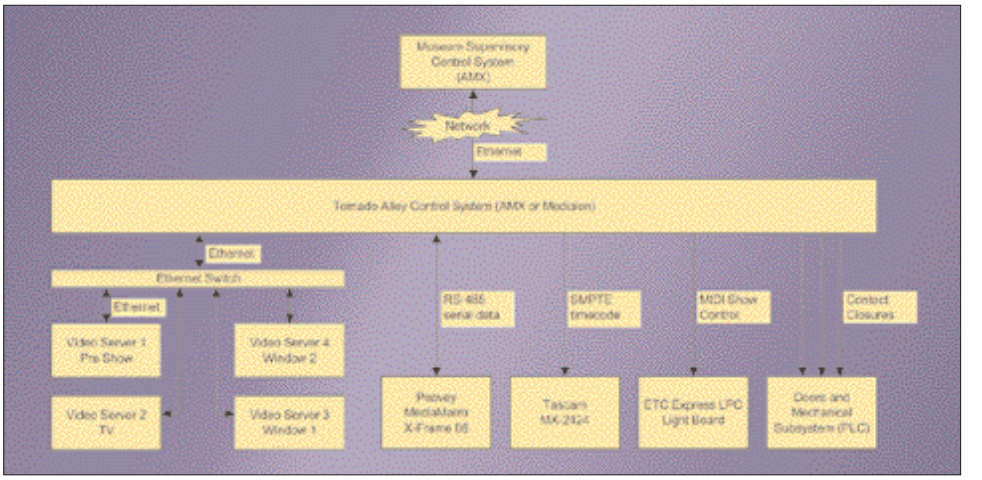
John Huntington and Jim Janninck

Show Time



When do you need a show control system?

The preshow video ends, the automated doors swing open, and the audience at Science Metropolis files into *Tornado Alley,* where we see the interior of a Midwest home. Suddenly, the terrifying sounds of a tornado approach, the living room TV springs to life, and the local weatherman warns that a tornado has been sighted heading for our town. The tornado sound builds in intensity and envelopes the space while the light outside the windows turns an ominous green. The lights flicker and go out, and we see debris flying past the windows in the sickly glow. Suddenly, SMASH, a huge tree crashes through the wall! The tornado finally moves on, and the sound abates. The houselights come up, the local TV weatherman appears again on video explaining tornado safety tips, and the room reconstructs itself before our eyes.

With this *Tornado Alley* attraction, your local science museum wants to add a little theme park glitz to its otherwise staid facility. The museum already has in place a supervisory media control system (such as those from AMX or Crestron) to do standard audio/video control functions, like turning on and off video monitors and exhibits throughout the facility at the start and end of each day. The *Tornado Alley* show designers are pushing for a show control system, but the museum management would prefer that this attraction be run by a media control system, because it already has heavily invested in training, spare parts, and so on.

WOULD YOU TAKE THIS CONTRACT?

The *Tornado Alley* attraction includes elements many AV contractors and consultants work with every day: video, audio, lighting, and projection. It also includes some lesser-known areas—mechanical effects and automated entry doors—but from looking at the design, you see that those are simply controlled with a few contact closures.

Assuming your company has quite a bit of experience with media control systems for home theaters, boardrooms, and other similar facilities, would you make a quotation for this attraction, based on a media control system? Before you answer, here are some important points to consider.

What is a media control system? For the purpose of this article, the term *media control system* refers to a system, typically made by companies like AMX or Crestron, which is used as an electronic

Above: FIG. 1: Shows how the hardware in Tornado Alley is connected. [QQQ]

