

# Seven Steps to a Theatrical Sound System Design

by

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Literally the first image that came up when I Googled “Sound System” (Pixabay user Mizter\_x94)

## ABSTRACT:

Texts exploring the discipline of sound system design are too often aimed at the advanced practitioner, detailing techniques that are logical and useful if the reader has already designed, installed, and operated many systems, but that are often over the head of inexperienced designers trying to learn the discipline. There is a gap in the literature, and this article presents a logical, orderly process for analyzing a production’s sound needs, selecting appropriate equipment, and creating an operating plan. By breaking the process down into manageable and clear tasks, this guide demystifies the essentials of theatrical sound system design.

## INTRODUCTION:

Theatrical sound system design is currently in a renaissance—the rapid advance and decreasing price of digital technology is allowing designers to create systems, and thereby sonic experiences,

unimaginable even 25 years ago. For inexperienced sound designers (or those who have only had the experience of working in venues with pre-existing sound systems), the process of designing a contemporary sound system can seem Byzantine and unwieldy. Over the course of 20+ years as a sound system designer (for theaters, theme parks, concert halls and festivals, corporate events, and more), and nearly a decade of teaching sound system design and engineering to undergrad and graduate students, I have witnessed countless designers wrestle with the challenge of breaking down the process of conceptualizing a sound system into manageable, logical blocks of work that can be assembled into a coherent whole. In response, I have developed a method of approaching this process that allows for designers of all experience levels to engage with it in a meaningful fashion. While this process is not comprehensive, and the order of events may fluctuate depending on how your individual theatrical production evolves, the steps outlined here will allow even beginning designers to at least assemble a system that meets the needs of the production. It is assumed that readers of this article have some basic familiarity with types of sound equipment, basic terms of art/specifications, and signal flow. The reader should understand that everything below is generalized to allow for easy understanding of the process. Each production is unique, and every suggestion below is to be taken as just that, not as a hard and fast rule.

#### THE GENERAL PROCESS:

- 1) Understand the source material
- 2) Understand the venue
- 3) Understand the audience

- 4) Understand the budget (and available resources)
- 5) Select loudspeakers (and positions)
- 6) Select remaining equipment (and plan for operation)
- 7) Refine your choices

#### STEP 1: UNDERSTAND THE SOURCE MATERIAL

When designing a theatrical sound system, there are two fundamental “sources” we must grasp. The first is the range of content we will be tasked with delivering (our literal input sources to the system), and the second is the type or style of production within which we will be delivering (the source of our design choices).

A theatrical sound system will deliver some combination of the following three basic categories of sound content:

- 1) Voices
- 2) Music
- 3) Sound effects

Each of these comes with a host of considerations, some of which we can glean right away from the source material and conversations with the content designer (or analysis of our own, if we are also designing the content), and some of which will require subsequent steps in our design process in order to fully interpret.

- **Voices:** Do we need to amplify the vocals? This is a question too many young designers race past before truly examining. Some productions, particularly of straight plays with trained actors in black boxes or other small venues, have utterly no need of vocal amplification. If, however our production does require vocal amplification, we must consider the following:
  - **Speech vs. singing:** does our production feature any singing? If so, does it need to be elevated over a live or pre-recorded orchestra? Is it a capella? How many voices must be heard at once? If voices are speech-only, are they intended to be “natural” or do any of them call specifically for an amplified sound (like the announcer at a sports arena)?
  - **Reinforced or replaced:** Vocal *reinforcement* may be thought of as a simple lifting of voices to help intelligibility while intending to remain “transparent” and localized to the performer onstage. Vocal *replacement* may be thought of as a more “rock concert” style sound, where we are intended to hear the microphones and speakers, as the amplification is part of the sonic goal. A production of a Rogers & Hammerstein show is more likely to require reinforcement, whereas *American Idiot* might tend to sound more replaced.
- **Music:** Music can come in many forms in theatrical productions, of course, from a full-blown musical, to a straight play that requires one lone song to play diegetically over a prop radio onstage. If our production contains music, we must assess:

