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# Show Technology Comes of Age

By: John Huntington

After years of innovation, has the industry reached a plateau? What comes next?

When I graduated from college in 1985, the live entertainment technology industry was pretty small and relatively simple. But change was on the horizon: The era of the long-running, high-tech Broadway musical was beginning; concerts were getting larger and more sophisticated; corporate industrials were opening the door to the massive world of event production; Disney had recently inaugurated its second Florida park, EPCOT; WWE (then WWF) was undergoing a major expansion; and Cirque du Soleil was about to embark on its first-ever tour of the US.

Simultaneously, the industry entered a period of intense technological development, continuing at a rapid pace into the 2000s; every few years, it seemed, we were ready to throw out all our gear in favor of the latest, much to the horror of rental companies and producing venues. Somewhere around 2010, this intense period of development slowed down; the technologies cobbled together in the 80s—and many others developed since—became mature, commoditized, mainstream storytelling tools found everywhere from the stadium tour to the local catering hall, and from the opera stage to the local rock club. Let's take a look at how we got here, and what it means for the future.

## Eras of development

I've broken down this history into three eras: Early Days, Rapid Development, and Maturity, using a timeline to

explore and better define them. Before we start, a few disclaimers: To make it onto the timeline and be designated as mainstream, a technology must have been made for live performance and pass two tests. First: It must be a complete system that a production can buy or rent and use (e.g. lighting console and moving lights) and/or easily customize (like a digital printed backdrop). Second is the well-funded party test: A technology must be available in some form for a well-funded bar/bat mitzvah, sweet 16, quinceañera, wedding, etc.

The decision about when exactly a technology matured and became mainstream is subjective, but I've tried to establish evidence; for example, when a written industry standard was developed, or a product version was released that became widely used. And while I strove for accuracy, the exact dates aren't that important for my purposes here, where I'm mostly interested in the overall trends. In that vein, too, I haven't included technologies that died; the focus here is on those that succeeded or led to something that did.

## Early days

The first era spans 1965, when the Beatles played Shea Stadium (to many, the start of modern show production), to 1985. During this period, developments occurred at a relatively slow pace and show production techniques remained fairly traditional. The 1970s saw interesting innovations in

ice shows, circuses, and touring concert acts, in terms of putting them into large arenas and similar buildings not designed for them; these include using chain hoists "motor down," developing new truss designs, touring power distribution schemes, and refining performer flying.

Broadway in the early '80s saw the arrival of scenic automation, driven by control systems adapted from factory automation and industrial control, along with early CAD systems and automated scenic construction tools. Lighting control typically involved simple analog and logic-based systems, although proprietary digital control systems came into play. Color scrollers were developed, along with moving lights. (Moving light technology was considered so revolutionary that proprietary units were carefully guarded behind curtains even on show sites.)

Sound during these years was analog, although the first digital delay lines began turning up; wireless mics moved past primitive designs, becoming more common; and new speakers were designed with live performance in mind. Still and motion picture film projection was king, and analog video systems were enlisted for image magnification. Lasers and fog and smoke systems became popular.

## Rapid development

The rapid development period covers 1985 — 2010, a time of astonishing development in show technology and massive growth in the live show market. Truss and chain hoists became ubiquitous, and performer flying went mainstream. Scenic automation was widely used, as were CAD and automated fabrication techniques (CNC

machining and similar technologies), and digital printing of backdrops and similar technologies became affordable. In lighting, the DMX control standard was developed, dimmers went dimmer per circuit, and color scrollers and moving fixtures proliferated. Lighting control consoles matured, and incandescent fixtures, which hadn't changed in a generation, were re-engineered. LEDs grew in popularity, which—along with the rise of dichroic filter technologies in moving lights—led to the demise of the color scroller. Ethernet networking came to lighting control and other areas, wireless DMX became popular, and RDM was developed.

In sound, consoles and digital signal processing matured, leading to more power in fewer boxes than ever before. Wireless mics and in-ear monitors became ubiquitous, computerized audio playback appeared and became more sophisticated, as did network audio distribution. The era saw the ascendancy of self-powered speakers and line arrays, both of which previously existed but now got optimized and grew in popularity. Audio measurement went from clumsy lab analyzers to laptop software suitable for use on any show.

Visual media transitioned from film to video and from analog to digital, killing off videotape and film projection and giving rise to the video server. Video projectors evolved from the early days of “How bad is it going to look?” to inexpensive, very bright, high-res performance, thanks to the DLP chip, which facilitated the development of projection mapping and—along with affordable high-quality cameras—the widespread use of image magnification. Video walls, originally analog, got cheaper and better with the arrival of the blue LED and, eventually, went high resolution and digital. Lasers, which began disappearing from shows, resurged, thanks to air-cooled and “white” units and affordable projectors. Show control and other forms of automation and

integration moved out of theme parks, landing on general-purpose computers backstage at live shows. Other technologies—like pyro, fog, and smoke control—evolved and became more systemized; new technologies, like performer motion tracking, appeared and matured.

