C4ISR Facility Planning, Design and Human Factors Engineering

Robins AFB, SAME Post

Engineers Week, 2018

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Important

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Agenda

C4ISR Mission Uniqueness

C4ISR – Site planning Considerations and Principles – *Distributed Common Ground System*

C4ISR – Facility Design Drivers

C4ISR – Human Factors Engineering

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What Makes the C4ISR work so unique?

Forward leaning Innovation

- They are technology driven
- Constant push to stay ahead of technology: AI – IA – VR – holograms – big data
- Hardware and software are changing how we fight.
- Facilities as an extension of their weapons system.
- Fast paced – team play Designers need to be like the OEMs and bring new ideas ahead of the needs
- Innovations from other industry sectors.

Its all about the operators and their work space

"The **single largest enabler** of DCGS productivity is the **cadre of Airmen** who work 24 hrs, 7 days a week in support of the war efforts and the greater IC.

Recognizing this fact, the 480th Intelligence, Surveillance, and Reconnaissance (ISR) Wing (Langley AFB, VA) in the last several years has initiated large scale efforts to re-envision how the Airmen of the DCGS perform their daily work."

Excerpted from report prepared by USAF 711 Human Performance Wing

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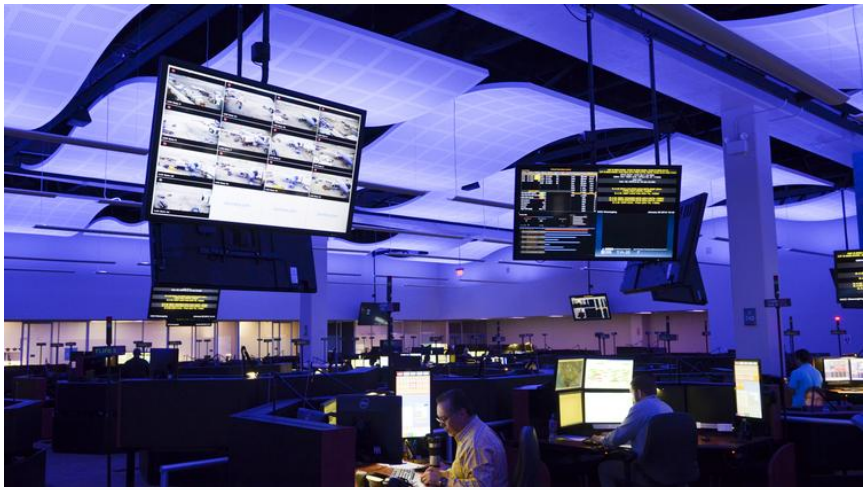
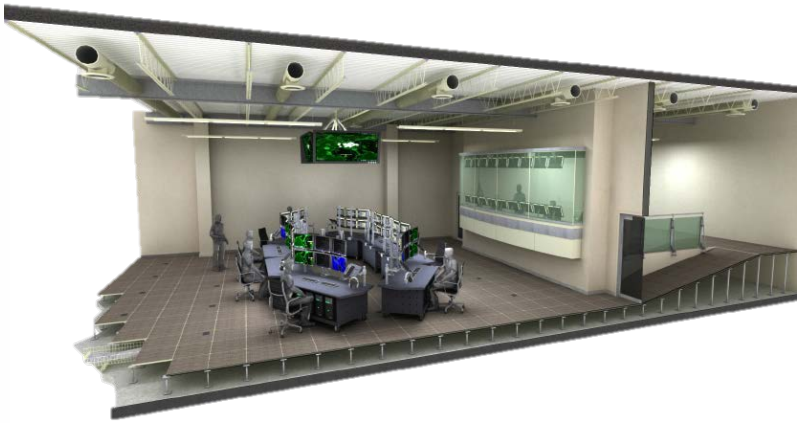
What is Unique for C4ISR Interiors?