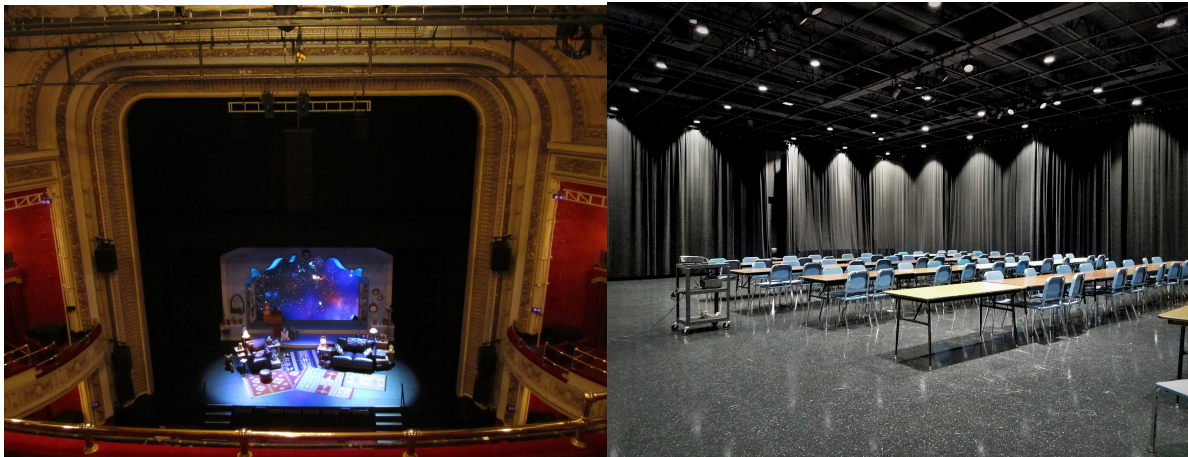
- Live or pre-recorded: If it is live, does it require amplification? If so, where are the musicians located? If pre-recorded, is it intended to be loud and full-range, or quiet and bandlimited (as in the radio example)?
- Diegetic or non-diegetic: Is the music underscoring meant only for the audience's ears, or is it music the characters are aware of? This has a huge impact on speaker placement and range.
- Sound effects: this category may vary the most of the three main types of content. The system needed to deliver a convincing earthquake to an audience of 1000 will be very different than the system needed to make a telephone ring on a scenic wall in a 99-seat theater. We must determine:
  - Magnitude of effects: how loud/present must they be?
  - Type of effects: there are two basic types of sound effects in theater:
    - Spot effects: cues that accompany specific actions, e.g. the sound of a car pulling up outside of a house just before a character enters through the front door of the house set, or the ringing of a telephone that then must be answered.
    - Ambient effects: cues that are intended to set mood, place, time, theme, and the like, but that are not directly tied to any onstage actions in specific.
  - Frequency range: Are we delivering a full-range battle in Iraq? Or just crickets outside the windows at night?
  - Localization: are there effects that must come from a specific spot onstage, or just smeared around the room, or both?

By evaluating what type of production we are involved in, we can often predict what type of content we'll be delivering even before design meetings begin:

- Straight play:
  - Voices: likely present, but whether they need amplification is down to size of venue and/or inexperience of actors. Spoken, not sung.
  - Music: if present, typically minimal.
  - Effects: depend greatly on the production itself, and can range from no effects at all to quite a few elaborate effects.
- Musical:
  - Voices: present, sung and spoken, likely need amplification of some kind (except in rare cases and/or very small spaces)
  - Music: present, likely needs amplification to some extent (see previous note)
  - Effects: minimal, if at all
- Experimental/Devised:
  - All categories: Maybe? Experimental works<sup>1</sup> represent a special category in that anything goes. Some devised works are highly technological and require elaborate sound systems (even incorporating interactivity on the part of the audience and/or performers)<sup>2</sup>, and some require no sound system at all. This is the most difficult category to predict before getting details of the specific production.

Regardless of your ability to predict the needs of your system before meetings begin, as you enter the design process, always keep the type of content needing to be delivered and the style of production in your mind as you plan.

## STEP 2: UNDERSTAND THE VENUE



One of these things is not like the other...

