indicator) . Then, the absolute noise level ($Lden\_absolute$) is attributed to each point of the map grid.
Secondly, for each point, a circled area with a 250 m radius (representing the surrounding neighbourhood) is considered, and the arithmetic average of Lden values, associated to the map grid points included into the circle, is calculated ($Lden_{aritmetic\_average}(R = 250\ m)$).

Finally, for each point of the grid the difference between the absolute level and the average one is calculated:

$$\Delta = Lden_{\_aritmetic\_average}(R = 250\ m) - Lden\_absolute$$

With this formulation a positive value of Δ means that the grid point is less noisy than the surrounding neighbourhood. Thanks to this approach, it is possible to define four categories considering both the absolute ($Lden\_absolute$ > or < 55 dB(A)) and relative (Δ > or < 10 dB(A)) levels. Each category is identified with a colour (green, yellow, orange and white) as follows:

Colour	***Lden_absolute* dB(A)**	**Δ dB(A)**
Green	≤ 55	> 10
Yellow	≤ 55	≤ 10
Orange	> 55	> 10
White	> 55	≤ 10

Table 4: possible categories of QUA coming from rQUA method

From Table 2 it is possible to classify the area in the following categories, to be considered for the subsequent phase of management:

- presently quiet, based on the absolute acoustic criteria (Lden<55dBA) (green and yellow areas);

- presently critic, based on the absolute acoustic criteria (Lden>55dBA), but potentially quiet (orange). Ideally, even the white areas are possibly supposed to be potentially quiet, in general they

are not regarded as such, considering that the interventions needed are supposed to be hard to put in place.

The ones colored in orange, i.e. with a Lde > 55 dB(A) but Δ > 10 dB(A), need particular attention as they would not have stood out with a simple analysis of the absolute noise of the map, whereas these spaces have advantages in a noisy neighborhood.

Referring to the potential quiet areas, the rQUA method provides further indications concerning the sound sources and the possible noise reduction interventions:

- orange areas: the most relevant noise source is well localized and limited interventions performed at the edge of the areas (acoustic barriers, low noise paving, etc.) can be performed. Moreover, an optimization of the position of the actual used areas can be performed.

- white areas: a predominant noise source is not identified and only strategic interventions at block level (designing of low speed zones and/or without vehicles, etc.) can be performed.

In this phase a first political evaluation or a public consultation could be already planned, e.g. in order to exclude some areas from further actions based on the results of the rQUA analysis.

Appendix 2 Tool 1: EXPERT CRITERIA for the delimitation of Homogeneous Units of Analysis (HUA).

The delimitation of HUAs is connected with the following items:

Item 1 - Landscape: the area must be characterized by the same visual elements and landmarks.

Item 2 - Use: there is only one main and specific use or function of the area. This is connected with facilities and furniture in the area. For instance, in a park, many different uses can be addressed in different areas depending on the facilities: sports areas, recreational areas, resting and relaxing areas.

Item 3 - Distance and Presence of sound sources: the influence of environmental noise sources (road traffic, rail traffic, air traffic or industrial activities) or other sound elements must be homogeneous in the area.

Appendix 3 - Tool 1: EXPERT ANALYSIS FOR THE NON-ACOUSTIC DATA COLLECTION

There are some non-acoustic factors that might be required for an area to be considered in the assessment of the quality of QUAs . They are schematically reported in the following tables. In table 5 the factors are listed, while in tables 6, 7 and 8 they are detailed. All of them should be studied and taken into account.

CRITERIA
Non acoustic principal factors
Landscape
Cleanliness and maintenance
Safety
General analysis
Urban context
Proximity from/to residential areas
Accessibility
Proximity from/to noise sources
Presence of a multi-sources scenario
Noise reduction interventions
Behaviour factors
Number of users
Distribution of users (geographical)
Activities performed

Table 5: Appendix3-Tool 1-variables

NON ACOUSTIC PRINCIPAL FACTORS

Yellow or red status indicates not completely satisfactory condition with respect to the considered criterion.