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Planning - Evolution at the 9th Wing Beale AFB

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Evolution at the 9th Wing Beale AFB

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Evolution at the 9th Wing Beale AFB

The Beale AFB

- B2145 – former SAGE building
- B23260 – admin facilities, warehouse, CMCC demonstration site

- Common Mission Control Center (CMCC) – NOT a 480th facility
- 9th IS Tech Pad
- Future Substation (in CMCC project)

ISR Campus

- 548th IS Operations Center (DGS-2)

- Distributed Common Ground Station (DCGS) Operations Center
- Future connector buildings (red)
- Zonal Maintenance Garage

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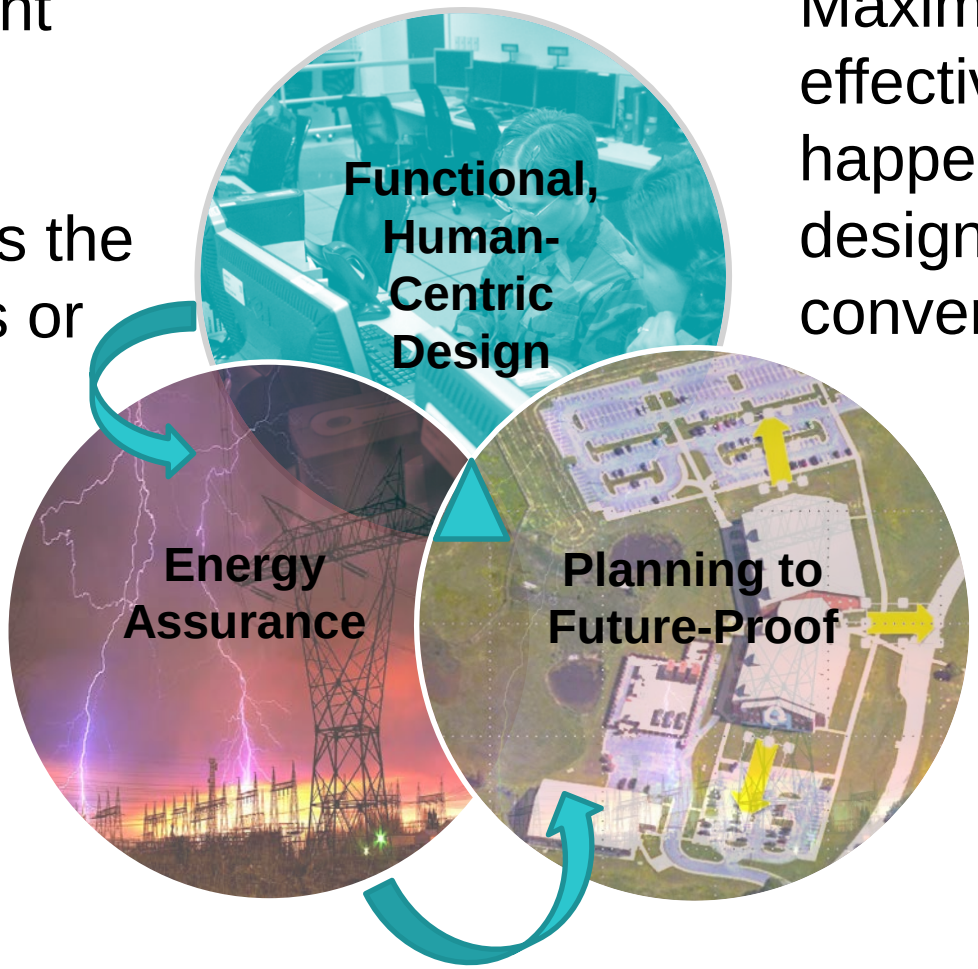
Planning Principles to Consider

- Operates best as a campus
- Plan for significant expansion
- Highly reliable supporting infrastructure
- Triple redundant uninterrupted power
- Fire and Life Safety Standards
- Isolate the vehicles
- Plan for visual and physical relief
- Footprint internal to the installation core

