ACTIONS TO IMPROVE SOUNDSCAPE IN THE "PLAZA NUEVA" IN BILBAO.

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Abstract

One of the main challenges of the cities is to improve the quality of life of their citizens by means of the urban design. To achieve this goal, urban design should integrate the sensorial dimension of spaces considering not only aesthetic aspects, but also the sound atmosphere or soundscape.

Plaza Nueva is a characteristic Square of Bilbao (municipality in the north of Spain) with the main function of allowing on it meetings with friends in pubs and in public areas, including conversations, food and drinks. The square also offers places where children can play around. These activities are directly connected with the cultural heritage of people from Bilbao, which is interesting to be preserved.

The square is placed in the historical district of Bilbao and the municipality has opened a public participation process to define the strategy for the renewal of this district. One of the objectives defined in this strategy is to maintain the places for leisure activities, balancing their use with a more comfortable environmental experience. Tecnalia proposed to consider sound dimension as an urban design parameter in this renewal strategy. On that sense, one of the public spaces analysed is the Plaza Nueva. As a first step a diagnosis of the current soundscape was developed.

The methodology for the soundscape study combines two approaches: development of acoustic measurements and psychosocial assessment (questionnaires). This study is complemented with an analysis of the architectural elements of the area to identify which of them deals with soundscape and how do they influence in the sound atmosphere.

This approach is useful to identify the urban elements that can improve this sensorial dimension of public places and to propose actions in which possible interventions could be defined once the renewal process would start.

Key words: Soundscape, urban public spaces, sound atmosphere, urban design

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1. Introduction

For the first time in human history there is more people living in cities than in rural areas [1]. It is known that spending time in natural areas contributes to well being and health [2, 3]. But the possibilities of citizens enjoying these benefits depend on the proximity of these natural areas to their residential areas. It is a fact that the citizens of urban areas do not have many opportunities of being in natural areas.

A possible solution to this handicap is creating areas in the cities, as "natural" as possible. Citizens refer to "quietness" as one of the aspects that they associate with the natural dimension of places [4, 5]. This concept involves much more than the acoustical atmosphere of the places, although this is one of the items to be considered.

On the other hand, there are a lot of references that conclude that the acoustical comfort of places not only requires low noise pollution, but it also needs to consider the soundscape concept, that is related with the perception of sounds [6, 7, 8].

Finally, improving the quality of life by means of the urban design involves considering the integration of all the senses, not only the aesthetical and functional dimensions. This approach of considering other senses (such as hearing) is especially interesting in squares and parks (areas to be enjoyed).

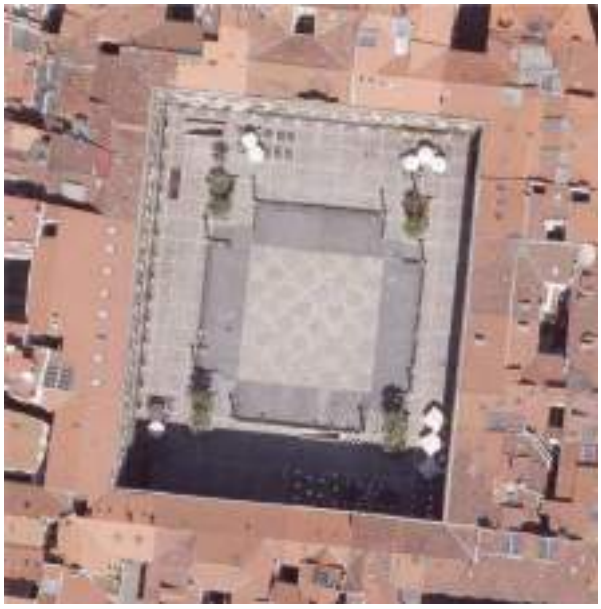
All these different points of view derive in the same conclusion: it is necessary to consider the acoustical comfort (soundscape) as a parameter to be integrated in the urban design of places.

The Bilbao municipality, being aware of this fact and with the main objective of improving the quality of life of citizens, is collaborating with Tecnalia to integrate the soundscape approach in urban squares renewal processes. The challenge is that soundscape analysis would give relevant conclusions to be considered when making decision about the renewal interventions to be adopted in public places.

