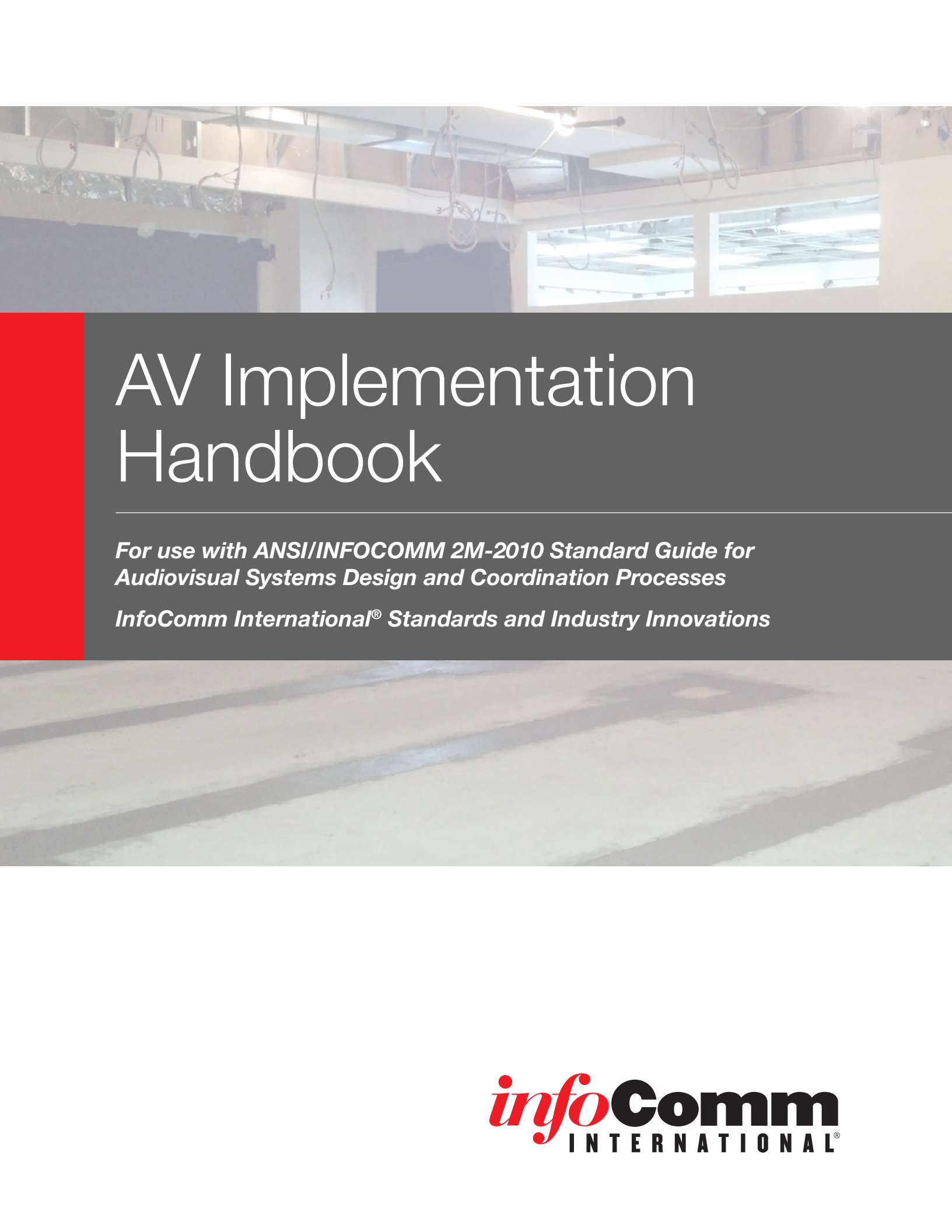




AV Implementation Handbook

*For use with ANSI/INFOCOMM 2M-2010 Standard Guide for
Audiovisual Systems Design and Coordination Processes*

InfoComm International® Standards and Industry Innovations

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InfoComm International® is the international trade association representing the professional audiovisual and information communications industries. Established in 1939, InfoComm has more than 5,000 members, including manufacturers, systems integrators, dealers and distributors, independent consultants, programmers, rental and staging companies, end users and multimedia professionals from more than 80 countries. InfoComm International is the leading resource for AV standards, market research and news. Its training, certification and education programs set a standard of excellence for AV professionals. InfoComm International is the founder of InfoComm, the largest annual conference and exhibition for AV buyers and sellers worldwide. InfoComm also produces trade shows in Europe, Latin America, the Middle East and China.

Preface

It's clear that audiovisual projects are becoming increasingly complex. Project complexity can come in many forms:

- Project delivery methods
- Integration of multiple technologies
- Coordination with other industries
- Sustainability initiatives

As another example, the broad applications of AV technology can vary from simple signage for a handful of rooms, to full mission-critical operation communications centers that rely on sophisticated IT infrastructures. On the surface, it may seem that if you shield or isolate your team from all the complexity, the project will somehow come out right. However, with the advance of alternate project delivery models such as Integrated Project Delivery (IPD), the real key to measurable success is how effectively your team can partner with others. So, what other factors are driving the complexity of projects?

Clients want increasingly powerful systems that satisfy multiple requirements in compressed timeframes and limited budgets. These typically go well beyond intuitive, portable control options. For example, building stakeholders may have sustainability requirements that enhance the experience of the building's users, reduce operating/maintenance costs, or make the building more attractive to potential new clients. Many times, these objectives must be incorporated into the AV project.

One effort to encourage sustainable practices in the built environment is the Sustainable Technology Environments Program (STEP™). It is a rating system that uses a five-phase approach for addressing energy consumption and sustainability in low-voltage systems (i.e., audiovisual, communications, building automation).

AV designers and integrators want to achieve greater efficiency and effectiveness with other trades and consultants in the construction industry. Some of the contributors to successful project delivery are early involvement, establishing partnerships, and determining accountability.

Quality is now a major force in systems design. To meet quality requirements, many firms are considering virtual platforms such as Building Information Modeling (BIM). In a digital-design world, the continuous distribution of project change orders and revisions as they occur has major implications for how the AV industry partners with other trades.

Unique resources are needed to minimize surprises, delays, and errors during the project life-cycle, and to accurately reflect today's complex business environment. To address these new challenges, InfoComm International is pleased to offer this product that aims to help everyone involved in the delivery of projects minimize pain and maximize the likelihood for success.

Acknowledgments

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Introduction

It could be said that the potential success of an AV project is directly related to the quality of the documentation and who is accountable for the results. A good project manager understands the importance of this goal and responds by providing accurate and meaningful documentation in a timely manner to the appropriate people.

This handbook helps you improve your project documentation. It's a roadmap that clarifies the tasks on the Coordination Processes Checklist in *ANSI/INFOCOMM 2M-2010*. It also contains unique insights from industry experts that the standard guide does not cover.

InfoComm's publication, *Audiovisual Systems Project Documentation Sample* is a third resource for improving your AV projects. This publication is a collection of the documents required for AV systems.

As a group, these resources enable you to orient AV professionals, architects, engineers, and clients for the purpose of increasing awareness of the issues that influence AV design, as well as answering three common project delivery questions:

- What are the AV project tasks?
- Who will complete them?
- Who will sign off that they have been completed?

The Client's Perspective

There are many components of an AV project that are always the same. However, one component that is unique is the client's requirements. All clients and owners want to feel that their AV project was a worthwhile investment that met their requirements, was completed on schedule and within their budget.

The owner is the entity buying the system and is frequently also the end user. For the most part, the owner is taking on financial risk and resources to meet business goals. Obviously, the owner's input is required.

Documenting the owner's requirements may take several forms (photos, sketches, descriptions) and clients may need some assistance with technical aspects of their project. In order to distinguish yourself among your competitors, you can offer examples, arrange site tours, and provide sample products.

Clients may also not be aware that AV providers (consultants and integrators) typically are contracted to do specific work. The contracts may describe specific responsibilities that cannot be passed from one role to another.

Project Considerations for the Client

There are many non-technical questions pertaining to the project that your client can think about early in the project. The client may be able to identify some of the major characteristics of their own project by considering some broad questions and prior to working with an AV provider. Here are some questions the client/owner entity can ask of themselves:

- What is the timeframe for my project's completion?
- Is my project a new installation or an upgrade?
- Is my project for one space or several spaces?
- How complex are the AV systems?
(Digital signage for a museum is much different than presentation systems for a boardroom.)
- Does the AV provider employ technical staffs that hold an ANSI accredited certification and are they available for the project (e.g., CTS®, CTS®-D, CTS®-I)?
- Does your AV provider participate in InfoComm's Certified AV Service Provider (CAVSP®) program?
- How much AV expertise does my company/institution have in-house? If I have AV professionals with experience on staff, then I may have more flexibility in choosing who to provide AV services for a particular project.
- Do I have any internal standards or recommended practices I need to implement?

In a different light, for the AV professional, this list of considerations may also be helpful to enhance the sales process or developing client relationships. ANSI-approved, ISO-approved, or other industry standards and best practices may be applicable in several areas of a project. Wherever it is appropriate, they should be identified early on in the discovery or needs analysis phases. Designers might also propose to the client that InfoComm performance standards need to be applied at every phase in the project process.

At a deeper level, there are more considerations that can assist clients prior to working with an AV provider. Here is a list of further considerations for the client:

- Is there a compressed project timeframe (e.g., unexpected budget change or business need)?
- Does the AV provider offer optional services (e.g., acoustical services, IT services)?
- Is it necessary to bid or tender?
- Is there the option to create efficiencies by integrating multiple building technologies?
- Budgeting and cost estimating issues.

