Audiovisual Technology Standards Support Accessibility:

Societal Inclusion, Emergency Preparedness, and Protection from Harm

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Introduction: Sensory, Physical, and Cultural Disabilities

Throughout history, mankind has sought to overcome his and her disabilities in ingenious ways, leading to advances in technology and medicine, social structures, transportation, and communications. We are all familiar with eyeglasses, crutches, wheelchairs, and a variety of prosthetic devices, for example. These age-old solutions provide comfort and accommodate us on a personal level, enabling us to perform everyday actions- and much more. Accidents, wars, birth defects, and crimes debilitate people in many ways that must be overcome in order to lead a "normal" life. We seek ways to accommodate people with these special needs in our buildings and communities out of compassion, in the interest of inclusion, of necessity, and in the interest of upholding the human spirit. This idea of providing people with disabilities with a similar experience is broadly described as "accessibility."

Many of the recent advances in accessibility have come from the audio and video industries, whereby computer and audiovisual technologies compensate for one's disabilities with enhancements of one's abilities. Conversely, many physiological problems have been created by these technologies, including well-documented cases of carpal tunnel syndrome, (computer keyboards and mice) cancer, (cell phones,) and hearing loss (portable media players.) In the United States, some of these accessibility concepts have been written into regulations in the form of the Americans With Disabilities Act[1]. Due to the increasing amount of these applications and a rising need within the population, a variety of standards have been and are being created to lead industry into unified paths of technology development. This paper reviews some of the concepts of how audiovisual technologies are at the nexus of providing accessibility to people with a wide variety of physiological challenges, and how efforts are being made to mitigate the negative effects of the technologies themselves: utilizing the powerful tool of standardization.

Standards are created for many different purposes, accommodating a wide range of phsyiological differences...

Types of Audiovisual Standards and Human Perception

In reviewing the available and emerging audiovisual accessibility standards, it is evident that there are at least three categories that characterize them:

[1] United States Department of Justice, Code of Federal Regulations, Nondiscrimination on the Basis of Disability by Public Accommodations and in Commercial Facilities, Americans with Disabilities Act, Standards for Accessible Design, 28 CFR Part 36, Revised July 1, 1994

1) Standards that provide guidance for enabling people with disabilities to cope with everyday activities
2) Standards that protect people from becoming disabled by the environment and media techologies
3) Standards that define nominal (baseline) parameters for creating useful (intelligible, legible, etc.) systems for people without "disabilities" (but considered to be physiologically normal within age and cultural bounds.)

Standards for measuring sensory perception define the technical aspects of the measuring equipment...

Human perception via the senses is not defined by a single absolute number representing all people. In fact, there is a very wide range of sensory definition and norms; understanding these is an ongoing scholarly investigation into physiology, psychology, and ergonomics. Standards that specify human factors must be written to accommodate variations across the vast spectrum of humanity. This idea is different from many other standards that may be written with absolutes dictated by engineering tolerances. Standards that enable people to see and hear under different circumstances must be framed by the physiological data of real people, not only by the rigid concepts of perfect people with 20/20 vision[2], or "perfect hearing[3]." Instrumentation is under constant development to measure physiology and environmental conditions.

Many of the most common and debilitating disabilities involve the senses, particularly hearing and sight...

Sensory Disabilities

Amazingly, most people with full sensory capacity take their vision and hearing for granted, and do not care for them as well as their other physiology, such as their teeth. Hearing aids and eyeglasses are certainly the most

[2] ANSI Z80.21 – 1992 (R2004): Ophthalmics - Instruments - General-Purpose Clinical Visual Acuity Charts

[3] IEC 60645-1 (2001). Electroacoustics - Audiological equipment. Part 1 - Pure-tone audiometers, IEC 60645-2 (1993). Electroacoustics - Audiological equipment. Part 2 - Equipment for speech audiometry, IEC 60645-3 (1994). Electroacoustics - Audiological equipment. Part 3 - Auditory test signals of short duration for audiometric and neuro-otological purposes. 60645-4 (1994). Electroacoustics - Audiological equipment. Part 4 - Equipment for extended high-frequency audiometry, 60645-5 (xxxx). Electroacoustics - Audiological equipment. Part 5 - Instruments for the measurement of aural acoustic impedance/admittance (Committee Draft, revision of IEC 61027, 1991).

common prosthetic devices, due primarily to aging – but also to environmental factors. The environmental issues that contribute to injury are of the most concern, as they can be mitigated by behavior modification: cataracts caused by sun exposure (remedied by sunglasses use), overly loud music listening (yes, the "rock and roll" culture is mostly to blame), overexposure to television and computer screens, etc. Audiovisual technology can be specifically tailored to people with these sensory disabilities, considering that by its nature, audiovisual is about sight and hearing. Curiously, standards that concern some of these issues are only now emerging.

