The Ergonomic Design Approach of control workstations and the layout of the control room should all contribute to achieving the performance objectives set for the control room. Every aspect of interaction between man and machine and the environment should be considered, from raised flooring to acoustic concerns to indirect lighting and the well being, health and safety of each operator all need to be addressed.

At Winsted, we address multiple ergonomic issues making your installation meet the highest standards by providing quality world class consoles for a productive environment.

**Top-down Approach**

A *Top-Down* approach provides a framework where decisions on such matters as equipment selection, operating practices, working environments and furniture selection are based around the operating demands. No matter how well designed a workstation might be, the overall system will fail if operators are overloaded, undertaking tasks for which they are poorly trained or straining to read displays which are illegible. With a *Top-Down* approach, the limitations of the operator are automatically included and potential mismatches between operator capabilities and system demands are minimized. The ISO 11064 is the backbone of the International Standard on ergonomic design of control rooms. The essence of this approach can be defined within a single term – “USER CENTERED” design.

Use the *Top-Down* approach by first spelling out the goals of the control center (Situations: normal, off-normal, emergency, outage and startup). Determine what systems are required to achieve these goals, then list first the functions best undertaken by machines (such as repetitive calculations), then those functions with which the human operators are superior (like coping with unexpected situations). The result will define system specifications for computers as well as those tasks to be conducted by human operators.

The flowchart presents the 'idealized' path for the systematic introduction of ergonomics.
Ergonomics

Ergonomics is the study of the relationship between workers and their environment. Most previous console standards were set back in the 60’s. These standards have been revised to consider both these new technologies and new understandings of how our head, neck, and eyes operate.

Revolutionary changes in technologies are also aiding in an aesthetic overhaul. The emergence of digital technology, system integration and flat panel displays have allowed us to design a wider variety of consoles with a smaller footprint. As we change the way we design, we are also looking at the way people use the console by applying ergonomics.

Past ergonomic studies were done with a person in the “sitting tall position,” with their hips, shoulders and ears in a straight vertical line. Realistically no one would sit in such an uncomfortable position, especially for the duration of an eight hour shift.

Because we now understand more about how the neck, head and eyes operate, today’s ergonomic standards are based on more realistic assessments of how operators work at consoles. Present ergonomic studies of people sitting in the relaxed position show that our heads tilt forward approximately 8° to 15° at a viewing angle of minus 30° to 35° down, and an average viewing distance of 30” to 35” to the screen. With that in mind, newer consoles are lowering the target angle of the primary viewing displays.

Workstation Specification

In the design of a console it is necessary 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 workstations mounted electronics to remote monitor walls or displays and the clearance underneath the work surface should allow for the tallest operator to sit comfortably.

Physical layouts should consider non-electronic equipment needs such as log-books, maps and clip boards. An element of flexibility should also be allowed for positioning such items as telephones, keyboards and writing areas. This will enable operators to change posture during their shift and minimize the effects of fatigue.

Displays/Monitors

Use the Top-Down approach when designing display layouts, starting with management objectives rather than attempting to see how many monitors can surround an operator. Keep in mind that the amount of information that an individual can handle is limited. Operator performance targets the amount of activity associated with each monitor image, and the size of detail. All affect the detection of significant events.

Displays that are used for close image inspection should be positioned directly in front of the operator, with sizes typically ranging from 15” to 19”. Displays outside the workstation and positioned at a greater distance or behind the console should range in sizes from 19” to 42” or larger.
With the introduction of flat panel displays and touch screen technology, they have also made a major impact on console design.

First, large CRT-based monitors are rapidly being replaced with flat panel screens that use considerably less space within the console. Second, touch screen technology is affecting the ergonomics of new console designs, especially in high security or high attention environments.

As the acceptance of flat-panel LCDs by industry grows, the ability of a supplier to offer the right console is essential in obtaining the correct ergonomic solution for control room operations.

