By Mitesh B.Desai – RCDD

INS Manager – GBM

COMMAND & CONTROL CENTERS

" DESIGN STANDARDS,TECHNOLOGY & INTEGRATION CHALLENGES "

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

BICSI

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

BICSI

Control Rooms…

- 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

Bicsi

Control Rooms – then….

Control Rooms – then

Control Rooms – Now…

BICSI

Control Rooms – Now…

To
LED Monitors
Remote workstations
Consoles
Digital
IoT
Big Data

Bicsi

Control Rooms – Now…

Modern
Alive
Nerve Center

Bicsi

Control Rooms – Now…

The “ Design” Philosophy

DESIGNING OPERATIONALLY EFFECTIVE CONTROL ROOMS

Planning | Designing

- 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?

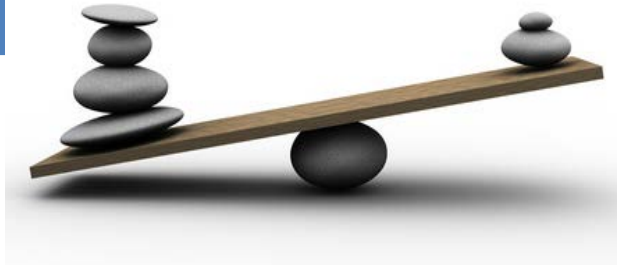
Planning | Designing

- 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



Let Us help navigate
a path through

Constraints:

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

Bicsi

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)

ISO Driven Control Room Design Process Flow

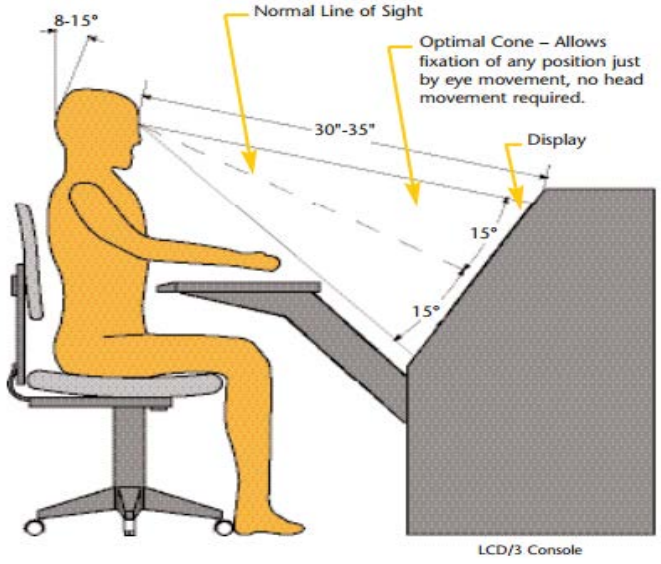
1 - Predesign Analysis

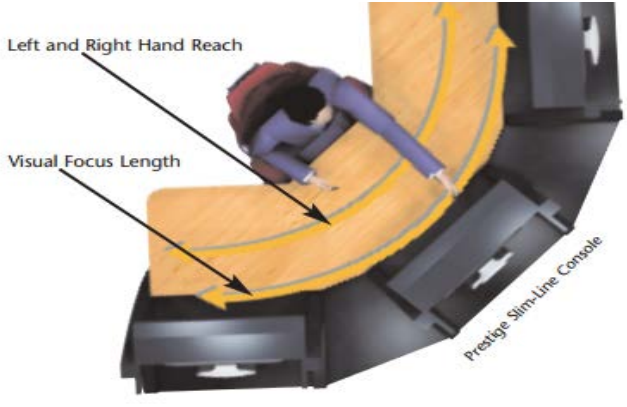
- Site Surveys and Information Gathering Visits
- Audit of existing AV / IT infrastructure
- Analyze client needs based on acquired information
- Define goals for design, safety and functionality
- Collect , pool and measure data using surveys, site visits, operations and standards
- Space Planning

ISO Driven Control Room Design Process Flow

2- Control Room Design

- 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





ISO Driven Control Room Design Process Flow

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 Process Flow

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

Bicsi

Why Ergonomics?

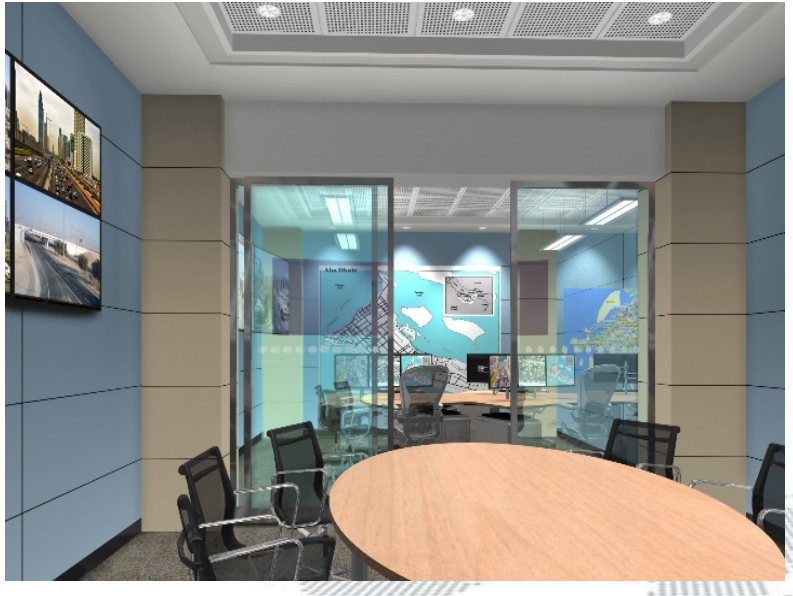
- Very Important Planning in Productive and Healthy Workspaces
- Promotes Engagement
- Harbours Collaboration & Cooperation
- Design Approaches
- Better Workspaces

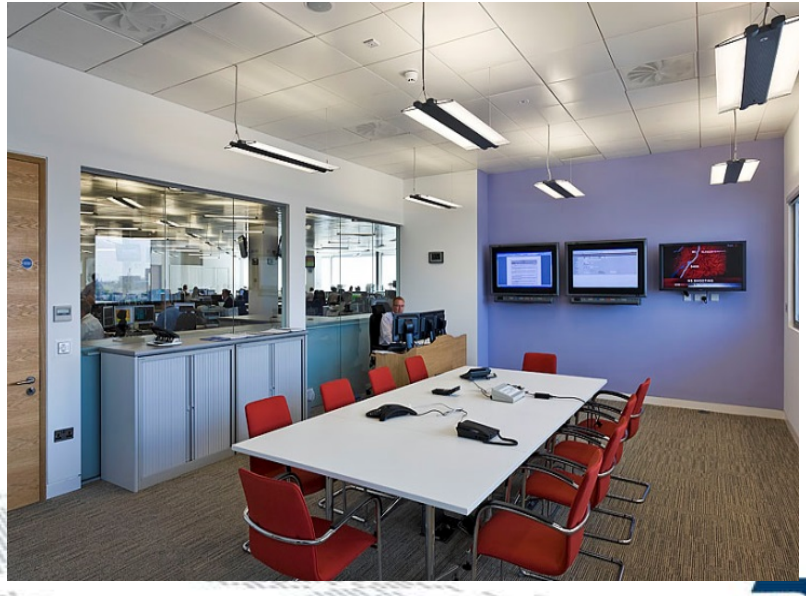
Good Ergonomics

- Need for posture change & to move around

Good Ergonomics

- Reflect move to strategic problem solving & decision making



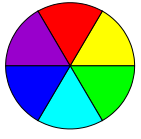


Why have a Videowall ?

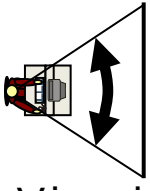
- Provides an overview of the total system – The “Eagle Eye view”
- Operators have personal data and Interactive processes at their desk
- The Videowall shows the whole process