(Left, Royal Alexandra Stage By Mack Male from Edmonton, AB, Canada (Toronto Uploaded by Skeezix1000) [CC BY-SA 2.0 (<https://creativecommons.org/licenses/by-sa/2.0>)], via Wikimedia Commons; Right, Nimitz High School Theater By Nadia Eimandoust (Own work) [CC BY-SA 4.0 (<https://creativecommons.org/licenses/by-sa/4.0>)], via Wikimedia Commons)

Different venues will require different approaches to sound system design. A 1000-seat proscenium house hosting a musical will need a different speaker configuration than a black-box presenting Edward Albee one-acts in the round for an audience of 100. There are four main areas a system designer needs to consider regarding the venue:

- 1) How close is the audience to the action? If your proscenium venue keeps the actors a good 3 meters from the front row, that makes vocal amplification without feedback a lot easier than if you are in a small venue where actors are 1 or 2 feet from the front row. Of course in the latter case it is rare, but not unheard of, to need vocal amplification and in

those cases speaker placement and source localization become challenging. Proximity will also determine how much power is needed to achieve a desired SPL.

- 2) What are the acoustic properties of the venue? A venue with a ton of natural reverberance may require more direct sources in order to deliver good speech intelligibility, where a dry, tight space may need more power to achieve an immersive, rumbling sound effect.
- 3) Where can you safely mount equipment? How high are the ceilings? How much weight can mounting points support?
- 4) What electrical resources are available? How many circuits for amplifiers, and is sound power separate from lighting (and other production) power, in order to ensure clean signal?

### STEP 3: UNDERSTAND THE AUDIENCE



One of these groups is not like the other...

(Left, By Bertrand from Paris, France [CC BY 2.0 (<http://creativecommons.org/licenses/by/2.0>)], via Wikimedia Commons; Right, Official White House Photo by Pete Souza)

The audience is our target. Different audiences will require different strategies on the part of the sound system designer in order to properly deliver the intended results. Everything we do as

sound system designers is intended to have a specific set of effects on the audience, so we must grasp some details about this group of people early in our process:

- 1) How large is the audience? A very large audience is A) more likely to need vocal amplification regardless of production style, and B) will absorb more high frequency content, necessitating more direct sources if HF intelligibility is a goal.
- 2) What kind of experience does the audience need to have? Is this intended to be a Cirque du Soleil-style spectacle, replete with immersive soundscapes and swelling musical numbers? Or is this an Arthur Miller play, dependent on portraying a vision of reality in which the audience can believe? Identify how loud (in SPL) your content needs to be for your audience, how close the sounds delivered must seem to be to the audience, and where (and to what extent) the audience is meant to localize sounds.
- 3) Demographics? This is often overlooked, but important. If you are doing a midnight presentation of *The Rocky Horror Show*, your audience is probably young, and in for a loud and raucous night. If your audience is older, and even into the demographic associated with hearing loss, you may need to focus particularly on dialog clarity, and special attention should be paid to the feed being sent to the Assisted Listening System.<sup>3</sup>

Many sound system designs begin with the question of what content needs to be delivered, at what SPL, to whom, and expand out from those core ideas.

#### STEP 4: UNDERSTAND THE BUDGET (AND AVAILABLE RESOURCES)



We're always dealing with this guy...no one likes to deal with this guy...

(Street art by Alec Andon aka Alec Moneybags, photo by Flickr user aisletwentytwo)

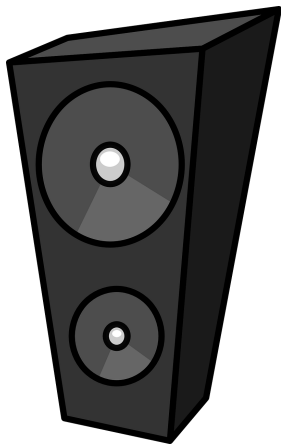
Let's be honest, no one wants to think about this step. We'd all rather just select the equipment that will make our designs work, and say that it costs what it costs, but unless you are working for a very rich prince somewhere, budget should always be in our minds. There are two main concerns:

- 1) Do you have a budget for the sound system?
- 2) Does the producing entity or venue have resources you can use?