CRITERIA	DESCRIPTION	PARAMETERS	RATING	INPUT TO DEFINE POSSIBLE SOLUTIONS
Landscape	View form the area of greenery, water, specific view (architecture,…)	None		
		Only in 1 direction (N, S, E, W)		
		3/4 directions (N, S, E, W)		
Cleanliness and maintenance	Evaluation of cleanliness by observation from experts	not maintained (uncut grass, broken benches, etc.) and unclean (garbage on the ground and/or out of the trash bin, etc.)		Propose interventions to improve cleanliness.
		Regular degradation /badly maintained		
		regularly maintained and clean		
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.
		Not guarded spaces or dark zones without lighting		
		Guarded and lighted spaces		

Table 6: Appendix3-Tool 1-non acoustic principal factors

GENERAL ANALYSIS

Yellow or red status indicates not completely satisfactory condition with respect to the considered criterion.

CRITERIA	DESCRIPTION	PARAMETERS	RATING	INPUT TO DEFINE POSSIBLE SOLUTIONS
Urban context	Placement of the area with respect to social key-points in the city (e.g. library, church, etc…)	Far from key-points		no immediate solution
		No key-points		
		Close to key-points		
Proximity from/to residential areas	Proximity to residential area increases the number of users of the area	More than 3 km		no immediate solution
		Between 500 m and 3km		
		Less than 500 m		
Accessibility	Accessibility (considering also people with reduced mobility) by public transport or by cycle path and/or pedestrian path	Only by public transport (underground, bus)		Create cycle and pedestrian paths; develop public transport; add bus stops or lines; create low speed zone.
		Only by cycle path and pedestrian path		
		by public transport, cycle path and pedestrian path		

Proximity from/to noise sources	Proximity to noise sources means possible high noise levels. In case users can see the noise source, this psychologically affects their noise perception	Main noise source is close to the HUA and it is visible by users, potentially audible		The choice of solutions should consider interventions that visually hide or mask the sources.
		Main noise source is close to the HUA and it is not visible by users, potentially non audible		
		Main noise source is far from the HUA potentially audible		
Presence of a multi-sources scenario	Presence of multiple noise sources of one or more kinds (road traffic, rail traffic, air traffic, industrial site)	3 or more sources		Assess contribution of every kind of noise sources and study solutions also evaluating combined effects for all main sources.
		2 sources		
		1 source		
Noise reduction interventions	Possibility of noise reduction interventions	Interventions with good acoustic efficacy are possible but not present		Propose possible integration of current intervention to improve acoustic efficacy. The choice of solution should be integrated also by data processing related to end-users questionnaires.
		Interventions with average acoustic efficacy are possible		
		No interventions are possible		

Table 7: Appendix3-Tool 1-variables for general analysis

BEHAVIOUR ANALYSIS

Yellow or red status indicates not completely satisfactory condition with respect to the considered criterion.

CRITERIA	DESCRIPTION	PARAMETERS	RATING	INPUT TO DEFINE POSSIBLE SOLUTIONS
Number of users (the overall user number during the opening hours)	Number of users gives an idea about perceived pleasantness	Less than 1 user / 9 m^2 (Italian urban parameter, ref. Italian Decree n. 1444/68)		Examine problems connected to poor attendance by using results coming from the end-users questionnaire and propose intervention to solve them.
		Between 1 and 2 users/ $9m^2$		
		More than 2 users / 9 m^2		
Distribution of users in the HUA	Preference to stay in a precise sub-area	HUAs are not uniformly used (attended) and less than 50% of HUAs is appreciated		Propose attractive activities or insert elements to encourage users to stay in all the sub-areas. The solution choice should be guided also by the results of end-users questionnaires.
		HUAs are not uniformly used (attended), but more than 50% of HUAs is appreciated		
		HUAs are uniformly used (attended)		
Activities developed	Be able to perform different activities (with particular attention to mental and relaxing tasks)	Only one activity is performed and without mental tasks (e.g. sport)		Further evaluations according to the size and type of the area. In those areas where different activities are expected, consider to create different soundscapes related to different activities. The solution choice should be guided also by the results of end-users questionnaires.
		Different activities, but including mental tasks (e.g. reading), are performed		
		Different activities, including mental and relaxing tasks, are performed		

