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THE ASSESSMENT OF ENVIRONMENTAL NOISE - ISO 1996

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1. INTRODUCTION

The concept of a grand '*general noise annoyance model*' that attempts to take all possible sources of variation into account is very attractive, and indeed many of us were working towards this objective only a few years ago. However, it now seems doubtful whether any such simple model could ever be developed. Individual differences in noise sensitivity are important, but what is probably even more important is the fact that human auditory perception is selective, focusing on whatever is the most relevant or interesting component within the overall environment at the time. Except perhaps in the case of environmental noise exposure which is so extreme that assessment cannot be in doubt, this selective attention process is essentially unpredictable, and makes the modelling of individual perceptions and opinions unworkable.

The importance of these selective attention mechanisms to environmental noise assessment was first recognised in our '*acoustic feature model*' described in 1993 (1). This model was specifically addressed to focusing attention onto the particular features causing the problem in the first place, rather than just concentrating on the overall noise level, however this is measured. The next step has been to develop the model to the point where it can usefully form the underlying framework for the current revision of ISO 1996 '*Description and measurement of environmental noise*' Parts 1, 2, and 3. This standard has been adopted in the UK as BS 7445 Part 1: 1991 '*Guide to quantities and procedures*', BS 7445 Part 2: 1991 '*Guide to the acquisition of data pertinent to land use*', and BS 7445 Part 3: 1991 '*Guide to application to noise limits*'. It is widely used in the UK for the definitions and other guidance contained therein.

In principle, we are concerned that any method of assessment should lead to outcomes which are useful in defining policy in practical situations; that it should be based on the results of scientific research wherever possible; that it should be inclusive of competing methodologies rather than exclusive; and that where arbitrary decisions have been made on the basis of administrative convenience, then this should be explicit in the description of the method. In short, this means that the revised standard should recognise that there is more to environmental noise assessment than simple comparisons against absolute criteria defined in L_{Aeq}.

Together with Bernard F Berry, we recently published (2) an outline of the main features of the new model, setting out the way in which we propose to develop and then incorporate it as a framework of methods of assessment into the current revision of ISO 1996 being carried out by the ISO/TC 43/SC 1/WG 45 working group. The three of us currently comprise the entire UK representation on this important working group. The main purpose of this paper is to invite suggestions and comment so that we can gauge the level of support that exists within the UK acoustics community for these ideas.

2. A NEW APPROACH

The possible approaches to environmental noise assessment range from the typically German method of having a precisely defined DIN standard to apply to almost any situation to the other extreme of allowing noise makers and complainants to sort matters out for themselves. There are advantages and disadvantages to both approaches, but we believe that our proposals can accommodate the best aspects of both. To do this, we first consider the *process* of noise assessment as acting on *input* data and leading to *outcomes*. Defining the new revised standard simply becomes a task of defining the necessary inputs, processes and outcomes to achieve the objective of the assessment. It is important to stress here that there are likely to be many parts of the revised standard which might be unaffected by our proposals, or which might need to be revised for other reasons. It has been agreed in the ISO working group that these other revisions, not concerned with the underlying assessment framework, will be carried out by other international representatives. The UK representation on the working group has been solely concerned with the underlying assessment framework.

The second key aspect of our new approach is that we recognise that different features, both acoustic and non-acoustic, might be more or less important in different situations, depending on the precise purpose of the assessment. This means that different combinations of inputs, processes and outcomes might be appropriate for different situations. The ultimate test of any procedure is that it should be capable of yielding outcomes which can inform policy. Any methodology that simply predicts, for example, the percentage highly annoyed as based on some assumed noise exposure-community response relationship might actually be very difficult to interpret in terms of practical noise management.

To make matters as simple as possible, there are really only three outcomes that need to be considered. These are:

Class A	Zero or negative noise impact	No action required.
Class B	Intermediate noise impact	Action only to balance costs against benefits
Class C	Unacceptable noise impact	Action imperative regardless of cost.

Examples of where these different outcomes might occur are as follows; Where development leads to an improvement in the overall noise climate, then this might be considered as outcome class A. In practice this might depend on the relative masking effects of different noise sources present, but even if a secondary noise source was to become relatively more prominent because of some reductions in a more dominant noise source, it is difficult to argue that those reductions should not take place for that reason. Where development leads to noise levels causing proven adverse health effects in the surrounding residential population, then this might be grounds for an assessment in outcome class C regardless of any economic and social costs of not permitting the development. Many situations will in practice result in an assessment outcome in class B where the benefits of noise control must be balanced against the costs and inconvenience of noise control. The problem here is that the terms '*acceptable*' and '*unacceptable*' are often used without placing them in a proper context since without some external reference, they can sometimes have very limited meaning. It is not possible to eliminate all environmental noise exposure from modern industrial society without effectively closing down all economic activity and all assessment methodology must recognise this fact.

Why is the assessment taking place? This is a very important issue that in our view should be taken into account when selecting the methodology since it has to do with the practicality of different policy alternatives resulting from the assessment. The controls that can be applied to new noise sources are different in scope from the controls that can be applied to new housing development and there are likely to be different public expectations involved. There is an argument which suggests that people should be allowed to develop and occupy houses in noisy areas if they so choose providing that they fully understand all the implications of their choice. On the other hand, to expose existing residents to new, previously unanticipated and significant noise without giving them any choice in the matter will always require some wider or higher level justification.