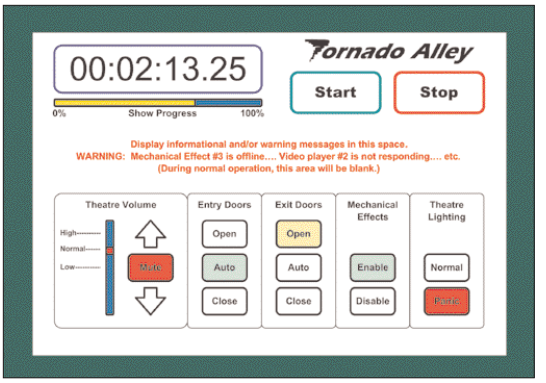
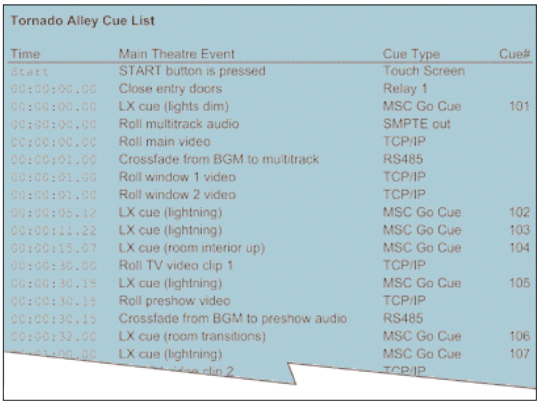


FIG. 2: Operator interface design.



Tornado Alley Cue List

Time	Main Theatre Event	Cue Type	Cue#
Start	START button is pressed	Touch Screen	
00:00:00.00	Close entry doors	Relay 1	
00:00:00.00	LX cue (lights dim)	MSC Go Cue	101
00:00:00.00	Roll multitrack audio	SMPTE out	
00:00:00.00	Roll main video	TCP/IP	
00:00:01.00	Crossfade from BGM to multitrack	RS485	
00:00:01.00	Roll window 1 video	TCP/IP	
00:00:01.00	Roll window 2 video	TCP/IP	
00:00:05.12	LX cue (lightning)	MSC Go Cue	102
00:00:11.22	LX cue (lightning)	MSC Go Cue	103
00:00:15.07	LX cue (room interior up)	MSC Go Cue	104
00:00:30.00	Roll TV video clip 1	TCP/IP	
00:00:30.15	LX cue (lightning)	MSC Go Cue	105
00:00:30.15	Roll preshow video	TCP/IP	
00:00:30.15	Crossfade from BGM to preshow audio	RS485	
00:00:32.00	LX cue (room transitions)	MSC Go Cue	106
00:00:00.00	LX cue (lightning)	MSC Go Cue	107

FIG. 3.: Cue list.

"glue" to tie together the control of many disparate audiovisual devices. Modern media control systems pack tremendous processing power and features into a highly reliable, inexpensive hardware box and are found in applications as diverse as home theaters, NFL locker rooms, retail establishments, schools, and boardrooms. Most of these applications have one thing in common: they are manually controlled by a human pushing buttons on a touch screen.

What is show control? A show control system is a linkage of separate live entertainment control systems into a metasystem, a system of systems. The key element of this definition (which has its roots in the theme park world) is that show control is a technology used to link together multiple production elements such as lighting, sound, video, and special effects. Therefore, using a computerized lighting console to control moving lights is not show control, but syncing those light cues to a soundtrack and some video is.

Show control systems are flexible and can work in several different ways, depending on the application. In a synchronous presentation like *Tornado Alley,* a show might be linked to a master clock or locked to some linear media such as a soundtrack or a video segment. Alternatively, a show control application could be completely interactive, or *asynchronous.* For example, in a walk-through haunted house, the audience members might trigger show events themselves, and there is no shared time reference. The third general type of show scenario is a live show (including performers), such as you might find in a theater or concert, in a theme park stunt show, or in a cruise ship review, where a show control system is used to leverage the abilities of a small technical staff. (Of course, many applications are a mixture of these three types.)

Is it possible for a media control system to be effective in these applications? Well, yes and no. At first glance, media and show control systems look quite similar. However, there are significant structural differences that make each better suited to different applications. We will now explore those differences.

IT'S A SHOW

In a home theater or boardroom, the prerecorded media to be played back is the show, so these applications are generally preprogrammed in a maximally generic way. A show like *Tornado Alley,* on the other hand, is essentially "authored" in place in the venue. The creative team requires all elements (actors, video, and mechanics) in place in the space to actually work everything together. In show programming, you are assured of only one thing: changes will not stop until all resources (money, time, and so on) have been exhausted. To bid the job effectively, one has to assume that each possible minute allocated will be used for programming.