While touch screens are not used in many applications, new studies show that when people get extremely nervous or are under high stress, they have trouble operating a mouse to find and click on an icon, but have less trouble pointing with their finger to a touch screen. As a result, touch screens are becoming more and more prevalent in high security, high stress or control room applications. Consoles incorporating touch screen technology feature a smaller distance between the operator and the screen, so operators can comfortably touch the screen while sitting in the “relaxed position.”

With digital electronics and systems becoming more and more intelligent, operators require fewer control elements within the console. Corporations are placing larger equipment in secured air conditioned rooms and console designs become ergonomic with smaller footprints. Today, operator attention is on a single display source, focused on vital information that is relevant to each current situations.

Operator Considerations

- Test console layout with users for “Human Tasks” including sequential task simulations, then, if necessary, modify console layouts from trial feedback.
- Develop workstation layouts based around acceptable reach zones and visual limitations.
- Take into account maintenance requirements and removal of equipment in running applications, from both the front of the workstation, and the side and back of the console.
- Provide ergonomic footrests where appropriate.
- In workstation dimensions, consider the full height range of the users and the size range they may exhibit.

The command control room should be designed for more than just day-to-day operation. You need to consider every situation in the initial design and or future upgrades. Enough space should be maintained in and around the console so

Environmental Design

The provision of an appropriate working environment is essential for control rooms where speech and visual tasks are predominate. multiple groups of personnel, from supervisors to security professionals, emergency service personnel or even government officials can view and analyze information quickly and efficiently. Design for crisis – hope for routine.

Where speech communication is important, all auditory environment needs are to be appropriately specified. Ambient noise levels need to be controlled by consideration of such factors as room and console finishes, noise output of equipment and control of external sources of noise.

Air quality and air temperature can play an important part in keeping operators awake. One of the most common criticisms about a control room is a consistent ambient temperature. Air-conditioning systems that operate on a 24 hour basis, can be automatically set to increase the ambient temperature to compensate for when body temperatures are naturally decreasing in the early hours of the morning. This is one example of the way in which environmental design can contribute directly to the operator performance.

Where an extensive array of displays are used together, lighting within control rooms should be sufficient and suitable for all visual tasks. A lighting scheme largely based on indirect ambient lighting, where the ceiling is used to reflect light down into the room, has been found to offer an effective solution. In designing a lighting scheme, attention needs to be given to the range of tasks undertaken as well as the ages of the operators. Low levels of lighting may be fine for image monitoring but pose problems with paper-based tasks and, both older operators and their younger counterparts alike, will require adjustable lighting to conduct the same visual tasks.

Operators typically do not like working in windowless environments. Unless required for operational purposes, it is strongly recommended that a window is included in a control room – primarily for psychological purposes. Any such areas will need to be taken into account for security and potential sources of reflections and glare.
With all of the new ergonomic trends happening concurrently, the technical furniture industry and Winsted have evolved to create new ergonomic console designs that are not only functionally superior but also aesthetically pleasing in form.

Of course, very few command control centers have the same form or function. For example, the number of cameras, operators, console equipment, and aesthetic requirements may differ largely within the control room of a campus security office, a communication center, a process control plant, and a nuclear power plant.

Companies such as The Winsted Corporation have risen to the challenge. Winsted’s new line of Low Profile consoles are designed to lower the target viewing angle for the operator’s primary monitors. This new design also allows large flat panel displays or video projectors to be placed at the front of the room and be easily viewed by the operator.

The ability to provide a broad range of product offerings is paramount. Winsted specializes in modular and custom manufactured technical furniture for every size operation, from NEWS editing rooms to NYSE trade rooms to FULL COMMAND control rooms.

We offer fourteen product families to choose from that are designed exactly to your requirements and work very well with the International Standards.

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Bank House
81 St Jutes Road
Englefield Green, Egham, Surrey, TW20 0DF

The Changing Face of Console Design, Neal Linnihan
615 1st Avenue NE
Minneapolis, MN 55413

We have addressed a few ergonomic considerations, but for the complete resource, refer to: Ergonomic Design of Control Centers, which is the International Standard ISO 11064.