Standards apply to people with partial hearing loss and total hearing loss (deafness)…

Hearing Loss and Deafness

Helen Keller famously noted that "Blindness cuts you off from things; deafness cuts you off from people.[4]" There are two different approaches to aiding people with partial hearing; only one for deafness. Audiovisual technologies are applied to both of these. In the case of deafness, solutions exist to provide information through eyesight. Text or sign-language information delivered by these technologies must be large enough, have adequate contrast, legible

[4] *Helen Keller in Scotland: a personal record written by herself*, edited by James Kerr Love (London: Methuen & Co., 1933).

fonts, etc. to be useful. In the case of partial hearing, devices that provide amplification can be applied. However, this amplification must be delivered with proper equalization, intelligibility, a correct level, etc. Emerging standards address these performance issues.

Standards address the prevention of hearing loss...

Noise-Induced Hearing Loss

When an individual is over-exposed to excessive sound levels, sensitive structures of the inner ear can be damaged. This can result in permanent “noise-induced hearing loss” (NIHL). These structures can be injured by exposure to a brief but intense sound, such as an explosion, or from regular exposure to excessive sound levels over time. NIHL can be prevented through the control of sound levels or proper use of hearing protection devices (HPDs), such as earplugs or earmuffs. Standards address both the level of the sound and the exposure time[5]. A staggering amount of people suffer from this condition, and the cost to society is incalculable. Most striking is the fact that much of it can be prevented.

According to the NIDCD, a U.S. Government health research arm[6]:

- Men are more likely to experience hearing loss than women.
- Of adults ages 65 and older in the United States, 12.3 percent of men and nearly 14 percent of women are affected by tinnitus. Tinnitus is identified more frequently in white individuals and the prevalence of tinnitus is almost twice as frequent in the South as in the Northeast.
- Approximately 17 percent (36 million) of American adults report some degree of hearing loss.
- There is a strong relationship between age and reported hearing loss: 18 percent of American adults 45-64 years old, 30 percent of adults 65-74 years old, and 47 percent of adults 75 years old or older have a hearing impairment.

[5] Occupational Safety and Health Administration (OSHA): Occupational Health and Environment Control, Standard Number 1910.95, Occupational noise exposure
[6] National Institutes of Health; National Institute on Deafness and Other Communication Disorders: Statistics and Epidemiology, June, 2010

- The NIDCD estimates that approximately 15 percent (26 million) of Americans between the ages of 20 and 69 have high frequency hearing loss due to exposure to loud sounds or noise at work or in leisure activities.

Since Noise-Induced Hearing Loss is a renowned problem, why is it hidden…

Aging population, loud music

There are different categories of people with NIHD: 1) people with normal, age-related hearing loss (presbycusis), 2) people with high risk factors such as diabetes or smoking, 3) people affected by industrial noise and loud music, and 4) younger people with "earbud" induced hearing loss. The older workforce suffered hearing loss before there were regulations guarding against exposure, during the prosperous industrial era of the mid and late 20th century. This type of hearing loss is now a concern for developing nations that have not yet adopted standards to guard against it (see OSHA, below.) This is a hidden epidemic. Our vanity has led to either denying the problem, or hiding it with smaller and smaller, nearly-invisible hearing aids. The "ticking time bomb" in this case is the younger generation using portable media players, aware of the issue but denying that it will affect them. There are no standards for acceptable levels of "earbud" use, although some manufacturers have begun to limit the maximum loudness level of their portable media devices;[7] in the case of Apple, it was partly in response to noise level regulations in France.[8]

Sometimes standards become laws: in the forms of codes or regulations...

Fortunately, there are standards that have become laws to govern maximum levels of environmental noise in the United States. The graph below indicates the levels and durations that are considered safe by OSHA (Occupational Safety and Health Administration.) People with a real-world understanding of what these data points represent are startled at how real and easy the damage to hearing can be.