Display Performance Factors…

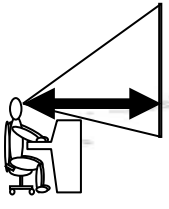
Colour



Viewing Angles

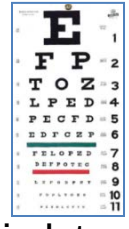


Viewing Distance



Screen Size & Position

Font Size & Resolution



Brightness & Contrast

BICSI

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

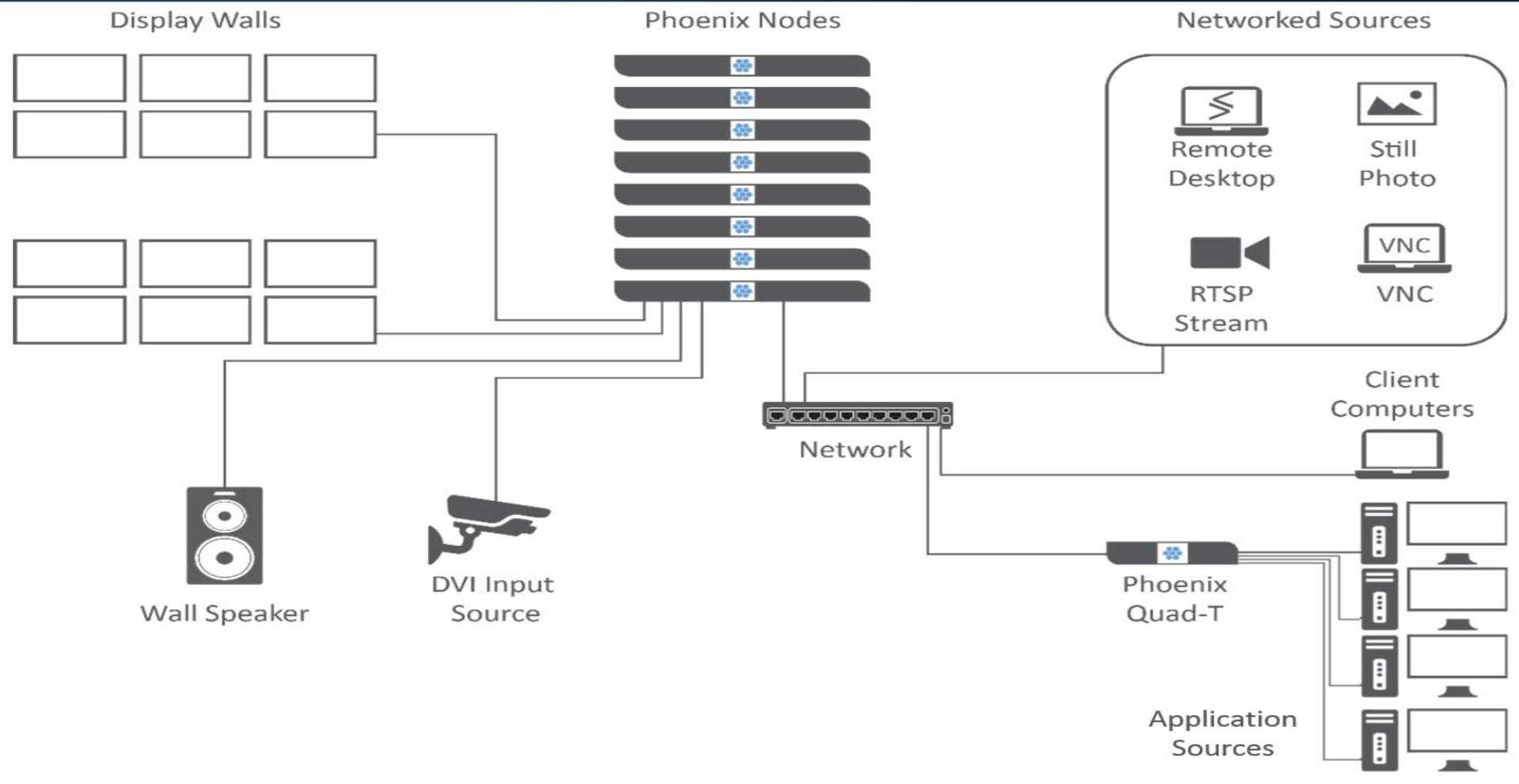
Front/Rear Projection	Tiled LCD/LED Panels	Rear Projection Cubes	LED Direct View Tiles
Smallest system depth	Professional (Commercial) vs Consumer	The standard for Large screen displays	R, G, B Discrete Direct View LED
Totally variable screen size, high resolution possible	Small form factor, increasing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

Flexible Content Display on Video Wall

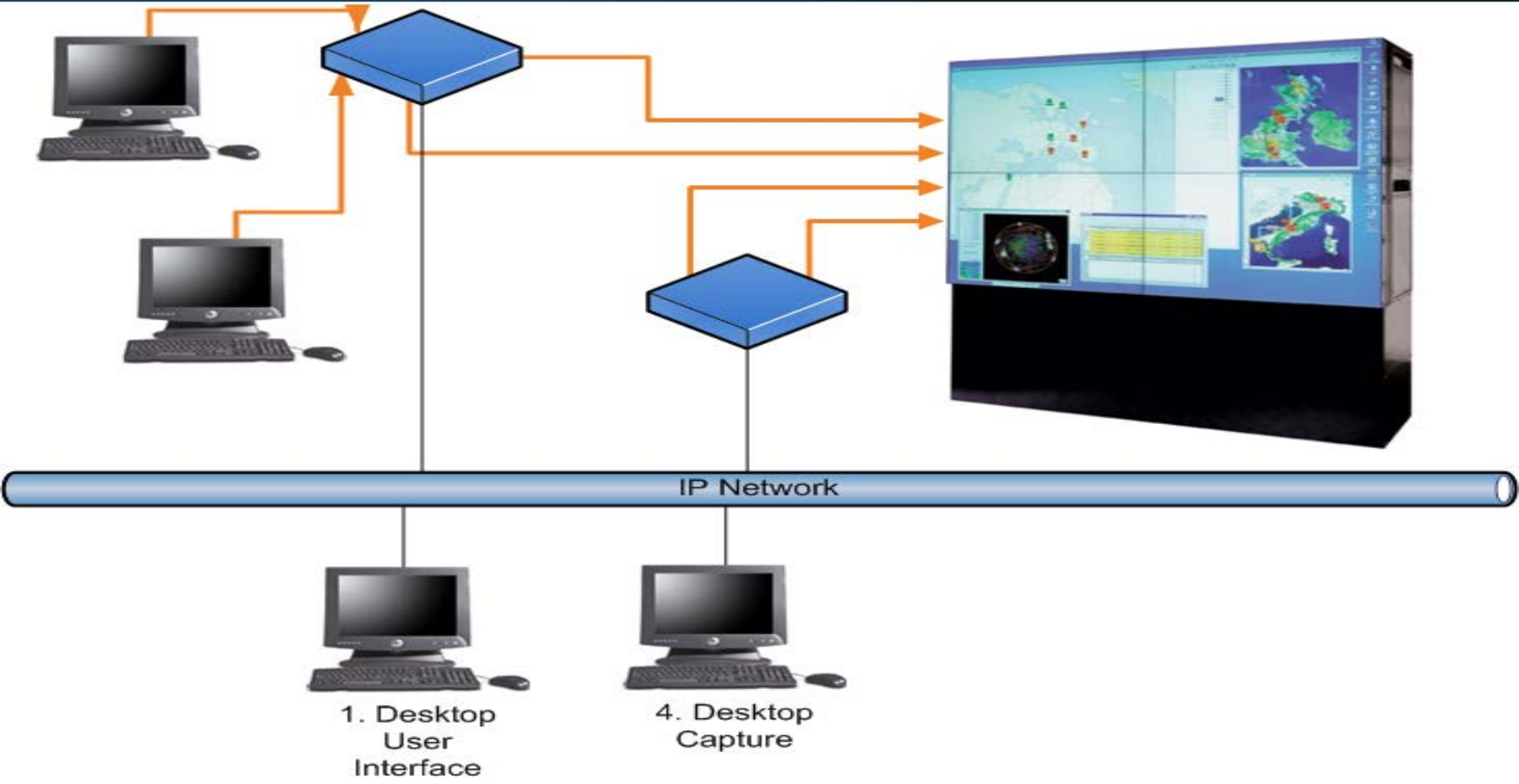
Requirements

Push / Pull data	•Requirement to control multiple display areas from multiple control points
Ability to handle various input types	•Direct Digital (DVI/HDMI), IP Based / RTSP H.264 Cameras/IP Video, Network capture (VNC/RDP), Audio
Utilise existing network infrastructure	•No additional AV cabling
2K and beyond	•H.264 running at 2K, what about greater than 2K & 4K
Same information	•Connected data should be available across all control points
Same time	•Information should flow across control points and be available at the same time
Multiple locations	•Data not limited to single display areas, have the ability to display in multiple locations
Compatible with BYOD	•Requirement to connect to an array of BYOD devices