**Maturity**

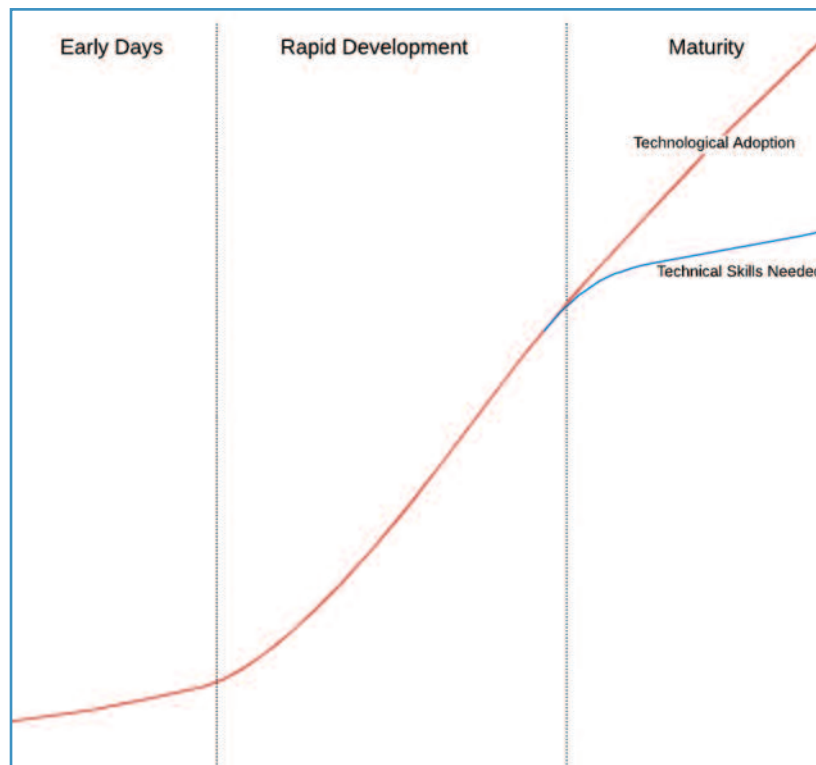
Picking a year where today's show technology became mature is the biggest challenge; I've chosen 2010. Early on in this period, technologies from the previous two eras became widely available and mainstream: audio networking, “holographic” displays, video walls, projection mapping, and RDM for lighting control. A few new technologies are still developing but are not yet mainstream: audience interactive lighting (light-up bracelets, etc.), LED drones, etc. We're also waiting for video signal distribution to fully (and cheaply) move onto Ethernet in a standard way; this should happen relatively soon.

As the evidence suggests, show technology has standardized to the

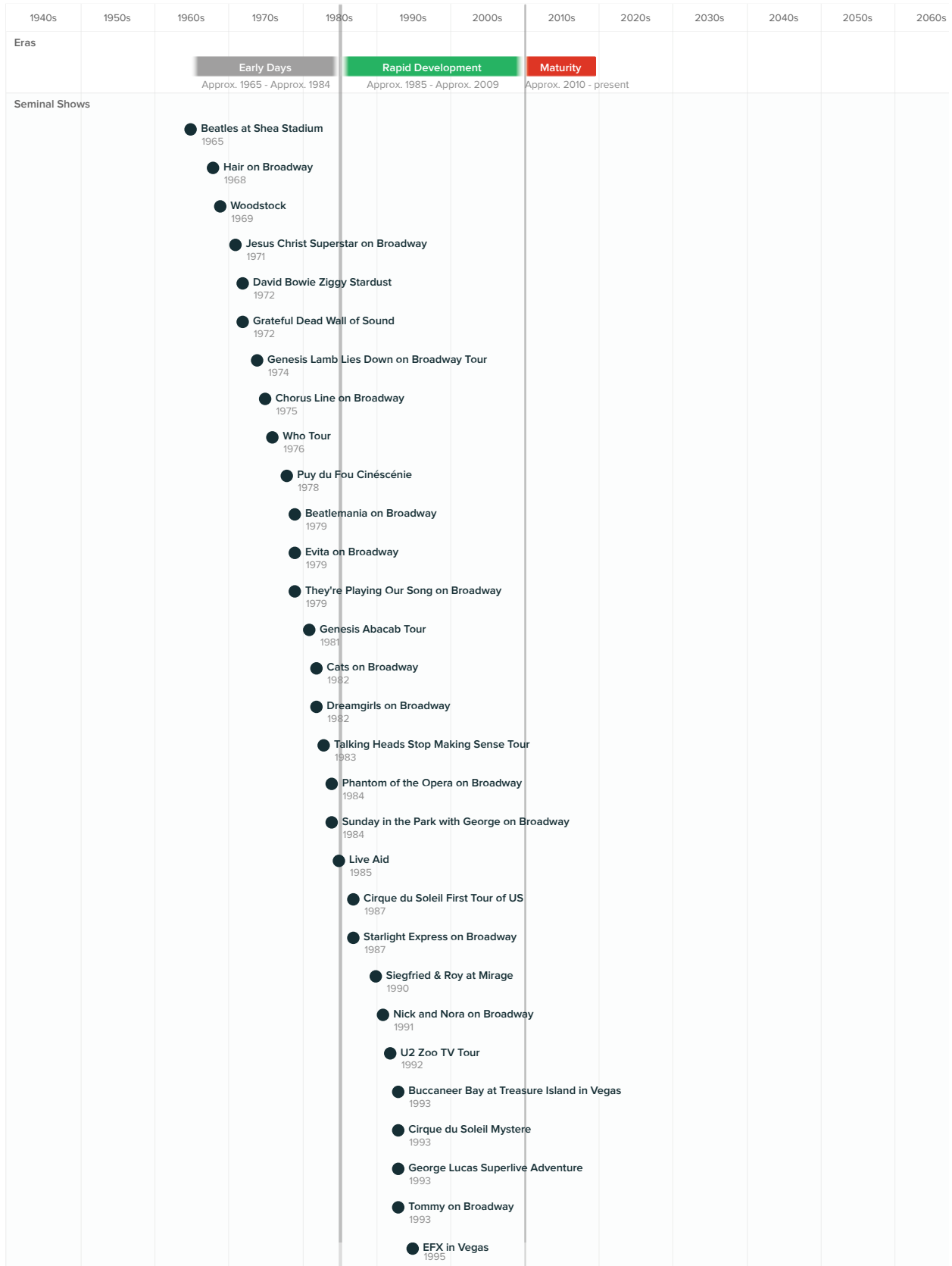
point that most devices in use today need only rigging, power, and data delivery, the basics of which are pretty well sorted out. With this foundation in place, technological change moves away from individual elements—truss, chain hoists, speakers, moving lights, video walls, and laser projectors—into areas with fewer physical creative limitations: software, integration, and managing all of it. Of course, there will always be innovation and development, but today we have a robust tool kit, the capabilities of which designers are still exploring.