C4ISR Key Facility Design Principles for the next generation of ISR Investments

Striking the right balance in the competing requirements is the key to success or failure



Maximum mission effectiveness happens where key design principles converge

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Next generation ISR facilities feature:

- Space, power, and cooling systems designed to support the mission
  - Functional: operations, operations support, analyst support, command and control
  - Reliable, survivable, and adequate capacity infrastructure
- Human-centric design enables and supports analysts
- “Future-proof”: State-of-art system
  - Flexible/Adaptable/Reconfigurable
  - Expandable

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Functions and Spaces

- Operations
- Operations support
- Command and control
- Analyst wellness and support
- Building systems (could be 15-20%± of gross area)
- Other assigned functions

Spaces & Functionality

- Operations
- Operations support
- Command and control
- Analyst wellness and support
- Building systems
- Other assigned functions

Operations floors
Server rooms
Briefing
Mission planning

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Spaces & Functionality

- Operations
- Operations support
- Command and control
- Analyst wellness and support
- Building systems
- Other assigned functions

- Operations Manager(s)
- Training and simulators
- Audio-visual equipment
- Systems set-up & support
- Maintenance Support

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Spaces & Functionality

- Operations
- Operations support
- Command and control
- Analyst wellness and support
- Building systems
- Other assigned functions

- Command suites
- Conference, VTC
- Admin offices
- Auditorium/Large Briefing Rooms

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Spaces & Functionality

- Operations
- Operations support
- Command and control
- Analyst wellness and support
- Building systems
- Other assigned functions

- Counseling, Physician, Exam, Rooms
- Showers, Lockers
- Fitness area
- Coffee/Break areas, healthy food options
- Bike storage

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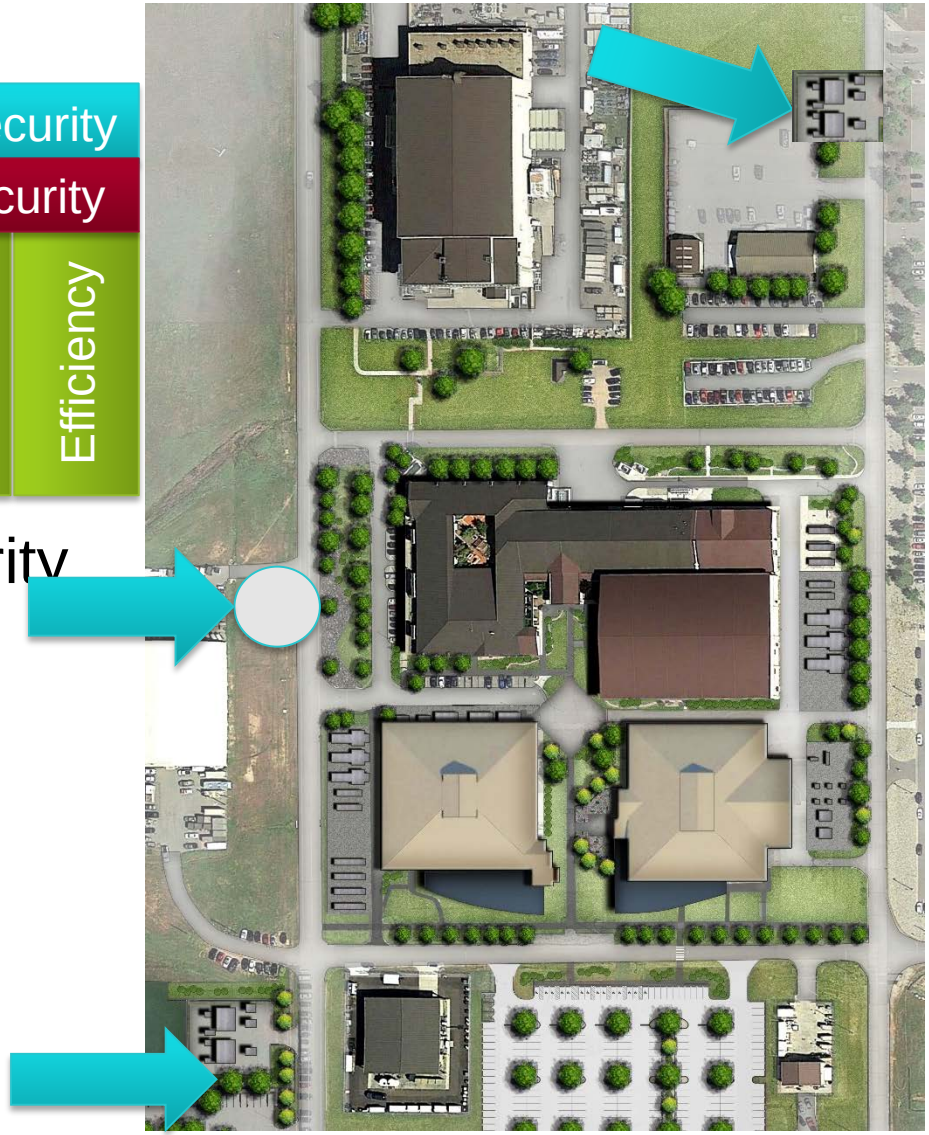
Energy Assurance