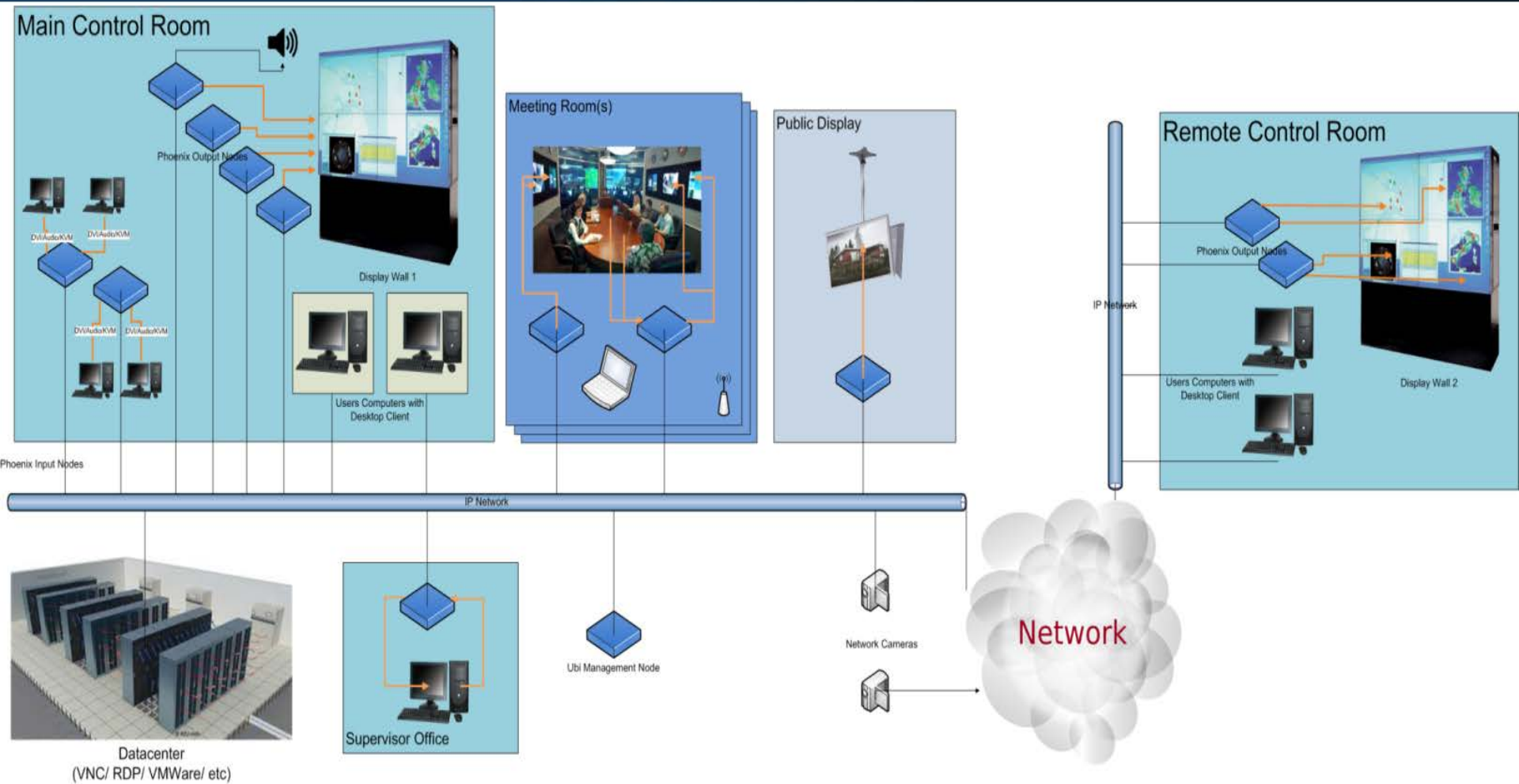
Nodes | Nerve Centres



From this



To this


Main Control Room
Phoenix Output Nodes
DVI/Audio/KVM
DVI/Audio/KVM
DVI/Audio/KVM
DVI/Audio/KVM
Display Wall 1
Users Computers with Desktop Client
Meeting Room(s)
Public Display
Remote Control Room
IP Network
Phoenix Output Nodes
Users Computers with Desktop Client
Display Wall 2
Phoenix Input Nodes
IP Network
Datacenter
(VNC/ RDP/ VMWare/ etc)
Supervisor Office
Ubi Management Node
Network Cameras
Network

Why Consoles are important in “ Control Rooms?