[7] Cohen, Peter, "iPod Update Limits iPod Volume Setting," Macworld, March 2006
[8] Cohen, Peter, "Apple Sued for iPod Hearing Loss Risk," Macworld", February 2006

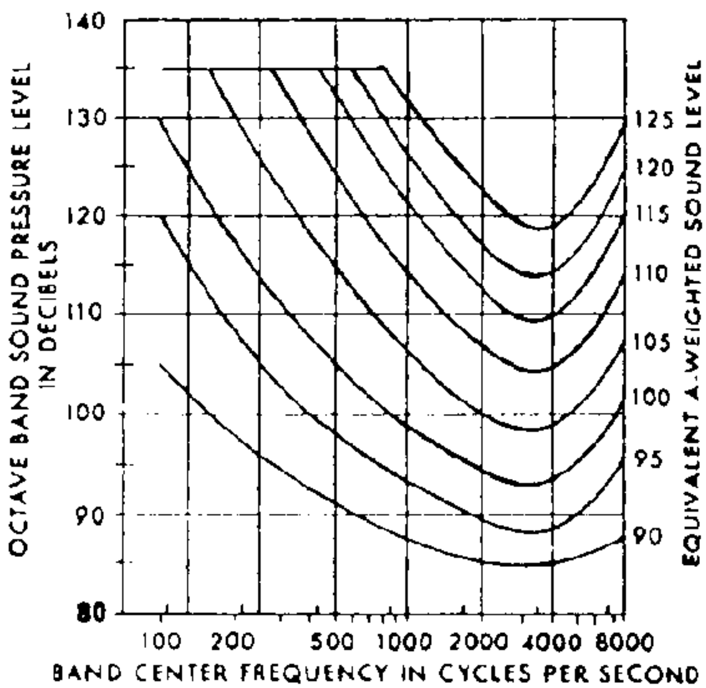


FIGURE G–9

This particular data set is now contentious and under review, nevertheless these guidelines are very useful and effective. Both the data points themselves and the fundamental nature of the measurements are being considered. Questions such as, "does the dBa adequately characterize hearing?" and "are these levels appropriate when considered with statistics collected since the standard was derived?" still remain.

Does accessibility mean everyone should be able to hear, including people that can hear…

Live Sound

Partial hearing loss of an audience should be, but is not always, a concern for designers of audiovisual systems. Taking into consideration the broad variations in hearing ability described above, there are factors in sound design that must be holistically addressed. The design must consider the "system" as a whole, which includes the audience's ears; the room with its acoustical nature, and the technology used to reinforce the sound, be it speech, music, or recorded program material. The sound in the room - the interaction of the system with the acoustics - must be characterized in terms of the domains of time, energy, and frequency. Each of these interacting parameters affects the way we hear, and adds further complexity to the way we think about hearing loss. A common misconception, for example, is that if the speech reinforcement system cannot be understood, it is not loud enough. Turning the volume up is rarely the solution: usually there are issues with distortion, reverberation, equalization, ambient noise, etc.

When these issues are examined, it is apparent that accessibility to a venue with sound as a primary product must be equipped with a "quality" sound system. Defining this idea has been elusive and subjective, however, as there are so many "experts" and ideas. To complicate matters, the real-world economics of venues do not always provide adequate budgets for this quality. Yet, quality is not necessarily expensive, and we can all agree that every paying customer deserves to hear the program. Without standards in this area, however, it has not been possible to define what a quality sound system's performance parameters should be.

The major standards developers (SDO's) in this area have been the AES (Audio Engineering Society) and the ASA (Acoustical Society of America.) These venerable associations have created countless standards that define many of the physiological, technical, architectural, and acoustical parameters of sound. These ideas are used throughout the world for characterizing many types of systems, in venues, in personal devices, underwater, etc. The test and measurement equipment specifications, the fundamental organization of audio science and the interaction with humans has undergone exhaustive research. This body of knowledge can be highly theoretical and esoteric however, and making it accessible to real-world practitioners of sound system design and installation has been challenging.

