inter.noise 2000
The 29th International Congress and Exhibition on Noise Control Engineering
27-30 August 2000, Nice, FRANCE

I-INCE Classification: 5.2

HOW COMMUNITY GROUPS RESPOND TO ENVIRONMENTAL NOISE SIMULATIONS

D. Dubbink

Noise Management Institute, 864 Osos Street, Suite D, 93401, San Luis Obispo, United States Of America

Tel.: (805) 541-5325 / Fax: (805) 541-5326 / Email: dubbink@noisemanagement.org

Keywords:
COMMUNITY, INTERACTIVE, DEMONSTRATION, SIMULATION

ABSTRACT
The Interactive Sound Information System (ISIS), is designed to explain and de-mystify the complex metrics used to describe noise impacts. Central to the ISIS package is the idea that "real" noise examples, shaped to reflect local situations, are the very best way to build an understanding of noise management issues. Presentations can be customized to fit specific geographic settings. Experiences in hundreds of community settings have produced interesting reactions from both audiences and project sponsors. Community groups and decision makers appreciate the system's interactive capabilities and trust its results. The system expands the possibilities for community discussion of noise control measures. The popularization of noise planning technologies is more than a new way of delivering information. It empowers non-technicians and this can transform the decision making process.

1 - NOISE AS A COMMUNITY ISSUE

Noise is more than an annoyance. It can become a deciding factor in planning decisions that can impact the regional or national economy. Some of the biggest noise sources, such as airports and motorways, are also major forces in shaping the economy. Military training activities also generate noise. Noise-related training restrictions can have impacts on military preparedness. In such situations, "Noise" becomes more than just an annoyance. Information about noise impacts can become a decisive factor in larger political contests related to expansion of trade, protection of the environment or to maintenance of military alliances.

The presence (or absence) of accurate, readily understandable information about noise has the same sort of political significance as other sorts of special information. The decision to present (or withhold) information about the noise impacts of projects can affect their acceptance and influence the direction of community decision making. If noise control information becomes more accessible and the technologies employed in dealing with noise become more transparent, it has the potential of altering the political debate in very fundamental ways.

This paper describes a technology for presenting noise management questions in a way that is readily understandable to most audiences. We have used the system in multiple settings, dealing with a number of common sources of environmental noise. Our clients have been both the noise producers and communities concerned about noise intrusions. We believe that the technology has clearly transformed the debate. This paper is intended to share some of the insights and reflections that have come from our experiences.

Noise management questions are traditionally presented in a technocratic format where understanding requires a level of special knowledge. There are multiple problems in explaining noise control problems in ways that most people and decision makers readily understand. Noise energy decreases geometrically with distance, and the decibel, the basic unit of noise measurement, is a logarithmic unit. This adds a unique math to noise calculations. Moreover, there are different metrics employed to describe the loudness, duration, and tonal content of sounds. To top things off, community noise characterize noise environments by combining noise events over hourly and daily periods.

Citizens impacted by noise rarely have the patience to sit through a short course in sound control engineering. They just want to know what the proposed project is going to sound like and what the

officials intend to do about it. The decision makers want a way of sorting through action alternatives that they understand.

2 - THE INTERACTIVE SOUND INFORMATION SYSTEM

The Interactive Sound Information System (ISIS) is an established computer based package for presenting information about noise in the environment. The current release is based on technology that has been under development since 1988. The package was designed as a presentation tool for addressing noise issues in a format that can be understood by citizens and by decision makers with no special technical knowledge of noise management strategies. Central to the ISIS package is the idea that "real" noise examples, shaped to reflect local situations, are the best way to build an understanding of noise management issues. The reason that these real noise examples are so useful is that they are more direct and easy to understand than the written reports describing noise impacts using descriptive metrics. The interactive nature of the programming also makes it possible to test out, "What if?" situations and to respond to specific questions. The technology has been applied to many different types of environmental noise problems but it has been used most extensively in addressing airport noise issues. The system enables people to listen to sounds such as aircraft flyovers at different locations, or move from outdoors to indoors and evaluate the effectiveness of differing noise mitigation strategies.

3 - PROGRAM FEATURES

The complete program has more than twenty separate interactive sequences. There are sections that describe the nature of sound, its measurement, and the features of noise management programs. The training component builds from the basics to a demonstration of how individual sound events are accumulated into 24 hour measurements such as DNL. The presentation system is designed to deal with various aspects of sound in separate program elements. A presenter can pick and choose among components to suit specific noise issues or audiences. The following paragraphs describe several of these components and are helpful in understanding the functioning of the program.

A common problem facing planners and decision makers is the task of understanding and explaining the consequences of actions not yet taken. The standard strategy is to develop, describe and evaluate alternatives. Computer scene simulations have become a common tool for evaluating the visual effects of projects. An analogous strategy works in the acoustic realm. Simulations can be used to interpret the impact of such things as building a sound wall or constructing new noise sources – such as an additional airport runway.

