Designers Lighting Forum

Digital Lighting in the Post-COVID Era

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

LEDucation

Session Description

Digital Lighting in the Post-COVID Era

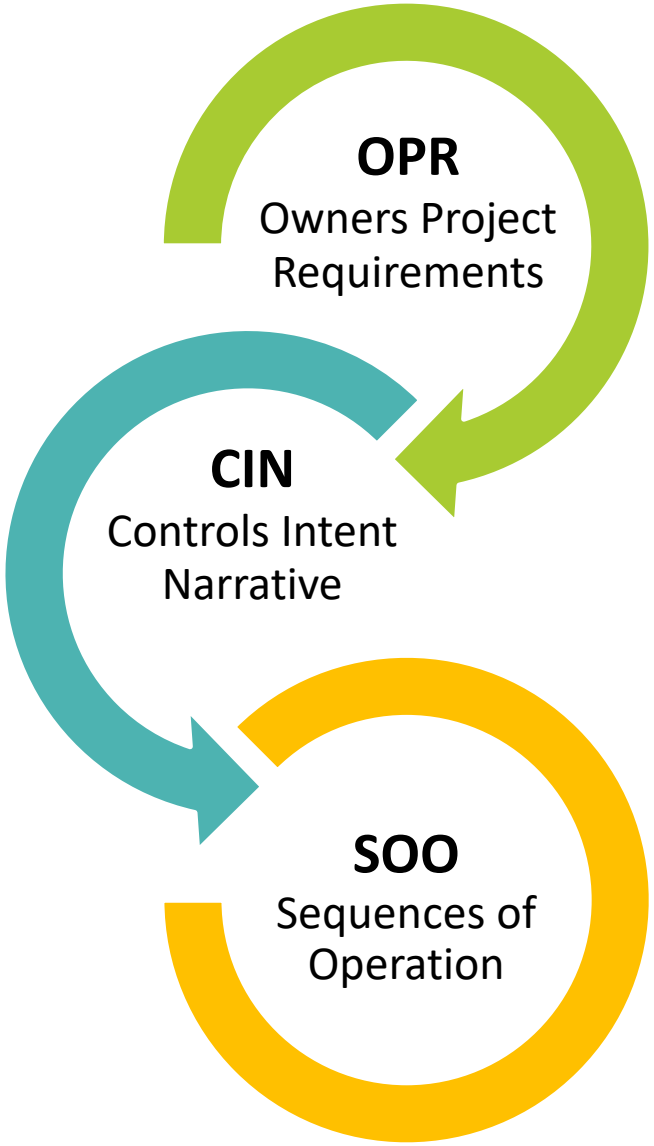
Owners, managers and tenants have more reasons than ever before to need real-time information about their buildings, for safety-driven use cases like flexspace reservations, hybrid schedules, reduced worker density, contact tracing, wayfinding and more. How does lighting contribute? And how can lighting integrate with other high value digital technologies? This session will provide an updated and agnostic overview of the most relevant options, along with a methodology to help specifiers navigate and stay competitive with beyond lighting features. Special attention will be paid to protect lighting quality with specifics about interoperability and Controls Intent while meeting Owners Project Requirements.

Learning Objectives

At the end of this course, participants will be able to:

1. Learn how to parse through Owner's Project Requirements (OPR) to know how to refine lighting and digital integration requirements into Controls Intent Narratives (CIN).
2. Understand how to carefully evaluate different digital and IOT technologies and determine what will genuinely support the OPR, CIN, interoperability and lighting quality.
3. Provide successful examples for multiple applications and building types, ranging from common to customized options.
4. Summarize how these methods, technologies and criteria will deliver solutions that meet the needs of post-COVID owners, operators and occupants.

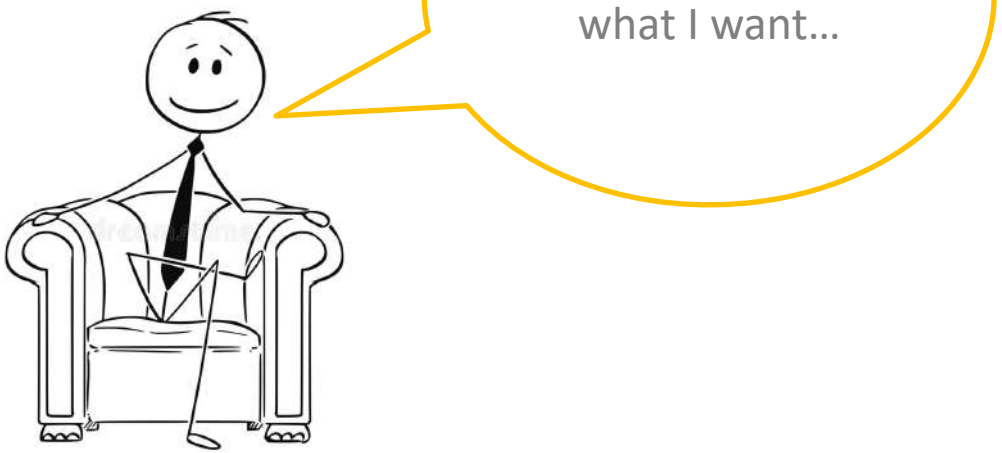
OPR > CIN > SOO… Come again?



	DEFINITION	WHY IT MATTERS
OPR	*The OPR defines the specific functional and operational requirements for all building systems and their interaction FROM THE OWNER'S POV.*	*This is the owner's brief for the project. It tells the design and commissioning teams what's expected from the building/project.*
CIN	*The CIN provides a broad brushstroke view of the lighting control system and its functionality. It draws on information from both the OPR and other Basis of Design docs.*	*An overview, IN ENGLISH, of how the lighting control operates and what happens. Provides both description and guidance.*
SOO	*The SOO is the specific, **contractually enforceable** expression of how the lighting control system operates. It specifies limits and set points, timing, and equipment.*	*Defines the system and its function for suppliers, programmers, and installers. Provides guideposts for M&V.*

The reality of OPR

OPR
Owners Project Requirements



WHERE TO FIND

- *Public RFI's*
- *Programming phase documentation*
- *Institutional guidelines*

WHAT DOES & DOESN'T WORK

Because its generally developed prior to the beginning of the project, the design team may or may not have access to a cohesive document.