Why is there not a single set of rules and standards that govern the quality of a sound system…

The InfoComm Sound System Performance Standard Suite

Recognizing the need for practical and readily verifiable audio system standards, InfoComm International, an ANSI Accredited Standards Developer (ASD) has embarked on creating a "suite" of standards that will establish the baseline of audio systems quality. A fundamental tenet of this idea is that many people who are unable to "hear" (cannot understand the program material) in venues cannot discern whether their issue is with their hearing, their hearing aid, the sound system, or a combination of these. The parameters discussed above, Time, Energy, and

Frequency, are all accounted for. The standards completed, in development, or under consideration, are: 1) Nominal Sound Pressure Level, 2) Audio Coverage Uniformity[9], 3) Room Equalization Curves, 4) Undesirable Sound (distortion, hiss, hum, etc.), and 5) Reproduced Speech and Reproduced Music Quality. The simple (yet complex!) intention is to connect these standards in such a way that conformance to all five and the ASA Noise Criteria (NC) Standard[10] will ensure venue owners, architects, etc. that all attendees will experience quality sound, and that they will be able to understand and appreciate the program no matter where they are in the venue.

There is formal recognition that the quality of sound in architecture is important…

Green Building Standards Include Acoustical Standards

One of the major trends in modern architecture and construction is "green buildings." This concept includes ideas such as energy efficiency, renewable materials, resource conservation, and human comfort. The predominant green building guideline, LEED (United States Green Building Council Leadership in Energy and Environmental Design) acknowledges sensory accessibility in the "LEED for Schools" Rating System. Points are awarded for conformance to the ASA "Classroom Acoustics" Standard[11], ensuring that the acoustics of a classroom are designed for optimal speech intelligibility. According to the USGBC, "Green schools are healthy for students, teachers and the environment. Built right, green schools are productive learning environments with ample natural light, high-quality acoustics and air that is safe to breathe." How appropriate that in the 21st century we are finally paying attention to the fundamental purpose of a classroom: providing accessibility to students to comfortable and intelligible spaces in which they can clearly see the content on screens – and focus on learning.

Sometimes it is necessary to augment a sound system for attendees with partial hearing loss…

Assistive Listening Systems

[9] ANSI/INFOCOMM 1M:2009 Audio Coverage Uniformity In Enclosed Listener Areas
[10] ANSI/ASA S12.2-2008 American National Standard Criteria for Evaluating Room Noise
[11] Acoustical Society of America ANSI/ASA S12.60-2002 (R2009) American National Standard: Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools

At some point it is impractical to expect a sound reinforcement system to allow people with more severe hearing loss to hear the program. A Personal Listening Device is a specialized audio subsystem, called an "Auditory Assistance System" or "Assistive Listening System" to allow close listening where required. There is a requirement in the ADA to provide these systems, and in Section 4.33.7 (Types of Listening Systems) they are described as follows. "Assistive listening systems (ALS) are intended to augment standard public address and audio systems by providing signals which can be received directly by persons with special receivers or their own hearing aids and which eliminate or filter background noise. The type of assistive listening system appropriate for a particular application depends on the characteristics of the setting, the nature of the program, and the intended audience. Magnetic induction loops, infra-red and radio frequency systems are types of listening systems which are appropriate for various applications." The ADA code describes how to calculate how many of these devices are required in a venue, where the seating should be placed in conjunction with the transmitters, etc. These devices are tremendously useful to people with partial hearing loss, and can be individually adjusted by the user. Their integration within a venue is carefully planned and connected to the audiovisual system.

Standards implementations are connected to other standards, sometimes unexpected, beyond their scope …

As described above, there are three major techniques used to broadcast the audio signal to people using the ALS: Radio Frequency (RF,) Infrared (IR,) and Inductive Loop. Each of these is effective, and systems designers consider which is best for each venue, based on a variety of issues. Due to the frequency allocation changes brought about by the global rollout of digital television, many of the traditional radio bands used for devices such as wireless microphones and ALS have been shifted or eliminated. These “RF White Spaces Issues” are covered by new standards[12], and must be considered when installing the RF versions of ALS. The RF implementations are very popular, and there are solutions available to these problems.

There are considerable standards defining visual supplements of program material for deaf people…

Video Display Systems with Deafness Accessibility

In the case of complete hearing loss, individuals with sight have options for communicating visually. Many of these options are augmented by audiovisual technology, which is still developing in several areas. The two main options are text information and sign language. In the case of text, the use of computer displays, presentation displays, and signage are areas of considerable interest in the marketplace at present: much of this is due to the desire to provide accessibility.