CONSOLES

Control Room Consoles

Desking versus Consoles

Return on Investment

Human Factors, Operation, Image, Maintenance, Flexibility

Different Applications | Same Considerations

Broadcast

Oil, Gas & Power

Security

ATC Simulation

Bicsi

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

Bicsi

What's not seen…

Cable Management

Internal Structure

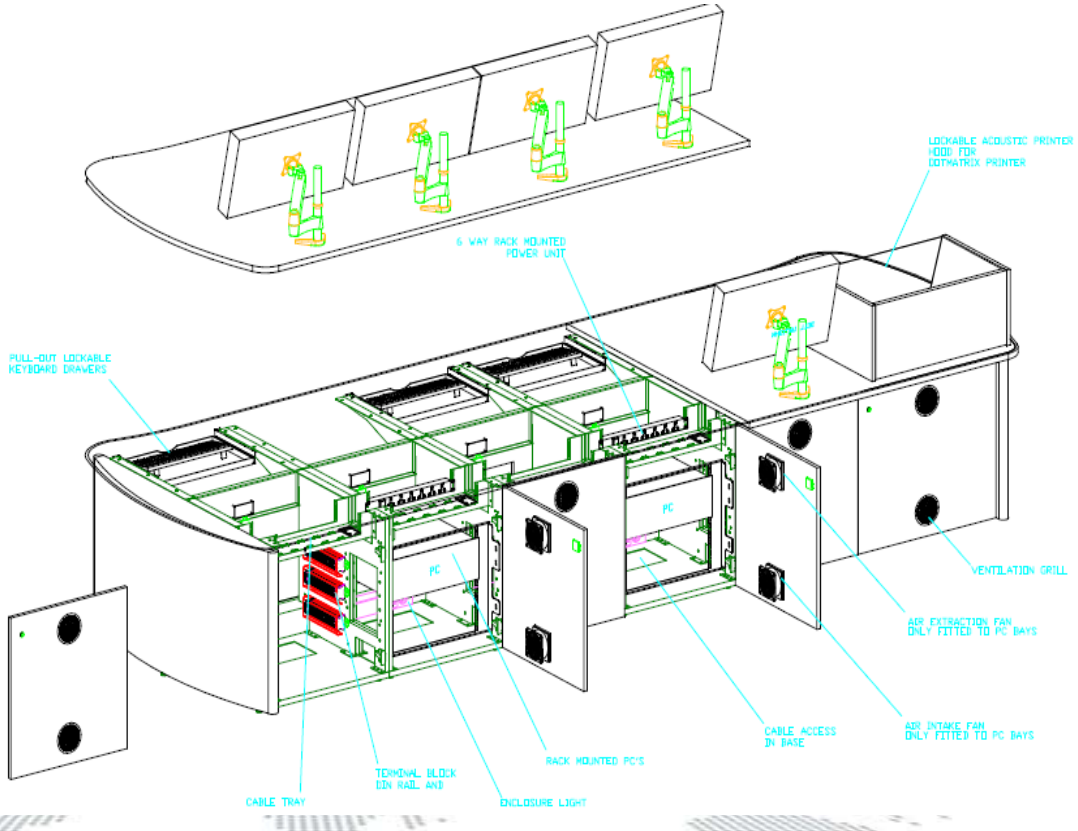
Equipment Mounting

Power Distribution

Ventilation & Temperature Control

Acoustics

Inspection Lighting



The Operators view…

Equipment Position

Seating

Legroom

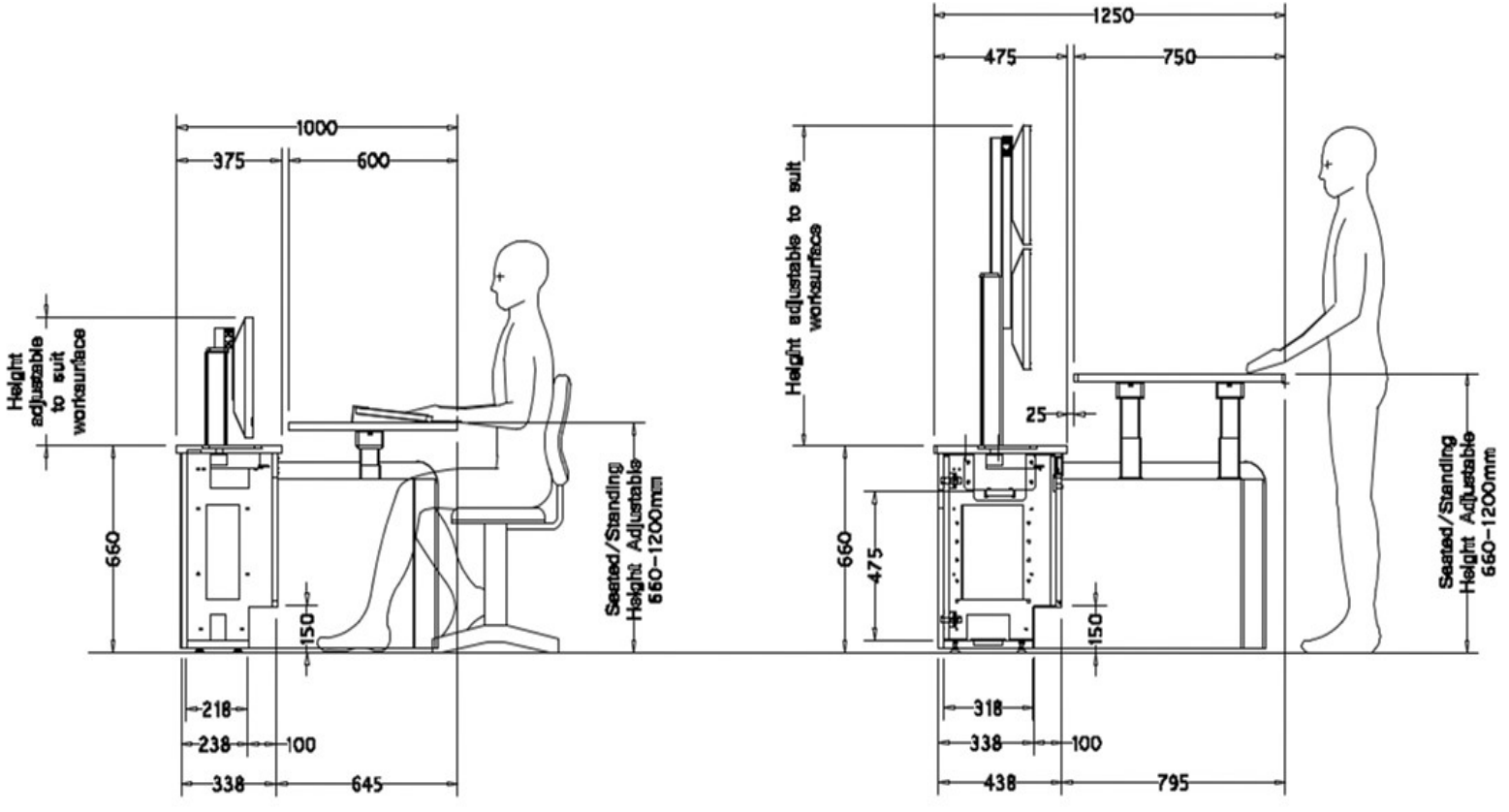
Seating

Finishes

Space

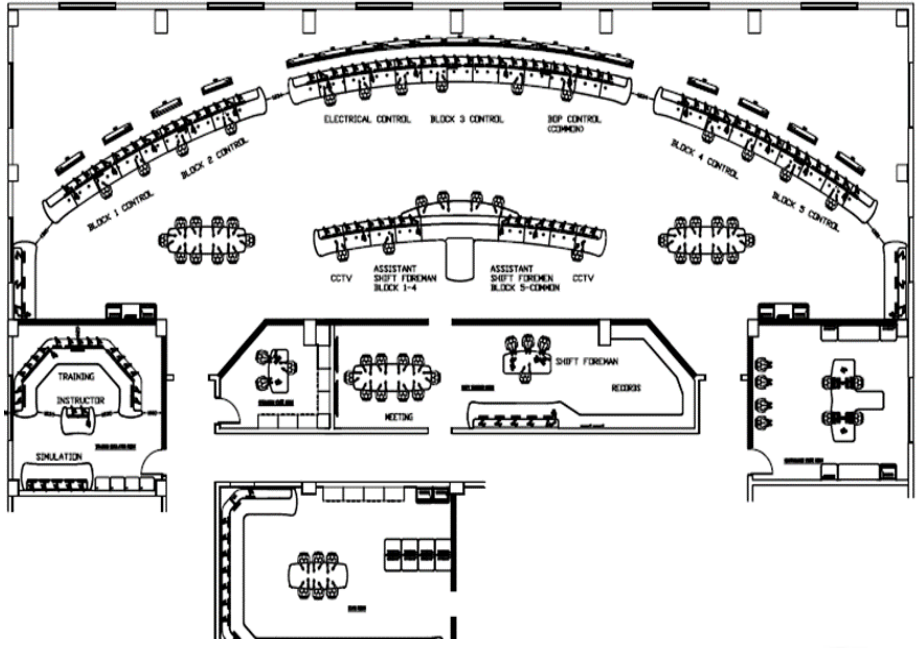
Height Adjustable Consoles

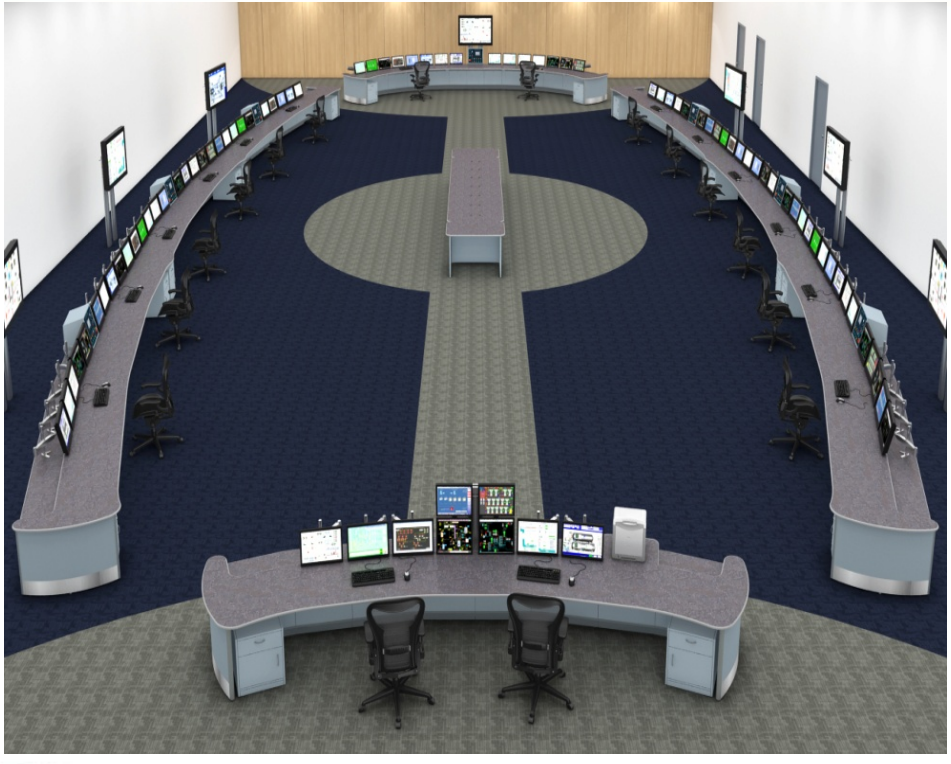
Trends



Control Room Consoles

Trends





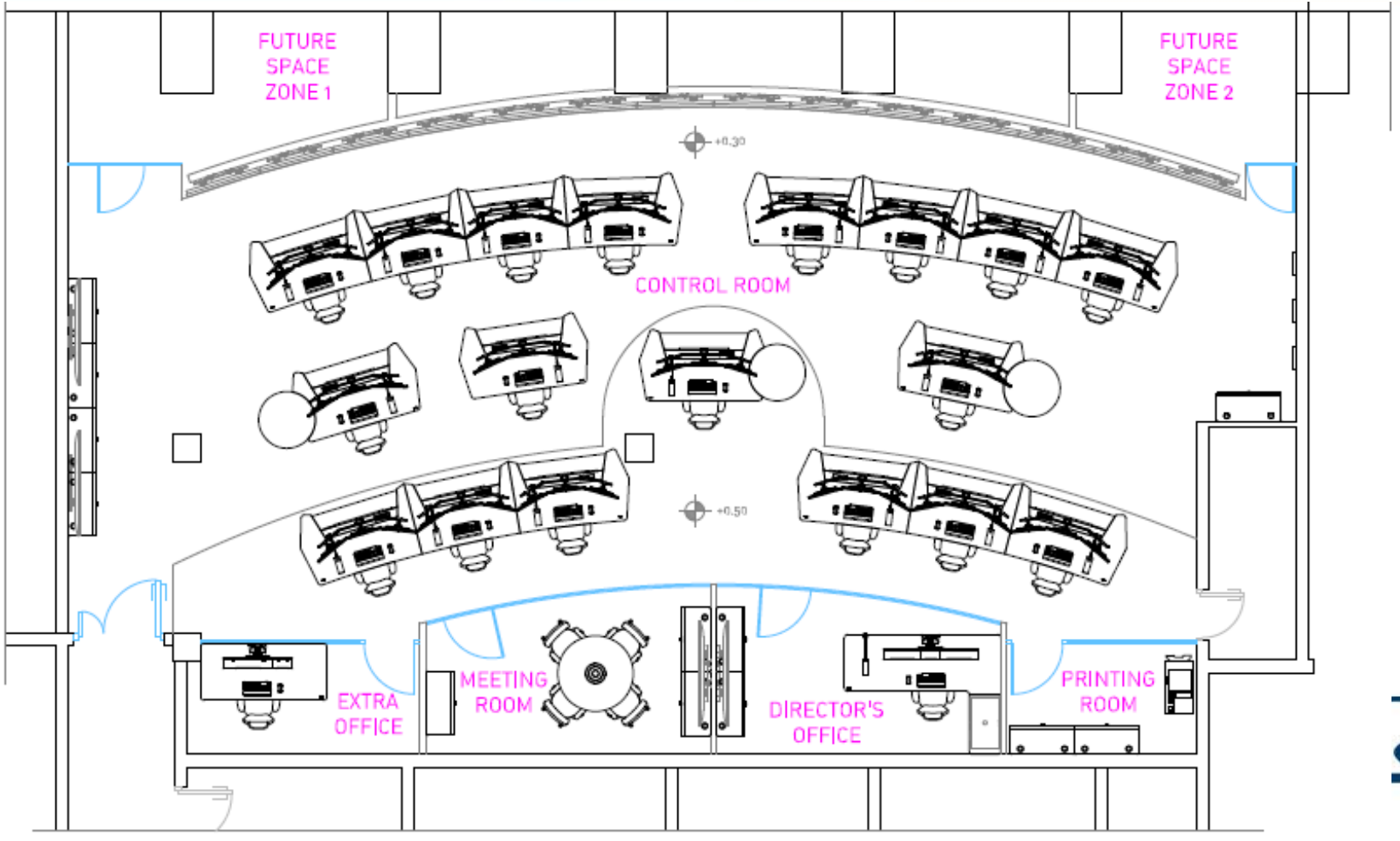
Centralized Control Rooms | Multi Groups