I, Huntington, once received a call from an accomplished programmer of media control systems, who had been asked to provide a competitive bid for the programming of a show. A consultant had appropriately specified a show control system for the project. The media control programmer asked, "How many hours would it take to program the system?" Coming from a show background, I was baffled. "How much time do you have?" I asked. "If you have a week, it will take a

Time Comparison

Task	AMX	Medialon	Approx. Ratio
Initial rough-in programming	8½ hours (4½ hours for program creation, 4 hours estimated for entering of device control strings)	4 hours, including all device support (no device control string entry needed)	2:1
Change 10 cue positions while show stopped	4–5 minutes	4–5 minutes	1:1
Change 1 cue position while show running	Not possible[1]	30 seconds	n/a
Trim 18 seconds out of the show, from 0:05 to 0:23	20–30 minutes	2 minutes	10:1
Roll show from 1:05 instead of 0:00 to speed up the testing effort	Not possible	1–2 seconds, can locate anywhere in the show and position track	n/a
Pause show on director's verbal command	Not possible	Reaction time of operator	n/a

[1] With a highly experienced programmer, it would be possible to make these changes but only with a low-level terminal connection to the time code card or creation of a "pause points" superstructure by the programmer. Creation of this superstructure would take hours (or even days) of programming time, depending on the complexity of the show, and would only offer the ability to jump to a set of predefined points in time, so we didn't include it.

week. If you have two months, it will take two months." Now the media control system programmer was baffled. "I usually charge by the development of the touch screen," he said. "One hour for this type of button, two hours for this kind of display, and so on." Eventually, the media control programmer declined to bid this show control job.

FAST AND FURIOUS

In a boardroom, a media control programmer might create the touch-screen design and program off-site, come to the site for a test-and-adjust period, and then go home. Later, the programmer might get a call to make a few modifications. A show control programmer, on the other hand, may get minimal opportunity to configure or program the system before technical rehearsals begin. At this point, the show control programmer is an integral part of the show creation process. If the creative director, lighting designer, sound designer, video designer, or facility owner wants changes, the programmer has to implement those changes immediately, right in the venue. Changes must be tested with the full production, including performers, and this cycle of changes and rehearsals may even continue to opening day while the show is running in front of an audience. For those reasons, show control programming environments must be designed from the ground up to enable the programmer to make coding changes as quickly and easily as possible. George Kindler, a consultant with Kelley Technologies LLC, has worked on many large-scale show and media control projects, and reinforces this point: "Show control systems allow for easy updating of show sequences in the real-time environment of show production. Media control systems are best programmed when the client, producer, or possibly the entire production company are not standing around waiting for results."

ALL IN THE TIMING

Modern show control systems can handle multiple time streams, or *timelines,* all running independently, separately, and asynchronously (or not at all in interactive applications). These systems allow timed sequences to trigger interactive events, or vice versa. Most good show control systems today can also offer real-time operation, guaranteeing that the entire program can be executed at least once per video frame. Media control systems may have some built-in time-based functionality, which might be perfectly suitable for boardroom and home-theater applications, but these features are typically too limited for use in shows.

PAUSING AND RESTARTING

Modern show control systems also have the ability to "pause" an entire show (video, audio, mechanics, lighting, and so on) so that precise edits can be made at the pause point. In addition, during rehearsals, it is often necessary to start at a randomly selected point anywhere in the show, so a modern show control system needs the ability to reposition or cue up all the