Closed Captioning is a technology familiar to many who have watched television: this is an enormously effective means for deaf people to enjoy entertainment, to be informed, and to be educated. The spoken word in the program and some narrative as to the sound effects and ambient noise in the program are typed into data terminals, and displayed in a box somewhere on the presentation display. This technology has been a regulated requirement in the United States for 20 years, since Congress passed the Television Decoder Circuitry Act. The Act requires that television receivers with picture screens 13 inches or larger conform to a standard that defines built-in decoder circuitry designed to display closed captioned television transmissions.[13] This law was enhanced in 1991 to include all cable television STB's (Set-Top Boxes.) This powerful idea was an amendment to Section 303 of the Communications Act of 1934 (47 U.S.C. 303). Since the mandatory deployment of digital television, this technology has completely changed. Standardization of these digital protocols has been developed by the CEA (Consumer Electronics Association) and the EIA (Electronics Industries Alliance.)[14]

[12] Federal Communications Commission: FM Broadcast Translator Stations and FM Broadcast Booster Stations 47 CFR Part 74

[13] Public Broadcasting System Engineering Report E-7709-C, May 1980, as amended by the Telecaption II Decoder Module Performance Specification, National Captioning Institute, November 1985

[14] EIA-708-B, Digital Television (DTV) Closed Captioning

Visual Paging is a related technology to Closed Captioning. Where CC is a regulated, mandatory component of broadcast, Visual Paging is a closed-circuit variation that applies to facilities where digital signage and public announcement (PA) systems are prevalent or mandatory. This includes most large venues such as public transportation terminals- airports, train stations, bus terminals, etc., and large public facilities - sports arenas, entertainment complexes, etc. Visual paging describes a technique whereby public address system announcements and the pages to individuals are keyed into computers, and displayed via the digital signage in the facility. This is an emerging technology that is gaining rapid importance, and is included in the ADA codes. It is also a code defined in the United States; The Air Carrier Access Act: Airport Facilities. The Air Carrier Access Act prohibits discrimination on the basis of disability in air travel and requires air carriers to accommodate the needs of passengers with disabilities. In 1990 The Department of Transportation issued a rule defining the rights of passengers and the obligations of air carriers under this law.[15]

[15] United States Department of Transportation Title 14 CFR, Part 382

Audible Alarms and Visual Alarms are another category of communications that are not necessarily spoken word pages, but also tones. Because of the emergency implications of paging, the idea of visual paging is being implemented as part of the evacuation systems of buildings. This technology ties into the mandatory necessary codes that are based on the National Fire Protection Association standards in the United States. Specifically, emergency evacuation, visual alarms, audible alarms, and aspects of the intelligibility of these systems are covered in NFPA 72[16]. This describes "the application, installation, location, performance, inspection, testing, and maintenance of fire alarm systems, fire warning equipment and emergency warning equipment, and their components." Accessibility to these emergency announcements is paramount and considers both blind and deaf occupants. These codes are also components of the ADA.

[16] NFPA 72: National Fire Alarm and Signaling Code, 2010 Edition

Deaf participants in live events may benefit from a newer technology called "Image Magnification," or "IMAG." This simple idea utilizes video cameras and presentation displays to show the presenter at a podium on a large display, such that a large audience can see the performance or lecture. Often this medium is used for sign language interpreters as well, providing accessibility to large deaf audiences. The prevalence of these events has given sign language an increased public awareness, and has enhanced the awareness of deafness issues.

Standards are under development to ensure the visibility of all of these presentation media…

Presentation Displays and Digital Signs

Visual displays in classrooms, houses of worship, presentation rooms, digital signs, and so many other venues are only legible if certain best practices are followed. InfoComm International, in the same manner as the audio systems described above, is endeavoring to bring standards to these technologies. The nominal target parameters of image size, brightness, and system contrast[17] are the initial areas of standardization. These standards are performance-based and practical by nature, and consider the range of "normal" human vision in the areas of visual acuity and light accommodation. The forthcoming standards build on those developed by SMPTE, (the Society of Motion Picture and Television Engineers,) the SID (Society for Information Display) and THX, an industry consortium standards developer.

