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Improving sound quality measures through the multifaceted soundscape approach

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ABSTRACT

Soundscape research represents a paradigm shift in the field of sound evaluation. First, it improves human perception, and, second, it expands on classical physical measurements and makes reference to the use of different investigative measurement methods. This multifaceted approach is basic to improving the validity of the research outcome on any subject or phenomenon, and it avoids systematic errors that can occur when relying on only one approach. The soundscape approach considers the conditions and purposes of a sound's production and how it is perceived. Consequently, it is necessary to understand that the evaluation of sound is a holistic process. The International Standard ISO/DIS 12913-1 has as its purpose the enabling of a broad international consensus on the definition of 'soundscape' and its respective evaluation. It is more than urgent to understand that there is the need to provide a solid foundation for communication across disciplines and professions with an interest in achievements on better solutions for the people concerned.
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1. INTRODUCTION

Soundscape is the human perception which depends on the socio-cultural background and the psychological dimension with the acoustic environment in context. Other concerns include safety, sustainability, mobility and ecology.   The concept of sound as a resource reaches across a broad range of applications. (NWIP ISO 12913-2, 2014)

Product Sound Quality is a descriptor of the adequacy of the sound attached to the product. It results from judgment upon the totality of auditory characteristics of the said (spoken) sound- the judgment being performed with reference to the set of those desired features of the product which are apparent to the users in their actual cognitive, actional and emotional situation. (Blauert, Jekosch 1997) (1)

Customers make judgments about product sound in terms of its loudness, annoyance, amenity and what it says about the product. In other words, customers make their judgments based on a product's Sound Quality…So, in acoustics we have a better situation than they do in Sensory Testing for taste, touch and flavor. We can in fact record very precisely what is presented to our ears. But the cognitive processes that convert sounds to feelings and intelligence are not captured by our calculations. Metrics are at best a bridge between the sound pressure signal and our evaluations of SQ for products. We will continue to need people to listen to and evaluate product sounds. And, they will need to mind their (AS)Ps and their (S)Qs (Dick Lyon, 2003) (2)

2. THE NEED FOR A CONSISTENT FRAMEWORK

2.1 Interactive Approach

Because of the omnipresence of sound in our perceptual world, the sensory element influences the quality of life. The complex interplay between the diverse dimensions (physical, psychological, psychoacoustic, cultural) leads to classifications of sound like annoying, pleasant, loud, quiet, disturbing, comfortable. The perception of sound can only be retraced with the help of a multidimensional approach, which covers the different dimensions.

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Therefore, it is important to have a consistent framework for defining the context for the Soundscape being managed via an interactive approach using the resources through participation and collective management. Relevant stakeholders should be considered, depending on the context. Over the years strong impact was given to introduce this concepts in science and applications.

While classical noise indicators are known to show strong limitations under certain sound conditions (low frequency noise, tonal components, multisource environments) it is central to Soundscape research and implementation to fit the applied indicators to the perception and the appraisal of the concerned people. The fit of indicators depends, however, also on the type of investigated Soundscape. It is extremely important that the fit of indicators reflects the situation and context (personal, social, cultural, land use, economic, geographic) which define the sonic listening space, and also enables tracing dynamic changes like time variances of the Soundscape over the day or seasons. In practice there is still a significant gap between Soundscape indicators which are used in some standardized way in "measurement by persons" and those applied in "measurement by instruments". Psychoacoustic, ecological and landscape acoustics need techniques to be more tightly integrated in such studies to mediate between personal experience and group-area-society requirements and needs. Only through proper integration of these techniques can the potential of the Soundscape approach be implemented in planning and design. The Soundscape approach relies by definition on this strategy and in the strict sense it can be said: any study which does not use *triangulation (people, acoustic environment, context)*, that is, a combination of several differing investigative methods, cannot be considered a complete Soundscape study. So we must look at each Soundscape situation from several viewpoints to obtain a more complete picture of reality.
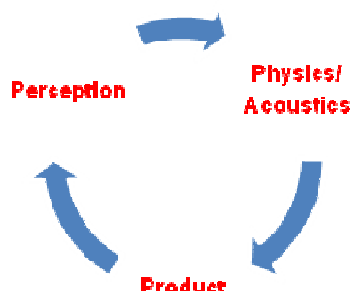