**Learning curve**

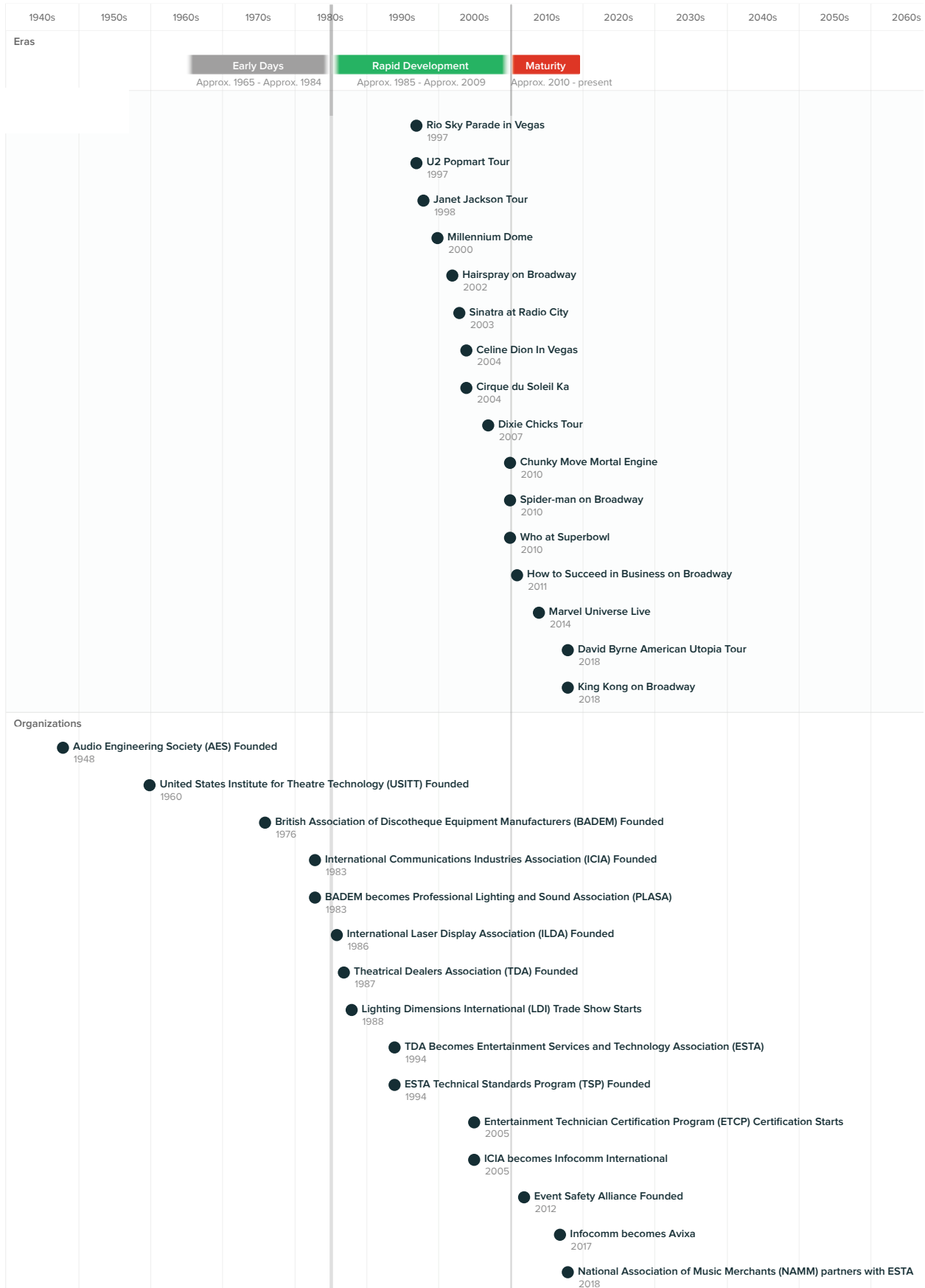
The learning curve has flattened out a bit in the Maturity period. While the level of technical knowledge required for successful entertainment technicians has increased massively, you don't need new technical skills to do more of the same thing. In addition, many skills now are common across many departments, especially in my big three: rigging, power, and data. Here's a contrived, unitless graph expressing this idea:



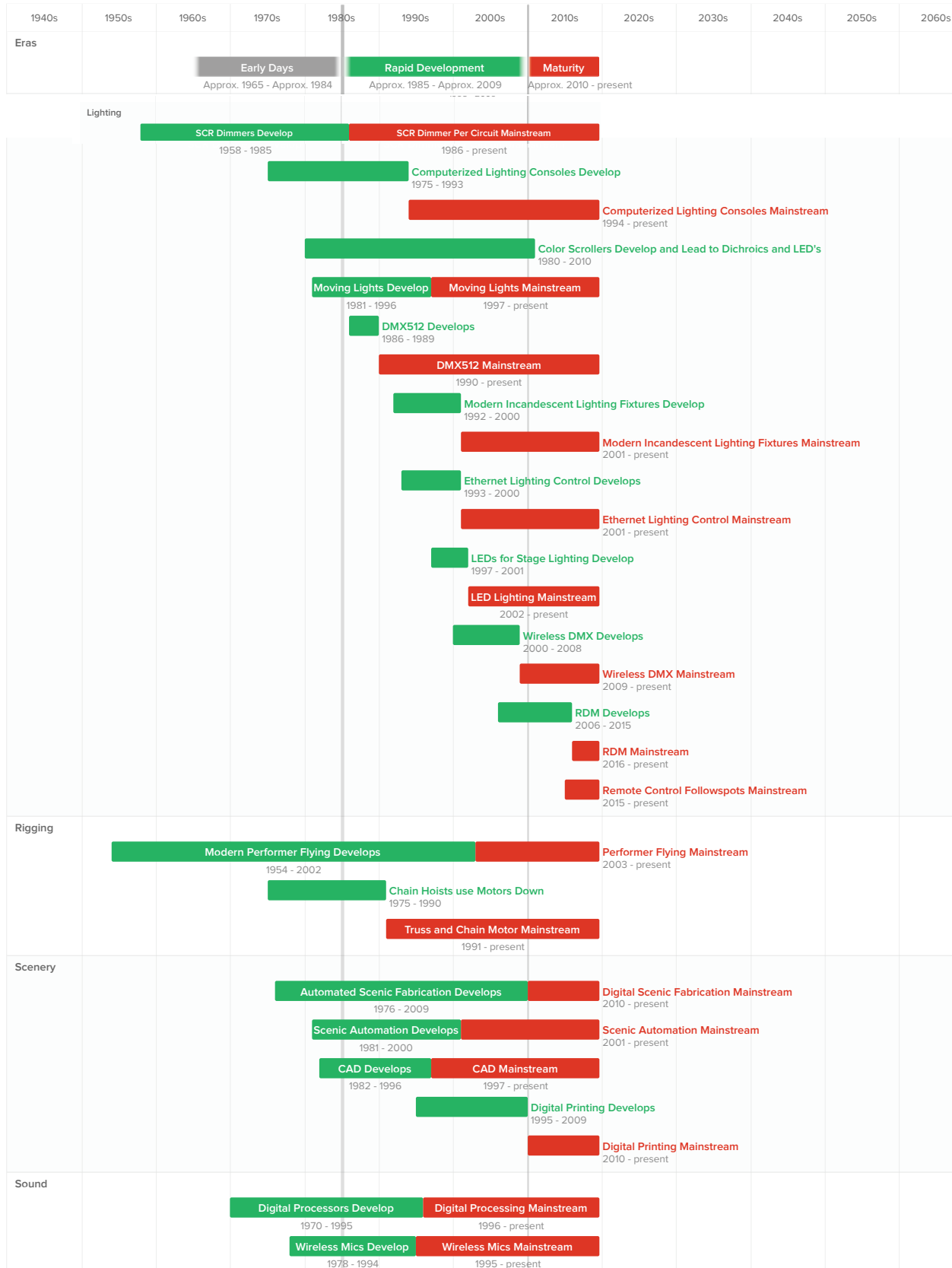
# John Huntington's Show Technology Development Timeline



