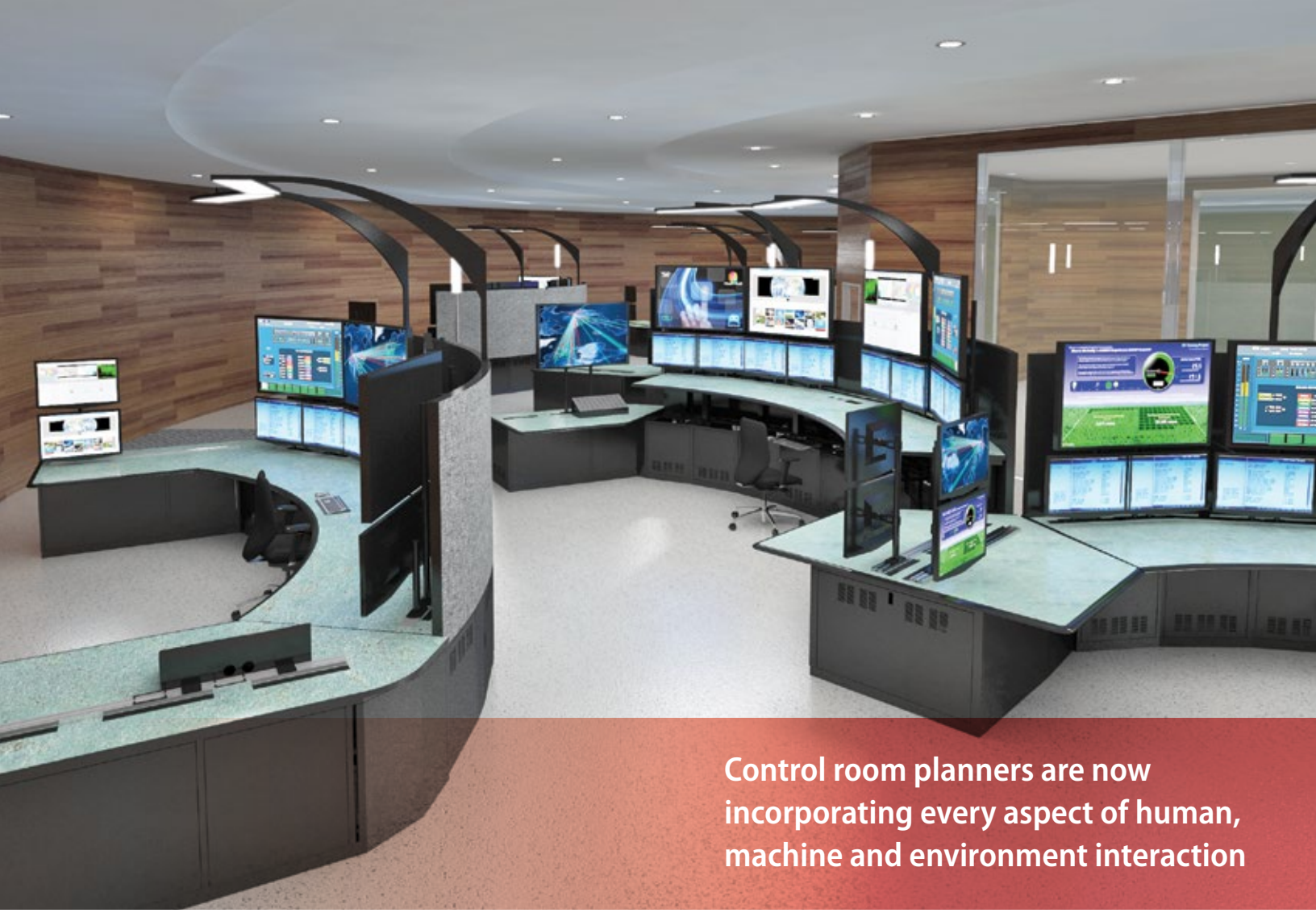
Top Considerations

When Designing an Ergonomic Control Room



Control room planners are now incorporating every aspect of human, machine and environment interaction

Defined as "the science of fitting workplace conditions and job demands to the capabilities of the working population," by the Occupational Safety and Health Administration, ergonomics sounds like a simple match game between the employee and work conditions. However, with all the factors that affect control room ergonomics, it has become more about designing the console around the employee.

To truly satisfy today's heightened ergonomic standards, console design has experienced a dramatic shift to deliver solutions that are smaller, with improved functionality and more appeal than ever before. Current console design is done with a more comprehensive, top-down approach to control room planning, examining every element of the console itself, as well as the overall layout of the room. Control room planners are now incorporating every aspect of human, machine and environment interaction, from monitor tilt and indirect lighting to air temperature and movement, to create the optimal working conditions and comfort level.