- Do I have any recommendations from trusted professionals?
- Do all facilities have different needs and/or are there consistencies?
- Where are potential AV providers located (e.g., travel costs, shipping costs)?
- Do I need AV technologists to operate and maintain the systems?

Once some of these considerations have been clarified, clients may be able to confidently partner with the appropriate AV provider. From the perspective of the AV professional, initial project-related questions that are answered early mean fewer problems later.

Engaging in these types of dialogues helps to establish a common language between teams, as well as to expose potential design issues before services are procured or construction is initiated. Standards can assist with client dialogue and needs analysis, addressing infrastructure issues in spaces or problem solving with other trades, and verifying that the final system meets the design intent. As an example, an architect would like to have the requirements and standards defined for the spaces because it minimizes the risks for successful project delivery.

More on AV Providers

Throughout the project process, clients work with AV providers to analyze their needs and translate them into infrastructure and systems designs. AV providers must be focused on coordinating and monitoring the process from start to finish to ensure the AV system's success. To that end, the AV provider is the source of collaboration and coordination for all other design professionals such as mechanical and electrical engineers, lighting designers, and acoustical consultants on the design team.

As professionals, AV providers are committed to communicating any concerns with the AV component of the project. AV providers should be heavily involved in the interior design, acoustics, aesthetics, and services within a project, and be accountable for the final outcomes. In the AV industry, AV providers can be separated into basic roles: integrator and consultant. The sharing of ideas, technology, product demonstrations, solutions, and samples promotes teamwork, opens the way for better products, ensures greater client satisfaction, and ultimately promotes the AV industry as a whole.

The AV Integrator

Professional AV integration firms sell, engineer, install and provide ongoing service and support for a wide variety of audiovisual and related technologies, complete systems solutions, and equipment. Integrators are capable of designing systems all the way through to installation and completion of the project. Equipment manufacturers may also provide similarly convenient services. In addition, owners may choose to have audiovisual systems designed and/or built by their in-house staff.

The AV Consultant

The independent design consultant determines the best options for the design of a system and produces specifications, technical drawings, and other project documentation for the job that can then be competitively tendered or bid upon by qualified systems integrators or negotiated with a preferred integrator. Handling video, audio, data and PC-video, as well as designing the acoustics, lighting, electrical power and other infrastructure appropriately in a room requires the expertise of a system designer who understands complete system functionality.

The Value of Optional Services

There can be optional services offered by AV providers beyond what is typically found in a project timeline. While these may not be a part of the core project, they are important for building and maintaining a good rapport with clients and vendors. Also, services such as regular system testing or master planning can help clients get the most out of their AV system investments after construction is complete.

Some optional services could be:

- Mockups of AV systems
- Control system design and programming
- Technology master planning
- Regular system testing and adjustments
- Best practices and AV technology seminars

For details about specific optional services, please refer to *ANSI/INFOCOMM 2M-2010*.

Project Planning and Coordination

All parties involved in a project want the final product to meet the design intent, be completed on time and within budget. A successful project will be the result of clear and consistent communication throughout the project. In addition, clear management of client expectations will ensure that the delivered design has incorporated the needs of the stakeholders. One of the avenues for these goals is a series of meetings held throughout design and construction. The type, timing, and quantity of the meetings should be adjusted to reflect the project requirements. A contract should delineate the number and location of meetings to be held throughout the design effort.

These meetings will serve a variety of purposes throughout the project and should include the following:

- Technology programming meetings are held to understand the client's goals and level of technical sophistication.
- Design coordination and review meetings are held at major project milestones to review the progress of the design with the client and to coordinate progress with the rest of the design team as well as to review the progress of the design with the client.
- Pre-bid meetings are held with the client and potential contractors to review the scope of a project where bidding is required.
- Pre-construction meetings are held with the client and potential contractors to review the scope of the project.
- Construction meetings are held during construction to observe the progress of the work and address issues on-site.
- Post-construction meetings are held with the client to review the project.

The minutes from each project meeting should include these components:

- Date and location
- Purpose of the meeting
- An agenda
- Attendees and their respective roles (e.g., job titles, who they represent)
- Items that were discussed/resolved
- Action items



Scheduling and Agreement for Meetings

The greater integration process includes scheduled coordination meetings with these professionals throughout all phases of the project:

- Building architect
- Interior designer
- AV professional
- IT consultants
- Acoustical consultant
- Lighting designer
- Structural, mechanical, and electrical systems engineers

The process should include the following meetings:

- Programming meetings during pre-design and schematic design
- Design coordination meetings throughout design development and construction document phases
- Design review meetings with stakeholders

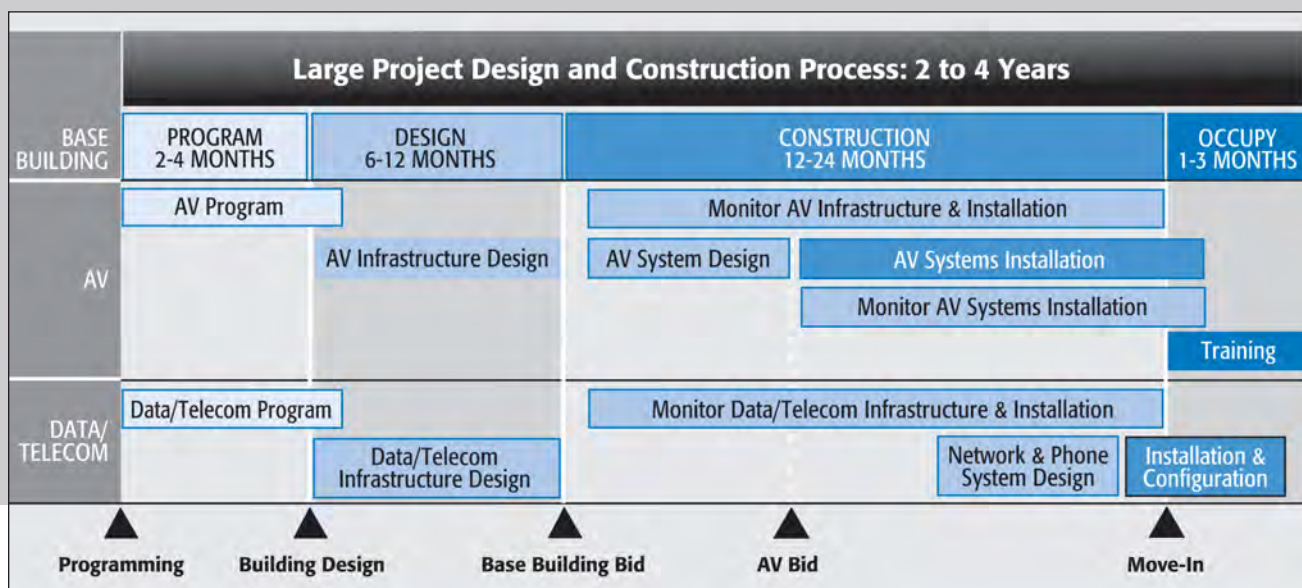
The purpose, frequency, duration, and location of each meeting should be predetermined.

The design documents need to be reviewed, commented, and agreed upon on by the owner (usually at the end of each phase) prior to the construction document phase. The construction documents need to be approved prior to releasing for either bid or construction. While face-to-face meetings may not be required, it is important to have these reviews before committing to the next phase in the project.

Project Schedule

The schedule for the entire construction project should be brought to the planning meetings by the responsible party. One reason for this is so that everyone involved in the project can visually see their role in the project. Early in the project, a major concern for the AV professional is to have the AV project team represented on both the design and construction schedules for the entire project.

It is the responsibility of every AV professional to be assertive -- meaning that dates for milestones and task dependencies should be provided, insights on long lead times should be shared -- and see that the AV team is represented at all meetings. The construction manager or general contractor may not understand the overall impact of AV processes and requirements. No matter the scale or complexity of the project, the entire team should understand the role of the AV team, and where and how they interface with the AV team in order to deliver a successful project.



Program Phase

The basic premise for all well-executed building design is that form follows function. In other words, the user's requirements will have a major affect on the characteristics of the systems design. After the functions for a given building are determined, as reported by the future users, the building's form should be designed to accommodate those functions. The same is true for professional AV systems. Once the functions have been defined, the system with its infrastructure can be designed.

The purpose of the program phase is to discuss, clarify, and document the owner's needs, concerns, expectations, and constraints, in order to complete a needs analysis. The information that is gathered will be used to create the project scope, and the results will be used to guide the design team in its approach to the functionality and cost of the AV systems.

Needs analysis is the most critical stage of the design process because the results determine the nature of the user's systems, their infrastructure, and the system budget. This may also determine the influence of expenses on the base building. This process includes a series of meetings, owner and user interviews, questionnaires, and site surveys of existing facilities. All of the information is then documented and finalized in a document called the program report.