EXAMPLES OF DIGITAL OPR'S

I want unobtrusive sensors connected to my lighting fixtures so I can do cool stuff on my phone and connect it to other building systems. I want it to be easy and intuitive and be remotely upgradable to new software. No vendor locks please, I hate that.

The reality of CIN

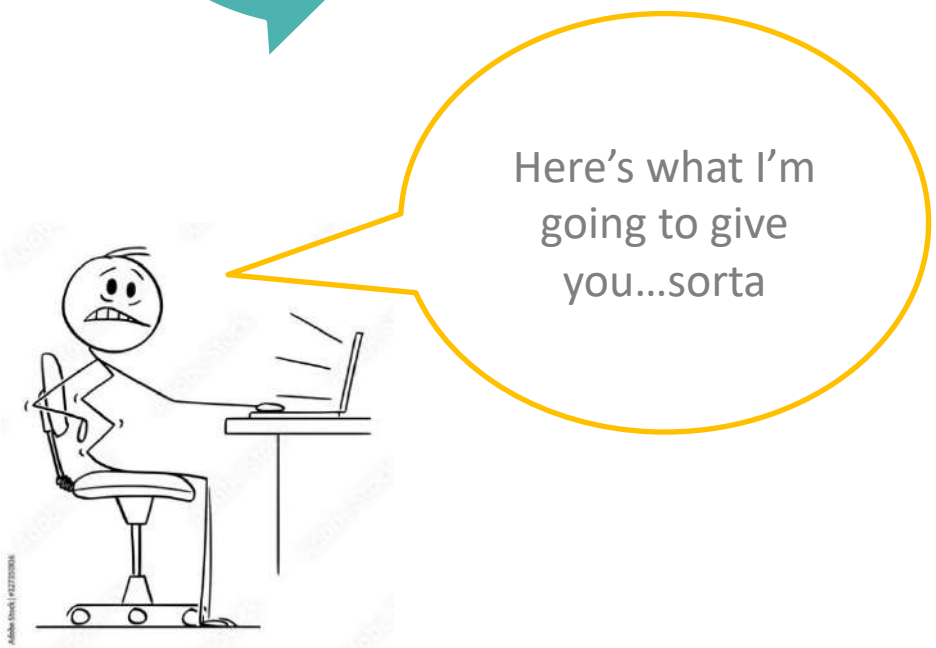
CIN
Controls Intent
Narrative

WHERE TO FIND

- *Lighting Design Specs*
- *Manufacturer Performance Specs*
- *CSI sections 26 0925*
- *Electrical drawings*

WHAT DOES & DOESN'T WORK

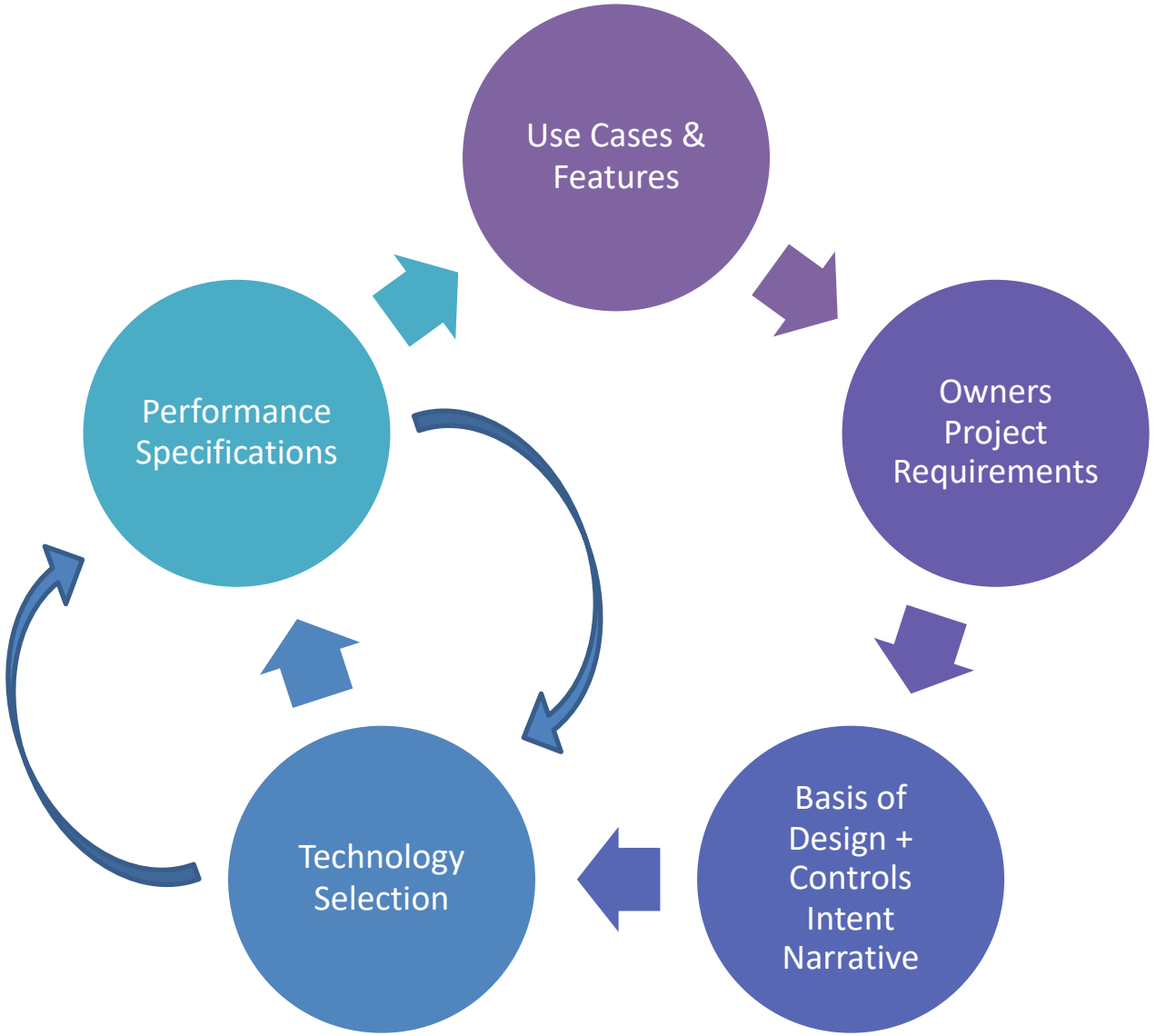
- *CIN may be composed without OPR*
- *CIN and Specification may be composed by different teams*
- *Widely different formats*