Defining a Control Room

Put simply, a control room is a place where a facility or service can be monitored and controlled. While the equipment in the control room is essential to operation, to be effective, it has to support the requirements of the operator. It's important to keep in mind that while in a control room, a person's ability to use their senses is diminished—which requires them to rely on technology within the control room to determine what is happening and/or what action needs to be taken.

Since the control room acts as a person's "eyes and ears," the design of it is extremely important. When designing a control room, it's critical to consider all factors, for example, equipment selection, operating practices, working environments and furniture choices. In addition to the design of a workstation, operators within the control room must be considered. The overall system will fail if operators are overloaded, undertaking tasks for which they are poorly trained or straining to read displays that are illegible. It is necessary to identify the limitations of the operator to minimize potential mismatches between user capabilities and system demands.

Control Room Design Considerations

Room Architecture

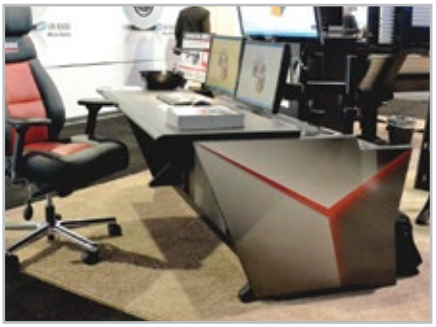
Size and Layout
The control room itself is important because it serves as the shell of the system. When selecting a room, designers should consider the control room objectives and determine how much equipment and people the room will house. The size of the room should accommodate all necessary equipment, while allowing for people to comfortably move about.

Physical layouts should also accommodate the use of non-electronic equipment and documents, such as operations manuals, log books, maps and clipboards. Space should also be allowed for positioning such items as telephones, keyboards, mice, controllers, radio/intercom and writing areas.

Shape
In addition to size, there are a variety of room shapes. A rectangular room provides the most options for equipment, display and console positioning. In general, rooms with sharply angled walls or with support columns should be avoided. Designing a control room of the right size and shape can go a long way toward achieving an efficient, comfortable operating environment.

Materials
The room materials should also be considered. Ceiling materials should offer moderate to high reflectance of 0.8 or higher to improve light distribution throughout the room and reduce energy cost. The ideal walls in a control room feature an off-white matte or flat finish with a reflectance range of 0.5 to 0.6. Floor materials should have a lower reflectance of 0.2 to 0.3 for carpet or 0.25 to 0.45 for floor tiles.

Windows
Operators typically do not like working in windowless environments. Unless prescribed for operational or security reasons, it is strongly recommended that north-facing windows are included in a control room, primarily for psychological reasons. However, such light sources also present potential security challenges and can contribute to reflections and glare. Windows and doors should be out of the primary field of view but visible from a seated position. Also, it is important to allow circulation space around doors to minimize congestion.



Aesthetics
Customized consoles with logos, images and designs allow companies to create a one-of-a-kind console that highlights their corporate identity. From a simple decal to an intricate, multi-color Corian inlay, custom consoles provide a unique control room solution.

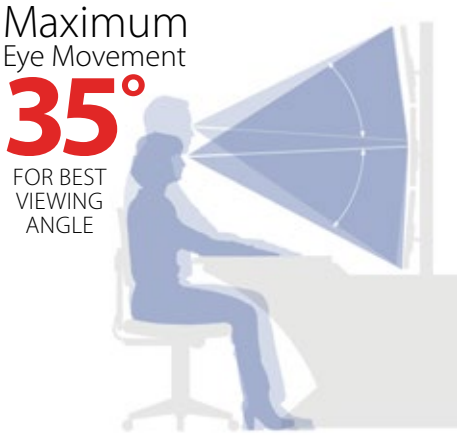
Consoles have extensive functionality advantages over basic office furniture.

Furniture

Consoles

When determining console placement in the control room, it is important to consider the room's dimensions, number of stations, measurements of each station, video wall sizes and aisle width.

For the ideal viewing angles, there should be little head movement and minimal eye movement (maximum eye movement is 35 degrees). It is critical to determine if the workstation will be used as an isolated unit or in conjunction with overview displays or other workstations. The height of the console should be calculated so the smallest operator can see over the top of any mounted electronics, walls or displays, and the clearance beneath the work surface should allow for the tallest operator to sit comfortably.



For optimal viewing of a large-screen display or group of displays, the distance should not be less than twice the display's largest image height or greater than six times its height for normal video. However, if this is the primary monitor and it should fit into the 30 degree cone-of-viewing, then the longer-range formula for viewing should take precedence.

It is critical to factor every type of situation and future upgrade, not only day-to-day operations, when designing a command control room. Sufficient space should be maintained in and around the console to allow multiple groups of personnel to view and analyze information quickly and efficiently.