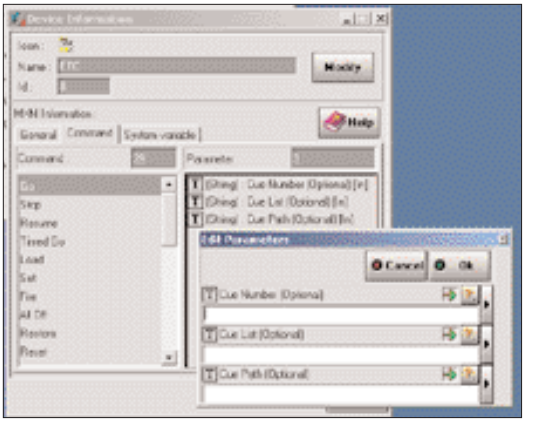


FIG. 4: Creating a MIDI show control cue In Medialon Manager.

controlled devices. Ted Mather, an entertainment lighting designer who has worked on major live and themed attractions around the world, once did a project similar to *Tornado Alley,* except that the owner insisted on a media control system. According to Mather, the media control system "limited the creative design of the project by wearing us out with the time it took to program." Every change to the code required the program to be rewritten, compiled, and downloaded, and restarted from the beginning of the show. A majority of the lighting effects (like a series of lightning flashes coupled to thunderclaps) were at the end of a 20-minute program, so to see changes, the entire crew had to wait for the cues. "We started at about 7 p.m. and finally gave up at 3 a.m. because we were all too tired to continue any longer," says Mather.

TIME EQUALS MONEY

Media control systems can look more cost-effective from an up-front, preprogramming perspective, but any installation savings are often offset by the time lost in the programming period. The effects are felt in both the budget and the quality of the finished product. "I always push for a show control system from the beginning of a project," says Mather. "I inform the client that my time will quadruple for the programming period if [a media control system] is used versus a real show control system. If the cost of [the media control system] is cheaper than my time, [the media control system] is usually used."

WORKING TOGETHER

Many experts find that using a blend of technologies in a single application maximizes the potential for a highly effective show. "I have frequently used media control systems and show control systems in conjunction with each other," says Kindler. "Sometimes that media control system is the property-wide supervisory system, and the show control system is used as a sub-

system to control a show-oriented time-based synchronous part of the overall presentation. This is common in museums and retail projects. Sometimes the large available inventory of control types [touch panels, wall controls, and so on] makes a media control system a good choice for user interface, while the show control system controls the target devices."

TO THE TEST

We tested the assertions made in this article by asking a show control expert and a media control expert to program a version of *Tornado Alley* in their representative systems. To give each programmer equal footing, we created a single *Tornado Alley* control design and gave it to both programmers in advance.

The ideal show control system design consists of three primary pieces of information: a system block diagram, showing how the hardware is connected; a design for the operator interface (which could be hardware or software—in this case, it's a touch screen); and a detailed cue list, indicating every cue in the show along with the specific time codes at which each cue should be triggered. Of course, in many real-world applications, one or all three of these pieces of information may be missing at the start of the project, making the programmer's life even more difficult.

(Note: It would be possible for this application to extend the museum's existing media control system out to cover the show, but we didn't do that in this case because it would not make for a fair comparison.)

System block diagram. Fig. 1 shows how the hardware in *Tornado Alley* is connected. The system controls the following devices (note that these devices were chosen because they are commonly used in the industry—not because the authors necessarily recommend or endorse their use): four Adtec Edje video players via TCP/IP messages sent over Ethernet: one for the preshow area, one for a TV on the set that shows Tornado warnings and radar, and two for video projectors outside the set windows; one MediaMatrix X-Frame 88 audio processor via RS-485; one Tascam MX-2424 multitrack audio source via SMPTE time code; one ETC Express LPC theatrical lighting controller via MIDI show control; and three mechanical effects via three relay contact closure outputs.

The show's control system provides its own operator interface for manual show starts or can be started through TCP/IP from the master museum supervisory control system.

Operator interface. Even though the shows will be started by the museum's supervisory control system, we specified a touch screen for monitoring and manual override and specified that this screen should be located 250 feet from the control racks The design for the operator interface is shown in **Fig. 2**.

Cue list. Because *Tornado Alley* is a time-based, synchronous show, the cue list includes specific SMPTE time-code times in hours:minutes:seconds.frames format for each cue. A partial list is shown in **Fig. 3**.