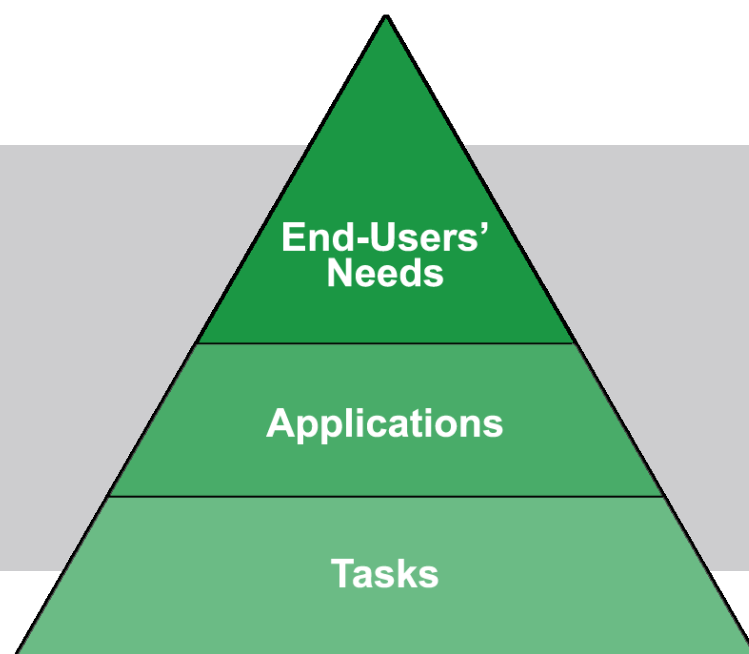
Here is a short list of some important considerations to address during the needs analysis process and program meetings:

- What kinds of information might be communicated (e.g., meeting content, interactive surgical training)?
- How are existing systems currently used?
- How do they want to operate and interface with the AV systems?
- Are there any existing facilities that might be used as a benchmark?
- How satisfied (or frustrated) is the client with the existing systems?
- What is the experience/comfort level of potential users of the system?

Notice that the questions are not focused on equipment, but on business goals, and user comfort levels with technology. Realize as new information is uncovered, that additional questions will come up such as resolving probable budgetary issues, additional contacts to interview, and surveying other rooms, facilities or systems.

Program Phase Startup Meeting

The client's needs and concerns are typically revealed in the needs analysis process which is a part of the program meetings. Program meetings provide the opportunity for interviews and discoveries of many important factors such as how users may want to operate the equipment, past failures and successes, and available financial resources.



Sometimes, the discussions begin with an equipment list in the program meetings. The client may start out describing requirements by referring to equipment, “I want a display and a surround sound system with a remote control like the system in my basement at home.” But only by conducting a complete needs analysis, which primarily focuses on the purpose of the AV systems, will the needs of the client be fully addressed. The goal is to meet the client requirement of communicating a message in some way, and not to overly focus on equipment first.

During the program meetings, it will be vital to have the stakeholders and other responsible parties at the initial meeting. Here is a list of suggested meeting attendees:

- Lead designer
- Architect
- Client or owner’s representative(s)
- Owner’s Chief Technology Officer (CTO)
- End users of the systems

If these individuals are not available, their contact information should be obtained for future use.

During the program meetings, it is beneficial to complete surveys of existing facilities, inventory existing equipment, and discover additional project requirements. Also, interviews with individuals such as the CTO, building committee chair, and AV or IT department manager will often provide an overview of their vision -- what they want to do with the systems and how they want to operate and interface with the AV systems. They may point out companies they see as competition or as providing the kinds of AV systems needed in their facility.

These meetings should also address the owner’s use of in-house facility standards, the level of satisfaction with current design standards and equipment, and expectations regarding quality and cost. Throughout the interviewing process, many other issues and factors may surface while the AV provider is exploring how to meet the owner’s needs.

Interviews With End Users

Interviews with end users or technical support staff and the use of questionnaires may reveal discrepancies between the ideal vision and the final product that will need to be reconciled in the program report and budget. This may require the presentation of several options and associated costs, as well as negotiations between interested parties. The AV provider will need to explain to the architect and the design team what is expected or required and how this will impact their design. For example, there may be issues with structural support, mechanical cooling systems, and architectural finishes.

Surveys of Existing Facilities

Onsite survey checklists are very powerful tools for discovering potential issues before design begins.

Here is a short list of potential questions or tasks that can be used to gather information about the facilities, how they are used, and other AV system design considerations:

- Gather site contact information: name, phone number, etc.
- Identify the location(s) of loading/unloading access.
- Examine acoustical properties of the room.
- Identify existing lighting in the space.
- Examine electrical power (loads, receptacles or outlets).
- How are existing spaces being used?
- Identify potential noise/traffic problems regarding room location.
- Security concerns -- is the area able to be locked and who will have access?
- Examine current site conditions for clues to system problems.
- Look for opportunities to meet technical support staff.

These considerations can provide a great deal of information about user’s experiences -- good or poor. Also, it will provide you with support for any recommendations you offer in the program report to resolve existing issues. An example of a completed site survey list can be found in InfoComm’s publication, *AV Systems Project Documentation Sample*.

During the site visit observe and record construction issues such as:

- Room layouts
- Noise sources
- Room adjacencies

Also take note of installed technologies:

- Manufacturers
- Model numbers
- Camera locations

Use a digital camera for keeping a visual record of the findings.

Inventories of Existing Equipment

During the site visits ask for a room-by-room inventory of the client's audiovisual equipment. If one is not available, then take the time to assemble it prior to preparing the program report; this may require the scheduling of a return visit or arranging for the client to prepare this list. The inventory should include several columns for each type of device (e.g., amplifiers, signal processors, cameras) and related model/manufacturer information.

Take a moment to look in the back of equipment racks, inside lecterns, or under conference tables for any added-on pieces of equipment. These devices might suggest temporary solutions that were put in place in order to maintain or change system functionality. Careful attention to these seemingly minor issues will provide clues as to the level of technical sophistication and prior frustrations with the client's existing AV technology.

It can be beneficial to test existing equipment that might be used in the new project. This may help the client save on costs and show that the AV design team is interested in reusing equipment that meets the design intent. Also determine who will be responsible for the removal or recycling of unused equipment. Whoever wishes to take responsibility for this role should determine a strategy for how this will take place.

Discovery of Additional Project Requirements

Investing time in the issues that matters to your client, and reviewing the systems' operation, results in a better design. Additional project requirements can cover a broad range of issues:

- A space may require additional acoustical treatments.
- Information communication technologies may be inadequate to support the client's videoconferencing systems.
- Sustainability requirements, such as connections to other building systems, may unexpectedly surface.

These items should be documented in the program report as well as in discussions with the client.

Discussions with the architect and/or the client provide an opportunity to determine if the project's scope needs to be updated. This can allow for the expansion of services on the project and allow the AV provider to recommend the expertise of another firm capable of implementing a solution.

Program Report

At the conclusion of the program meetings and the needs analysis process, the information is captured in a written report. The exact title of the report can vary. Here's a short list of alternative titles:

- AV Narrative
- Discovery Phase Report
- Return Brief
- Concept Design Report

This non-technical document describes the client's specific needs, system purpose, and functionality. Also included is the designer's best estimate of probable cost, and approval by the owner. The exact contents of the program report will vary because every project is unique in its complexity. The common contents of the program report are included in *ANSI/INFOCOMM 2M-2010*.

Once this document is distributed to the respective stakeholders, reviewed, and approved, it becomes the basis for the subsequent design phase. This review and approval process may take several rounds to complete to obtain owner and/or end user sign-off.



Design Phase

The results of the program phase, along with the program report, are utilized to create two more groups of documents in the design phase. As a whole these new groups of documents provide the backbone for communications and coordination among the design team: the contractor(s) and owners. The purpose of these activities and their associated documents is to identify the functional, physical and design requirements to meet the owner's or client's needs.

The design phase contains two major categories of documentation:

- **Architectural and Infrastructure Requirements:** The architectural and infrastructure documentation is focused on the physical spaces that will be affected by the AV systems and devices. The drawings are a graphical representation of the facility (architectural and infrastructure) and indicate how the AV equipment integrates with the built environment -- locations of such visible items as loudspeakers, projectors, cameras, and equipment racks.
- **AV System Documents:** These documents detail the qualifications, items and performance requirements necessary to complete the scope of work for the AV systems. The AV system drawings also include diagrams that show what equipment is provided and how it is connected. Also, installation procedures, testing procedures, warranty period, and other information, may also be a part of the group. The specifications may also provide information on the manufacturers, models, and quantities required to implement the design.

If a project is required to be bid upon, the bid specifications or tender belong to the AV system documents group.

Architectural and Infrastructure Requirements

AV systems design is influenced by and influences a broad range of disciplines and concerns. These can include:

- | | |
|-------------------------------|---|
| ■ Wall height | ■ IT networks |
| ■ Room and system adjacencies | ■ Furniture |
| ■ Ceiling layouts | ■ Casework |
| ■ Room finishes | ■ Fire alarm and emergency notification systems |
| ■ Lighting | ■ Wall penetrations |

The Startup Meeting

Design startup meetings are usually held at the beginning of each phase of design (schematic design, design development and construction documents phases). They are held to update everyone on the status of the project, changes in schedule, and budget. Typically, startup

meetings may include the architect, mechanical electrical and plumbing/public health (MEP) trades, structural engineers and IT professionals.

It is critical for an AV professional to be in attendance at these meetings. This is an opportunity to establish good communications and to ensure that all parties are aware of the AV design process requirements. In addition, the AV design team must remain aware and engaged in the process by examining, listening, and communicating with collaborators. The AV professional should use the list of issues to facilitate the early resolution of any problems. Ultimately, as the project evolves, productive relationships are key to successful project delivery.



a. Projection and Viewing Sightlines and Distances

Precise projector and screen placement is of critical importance to the eventual quality of the projected image. The installation location of a projector can be impacted by ceiling joists, support columns, sensors, lighting fixtures, and ductwork in the ceiling. The placement of the projection screen can be affected by chalkboards or whiteboards, loudspeakers, fire alarm signaling devices, assistive listening emitters, and so on. Therefore, coordination with other trades is important. The architect may look to the AV project team for a recommendation. Also, an interior designer may have aesthetic concerns and other structural elements may become an issue.

b. Lectern Locations and Presenter Ergonomics

The location and design of the lectern is important. AV designers should ensure that the system design follows

ergonomic principles to create an optimal environment for the users and their usage of the audiovisual equipment. In general, AV designers should strive to satisfy the needs for all users of the system. To meet these goals there are several considerations to take into account.