Case Study:
Energy Security:
Reliability

- Energy and Water top priority
- All utilities must be considered
- Utility Redundancy
  - Concurrent maintainability
  - Multiple paths
    - Power
    - Comm.
  - Water storage



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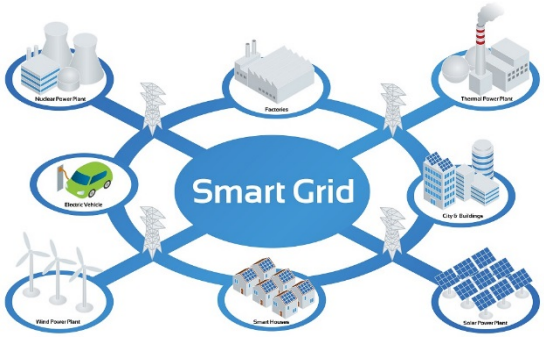
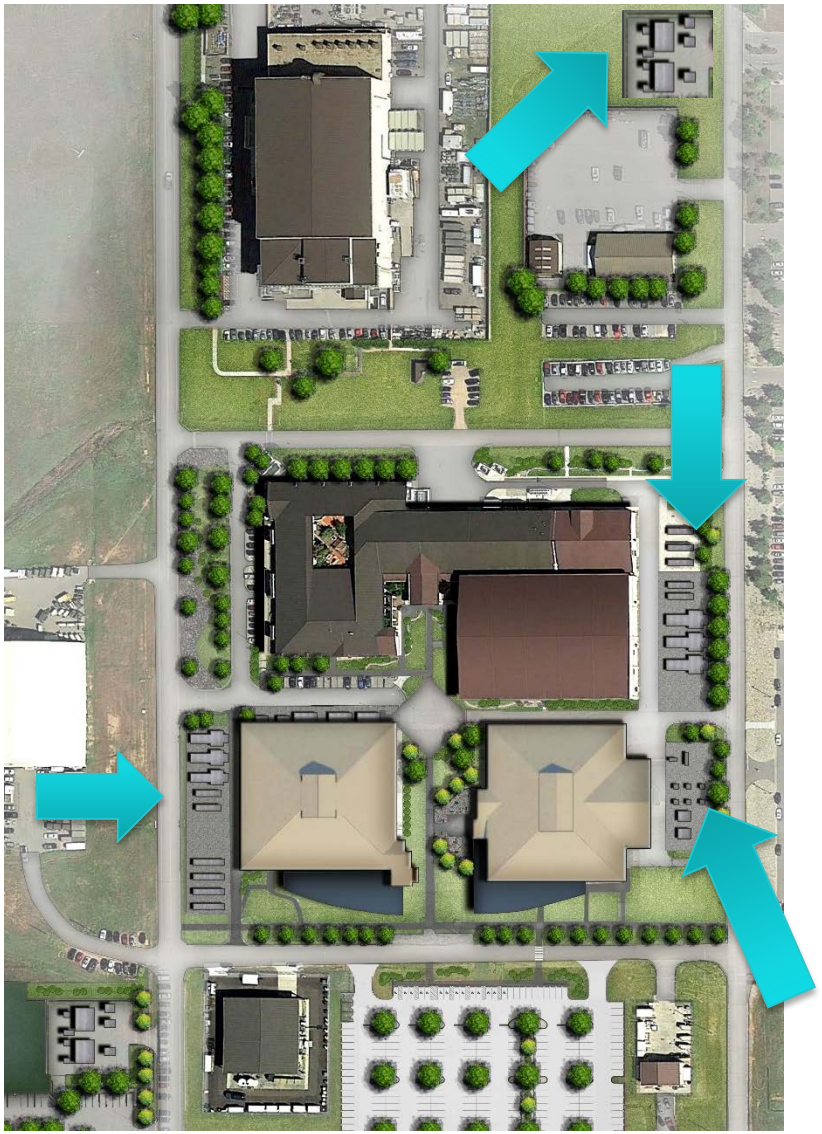
Energy Assurance