An element of the program was created to simulate the effects of a noise barrier (Figure 1). The height of the barrier can be changed and the distance between the barrier and the source or the barrier and the listener can be altered. We also include features that permit us to change the surface conditions between listener and source and to allow the listener to hear sounds from indoor or outdoor positions. The sound source or barrier material can also be changed.

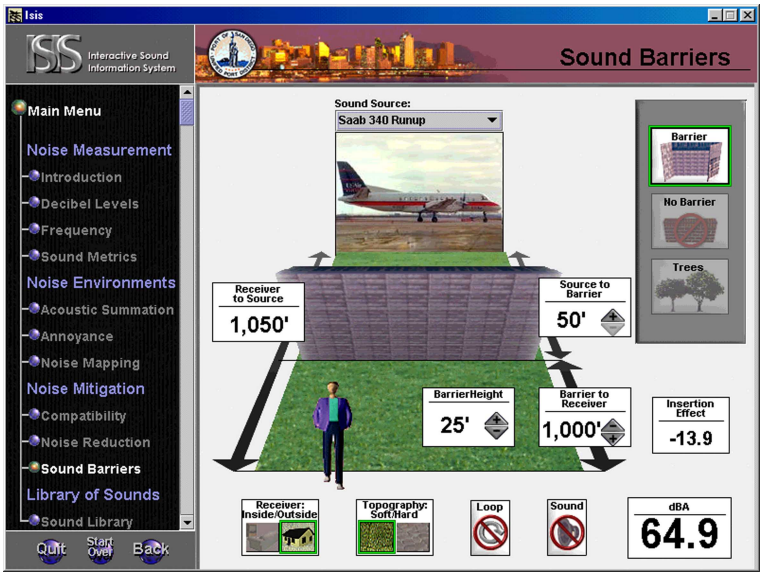

Figure 1: Interactive noise barrier display.

Behind the graphic controls is a simplified version of an infinite barrier model. We have the capability of modifying the frequency spectrum of sounds at different distances or sounds heard indoors and outdoors. However, we have not attempted to recreate every nuance of sounds heard in different situations.

Figure 2: Simulated flight operations in virtual reality.

The airport simulations are more ambitious. We developed a community information program for the Port of San Diego that described the acoustic consequences of an alternate runway configuration (Figure 2). The presentation describes the impacts from the viewpoint of the neighborhoods surrounding the airport. This program element is constructed using Virtual Reality Modeling Language technologies (VRML).

By making selections from menus and buttons that appear along the base of the screen it is possible to choose aircraft type, select between departure or arrival operations, choose a neighborhood location (by runway end), and add or delete the runway extension. Based on the combination of selections, an animation is produced that shows the appropriate flyover accompanied by sounds that are calibrated to match what would be heard at the selected listener position. Additionally, the sound of the overflight can be heard from either an indoor our outdoor location.

The, "where am I?" question is answered through a change of camera position. At any time during an animation it is possible to pan the scene − from a viewpoint looking upward from the ground − to a side angle view taken above ground level − to a straight down top view. The base map graphic is clearly marked to show the listener positions at the end of each runway. Changing the viewpoint does not stop the animation and the plane can be seen flying over the listener's location in side or top views.

The sound levels that accompany the animations have been precalculated and the sounds are from digital recordings made at distances similar to those being illustrated. The software alters the amplitude of the digital file to suit the situation. Given that the 3D scene are represented as VRML text files, the mix and match of locations, runways, operations, and aircraft can be accomplished through dynamic editing of the file. In other words, a very substantial collection of acoustic and visual experiences can be produced from a limited set of components.

We also use the 3D imaging technology to depict the DNL or "Day Night Level" metric. DNL represents average daily noise exposure and is a regular feature of community noise studies.

We show the 24 hour noise accumulation as a three dimensional object, dynamically building up around the noise source. The animation shows noise accumulation rising as a mountain, with color bands depicting lines of equal elevation. We tilt the noise accumulation for an oblique view where we see its 3D nature. Then we can lift the viewpoint to a straight down viewing angle and see the radiating whorls that are characteristic of a DNL contour map.

An animation such as this is invaluable in explaining exactly what is being represented by the standard 2D mapping of DNL. One failing of the conventional 2D maps is that there is a tendency to interpret the contour intervals as areas of uniform noise intensity. The 3D image, by contrast, shows noise exposures as gradients.

4 - EXPERIENCES USING THE ISIS SYSTEM

Using a system such as ISIS interactively and testing a variety of noise control strategies a group without specialized technical training can quickly develop a respectable understanding of a complex, multidimensional noise management problem. It is instructive to consider how different groups have responded to presentations using the ISIS system.

It should be acknowledged that communities in the United States have a form of local democracy that makes even the most technical of planning decisions a matter of community debate. The ISIS package was inspired by the problems of decision making within this governmental context. The presumption was that both elected officials and the general public could benefit from having a device that simplifies noise management decisions. In a more command-oriented governmental structure it might be possible to dispense with community information efforts. As one acoustic specialist with experience in a different governmental culture put it (after seeing an ISIS presentation), "I do not know why you are doing all this − all you have to do is tell them what the regulation is." However, we have worked in a governmental setting where there was no tradition of local democracy. We noted that decisions still required the collective consensus of a surprisingly large number of persons who were not acoustic experts and who clearly welcomed the immediacy of the sound samples.