Table 8: Appendix3-Tool 1-variables for behavior analysis

Appendix 3 Tool 2: IN SITU QUESTIONNARIE

The key variables of the questionnaires to be analysed are the following ones:

- Percentage of users that consider the sound atmosphere as CALM.
- Percentage of users that consider the sound atmosphere as PLEASANT.
- Percentage of users that consider the sound atmosphere as CONGRUENT with other characteristics of the area.
- Sound sources (dominant ones) and the way they are perceived (pleasant or unpleasant) by users and citizens in the area.
- percentage of users that consider the area as safety
- percentage of users that consider the area as clean and well maintained
- percentage of users that consider the area as accessible
- percentage of users that consider the area beautiful, pleasant or/and natural (from aesthetic point of view)
- Activity: type of activity, metabolic status and purpose of the visit to the area.
- Other environmental conditions: lighting, thermal conditions, odours, etc.
- Reason for frequentation.
- Frequency of visits.
- Duration of stay in the QUA
- Global satisfaction with the place.

The questionnaire is elaborated in an English version, according to the previous variables.

For a correct submission of the questionnaire, partners having in charge the submission will have to:

- translate the questionnaire in the interviewer language;
- follow the submission procedure described in the questionnaire as "Comments"**Appendix 3 Tool 3: IN SITU SOUND MESAUREMENTS**

Principal variable: short term measurements

The short term measurements have the aim to collect acoustic information about the present sound levels during the time of in situ analysis.

In this tool some minimal requirements are given. Nevertheless, some different requirements could come from the pilot case experiences.

The minimal requirements for a generic QUA are defined below:

- at least a measurement position per each HUAs;
- 1,5-1,8 m as the microphone height above the ground (according to the supposed ear height);
- 30 minutes as the minimal duration of the short term measurements;
- the short term measurements should be carried out in a time span when the HUA is typically used, in parallel to both the long term measurement and the end-users interviews (see App. 3 – Tool 2);
- the measurement position should be close to the interview location, but far enough (at least 3 m distance) not to be corrupted by the on-going interview;
- Time History, 1 second based, of overall equivalent continuous A-weighted sound pressure level (LAeq,1s) should be considered;
- other acoustic parameters to assess possible presence of pure tones should be evaluated: i.e. at least, Time Histories of 1/3 octave band spectrum, 1 second based, of both equivalent continuous sound pressure level, Leq,1s, and the lowest noise level obtained when using Fast (0,125 s) time constant, LFmin should be carried out;
- other acoustic parameters to assess impulse noise should be considered only if such components are supposed to be present. An impulse noise is supposed to be present only in presence of specific sources in the study area, e.g. industrial machineries. This kind of evaluation can be carried out by the acoustic technician performing some specific measurements, if necessary, or without measurements, simply evaluating the sound source type. For example, in presence of noise from infrastructures (railway, road traffic, airport) the suggestion is to not carry out impulse noise parameters.

Based on the Time History of sound pressure levels (LAeq,1s) the following parameters should be used for the further analysis: LAeq; L10 – L90; number of events exceeding the threshold level. According to the partners' experiences the event is defined when a $L_{Aeq,1s}$ is 10 dBA higher than the Back Ground Noise (BGN) of the minute in which the event is centred, 30 s before and after the event, defined using the L_{90} parameter for BGN. The noise source that causes the event is identify

and the analysis of the questionnaire will determine if this noise source, and therefore the event, is classified as unpleasant by citizens.

Furthermore, based on Time Histories of 1/3 octave band spectrum, 1 second based, of Leq and/or LFmin, the presence of pure tones should be considered.

The previous parameters should be evaluated into a 30 minutes time span (a temporal unit of time of 30 minutes is proposed to be used, since it is considered as the average time people remain in the areas) in which an interview takes place. In this way, the acoustic parameters will be strictly linked to the interview.

The measurement system should be in accordance with class 1 according to the international standards IEC 61672 (IEC 60651, IEC 60804) for sound level meters, IEC 61094 for microphones, IEC 61260 for filters 1/1 and 1/3 octave band.