Case Study:
Energy Security
Resiliency

- Campus “Island Mode”
  - Smart Micro-grid Control
  - Distributed Generation





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Energy Assurance

Case Study:
Energy Security
Resiliency

- Diverse Self-Generation
  - Diesel
  - Natural Gas
  - Renewables
    - Wind
    - Solar Geothermal
    - Fuel Cells

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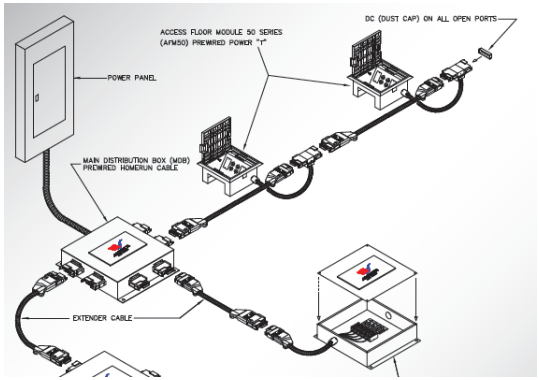
Building Power

- Adaptable and Flexible
  - Plug-and-play power
  - Bus-ducts
  - Flexible rack mount PDUs
  - Worst case design



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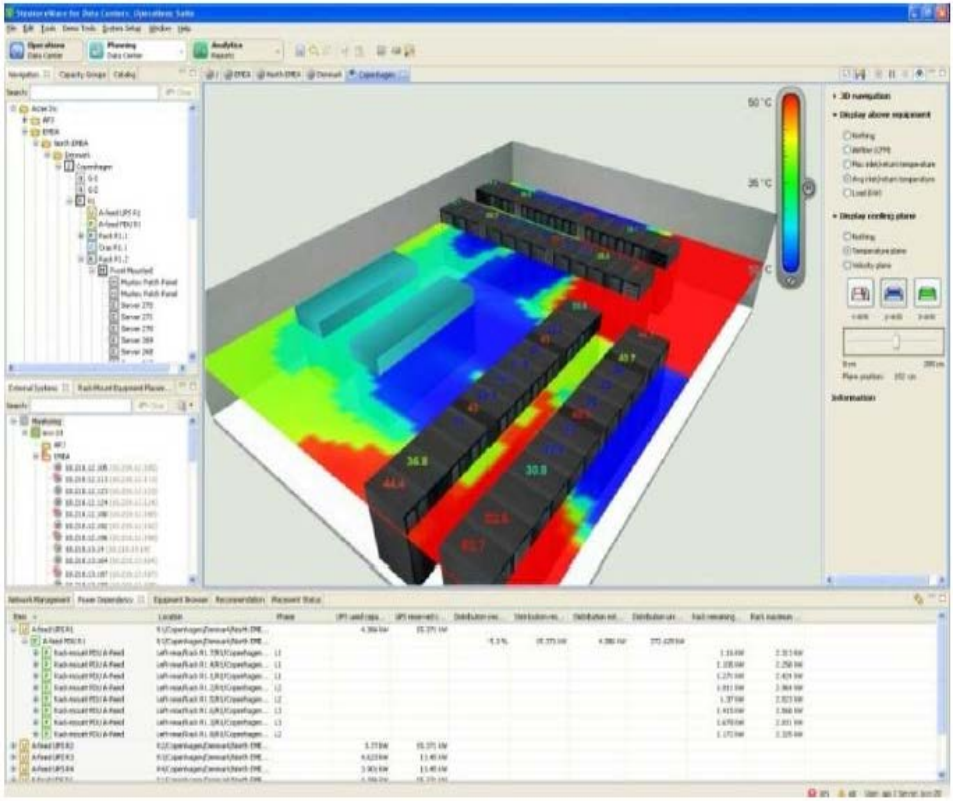
Building Power