The architect and/or interior designer will likely be interested in designing or helping select the look of the lecterns for use within the room. Lecterns can be pre-manufactured or custom-designed to meet specific design requirements. Remember that some presenters have limited mobility. Taking mobility issues into account may change lectern design specifications. Some countries have requirements for accessibility that should be addressed, as well.

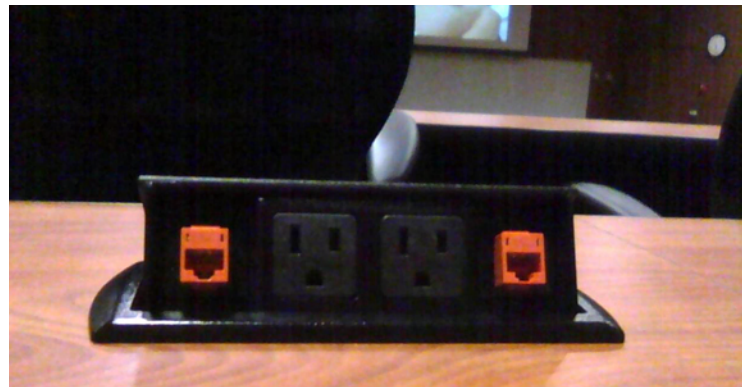
While presenters are at the lectern, they may prefer to access controls that are built into or adjacent to the lectern. Keep in mind that presenters shouldn't have to search for common controls or be distracted while trying to use technologies. Indicating the location of the lectern for presenter comfort is also a factor. In addition, consider the placement of microphones, ventilation of heat for equipment, as well as power and space for presentation media.



c. Custom or Integrated Millwork, Furniture, and Casework

AV designers often partner with interior designers to design the millwork detail for structures that hold the projection screen or a loudspeaker's grill in place. Most of the major furniture manufacturers can accommodate AV requirements with their standard or custom products. When communicating furniture needs to the architect or interior designer, be sure to include furniture dimensions, equipment cooling requirements, and coordinate color schemes and finishes.

If the furniture is custom-designed make sure to include detailed drawings with all appropriate dimensions. By creating the detail drawings, the exact locations of the audiovisual elements are communicated to the design team. The contractor can build or install what is needed.



Casework includes such items as cabinets, benches, and lecterns. There is a range of integration issues associated with casework. Here are some common questions concerning casework:

- What needs to go on the furniture?
- How large should the components be?
- What connections are required to interface with the AV system?



d. Disability Access Recommendations and Codes

All buildings are required to comply with a wide variety of construction, safety, and disability access codes or regulations. For the AV design team, there may be requirements for the installation of Assistive Listening Systems (ALS) or Auditory Assistance Systems (AAS) in classrooms or conference rooms. Similarly, the muting of audio systems when fire alarms or other building evacuation systems are in use may be required.

In case of an emergency inside a facility, occupants of the facility may be given instructions over an announcement system. The AV design team may be asked to consult on intelligibility and sound pressure requirements. Client standards for the type of ALS used (e.g., IR, RF, loop systems) and what constitutes “access” (i.e., does each room require a system or just a connection for a portable system?) may vary from one client to the next.

e. Finishes

The AV designer will often collaborate with the architect or interior designer to ensure that room characteristics harmonize with the AV considerations for the space; form does follow function. Consider the aesthetics of the completed room as well as the building itself. Colors, materials, and carpet patterns are all a part of ensuring compatibility with the combined interior and AV system design.

f. Wall and Ceiling Height Recommendations

Recommendations for walls and ceiling height are critical for rooms that have requirements for visual systems, videoconferencing cameras, or sound system/acoustic needs. The rooms must be assessed for proper vertical and horizontal sightlines, as well. The results can have

implications for the seating plan, floorplan, lighting designs, room device locations and even the building height in some cases.

If ceiling height is not able to be changed, the design of the viewing and listening areas will have to reflect these constraints. A limited ceiling height also influences the layout and density of loudspeakers, which also impacts evenness of coverage, speech intelligibility, and loudness. Examination of the room sections and elevation drawings will help with locating other AV gear such as cameras, loudspeaker clusters, and wall-mounted displays.

g. Stage Sizes and Heights Recommendations

If the space being designed includes a stage, the architect may need a recommendation on the stage dimensions. The height, width, and depth of a stage can profoundly affect visual sightlines, acoustics, and loudspeaker placements.

h. Seating Tiers and Row-to-Row Distances

There are often situations where the architect needs a recommendation on distances between rows of seats and aisles. In these scenarios, there’s a need to balance capacity and audience comfort (acoustics, viewing sightlines, etc.). Two common seating layouts are “staggered” and “aligned.” They can be applied to create the best viewing environment for the audience. In addition, the distance between seats can also be varied.

There are three common floor layouts: flat floor, sloped floor, and tiered floor. Flat floor layouts are most common. Sloped and tiered floors are typically found in amphitheaters, training facilities, and other larger capacity meeting spaces. Seating tiers allow for improved sightlines for the audiences.

i. Equipment Booths, Central Control Rooms

AV equipment rooms and central control rooms at a minimum will need cooling, and power because equipment generates heat. Equipment and control rooms should not be located in an electrical closet or room because magnetic fields from power transformers and motors can be picked up by AV equipment.

If there is a need for multiple people to access an electrical room due to shared resources in the same room, the need should be very carefully assessed. AV equipment rooms can be shared with Intermediate Distribution Frame (IDF) or Main Distribution Frame (MDF) spaces. These spaces may also be referred to as Telecommunications Rooms (TR). Due to safety concerns, it is not safe to allow anyone other than licensed electricians to work in electrical closets. In general, the following recommendations should be made:

- It is preferable that AV equipment not share space with electrical panels/equipment.
- Equipment shouldn't share space with lighting control and dimming systems or any other any other sources of ElectroMagnetic Interference (EMI).

More on Control Rooms

Control rooms and master control rooms refer to two different types of spaces. If the control room is for a venue such as an auditorium, the number of operators, type and duration of meetings, control of equipment (video, sound, lighting, etc) will need to be discussed. The countertop space should be planned to accommodate the different devices required for various control requirements. Where glass is in place for viewing the stage or presentation area, the counter height will also be determined based on the height of the audience in front of the control room. In addition, if audio control is a function of the room, avoid installing glass so that the operator can get a sense of audio quality in the space during the event. It is very important to discuss the ergonomics and comfort for the individuals in this space.

j. Ancillary Spaces: Breakout Rooms, Green Rooms

Ancillary spaces are important because they are often used as overflow rooms or spaces for special events. Adjacent spaces should be examined, as they can be a source of additional noise and vibration. These rooms should be considered for additional connectivity for AV and data systems.

Other uses for these spaces are for videoconferences, audioconferences or media events for interviews, and films. Consulting with other trades on the additional uses of these spaces can add some AV value to the project.

k. Equipment Cooling and Ventilation

All AV equipment in a space generates heat. Heat can be generated from within a rack, or from a projector in a room, or other types of gear in casework and millwork. Heating and cooling engineers need to generally know how much heat is being generated in each space. An AV designer will typically estimate the total British thermal units (Btu) in a system and provide that information to the heating and cooling engineer. The engineer will then design cooling systems to balance the heat output of the AV equipment. This should create a more comfortable environment for people using the space and protect the equipment from overheating

l. Structural and Fire Rating Impacts

Life safety consultants provide emergency notification systems to building occupants. Local systems may be linked to other buildings or entire campuses creating Mass Notification Systems (MNS). These larger systems can include mobile devices, signage, messaging and more. The most common design issues are related to fire detection, occupant alerts, or hazardous substances, such as natural gas and refrigerant leaks. Coordinating AV system designs can validate that the appropriate lighting and audio control interfaces/overrides are in place. This is critical in all public assembly spaces and venues.

The life safety consultant needs to know where the AV systems and equipment are located in the building to ensure that the emergency life safety systems (i.e., lighting, public address, fire alarms, sprinklers and egress) meet code requirements. Heat from AV equipment, locations of screens, and projector mountings should be considered.



m. Lighting Plan, Zones and Control

Discussing the lighting for all spaces within the project is critical to a successful lighting design. General discussions concerning fixture layouts, lighting zones configurations, color temperature, and options for control and zoning should be determined. These issues are extremely important with projects incorporating videoconferencing and other types of streaming media.

If sustainable solutions are required, more attention should be focused on maintenance, room ceiling surfaces, LED lighting, daylighting, and even digital addressable systems possibilities. Window treatments, such as shades, curtains, and occupancy sensors can also be a part of more sustainable solutions.

n. Delivery and Installation of Oversize Products

There may be a need to address special circumstances that relate to this project specifically for AV. If some pieces of equipment for the project are unusually heavy, long or awkward, access or security requirements for working in the building may be required. This can include coordinating delivery schedules, loading dock access, or acknowledgment of specific site conditions.

Dimensions of stairwells, loading docks, elevators, doorways, and corridors must be large enough to allow delivery of equipment. Large rear projection screens and millwork that is fabricated off-site can be very difficult to transport.



Electrical

Electrical engineers need to know a great deal about the system requirements and it is the responsibility of the AV professional to provide adequate documentation. Some initial factors for the AV professional to consider are:

- Discussion of all applicable standards and codes
- Power distribution scheme
- Earthing or grounding scheme
- Raceway, reticulation or containment systems for wiring and cable

Here are some additional requirements:

- Connected power loads
- Anticipated plug loads from portable equipment
- Cable and signal requirements for separation and shielding
- Energy management and control

In turn, the electrical engineer will also need to inform the project team of subpanel locations, and cabling pathways, among other elements. The AV electrical and pathway requirements should be identifiable within electrical drawings and specifications. The AV designer, through observation and coordination, will verify that the infrastructure required is incorporated in the electrical engineer's design package. The project electrical engineer should deliver power, signal pathways, electrical noise immunity via signal shielding and grounding practices, life safety interfaces, as required to deliver complete, functional and reliable systems to the facility stakeholders.