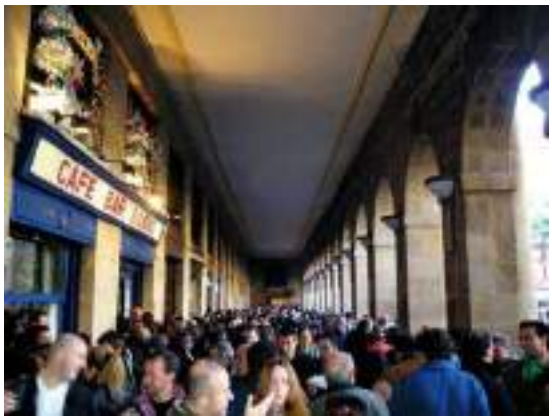
In this approach, soundscape study involves not only the consideration of the acoustical atmosphere analysis (objective and physical dimension of sounds), but also the perception approach (in this case using questionnaires).

2. Description of the study area

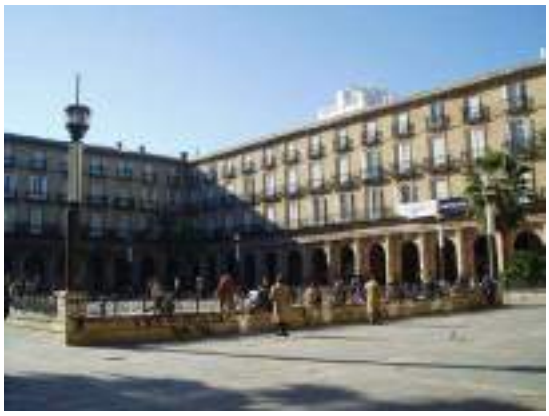
The area that was studied is an urban square located in the historic district of Bilbao called "Plaza Nueva".



The area is divided in subareas, applying variables of differentiation of the spaces based on their functionality and use. In the Plaza Nueva two differentiated subareas were identified.
Each subarea is considered as a homogeneous unit for the soundscape approach. Each subarea has common characteristics regarding to soundscape, so, it must have, not only the same sound atmosphere, but its use or functionality must also be similar, since this characteristics influence the expectations of the citizens [9].



Subarea 1: Arcade unit. This area is covered by arcades and people meet in the vicinity of bars in the area. It is an area with cultural meaning.



Subarea 2: Square center unit: it is an open area used by children to play, while adults are enjoying their time at Subarea 1.

The municipality has opened a citizen's participation process to define the renewal strategy in the historical district. On that sense, different forums and meetings with stakeholders are in course. This analysis includes Plaza Nueva, since it s one of the most popular places in the district. The results of the soundscape approach presented in this paper will be one of the inputs in the decision making process of selecting renewal actions to be considered.

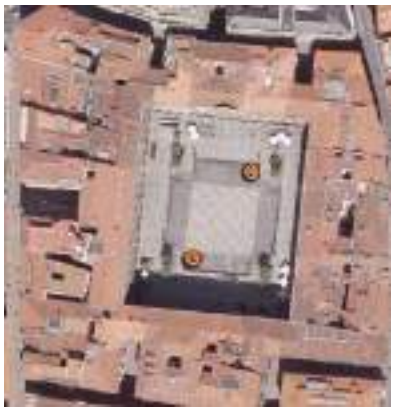
3. Soundscape approach

The analysis was developed on weekdays (always on Wednesday or Thursday) during the timetable of use of the areas by the citizens (from 17:30 to 19:00). The evaluation was done during a total of an hour and a half, but the data were processed for each half-hour, as this is the average time of use of areas (estimated time that the same person spends at the same place).

The assessment involves two complementary approaches:

A- Physical Acoustic Measurements: ESEI (Environmental Sound Experience Indicator).

In each homogeneous unit, the measurements were developed at two points. The locations of the points were selected avoiding the limits or the centre of the area.

Subarea 1: Arcade unit	Subarea 2: Square center unit
	

The acoustic setting of the measurements were fixed to a temporary resolution of 1 s, and a spectral analysis of 1/3 octave resolution. The physical acoustic indicators analysed were: L_{Aeq}, L_{AFmax}, L_{AFmin}, L_{10}, L_{50} and L_{90}.

Besides, the sounds present in the area during the measurements were stereo recorded. The aim of this recording is to obtain complementary information to process the information in order to calculate the ESEI (Environmental Sound Experience Indicator).

