COMMAND & CONTROL CENTERS
“DESIGN STANDARDS, TECHNOLOGY & INTEGRATION CHALLENGES”

By Mitesh B. Desai – RCDD
INS Manager – GBM
Agenda

• Command & Control Centres- Importance
• Command & Control Centres- Evolution
• The Design Philosophy, Standards & Technologies
• A Typical Design – Case Study
• Possible Applications
• Realistic view of the Future- What Next ?
Why Command & Control Centers?

- Increasing Technology dependence
- Big Data, Data Mining, Video Analytics, IoT
- Social, Residential, Commercial, National Security
- Closed Proprietary Networks Different Teams working on Different Silos independently in different locations
- Disparate Systems impact Operational efficiencies of the Businesses driving up costs
Why Command & Control Centers?

- Creation of a collaborative workspace regardless of the geographical locations
- Eagle Eye View for the – “the decision makers”
- Leveraging technology as a tool
- Improving strategic & tactical operations
- Convergence, Collaboration – Action VS Reaction approach
- Open Scalable Architecture
Why Command and Control Centers

• IP Based Networks; Non-Proprietary based networks
• Leveraging existing infrastructure
• Automate Policies and Response Plans
• Control, Monitor and Maintain disparate networks
• Provide a single customized dashboard interface which increases situational awareness
• Promote situational awareness with control and monitoring; Design remains critical
• Relies on budget, organizational structure, purpose of facility and staff break up
• A place where different technologies come together to create an “efficient and operational” requirements
CONTROL ROOMS “EVOLUTION”
Control Rooms – then....

From Dials Buttons CRT Monitors Papers
Control Rooms – then....
Control Rooms – then
Control Rooms – Now...
Control Rooms – Now...

To
LED Monitors
Remote
workstations
Consoles
Digital
IoT
Big Data
Control Rooms – Now...
Control Rooms – Now...
The “Design” Philosophy

DESIGNING OPERATIONALLY EFFECTIVE CONTROL ROOMS
• What are the personality types in the control center?

• Are they going to take naturally to collaboration & interaction?

• What are the tasks? Does collaboration help? Where and when does it help?

• What is the nature of the collaboration and communication?
Planning | Designing

• Is some of it formalized & planned? What is informal and spontaneous?

• How does this align with the culture?

• Collaboration not usually key part of Concept of Operations

• What is the vision for collaboration between people & teams?
• What is the leadership like around this area? Does it encourage and foster a culture that is collaborative?
• How does the organizational structure facilitate communications?
• What is the leadership like around this area? Does it encourage and foster a culture that is collaborative?
• What is the objective?
Designing Control Rooms – Physical Factors

**Requirements:**
- Flexible
- Dynamic
- Distributed
- Reactive
- Mobile
- Realtime
- Scalable
- Expandable
- Redeployable

**Constraints:**
- Function
- Viewability
- Physical room area
- Room layout
- Screen area
- Company “Buy-in”
- Heat, Noise, Power
- Cost
- Throughlife cost etc.

Let Us help navigate a path through
Did you know?

Collaboration is happening in “REAL TIME” in Control Rooms

- Information Exchange – quick exchanges that answer questions
- Co-Creation – working together to achieve outcome
- Social Interaction – basis of social relations
- Knowledge Transfer – passing on what you know
- Focus – heads-down work
ISO 11064 - Control Rooms

ISO Standard for Ergonomic Design of Control Centers

ISO 11064-1:2000
Part 1: Principles for the design of control center (ratified in 2010)

ISO 11064-2:2000
Part 2: Principles for the arrangement of control suites (ratified in 2010)

ISO 11064-3:1999
Part 3: Control room layout (ratified in 2009)

ISO 11064-4:2013 Part 4: Layout and dimensions of workstations (ratified in 2013)

ISO 11064-5:2008 Part 5: Displays and controls (ratification pending)

ISO 11064-6:2005 Part 6: Environmental requirements for control centers' (ratified in 2014)

ISO 11064-7:2006 Part 7: Principles for the evaluation of control centers’ (ratified in 2009)
1 - Predesign Analysis

- Site Surveys and Information Gathering Visits
- Audit of existing AV / IT infrastructure
- Analyze client needs based on acquired information
- Define goals for design, safety and functionality
- Collect, pool and measure data using surveys, site visits, operations and standards
- Space Planning
• Ergonomics – study of workers and their environment
• Choosing the Right Furniture
• Positioning of the furniture
• Defining Lateral Workspace per workstation
• i.e. work surface height to be 730mm
3 – Interior Design