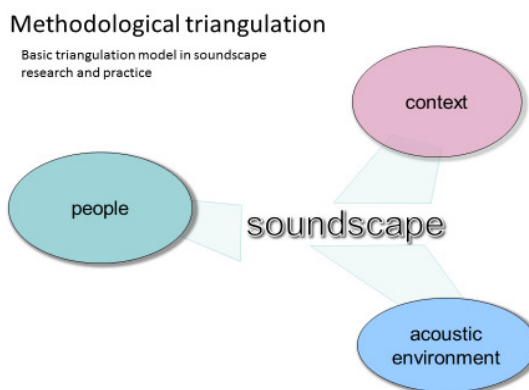Figure 1- Constellations (Schulte-Fortkamp)   Figure 2 – Triangulation (Botteldooren) (4)

3. SOUNDSCAPE AND SOUND QUALITY

3.1   A Taxonomy

To assist in source reporting, a classification for all sound sources in any acoustic environment a common framework, or checklist, for broad identification of sources has been suggested by Brown, Kang and Gjestland in 2011. This taxonomy has been constructed on three levels: categories of place, categories of sound sources and sound sources. Categories of places are, broadly, indoor and outdoor, and within the outdoor environment: urban, rural, wilderness. One can thus refer, for example, to the acoustic environment of a wilderness place, or the acoustic environment of an urban place. Having broadly characterized type of place, the taxonomy then categorizes all sources of sound that could be present. The set of sound sources is

intended to be universal. Most importantly, the nomenclature of sound sources has been carefully chosen to avoid value judgments, or connotations, regarding these sound sources, irrespective of the type of place (for example, *motorized transport* is preferred to *intruding traffic noise*, or the *passage of lorries*). In some places, various sounds of human activity, say footsteps, may be present, with only infrequent sound from roadway traffic, but in another, roadway traffic may constitute the only sound source. In each of these examples, the universal taxonomy of sources is applicable, and encourages description of sources using a common terminology. Of course the distinctiveness of particular acoustic environments lies, amongst other things, in the presence or absence of these different sources and their relative intensities. However, a universal framework for sound source identification should assist in comparing the reporting of sound sources across places, and make other labels, value judgments, and definitions more transparent, and thus portable, across different studies.(3)

3.2   Approaching peoples' mind

The soundscape approach requires that physical noise criteria match perceptual descriptors.   There is a need to correlate complaint language with metrics for policy, and to introduce the perceptual methods of Psychology and Sociology to engineering analysis, combining quantitative and qualitative tools for land use planning.

Soundscape analysis should place sound in context, with noise and sound linked to activity at realistic study sites. The connection between research and design e.g. for communities is a creative process. To complete this connection we need methods to measure and identify design values, develop a lexicon of qualities/values for soundscape design, investigate a subject's control/non-control over the environment, understand the motivation of people to choose a particular environment, and create soundscape simulations for proposed sites for evaluation of officials.

Continuing soundscape research can provide practical data which can be applied to create acoustical environments. Areas identified for further development include economics/noise policy-standards, combined effects, common protocols/ cross cultural studies and education about soundscape. Also, improved combined measurement procedures concerning perceptual and physical parameters-including the character of sounds and cross cultural questionnaires.   The importance of a survey site selection has to be emphasized. Moreover, "Product Planning tries to take information about those judgments and specify to designers what needs to be accomplished regarding the sound…A product team therefore has to make the transformation between the judgments of users and the engineering choices for structure, gearing, motors, fans, electrical components, etc., that make up the product. The process needs a mapping between the two.(Dick Lyon 2003)