The ESEI indicator takes into account the following inputs to assess the acoustical atmosphere:

- Sound levels: the amount of acoustic energy that is received in the area.
- Sound sources that are dominant in the generation of the acoustical atmosphere. Identification of those sources present during more time and with more energy.

- Number of acoustical events that are relevant with respect to the background noise level [10].
- Subjective evaluation of sound sources: it relates to whether the sources that characterize the sound atmosphere are perceived by the people as "pleasant" or "unpleasant" and if they are congruent (expected to be listened) or not in the specific place [11].

As it is shown, the ESEI indicator not only considers the results of the acoustic measurements, but it also considers some data from the psychosocial study about user's evaluation of sound sources. The recordings are also useful for a "post in-situ" evaluation.

The ESEI indicator values range from 0 to 12.. A high value of the indicator means a positive soundscape (perception of the sound atmosphere). The sound quality of an urban public space can be divided in 3 classes depending on the ESEI results:

- ESEI values between 0 and 5 mean that the soundscape is not suitable for the area. In the case of urban areas it can be related with the presence of environmental noise (pollution).
- ESEI values between 5 and 10 means that it is possible to include soundscape concepts in the area, going beyond aspects merely related to acoustic pollution. Therefore, in this range of ESEI values, possible actions to improve soundscape will not only include noise abatement measures.
- ESEI values between 10 and 12: (10 is the threshold of excellence). A soundscape with these results of ESEI means a good situation, so it must be preserved or protected.

B- Psychosocial approach: Soundscape questionnaire

The main objective of the psychosocial approach is to collect the users´ evaluation about soundscape. Besides this, the questionnaires also provide information regarding the general perception of the place. There are several previous researches about the analysis of the acoustic comfort by means of the sound perception [12, 13, 14].

The psychosocial evaluation was partially based on conducting questionnaires to people present at the place, simultaneously to the acoustic measurements. A total of 50-60 questionnaires were gathered at each unit of analysis .The questionnaire includes open and closed questions. The content of the questionnaire was defined, trying to optimize the time to fill it, getting a good compromise between maintaining the interest of people answering the questions and obtaining of as much quality information as possible. The questionnaire requires a total of 5-10 min to be answered by citizen

Other interesting information was also collected by the questionnaires. This type of data can be described as it follows:

- Socio demographic information of the person.
- Information about their health and lifestyle.
- Psychosocial factors: satisfaction, noise sensibility …
- Experience at the place and perception of it: frequency of visiting it, activity developed on it, time of presence, descriptors selected for the place, best and worst rated items…
- Emotions: regarding the experience of being in the place.

Information obtained from the acoustic measurements and the questionnaires is very useful for the soundscape approach. The analysis combining information from both approaches allows a good understanding of the reasons of a particular soundscape perception. This understanding will be a solid base to define actions to improve the soundscape.

4. Results of the analysis at Plaza Nueva

4.1 Soundscape Assesment

The following paragraphs show the ESEI results for each subarea. Each resulting value is acoustically explained for a better understanding of its meaning. It is also presented the information obtained on the psychosocial analysis considering, not only the soundscape assessment, but also more information regarding the use and the perception of the place.

These inputs are used to propose some key aspects in which interventions could be focused for the soundscape improvement of the place.

Subarea 1: Arcade unit

ESEI value: 6.6
The sound levels in the area are around 70 dBA LAeq. Sound levels are mainly associated with human activities. There are some sound events and most of them are well perceived by citizens.

Psychosocial analysis:
The main use of the area is social meeting with friends, talking and drinking outside the bars in the area. People are mainly standing up in groups outside the bars.
The place is perceived as pleasant and spacious.
- The most appreciated characteristic of the area is that is pedestrian and covered.
- The less appreciated characteristic of the area is that it is too noisy (due to reverberation at arcades) and it is a bit crowded.

Description of Soundscape: citizens consider that the soundscape is not relaxing. Sound of voices (40%) and some natural sounds (wind) are considered as unpleasant.

Other sound sources that are identified in the area are related with bars activities: ventilation, air conditioning, kitchens, etc.

Subarea 2: Square center unit

ESEI value: 7.5
The sound levels in the area are around 65 dBA LAeq. Sound levels are mainly associated with human activities. There are some sound events and most of them are well perceived by citizens.