Future Trends

- Data Center Information Management (DCIM)
  - Remote Management Capability
  - Building Systems Integrated Monitoring
  - Network and Server Equipment Monitoring
  - Cable Management
  - Live Load CFD Modeling



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Human-centric design

- Challenges related to personnel:
  - Intelligence analysts experience health issues ranging from stress, depression, anxiety, and repetitive motion injuries to suicides
  - Recruiting and retention competes with tech industry
  - Transitioning between work and personal time generates added stress for in-garrison missions

Or?

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Human-centric design

- Consider a variety of human factors:
  - Ergonomics
  - Stress management and wellness support
  - Circadian rhythm disruption
  - Focus and alertness
  - Transitions between tasks, different work environments
  - Focused work vs. collaborative tasks
  - Evolving workplace environments; e.g., rejuvenation spaces, “caves and commons”, internet café, benching, wifi, cell phone use, etc.

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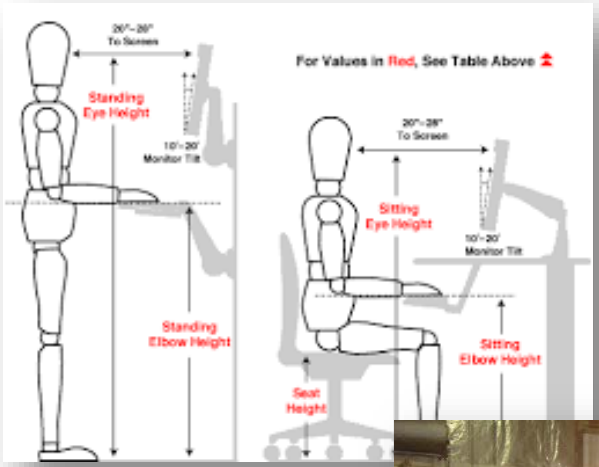
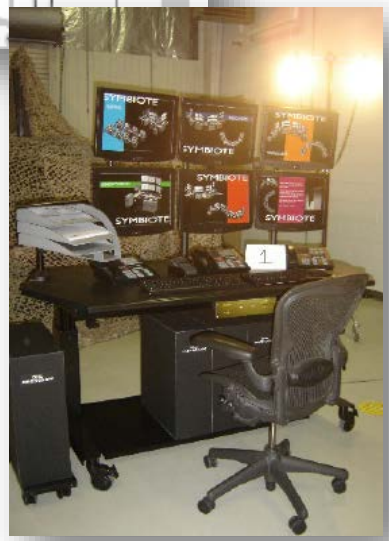
Human Factors: Ergonomics

- Configurations differ for each person
- Allow for customization, adjustability
- Consider impacts on operations floor overall (e.g., standing height workstation may obstruct sightlines)
- Consider maintenance access to equipment
- Consider locating servers and CPUs away from workstations
- Determine location of workstation equipment and types of equipment planned (e.g., thin or fat clients, cloud, etc.)