At many smaller, or even mid-level regional, theaters, sound system and sound production is not a line item that receives a ton of money on a typical production. Many regional theaters have a stock of equipment that they plan on using, and these are your available resources. If you are fortunate enough to have budget to hire in gear that you select exactly for your needs (or, if you are designing for a Disney Broadway show, intended to run for years, to *buy the gear outright* that you need), then you will need to understand how far your dollar will or will not go, and what the priorities need to be. If you're designing a musical, chances are you will want to spend money on fresh (and spare) wireless mic elements for your performers. If you're designing a show that

needs to convince the 1000-seat audience that there's an earthquake, perhaps you should focus on renting subwoofers. Each market around the country will be different (in terms of rental costs), and different times of year will find gear rented for different amounts. In addition, a house that had reserved a ton of gear for a production that ends up being canceled may rent you equipment for far lower than standard rate, just so that they don't lose out entirely on generated income from that equipment. There are so many variables in budgeting a sound system that this paper can't hope to address them all, but you need a firm understanding of what's available to you as you plan. If you have a budget of \$1000, and a company that owns no speakers, you probably shouldn't design a system requiring 100 Meyer boxes, as you'll only be disappointed and have to re-do the work. If your company has existing resources, usually you will be called upon to use these before spending any budget, and if you insist on spending money instead of using in-house gear, you'd better have a good explanation for the producers about why those expenditures are absolutely necessary.

#### STEP 5: SELECT LOUDSPEAKERS (AND POSITIONS)



Literally the first image that came up when I Googled "loudspeakers" (free clip art, no artist credited)

Loudspeakers are the most important part of any sound system. You can have the loveliest microphones, the most expensive console, the most advanced DSP, and if you've selected the wrong speakers for your tasks, all of that pristine gear is for naught.

The art of selecting the proper speakers for a given application, then placing them optimally for your venue and audience, is the central technological task of sound system design. While all of the supporting infrastructure is certainly important, it takes a sideline to the primacy of the speakers.

While this article places the selection of loudspeakers as Step 5, and the selection of the remaining equipment as Step 6, it could certainly be argued that these should be the other way around. After all, how can we select loudspeakers if we don't know what we're amplifying? However, if we've done the work of analyzing our sources in Step 1 of this process, we should be able to select speakers before selecting our detailed infrastructure. I have placed the steps in this order, in part, to emphasize the importance of speaker selection, and in part because in the course of working with and interviewing countless professional system designers for my research, many if not most of them explained their process in this order. If I know I am planning a system for a musical, and I know my venue, I can definitely plan my loudspeaker selections and coverage before I've determined which mixing console I will use, or what variety of interface I will use for my QLab playback.

We must ask the following questions of our production when planning our speaker complement:

1) What job does a given speaker need to do?

- a. Coherent systems versus subsystems: Theatrical sound systems usually come in one of two basic flavors of speaker selection. Coherent systems are those (usually with limited speaker counts) where all content—voices, music, effects—are all sent to the same speakers. In a venue that only possesses two main full-range speakers, hung left and right of the proscenium opening, all sounds of any kind will generally be run through these speakers, and that's the end of the story. However, in professional systems, we often separate things out into subsystems. We generally dedicate different speakers for vocal reinforcement and sound effects (in part due to localization demands, since effects often need to come either from around us or offstage—or a particular prop onstage—and vocals need to come from the downstage edge of the performance area, ideally timed back to the performers themselves, these tasks are usually handled by separate speakers). In addition, in production of musicals, we often make use of what is called an A/B system configuration, where there are separate speaker systems for vocal delivery (often consisting of a center cluster or unit, front fills, and over/under-balcony coverage), and music delivery (often in the Left/Right mains and/or surrounds). These A/B systems are sometimes fed by parallel mixing consoles, run by two separate mix engineers. The principles at work here are fairly simple: by keeping the vocals and music separate physically, each set of speakers can be driven more efficiently at lower level to deliver the same clarity, and the physical displacement of the speakers from system A to system B allows for summing in the space, which

is often a more acoustically desirable summation—more similar to the unamplified natural summation of singers and pit orchestra—than the summation forced by squeezing all such sound through one set of speakers.