Audiovisual standards provide accessibility for people with various physical limitations to communicate …

Physical Disabilities: Speech Recognition

Individuals with physical, cognitive, sensory, and learning impairments may have difficulty accessing computers. Traditionally, a computer user accesses a computer with a standard point and click mouse and a QWERTY keyboard (named for the top left-hand side of the rows). The computer takes the information that is inputted and processes it. Individuals with physical, sensory, or developmental limitations may not be able to use these standard input devices effectively and may benefit from using speech recognition software. Standard computer input devices are keyboards

[17] INFOCOMM DRAFT STANDARD 3M: Projected Image System Contrast Ratio

made for typists who use two hands and ten fingers; speech recognition software is made for computer users with a variety of limitations, including individuals with no hand or finger movement. Speech recognition technology has several components: noise-canceling input, a speech recognition engine, vocabularies, application interfaces, and rudimentary natural-language processing. A related technology is "voice recognition," which refers to voice-print security systems, commonly called voice ID, providing accessibility to people unable to enter physical security codes.

Speech recognition began with medical dictation equipment. This technology has had far-reaching application since then. The earliest standard was DSS: an acronym for Digital Speech Standard, an audio file format. DSS was jointly developed by Olympus, Grundig and Phillips in 1994. The DSS format is maintained by the International Voice Association (IVA), which was founded by these companies to ensure that all specifications are defined according to the standard. These companies and others use the Digital Speech Standard file format (.dss) in their handheld audio recorders. Many other speech recognition standards exist today, such as Microsoft's SAPI and JSAPI computer-based audio engines.

The World Wide Web Consortium (W3C) is the main international standards organization for the World Wide Web. Speech Recognition Grammar Specification (SRGS) is a W3C standard for how speech recognition grammars are specified. A speech recognition grammar is a set of word patterns, and tells a speech recognition system what to expect a human to say. For instance, if you call a voice directory application, it will prompt you for the name of the person you would like to talk with. It will then start up a speech recognizer, giving it a speech recognition grammar. This grammar contains the names of the people in the directory, and the various sentence patterns callers typically respond with. This Standard has been developed as part of a family of voice recognition protocols by the IETF (The Internet Engineering Task Force.)

Accessibility can also apply to societal issues…

Cultural Disabilities: Multilingual Applications and English as a Second Language

An advanced audiovisual technology in use worldwide is the "simultaneous interpretation system." This is a real-time, meeting enhancement technology developed to accommodate gatherings of people who speak multiple languages. Multiple interpreters listen to the presentation, and in real-time, speak the interpreted version into a microphone. This is heard through headphones by people who speak that specific language. As many as ten languages at a time may be common occurrence for meetings of international importance, such as the United Nations. Standards have been developed to define the technical aspects of the SI booths that the interpreters work in.[18] [19] SI may also be accomplished remotely using full-duplex audio CODECs connected to remote interpreters.

Awareness of accessibility accommodations is mandatory for building designers…

Legal Ramifications

As the awareness of audiovisual accessibility technology has spread, so has the demand for every public venue to include all of the accessibility technology possibilities. Awareness on the part of venue designers must include these technologies in order to ensure their smooth integration. The failure to attend to these issues can be costly, and there are already many instances of legal actions taken against venue operators. Two high-profile cases involved the Spy Museum in Washington, D.C., and the San Francisco International Airport.

In the case of the Spy Museum,[20] legally blind visitors were not able to appreciate the full experience of the exhibits. "The investigation was commenced when the Department received a complaint dated August 14, 2004, from Mr. Michael Byington, the president of the Kansas Association for the Blind and Visually Impaired. Mr. Byington, who is legally blind, alleged that he and a group of individuals who are blind or have low vision were denied full and equal enjoyment of the Museum's goods, services and facilities of the Museum in violation of title III of the ADA. Specifically, Mr. Byington alleged that the Museum's exhibits and programs were inaccessible to visitors who are blind or who have low vision."

In the case of the San Francisco International Airport, legally deaf travelers were not able to hear the pages over the public address (PA) system.[21] "Plaintiffs in the case were represented by Disability Rights Advocates, a non-profit

[18] ISO 2603:1998, Booths for simultaneous interpretation - General characteristics and equipment. ISO 4043:1998, Mobile booths for simultaneous interpretation – General characteristics and equipment

[19] CEI/IEC 60914:1988 - International Electrotechnical Commission: Electrical and audio requirements for conference systems

[20] Settlement Agreement Between the United States of America and The International Spy Museum Under Title III of the Americans with Disabilities Act, DJ No. 202-16-130

