

### Introduction

To get the most value from a Mission Critical Control Room, good design and construction is not enough. Optimal functionality depends on an engineering approach that is based on scientific principles and complex calculations unique to each mission critical installation.

Whether the goal is to monitor and analyze geospatial data, manage utility infrastructure, or operate and control intelligent transportation systems, a deep understanding of the workflow and day to day use is necessary. This understanding must be combined with the knowledge of ergonomics and human factors engineering to enable an environment that makes managing mission critical events easy, intuitive, and engaging.

### **Five Key Elements**

Every Mission Critical Control Room is built around five key elements. These include the operator, the console, content management, the displays, and image processing. Ideally, these are developed holistically to create the optimal working environment specific to how the space is meant to function. With capabilities and technologies rapidly advancing, most control rooms will require some upgrades every three to five years. Technology roadmaps and scalability should always be considerations when selecting systems and components to future-proof the investment.



#### The Operator

A well-functioning control room begins with the operator. All the other elements should be engineered around operator needs and requirements. Ideally, time and motion studies are performed to systematically observe, analyze, and measure how the job of the operator is performed. With this information, the engineering team deepens its understanding of how all the operators in the environment work and collaborate. These studies provide an understanding of where they need to sit, what they need to see, and how the lighting and sound environment should be designed.

While many companies that design and build mission critical control rooms spend roughly 10% of their time understanding the operator, they commit much more time to management, IT, and facilities. Although management ultimately makes the buying decisions, operator input is important for truly optimized functionality. In a best-case scenario, 90% of the information needed to engineer a control room, comes directly from the operators. Keeping operators comfortable and happy mitigates the impact of fatigue, boredom, and distractions. This environment is crucial for the mission critical role that they play. Ergonomic seating and consoles are essential.

Traffic flow must be analyzed to determine where doorways are placed, or in the case of an existing room, how consoles will be positioned relative to the entry and exit points.

The number of operators, the size, layout, and dimension of the room and display technology all determine the calculations that go into configuring a space. These factors influence many design elements including heating and cooling systems and sound masking. For example, in condensed spaces, noises such as a sound shower, white noise, or music, form an acoustic cone over each operator to create a pleasant environment to help drown out distractions. Flexibility in the sound environment, overall comfort, and state-of-theart systems drive better performance and contribute to operator retention.







#### **Consoles**

Consoles play an essential role in smooth operations. Together, with ergonomic chairs, can contribute to attracting and retaining talent. Whether fixed height or adjustable, consoles must be heavy-duty to withstand adverse conditions. Their key role is to provide support for an array of monitors as well as storage and management of wireline connections. They must also provide a work surface and support the control boxes that enable source switching.



While sit/stand desks maximize flexibility and comfort for the operator, ceiling height and room configuration will contribute to whether they are a feasible option. A good engineering study helps define which consoles best serve the specific mission critical environment. Studies can also eliminate potential issues such as standing desks that block the view of back row operators.

#### **Displays**

A prominent large-scale display is the centerpiece of nearly every mission critical control room. This provides an overview of the system as well as a composite view of critical data. It can be used to share video feeds of key sites, events, or cable news programming in real time. The large-scale display helps the control room manager see and reference a big picture overview. It also helps give the team context for their individual parts. In some cases, they also serve to instill confidence during VIP visits, demonstrating the sophistication and effectiveness of the operation. Like consoles, display systems must be engineered to meet the needs of the organization's specific network architecture, source requirements, and operator profiles.

The most popular large-scale displays commonly used today are LCD panel arrays and direct view LEDs. Older rear projection cube video walls were previously commonplace, but due to their weight and large footprint, most have been replaced with next-generation systems.



#### LCD Panel Arrays

The majority of today's mission critical control rooms use LCD video walls due to their relative affordability, reliability, and high-resolution options. They can be viewed with clarity even at close range and from side angles. However, when tiled to form large scale wall displays, the seams between individual panels are somewhat visible and the effect on image continuity can be distracting. LCDs are also vulnerable to reflections, so other light sources in the room must be carefully placed.



LCDs provide high resolution imagery with sharp detail due to their high pixel density and typically function non-stop for years without mechanical failures. Built on solid-state electronics, they have no consumable parts, and are resilient to environmental stress like vibration, humidity, and UV light. As newer technology enters the market, pricing for LCD displays continues to drop, making it a costcompetitive display option. Professional grade displays should be considered for their adjustability (for consistent colors across large walls), 24/7 operational design, and warranties.

#### Direct View LEDs

Initially developed for digital signage, direct view LED displays are gaining popularity for use in control rooms. Today, many managers of control rooms with LCD displays are considering upgrading to LED technology due to LED brightness, color accuracy, and continuous seamless imagery.

LED displays have a shallow profile for a broad range of mounting options. Their high reliability and energy efficiency can reduce operational costs and have less maintenance. With the highest maximum brightness of any leading display technology, LED systems work well in control rooms with significant ambient light, and they are not prone to reflections from other light sources in the room.

LED technology is very robust and reliable with typical lifespans of roughly 100,000 hours compared to a 20,000-hour expected life for LCDs. The image quality of LED displays remains consistent over the life of the installation.