Flexibility is also key when considering console furniture. Depending on the control room objectives, consoles should be reconfigurable, allowing designers to move or install them in multiple locations. Further, consoles that are easily expandable are also useful for applications that require various console size requirements.

Functionality

Oftentimes, many control room designers weigh the differences between consoles and office furniture, and argue that both can be used interchangeably. However, because the functions that take place within the control room are so important—often, life or death decisions—consoles have extensive functionality advantages over basic office furniture.

Control room environments run 24 hours a day, 7 days a week and put incredible stress on the equipment in them.

CONSOLES OFFER THE FOLLOWING FUNCTIONAL ADVANTAGES OVER OFFICE FURNITURE:

High Equipment Loads: Consoles are designed for handling high equipment loads, including multiple monitors and processors, while remaining ergonomically correct. Further, these monitors can be configured in many different ways to accommodate operators. On the other hand, traditional office furniture is only optimized for one or two monitors, and the addition of extra monitors reduces the ergonomic correctness.

Device Management: The other aspect of equipment load is the management of processors and other peripheral devices. Consoles keep processors safely behind closed, lockable doors in the base of the console. This eliminates failure due to equipment being knocked or wires being pulled out of equipment. Traditional office furniture might offer a processor holder, but it does not offer equipment protection.

Front and Rear Access: Control room consoles are built with both front and rear access to processors and rack-mounted equipment, allowing IT departments and other service providers' quick access for equipment repairs, replacements or updates without disrupting the operations of the room. Traditional office furniture does not provide full access, requiring disruption to operations.

24/7 Demand: Control room environments run 24 hours a day, 7 days a week and put incredible stress on the equipment in them. Consoles are built to withstand the rigors of this type of use, featuring a steel substructure and high performance materials that resist wear. Office furniture is typically designed for 8 hours a day, 5 days a week use and may wear out up to three times faster than a purpose-built console.

Wire Management: Consoles offer multiple levels of wire management, allowing installers to separate high and low voltage wires, (power and data), and provide wire management capabilities right up to the user interfaces. Typical office furniture is not designed with heavy wire management capabilities.

Guaranteed Warranty: Most console furniture is designed and warranted for 24/7 use, while traditional office furniture is not. Even if you find a supplier that will warranty their office product for 24/7 use, they most likely will not have the infrastructure to handle repairs and replacements in a timely fashion the way a console manufacturer does.

Reconfiguration: Another important factor in control room environment is the ability to reconfigure the technical furniture to accommodate future changes. Traditional wood, glue and screws furniture has no future flexibility in the design.

24/7
Durability

UP TO
3X
LONGER LIFESPAN

Device Management

Wire Management

Front and Rear Access

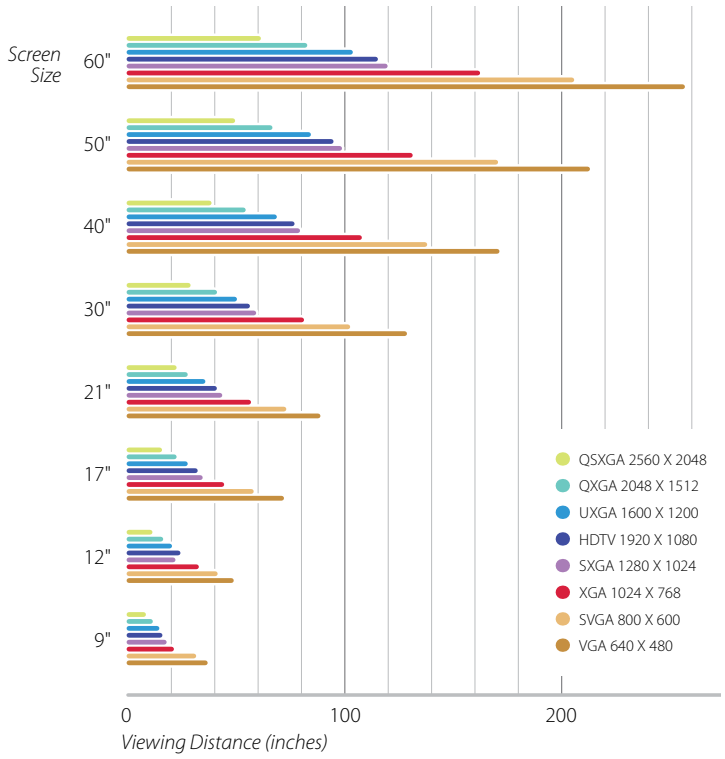
A separate equipment room to house CPUs, servers and rack-mount equipment will remove the biggest sources of heat and noise from the operators' area.

Monitors

When designing display layouts, it is important to keep in mind that the amount of information an individual can handle is limited. Maximizing operator performance requires that the designer know the exact amount of activity associated with each monitor image and the size of detail. Displays that are used for close image inspection should be positioned directly in front of the operator, with sizes typically ranging from 19 to 24 inches. Displays outside the workstation and positioned at a greater distance or behind the console should range in sizes from 24 to 42 inches and larger.