Bicsi

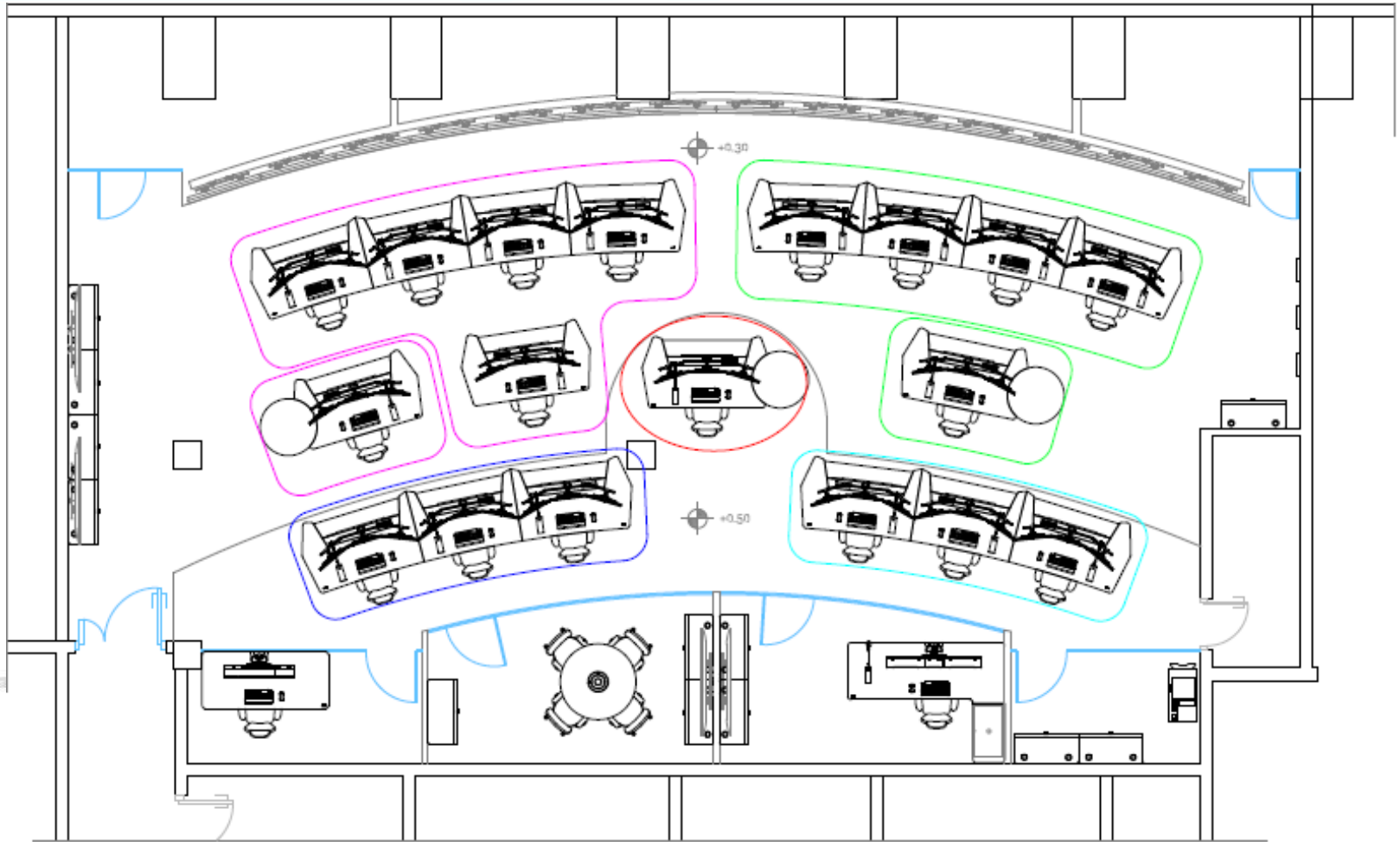
Case Study

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

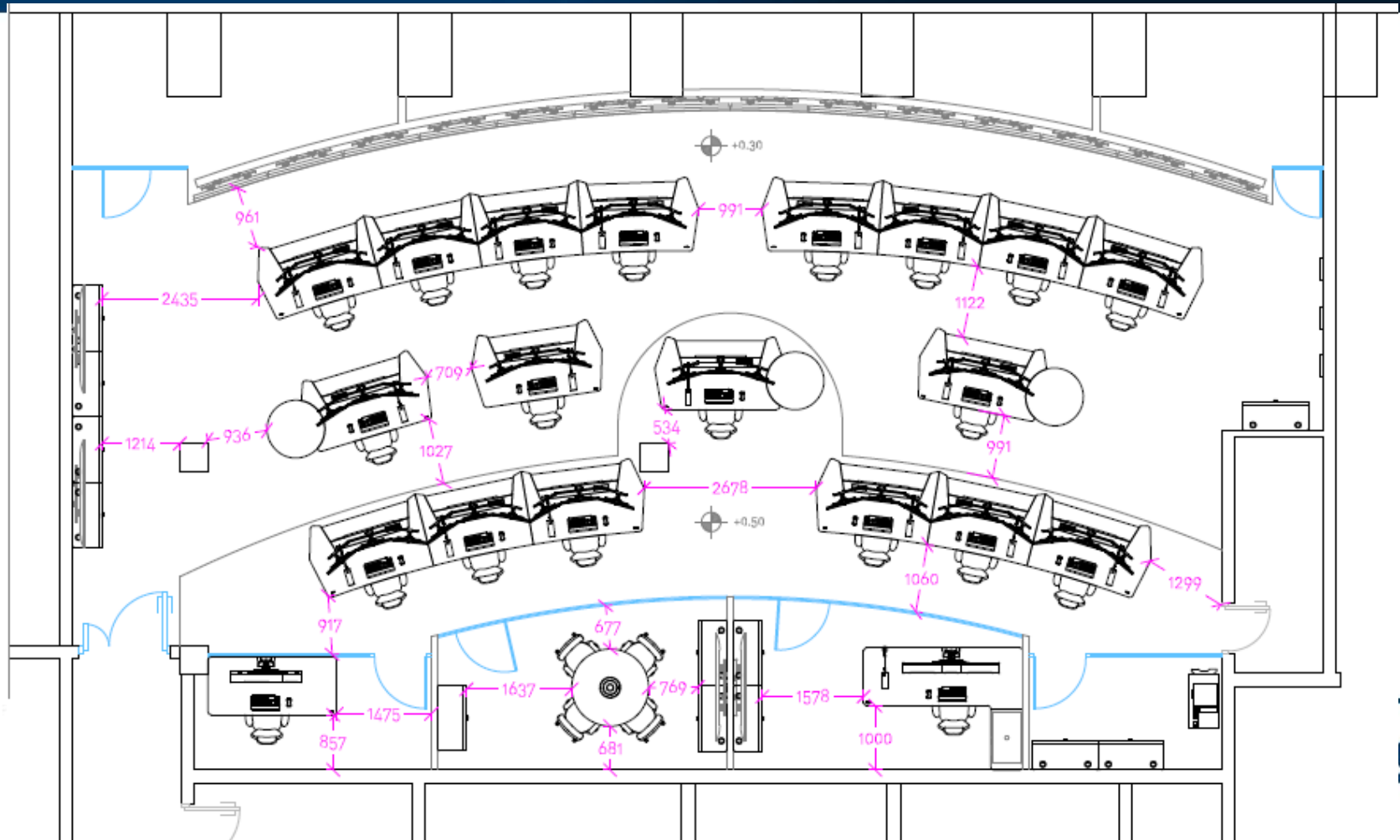
Case Study


FUTURE SPACE ZONE 1
FUTURE SPACE ZONE 2
+0.30
CONTROL ROOM
+0.50
EXTRA OFFICE
MEETING ROOM
DIRECTOR'S OFFICE
PRINTING ROOM