[21] Disability Rights Advocates and the California Center for Law and the Deaf v. San Francisco International Airport, 2002

law center based in Berkeley, California, that specializes in cases brought under the Americans with Disabilities Act, and by California Center for Law and the Deaf (CalCLAD), a non-profit committed to the protection and advancement of the legal rights of deaf and hard-of-hearing people." As part of the settlement, the Airport rolled out a visual paging system that includes an additional 80 visual paging monitors at the Airport's domestic and international terminals, in addition to the Airport's original 46 monitors. The monitors enable deaf and hard of hearing passengers to have equal access to the information broadcast over the public address system, including courtesy pages and emergency information. Travelers who are deaf are also able to use a special number posted at white courtesy telephones and TTY phones to page family or friends with whom they are trying to connect at the Airport. The monitors also provide an alternate means for hearing passengers to obtain important Airport information.

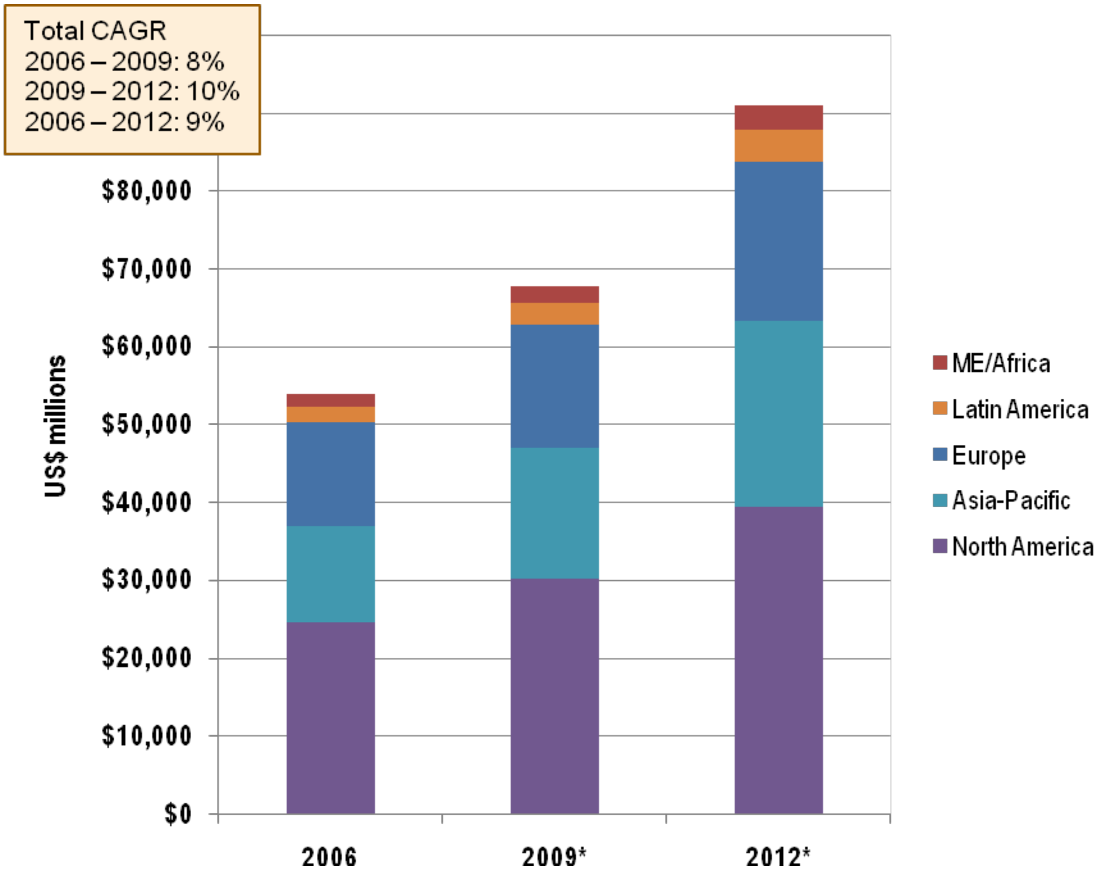
Clearly in both cases, it is less expensive both logistically and legally to include the technology in the project from the beginning. Interestingly, the accessibility issues are not just about completely deaf or blind people, but include partial sensory loss. This is exactly the increasing category of people described above.