The introductions of flat-panel displays and touch-screen technologies have had a significant impact on console design. Flat-panel screens take up considerably less space, reduce power consumption and require less cooling within the console. Further, today's displays range from 800 x 600 (SVGA) to 1280 x 1024 (SXGA), 1600 x 1200 (UXGA), or even greater. With increased screen resolution, operators can get closer to the display and still not be able to detect the individual pixels. A general rule for viewing video images is that the operator should be at least twice the distance from the screen as the height of the largest image displayed (not the display itself), but not more than eight times; the ideal spot is four to six times.

MINIMUM RECOMMENDED VIEWING DISTANCE FOR DISPLAY



Touch screen technology also affects the ergonomics of new console designs, especially in high-security or high-attention environments. Studies have shown that when operators get extremely nervous or come under high stress, they have trouble finding or clicking on an icon using a mouse but have less trouble pointing with their finger—making them ideal for high-stress environments. However, consoles incorporating touch-screen technology must offer a shorter distance between the operator and the screen—typically less than 28 inches from the edge of the console work surface—so that the screen can be reached from a relaxed sitting position.

To maintain the most consistent operator environment, a separate equipment room should be provided to house CPUs, servers and other rack-mount equipment. This will remove the biggest sources of heat from disk arrays and processors, in addition to noise from cooling fans from the operators' area. It is also beneficial to store the most sensitive equipment in a secure, limited access area that is designed for proper cooling.

Environment

Design managers must account for environmental factors, including a requirement for auditory or visual tasks, air quality and temperature, equipment housing, lighting, structure materials, windows and room shape.

Auditory or Visual Tasks

For control rooms that require speech communication, all auditory needs of the environment must be appropriately specified. To control ambient noise levels, users must consider room and console finishes, noise output of equipment and external commotion. Ceiling acoustics should strive to achieve an NRC (noise reduction coefficient, a measurement of sound absorption characteristics) of 0.65 to 0.75 or better and an AC (articulation class, a measurement of attenuation) of 40 to 44 or better.

Air Quality and Temperature

Air quality and air temperature play an important role in keeping operators awake and alert. One of the most common criticisms of control room design is the lack of consistent ambient temperature. For example, an air conditioning system is automatically set to increase the temperature to compensate for natural early-morning drops in body temperature. For optimal comfort, room temperature should range from 70 to 72 degrees Fahrenheit, with relative humidity from 40 to 65 percent. Air movement should not exceed 4 to 6 inches per second.

Lighting

Lighting within control rooms should be suitable for all visual tasks. A lighting scheme largely based on indirect ambient lighting, where the ceiling reflects light down into the room, has been found to offer an effective solution. In designing a lighting scheme, attention should be given to the range of tasks performed as well as operators' ages. Low levels of lighting may be fine for image monitoring but can pose problems with paper-based tasks. Operators of all ages, but especially older workers, will require adjustable task lighting to conduct small-scale visual projects.

Operator Requirements

Operator requirements vary for each control room, as they are dependent on not only application but also on the overall objectives and functionality of each control room. The number of operators on staff depends largely on the application and size of the overall organization. However, in any given control room, typical job duties can include:

- Ensuring that everything is under control and working as desired
- Monitoring, troubleshooting and managing equipment usage and work progress
- Assessing machine logs and supporting troubleshooting
- Adhering to plant operational procedures for production goal achievement and handling work safely
- Inputting operational system status with applicable journals and control system tools
- Functioning as plant operation to calibrate and troubleshoot automation, power and building interface systems
- Gaining awareness of system operating requirements and trends and suggesting operating adjustments
- Managing electrical and mechanical equipment and facilities with the competency of a plant operator
- Conducting emergency operations for electrical service and protecting station equipment
- Overseeing control desk
- Replying to production floor requests and machine stoppage alerts
- Overseeing productions and process key metrics for operating plant machinery within parameters
- Handling equipment maintenance and tag-out as per standard operating procedures
- Ensuring timeliness, completeness and administrative requirements accuracy
- Receiving and replying to calls on organizations and agencies

Project Management

As most control room projects are large and complex, they must meet certain budget and time constraints. It is important to select a trusted supplier that offers stock, customized and custom console solutions to meet diverse requirements. Some suppliers offer value-added services as well to streamline projects, including on-site consultations, design services to ensure equipment is ergonomically correct, design software for an interactive experience and project support to assist in any phase of the overall project.

WEB: winsted.com • **EMAIL:** info@winsted.com • **TEL:** 800.447.2257

Winsted Headquarters
10901 Hampshire Ave. S.
Minneapolis, MN 55438-2385 USA