Psychosocial analysis:
The main use of the area is relaxing and caring of the children. People are mainly sit down in benches and secondly going through(walking). Children are playing around, running and moving all around the area.
The place is perceived as pleasant and noisy.

- The most appreciated characteristic of the area is its quietness and aesthetic.
- The less appreciated characteristic of the area is the fact that children play with balls. Neither it is well appreciated that the area is windy and crowded.

Description of Soundscape: citizens consider that is a harmonic and natural soundscape. Regarding identification of sound sources, in most cases sound of voices (including children) is considered as pleasant.

4.2 Key aspects for possible interventions

Ideas and key aspects that could lead to possible intervention actions to improve soundscape were defined following a two steps methodology:

- Defining the clue ideas or general requirements that would condition any proposal.
- Developing a "brain-storming" process with acousticians, architects and psychologists to obtain the more proposals as possible, as open ideas.

Some open ideas were obtained through the application of this process. Anyhow, all of them should be discussed with responsible of the municipality to select the most interesting ones and to analyse their possible integration at the moment of addressing the renewal of the square Plaza Nueva.

The results obtained for each subarea of the square are described as follows:

Subarea 1: Arcade unit
General requirements: it is an area highly valued because of its use (connected with the cultural heritage of being a citizen of Bilbao). The main aspect to change regarding the sound atmosphere is the chaotic situation caused by the high acoustical reverberation caused at the arcades. It is considered as a non relaxing soundscape.

Key aspects for possible interventions:

- Reduction of acoustical reverberation in arcade.
- Abatement of noise sources related with bars activities: ventilation, air conditioning, kitchens, etc.

Subarea 2: Square center unit

General requirements: Enhance the natural value and pleasantness that is referred at the place, but avoiding elements that can increment the windy sensation. The presence of children is assessed positively, but not some of the activities they do (play with balls).

Key aspects for possible interventions:

- Increase the option of enjoying the place with relaxing activities. Extend the options to people of being sat.
- Strengthen the perception that the square is natural. It is excluded the option of installing some water elements in the square since the square is perceived as windy and the water could worsen the perception, creating a sensation of cold. The open idea is to include more greenery items (more natural elements).
- Make it difficult for children to play with balls and, instead of this, encourage alternative activities for children to play. It might be interesting to build some installation to facilitate other types of games.

5. Conclusions and expected results

This paper presents an initiative for the consideration of soundscape as an interesting point of view in urban renewal processes.

To develop this task, after analysing different approaches [(15)], a five steps methodology has been defined:

A- Preliminary analysis of the area: delimitation of homogeneous units for the soundscape approach, identification of relevant urban elements and design of the measurement campaigns for the second step.

B- Soundscape assessment: acoustical and psychosocial analyses are combined to obtain conclusions regarding the sound atmosphere quality in the area and the elements that originate it.

C- Identification of aspects of soundscape to be improved and definition of general requirements for the interventions. The actions and the variables that condition the interventions are defined taking into account the results of the previous step, and also the general characteristics of the place, its perception and the interactions between the place and the citizens, derived from the psychosocial evaluation.

D- Definition of open ideas about the interventions: to obtain as much ideas as possible, a brain storming dynamic is proposed. In this process is recommended to involve diverse professional profiles, such as, Acousticians, Architects, Psychologists and Urban designers. This step finishes with the selection of the specific actions that are interesting for the interventions.

E- Final design of the interventions: this step includes the definition of a prototype and a very detailed design of each solution or action that will be implemented to improve soundscape. This step deals with the challenge of adjusting the action to the particular environment of implementation.

In the case of the area studied, the square in Bilbao called “Plaza Nueva”, the process is at this moment in the forth step. All the open ideas found in the process should be discussed with responsible of the municipality to select the most interesting ones and to analyse their possible integration at the moment of addressing the renewal of the square Plaza Nueva. The most challenging aspect will be to be able to provide a prediction of the effects of the actions designed in the fifth step on the soundscape of the studied area. Tecnalia foresees showing the outputs of this prediction in terms of ESEI and soundscape semantic differential scale.

6. Acknowledgements

The content of this paper is an example of the first results of the bet of the City of Bilbao of integrating the environmental comfort and, more specifically, the soundscape in the renewal processes of urban squares. It is gratifying that the City is relying on the technical capabilities of Tecnalia to contribute in their challenge of improving the quality of life of citizens.

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