LIGHTING CONTROL CHANNELS

FEBRUARY 3RD, 2022

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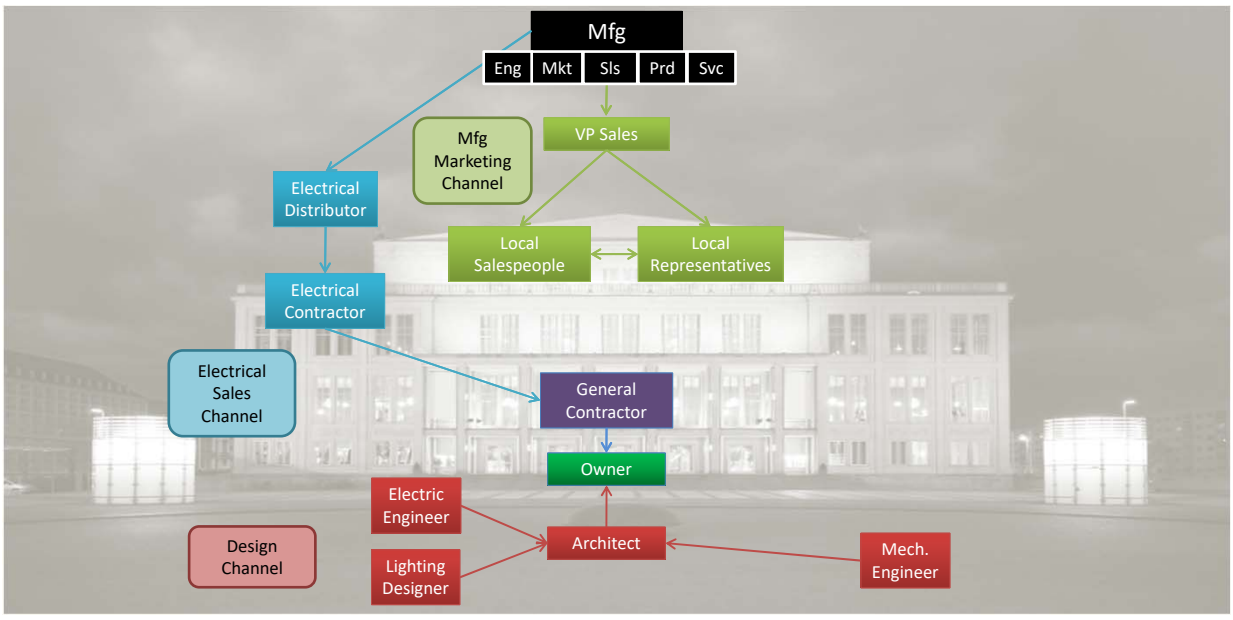
designed to be better.