System comparison. For our representative media control system, we chose AMX Netlinx, even though most of the concepts discussed here would be valid for Crestron or other systems, too. Dave Christoffers, an Orlando, Florida–based AMX expert, volunteered his time to design and program. For our show control system, we chose Medialon Manager. Other show control solutions from Alcorn McBride, Anitech Systems, AV Stumpfl, Dataton, Mediamation, Richmond Sound Design, and Stage Research

AMX System
Cost Details for *Tornado Alley*

		Price	Qty	Total
Note: All prices are manufacturer's list price				
Netlinx master card	NXC-ME260	$2,520	1	$ 2,520
Netlinx relay card	NXC-REL10	$400	1	$ 400
Netlinx RS-485 card	NXC-COM2	$500	1	$ 500
Netlinx master hub shell enclosure	NXF-MHS	$ 200	1	$ 200
Netlinx net module shell enclosure	NXF-NMS	$ 200	2	$ 400
AMX rackmount kit for 3 NetLinx boxes	AC-RK	$ 80	1	$ 80
Axcess MIDI card	AXC-MIDI	$ 400	1	$ 400
Axcess SMPTE card	AXC-SMP	$ 650	2	$ 1,300
Axcess card frame	AXF-MINI	$ 800	1	$ 800
10.4" touch screen	AXM-CA10	$ 6,000	1	$ 6,000
Power supply	PSN-6.5	$ 460	1	$ 460
				$13,060

Medialon Manager System
Cost Details for *Tornado Alley*

	Price	Qty	Total
Manager Software License (Full)	$ 8,100	1	$ 8,100
Medialon industrial PC w/ Ethernet & MIDI	$ 3,472	1	$ 3,472
RS-485 card	$ 312	1	$ 312
SMPTE card	$ 765	1	$ 765
Relay card	$ 500	1	$ 500
15-inch LCD touch-screen monitor	$ 700	1	$ 700
Cat-5 KVM extender	$ 1200	1	$ 1200
			$15,049

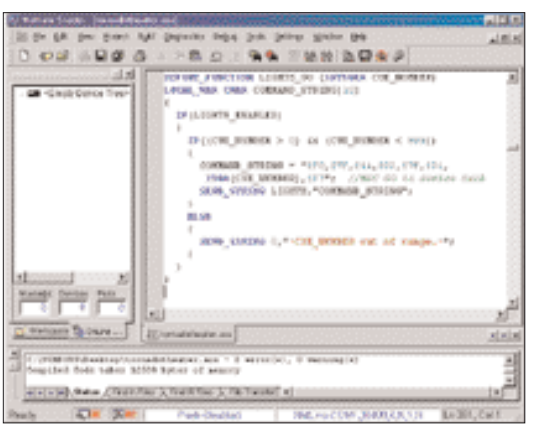


FIG. 5: Creating a MIDI show control cue in AMX NetLinx.

could have worked, as well. Sierk Janszen, programmer for the Dutch show control company Ground Zero, volunteered his time to design and program the manager system.

Hardware support. Both systems offer hardware support for all the necessary target devices (see the table for detailed configuration). The Medialon system handles all communications natively through PCI peripheral cards within an industrial PC, and for comparison purposes, we priced the computer, fully integrated, from Medialon.

The AMX system offers native NetLinx hardware for Ethernet, RS-485, and relay outputs but does not offer interface cards for MIDI or SMPTE, two protocols critical for *Tornado Alley* (and most other shows of any type). AMX is still supporting its legacy Axcess line of equipment, and these older MIDI and SMPTE interface cards can be integrated with the more modern NetLinx system; however, NetLinx offers timing accuracy of ⅟₁₀₀₀ of a second, but the older Axcess hardware is structurally limited to ⅟₀ second resolution. So with the older Axcess SMPTE card, even though execution times can be specified down to ⅟₀ of a second (one frame), the cues are actually only executed at the next ⅟₀ second clock tick.

