5 Best Practices for Real-Time Operation Centers Design in the Oil and Gas Industry

Control rooms and real-time operation centers (RTOCs) serve many purposes in the energy, oil, and gas industries, particularly in support of upstream activities. From emergency response to immersive visualization, control rooms enable oversight of sensitive resources, accelerate the delivery of informed decisions, and reduce skill-development time.

While these rooms are essential to energy, oil, and gas companies, few are optimally designed, resulting in operator fatigue and lower productivity. This paper describes five best practices for control-room design based on AVI-SPL's 10 years of designing control rooms for energy companies. The paper presents lessons learned from operators, systems analysts, and IT managers, including:

- *Design to the use of the room, including data and visual images*
- *Select displays that yield appropriate resolution, including appropriate size for operators to easily view and understand*
- *Consider human factors*
- *Standardize design across locations*
- *Plan for ongoing support and future expansions*

Designing a RTOC is no small task. These multimillion-dollar control rooms enable energy companies to monitor, analyze, and control drilling and other critical operations throughout the world. Traders use control rooms to maintain a clear view of all market data so they can capitalize on fluctuating energy prices. Safety operators use emergency response rooms to visually inspect assets and drill sites and thereby make informed decisions to ensure compliance and mitigate risk. Geoscientists use visualization rooms to identify potential exploration sites through immersive visualization technologies that improve accuracy and accelerate energy exploration and delivery.

It's a pressure-filled environment where mistakes can cost millions of dollars a day. According to the ARC Advisory Group, the global-process industry loses $20 billion, or 5% of annual production, every year due to unscheduled downtime and poor quality. ARC estimates that almost 80% of these losses are preventable; 40% of the preventable losses are due to operator effectiveness issues in the control room.

For IT professionals in the world of petroleum engineering, your role includes providing the tools and environment that facilitate all the activities that take place in a RTOC. To assist you, the best practices explored in this paper provide insights and lessons learned from control room integrators, IT professionals, and RTOC users.

Expert Advice

"If you're building a control room, we say that you have to start from the inside out," says Dr. Peter Bullemer, senior partner at Human Centered Solutions. "You have to first understand the operators and what they need on their consoles, and then arrange those consoles based on how they collaborate. Then you define who the operators interact with and prioritize who needs to have access or be next to the control room."

Best Practice 1: Understand the use of the room

Typical Practice—Many control rooms are designed using a technology-focused approach. The project team identifies the type of equipment for the room and proceeds to the build phase. Often the project is well under way before anyone considers the perspective of the room's user or what efficiencies can be introduced into the day-to-day operations in this new environment. At best, this approach adds expense to the project as design shortcomings are uncovered and corrected while the room is built. At worst, the operators end up with a room that isn't optimal for their workflow. The consequences of a suboptimal control room include operator fatigue, non-productive time, and errors.

Best Practice—The best approach to RTOC design is operator focused. That means considering the user's perspective and the tools required to perform their tasks before any requirements documents or design plans are drawn up. Ideally, every project team includes user representatives. This practice lets users provide important insights and increases the likelihood of user satisfaction when the project is finished.

For users to be effective in their job, they need a control room environment that makes it easy to comprehend and respond to the information presented. By understanding the user's workflow, and how and what type of information they need to access, the project team can guarantee the room environment increases productivity, improves work quality, heightens worker satisfaction, and reduces or eliminates human error. As a bonus, a properly designed work environment is usually a major factor in employee satisfaction and retention.

A word about budgets

Budgets are the reality that often stand between a project team and optimal room design. To ensure the best possible outcome, all parties must understand the budget. Plan and execute control room design in phases to create a path that leads to the optimal room.

Information Checklist

- ☑ Define the use of the room
- ☑ Learn what operators need to accomplish
- ☑ Identify what information operators need to view
- ☑ Identify what tools operators need to perform their tasks
- ☑ Understand the workflow of the room
- ☑ Know the budget
- ☑ Determine staffing and scheduling requirements
- ☑ Find out about any building restrictions that could impact room layouts

Best Practice 2: Select displays that support the content

Typical Practice—Large overview displays are the component most associated with control rooms. They are highly visible and give rooms a futuristic "wow" factor. From rear-projection wall-to-wall screens, front projection screens, or seamless tiled displays, the large displays provide a complete overview of the work in progress. The smaller desktop displays located in each operator's workstation or console show information that is relevant to the operator's area of focus.

