Effectively Managing Sound in Museum Exhibits

by Steve Haas

What does it take to effectively manage sound in a contemporary museum? A lot more than most people realize! When a single gallery might have dozens of audio programs, a few exhibits that make mechanical sounds, and live demonstrations—all occurring simultaneously—the potential for sonic cacophony is high. Throw in the clamor of a few busloads of school children, and suddenly the control of sound takes on a whole new meaning…a challenging one, at that!

Over the past 30+ years, I have explored all aspects of a museum creation or renovation that generate or affect sound in one way or another, and built a proven strategic process for optimizing the quality and control of sound. The goal is always to provide a great aural experience from the moment someone enters the museum to the point where they depart.

Below are some brief highlights of what makes up a typical sound management effort. The focus here will be on media-rich exhibit galleries; but many of the same principles can also be applied to performance theaters, conference centers, event atriums, and other sound-critical spaces commonly found in today’s museum facilities.

What are the main aspects to address with sound management?

1) Preparing the acoustic environment – controlling excessive reverberation and echoes with acoustic treatments, preventing unwanted sounds from other spaces in the building or outside from intruding upon the gallery, and establishing appropriate background noise levels from HVAC and other building systems.

2) Defining audio delivery strategies for all programs – choosing loudspeaker types, quantities, locations, and mounting methods to deliver the most intelligible and
immersive experience, while controlling sound bleed to adjacent exhibits when necessary.

**Can we address one of the above without the other?**

Unfortunately, no. The most well-controlled acoustic spaces can still have exhibit sound programs fail by installing speakers with poor fidelity or inappropriate dispersion of sound. Conversely, high quality loudspeakers installed in an untreated space with a large cubic volume can end up sounding completely unintelligible and interfering with many other programs and activities in the museum. The bottom line is that the method of delivering sound cannot be separated from the quality of the environment receiving the sound.

**What other factors are important?**

Often overlooked is the nature of the actual audio (or audio+video) productions themselves. It is critical to ensure that the general characteristics of the soundtracks are appropriate for the particular playback environment and are well coordinated with other nearby productions.

**What are the challenges in ideally preparing the productions?**

It starts with the producers understanding that what they hear during studio mixdown doesn’t necessarily translate linearly to a built exhibit environment – especially when played back in a more open space. Often, the dynamic range (volume difference between softest and loudest sounds) has to be purposely limited so that no sounds stick out too much or are inaudible when surrounded by other programs.
Also, it is quite common for producers to forget to “normalize” each audio clip within a single production. That means to set the average volume levels relatively similar. For example, if an interactive station has a series of narrative testimonials, but the volume of some voices is as much as half as loud as others (which happens far too often!), it is nearly impossible to achieve a calibrated result where no voice is out of balance.

Finally, things can really start to spiral out of control when a single gallery has audio programs provided by multiple producers who have no idea what the others are doing relative to sound experiences. It is up to the Exhibit Design Team and/or the museum itself to try to coordinate the various programs, not just on their content relationship, but also how the various sound programs acoustically overlap and/or correlate to each other.

**With all of this in mind, where does one begin the process?**

Going back to the premise of addressing both acoustics and audio delivery, we want to understand the nature of each gallery experience as early in the design process as possible – i.e., is it meant to be “fun and full of energy”, “serene and contemplative” or somewhere in between? How will audio be used? Are there other mechanical sounds planned with the exhibits, such as a science experiment involving things being dropped from a height or knocked over?

The answers to these questions drive the approach to acoustically-treating the gallery environment. It is usually necessary to provide a global acoustic treatment over the entire gallery to reduce excessive reverberation and, at the same time,
“tame” the buildup of crowd noise to a manageable level. Yet, in tall galleries with a lot of media programs, this is almost never enough.

Additional acoustic treatment needs to be strategically incorporated within the exhibit structures in order to gain control over unwanted sound reflections in the horizontal planes at visitor level. This is especially critical with mini-theaters and other higher impact programs, yet there are also significant benefits to introducing periodically-spaced treated areas, where sound-absorbing material can be concealed behind high-quality digitally printed graphics on an acoustically transparent fabric.

Why is achieving an appropriate ambient noise level from HVAC and other building systems so crucial in an exhibit gallery?

It is imperative that a media-filled gallery be prepared with a constant background noise level that is neither excessively loud nor quiet. A loud background noise level results in patrons psychologically elevating the volume of their conversation (think about all those loud, reverberant restaurants you couldn’t wait to get out of!). This condition then necessitates the audio programs having to be turned up in response, until the cacophony is quite evident. Many major museums suffer from this phenomenon and their knee-jerk response - once they realize that raising the audio programs to a higher volume no longer works - might be to just turn all the audio down and use closed captioning on a video monitor to deliver the message – hardly a sophisticated or practical outcome to the intent of the gallery experience.