New Construction Project Flowchart – Lighting Controls



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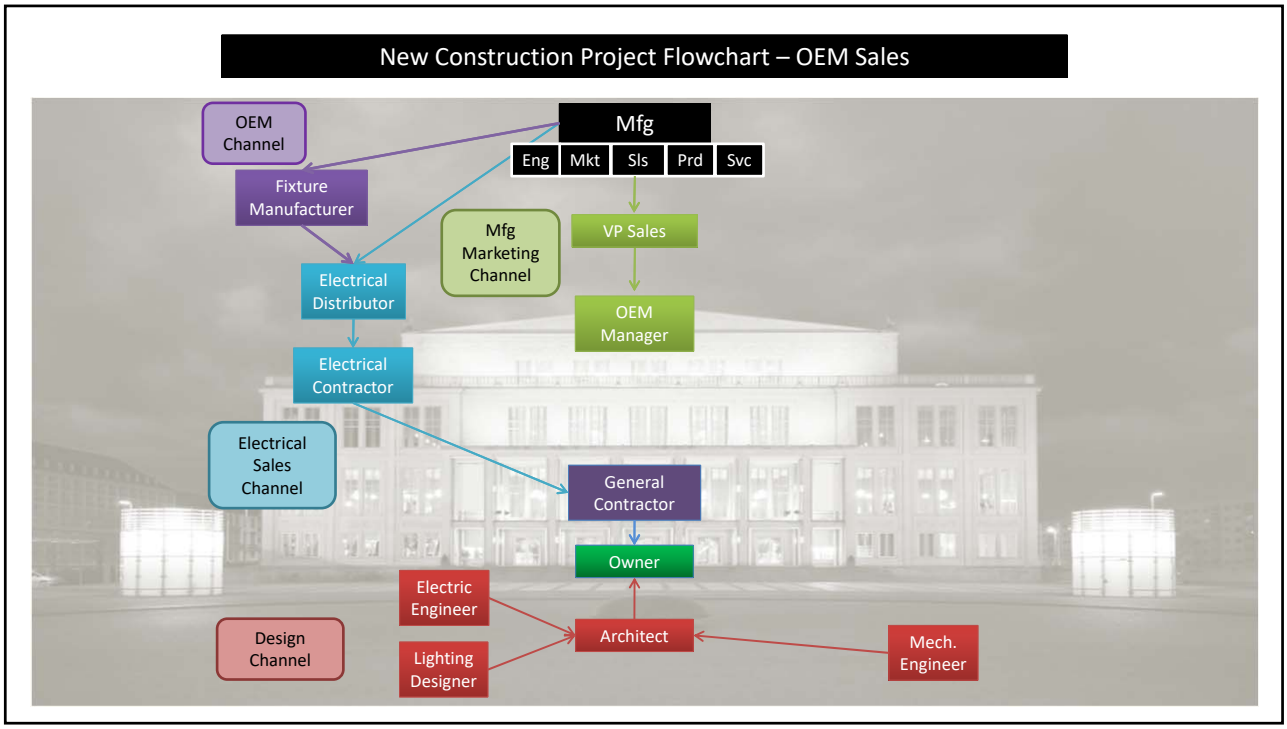