This typical setup is a challenge, though, when information that looks clear and sharp on a 24" HD desktop is sent to the large overview display for group viewing. It doesn't look clear and sharp on the large display. The typical design doesn't address issues such as loss of resolution, improper pixel mapping, and black edges

Operator Perspectives

"My company invested millions of dollars into a central monitoring facility, with a large video wall. The idea was the video wall could display news and weather alongside alarms and outages in real time, with geographic mapping capabilities. Workstations had quad displays.

It was impressive when it was built, but within a couple years, the video wall had been dismantled and parts sold off due to its impracticality. The right software was never found to perform the type of "geographic" monitoring conceived, partly due to bureaucracy. Network redundancy was overlooked, which made the monitoring facility itself nonfunctional during an outage. The quad displays ironically obstructed the view of the video wall when it was still in place, and did not fit in the cubicles when they were installed, so these were reduced to two."

Best Practice—It's not easy to replicate the image quality delivered by a desktop HD display. Yet adequate resolution and color conformance is critical to the operator's ability to easily understand and interpret the information. It's imperative to use two critical considerations when defining display requirements: usage level (24/7 or other) and type of content (text or image).

For example, high usage or 24/7 facilities should avoid LCD- or LED-lit LCD type screens because they ultimately decay and display burn-in. This means the popular LCD screen will need to be replaced in 2 to 3 years.

As a RTOC designer, don't neglect to factor in the type of content transmitted. Typically, images handle the resolution process better than text. However, text and vector graphics require more precision to avoid user eyestrain and ensure easy comprehension. To provide the optimal experience, make sure the displays support pixel mapping.

Pixel Mapping

For this paper, pixel mapping refers to changing between resolutions or matching digital resolutions. ControlBooth.com provides this definition. "Mapping a 1366x768 image to a 1920x1080 native display both require resolutions that are a 16:9 format. However, 1:1 pixel mapping would only use a portion of the display and filling the display with the image would require a much more complex process to "remap" the original 1366x768 pixel resolution image to a 1920x1080 pixel resolution image.

Display Options

Multiscreen Windowing—If the user requirements include pixel mapping and color conformance, consider a rear-projection cube multiscreen and video windowing and processing solution. This solution allows 1:1 pixel mapping. Multiscreen windowing tiles create edge-to-edge displays and maps images across these screens. It can be a complicated and expensive solution so it is important to understand the users' needs and how they prioritize them.

Expert Advice

"In an all-too-typical operations center, human factors rank as afterthought as best, with little attention paid to traffic patterns, operator station ergonomics and even less to user interface design."

Keith Larson, Plant Operations: Operator Effectiveness: The Case for Investment. 5/17/2012

LCD Screens—LCD screens are typically found in control rooms. These screens have bezels so they are not optimal for tiled displays that need perfect alignment. For example, if the user needs to show a large SCADA system that includes lines that cross screens, the lines may not align properly because of the bezel gap. The result is an image that doesn't look right and confuses the eye. As mentioned, LCD screens are not designed for 24/7 use.

Rear-Projection Cube Technology—This solution comprises multiple cubes that can be arranged to create any size video wall. Rear-projection cubes have the smallest gap between screens. When there are contiguous lines from screen to screen, users are able to follow easily with their eyes. If the room is used 24/7 and users view these types of images, this is the technology to consider.