How should we deal with noise complaints? These often arise with existing residents and existing noise. Usually, something must have changed to precipitate the complaint,

but the most important issue is to decide first, whether or not the complaint is justified and second, to decide whether or not any action can be or needs to be taken. Ameliorative action is imperative after an assessment outcome in class C, it is desirable depending on cost after an assessment outcome in class B, and all that happens after an assessment outcome in class A should be that the complainant receives a polite and conciliatory letter in reply.

Finally, we need to consider strategic assessment of policies and plans. For example, what are the environmental noise implications of policies that encourage transport users to switch from road to rail? The key issues here might not be the general advantages or disadvantages of different transport modes in terms of environmental noise but the specific implications of the particular policies under consideration and how these might affect the gross numbers of residents likely to be affected under each policy alternative. A problem often arises when comparing overall numbers of residents affected, since even if the overall numbers are reduced, there will often be a small minority who are exposed to more noise rather than less. It can be difficult to explain the benefits of a new policy of this type to such minorities.

In general there seems to be only three processes which can differentiate between these three outcome classes (3). In numeric terms these are all comparisons as follows:

Type 1.	Comparison of the new specific noise against existing specific noise.
Type 2.	Comparison of the new specific noise against existing residual or ambient noise.
Type 3.	Comparison of the new specific noise against absolute criteria.

Note that the term noise *level* is not used to reflect that fact that it may be some feature other than noise level per se which is important in any particular case. Different combinations of the three comparisons will be more or less appropriate in different situations depending on the purpose of the assessment. For example, when assessing a possible site for new housing or when carrying out some strategic assessment it is likely that comparisons of type 3 against absolute criteria will be most useful. When assessing the relative impact of some new development on existing residential areas, then it is likely that all three comparison types will be useful in some way or another.

Comparison type 1 - The new specific noise must be increased compared to the existing specific noise for there to be any impact. Where there are no major changes in

sound character or other features (both acoustic and non-acoustic) then changes in the specific noise of less than 3 dB are unlikely to be perceived as changes in noise level. Of course, where there are other more dominant noise sources present, then quite large changes in specific noise might lead to even smaller changes (of 1 dB or less) in ambient noise level and still be significant in terms of community response to that specific noise.

Comparison type 2 - Where the new specific noise is comparable with or below the existing residual noise, then it is difficult to consider the new noise as significant. Acoustic features such as tonality or impulsivity can be particularly relevant here in determining the precise cut-off below which the new noise should properly be considered insignificant. This is not the same issue as audibility, which can be hard to predict without taking into account the time-varying frequency spectrum of the new noise against the existing residual noise. Tonal or time varying features can be audible at A-weighted average sound levels as much as 10 dB or more below the residual sound level, but this does not of itself necessarily mean that such features are significant from an assessment point of view.

An alternative process is to compare the new noise against the existing ambient noise. This process is less protective of the environment as it clearly increases the proportion of outcomes in class A, but it might nevertheless be more appropriate in some assessment situations.

Comparison type 3 - The recently published WHO guidelines on community noise (4) provide considerable assistance in determining the lower threshold noise levels below which residual noise impacts can probably be considered negligible (outcome class A). Below around 55 LAeq measured outdoors during the daytime, only a very small proportion of the population are likely to be '*seriously annoyed*'. An equivalent interpretation of the upper threshold noise levels is more difficult (outcome class C) as unacceptability has to be defined in some way. For example, a highly protective community, state, or legislative assembly might decide that for even a minority of its population to be moderately or seriously annoyed at around 50 to 55 LAeq measured outdoors is completely unacceptable and would therefore have to take appropriate steps to cut noise exposure regardless of social and economic cost.

It might be considered more practicable to decide that the threshold of unacceptability (outcome class C) is not reached until noise causes proven physical harm such as noise induced deafness or some other non-auditory long term health effect. In the absence of any definitive research showing non-auditory health effects at lower levels of noise exposure, this in practice means that typical residential exposure to environmental

noise would almost never reach assessment outcome class C. The real question here is to what extent mere reported annoyance can be considered as an over-riding unacceptable consequence of environmental noise, or whether some more definitive health effect should be considered instead (5). Current interest in expanding the research base underlying the non-auditory health effects of environmental noise is to be strongly welcomed in this regard (6). Of course, it is also important to bear in mind that comparison type 3 is only one of three generic comparisons that might be applied to determine the assessment outcome in any event.

3. WHAT NEXT

A number of preliminary meetings of the ISO working group were held over the past two years. Having made several suggestions at earlier meetings, the UK delegation were invited to make concrete proposals at the most recent meeting held at the Hungarian Standards Institution in Budapest in August 1997. This meeting was held on the Sunday before the Inter-Noise 97 international congress. Those present at the meeting substantially accepted our proposals for the new assessment framework and agreed with our proposal that the title should be changed to '*Assessment of Environmental Noise*'. We were then invited to start work on the first draft of the core sections (scope and methodology) of the revised standard, leaving others to work on the remaining detailed sections as agreed. The final version will go through a number of drafts before it achieves international acceptance which will not take place unless a general consensus can be achieved.

In many respects, the new approach for which we have attempted to set out the basic principles is not in fact all that new. Many practitioners might argue that they are already following many of the principles we have set out above. On the other hand, it seems to us to be important that all these principles should be properly set down and placed in the context of a proper framework enshrined in an over-arching international standard. We have not seen these principles written down in quite this form before. To this end, we cannot be too prescriptive or too definitive in the way that the standard is written because it would then be impossible to achieve an international consensus. On the other hand, we believe that having this framework of required inputs, processes (comparisons) and outcomes properly specified for the different purposes of assessment to which it might be applied will ultimately prove helpful for everyone concerned in environmental noise.

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