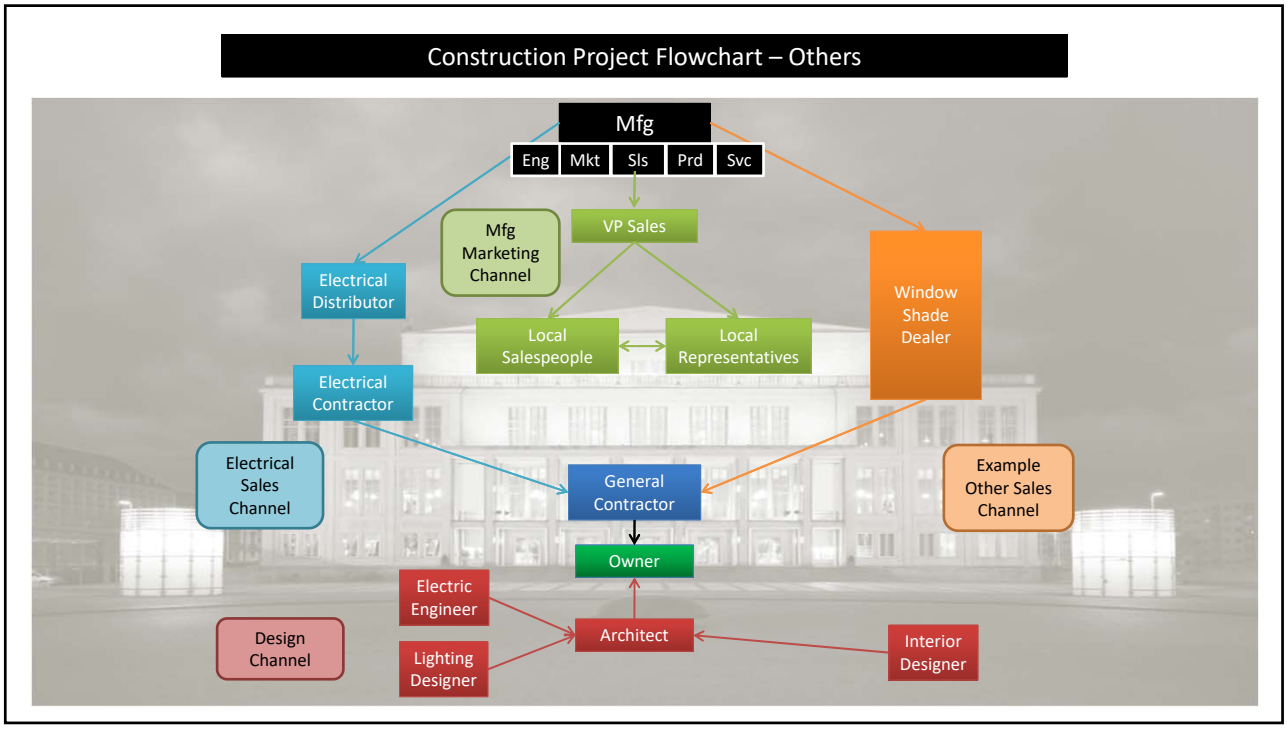

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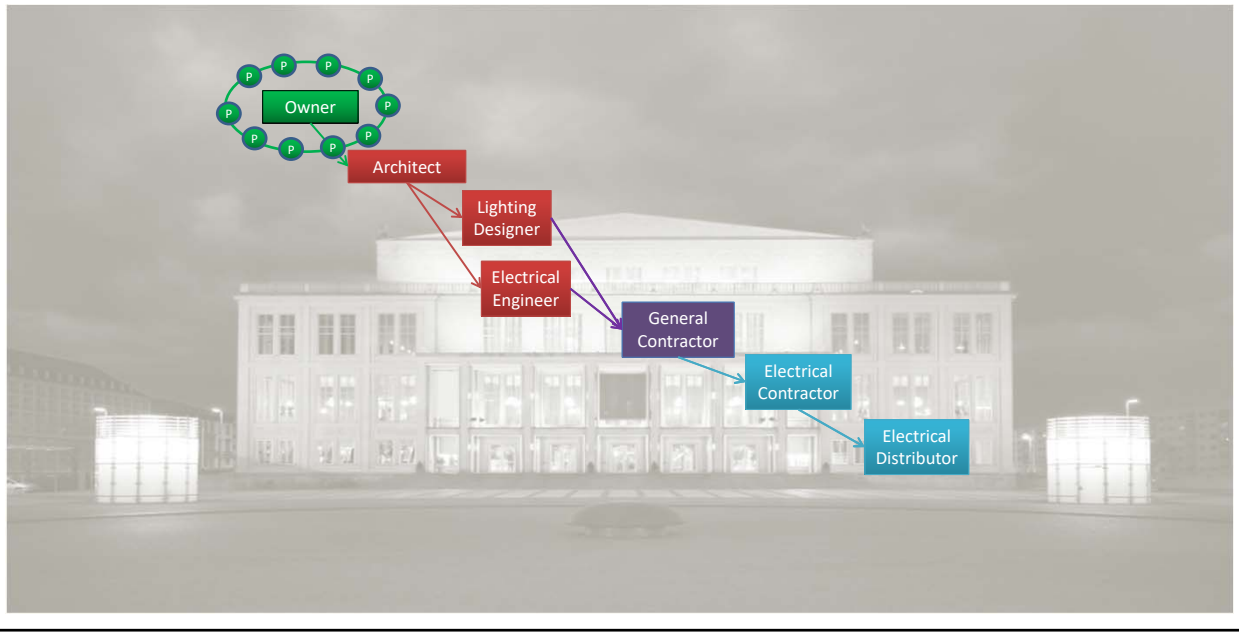
"Influence Waterfall" for Lighting Controls