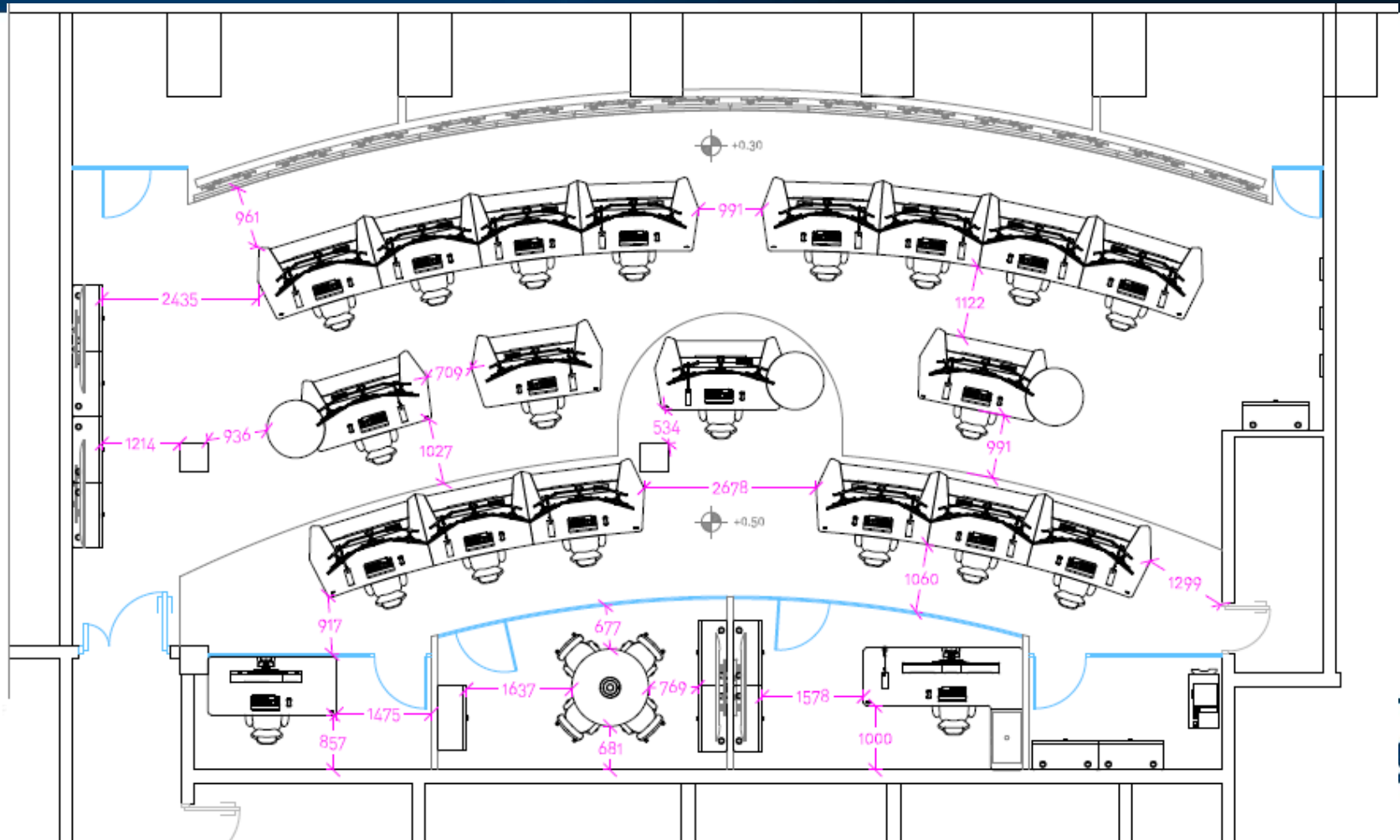
Case Study



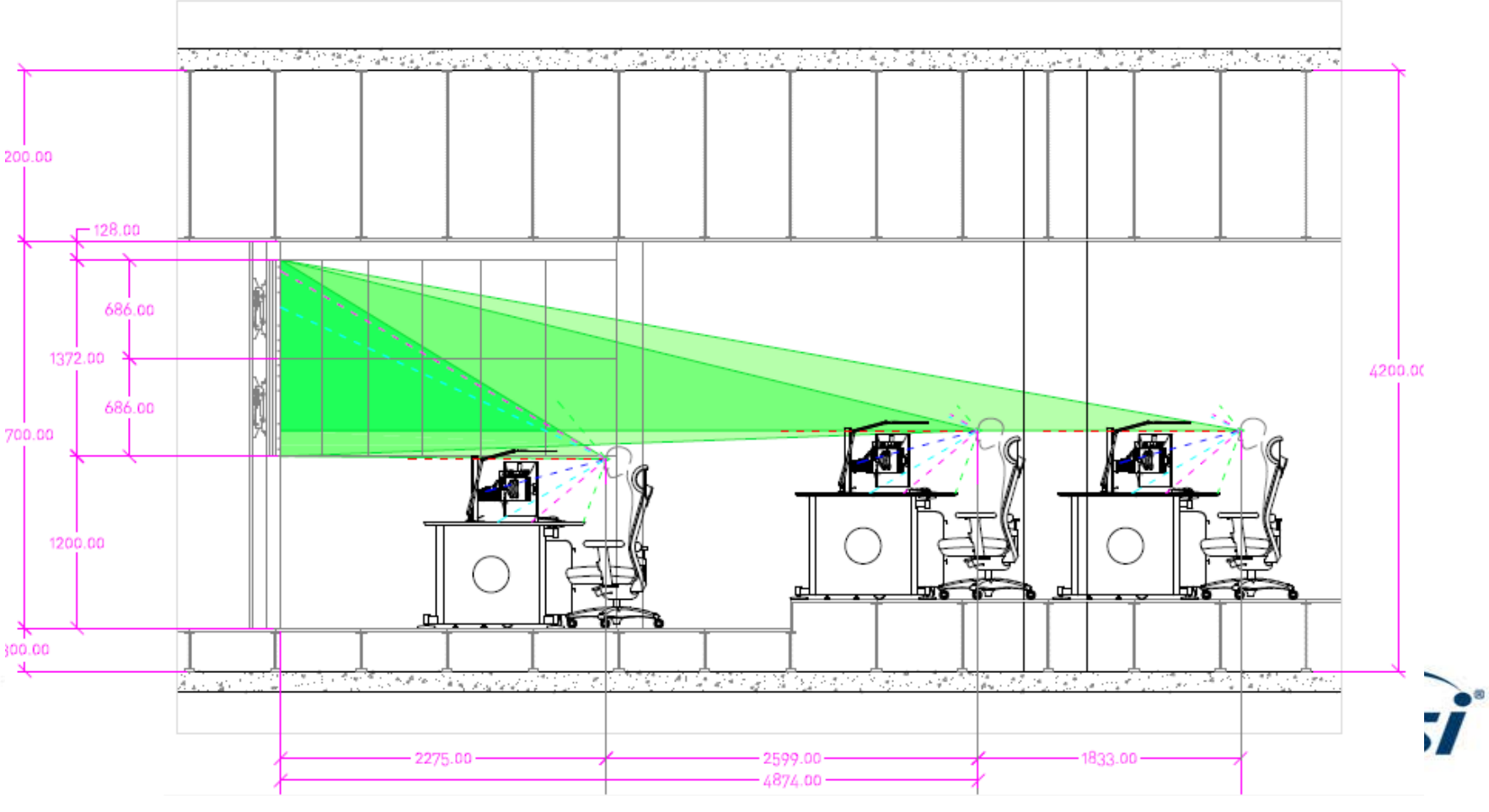
Case Study


+0.30
961
991
2435
1122
709
1214
936
1027
534
991
2678
+0.50
1060
1299
917
677
1637
769
1578
1475
857
681
1000