- Define colors, textures and materials for an aesthetically appeasing setup
- Define Furniture consoles, workstations, lighting ambience and acoustics requirement
- Interfacing with MEP to define HVAC, containment and power load requirements
- Interfacing with Fit Out Contractor to carry out civil works as per the Authorities requirements
- ISO 11064-4:2004 Part 4: Layout and dimensions of workstations
- ISO 11064-5:2008 Part 5: Displays and controls
- ISO 11064-6:2005 Part 6: Environmental requirements for control centers
- Excerpts from ISO Standards:
  - Noise levels should not exceed 55dB(A)
  - Lighting levels should be task dependent, adjustable and minimize discomfort glare
  - Outside view to be provided if possible. If not some form of visual relief such as scenic posters should be provided.
  - Adequate provision should be made during the design of the layout/arrangement so that control operations are not interrupted by either visual or auditory instructions made during general circulation
ISO Driven Control Room Design

4- Control Room Security & Maintenance

- Threat and Risk Assessment
- Define Ingress / Egress Procedures and Protocols
- Define Administrator and operator rights
- Control rooms to be secure and resilient
- The layout of the control room should allow for easy and orderly evacuation of the room.
- Rear access to workstations for maintenance is required with adequate clearance of 52 inches behind the workstation
- Control room circulation routes should be arranged to avoid cross-circulation.
Factor 1 - Ergonomics

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system.
Why Ergonomics?

- Very Important Planning in Productive and Healthy Workspaces
- Promotes Engagement
- Harbours Collaboration & Cooperation
- Design Approaches
- Better Workspaces
Good Ergonomics

- Need for posture change & to move around
Good Ergonomics

- Reflect move to strategic problem solving & decision making
Why have a Videowall?

- Provides an overview of the total system – The “Eagle Eye view”
- Operators have personal data and Interactive processes at their desk
- The Videowall shows the whole process
Display Performance Factors...

- Colour
- Screen Size & Position
- Font Size & Resolution
- Brightness & Contrast
- Viewing Angles
- Viewing Distance
Display Performance Factors...

Screen Size/Resolution
- How big is the screen
- What type of info will be displayed
- What space is available
- What distance are the viewers

Screen Type
- Screen Viewing Angles
- Location of viewers
- Ambient light reflection
- Anti Reflection

Ambient Conditions
- What ambient light is there
- Total avoidance of screen glare
- Contrast ratio delivery

Display Device Brightness
- Measured in cd/m2 or nits
- Function of screen area and device brightness
- Aim to reduce operator fatigue
## Display Technologies

<table>
<thead>
<tr>
<th>Front/Rear Projection</th>
<th>Tiled LCD/LED Panels</th>
<th>Rear Projection Cubes</th>
<th>LED Direct View Tiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smallest system depth</td>
<td>Professional (Commercial) vs Consumer</td>
<td>The standard for Large screen displays</td>
<td>R, G, B Discrete Direct View LED</td>
</tr>
<tr>
<td>Totally variable screen size, high resolution possible</td>
<td>Small form factor, increasing popularity</td>
<td>Smallest seam size between screens &lt;1mm</td>
<td>Smaller pixel pitches gaining interest in Monitoring</td>
</tr>
<tr>
<td>Heat and Noise above operators</td>
<td>Colour matching available with professional units</td>
<td>Solid state projection devices</td>
<td>Common 1.2 – 2.5mm for Critical viewing</td>
</tr>
<tr>
<td>Large screens demand high brightness units = regular lamps changes or SSI illumination</td>
<td>Seam size – smaller the better typically 1.8-3.7mm screen to screen</td>
<td>Multiple sizes available – 0.4M to 1.6M wide; Mid life engine upgrades</td>
<td>High brightness Seamless, Long life 1:1 and 16:9 panels available</td>
</tr>
<tr>
<td>Screen material kept dark to achieve a good contrast ratio</td>
<td>Image retention is a potential issue</td>
<td>Auto colour and brightness maintenance</td>
<td>Variable brightness capable</td>
</tr>
<tr>
<td>24/7 if using DLP technology</td>
<td>20/7 rated – 24/7 with caution</td>
<td>24/7 – no problem</td>
<td>24/7 rated</td>
</tr>
<tr>
<td>Low capital cost, high running cost – high TCO</td>
<td>Low capital cost – high TOC</td>
<td>High capital cost, low running cost and long in service life = Low TCO</td>
<td>Highest capital cost, low running cost and long in service life = Low TCO</td>
</tr>
</tbody>
</table>
## Requirements