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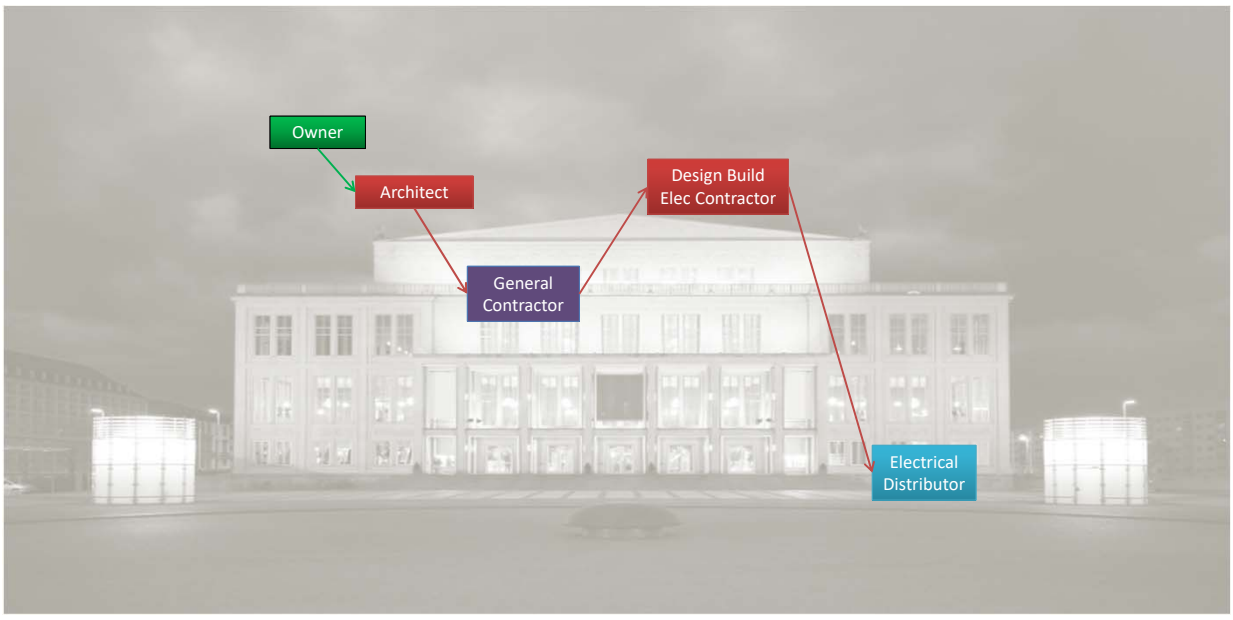