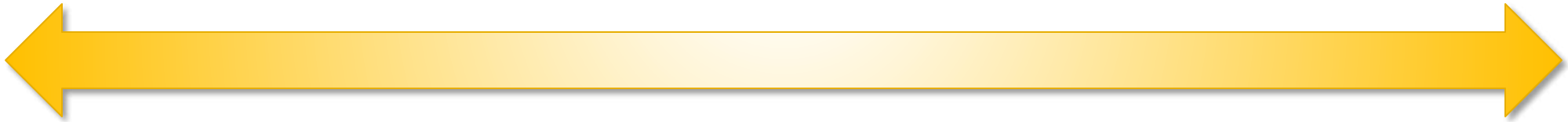
EXAMPLES OF DIGITAL CINS's

So ummm… I've never done this IOT thing before, can I get an example please? Geez it would be great if I could hire someone to figure this out for me. Is there an installation nearby? Who's responsible for this, is anyone else working on it? How do I know what the owner wants after the building opens?

Decision Process



Spectrum of Digital Options

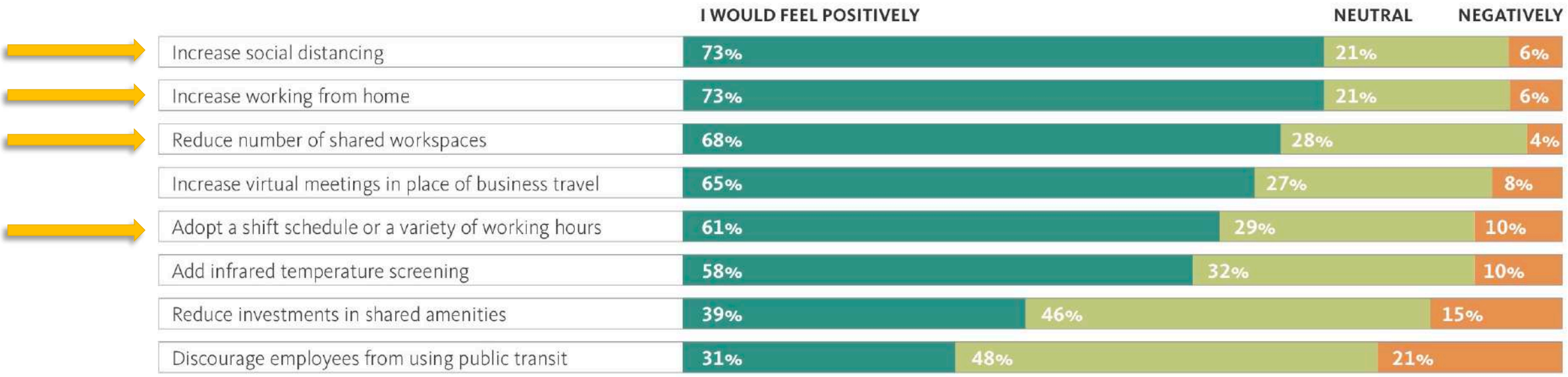


Market drivers for popular digital use cases, impacts of COVID-19 on buildings projects, checklist of varied use cases, examples of OPRs and CINs, interoperability, lighting quality, summary thoughts

Custom digital applications, project-specific opportunities, integration and programming required, case study examples, advisory input

COVID-19 Impact on Workspace Preferences

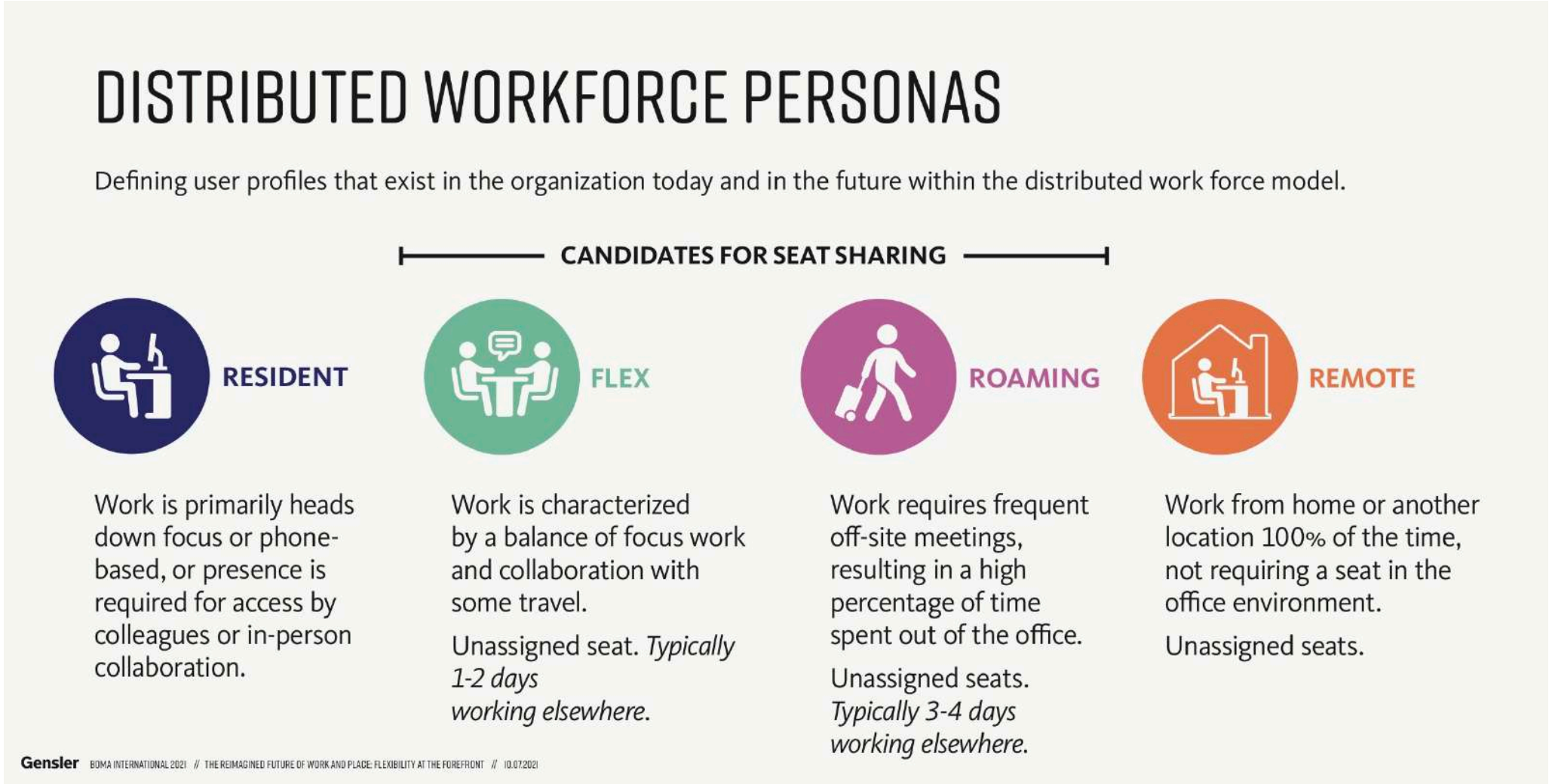
- Increase social distancing, 73%
- Increase working from home, 73%
- Reduce number of shared workspaces, 68%
- Adopt a shift schedule or a variety of working hours