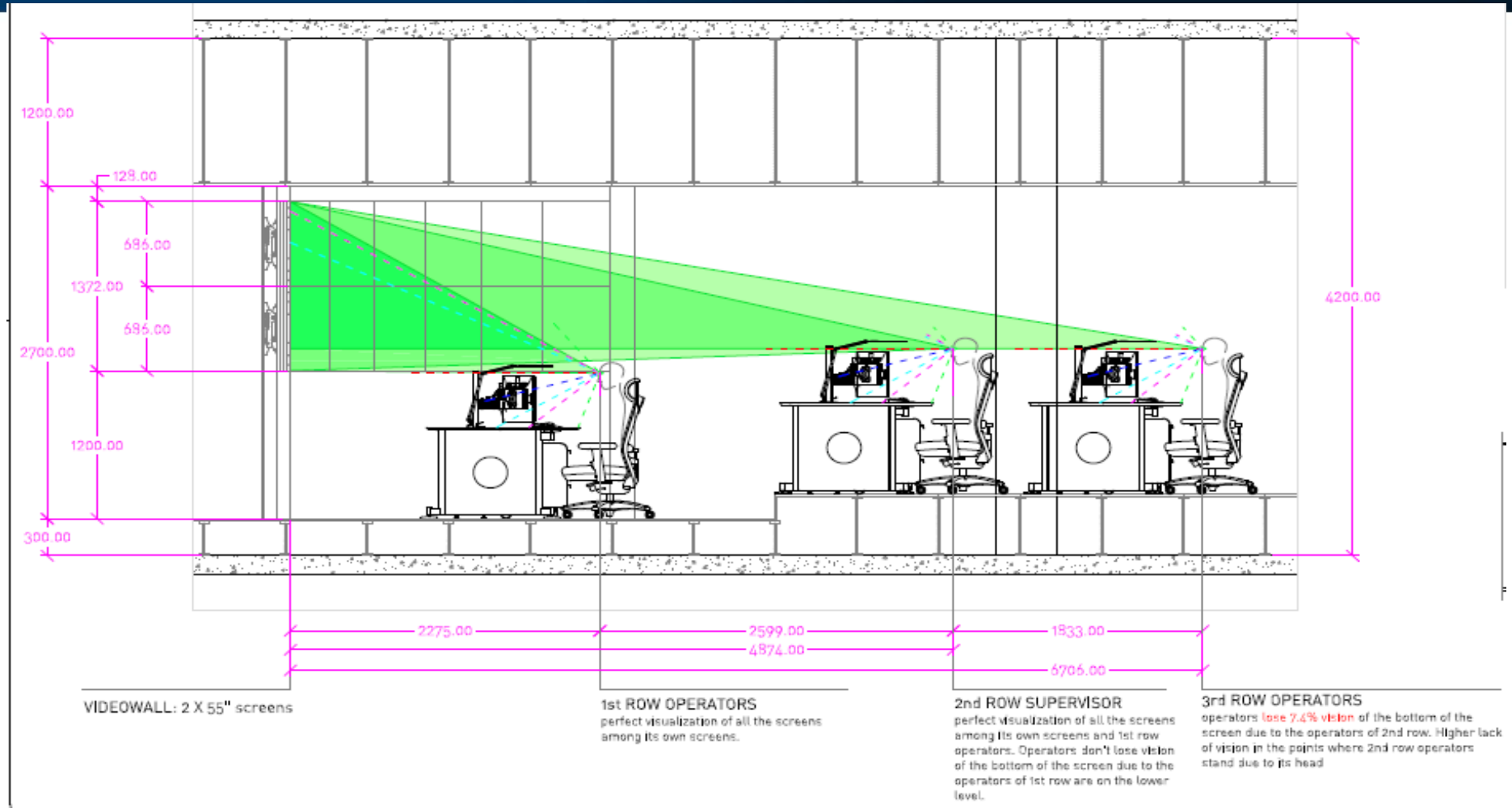
Case Study


+0.30
961
991
2435
1122
709
1214
936
1027
534
991
2678
+0.50
1060
1299
917
677
1637
769
1578
1475
857
681
1000

Case Study


200.00
128.00
686.00
1372.00
686.00
700.00
1200.00
300.00
4200.00
2275.00
2599.00
1833.00
4874.00

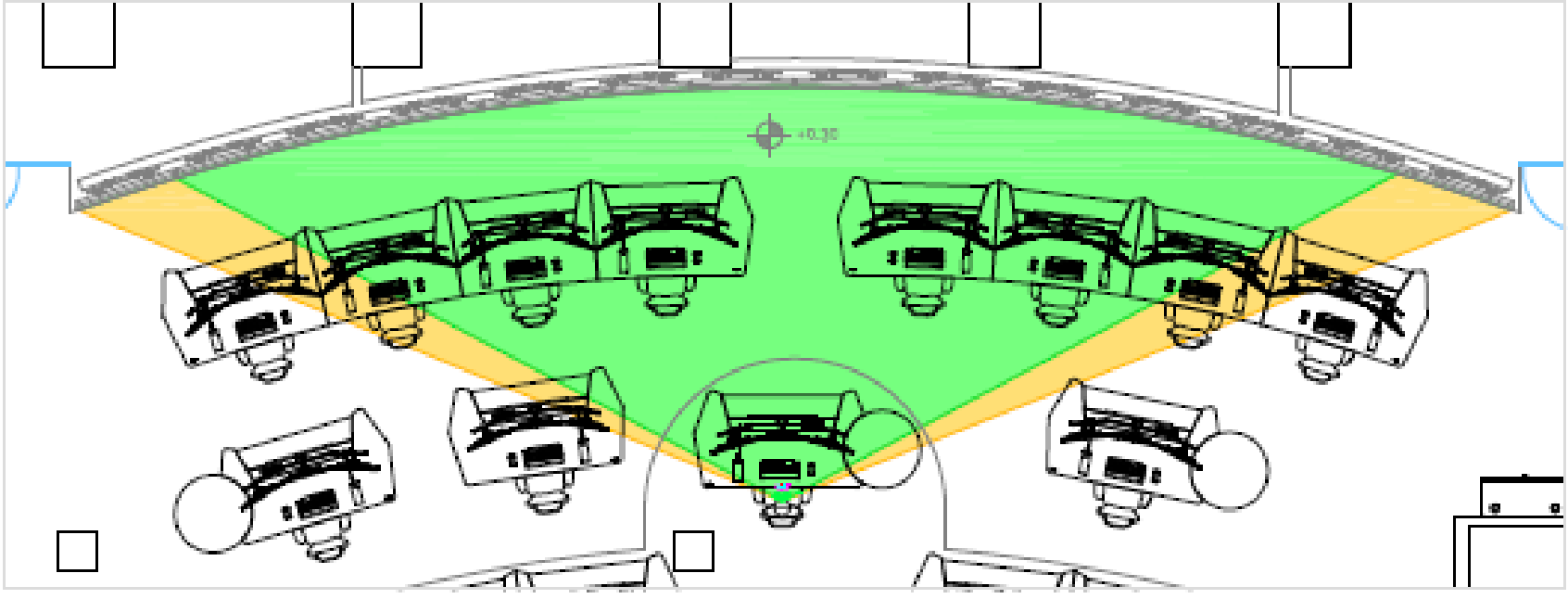
Case Study


1200.00
128.00
686.00
1372.00
686.00
2700.00
1200.00
300.00
4200.00
2275.00
2599.00
4874.00
1933.00
6706.00
VIDEOWALL: 2 X 55" screens
1st ROW OPERATORS
perfect visualization of all the screens among its own screens.
2nd ROW SUPERVISOR
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.
3rd ROW OPERATORS
operators lose 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

Case Study

MASTER SUPERVISOR

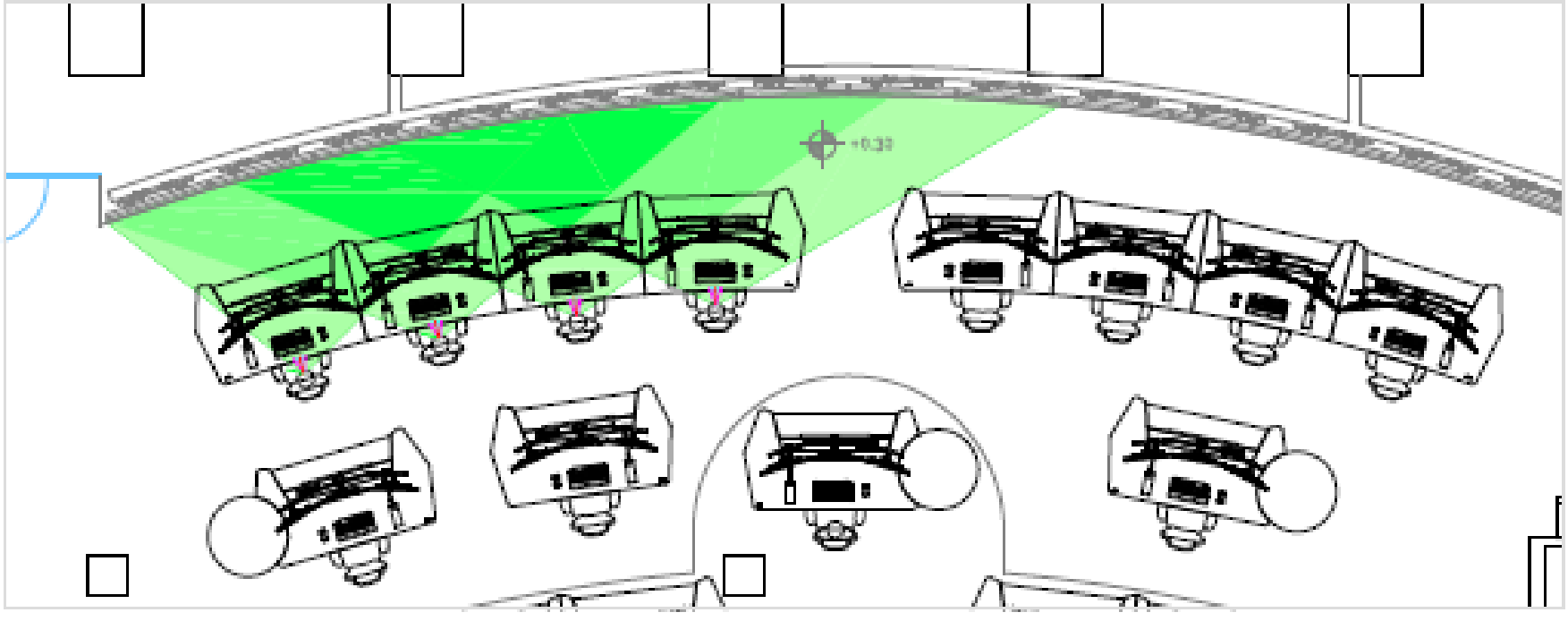
All videowall screens are in the perfect visualization field, reached with a slightly rotation of the head (orange zone).