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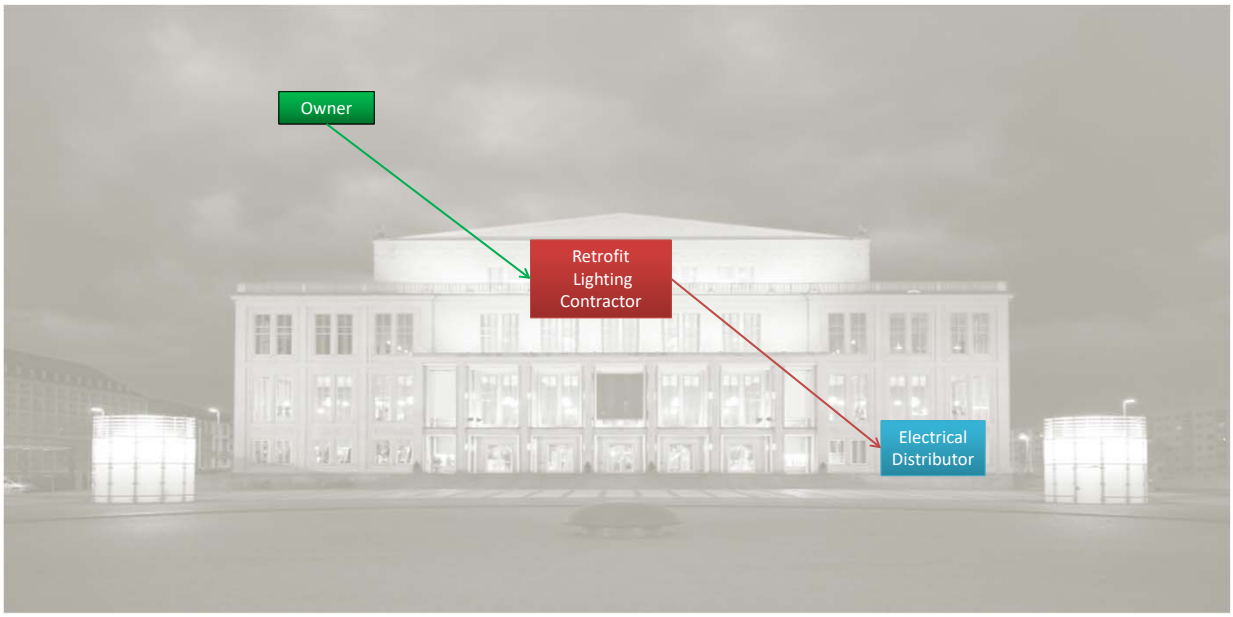
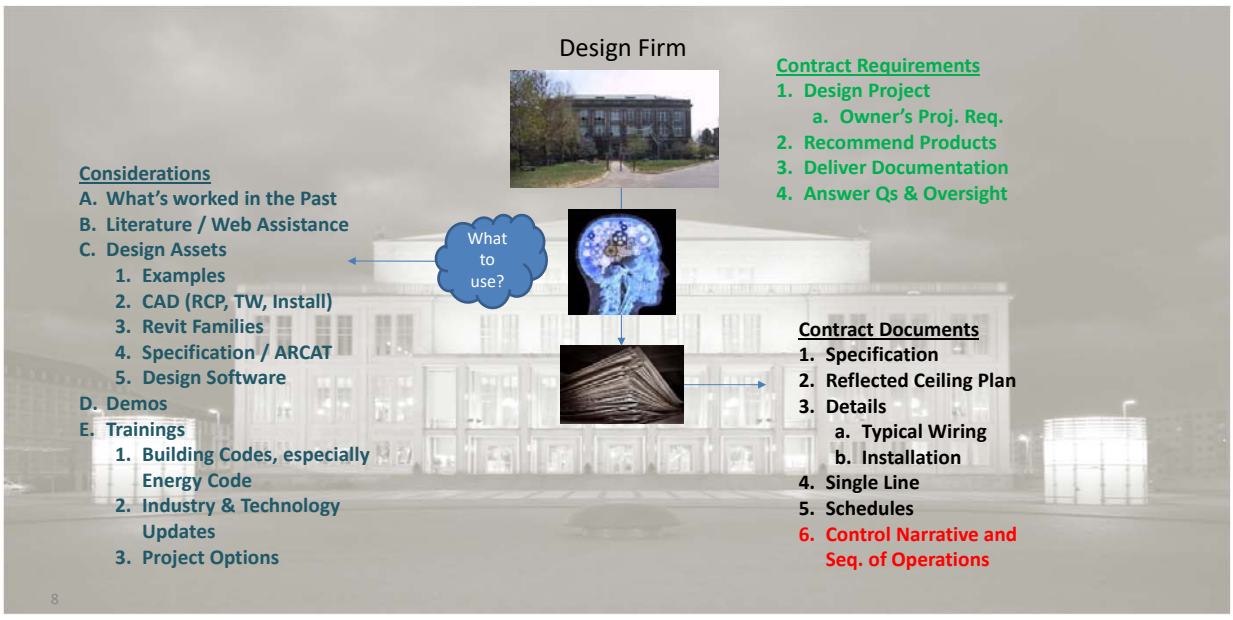
"Influence Waterfall" for Lighting Controls - Retrofit



Specification Process



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THANK YOU!