Gensler RESEARCH INSTITUTE

Source: Gensler Research Institute, 2020. "U.S. Work From Home Survey."

User Profiles within Distributed Workforce



Source: Gensler International, 2021. "The Reimagined Future of Work and Place: Flexibility at the Forefront."

Digital Aspects of Space Management

PROGRAMMING & SPACE MANAGEMENT

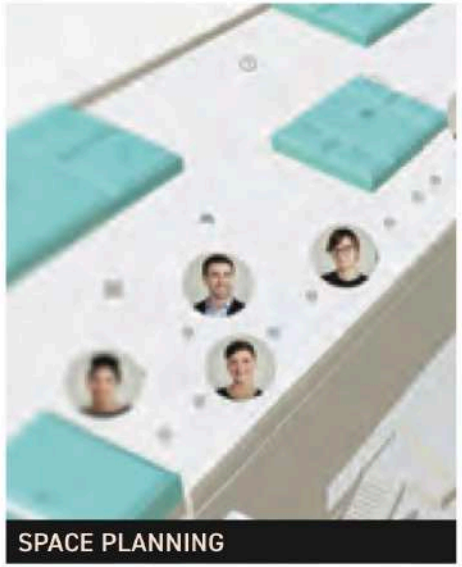
Are you delegating the task of space management to automated systems that monitor activity and find the most efficient utilization for a given area?

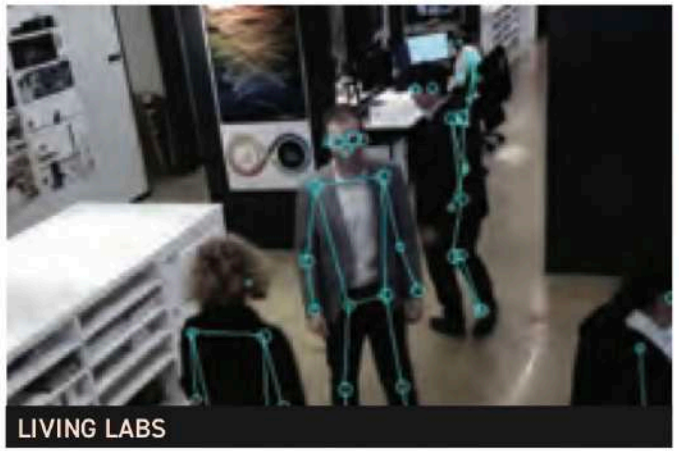
Occupancy Analytics — better understanding of space usage through sensors and intelligent video increases the ability to adapt and optimize the program

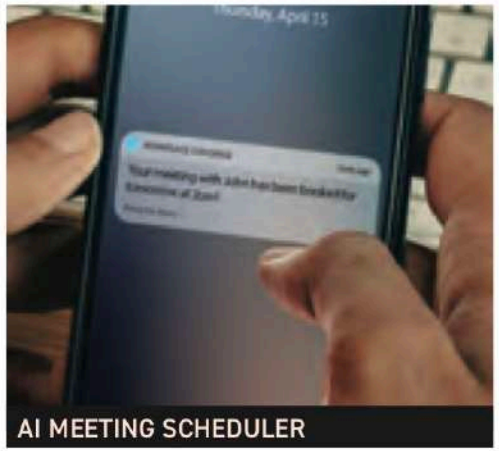
Smart Seating — an infrastructure for assigning seats with mobile assistants and location-tracking modulates density to streamline health requirements

Enhanced Room Booking — reservation apps maintain optimal usage of shared space through smart scheduling


OCCUPANCY SENSORS


SPACE PLANNING


LIVING LABS


AI MEETING SCHEDULER

Source: BOMA International, October 2021. "The Reimagined Future of Work and Place: Flexibility at the Forefront." Gensler.

Rating Systems are Moving ESG to the Mainstream

Environment
Social
Governance

- Voluntary Disclosure Frameworks
- Guidance Frameworks
- Third Party Aggregator Frameworks

Source: ESG Investing Going Mainstream and the Implications for Commercial Real Estate. BOMA 2021, October 2021.

leducation.org

Digital Tenant Services – Lessons Learned

Building and tenant system **interoperation complexity can be significantly reduced** with cloud services

Like interior design, you need a **digital experience vision** from the start

Like choosing colors and finishes, **products and building systems need to align** to digital vision

IT & OT will change faster than your building, so **design with flexibility in mind**

Proprietary systems cause vendor lock-in, **all systems should offer open APIs** for interoperation

Small tenants may want your app, but **big tenants want their own to integrate** with your systems

Don't just sell location, views, furnishings and the lobby, **digital services have significant tenant value** and can be monetized too

Source: "Unlocking the Next Wave of Value: IoT, 5G and Digital Tenant Services." Accenture. BOMA 2021, October 2021.