The knowledge of assessment which concerns several noise sources and sensory qualities must be placed in the context of recent policy developments which need a firm basis for effective and efficient action. Moreover, multi-sectorial environmental health impact assessment, the perspective on sustainable development, environmental zoning, citizen involvement, preservation of quiet areas, consideration of "sensitive areas" and the design of "supportive environments" require new insights into the existing annoyance data and new integrative research strategies.
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3.3   Recent work in Soundscape and Sound quality

Recent work in collaboration with HEAD acoustics Germany with regard to Master theses in Sound Quality and Soundscape refer to e- mobility and wind turbines. Physical measurement as well as interviews – meaning collecting data with regard to peoples' expertise in the respective areas- clearly showed the evidence of the so called new experts meaning the people concerned. Evidently, acceptance and disaffirmation are based on the respective background and strongly related to quality of life. It is important to evaluate each case with respect to such indicators and possible intervention based on people's confirmation. The triangulation of data is most important.

The concept of triangulation is borrowed from navigational and land surveying techniques that determine a single point in space with the convergence of measurements taken from two other distinct points. The idea is that one can be more confident with a result if different methods lead to the same result.

Triangulation for Soundscape measurement is a powerful technique that facilitates validation of data through cross verification of three components: people, context and acoustic environment. In particular, it refers to the application and combination of several research methodologies in the study of the same phenomenon.
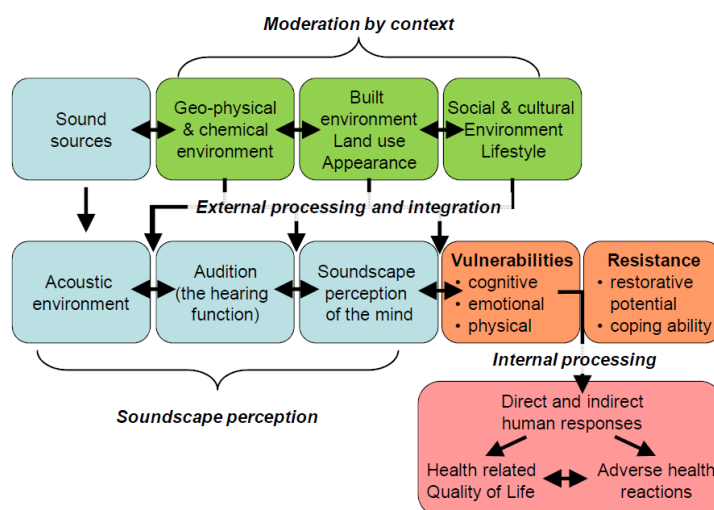

Figure 3- Extended box diagram (Lercher) (4)

4. CONCLUSIONS

The acoustical properties of sounds and sound quality and the respective assigned meaning and interpretation affect significantly the sound evaluation. The context of sound can provoke feelings, sound can be pleasant, familiar, lifestyle-representing, helpful for orientation, irritating, etc.. Such attributes and their meaning respectively have a great impact on the evaluation of the soundscape. The soundscape approach assures a promising access into the world of human perception.

In fact, contextual, meaning (cognitive representations), source identification effects as well as the socio-cultural background and lifestyle influences affect the perception and evaluation of sound. In this context, further studies in soundscape will help to identify and understand the differences as well as analogies in the perception and evaluation of sound between different areas. An identification of the similarities and differences of sound in dependence on the source, context, activity, etc. in case of a situation where e.g. a resident is exposed to environmental noise will allow for a deeper understanding of the evaluation of noise.

"Soundscaping procedures" will guarantee sound as meaningful events. Sounds are actually processed differently by the diversity of cultures and different meanings and evaluations can be given to the "same" acoustical event depending on living situations

The challenge for soundscape with regard to sound quality is to combine human and social sciences to physics within the multi disciplinarity along with the involvement of interactive research to improve the quality of life.

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