Questions welcomed.

SEQUENCE OF OPERATION

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Sequence of Operation

You'll wind up with "SoO"s on your project one way or the other

Either: A clear Sequence of Operation is provided for key systems
Or: When the contractors on the project are trying to finish, you'll hear:

"SoO"…
…How are we supposed to set the system up?
…Is this system supposed to communicate with that one?
…Why am I here? Isn't that their responsibility?

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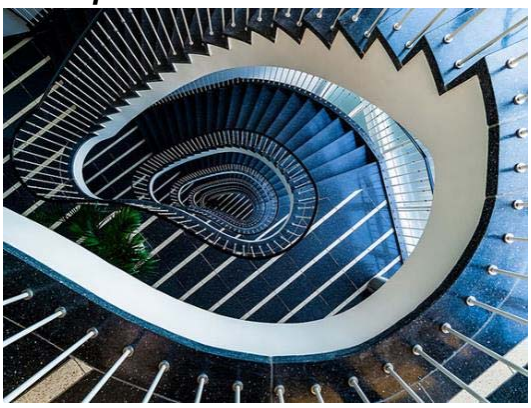
Sequence of Operation
Manufacturer Viewpoint



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The Manufacturer's Viewpoint

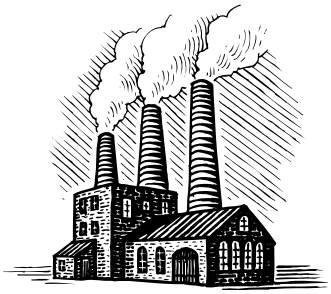
Without a proper **Sequence of Operation**, the best hardware in the world won't provide the experience or effect your client is looking for. Sequences take time, and require interactions between many people, to execute correctly

Salespeople **don't want to say "No" to a customer**, so we're always trying to balance between adding features based on Engineer's requests, while keeping the products simple and easy to use

Standardization would be beneficial for a lot of reasons, as long as it doesn't limit new products and features.

We very much want to help people understand our systems; **the more experience with a manufacturer's hardware**, the better the Sequence of Operation (and all other Contract Documentation) will be.

"Do you really want the last contractor on the project and the startup tech to choose how your project should operate?"



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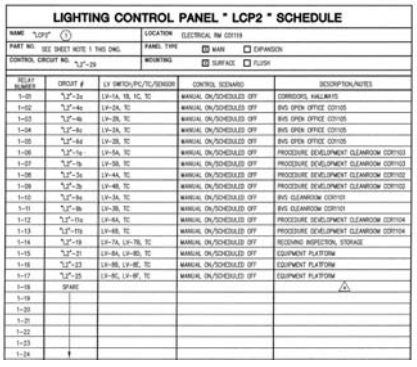
Why a Sequence of Operations?