Within the United States, it is extremely important to know that the design and certification of electrical systems falls under the domain of electrical engineers who are professionally certified by their state to engage in electrical (power systems) engineering.

For more details on electrical considerations, refer to *ANSI/INFOCOMM 2M-2010*.



Workmanship and Technique

Some jurisdictions require the use of licensed electricians, licensed low-voltage cable installers, members of labor organizations, and/or certified professionals for some of the tasks included in an AV contractor's scope. The level of coordination in these circumstances escalates to include many items beyond purely power and related infrastructure concerns.

a. Verification of Licensing and Permits

Architects, mechanical, electrical, and structural engineers are required by law to be certified and licensed because of the life safety issues associated with their designs.

Though some AV designers may operate without formal certification, they should still be thoroughly knowledgeable in their field. For AV designers, InfoComm's Certified Technology Specialist -- Design (CTS®-D) certification is recommended.

Almost all projects involving construction or changes to an existing structure require permits. In general, a permit means that your plan meets requirements set by the Authorities Having Jurisdiction (AHJ) and that you may proceed.

b. Expectations for Workmanship

The quality of the work being completed is very important. The expectation is that installation and operation of the systems adheres to all appropriate national, government, and/or local life safety and/or support codes.

To meet the expectation, contractors should have experience that is equivalent to or exceeds the project requirements for fabrication, assembly and programming. This should include expectations that technical people on the project be fully trained and/or certified for installation, operation and testing (e.g., field wiring methods and techniques such as separation of signals).

c. Cable Termination Standards

All cable terminations should follow best practices or standards set by organizations such as TIA/EIA wiring standards, BICSI, and/or InfoComm International. Typically, the AV drawings for the individual systems indicate the connectors to be used and how they are to be terminated.



Acoustical Recommendations

This work involves the coordination of acoustical design criteria for the project and conditions that could directly influence the audio systems designs. The project's acoustical consultant or designated member of the design team defines the acoustical requirements for the project. The audiovisual systems designer may also provide input

a. Architectural Acoustics

Seeking the expertise of an acoustical consultant at the beginning of the program phase can enhance the occupant's listening experience. The audiovisual systems designer may assist with this effort by offering design criteria for ambient/background noise levels, reverberation time and room acoustic conditions that could directly impact the audio systems designs.

Acoustic treatments, which can significantly affect the performance of audio systems, must be considered. Wall, floor, ceiling, window, furniture/upholstery and other treatments all affect the acoustic behavior of a space. Two common recommendations are for the improvement of architectural acoustics and the reduction of mechanical system noise/vibration.

b. Mechanical Systems Noise and Vibration Control

Buildings contain many mechanical systems, and the noise and vibrations they generate may affect AV systems. Air ducts carry the tones generated by fans and they cause additional noise by inducing turbulence in the airflow. Some of this noise is carried through the ductwork to grills in rooms and some of it is radiated directly from the duct walls. This is known as "breakout noise." The most common plumbing system noise sources are water flowing through pipes and noise radiating from the pipe surfaces. Vibrations can make ceiling mounted projectors and wall-mounted screens shake. Microphones can pick up disturbances from airflow.

A professional acoustician can identify the sources of noise present in a space and will recommend or specify methods of minimizing their effects. Recommendations and specifications may identify the use of special materials, surfaces, or indicate room dimensions.

Information Technology (IT) Recommendations

This work involves the coordination of AV-specific requirements with IT professionals. The function of IT infrastructure in AV projects now covers many technologies and services:

- Transport and storage of multiple content types
- Network structure and bandwidth capacities
- Video streaming or conferencing capabilities
- Metadata tagging and searching of archived content (e.g., video ondemand)
- Data security, protocols, policies and encryption needs
- Network security posture, (this is an entity's overall approach to risk)

The audiovisual systems designer typically provides input to the project team for items such as:

- The specific location and type of data endpoints such as analog or digital.
- Special patching requirements for specialized "hybrid" equipment (i.e., non-data use of IT infrastructure).
- Bandwidth requirements (e.g., telepresence, VTC, IPTV systems, multicast streams).
- Security concerns (ftp or telnet)
- Quality of service (QoS)

Questions from an IT Professional for the AV Designer

For most clients, their network standards, infrastructure, and data security needs are constantly being upgraded. There are many questions that an IT professional may pose to the AV team concerning network enabled devices. Some initial questions coming from an IT professional might be:

- Are there static or dynamic IP devices?
- What types of content are expected to be commonly used?
- Are there VLAN implications to be considered?
- What ports need to remain open on firewalls and gatekeepers?
- Are there any devices with web-enabled user interfaces that should be password protected?
- Is there a need for protected or secure communications such as IPSec, SSH, and SSL?
- Is there a requirement for remote access to systems?
- Can networked AV devices be tested prior to installation?
- Is there a need for wireless connectivity?
- Are there requirements for VPN services?



Client Interest in High Definition Systems

Client interest in High Definition (HD) video and audio systems is commonplace. To deliver these systems, collaborating with IT professionals is very important. If the content is transported by Cat 5/6 or optical cabling, IT professionals will need to have documentation of many requirements. Some initial needs would be:

- Bandwidth requirements
- Aspect ratio (16:10, 16:9, 17:10, 5:4, 4:3)
- Backward compatibility (interchangeable signal compatibility)
- A list of all devices that will be connected to the company network
- Architectural drawings indicating locations of data outlets in the affected spaces
- Devices that require optical cabling
- Content protection
- The purpose or function of individual devices
- IT device inventory document



AV System Documents

The design package consists of two basic components:

- Specifications
- Drawings (e.g., facility, design, system, custom application documentation)

System documents are the one common and essential element of the design deliverables among almost all the building trades, including AV. Specifications are a structured written description of standards, products, and execution that guide the installation. The drawings depict how the systems are generally intended to be configured.

There are multiple contract delivery methods and procurement vehicles including design-build, design-bid-build, Integrated Project Delivery (IPD), alliance scheme, and LEAN design. One specific example commonly used is design-bid-build which is described below.

In the bid process, the design documents must include enough information for the design intent to be conveyed and a reasonable amount of detail so the bidders' responses can be accurately and fairly compared.

1. Bid Specifications

The bid specification document details the qualifications, items, and performance requirements necessary to complete the scope of work for the audiovisual systems. The specifications are described in a three-part document (general, products and execution). For more details, please refer to *ANSI/INFOCOMM 2M-2010*. Competitive bidding requires written specifications of the audiovisual systems equipment and installation. It is recommended that audiovisual specifications are inserted into the project construction documents. These documents should conform to the owner's requirements and approved industry formats. Here are three common specification formats:

- National Building Specification (NBS) used in the U.K.
- NATSPEC used in Australia
- Construction Specifications Institute (CSI) MasterFormat™ used in North America

2. Design Drawings

The documents should conform to the overall project's document format and contain specific details. These elements are typically defined by the lead design professional. Each drawing package should include keys, schedules, and notes pertaining to the audiovisual systems. Uniformity among all the drawings is vital for more effective coordination. For more information on the drawing title block, cover page, and details, refer to *ANSI/INFOCOMM 2M-2010*.

3. Facilities Drawings

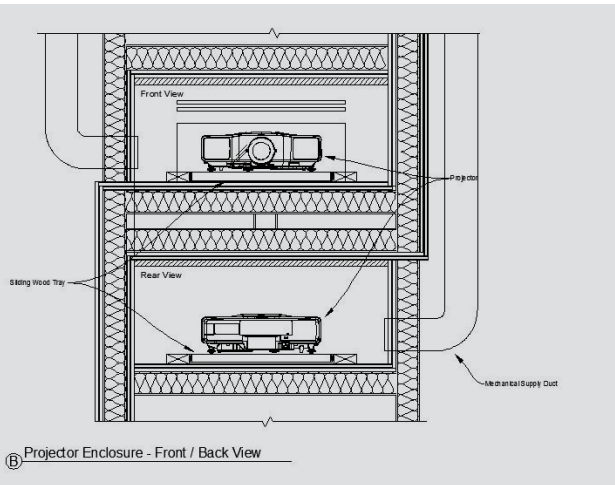
These documents include floorplans, reflected ceiling plans, and site plans, that show the general locations of devices and infrastructure in the facility. For more information, refer to *ANSI/INFOCOMM 2M-2010*.

b. Equipment Mounting Details

These drawings provide specific details for the mounting of AV devices to the floors, walls and ceilings of a facility for each device requiring mounting, rigging or other suspension. Indications for the mounting of equipment, layouts of patch panels, and rack elevations should be included as required by the project.

The mounting of AV devices to the floors, walls and ceilings of a facility require specific details for each device requiring mounting, rigging or other suspension, including blocking or other structural supports, cabling routing, and special notes for mounting that may be manufacturer specific.

A note about the installation team: For the AV installation team, the facility drawings help them analyze the physical capabilities of the building. This information is then used to determine the mounting needs. Also, they may need to request the opinion of a structural engineer for life/safety purposes.



c. Miscellaneous Details

These drawings include any details, drawings or information necessary for coordination with other building systems and elements to effectively convey the project requirements and design intent for the audiovisual systems.

If the project uses ANSI performance standards that require markings on a floorplan or a floorplan as a part of conformance, include those documents in this section.

4. System Drawings

These drawings are sometimes referred to as “Block,” “Flow,” or “Schematic” diagrams. They indicate an overview of the system signal flow in its entirety and illustrate the interconnection of the audio, video, and control subsystems.

a. Functional Diagrams

Functional diagrams include references to related subsystems and provide the reader with a clarification of the boundaries of the AV scope of work. The diagrams include contractor-provided and owner-furnished equipment, as well as equipment supplied by others.