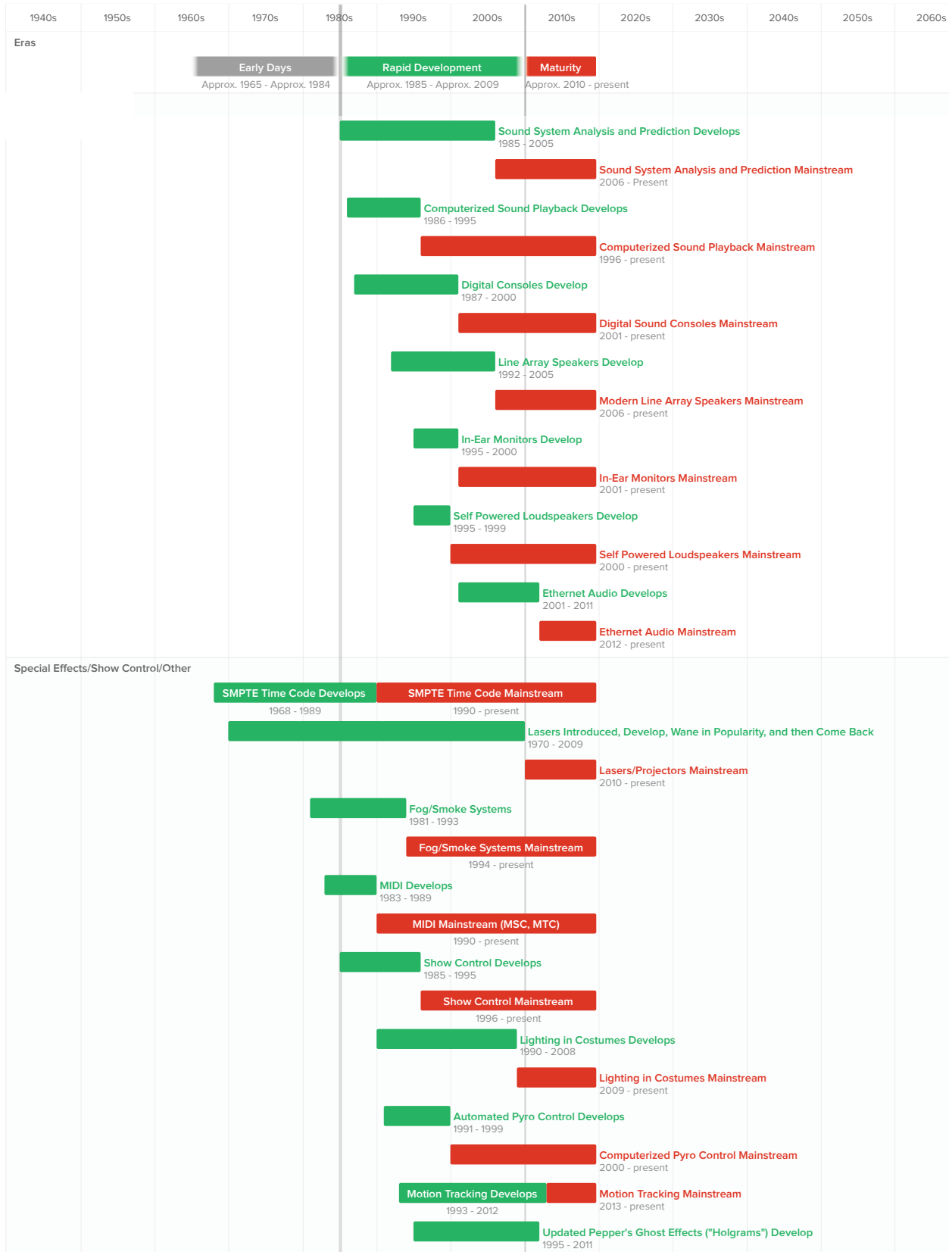
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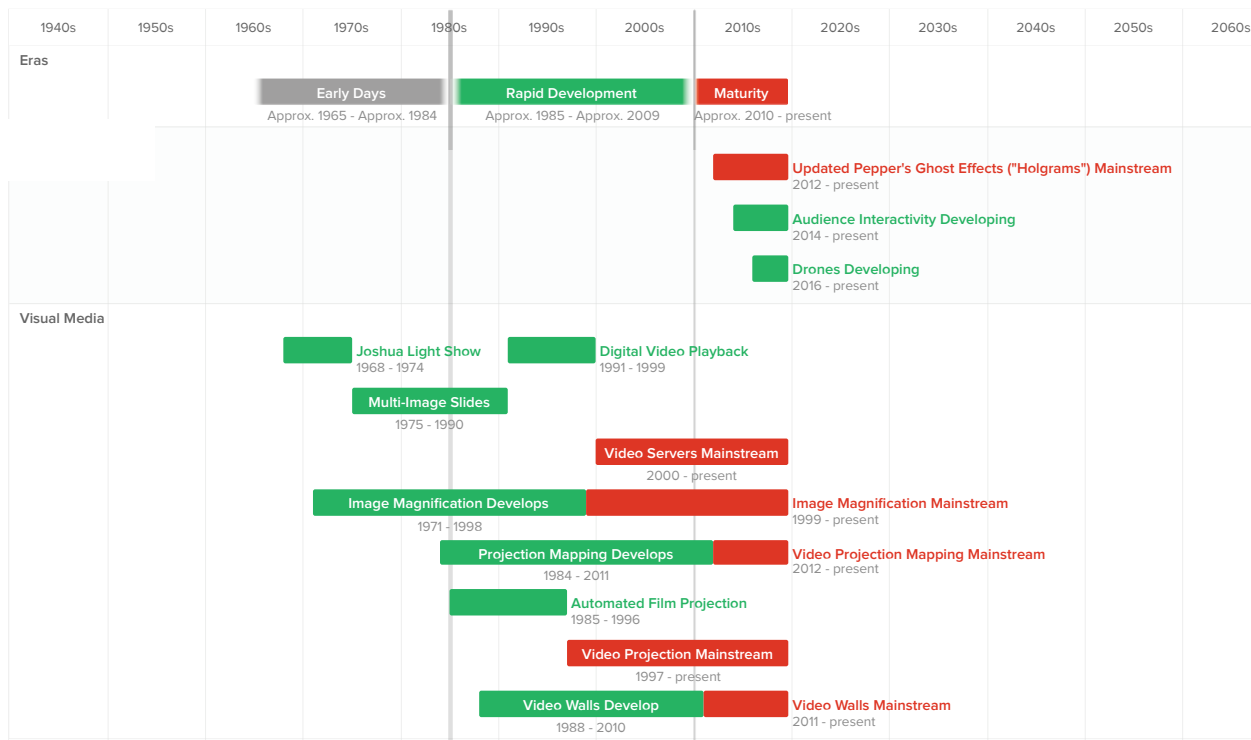
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**Impacts of maturity**