Before and after each measurement session the measurement system should be checked using a class 1 calibrator according to the international standards IEC 60942. Differences included into the accuracy of 0,5 dB are expected for a validation of the measurement session.

The measurement and calibration system should be checked by an accredited laboratory since minus than 2-years.

Based on the results of analysis carried out in the pilot cases, the adequate parameters and indexes will be chosen.

The Time History of LAeq,1s will be enough detailed to permit a further analysis and choose different parameters, if necessary.

Principal variable: long term measurements

The long term measurements have the aim to collect acoustic information about the variability of sound levels vs time.

In this tool some minimal requirements are given according to a general QUA. Nevertheless, some different requirements could come from the pilot case experiences. In particular, some different requirements are expected in small QUAs with a reduced opening time such as the school gardens.

The minimal requirements for a generic QUA are defined below:

- at least a measurement position is expected per QUA (combined to short term measurement in each HUA);
- 4,0 ± 0,2 m as the microphone height above the ground (according to END suggestions, defined in Annex I of END). Other heights may be chosen, but they must never be less than 1,5 m above the ground, and results should be corrected in accordance with an equivalent height of 4 m (the correction could be obtained performing a short measurement, 30 minutes duration, in parallel to the long one at the height of 4 m above the ground).
- 1 week as the minimal duration of the long term measurements;
- the measurement position should be close to the interview location, but far enough (at least 3 m distance) not to be corrupted by the on-going interview;
- Time History, 1 second based, of overall equivalent continuous A-weighted sound pressure level (LAeq,1s) should be considered.

Based on the Time History the following parameters should be used for the further analysis:

- LAeq,T (where T is the opening time period of the QUA)

- Lden

- Lday

- L10 – L90, related to both the daytime period (defined according to END and national legislation) and the opening time period of the QUA.

- Number of events exceeding a threshold level, related to both the daytime period (defined according to END and national legislation) and the opening time period of the QUA. According to the partners' experiences the event is defined when a $L_{Aeq,1s}$ is 10 dBA higher than the Back Ground Noise (BGN) of the minute in which the event is centred, 30 s before and after the event, defined using the L_{90} parameter for BGN.

The measurement system should be in accordance with class 1 according to the international standards IEC 61672 (IEC 60651, IEC 60804) for sound level meters, IEC 61094 for microphones, IEC 61260 for filters 1/1 and 1/3 octave band.

Before and after each measurement session the measurement system should be checked using a class 1 calibrator according to the international standards IEC 60942. Differences included into the accuracy of 0,5 dB are expected for a validation of the measurement session.

The measurement and calibration system should be checked by an accredited laboratory since minus than 2-years.

Based on the results of analysis carried out in the pilot cases the adequate parameters and indexes will be chosen.

The Time History of LAeq,1s will be enough detailed to permit a further analysis and choose different parameters, if necessary.

Complementary variable: WAVE (.wav) file recording

The WAVE file recording has the aim to collect acoustic information about the actual sounds during the time of in situ analysis strictly linked to the end-users perception.

In this section some minimal requirements according to a general QUA are provided. Nevertheless, some different requirements could come from the data collection in the pilot cases.

The minimal requirements for a generic QUA are defined below:

- at least one recording position or a "sound walk" should be carried out into each HUA;
- the recording positions should close to the interview location, but far enough (at least 3 m distance) not to be corrupted by the on-going interview;
- a binaural data acquisition system is required;
- the recording measurements should be carried out in a time span when the HUA is typically used, in parallel to both the long term measurement and the end-users interviews (see App. 3 – Tool 2);
- a WAVE file (44.1 kHz sample rate) should be recorded.

Based on the post-elaboration of the WAVE file, the psychoacoustic parameters (e.g. *loudness*) should be computed.

Before and after each measurement session the recording system should be checked using a class 1 calibrator according to the international standards IEC 60942. The calibration signals should be recorded. During the measurement session the system recording settings should not be changed.

The calibration system should be checked by an accredited laboratory since minus than 2-years.

Based on the results of analysis carried out in the pilot cases, the adequate parameters and indexes will be chosen.