The opposite scenario of a gallery being too quiet is also a problem of a different sort. Quiet ambient conditions don’t provide any low-level “masking” sound; so every conversation, every noise from footsteps, etc. carries far and wide in a prominent manner, making the experience of being in a gallery quite uncomfortable and disruptive.
The answer is to strike a mid-ground and achieve a level within a range so that neither extreme is realized. In terms of the standardized Noise Criteria (NC) curves, a recording studio or concert hall can be as low as NC 15, where an average quality open-plan office could be as high as NC 40. Therefore, the ideal criterion that has been proven to work for galleries over many years and projects is right at NC 30, but certainly no greater than NC 35. For more enclosed theaters within galleries, this criteria should be lowered to NC 25 to allow for greater dynamic range without undesirable masking effects for low level sounds.

**What is involved in establishing the best strategies for Audio Delivery?**

One must have as much understanding as possible of the nature of the media content to hone in on the ideal audio delivery strategy for each program. In the early design phases, perhaps when media producers are not even yet contracted, the questions to be asked may include:

- What will the program audio contain – narration, music, effects, etc.?
- Will the narration be didactic?
- Will the effects be light, feedback sounds, or full frequency impactful sounds that may require low-end augmentation (i.e., subwoofers)?
- Is the coverage to be one or two people, a small group, or widespread (for an ambient soundscape, as an example)?
- Is the quality of audio based on a contemporary recording, archival material or some of both?
- What is the physical proximity to other media productions that contain audio or to sound-sensitive areas in the building?

Of course, once preliminary media “treatments” have been developed by a producer, the Design Team must be able to translate that into an effective selection of loudspeakers, whose type, quantity, location and mounting method will create the exact type of experience that the producers request.
What factors are important in selecting acoustic materials for an exhibit gallery?

Besides the primary areas to locate such materials, it is also critical to know how the material performs at all frequencies of interest. Too often, thinner materials (1” or less) are selected by architects either because of the ease of integrating them or for their lower cost. While both of these aspects are certainly important, the fact is that any material less than two-inches in thickness is not going to evenly affect all speech frequencies.

This can have dramatic results when the material is being counted on to both tame crowd noise and narrative audio programs. Instead, higher pitched female and children’s voices are appropriately subdued, but the deeper male voices (as well as full-range music and effects) are resonating out of control!

We once had to tell a museum, after they spent tens of thousands of dollars on treatment with a highly-aesthetic finish surface, that the reason the programs and events in their gallery sounded so strange was because the acoustic material was less than an inch thick and just not affecting enough of the speech range...an expensive lesson which resulted in having to completely replace the material, which they did, and they finally ended up with great results.

While acoustic performance of a treatment is quite important, we understand that, without the ability to aesthetically integrate any solution with the architecture or exhibitry, total success can not be achieved. Often lower cost materials can be hidden behind sound-transparent fabrics that have high-resolution digital images printed on them. This can be a great solution, not only for the sound absorptive
treatments, but also to conceal loudspeakers…also adding to the “suspension of disbelief” factor.

**What are the final stages of the process?**

Assuming all the right “tools” have been incorporated in the exhibit design – sound-absorptive treatments, HVAC noise attenuation, strategic audio delivery configurations and well-prepared audio productions – there is still the matter of making sure that it is all installed and calibrated properly. Even the best exhibit fabricators and audio-visual integrators may need guidance from the acoustic experts on the Design Team to ensure that all intended solutions are realized during both the Fabrication and Installation phases.

Some of the finer details of sound-optimization are only realized through a back-and-forth review and mark-up of shop drawings between the fabricators and designers. Then comes periodic inspections of the installation by the design experts to ensure that field conditions have not adversely affected the acoustic intent.

**Why does an exhibit audio system need to be tuned/calibrated and how does the process work?**

Systems integrators are primarily responsible for assuring that exhibit audio systems are fully functional and generally balanced in level. However, just as in the making of a music recording, where it is common for mixing and mastering engineers to turn the basic recorded tracks into what we hear as a well-mixed finished recording, the tuning and optimization of exhibit gallery audio needs to be done to essentially “mix down” the gallery.

To do so, the use of digital signal processing (DSP) is required to allow each sound source (e.g., loudspeaker) to be properly balanced in level, tonally optimized with equalization, time delayed where appropriate and routed/split/combined as needed to create immersive qualities.

During the tuning and calibration, numerous subjective decisions are made on balancing multiple programs related to the media content factors listed on Page 5 above as well as the apparent acoustic conflicts each program will bring at the level that is desired for playback in the gallery spaces. This essentially makes the calibration effort as much of an “art” as it is a “science”. 
Finally, the audio calibration also includes establishing global volume settings to ensure that the overall audio level remains balanced and intelligible at all levels of occupancy in the museum.

Closing thoughts?

Effectively managing the sound experience in a museum can significantly enhance a visitor’s overall experience – leading to better learning and retention of educational content. With the growing public exposure to “immersive” experiences in other types of venues, it is also very advantageous for museums to include similar levels of immersive sound and ensure that all aspects of such programs are delivered to a high level of quality and not come across as an after-thought.

The content in this white paper is intended to be a starting point for museums and museum designers to understand the basic principles of managing sound effectively from the beginning of a project. SHA is always willing to share more with those interested in achieving optimum sonic results in their spaces.

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