For this essay, I spoke to some of the industry leaders who led us through this transition. Bran Ferren, chief creative officer of Applied Minds, says, “It would be fair to say more changed in theatre and theatrical presentation design and technology than at any other time in history.” Jere Harris, chairman and CEO of PRG, says, “I think that it was a 95% craft industry when I started in the ‘70s and I would say today it’s 75/25 or 80/20 technology-driven craft.”

“The industry has gone through these step changes,” says Adam Davis, chief creative officer of TAIT. “Those step changes have been massive and have changed our world, but they do seem to be fewer and farther in between these days.” Steve Terry, director of standards and industry relations for ETC, says, “The level of technological maturation over the past three decades has produced an unprecedented end-product on stage.” Josh Weisberg, president of Navolo Audio Video and senior advisor to WorldStage, recalls, “As late as 2006, I can remember trying to con-

vince corporate event people to use media servers and people were saying, ‘Oh no, no computers on my show.’ And now we take it on faith that we can use a computer and it’s going to work.”

“This stuff is accessible now,” says James “JT” Tomlinson, the legendary automation and production manager. “In my early days, you made everything you needed because it wasn’t available. Right now, there’s a Sears catalog of available technology.” “One of the ways I look at it is in evolutionary terms,” explains Bob McCarthy, director of system optimization at Meyer Sound. “We were there during the Cambrian explosion, the point where, all of a sudden, all these species began, and every mutation was tried. Certain ones prospered, others failed, and others mutated again. What really strikes me is how diverse the system approaches were at that time—all these different things were tried and now we’ve reached a very different stage where some forms have dominated, and the amount of variation is quite small.”

Compare a show from 10 or 15

years ago it to an equivalent one today. You’ll often see more technology, but you won’t see much that is new. Tomlinson says his last few shows “have combined the same things, again and again. It’s so much easier these days, and there are not so many soldering irons in the room. People used to laugh at me because I wouldn’t use something unless I could modify it first. Now, that’s the last thing I want to do. I want to find a box off the shelf that does what I need, and if I need two boxes to do two different things, that’s fine.”

Weisberg says, “In the business mainstream, we’ve hit a stasis point; the designers have become so conversant with the tools out there that they use them as a painter would use a paintbrush: Let’s use an LED screen here because that’s the best tool to use. Let’s use a directional sound environment because that works. The toolbox is pretty big. It’s accessible.”

Davis adds that, today, “the real innovation is about packaging and speed. We’re trying to take more spectacle and move it quicker and faster, which allows us to do more shows

and more ticket sales.” He cites as an example Tait’s magnetic staging system, which allows massive show decks to be assembled rapidly. “That took years to figure out, but it’s not something the audience member sees as an individual piece. It allows us to do these crazy, complex spectacles that you couldn’t imagine doing 20 years ago because the technology to move them and make them reliable wasn’t there.”

### Cheaper/easier/faster

One benefit of a mature (and larger) market is that products are cheaper, easier to use, and can be deployed faster. Of course, big tech for big shows remains expensive, but it is less so (or the same cost but more powerful) than it was. You can buy a \$2,000 sound console with the capabilities of a \$50,000 mixer from 10 years ago. You might not want to mix the biggest band on it, but you could. “When portable radios went from AM to FM and transistors,” Tomlinson says, “we said, ‘Thank you space race.’ Now, in our industry it’s, ‘Thank you Rolling Stones and U2 and Genesis.’ Those shows had big pocketbooks and they developed technologies. Lasers used to be massive things with tremendous programming time, not to mention the maintenance and so forth. Now you buy something off the shelf, and it gives six beams at once; you sit there with your laptop, saying, ‘Give me 20 dots on this circle.’ And you can fit it in the trunk of your car.”

“It’s still a craft business,” says Harris, “but now it’s become the art of deploying and integrating technology into a craft. *Phantom [of the Opera]* was a mammoth undertaking. If I wanted to do the same show today, it would be much, much simpler, because we had to write code for everything that needed code. Today, the code is embedded in the processors and the chips.”