Big Picture Choice

DIGITAL

"Granular" sensing geolocated to a map = layered value propositions

ANALOGUE

"Room-base" or "Area" sensing = meets code

- Precise vs. general area
- D4i + Zhaga vs. 0-10v
- Smart vs. dumb sensing
- Data + Lighting vs. Lighting-only
- Server or Cloud vs. Stand-alone
- Integration with building systems/apps vs. wall control
- Value priced vs. first cost

Trends & Impact on Space Design and Lighting

DRIVERS

EXTERNAL TRENDS

- Hybrid models
- Flexspace (RE planning)
- Health and Wellness
- ESG + rating metrics
- New space planning models
- Expects digital functionality
- Real time use cases
- Interactive Grid + Codes/Standards
- Voluntary Programs (e.g. DOE ILC, DOE L-Prize, DLC)

INPUT TO OPR

DIGITAL INNOVATIONS

- Digital PIR sensors
- POE Lighting & Devices
- Room reservation systems
- Entry systems, Key fobs
- People counting
- Line of sight, gesture
- Tenant concierge apps
- Space Utilization
- Location, asset tracking
- Wayfinding
- UVC Disinfection
- Touchless, self-cleaning
- BLE beacons
- Personal lighting
- Circadian lighting
- Temperature sensing
- Digital layers and twins
- Live shooter apps

Post-COVID Use Cases

Flexspace / Hybrid Reservations

Reduced Worker Density

Asset Tracking

Wayfinding

Net Zero & Sustainability

Circadian Support

OPR to CIN Examples

Flexspace / Hybrid Reservations

In a flexspace model workers are in shared space (vs. dedicated) making space reservations a necessity. Sensors provide real-time information about the actual use of individual workspaces and conference rooms, to ensure that empty space is not wasted.

Sensors are to be used to support flexible space use, by providing real time information about available space, current worker locations, occupancy and space reservation thereby optimizing the use of space.

- Sensors shall be geolocated to space map and configured to detect presence at workstations and conference rooms.
- Integral luminaire sensor density shall be typically be 1 per 100SF overall with exact locations indicated on RCP.
- Working mockup shall be built with full system configuration to enable in situ testing and evaluate functionality using integrated software solution. Special attention will be paid to location accuracy to ensure locations don't get confused with nearby rooms or sensing technologies on other floors.
- Receiver technology shall be Bluetooth enabled tags to be worn by employees

OPR to CIN Examples

Reduced Worker Density

In COVID times, a lower density of people per area reduces risk of transmission and improves health of the workforce. Technology that can reliably indicate how many people are in a given space/area is high value.

Sensor and/or low-resolution camera technologies are to be used to capture real time information about worker density in selected locations, with user-friendly mobile app to notify authorized employees about high congestion conditions.

- Technology selection will be evaluated at the functional performance level to ensure real-time worker density information is reliably provided. Different technologies such as sensors and people-counting cameras will be considered in combination with software to support owner objectives.
- Any health-related data shall be held private and protected from any users or administrators of the app, employee health and privacy data is strictly private. Should health concerns arise they will be managed only by Human Resources.

OPR to CIN Examples

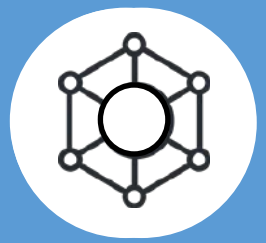
Asset Tracking

Track high value items, personnel, and/or customers through the airport using mobile and browser interfaces to support various operations, customer needs, and safety and security objectives.

Airport-wide asset tracking system is required to provide mapped real-time locations for high value items, personnel, and/or customers using mobile and browser interfaces.

- Sensor technology shall typically be integrated within and/or connected to luminaires, accessible and replaceable without ceiling access. Sensor density shall be sufficient to ensure accuracy within three feet, reliability and completeness of coverage.
- Cybersecurity testing is required before source selection to ensure the highest standards of safety, as measured by XYZ local and state standards.
- Location information and analytics shall be accessible to occupants and airport personnel with different features and dashboards depending on authorizations and credentials.
- Sensors, hubs, and all related system devices must be capable of over-the-air firmware and software upgrades to ensure longevity.

OPR to CIN Examples



Wayfinding

Indoor location mapping on mobile devices to support employees and customers in finding facility locations, occupants, and amenities within the building.

Indoor location mapping on mobile devices to support employees and customers in finding facility locations.

- Bluetooth beacon technology will be used to triangulate locations onto mobile device receivers.
- Beacon technology may be external to luminaires as a standalone system, or integral within luminaires as part of a lighting control system.
- Technology shall be configured for each physical location prior to deployment, such that locations are shown on a map with wayfinding directions graphically shown after location is requested.

OPR to CIN Examples

Net Zero & Sustainability

Lighting will contribute to Net Zero and Sustainability goals with individual luminaire addressability and control.

Addressable open protocol technology will be used to support energy and sustainability goals to provide minimum acceptable consumption over time, while meeting applicable IES and lighting design standards.

- Lighting shall meet Energy Performance Stretch Code XYZ 20xx.
- LLLC (Luminaire Level Lighting Controls) will be are required to meet DALI D4i, Zhaga Book 20, and DLC certifications and standards.
- LLLC luminaires shall be individually addressable and controllable. Lighting controls behaviors or profiles shall meet IES Standards.
- When luminaire-mounted integral sensors are used, control configuration and functionality shall meet lighting design objectives including but not limited to sensor grouping to ensure background light levels in large areas.
- Lighting control behaviors shall stay reliably intact and functional, regardless of functionality of the wireless network and data transfer.

OPR to CIN Examples

Circadian Support

Lighting that supports human wellness by providing color and spectral environments that more closely mimic lighting in the natural environment, and/or provide light levels or color content that has been proven to support health and well-being.

Hospital patient and nursing areas are to have circadian support lighting, supported by evidence-based design and in compliance with the most recent WELL Building Standard.