Information Checklist

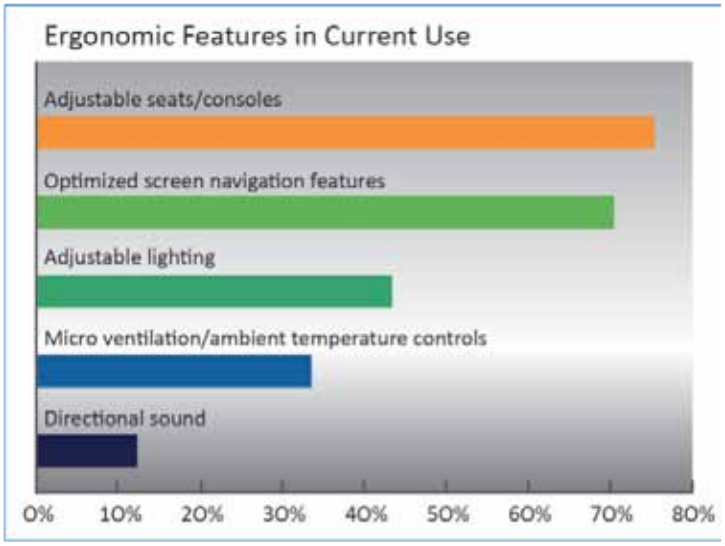
- ☑ Determine what type of information will be displayed, such as text, images, or continuous lines
- ☑ Select the right device for the use level: 24/7, light, or medium
- ☑ Select displays that allow 1:1 pixel mapping
- ☑ Avoid displays with bezels if building a continuous screen
- ☑ Consider what the content will look like on the screen from different angles and distances

Best Practice 3: Consider human factors

Typical Practice—In the 2012 book, Ergonomics – A Systems Approach, Per Lundmark identified the top issues in existing control rooms that use typical practices:

- Environment not optimized for the actual number of operators
- Large displays not implemented with the operator in focus
- Room built with limited focus on human factors and ergonomics
- Collaboration not factored in

A recent survey published by Control magazine reveals additional findings about ergonomic features, as shown in the following chart:



Operator Perspectives

"I've been an operator for just shy of 3 years now, and I can tell you the environment you work in plays a huge role in how comfortably you handle the workflow. It's nice to focus on the more technical bits such as equipment and infrastructure, monitors, etc., but do not forget that people have to comfortably be there for hours at a time. We do 12 hour shifts here, and the most important consideration for me would be the temperature and air quality."

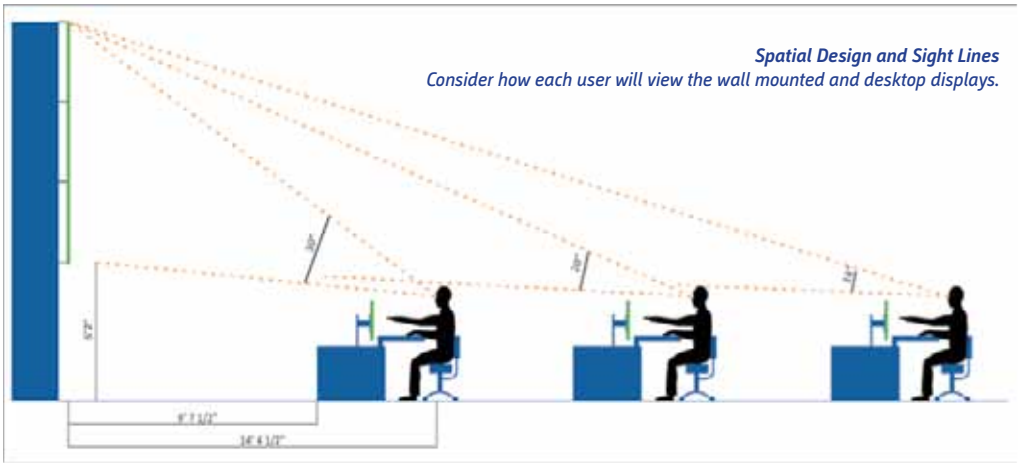
"Get the best and most comfortable chairs you can find and then get the ones that are even better. People will be sitting in these 24/7, you need the best you can get or they'll get worn down in mere months, both chairs and people. Full range of adjustability is essential, as is full back and lumbar support."

The study concluded that while most control rooms offer adjustable seating and configurable navigation, "climate controls and directional sound were used by a relative few."

Best Practice—A focus on human factors and the work environment has a positive impact on how operators perform. As a project team designing the room, focus on room flow, equipment placement, lighting, climate control, and noise control with the intended use in mind. This results in fewer human errors and accidents. At the same time, it increases operator productivity and overall work satisfaction.

As part of the design process for these spaces, factor in the implementation of central control systems to manage each element. Systems, such as those by Crestron, automate control overs lighting, HVAC, security and AV equipment, including feed selection and video wall configuration. The result is an environment optimized for operators and that streamlines the workflow.