“I look at what I need to do on a sound system today,” says McCarthy, “versus what I had to do to the system 25 or 30 years ago. Much of the optimization is already in the box, so

much of my work is done. The big pieces take care of themselves. It’s a matter of assembling the multiple parts into a whole.”

“Twenty years ago,” Davis says, “we could have a simple automated system with some cues that could be programmed in about 10 minutes.” These days, he adds, more skilled people are needed up front, but the benefit is that “we can do a lot more with it. You can have a hundred things synchronized and driving each other, making real-time decisions and being reactive.” Even with all this development, the industry still moves at a blinding speed. For major concert tours, Harris says, “We get a call 12 weeks, 20 weeks out. A Broadway show is eight to 12 weeks. No matter how big, we’re going to do the show. Here’s the bid session, here’s what we need, we want it in 12 weeks. It’s amazing what our industry does.”

From a creative perspective, this process of standardization brings sophisticated show technology into the hands of creative people outside traditional industry boundaries. Think of the insane home Christmas light displays, haunted houses, ubiquitous escape rooms, and new forms of theatre that have come about. “The more interesting stuff going on is in those underlying areas,” Weisberg says. “I see artists accessing certain aspects of the toolkit and using them in really innovative ways.” “The unfunded novice now has access to mature development tools,” Tomlinson says. “It opens up the art of entertainment to a younger or wider crowd.”

### Professionalism, certification, and standards

The maturation of show technology has led to a profound increase in professionalism of our crews, driven in large part by industry standards, both technical and safety-related. Terry says, “We have reached the point where we can afford to spend time and money on creating rational interoperability and safety standards. In the past, we did whatever needed to be

done, in the-show-must-go-on tradition. Now, we need to make sure that we’ll be allowed to do those things and that different manufacturers’ equipment will work together. That’s the role of industry-driven non-profit standards development organizations like the ESTA Technical Standards Program.”

Also available today is a large body of codified knowledge regarding safe and effective usage of show technologies, thanks in part to ESTA’s Entertainment Technology Certification Program (ETCP), which offers meaningful certification for rigging and electrical work. After some initial push-back, certification has really taken hold. “The younger folks got it, but with the older folks I think there was some fear involved,” says Adam Braunstein, a third-generation stagehand who is now vice president of IATSE Local One, its director of training, and IATSE house head at Madison Square Garden. “This stuff was taught from generation to generation and the reaction was, ‘How can you tell me that my father and my grandfather or my father’s friend was wrong?’ Now people are learning these skills in college and we had to keep up with it. The only way to stay current is through training, education, and technology.”

These developments are important because the rigging found on an arena ceiling today for a one-off show would be mind-boggling for someone from the 1970s. Big electrical power systems in the 1980s were kind of scary, knowing what we know now. We now have a new set of certified people who can build these massive systems safely. And, through newer organizations, such as the Event Safety Alliance, the industry is effectively addressing other concerns, such as severe weather threats and crowd safety.

### Education/career development

We know how to teach this stuff, too, and, in addition to traditional theatre conservatories and colleges focused on the broader world of entertainment technology (like mine), professional



and continuing education is widely available. A growing industry needs an unending stream of trained, skilled new blood; it also must update the skills of older workers. Bill Sapsis, president of Sapsis Rigging, says, “Requests for training have quadrupled and I’m providing more training in more places than ever before. It’s an ascending spiral that benefits everyone.”

In recent years, IATSE Local One has negotiated into its contracts permanent funding for a training, education, and technology (TET) fund, which, Braunstein, says, is “a benefit, like your health care, dental, your pension.” The fund is focused on updating and maintaining the skills of all members. He adds, “You can be the greatest programmer in the world and maybe you’ll program two shows a year. But everybody needs to know how to get gear out of the box and plug it up and to get the video on the screen or sound through the speakers.”

“Part of the maturation,” McCarthy says, “is a little less belief in magic. But the skills levels, on one hand, have gone down, because if everything is going right, you know, we’re just all going great. I could fly a plane as long as the computer was actually doing it. If something went wrong, the fact that I had no skills would be a real problem. It’s difficult to become an expert without doing some serious groundwork.”

## Networking and coding

Perhaps I’m biased—I wrote a book on the subject—but one area that deserves special mention is networking. It came relatively late, so many longtime technicians never got much background in it. Today, it’s the backbone of nearly everything we do and a main platform for future integration and expansion. Weisberg says, “The network engineer is going to be the most important person on the show, because they’re going to create the architecture that everyone is going to

feed into. It’s really just a way of getting packets from one thing to another. That’s where things will continue to be interesting.”

A lot of future development has moved into software, and at least some rudimentary coding concepts will need to be added to the technician’s basic skill set. Shows increasingly need people on-site with some coding experience, who can work quickly under high pressure on things like media servers, scenic automation and integration, and show control.

## Management

A lot of what we did early in my career was a kind of science project—not only technically, but from a management perspective: We had no idea if it was going to work or keep working, or how long it was going to take, because no one had ever done it before. These days, the best producers have vast experience; they know what permits are needed and who to call; they work with suppliers who are old hands with technology. They also know what they don’t know. Aside from weather delays or logistical challenges, there are fewer excuses for working unplanned, unexpected all-nighters.