- b. What SPL needs to be delivered? This specification is extremely common in concert and themed sound system design, but is becoming more common in theater (especially in the musical world, as shows draw more and more on electronic and/or electrified sounds that are always going to be amplified). While it is rare that a stage musical aims to deliver the face-melting 130dB SPL that might be the delivery spec for, say, a Metallica concert, it would not be surprising to find a rock musical system that needed to deliver at least 100 dB SPL. Set your target based on your content and intended effect on the audience, and pick speakers that will deliver your levels with headroom to spare<sup>4</sup>.
  - c. Frequency range: as mentioned earlier, a special on a wall that needs to mimic a telephone ring does not need to be a full-range speaker. It doesn't need sub-bass. A speaker, under, the audience rumbling seats for the earthquake probably doesn't need the best (or any) response above 10kHz.
- 2) Do the speakers need to be concealed from the audience? Much of theatrical system design is preoccupied with hiding speakers from view. Where, again, some contemporary or rock musicals relish the sight of mics and speakers, most theatrical systems still try to hide the speakers behind scenic elements. This need must be identified early, so that speakers can be selected that fit physically in the spots required, and that have enough

HF response to offset any attenuation caused by the baffling of curtains or scrim or other such that will be placed in front of the drivers.

Once you have an idea of the answers to these questions, you can begin searching for speakers that will suit your needs. The skilled system designer spends years listening to speakers of all types and collecting mental recordings of how those speakers performed in frequency, coverage patterns, loudness, transient response, clarity, etc. Here, beginning designers are at a particular disadvantage, as they haven't yet had the time to hear these speakers (much less use them), and often are working in schools or theaters that possess limited stock and limited budgets. How, then, is a beginning designer to overcome this obstacle?

There are two primary methods of surpassing this hurdle:

- 1) Read and understand spec sheets: Specification sheets are an invaluable tool in the designer's arsenal. Understanding the details of how a speaker covers space, what frequencies it can deploy, what level it can achieve, and so on, is key to selecting units for your design. However, even the designer with a crystal clear understanding of specs can be misled. Some speakers will perform very well compared to printed specs, and others...not so much. While it is not the business of this article to impugn any particular manufacturer or model of speaker, suffice it to say that equipment gets a reputation in the field. If you can speak to professionals, and get their opinions of the equipment you are thinking of selecting, you can often get a sense of whether the gear you are

considering is up to snuff. However, again, this isn't always an option for young designers<sup>5</sup>.

- 2) Modeling and prediction software: In the 21<sup>st</sup> century, we are blessed with the technology of 3-dimensional acoustic modeling of speaker performance. There are a variety of platforms out there, from the industry-leading AFMG EASE (which features data from almost every professional loudspeaker and manufacturer going, the ability to customize and acoustically treat a venue in the digital space, and more) to the free modeling platforms released by different speaker manufacturers (such as Meyer Sound's MAPP XT). EASE is an expensive software (though its licenses are perpetual) and has become a de-facto industry standard because it is so comprehensive in its ability to model complex system performance. EASE is also available in a limited version (EASE Focus) that only models speakers alone without the acoustic properties of the venue. EASE has a distinct advantage over proprietary systems, in that you can model mixed systems consisting of speakers from multiple manufacturers, whereas in, say, MAPP XT, you can get very accurate coverage maps, but only of Meyer Sound speakers. Regardless of what tool or tools you use, speaker system modeling has become an indispensable part of many sound system designers' process. By modeling speaker performance, a designer can assess whether a given model performs as anticipated based on reading the specs, can examine how speakers will interact in a given acoustic environment, and can play with positions, angles, and intensities until they find the optimal selections—all without calling a single crew member to the theater.

The topic of loudspeaker modeling is itself a topic of vast depth and detail, and beyond the scope of this article, but one key piece of advice bears mentioning before we move on:

DON'T MODEL SPEAKERS AT THE SAME TIME UNLESS THEY WILL BE CARRYING THE  
SAME CONTENT SIMULTANEOUSLY

This means that if you have a thrust stage, with three main vocal reinforcement speakers (one centered on each audience area), you would model all three together, because they will all be carrying vocals at the same time. However, if you then have a separate set of music speakers, you would NOT model the vocal speakers and the music speakers together, since they will only ever carry different content. If you have a dozen music speakers, all of which will carry the same music, in a diffuse surround setup, you WOULD model all of those together, since again they will be carrying the same content. It is only relevant to model speakers together if they are carrying the same content at the same time, otherwise they would be modeled individually (or not at all—if we have a small speaker mounted in a scenic cooktop to play cooking sounds, in a small black box theater, so long as that speaker will give us enough SPL to be heard across the audience, we don't really need detailed SPL and waterfall plots about its response).