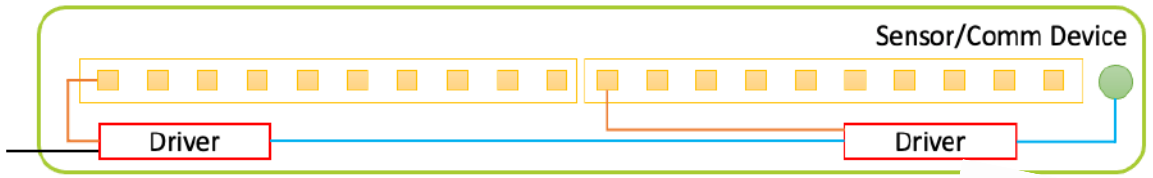
- Luminaire-to-luminaire appearance and color constancy are required to be achieved with DALIT8 technology to ensure digital calibration and control.
- Circadian and spectral programming and controllability is required for all patient and nursing areas but must be accessible only via facility-controlled interfaces, not to patients.
- Patient controls shall be limited to on/off and dimming control for light level changes.
- Circadian programming must be capable of following a pre-programmed “recipe” over time, as determined and maintained by circadian wellness domain experts.

Luminaire as the Home for Interoperability

- Role of digital sensor vs. digital driver
- Device interoperability vs. API/data interoperability
- Market transformation…?

IOT Analytics, Software and Apps

D4i + Zhaga Book 20 Certified Luminaire



Lighting Control Systems

DALI Part 250	Intra-luminaire DALI bus/power
DALI Part 251	Luminaire Data
DALI Part 252	Energy Data
DALI Part 253	Diagnostics Data
DALI Part 150	Aux Power Supply
DALI Part 351	Luminaire-mounted control device
DALI Part 209	Color Control
DALI Part 202	Emergency

Zhaga Book 20 Physical and electronic (sensor, connector, D4i)

+

NEMA LS 200000-2021 Physical interface only

What about Lighting Quality?

- Lighting Technologies
- Non-Lighting Technologies
- Impacts on Design Quality
- Architectural Considerations

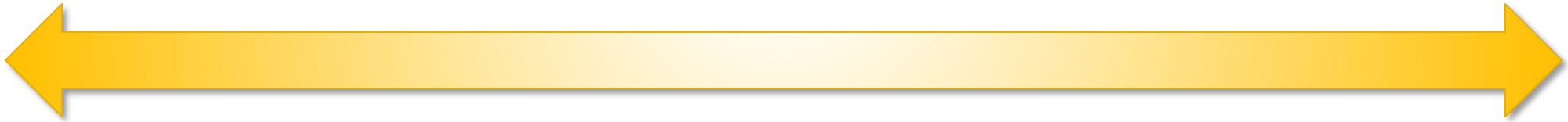
EXAMPLE CIN FOR SENSOR CONSIDERATIONS

- Locations without lighting fixtures where data collection is required to enable IOT applications shall receive an independent sensor and power source, external to the luminaire and without lighting control functionality.
- Sensors controlling luminaires located in perimeter areas designated for wall brightness or display shall be externally mounted in the adjacent ceiling or overhead area to ensure proper occupancy detection. Tuning and configuration of these locations shall support luminance consistency along the length of the wall as designated on drawings and SOO.
- Daylight locations where multiple sensors are deployed shall be configured to be grouped together to avoid highly variable dimming and ensure consistent appearance in the daylight zones.

Summary Thoughts

We aren't competing with each other; we are competing with battery solutions and new to market software	How Bluetooth works vs. radio, and why it matters to these applications	Different wireless topologies and why it matters to these applications	Small buildings and suburban trend due to COVID, and cost implications for digital bldg.
GENERIC PHOTO TO BE ADDED LATER	GENERIC PHOTO TO BE ADDED LATER	GENERIC PHOTO TO BE ADDED LATER	GENERIC PHOTO TO BE ADDED LATER

Spectrum of Digital Options



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Field Museum - Artifact UV Exposure Tracking

Opportunity for Improvement

- The museum desires a more clinically accurate way of determining how regularly they must change out their rotating artifacts to ensure items are available to the public as much as possible, without overexposing the artifacts to UV.

Field Museum - Artifact UV Exposure Tracking

The conservation team—including technicians Ellen Jordan and J. Kae Good Bear—examines, cleans, and documents some of the first 300 objects that were uninstalled from the preexisting Native North American Hall.

Image: John Weinstein

Known Conditions

- Given the textile nature of the artifacts in this exhibit, the lighting control system already needed to accommodate motion sensors.
- The sensors were required to bring up the illumination of these artifacts while under observation, and then return to a lower level of illumination while in their background state.

Integration

- An integration between the lighting control system and the museum's conservation database can allow for the actual tracking of UV exposure (in lux hours).

Field Museum - Artifact UV Exposure Tracking

Description
• The standard method of tracking UV exposure on sensitive artifacts is to estimate UV exposure based on a number of routine discrete readings. While these discrete readings are extremely accurate for the moment they're taken, they are applied on an averaging basis. Assumptions must be made in the application of these averages. As conditions, popularity, seasonal trends, and other dynamic factors change, the assumed averages may become less accurate over time. • By allowing for the real-time tracking of actual light exposure, it can then be determined how often the artifacts must be rotated. • Conservators can rest easy knowing that fluctuations are captured and tracked, and therefore the artifacts will not be overexposed.

Rocky Top Mountain Coaster - Twitter Integration

Opportunity for Improvement

- This project is a stand-alone roller coaster.
- As such, it does not have a guaranteed stream of patrons as part of a larger theme park experience.
- The single largest challenge is marketing and engagement.
- The client sought opportunities to integrate the social media experience with the physical experience of the ride.
- This promotes direct engagement on social media, which will boost a metric to expose your account more in dynamic searches.

Rocky Top Mountain Coaster - Twitter Integration

Known Conditions

- Given the lighting design planned for the roller coaster—integrations with the alpine coaster cars, tracking car position at specific locations on the track, as well as a minor integration with the security cameras and automatic photo system—an advanced lighting control system was already required.