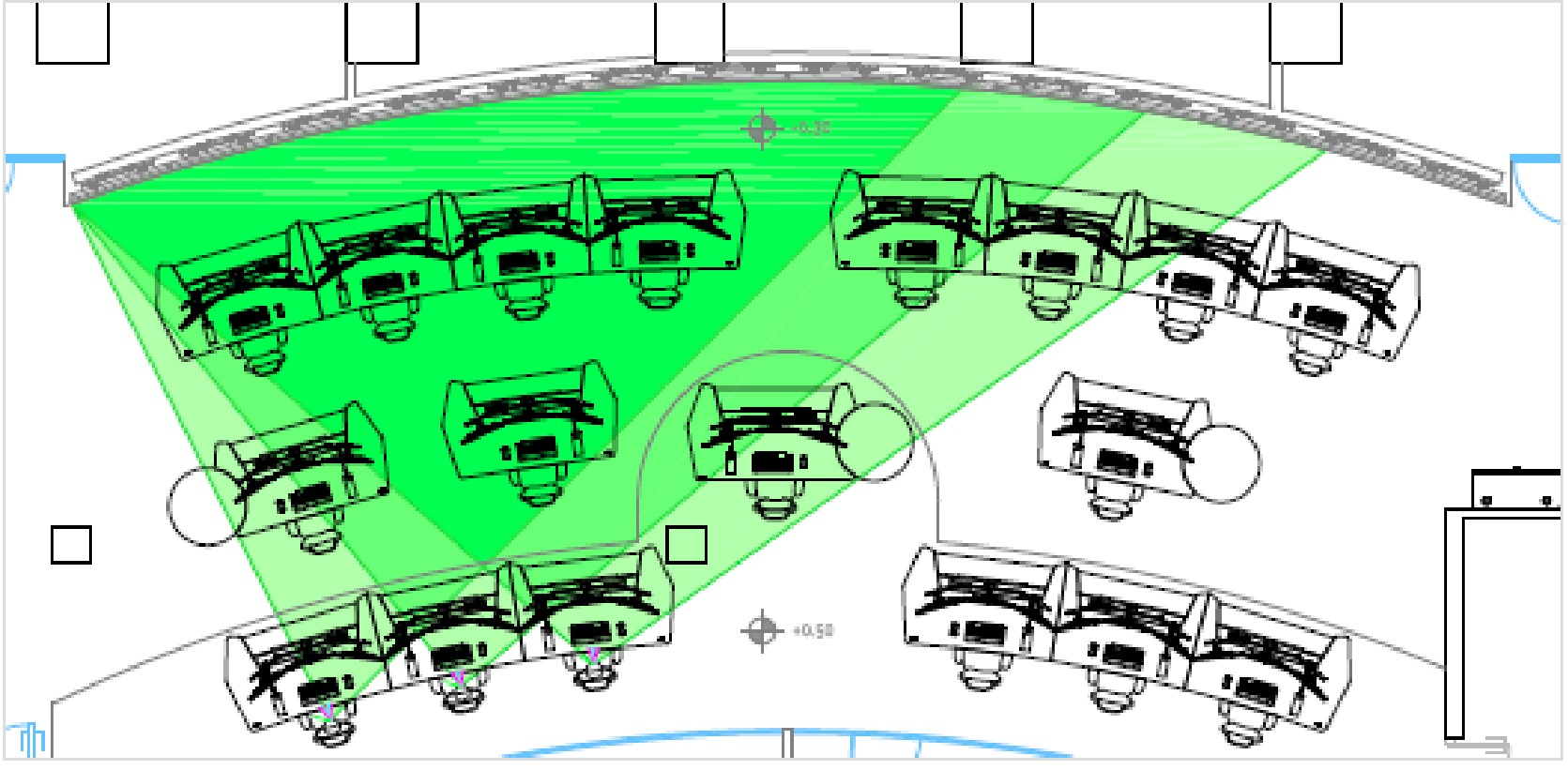
Bicsi

Case Study

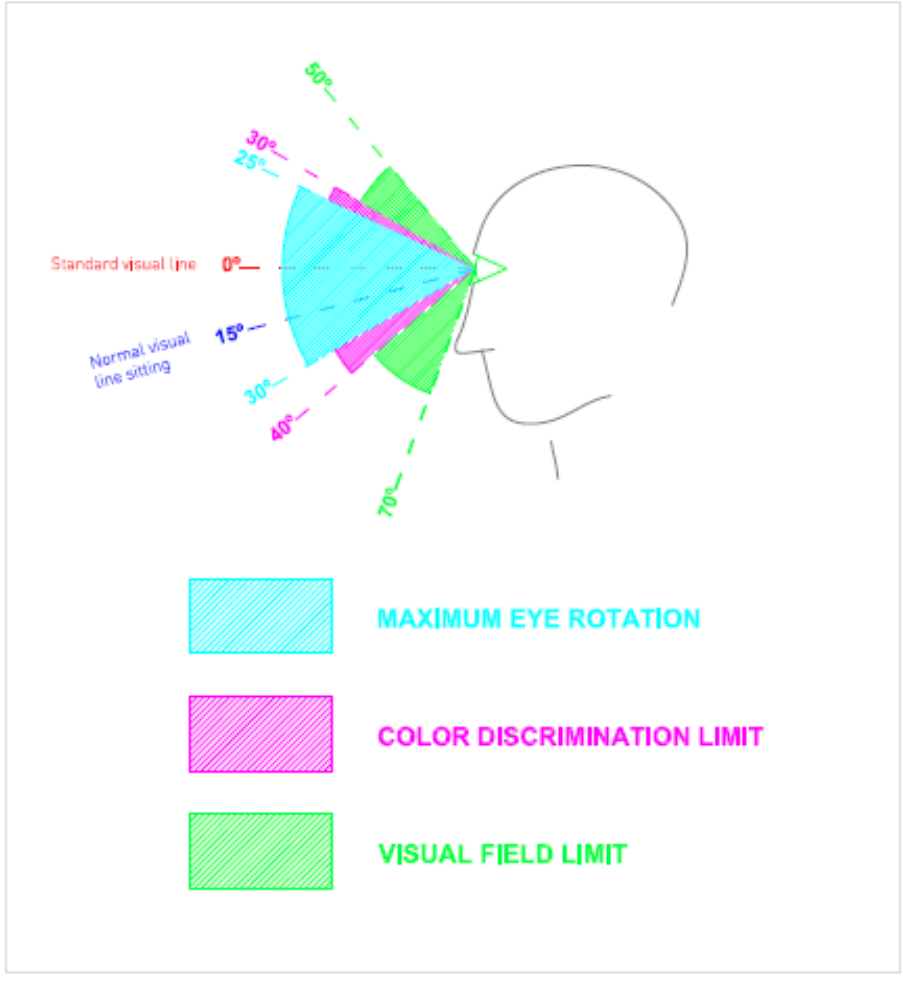
Each group has 9 videowall screens in its perfect vision field. Minimum videowall screens per operator: 4; maximum videowall screens per operator: 6.



Case Study



Case Study


50°
30°
25°
Standard visual line
0°
Normal visual line sitting
15°
30°
40°
70°
MAXIMUM EYE ROTATION
COLOR DISCRIMINATION LIMIT
VISUAL FIELD LIMIT

Case Study

Case Study

Applications

CONTROL ROOMS APPLICATIONS

“Broadcast” Room

An Example of a Control Room

Bicsi

“Roads Transportation” Room

An Example of a Control Room

BICSI

“Smart Cities” Room

An Example of a Control Room

Bicsi

“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

Bicsi

Security Operations Center

Space Operations Center

BIG DATA, IoT – Eagle Eye View of Information

VISUALIZATION OF INFORMATION – BIG DATA

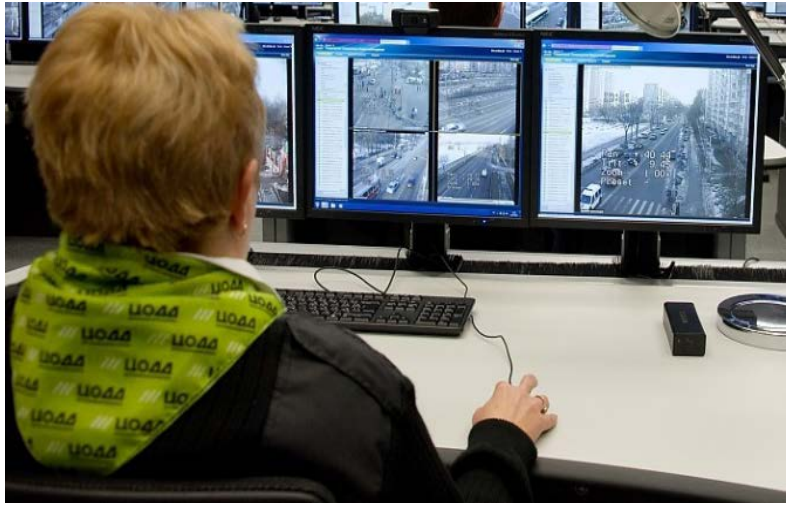
Bicsi

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

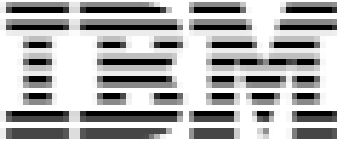
Its about seeing the Whole picture !



Situational Awareness

The right data to the right person at the right time

Citations & Copyrights




ANY QUESTIONS?