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Push / Pull data</td>
<td>Requirement to control multiple display areas from multiple control points</td>
</tr>
<tr>
<td>Ability to handle various input types</td>
<td>Direct Digital (DVI/HDMI), IP Based / RTSP H.264 Cameras/IP Video, Network capture (VNC/RDP), Audio</td>
</tr>
<tr>
<td>Utilise existing network infrastructure</td>
<td>No additional AV cabling</td>
</tr>
<tr>
<td>2K and beyond</td>
<td>H.264 running at 2K, what about greater than 2K &amp; 4K</td>
</tr>
<tr>
<td>Same information</td>
<td>Connected data should be available across all control points</td>
</tr>
<tr>
<td>Same time</td>
<td>Information should flow across control points and be available at the same time</td>
</tr>
<tr>
<td>Multiple locations</td>
<td>Data not limited to single display areas, have the ability to display in multiple locations</td>
</tr>
<tr>
<td>Compatible with BYOD</td>
<td>Requirement to connect to an array of BYOD devices</td>
</tr>
</tbody>
</table>
Consists of one or many hardware nodes and PC software that operates on a standard Ethernet network.

- Encode, decode and display simultaneously, all from the same box.
- Based on secure, industry-standard H.264 media encoding and decoding.
- Easy to install and configure and can be scaled up or down at anytime.
- Now with Quad x 4K (3840x2160) encoder option adding 4K input compatibility to the display.
From this
To this
Why Consoles are important in "Control Rooms?"

CONSOLES
Control Room Consoles

Desking versus Consoles

Return on Investment

Human Factors, Operation, Image, Maintenance, Flexibility

Bicsi
Different Applications | Same Considerations

- Broadcast
- Security
- Oil, Gas & Power
- ATC Simulation
Design Parameters

- Function
- Equipment
- Room Size
- Useable Space
- Control Equipment
- Standards & Specifications
- Finishes
- Weight
General Requirements...

Example
**Two Operators**

Large Overview Display

Remote CPU’s

Emergency Pushbuttons

Russian Standards GOST

Height Adjustable
What’s not seen...

Cable Management

Internal Structure

Equipment Mounting

Power Distribution

Ventilation & Temperature Control

Acoustics

Inspection Lighting

Bicsi
The Operators view...

- Equipment Position
- Seating
- Legroom
- Seating
- Finishes
- Space
Height Adjustable Consoles

Trends
Control Room Consoles

Trends

Centralized Control Rooms | Multi Groups
Case Study

• Stakeholder Management
• Different Teams working independently on different operation parameters
• Integration of Different Systems onto a Single Dashboard
Case Study
Case Study
Case Study

1st ROW OPERATORS
perfect visualization of all the screens among its own screens and 1st row operators. Operators don’t lose vision of the bottom of the screen due to the operators of 1st row are on the lower level.

2nd ROW SUPERVISOR
operators face 7.4% vision of the bottom of the screen due to the operators of 2nd row. Higher lack of vision in the points where 2nd row operators stand due to its head.

3rd ROW OPERATORS
MASTER SUPERVISOR
All videowall screens are in the perfect visualization field, reached with a slightly rotation of the head (orange zone).
Each group has 9 videowall screens in its perfect vision field. Minimum videowall screens per operator: 4; maximum videowall screens per operator: 6.
Case Study
Case Study
Case Study
Applications

CONTROL ROOMS APPLICATIONS
“Broadcast” Room

An Example of a Control Room
“Roads Transportation” Room

An Example of a Control Room
“Smart Cities” Room

An Example of a Control Room
“Theme “ Parks

An Example of a Control Room
Application Example : Smart Cities

• Helps Governments and leaders to make smart decisions
• Manage complex city environments, incidents, emergencies via single dashboard that offers operational insights
• Integrated Data Visualization, real time collaboration and deeper analytics of different systems acting as ONE
• Enhance City Response Operations
• Predictive Intelligence ; Act VS React to situations ; Threat Deterrent
Security Operations Center
BIG DATA, IoT – Eagle Eye View of Information

VISUALIZATION OF INFORMATION – BIG DATA
Now & Near Future

• More Centralization of Control Rooms
• Increased Demand for Failover
• Increased Demand for Secure Remote Working
• Escalation of Collaboration requirements
• The Rise of CXO Crisis Room
• More Focus on Ergonomics
• VR Goggles, Augmented Reality, Advanced Human Machine Interface (HMI)
Visualisation

It's about seeing the Whole picture!

Situational Awareness

The right data to the right person at the right time
ANY QUESTIONS?