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THE IMPLICATIONS OF CONTEXT-BASED ASSESSMENT FOR NOISE MANAGEMENT

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ABSTRACT

Generalised dose-effect curves based on noise levels and averaged annoyance responses can inform simple solutions for strategic noise management but they cannot reflect the true complexity of individual cases where differences in (for example) context, soundscape, or public perceptions of institutional motives can be as or more important than noise levels per se (see companion paper by Wright [1]). For effective management, each presenting noise problem should be defined by the available alternative courses of action; assessment should be addressed to all important variables (including context) affected by the available alternatives; and practical decisions will need to balance assessment of impacts against all other consequences of the available alternatives, including economic and social consequences.

1 - INTRODUCTION

Sound is a natural phenomenon which is essentially neutral unless it has some unwanted effect on people. Unlike many chemical pollutants, sound is not intrinsically toxic and does not accumulate either in the body or in the environment. Sound only becomes noise when it causes annoyance; masks speech; interferes with some desired activity; or contributes to sleep disturbance. Premature hearing loss after long exposure to higher noise levels (mostly industrial) is well-known but there are also suggestions that excessive community noise might contribute to other clinical health effects over the longer term. If there are any non-auditory clinical health effects, they would most likely arise due to some maladaptive response to sensory stimulation such as chronic and unrelieved annoyance rather than by any direct effects on the tissues.

In matters of noise pollution, there is no fixed cut-off above which noise is unacceptable and below which it is acceptable. *Acceptability* is a relative concept that is almost entirely dependent on context. Different noise effects vary in the extent to which they are mediated by the context in which they occur. Generalised dose-effect curves exist which usually represent the dose (measured by long term average noise levels) and the effect (measured by averaged reported annoyance or sleep disturbance). However these cannot reflect both individual and group differences in sensitivity and situation which might significantly affect perceived acceptability. Speech masking is directly dependent on the signal to noise ratios across the audio frequency spectrum, but the actual effect on message intelligibility or communication effectiveness depends very much on context. The overall effect in terms of disruption to daily life or interference with an educational process is even more dependent on context. Speech masking can often be overcome by increased talker and listener effort or by the use of repeated messages with high redundancy. Activity interference is highly context dependent. An example of this is sleep disturbance which is also very dependent on context. The noise level thresholds at which short term or transient physiological responses to intrusive noise events whilst asleep might contribute to more significant next day effects are presently unknown. Possibly because of these difficulties, reported annoyance has become

the de-facto outcome variable against which most noise exposure is judged, but even this variable is significantly affected by context.

Unfortunately, context can be difficult to deal with in any uniform way. This is because individual attitudes, opinions and priorities vary considerably in different situations. Noise management can be greatly simplified by completely ignoring context, such that the only criterion for noise control action would be whether or not long term average noise levels exceed some arbitrarily defined criterion or limit value. While this approach is administratively convenient, and possibly easier to 'sell' to both politicians and the public at large (as opposed to those members of the public who are actually affected by real noise problems!), it is also more likely to lead to irrational decisions. Scarce resources could be expended just because an arbitrary criterion is exceeded even though there might be no great public demand for a solution and no realistic prospect for a technically feasible solution either. The public are likely to be more concerned about issues where there are clear technical solutions available and where a lack of action is perceived to be unreasonable, regardless of whether any arbitrary long term average noise level criterion is exceeded or not.

The main problems here are that noise problems always have both a source and a receiver. Each party's attitude is always determined, at least to some extent, by their understanding of the other party's point of view. Practical experience shows that understanding the issues from both sides of the problem can often be at least as helpful as engineering noise control defined against arbitrary criteria. The best solutions require informed flexibility where established dose-effect curves may or may not be relevant but where clarity and understanding almost certainly will be. However, because of the almost infinite variety of different situations which might arise in practice, it is hard to define fully prescriptive methods. To achieve the best compromise solutions it is best to set out all relevant details of any particular case in a framework to maximise transparency. It is difficult to show this kind of detail on any kind of noise map.

2 - A FRAMEWORK APPROACH

We have identified five stages of noise management as follows;

- define the noise problem
- identify the available alternative solutions – these are the relevant outcomes
- process the available information – carry out a relevant assessment
- balance costs and benefits
- recommend 'best' solutions in priority order.

2.1 - A – define the noise problem

Noise complaints could be the primary stimulus for action. Decision makers can expect that a considerable amount of background information may be relevant. The problem is not just to identify whether a complaint is 'justified' or not, but to develop the best compromise solution. Complaints are not always a reliable indicator of the scale and magnitude of any problem. An absence of complaints does not necessarily indicate there are no problems, while the number and vociferity of complaints do not necessarily indicate how serious the problem really is.

New development may have future noise impacts. New transport, commercial or industrial development may affect nearby housing or other noise sensitive uses, while there may be a requirement for new residential development in existing noisy areas. Noise control is usually most cost-effective if designed in as an integral part of any development, but any decision must be based on predictive methods. It is generally possible to predict physical noise levels with a fair degree of accuracy but it is not possible to predict people's subjective attitudes to the noise in advance, particularly because the context in which the noise may be judged is unknown. Predictive methods based on standardised dose-effect curves assume an average population, which is unlikely to be appropriate in any particular case.

Strategic assessment is about evaluating the consequences of long terms policies and plans which might typically be applied on a regional or national basis. Vague directives such as 'reduce noise' are mostly valueless, but specific policy alternatives can and should be tested for likely costs and benefits in order to establish priorities for future action. Decision makers will need to know that resources directed to noise control action would not have been better spent on economic development, health or education (for example). Political expediency or even moral philosophy can be as or more enlightening than scientific research in this area. There will be many uncertainties, but it is better to be clear about these uncertainties than to pretend they do not exist.