## Future developments

Of course, show technology will continue to develop, but innovation now rests on a solid platform of mature technologies. Weisberg says, “The future lies in using our toolboxes to create an intimate environment that people can walk away from, feeling that their perspective has been changed, about art or theatre or dance or food.” Terry says “Increases in complexity of technology mean increased spending in that realm. The last 20 years have proven that the consumer of more expensive entertainment products will foot the bill. But who knows how much longer or to what degree that will be true?”

And while there’s a lot of buzz at the moment about virtual and aug-

mented reality (VR and AR), I saw both these things in the 1990s; while what I’m seeing today is cheaper and more ubiquitous, it hasn’t really advanced all that much from the audience perspective. And, as Ferren says, “If theatre isn’t a virtual reality where you’re getting people to suspend their disbelief, I don’t know what is.” We have had the tech for VR for a long time; what I haven’t seen yet is that killer application for live shows. VR in a public setting to me is inherently anti-social, although, of course, it’s really cool for gaming, previsualization of show designs, and so on. AR is useful for apps, and even for control of systems, but I haven’t yet seen it as the core of a compelling live performance. (A live performance made for a TV audience would be another matter, but that’s really a TV production at that point). However, the desire to make this work in the live setting is widespread, and there are very talented people interested in making it happen. Scott Faris, director of many groundbreaking, highly technological, live shows says, “The one thing I’ve often wanted to conquer is how to take the excitement of the gaming experience—the beauty that people get—and combine it with the intensive experience of augmented reality and virtual reality. How do we create a group experience that uses some of that technology? I think there’s a possibility to take that which is an individual experience and move it into a collective experience.”

One true game-changer I can personally envision would be a true volumetric image display—a real hologram—like we have seen in science-fiction movies. But what are inaccurately called holograms today really are updated versions of 19th-century Pepper’s ghost effects; they don’t work for large audiences, since they don’t allow you to truly look around the character in 3D. That Princess Leia “Help me, Obi-Wan Kenobi” technology is a lot harder than many people seem to think. This is an example of which a clear demand exists, but no one has

yet figured out a way around the technological and physics law obstacles. Talking about show technology in general, Tait's Davis referred to a version of Pareto's 80/20 rule: "If you look at a lot of the technology that has matured, we've hit that 80% mark. There's 20% left to do to refine it, but that will take 80% of our effort."

### Always about the experience

One thing that has not changed, however, is the power of the live experience. "People want to be with other people," Harris says. "People continue to go to theatre and concerts because they want to have that experience. The same as baseball and football. And E-sports is going to be tremendous. It will become much easier to do a lot of the things that weren't possible 30 years ago." Ferren says, "It's important that we remember what is actually unique about theatre and why this thousand-year-old technology is still relevant and, in many regards, superior to others. The ingredients are simple: The first is a great story. The second is living actors who we care about and who bring the story to life. And the third is the context and a relevant setting into which you place them. Our job as designers and creative technical professionals is to provide that context to enhance and develop the story and to enable the storytellers to accomplish things that they wouldn't otherwise credibly be able to do. To make it easier for the audience to suspend their disbelief."

### Looking to the future

We can't see the future, but I'm willing to wager—without going too far out on a limb—that, a decade from now, a show's backstage won't look much different from a similar show today. It will have rigging on chain hoists, power on cam-locks, and data over Ethernet. The usual things like moving lights, line arrays, wireless mics, video walls, and truss will likely be there too; there's too much invested in these fun-

damentals to jettison them in the short term, even if something new comes along. And I predict that the control systems will be increasingly linked together (not shared or common but linked).

But I've been wrong before, and Ferren, ever the future thinker, says, "I would argue that the theatrical lighting, sound, imaging, and automation revolution has barely begun. We're at the very dawn of this, with still largely inadequate tools and devices that are barely good enough to squeak by. We are at Kitty Hawk, not landing the first man on the moon. This is why I think it's such an exciting time, because so much is in the pipeline of fundamental technologies: microprocessors that can embed in light sources whose cost is effectively zero, high-speed network protocols that are highly robust and secure, wireless that is robust and works in the most complex of situations." He mentions active materials, imaging technology, and other emerging technologies, adding, "When those things become generally available, it's up to designers to come up with novel ways to use them to delight and amaze our audiences. The creative imperative is to keep advancing the state of the art."

### Conclusion

Writing this piece, I struggled with the word "maturity," but whatever term we use, something significant has changed in the last three-and-a-half decades. Virtually nothing in my approximately 132,000-word book, the first edition of which I wrote in the mid-1990s, was taught to me in school. But I've been teaching that information to undergrads and seasoned union members alike for a couple of decades, and in the most recent book edition, I cut material out, because of the maturation and standardization.

Wherever we are, and whatever comes next, we've come a long, long way. The Beatles at Shea Stadium started us out, even if, from a show

technology perspective, that live show was a failure. No one in the stands—or the band onstage—could really hear anything. "My wife and my brother will tell you they saw the Beatles, but they choose that word carefully," McCarthy says. He also points out how remarkable it was that "a booking agent could book a Shea Stadium with no plan. There was no technology available to actually stage that show." Today, the industry successfully does tens of thousands of similar shows every year—in tiny rooms and venues far more massive than the now-gone Shea Stadium. We know how to do this stuff now. 📶

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