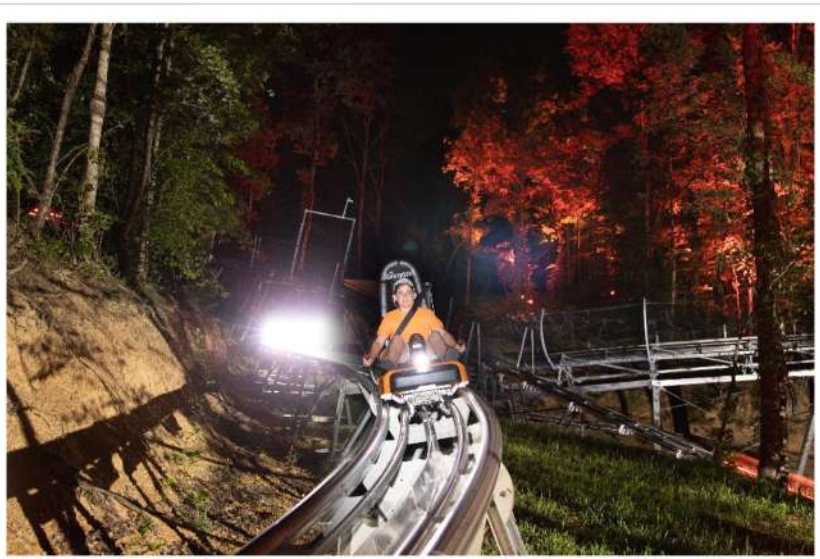
Integration

- When the lighting control system is set to "interactive" mode, patrons can Tweet using a hashtag that identifies the roller coaster; the coaster responds by playing its programming in the colors that it receives.
- For example, a patron might Tweet, “Show me the coaster in red and blue." The roller coaster receives *red and blue*, and utilizes the first color (red) for the foreground color and the second color (blue) as the background color.
- A provision is made for the signage to poll the lighting system regarding which colors are being displayed, and which patron prompted the colors.

Rocky Top Mountain Coaster - Twitter Integration

Description

- A simple program was written that polls the specified Twitter hashtag, parsing the text into one of 72 recognized colors. Those colors are then mapped down to one of 16 colors pre-programmed into the lighting control system.
- The program then sends a TCP-encoded message to the lighting control processor, which identifies the two source colors in order. This allows for more advanced integrations in the future.
- Inexpensive hardware was used for the computation, and therefore two backups can be maintained on site. Failure can be resolved by simply replacing the hardware with a pre-programmed backup.
- The project integrator specified the TCP message format and structure. The program (affectionately named “Twilight") simply had to deliver each message in that format. Total custom code is less than 70 lines.
- The lighting control processor handles all the output, as well as the logic of when and how this information is utilized, maintaining a single "system" in control of the lights at all times.



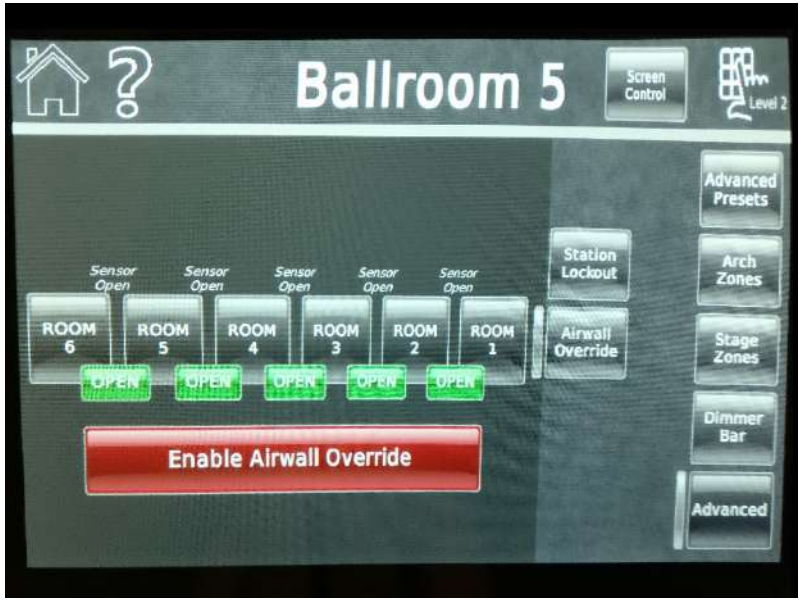
Rocky Top Mountain Coaster - Twitter Integration

Q Center - Airwall Integration

Opportunity for Improvement

- An opportunity was discovered to utilize the airwall state information already present in the lighting control system.
- Physically connecting and disconnecting networks via air gap relays between ballrooms allows for simpler operation.
- This also delivers infrastructure preventing Q Center events from conflicting with one another, while maintaining infinitely complicated technical capabilities.

Q Center - Airwall Integration



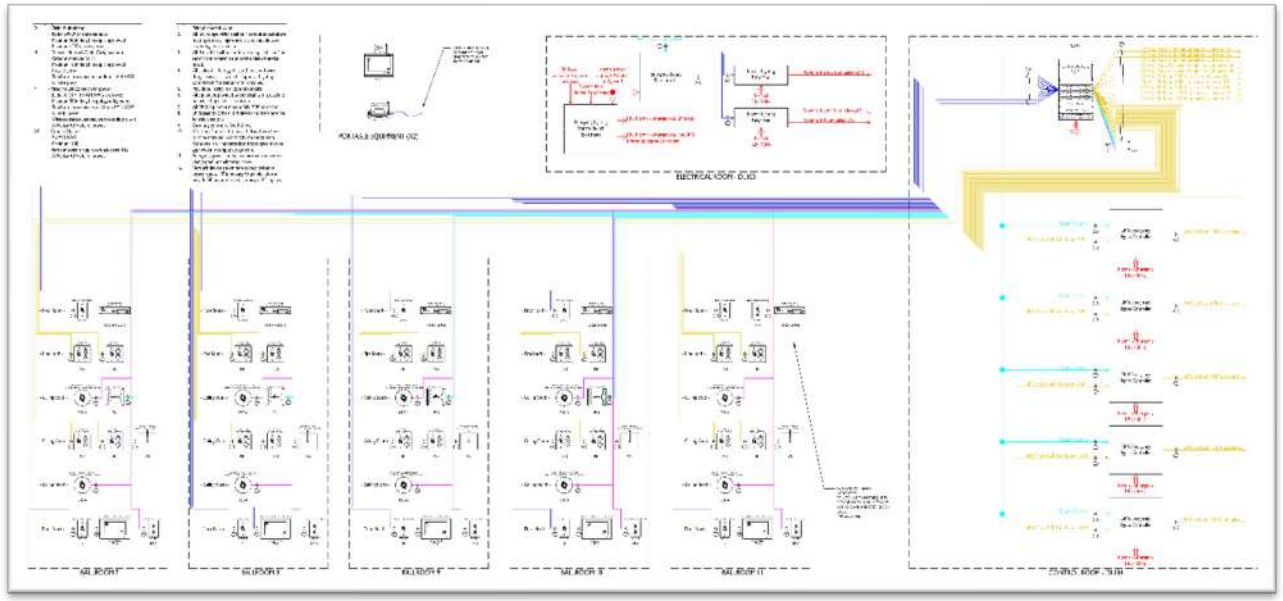
Known Conditions

- Sensors are required on ballroom airwalls to ensure that keypads and touchscreens always control the proper lights.
- The advanced color-changing lighting utilized, and provision for control of automated lighting, meant a sufficiently advanced lighting control processor was already required.
- Therefore, sufficient processing power was available to program additional functionality.