1. Audio Subsystems

Audio subsystem functional diagrams indicate the interconnection of all audio components (sources, processors, power amplifiers, loudspeakers). If there are multiple systems involved, multiple functional diagrams may be necessary.

Depending on system complexity or project requirements, these drawings may not indicate the termination type. Typically, generic indicator labels can be used for signal inputs/outputs such as “Channel 1.” Here are some more examples of other generic labels:

- Mic input
- Line input
- Aux 1
- Main 1

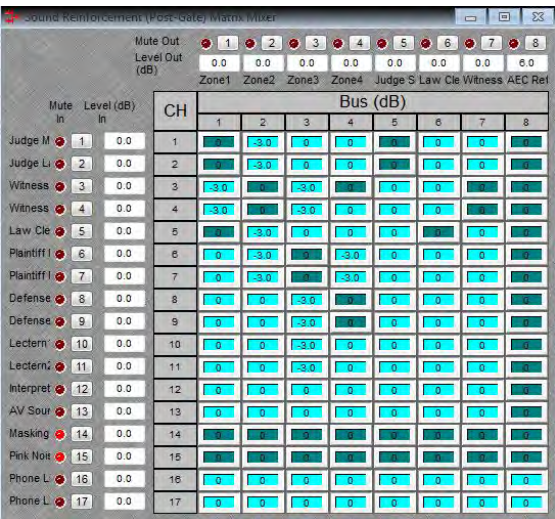


2. Antenna Distribution Systems

Antenna diagrams typically detail the coverage area with the target signal strength, cabling pathways, antenna locations, diversity arrangements and cable details to equipment cabinets.

3. Digital Signal Processing

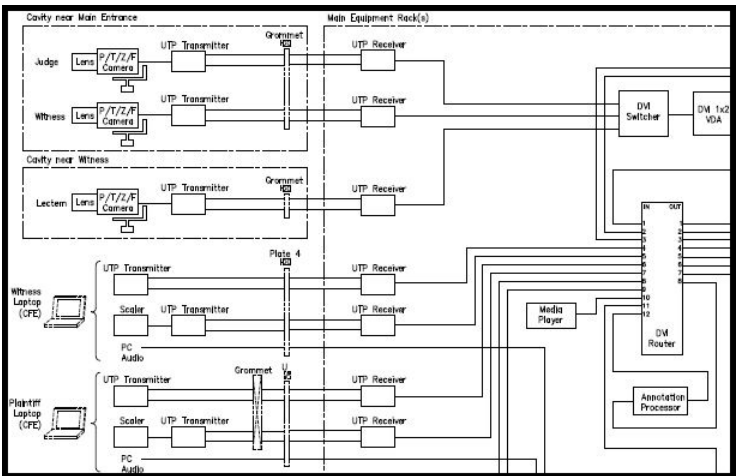
Digital signal processor diagrams typically indicate how audio inputs are mapped to outputs on a matrix or grid-like chart. Grids can also indicate any processing applied such as filters, pre-amplifiers, compressors, limiters.



4. Video Subsystems

Video subsystems flow diagrams show the interconnections of sources, processors, and outputs. In addition, diagrams will show connections to other required connections including faceplates, codecs, and cameras.

Video subsystems flow diagrams show the interconnections between sources, switchers, processors, and outputs, and other systems such as audio and control. In addition, diagrams will show connections to other required connections including faceplates, codecs, and cameras.



5. Special Video Subsystems With Interconnects

For complex AV systems that encompass entire buildings or campuses, it is often necessary to graphically show the interconnections between the various subsystems (e.g., broadcast production or video editing suites) which will ultimately be “tied” together into an overall project-wide distribution system. This allows the design team to accurately coordinate all system requirements and how each subsystem is to interact with the rest of the system. These subsystems will require careful attention to cable plant design, room location and layout, signal types, and how they will be integrated into the other systems in the facility.

6. Control Equipment

Control equipment flow diagrams indicate how individual devices are connected and controlled by the CPU. The types of devices and control points are vast, so the control equipment signal flow diagram provides a good representation of overall system complexity and usability.

Assessing the client’s needs through interviews, documentation, and sketches of touchpanel layouts is a major factor in the accuracy and functionality of the system. The control system programmer will also need to use this information to complete the work.

In the eyes of the users, this is arguably the most important system. If it’s convenient to operate the equipment from a human interface, such as from a touchpanel, then there will likely be a very positive perception of the entire AV system.



7. Voice/Data (IT) Systems Interface Components

In some projects, there may be a heavy focus on the use of IT-related devices to facilitate the transport of AV signals. It is important to indicate connections such as the use of twisted-pair transmitters and receivers, streaming media encoders, and VoIP systems.

8. Other diagrams and notes

Depending on the specific requirements of the project, it may be necessary to indicate connections between the AV systems and other building systems, such as lighting, drapes, shades, HVAC, security. These devices can utilize RS-232, IP or other interface protocols.

b. Equipment Rack Elevations

These drawings confirm that proper space allocation, ergonomics, accessibility requirements, thermal management, weight distribution, and cable management have been considered. For bid and engineering purposes, equipment rack elevations provide a means to estimate the quantities of required patch panels, bulkheads, interconnect cables, patch cables, equipment rack accessories, and other hardware necessary for a professional installation.

c. Specialized Plates and Panels

These drawings detail the information for all plates and panels, including size, connector arrangements, types of signals, labeling requirements, and any special integration or installation requirements for that connector. Plate details should be approved prior to ordering them.

Careful attention should be placed on any specialized connectors or plates that may be a part of the client's in-house standards. As an example, a educational institution may require separate plates for AV connectors (e.g., XLR, DVI, RGBHV) and IT connectors (e.g., 8P8C, fiber optic connectors). In addition, labeling the drawings to show what signals travel on which connectors may prevent confusion during installation.



d. Specialty Connector / Wiring

These drawings illustrate connectors, pin-outs and wiring used in special circumstances. The majority of connectors, pins and wires in an AV system follow industry standards for termination. In the case where a custom connector configuration is used, details for the termination of that connector are provided in the drawing set. The details include an illustration of the connector and its pins as well as a numbering schedule or other labeling of the pins and specific coordination of the pins to individual wires.

e. Custom Configurations and Modifications

Some elements of the AV system design may require internal modification or special configuration of devices to achieve the intended function in the system. This may include the setting of DIP switches, installation of internal jumpers, and similar. In all of these cases, details of the special requirements and settings are provided in the drawings to ensure readers understand the requirements and their impact on functionality.

f. Patch Panel Layouts and Labeling

These details serve to clarify the number and types of panels (by signal) as well as the number of connections per panel. The patch panel layout should be consistent and labeled with the signal type.

5. Custom Application Documentation

These documents illustrate and describe the requirements for the configuration of all software, programmable equipment, and other subsystems. This documentation can include the following: DSP, Consoles, and Work Surfaces, User Interfaces, and Asset Management and Scheduling. For more information, refer to *ANSI/INFOCOMM 2M-2010*.

b. User Interface

This section includes a visual or written description illustrating the logical sequence of the user interface. This may include a Graphical User Interface (GUI) layout and/or button-by-button description. For more details on this item, please reference *ANSI/INFOCOMM 2M-2010*.

c. Asset Management and Scheduling

This documentation includes information regarding the management or scheduling of the AV system via a data network. It may include a network diagram, software requirements, administrative assets, and other system components. This section also includes details about intersystem connectivity, user interface layouts, timing, sequencing, or automation of the AV systems.

Construction Phase

This phase involves three efforts that are interconnected and feed one another in a repetitive process; a good analogy might be thinking of them as three parts of a braid: procurement, coordination, and installation. The efforts are based on the contract documents created during the design phase -- the drawings, specifications, and equipment schedule.

The contract documents will be used to create more detailed drawings called shop or installation drawings. The shop drawings are used for offsite fabrication at the contractor's shop and onsite installation. They will also be used to procure equipment and materials, in addition to laying the ground work for system testing and adjustment and training at the end of the project.

Startup Meeting

The startup meeting is the first opportunity to gather all of the interested parties together to discuss how the project will be built. While the AV equipment must be integrated into operational systems, it is important to remember that these systems must also be integrated into the building. With this in mind, the startup meeting should include these representatives:

- General contractor and subcontractors
- Architect and their design team
- IT staff
- Owner
- Other stakeholders

During the construction startup meeting, logistical protocols and communication channels from earlier in the project should be reviewed. These include:

- proper forms
- authorizations (e.g., financial and design)
- process for payment
- request for information (RFI) process
- communication procedures

Here are some meeting agenda items that should be covered:

Site Logistics

- Construction office locations
- Construction storage and staging locations
- Site access (security, hours, parking, freight elevators, loading docks)
- Equipment sharing (scaffolds, cranes, lifts)
- Safety requirements
- Cleanup and recycling construction waste



Communications

- Introductions and sharing of contact information
- Contract procedures
- Document handling

Schedule

- Overall construction schedule and deadlines
- Current stage of the project
- AV construction process and schedule
- Construction project meeting schedule and location
- Submittals

At subsequent meetings, these stakeholders may be involved:

- Trade contractors
- Design professionals
- Owner (client)

Construction Drawings

Construction drawings, provided in an electronic or other unalterable document format, should include sufficient detail to convey the physical configuration of the AV systems to the installation team. These drawings are also known as "Submittal Drawings," "Workshop Drawings," or "Shop Drawings."