Interestingly, non-expert groups appear to have virtually no problem in adapting to a presentation system such as ISIS and, quite quickly grasp the significance of its interactive framework and begin asking the "what if" questions. After all, they see such things done routinely in TV shows and it does not seem unusual to them to have a system set up that has a computer producing sound samples and 3D scenes to order. The system is particularly attractive in decision settings where the normal mode of behavior is to make decisions at the time evidence is presented. In one situation, the town planning commissioners listened to simulated noise heard across property lines and, working interactively with the system, setting local noise regulations based on this experience.

By contrast, the noise specialists do not always see the utility of a system that demonstrates things they think should be obvious. A single ISIS presentation cannot instantly supply the wealth of knowledge that comes with a solid technical education or the wealth of experience that comes from performing years of acoustic studies. Written reports and tables can contain far more information and can include essential footnotes and qualifications. Cost is also a consideration since the resources required for such presentations can diminish the funds that could be spent to improve technical analysis. There is a darker edge to this in that it is evident that some noise experts are most comfortable with a role where they make prescriptions and there is no opportunity for public questioning. Their apprehensions are well taken in that ISIS presentations inspire often inspire intense discussion. It does not take long before a crowd is asking tough questions about the limitations of an acoustical study or challenging proposals. The interactive structure of the system gives a license to anyone to invent project alternatives.

There are situations where the sponsor of the technical studies has no self-interest in attracting attention to the noise implications of a proposal. In some cases the project proponent wishes to obscure or understate the noise impacts. There is also a division of opinion among public relations specialists as to whether it is appropriate to spotlight noise issues in discussions with communities. This point of view is shared by many commercial airport operators and by commanders of many military installations. They feel the emphasis should be on the economic benefits of airports or national security considerations. Having a system that gives such emphasis to noise issues imbalances the public debate.

In the context of a community meeting or a public hearing on noise issues the system has some interesting effects. The audience is composed of people who's daily noise experiences have given them the incentive to attend the meeting. The ISIS package provides something that is very important to them, the ability to demonstrate to the community and to the decision makers what they experience on a daily basis. While it might seem that demonstrating severe noise exposure experiences in a public setting would be inflammatory, in practice this can relax tensions. The system provides a mechanism that lets the decision makers directly appreciate what the noisemaker's neighbors already know. Written reports about noise exposure cannot do this.

Another counterintuitive response is that the most literal depiction of local situations may not be the best way to present problems. A measure of abstraction is beneficial. For one thing, we are limited in our technical ability to perfectly model any setting and supply an absolutely accurate example of the acoustic experience. There is also a problem related to people's willingness to transfer experience from one setting to another. While I may be willing to accept the proposition that an overflying aircraft or passing vehicle produces a similar noise experience in different geographic settings others may resist this idea. Initially, we tried depicting moving noise sources using video but discovered people were being distracted by the image details. We would get questions about why there were images of airplanes from

an airline that was not using the local airport, or why there were palm trees in the background. When we shifted to the simplified and obviously contrived VRML images, such concerns disappeared. People have good imaginations and can be relied on to fill in essential local details.
One interesting aspect of the system that has been discovered independently by several users is that the system can become a "neutral broker" in noise disputes. Persons with contending points of view on noise management problems use the interactive features of the system to present their competing points of view. There seems to be a willingness to assume that the computer is producing sound examples that are untainted by partisanship. Although it is possible to bias presentations there is an element of truth to this presumption. If fraudulent noise values were to be introduced, an audience might be able to discover this by shifting reference points to reflect situations that are familiar to them. We have found the system's noise examples to be quite helpful in checking not just the system's accuracy but also the reliability of underlying data and models. On occasion we have realized that there were errors in our forecast data only when we heard the system produce noise examples based on the faulty information and sensed that it was wrong.

5 - CONCLUSION

A noise explanation and demonstration system such as ISIS impacts the work of noise managers in several ways. As illustrated by software applications such as the one described here, local planning issues can be addressed using new media technologies. The creative use of 3D visualizations and acoustic examples makes it possible to simplify discussions concerning complex noise propagation issues and make them more understandable.
Probably the most enduring contribution of a system like the Interactive Sound Information System is that it redefines and broadens the limits of community discussion. When a technology becomes more accessible and transparent it changes the ways the technology is used and, more importantly, *who* can use it. Community noise analysis has been a domain of technical specialists − often in the hire of the noise producers. As the technology becomes more generally accessible, community groups can crosscheck the work. There is power attached to control of information and broadening access to information can alter the political and institutional landscape. Technicians may not only find their work being more closely inspected by community groups − they may find it being replicated, dissected and persuasively challenged.