Integration

- The lighting control system can monitor airwall configuration and, when configuration changes, send triggers to the network air gap relay device.
- The network relay device can then combine or de-combine networks as it tracks the ballroom's physical status.

Q Center - Airwall Integration

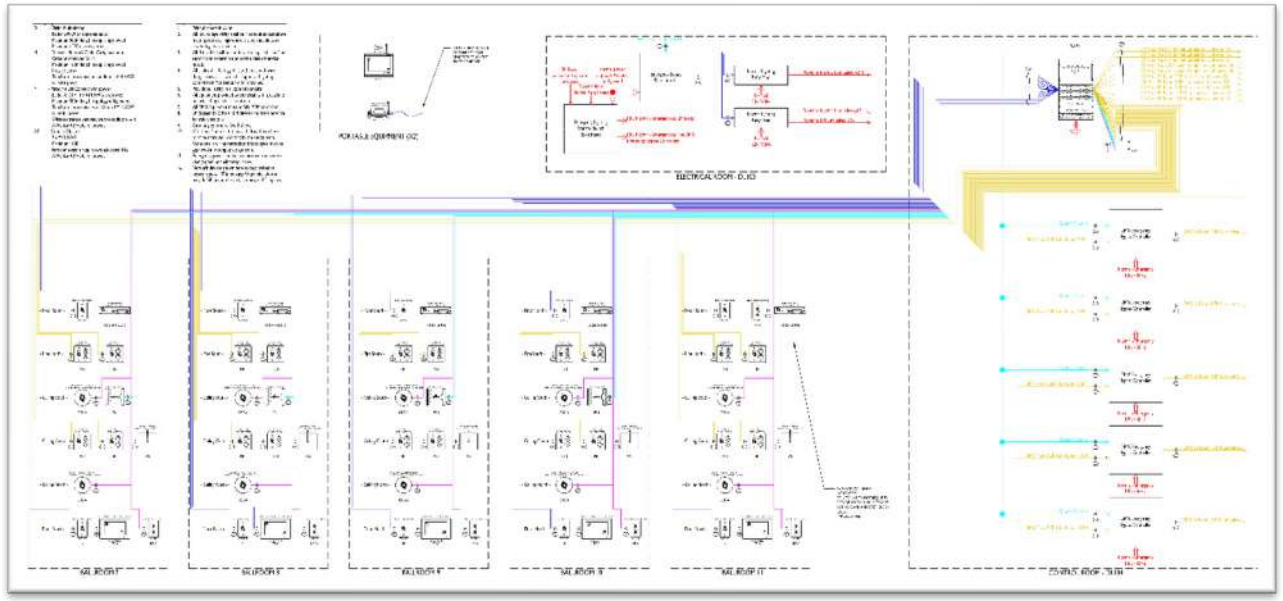


Consistency simplifies operation, allowing for quick reconfiguration of the room without any care or attention placed on the lighting. It also precludes the requirement for training on the lighting control system. This last point is integral to their operation, since these spaces are in use 24 hours a day, and technical staff is not always on site during events.

Description

- Unless overridden, a program is triggered to detect states of airwalls any time they are opened or closed.
- Control signals are sent to a series of cascading Ethernet air gap relay devices, which connect or disconnect adjacent Ethernet networks with one another.
- Any lighting, video, or client network traffic can be transported over this "room" network. This allows any other devices plugged into network ports in combined rooms to access one another. As the rooms reconfigure, the network will be reconfigured as well. This happens automatically, without training or manual user intervention. Manual overrides are allowed, but swept out at 4:00AM to ensure that smooth operation persists over time.

Q Center - Airwall Integration



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Description

- To further avoid confusion, DHCP assignment ranges in each room are non-conflicting. DMX addresses are unique to luminaire purpose, not the room. When the client turns on the "front light" zone, which controls adjustable spotlights, all "front light" luminaires in connected rooms turn on.

Look For… Other Sensor Needs

Look for needs that utilize sensors which are already required on your project.

Identify opportunities to improve the guest experience or street appeal "for free.”

Identify value in connections, and weigh that against the additional programming or complication costs.

Look For… What the Client Focuses On

Pay attention to how the client talks about a space to discover what they are focusing on. (This advice applies, of course, to more than just integration.)

- A museum may talk about their space in terms of conservation of the artifacts, or in terms of guest experience.
- A convention center may discuss the functional needs of their space, or the logistical concerns of reconfiguration.

Even if the client's comments are not directly relevant to the illumination of the space, these are opportunities to learn about the client's priorities, and how you might support their programming by integrating with other disciplines.

Don’t… Let Integration Conflict with Core Purpose

- Ensure integrations are secondary to the primary functionality. (Again, this is good general advice, e.g., "My cellphone’s a great camera, but a terrible phone!”)

- Integrations are a separate path and process. Ensure that lighting functionality, even if it can be directly affected by the integration, is not reliant on it. (“The lights turn on when XXX; if no connection for YYY time, then ZZZ.”)

- Not only does this catch edge-case conditions, where otherwise the lighting might not work, but it also reduces headaches during programming and commissioning. The lights are on when they should be, even if the integration isn't completely setup or functional yet.

Don’t… Integrate For the Sake of Integration

- Do not integrate for the sake of integration, or to check a box on a spreadsheet somewhere.
- Do not utilize integrations that the client isn't aware of, doesn't want, or otherwise doesn’t support their mission or programming.
- Do not allow integrations to unnecessarily complicate the system’s operation, or the client’s user interface(s).
- Support integrations that provide the client with value!

Designers Lighting Forum

Digital Lighting in the Post-COVID Era

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