Construction Drawing Components

The type of information and the layout of the title block components are generally defined by the project architect, general contractor, or whoever is the governing entity of the construction team. To maintain consistency throughout the construction documentation, specific information related to the project should appear in the same manner on all drawings received from all trades. For more information on title block components, please refer to *ANSI/INFOCOMM 2M-2010*.

Facilities Drawings

Facility drawings are a type of construction drawing that shows the location and size of equipment in a given space. They are a major source of communication for the project team. For the audiovisual industry, these objects would include projectors, screens, loudspeakers, and displays. The following are examples of the information represented in these drawings. These items can be found in *ANSI/INFOCOMM 2M-2010*.

a. Projector and Camera Locations

The location is critical for sightlines to screens and areas to be captured by cameras. To determine the correct location, coordinate with several parties: services engineering and structures. It is important to know about the specific locations of any projectors and cameras in relation to building elements such as lighting, ducts and sprinklers.

b. Device Aiming, Coverage, and Orientation

AV devices require specific aiming and orientation to meet the design intent. Loudspeakers, video cameras and a variety of sensors, antennas and emitters are some common examples. Device aiming and orientation can be adjusted during installation. These settings need to be documented in the as-built documents to reflect how devices were ultimately installed.

c. Integration of AV Equipment into Furniture

Special considerations should be made for millwork or joinery and furniture that incorporates AV equipment. AV integration may require custom cutouts or attachment. The contractor's shop drawings should be of sufficient detail to clearly show how the equipment is to be integrated.

Millwork with AV equipment requires proper sizing, ventilation, access, and cable management. The finish of components installed into millwork should be properly



coordinated with the architect and owner. Finishes for visible AV plates and devices should match furniture finishes whenever possible.

The millwork design must accommodate the following:

- Adequate depth for equipment rack and cable management
- Adequate ventilation for equipment
- Adequate working height for all AV equipment
- Adequate front and rear access for service and maintenance of AV components

d. Labeling of Device Type, Manufacturer, and Model

Every device within a system should be uniquely labeled (i.e., device ID). The device ID should be on all drawings that reference a given device and should include information such as room, rack, equipment, and cables. Device IDs should also be created on wire labels and rack-mounted devices.

Labeling schemes vary widely but realize that any labeling scheme is better than no scheme at all. Three years after the system is installed, will the next project team be able to reference the drawing set, and identify all of the devices as they examine and research the system?

System Drawings

Systems drawings for construction/fabrication include all of the information from the design documents with additional information required to complete fabrication and installation of the audiovisual system.

1. Functional Diagrams

These drawings include all of the information in the design documents with the following additions:

- Each device labeled by manufacturer and model number
- Labeling indicating exact connector type and gender
- Each connector and wire clearly labeled indicating type and/or manufacturing part number
- Cable numbers corresponding to the schedules
- Adhesive labels attached to each end of all wires including power cords
- Any additional information required to instruct the field technicians in the proper installation of the systems equipment.

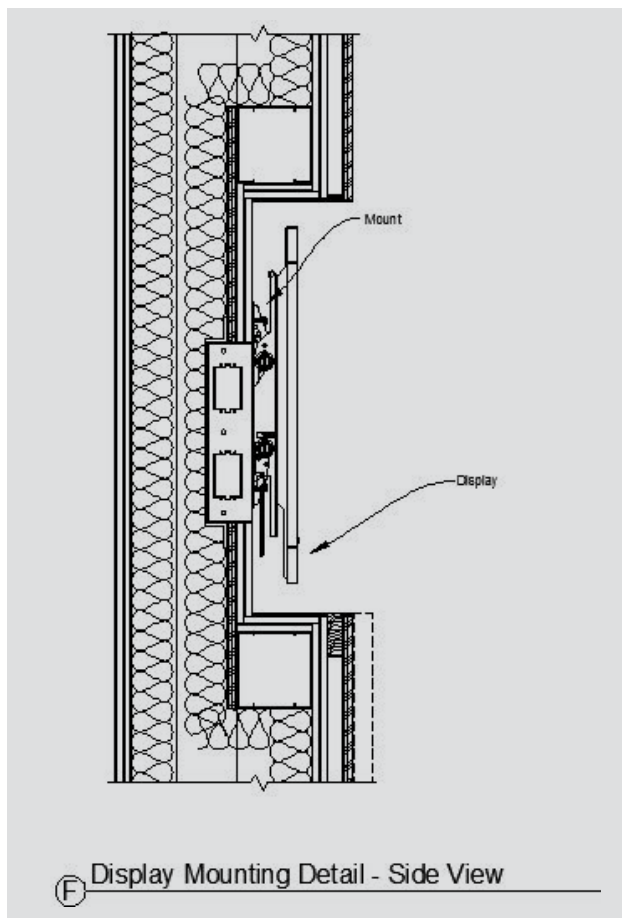
2. Equipment Rack Elevation Diagrams

Diagrams should clearly indicate the following (as applicable):

- Front view with the location of each piece of front-mounted equipment indicated in Rack Units (RUs)
- Manufacturer and model number of each piece of equipment
- Identification for each piece of equipment
- Side views for locations of internal mounted equipment, (e.g., power strips, power supplies, RF splitters)
- Cable entrance location notes

3. Other Details

These drawings and documentation include the following (as applicable): Verification of loudspeaker, projector, and other equipment mounting and aiming details, Specialized plate, panel, and connector details, including dimensioned engraving and punching instructions; exact patch panel layouts and labeling strip text; connector and miscellaneous wiring diagrams, as applicable; custom remote control and keypad labeling text.



Reference Documentation

This documentation clarifies details and settings of each device that requires specific configuration for its functionality in the system. Items that are typically documented could be device configuration tables, configured matrices, presets, or information required for integrating network-based devices.

a. Matrix Routing and Preset Configuration Tables

Audio and video routing matrices are typically configured using the completed signal flow diagrams. The functionality of many routing systems is now defined within the memory of the device, whether it is a video router or an audio DSP. The determination of signal path continuity typically now requires a computer and manufacturer-provided software to set and/or retrieve settings. Therefore, default routing information and parameters defined within macros and presets must be captured (e.g., table, chart, list, matrix diagram) to the drawing set or documentation binder for installation, confirmation or service.

b. Digital Signal Processing Configuration Details

Digital signal processing details refer to the configured virtual connections inside a DSP engine. Due to the customized nature of these configurations, including them in system documentation is critical because over time, the configurations are very likely to change.

Given the flexibility of such systems, and the limitations of internal processing capabilities, definition of processing requirements should be vetted prior to installation. After the configuration is complete, all settings including macros and presets should be documented in hard copy for reference during installation, system verification or service.

c. Wireless Microphone Transmission Frequencies

This item is not just limited to wireless microphones. The inclusion of wireless equipment requires frequency coordination for devices such as wireless microphones, intercoms, Interruptible Fold-Back (IFB), or wireless personal monitoring systems. This process will require a site survey and working closely with the manufacturer of the wireless equipment including:

- Coordinating around active and future television stations
- Other wireless frequencies already in use
- Governmental restrictions on allowable frequencies
- Application for licensing of frequencies as applicable



It is important to document all frequencies that are assigned to wireless devices. The documentation can be referenced for future additions, service replacements, or coordination with rental or visiting systems. Facility managers are an excellent resource for documenting this information. Taking the time to record this information is important because wireless equipment, including microphones, personal monitor systems, IR devices, and Digital Enhanced Communications Technologies (DECT) operate within a relatively small range of allowable frequencies. The successful operation of these systems often requires frequency coordination with pre-existing equipment such as two-way radios, or security systems.

d. Control Equipment

Control equipment refers to the systems and equipment that are used to control the audiovisual equipment within a space by user interaction, as well as external systems such as:

- Lighting
- Daylight control devices (e.g., blinds, curtain, drapes, shades)
- Security
- Paging
- Life safety
- Building automation

The AV designer is responsible for documenting how these systems will be interconnected. Equipment changes between bid and construction or the integration of owner-furnished equipment must be confirmed by the contractor. Interconnections are determined by the manufacturer's equipment and can be proprietary or standards-based, so having a record of how it was done is vital.

e. IT Integration Information

Several times during the construction process, there needs to be coordination between the AV team and the network team. The complexity of network systems may require several meetings with the AV professionals to confirm with the IT professionals the following:

- Number of IP enabled devices
- Device characteristics (e.g., IP, MAC address, static vs. DHCP)
- Network structure
- Structured cabling layouts
- Network security
- Information communications technologies (e.g., SIP, ISDN, T1, PRI)

Testing and Acceptance

The testing of all AV systems is a major milestone toward project completion and final system acceptance by the client. There are two stages to the testing and acceptance process:

- Technical performance: technical performance relates to whether the system has been installed to standards included in the project documentation.
- Usability: usability defines how the system operates according to user expectations.