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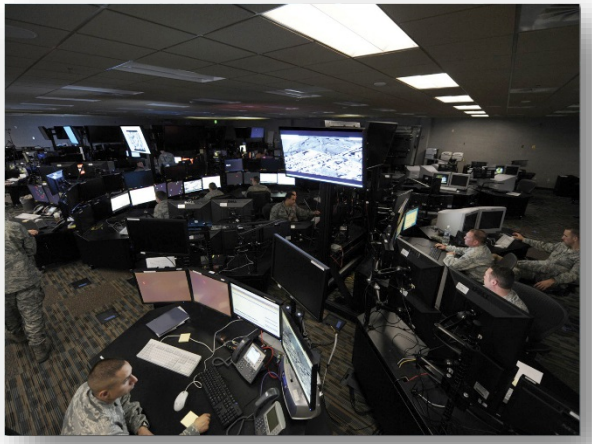
Human Factors: Acoustics

- Acoustics:
  - Design to alleviate noise from equipment, including servers fans, HVAC
  - Avoid high reverberant materials in large operations spaces
  - Locate large HVAC ducts outside rooms to the extent possible
  - Engage acoustical consultants to integrate noise and sound control in design
  - Consider workstation configurations that allow for conversation between coworkers (i.e., make sure monitors don't block sound)



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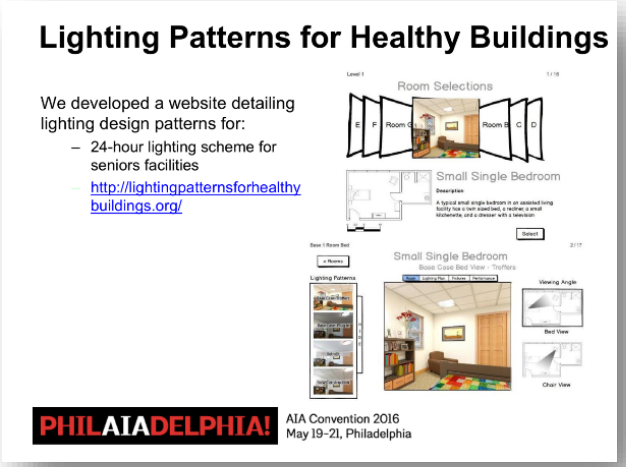
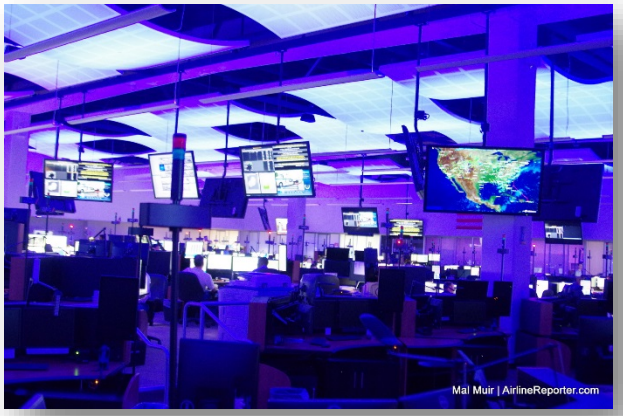
Human Factors: Visual Hygiene

- Track research on illumination related to eye strain, alertness, focus
- Use high flicker frequency lighting
- Provide areas with daylighting and views (coordinate with security)
- Provide multiple lighting sources to provide options for analysts
- Consider glare on work surface and monitors
- Minimize patterns, contrast in flooring
- Provide adjustable monitors to avoid eye and neck strain





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Human-centric design

- Circadian rhythm disruption leads to a variety of health concerns – consider windows, illumination, security, rejuvenation spaces
- Consider opportunities to provide access to daylighting and/or illumination systems that can trigger circadian rhythms

Circadian Disruption

Circadian disruption is associated with:

- Poor sleep and higher stress
  - Eismann et al., 2010
- Increased anxiety and depression
  - Du-Quiton et al., 2009
- Increased smoking
  - Kageyama et al., 2005
- Cardiovascular disease
  - Young et al., 2007; Maemura et al., 2007
- Type 2 diabetes
  - Kreier et al., 2007
- Higher incidence of breast cancer
  - Schernhammer et al., 2001; Hansen, 2006

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Human-centric design

- Provide discrete access to counseling, medical, stress management support
- Provide crew/analyst support spaces:
  - Dedicated crew break areas
  - Provide coffee bar and healthy food options
  - Provide fitness area, secure bike storage, showers

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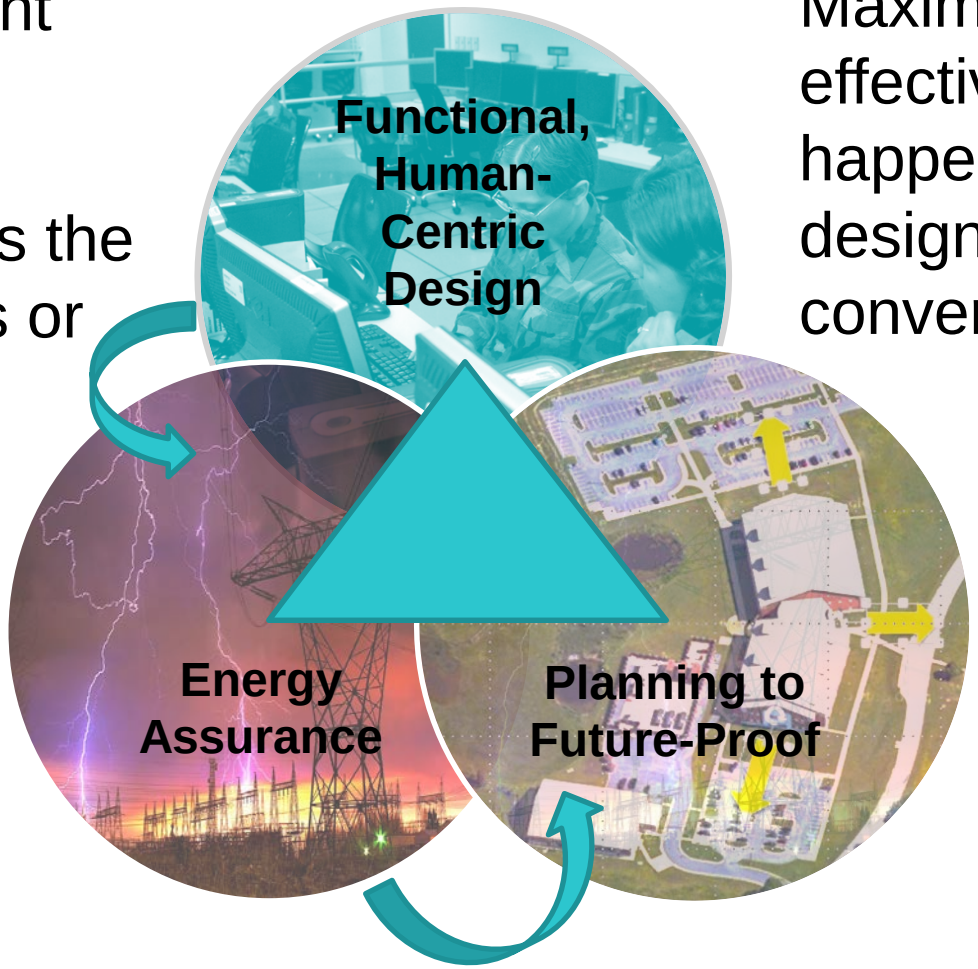
C4ISR Summary and Questions

Striking the right balance in the competing requirements is the key to success or failure



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Thank you and Happy 2018 Engineers Week!

March 6, 2018

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