Direct View LEDs tend to be lower resolution than LCD displays, but not all control room video walls require high resolution and up-close viewing. Engineering a mission critical control room includes understanding the character and line size required by the users. In many cases, ultra-high resolution may be overkill and less important than brightness, durability, and continuous seamless imagery. Pixel size and viewing distance ratios are calculated carefully in a well-engineered control room.

The structure on which the multiple LED panels are mounted and supported is a very important element of a solution because of the extremely fine alignment of the panels.



While the supporting structure is not seen once the LEDs are in place, a poor structure will be very visible over time because panels can become misaligned over time or after servicing. Especially with large walls, the weight of elements can cause a poor structure to sag over time. If the control room area is subject to occasional or regular vibration, the structure should allow for dampening and maintain alignment integrity through its expected life.

While they require a larger up-front investment, the total cost of ownership of a large-scale LED video wall provides a good value. Current pricing for LED displays is coming down as the technology is more widely adopted.





#### Content Management

Mission critical control rooms typically run imagery from System Control and Data Acquisition (SCADA) applications. Depending on the application, output such as an entire transmission grid can be viewed as a continuous image that spreads across an entire video wall, with windows for other significant feeds.

Engineering and human factors analysis will drive decisions on the character and line size of the readouts, as well as foreground and background colors, font choices, and colors. Content must be designed to mitigate fatigue and eyestrain and to preserve circadian rhythms. Circadian lighting is spectrally engineered to provide blue-rich white light during the day, and it automatically transitions to blue-depleted white light at night, which has been shown to improve the health and operator performance.

#### Image Processing

Increasingly, processing systems or content controllers are moving away from big hardware with input and output cards to systems that are more software driven. The content controller enables the display of multiple sources across any size screen or video wall. It also tells the computing system how to make the images the desired sizes and locations. Processors come with numerous intriguing features, but it is important to understand what features are going to be used on a regular basis before being confused by too many options. In a typical mission critical control room, the processor drives a big picture reference image such as a map or grid of the system. Then, the content controller windows in streams such as video camera feeds, weather feeds, stock market readouts, or satellite imagery.

Special features, such as drone video integration and collaboration tools may sound exciting, but it is important to focus on the tools needed every day rather than elaborate features that are unlikely to be used in the long run. It is possible to establish a test-bed area for new features before they are integrated into the environment for regular use. The best content controller is one that performs required functions and is scalable to add features as needed.



# Careful Engineering for Better Value

A well-engineered control room, focused on actual workflow and daily use cases, will lower costs compared to preset designs with customizable features. For example, high resolution displays may sound essential, but when ergonomics and human factors are considered, their usefulness is frequently limited. When character and line sizes are larger than an inch, which is often the case in mission critical control room displays, larger pixels are enough. In this scenario, a higher resolution display will not improve the visual experience. Paying for unused pixels is wasteful. Resources can be diverted to elements that bring real value.



(Thorough consulting, planning and staging will result in all an excellent long-term solution)

Another example is over-spending on a content controller or video processor. While elaborate features might be appealing, it does not make sense to pay for capabilities that will not be understood or used in the long run. A basic controller that is scalable can provide significant cost savings.

It is also important to compare total cost of ownership over the life of a control room rather than solely focusing on the initial investment. While LED displays are more expensive than LCD screens, the benefits of longer lifespans, long-term stability, and lower operating cost provide better ROI than lower cost alternatives.

## A Good Advisor

Mission critical control rooms require sophisticated systems with significant complexity. Whether implementing a new control room or upgrading an existing one, it is important to work with a partner or advisor that understands changing technologies and how to optimize them for every unique application.

The implementation partner should also have 24/7 availability to make sure that once the system is installed it is serving the expected purpose both day to day and in critical high-pressure situations. The relationship with the team that engineers a mission critical control room should be a partnership that extends throughout the life of the installation and beyond. Stakeholders need to be kept apprised of next-generation advances and opportunities for effective upgrades.

When the application is mission critical, there is no time for a vendor who claims that the issue at hand is not their responsibility, or says a problem resulted from someone else's software or hardware. A good partner is available when operators are first learning to manage a system, and later in the case of a glitch or malfunction.





## Conclusion

It is easy to find a company that will design and build a mission critical control room based on basic requirements. But an engineered implementation is a better choice when it comes to long term success. An engineered system is optimized to be costeffective, scalable, easy to use, and highly effective in meeting organizational requirements. Understanding the elements of control room systems and the technology advances that are driving today's upgrades is key to creating healthy environments that attract talent and perform flawlessly when failure is not an option

## About Mechdyne

Mechdyne is a broad-based technology company with many years of success in providing customized, turn-key audio visual and virtual reality solutions for complex information display and collaboration challenges. The company has significant successes in integrating systems for Fortune 500 companies, major universities, and government organizations.

Mechdyne works as part of highly integrated architecture, engineering and construction project teams. Mechdyne excels at planning and managing large projects. Its clients appreciate the company's culture of technical expertise, reliability, and technology agnostic long-term support. Mechdyne helps clients understand long term cost of ownership and provides a depth of expertise in technology lifecycles important to mission critical control room implementations.

Mechdyne has five other Business Units providing comprehensive, customized solutions that include Engineered Structures, AV Services, Software Services, IT Services and Security.