Professionals exist that understand these accessibility systems…

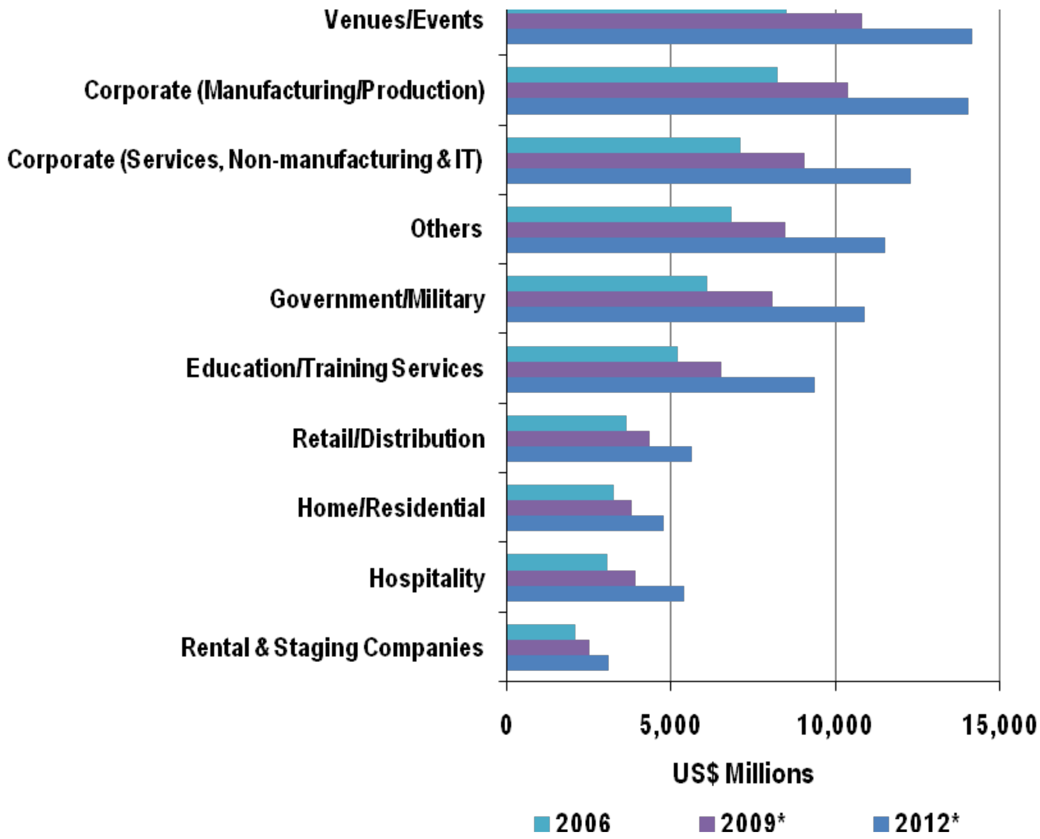
Integrating the Technology

Behind the scenes of all this technology is an entire converged industry of computer, network, audiovisual, broadcast, and security professionals. Working with architects, engineers, and other design professionals, it is their challenge to integrate the technologies into architecture, while providing aesthetically-pleasing results that also conform to standards. The audiovisual industry, in particular, is tasked with the sound systems, digital signage, displays, specialized control systems, and ergonomic interfaces across a wide variety of venues. This industry has been expanding rapidly and is only now becoming standardized: perhaps just in time. This table[22] represents this explosive growth from 2006 through 2012, much of it fueled by a need for accessibility, and on a global basis.

[22] InfoComm International, 2010 Global AV Market Definition and Strategy Study



Where is this technology found? It is everywhere, as evidenced by the results of this same market study, represented in the following graph. Each and every system represented requires some consideration of accessibility issues.



Conclusion

The changing nature of society has always forced our means of communicating to adapt, and this trend is accelerating in this era of rapid technological development. We have moved from orality to literacy[23], from radio to television, and from the Internet to personal communications devices and social media. All of these technologies require sensory abilities, and require everyone to have access in order to participate in normal societal interactions. Standards development is barely keeping pace with these changes, where most of the ideas are from commercial applications that become successful in the marketplace. Regardless of the application, the realistic range of human abilities must be accounted for, with societal inclusion, emergency preparedness, and prevention from harm the primary principles of standards development.

[23] Ong, Walter, "Orality and Literacy: The Technologizing of the Word," Methuen and Company Ltd., 1982