Loudspeaker selection is critical to the success of our project. When designing vocal amplification systems, it is common to assume that we want to cover the audience with the same SPL, and same relative clarity, no matter where they sit. Some designers (for some specific projects) may disagree with this, but professional practice generally dictates this as a major agenda item of the

system designer. Likewise with any sound that needs to be perceived equally by the audience in order for the production to succeed (the orchestra in a musical, for example). In many sound effects uses, we don't want an audience to all experience the effect equally, we may want the sound to localize to an object onstage, to have a realistic feel of falling off the farther we get from it (even if we've boosted the level so we at least ensure all of the audience hears it to an extent). Deciding what kind of coverage you need, how even it needs to be, and how to deliver that, is the crux of the system design process.

#### STEP 6: SELECT REMAINING EQUIPMENT (AND PLAN FOR OPERATION)

Once we know what speakers we will have, how many, and where they will be installed, we can detail the rest of our system.

- Mics: If we need mics, how many and what kind? If we're mic'ing actors, are we putting wireless body mics on them, or using area mics (very different sonic qualities, body mics are close and direct, area mics subtler and more tied to room acoustics). If we're mic'ing an orchestra, what mics will best suit the instrumentation?
  - If we have microphones, we probably need a mix engineer and a mixing console.If we're dealing with RF mics, we probably need RF crew offstage as well. How large is the cast? A cast of 4 can be just fine with one RF tech. A cast of 40 might need 2-3 techs, especially if there are quick changes involving mics.
- Playback systems: If we're playing back content, what it is, and how do we need to control it? Today, most theatrical systems are controlled via software-based playback systems, whether the straightforward and very flexible QLab, or a more advanced and complex

dedicated media server (for large scale spectacle productions). Regardless, determining channel count and routing is key.

- Can playback be triggered by the mix engineer? Do we need a dedicated playback operator?
- Console: Do we need a console? If we've designed a show that is playback only, we probably don't—the playback system can run directly to the DSP/amps and we don't need to mix in a board. If we have mics, we probably do need a console.
  - If we need a console, what features do we want/need? Many consoles (virtually all digital consoles) come with presets/scenes that can be recalled at the touch of a button (critical for musical mixing or other large-cast productions), and some incorporate even more theatrically-focused features, like selectable crossfade times and slopes between said scenes, actor profiles for easily replacing a lead with an understudy in an entire show's worth of cues, and so on.
- DSP (Digital Signal Processor): Any system that needs to be calibrated (speakers flattened in frequency response, time aligned for vocal reinforcement speakers—back to actors, or in the case of front fills vs. under-balcs, delaying under-balcs back to the FFs) needs a DSP. In the DSP we can EQ, delay, set limiters, and more. It is beyond the scope of this article to address all the capabilities of and reasons for needing a DSP, but:
  - THIS IS ONE ITEM YOUNG DESIGNERS OFTEN SKIP OR FORGET. This is because many of them have worked in churches, or their high schools, or universities with no budgets, and they operate without DSPs altogether. While, in very rare cases, an all-playback show using QLab can accomplish its needed tuning via plug-ins in

QLab itself, generally, any professional sound system needs a DSP between the console/playback and the amps/speakers.

- When selecting a DSP, one must make sure:
  - Signal connections are in the proper count and type—do you have a console sending audio out via DANTE? Then a DSP with DANTE in seems like a good choice. Is everything analog? Select a DSP with a lot of options for expansion in the analog I/O.
  - Control is compatible with available computers—some DSPs run software that is only compatible with PCs (not Macs), so make sure you can run the software needed in order to actually program and operate your DSP.
- Amps: Of course, we need power in order to make our sound louder (that is generally the whole point of a sound system, after all...). Are they external, for passive speakers, or are you using active/powered speakers? Select amps that will deliver enough power for your speakers, and ideally, that will give you the full SPL range of said speakers without amplifier overheating or distortion. Contemporary amps sometimes offer network connection for monitoring and internal DSP features, though there are plenty of old-style analog amps still being made.
- Control: A control system allows you to manipulate computerized devices in your system from other computers/tablets/phones in different locations. Is your mix position in a terrible location, so your mix engineer needs the wireless iPad control app that allows her to go into the house and EQ from the audience sections? Do your wireless mics offer network monitoring of RF, battery, and signal levels? Computer control is increasingly a

necessary part of contemporary sound systems, and while it is well beyond the scope of this article to detail all the myriad ways in which control systems interface with our sound equipment, suffice it to say that this must be addressed to the extent possible within your equipment selection and budget.