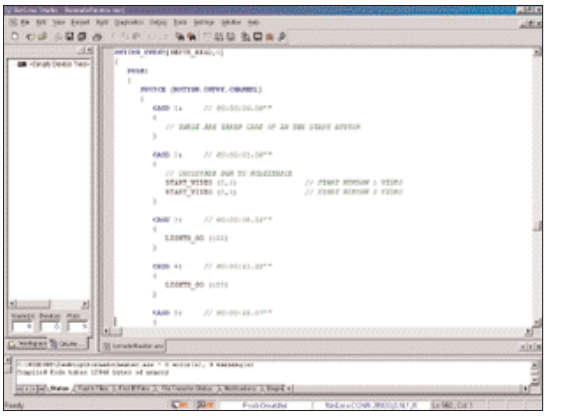


FIG. 6: AMX NetLinx Studio 2.0 programming environment.

Christoffers, who has extensive programming experience with AMX Wait statements and Timeline functions, found them too limiting for this show application. He devised a work-around by using a pair of AMX Axcess SMPTE cards in conjunction with the Netlinx system. The first card generated SMPTE time code to the Tascam audio playback unit and sent that time code back into the second card, which then executed the other cues (lighting, video, and so on) in the show. The cue list was stored in the card itself, and cues were executed as the card issued push commands at the nearest ⅟₀ second system clock tick after the desired SMPTE cue time.

Protocol support. Modern show control

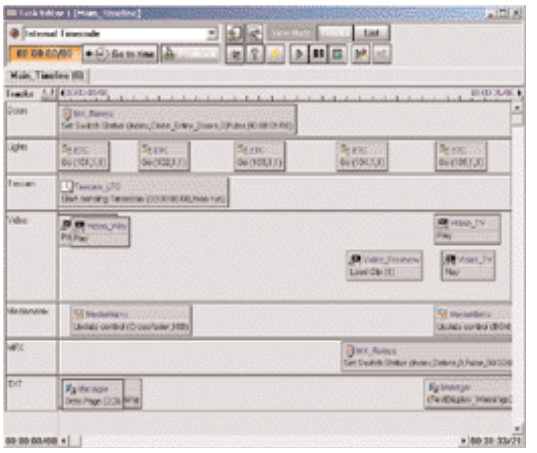


FIG. 7: Medialon Manager 3.0 programming environment.

systems offer support for a variety of device protocols, striving for a plug-and-play approach with a broad mix of audio, video, lighting, and automation equipment. You can see the windowed, graphical approach to entering a MIDI show control cue in Medialon Manager for the *Tornado Alley* lighting console in **Fig. 4.**

Manager's MxM device support files offer the user similar graphically based support for the Adtec Edje players, Peavey XFrame, and MIDI show control, and this gave the manager system an advantage during preprogramming (see Time Comparison). Media control systems are biased toward controlling electronics through infrared control, and in AMX serial strings for RS-485, MIDI, and Ethernet devices must be hand-coded in hex or ASCII by the programmer (unless an experienced programmer creates string libraries), as shown in **Fig. 5.** Device support files for common boardroom and home-theater equipment are available from AMX, but some show equipment and show protocols are not widely used in the media control market and are not necessarily supported.

Programming environment comparison. AMX NetLinx and Medialon Manager have dramatically different programming environments. Although the AMX environment provides powerful editing and communications tools, the programmer must work with individual bytes, strings, and button pushes, assembling those objects into higher-level functional blocks. Over time a library of useful modules can be built, and the programming process can become easier (see **Fig. 6**).

Although a Medialon Manager programmer can also operate on a byte and string level in the program when needed, manager also offers high-level graphically based functionality for timelines (see **Fig. 7**) and extensive conditional logic functionality, along with prebuilt device commands and behaviors, support for industry-standard protocols like MIDI show control, and position track timeline functionality (all controlled devices can be cued up automatically to any point on the timeline).

Another fundamental difference between the platforms is that AMX code must be compiled and downloaded to the hardware after every programming change, requiring a system reboot every time the program is altered. Manager permits editing and execution simultaneously, so changes can be made transparently even while the show is running.