Preliminary testing is typically performed by the system contractor; the results are reviewed by the designer. Testing and adjustment of equipment shall be performed by qualified technicians with general knowledge of video and audio systems alignment and troubleshooting, and knowledge of the specific equipment and systems in this project. System functionality and performance criteria must also be met or exceeded. Where applicable, industry standards for verification of system performance should be used as a benchmark.

a. Test Procedures Carried Out

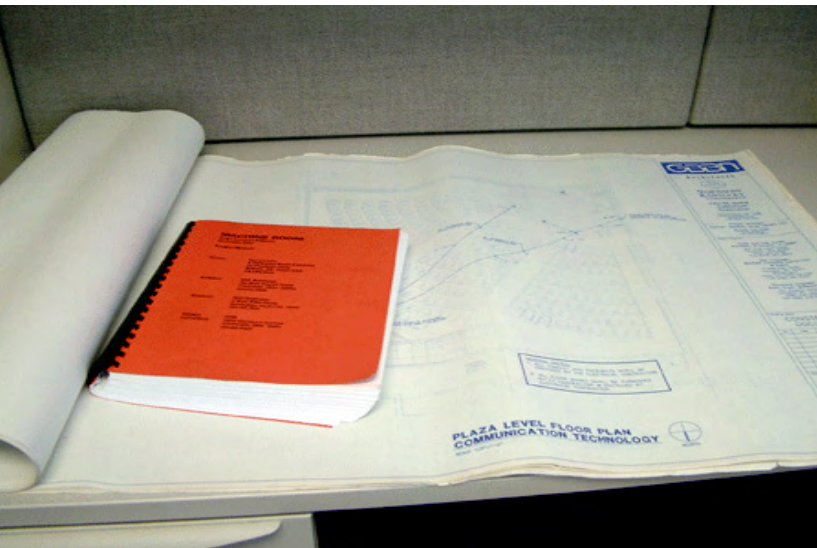
Test procedures defined in the contract documents will be performed and documented by the contractor. Test procedures are to be performed by qualified individuals who know how to properly operate testing equipment, perform the tests, and to make necessary corrections to bring the system into compliance with design intent.

b. Test Reports are Submitted

All test procedures and the resulting documents should be submitted for review by the party identified in the contract documents to verify that the design has been met and various performance criteria have been achieved. Successful completion of these tasks will close out the installation process and provide the basis for owner acceptance.

Project Closeout

After the installation has been completed, the client shall be provided with complete documentation of the entire project, including but not limited to as-built drawings, software code, final graphics, user manuals. Accurate documentation is essential to future service and maintenance of the systems. When service technicians arrive on site to repair an aspect of the system, they must have accurate information about the system that will allow them to quickly identify and resolve any issues. It is customary to provide this documentation in both hardcopy and electronic format, although this varies with the client and the specific requirements of the project, which should be verified at the startup meeting. The exact nature and extent of project closeout documentation will vary depending on contractual arrangements.



a. Drawings of Record or As-built Drawings

During installation, construction drawings are modified. “Drawings of record” or “As-built drawings” are the corrected construction drawings that reflect the actual installation configuration. The “drawings of record,” in turn, become part of the drawings in the project contract.

After the entire project has been tested and verified for conformance, drawings of record should be gathered and put into a single location or spline for future reference. In addition, this set of drawings can be a useful tool for end-user training.

b. Final Software Code

Software for control system source code is often proprietary to the hardware. Of special concern are the intellectual rights associated with the code. The contract should specify the terms and conditions of the source code ownership, distribution, and accessibility.

It is recommended to include a grace period after owner acceptance to customize the control system. Such contingencies do not only apply to fixes due to problems with the software, but are also intended to accommodate minor changes in the programming or interface if requested by the AV designer or the end users. If any major changes beyond this contingency are needed, then they would require contractual action to implement.

c. Final Graphics Files

There are several ways that the user interface and programming can be incorporated into the design documents. The system description may be detailed enough to have some control system functionality included, but much more detail is generally needed. It is best practice to provide GUI layouts and button-by-button functionality in design documents.

d. User Operations Manuals

The success of a completed audiovisual project lies not only in the systems design and execution, but also in the ability and willingness of the user to utilize the system to its full potential. Considering the often significant investment in the AV system itself, it is imperative that there be sufficient follow-through with the owner’s personnel to ensure the system functions at its optimal level. This can only be accomplished through proper training and user documentation.

Operational documentation may also be included in the spec and/or contract, including system specific custom user guides, and manufacturers’ owners and service manuals. Even if user documentation is not required by contract, training material still should be prepared. Simple and practical explanations of basic functions could be a part of a “quick start” guide of some kind. In the case of multiple systems, small laminated guides may also be appropriate.

e. Equipment Owner's Manuals, Warranty Cards

Owner's manuals and system warranty cards for all devices in the system should be assembled and put into a single binder or electronically stored. Creating this single resource is important because additions or changes may be required under the warranty or service agreement to maintain system functionality; these changes are typically covered under the service agreement. However, adjustments and modifications made by the owner, end user or other party may void an existing warranty or service contract.

f. Warranty Support Statement for System

The project sign-off typically signals the beginning of the warranty period, though in some cases it may start before this point. In projects with a long timeframe, or those with delays caused by parties other than the integrator, the warranty period may begin at substantial completion and/or when the client begins substantial use of the system, sometimes called "first beneficial use."

Typically, AV bid specifications and Request for Proposals (RFPs) describe warranty support requirements for the project. These warranty requirements may call for a warranty of systems and installation for one year from the first beneficial use of the system. Most warranty statements require the integrator and software programmer to provide phone support during specified hours of operation. For issues not resolved via phone support, many systems call for troubleshooting via remote access.

Optional Services

These services may be discovered at different times within the project timeline, such as prior to the design phase or near the end of project closeout. Optional services can come in a variety of forms: AV system mockups, custom programming for a control system, maintenance agreements, outsourcing of technology management needs and more.

Startup Meeting

Clients may not realize that their projects are highly complex and could require additional support. During programming and design, the need for any of these optional services may become apparent as you discover more about the client's expectations, or ability to support the project once construction is complete. The AV provider professional could offer technology support services or some custom solutions that enhance the perceived value of the product, and further develop long term relationships.

Listed below are some optional services that are organized by the phase they are likely to occur in. For more details on these services, please refer to *ANSI/INFOCOMM 2M-2010*.

Pre-Design Phase

- Benchmark facilities tours
- Best practices and AV technology seminars
- Mockups of audiovisual systems

NOTE: The need for mock-ups of AV systems usually is not apparent until after pre-design has been completed. This is usually done later, during Design, when issues such as layout and configuration, and human interface design can be discussed and tested with the client and the rest of the design team.

Design Phase

Control System Design and Programming

Control System programming directly impacts the overall effectiveness of the AV system. Proper programming practices are essential for completing profitable projects, gaining user confidence, ensuring customer satisfaction, and promoting future business.

The act of identifying the intent of the system during the Program Phase and understanding users' needs and expectations leads to accurately defining the requirements of the control system. The details collected will contribute to decision making such as device selection, control methods, user interface types, and description of functionality.

The effectiveness of control system programming depends upon the ability to define the user interface design and system functionality that is both easy to use, esthetically pleasing, and meets the needs of the users. In most applications the “three button press” rule is utilized – it should take a maximum of three button presses to execute a system function from any mode of operation.

Control System Files

Control system programming files can be categorized into two distinct parts: user interface design code and processor code. In order to make modifications and recompile source code, additional files would be necessary such as modules and drivers.



Custom Software Programming

Control system programming is a highly specialized skill requiring a person not only trained in programming of the specific control manufacturer's hardware, but also knowledgeable of user interface design, device communication, audiovisual system flow, troubleshooting, and customer interaction.

Control system programming can be provided by an integrator, consultant, end user or a specialist referred to as an independent programmer. It is important to be able to communicate and work well with the control system programmer in order to ensure the successful outcome of a project.

Post-Construction Phase

- Maintenance Agreement
- First-use Monitoring and Support
- Ongoing Technology Management Services
- Full Technology Management Outsourcing

For more details on optional services for post-construction phase, please refer to *ANSI/INFOCOMM 2M-2010*.

Sample Design and Coordination Checklist

Here is a sample design and coordination checklist that generally represents what a checklist for an actual project might look like. The actual tasks and assigned responsibilities will vary for each project.

ANSI/INFOCOMM 2M - 2010 Design and Coordination Processes Checklist (EXAMPLE ONLY)

	Owner				Design Team							Construction Team					
	CEO	CFO	CTO	Tech Mgr?	Architect	Acoustical Consultant	AV	EE	ME	SE	IT	GC	Millwork	EC	MC	AV	COMM
Planning/Program Phase Programming Meeting Facility Tour Equipment Audits End-user Interview Program Report Budget Client Sign-off	P		P	P	P	P	P				P						
	P			P	P	P	P				P						
				P							P						
	R		R	P	R	R	P	R	R	R	P						
	R	A	R	R	R	R	D				R						
	R	A	R	R	R	R	D				R						
	A	A	A	A	P	P	P										
Architectural and Infrastructure Design Infrastructure Power Systems Data Systems Cooling Systems Raceway Systems Structural Support Space Planning Equipment /Room Locations Aesthetics Acoustics/Noise Sightline Studies Lighting/Windows Casework Coordination Signals Fire Alarm Security Standards Integration Floor Plans Reflected Ceiling Plans Elevations					R		D	R									
							D										
				R	R		D	R			D, R						
					R		D		D, R		R						
					R		D										
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	System Design and Documentation System Drawings Rack Elevations Mounting Details Panel Details Specifications Equipment Schedule Equipment Selection Computer Modeling																
				R, A	R		D										
				R, A	R		D										
				R	R, A		D	R		R							
				R, A	R		D										
				R	R		D										
				R	R		D										
				R, A	R		D	R	R								
				R	R		D										
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Systems Integration/Construction Programming (DSP, Controls, etc.) Equipment Submittals Fabrication Drawings Changes and Clarifications Requests for Information Construction Observation Systems Testing & Performance Verification Record Drawings Test Results Operations and Maintenance Manuals Shop Acceptance Testing Site Acceptance Testing Punch List/Back Punch Training Installation/Fabrication Code Support Contracts Owner Acceptance				P, R	R		D, P, R				R	R	R	R	R	D	R
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				R	R		R				R	R	R	R	R	D, P, R	
		A		D, R, A	D, R	R	D	R	R	R	R	D	D	D	D	D	D
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Post-Construction Follow-up Site Visit First Use Support Follow-up Programming Changes Warranty Check-ups																	
Optional Services Pre-design Tours Mock-ups Technical Management AV Systems Asset Management and Tracking																	



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