- Com: We always like to skip com, but it's still usually our job. Talk with stage management and the other crews to make a list of everyone who needs com, how many channels the production will need, etc.
- Time: How much time will it take to install, test, and tune your system? Even if you can afford the gear, you might not be able to afford the time and crew it takes to use it. Are you working in a union house, or a non-union house? Union houses are vastly more expensive to operate in, and have a lot more rules that must be observed about call times, mandatory crew breaks, and the like.

## STEP 7: REFINE YOUR CHOICES

Ideally, you have prepared your system plan early enough in the production process that as the production rehearses and designs evolve, your system can be refined along the way. Sometimes, this means that items you specified are no longer needed, and your budget can be reduced (making the producers love you), and sometimes the inverse is true—a newly staged sequence demands new technological support, and thus more resources. A good system designer is in constant contact with the sound content designer (if they are not the same person), the other designers on the team, the director, the stage manager, and sometimes the producers. The best system is an efficient system, that doesn't waste time and resources by calling for equipment

that isn't needed, that doesn't specify more operating crew than is absolutely necessary, and that delivers all the intended content to the specified design goals. Many systems in larger/longer production processes will be put through "the dreaded V.E."—value engineering, which is a fancy way of saying that the money managers will pick apart your system trying to cut everything possible in support of lowering the overall cost of the show.

#### CONCLUSION:

Advanced sound system design is a master craft, made of dozens of interlocking, interdependent disciplines, but beginning sound system design can be as simple as seven steps to delivering content to your audience. No single article can detail all the factors that must be considered when planning close mics for an orchestra, or selecting between 7 different line-array speakers to find the one that will best suit your particular needs. These choices are creative as well as technical, and no article can presume to predict your creative choices. No single article can hope to truly deliver the full, complex, detailed path that a theater sound system design must take from first idea to realized technological solution, but by following the steps outlined here, beginning designers can hope to break this daunting task into manageable chunks of thought and work.

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<sup>1</sup> In this category, I count forms of production that are not truly "experimental" but represent significant deviation from the Western canon. To wit, production of Kathakali dance-drama is a long and storied tradition in India, but represents a deviation from the Western norm of theatrical presentation, and as such should be treated as a special case with regard to this process, involving music and possibly dialog or singing, as well as significant movement. Whether or not such a

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production requires a sound system at all will be down to the production itself, the venue in which it is held, and goals and intents of the company. Should the producers wish to present traditional Kathakali, no sound system would be employed. Should they intend to “translate” the experience to a Western audience and/or venue, some amplification systems may be required. It is difficult to reduce the specific needs of this or any other such non-Western performance style (Noh, Kabuki, Yoruba dance-drama, etc.) to the systematic approach detailed in this article, though once the goals of the production are established, many of the tactics listed in this piece will still be helpful in planning.

<sup>2</sup> For example, consider the Wooster Group of New York.

<sup>3</sup> Special Attention should always be paid to this feed, however, in many smaller theaters, neither the budget nor the infrastructure exists to support this work. In many such venues, the ALD (Assisted Listening Device) system is fed by a single program mic hung in the venue, and there is no board feed, or direct line from the effects system, or what have you. As theater audiences age upward (and for many of the costliest to attend commercial theaters, this trend is continuing), more and more sound designers are mixing specific feeds to the ALD system, paying particular attention to speech intelligibility.

<sup>4</sup> Headroom is available level above the desired max SPL. A standard headroom spec will demand that a system is capable of delivering at least 12 dB SPL beyond the intended operating level. This ensures A) that any momentary peaks don’t distort, and B) that none of the equipment is risking thermal overload when running at the intended average levels.

<sup>5</sup> And please, don’t trust random gear forums...they are filled with less-than-knowledgeable people and/or trolls...I have many times had to disabuse young designers of fondly held notions

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that they gleaned from hours parsing GearSlutz pages—just because a bunch of loud internet commenters think a certain thing is true doesn't make it so. While you may occasionally find actual decent advice via a forum, take everything you get from these sources with a hefty chunk of salt.