Debugging. During show programming and debugging, Manager offers full visibility into the code, all the variables, and their current status, so the programmer can keep tabs on what's happening in any part of the code at any instant. Perhaps even more importantly, Manager offers the ability to manually trigger any cue or event in the program on demand, show running or not. For equivalent functionality in AMX, the programmer must add extra debugging and testing code and can specify limited lists of variables to watch or set up a terminal session with the hardware, which complicates and slows down the installation and programming effort.

User interface. Both AMX and Medialon have strong user-interface creation tools, and it proved straightforward to lay out the *Tornado Alley* control screen with complete functionality in both AMX's TPDesign3 package as well as Medialon Manager.

Time comparison. To see how the two approaches fared in terms of time, we had Christoffers and Janszen keep track of their time as they designed and programmed the basic structures of their systems. The numbers are interesting, but keep in mind that the times are for Christoffers and Janszen, who have programmed dozens of sophisticated shows, and their times are likely much shorter than those for novice programmers. Finally, this was a simple show, so we have included a ratio column in the Time Comparison table for comparison purposes to give you an idea of how these times might scale up to a larger project.

In the hands of an expert with extensive show-programming experience, AMX can do most everything Manager can but at an increase in programming time. That time difference would be most apparent and critical during rehearsal/on-site programming, when hundreds of these types of edits might be necessary in the course of a rehearsal.

COST COMPARISON

The *Tornado Alley* Cost Comparison Summary table summarizes approximate costs of the *Tornado Alley* control systems. It's straightforward to compare actual hardware

For More Information

Adtec
www.adtecinc.com

Alcorn McBride
www.alcorn.com

AMX Corp.
www.amx.com

Anitech Systems
www.anitech-systems.com

AV Stumpfl
www.stumpfl.com

Crestron Electronics
www.crestron.com

Dataton
www.dataton.com

ETC
www.etcconnect.com

Medialon
www.medialon.com

Mediamation
www.mediamat.com

MediaMatrix
www.peavey.com

Richmond Sound Design
www.richmondsounddesign.com

Stage Research
www.stageresearch.com

Tascam
www.tascam.com

TimberSpring
www.timberspring.com

Zircon Designs
www.zircondesigns.com

costs using manufacturer price lists. The preprogramming costs come directly from Christoffer's and Janszen's time during our experiment and are based on an hourly rate of $100 per hour for simplicity of comparison purposes only. On-site programming costs, however, are much harder to estimate, so for purposes of comparison, we have chosen to scale on-site time using a 4:1 weighting (AMX:Medialon). This estimation is to achieve two shows of equivalent quality (though quality, of course, is a fuzzy metric), and the ratio seems reasonable to our panel of experts given our collective experience, knowledge of the industry, and the results of our tests.

In reality, though, it's rare that a project would have the luxury of this additional programming time before opening. So in most cases, show programming is actually halted prematurely when the resources of time and money are exhausted, and the overall quality of the attraction suffers. A poorly programmed show might translate into higher long-term operations and maintenance costs as well as lower guest satisfaction, which would affect the long-term success of the show.

CURTAIN CALL

Media control systems are an excellent choice when used in boardrooms, home theaters, and other applications for which they were designed. But if, instead, you are actually doing a show, we contend that you will save time, money, and aggravation and end up with a better finished product by basing your system design around a true show control system. ■

Tornado Alley
Cost Comparison Summary

	AMX NetLinx	Medialon Manager
Hardware Cost *(See table on p. 50 for details)*	$13,060	$15,049
Preprogramming	$850	$400
On-site Programming	$16,000	$4,000
Total Cost	**$29,910**	**$19,449**

John Huntington *is an associate professor of entertainment technology at New York City College of Technology and has published more than 40 articles and given more than 25 workshops on show control or sound. The second edition of his book,* Control Systems for Live Entertainment, *was released in 2000. He can be contacted through www.zircondesigns.com.* **Jim Janninck** *is principal of TimberSpring, an Orlando, Florida, firm offering consulting engineering to the entertainment industry. He can be reached at s+vc@timberspring.com.*

OVERFLOW