2.2 - B – identify solutions

Noise management is about deciding between available or feasible actions. These range from taking no action whatsoever to a complete shutdown of the noise source, with a whole range of intermediate actions in between. Only those noise assessment procedures which help to discriminate between available alternative actions are of any practical use. For example, simply drawing up a noise map of some city without any thought of comparing alternative noise control strategies is of no more than academic interest. Because of the effects of context on community response, no map of physical noise levels alone can on its own indicate public preferences for alternative noise control actions, whereas a direct questionnaire might, if carefully constructed. The use of standardised dose-effect curves to generate predicted community response variables is unlikely to be very helpful. For the common situation where the 'best' compromise solution available is really a matter of judgement, it is important that the quality and reliability of the information on which the assessment is based should be known.

2.3 - C – process information

The decision should be based on some assessment of the available information which to should follow some established procedure where applicable to maximise consistency. It is often administratively convenient to base decisions on numeric comparisons between various physical noise level indicators, although this approach can discriminate against context variables which are often equally or more important. There are three basic types of comparisons which can be applied as follows;

Step 1: change

Compare sound levels (or whatever other variables are considered most relevant to the assessment) before and after noise control action or development. If sound levels (or other variables) are reduced this represents a positive or beneficial impact. If sound levels (or other variables) are increased this is negative (not beneficial).

Step 2: soundscape context

Compare sound levels (or other parameters) in relation to the soundscape or context of what is there already. New noise can be introduced into an existing environment without necessarily having any significant impact if the existing background is already high. Conversely, only a small increase in sound levels from some specific source might be very significant if the existing background is low. There are many different ways of carrying out this comparison and the method chosen will require agreement between the parties concerned.

Step 3: benchmarks

Compare sound levels (or other parameters) against established benchmarks. Such benchmarks can be determined by reference to existing guidelines and criteria, or they might be separately agreed for any particular assessment provided that a proper justification can be given.

The order of comparisons

The three comparisons outlined above can sometimes take on a different order of priority depending on the type of problem presenting for attention. For example, when the consequences of new and potentially noisy development are under assessment, then the natural order seems to be to proceed from step 1 to step 3. For assessing the suitability of an existing noisy environment for new housing, or for overall strategic assessment, the step 3 comparisons would be most relevant. For the assessment of noise complaints, it should not be the justification of the actual complaints which is being assessed, but rather, the likely consequences of any noise control action which might be practical or feasible as a response to the complaints, in which case all three comparisons might be relevant.

It should be noted that many established guidelines, procedures and criteria are essentially step 3 benchmark type comparisons and might include no provision for steps 1 and 2. Methods may need to be found for taking steps 1 and 2 into account where appropriate.

2.4 - D – balanced costs and benefits

It is almost never appropriate to base noise management decisions on noise assessment alone (see stage C described above). As explained above, acceptability cannot be defined by reference to sound levels alone. This creates a problem for the interpretation of the results of the noise assessment if it is carried out in isolation of other relevant factors. If words like 'severe' or 'major' are used to describe the results of noise assessment carried out by using the step 1, 2 and 3 comparisons, these might be interpreted by decision makers as if they meant severe or major impacts balanced against the context of social, economic or political factors as well. This could be misleading. It is better to constrain the description of the results of the stage C step 1, 2, and 3 comparisons to within the boundaries set by those comparisons and reserve the use of evaluative descriptors such as severe, major and moderate for assessment which truly

takes the wider context into account. This is likely to require professional judgement in any difficult cases. The following table (based on [2]) is included as an example as to how this process might work:

Descriptor	Explanation
severe	Adverse effects of such importance that action should be determined on noise grounds alone, irrespective of other factors. An example might be community noise at such high levels that hearing damage is likely to occur in the general population. The magnitude of the noise effects is such that mitigation is not practical or is unlikely to be effective
major	Adverse effects important at a local or district level, but which might nevertheless be over-ridden by important social, economic or political factors. The adverse effects are such that they are unlikely to be completely removed by mitigation
moderate	Adverse effects which, while important for some individuals, are not really significant enough to be weighed in the balance against other factors. Mitigation likely to be completely effective
minor	Adverse effects which should be recorded but are essentially trivial in an overall context.
none	Either no adverse effects at all, or beneath the threshold for human perception.

Table 1: Significance criteria.

The above table is not intended to be definitive or prescriptive. It is merely an example of how such a scheme of interpretation might work. It should be noted that the same descriptors could be applied to assessment in almost any environmental discipline and could thereby assist overall evaluation. In addition, it should be noted that positive impacts should also be recorded in a similar way.

2.5 - E – recommend optimum solutions

The final recommendation of any assessment procedure should include a written description of the precise basis under which that assessment procedure has been carried out. Informed flexibility is not an easy option and will often require considerable documentation by way of justification. The main benefit of following established or standardised procedures is that the basis of assessment is already defined, and much of the documentation necessary under a flexible approach might be saved. However, no established procedure can realistically expect to be able to cope with all possible situations which may present themselves. To avoid making wrong decisions this is where an element of informed flexibility will always be justified. In essence, this is no different from any other form of management where if everyone always followed exactly the same procedures there would be no innovation or competition in the marketplace. Flexibility need not lead to inconsistency provided that where any assessment has departed from established or standardised procedures in any way, then this has been clearly stated, and could be challenged if agreement on the best compromise solution cannot be reached.

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