Spatial Design—Spatial design includes the relationship between the room size and the layout of the workspaces within the room. Your goal is to consider more than just the number of users. Your focus is on how the users function within the room and interact with the overall environment while performing their duties. When evaluating the room size, consider the number of workstations, individual offices, shared or common spaces, the overview display system, and any other required equipment.



Spatial Design and Sight Lines
Consider how each user will view the wall mounted and desktop displays.

Your key design goal? Creating a layout that encourages flow through circulation areas and doesn't obscure necessary lines of sight.

Lighting—You can't design room lighting without the visual systems in mind. Too much natural lighting creates glare or washes out the video, rendering a million- dollar video wall useless. Best practice lighting concepts incorporates indirect lighting because it's easiest to control and provides brighter task lighting at the console. Another critical design factor when the room has video conferencing and a collaboration element is proper color temperature.

Noise—Noise affects the acoustics of the RTOC. Use treatments on walls, floors and ceilings to create a best-practices design that suppresses reverberant, mechanical, and other noises The RTOC you design should ensure speech privacy while controlling ambient noise levels and containing the electronic system noises from adjacent spaces.

Climate Control—Control room operators frequently cited consistent temperatures and air quality as features that would enhance their work environment. In your design, consider creating different climate zones and installing an air filtration system.

Information Checklist

- ☑ Physical factors: working height, viewing angle, leg room, sitting comfort
- ☑ Ambient factors: lighting, noise level, temperature, humidity, air quality
- ☑ Lighting and colors depending on process state (smart textiles and daylight control)
- ☑ Sound systems for public and personal information
- ☑ Traffic control (field operators, visitors, and others not working as active operators)
- ☑ Access to other functions or rooms (for example, printer room, rest room, kitchen, toilet, meeting room, offices, computer room, library, exercise room, emergency room)
- ☑ Console proximity (communication and collaboration)

Best Practice 4: Standardize Design across Locations

Typical Practice—The design, layout, and equipment in control rooms vary from location to location. Since these rooms come online over time, technology is a rapidly changing asset. Typically, the work environment for a traveling user is dramatically different depending on the location.

Best Practice—The ideal approach is to create rooms easily replicated across an organization. Every piece of equipment should work the same regardless of which office or control room someone is in. This practice is particularly important in exploration. For example, if a geophysicist based in Houston needs to work in Calgary that worker brings map data with them and expects to connect seamlessly to the system in Calgary and work with the local team. They want the same layout and functionality as in Houston so they can immediately begin work without relearning the system.

Given the high value of geophysicists and exploration engineers, standardizing rooms across an organization provides an immediate benefit in productivity and user satisfaction. Most control and visualization rooms have a master control panel including a graphical user interface (GUI) on the color touch panel. Design these control panels with the same look, feel, and flow for ease of use regardless of location.

Information Checklist

- ☑ Consider current and future rooms for standardization
- ☑ Ensure every piece of equipment functions the same, regardless of location

Best Practice 5: Plan for ongoing support

Typical Practice—The reality of control rooms is that they require ongoing maintenance and support. They represent a significant financial investment. For companies to realize all the potential benefits, these rooms need to be online at all times. Many companies let the existing IT help desk and network teams absorb these support functions.

Best Practice—A lesson learned by the team at Saudi Aramco and described in a paper on Smart E&P Collaboration Centers, is the importance of dedicated support. The team cautions that "Having an embedded, multidiscipline, petrotechnical support professional … is important and indispensable in maintaining and supporting the collaboration facility." Dedicated support and a clear preventative maintenance plan ensure that RTOC rooms are ready, and more important, deliver the desired value.

Information Checklist

- ☑ Plan for upgrades and ongoing maintenance
- ☑ Consider a managed service provider with specific control room expertise
- ☑ Where possible, assign dedicated support staff
- ☑ Remember preventative maintenance is critical to ensure maximum uptime

About AVI-SPL

As the world's leading video communications partner, AVI-SPL designs, builds, and supports the systems and environments that enable communication and collaboration. AVI-SPL has highly-trained and certified system engineers throughout 40 offices across the United States, Mexico, Canada, the United Kingdom, and Dubai.

The Control Room Group (CRG) at AVI-SPL is North America's leading provider of mission critical control center facilities. This specialized group is solely dedicated to the design and build of 24 x7 mission critical control room facilities.

For more information about control room design, please contact AVI-SPL at 866.708.5034.

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