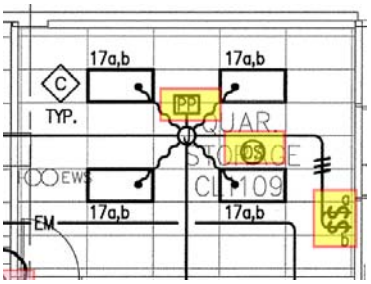
Lighting Control Before…



LIGHTING CONTROL PANEL " LCP2 " SCHEDULE

RELAY NUMBER	CIRCUIT #	LV SWITCH/PC/TC/SENSOR	CONTROL SEQUENCE	DESCRIPTION/NOTES
1-01	"LP" -2a	LV-1A, 1B, 1C, TC	MANUAL ON/SCHEDULED OFF	CORRIDORS, HALLWAYS
1-02	"LP" -4a	LV-2A, TC	MANUAL ON/SCHEDULED OFF	BVS OPEN OFFICE CCR105
1-03	"LP" -4b	LV-2B, TC	MANUAL ON/SCHEDULED OFF	BVS OPEN OFFICE CCR105
1-04	"LP" -4c	LV-2A, TC	MANUAL ON/SCHEDULED OFF	BVS OPEN OFFICE CCR105
1-05	"LP" -4d	LV-2B, TC	MANUAL ON/SCHEDULED OFF	BVS OPEN OFFICE CCR105
1-06	"LP" -1a	LV-5A, TC	MANUAL ON/SCHEDULED OFF	PROCEDURE DEVELOPMENT CLEANROOM CCR103
1-07	"LP" -1b	LV-5B, TC	MANUAL ON/SCHEDULED OFF	PROCEDURE DEVELOPMENT CLEANROOM CCR103
1-08	"LP" -3a	LV-4A, TC	MANUAL ON/SCHEDULED OFF	PROCEDURE DEVELOPMENT CLEANROOM CCR102
1-09	"LP" -3b	LV-4B, TC	MANUAL ON/SCHEDULED OFF	PROCEDURE DEVELOPMENT CLEANROOM CCR102
1-10	"LP" -9a	LV-3A, TC	MANUAL ON/SCHEDULED OFF	BVS CLEANROOM CCR101
1-11	"LP" -9b	LV-3B, TC	MANUAL ON/SCHEDULED OFF	BVS CLEANROOM CCR101
1-12	"LP" -11a	LV-6A, TC	MANUAL ON/SCHEDULED OFF	PROCEDURE DEVELOPMENT CLEANROOM CCR104
1-13	"LP" -11b	LV-6B, TC	MANUAL ON/SCHEDULED OFF	PROCEDURE DEVELOPMENT CLEANROOM CCR104
1-14	"LP" -19	LV-7A, LV-7B, TC	MANUAL ON/SCHEDULED OFF	RECEIVING INSPECTION, STORAGE
1-15	"LP" -21	LV-8A, LV-8D, TC	MANUAL ON/SCHEDULED OFF	EQUIPMENT PLATFORM
1-16	"LP" -23	LV-8B, LV-8E, TC	MANUAL ON/SCHEDULED OFF	EQUIPMENT PLATFORM
1-17	"LP" -25	LV-8C, LV-8F, TC	MANUAL ON/SCHEDULED OFF	EQUIPMENT PLATFORM
1-18	SPARE			
1-19				
1-20				
1-21				
1-22				
1-23				
1-24				

OR



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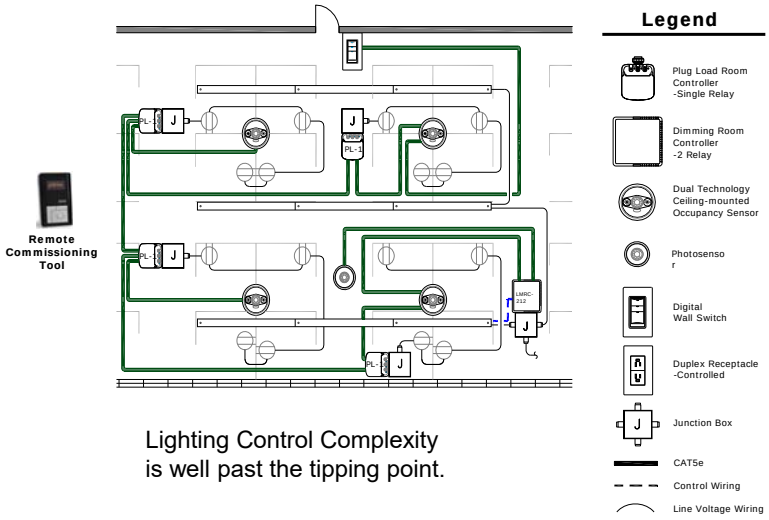
Lighting Control Now… An area of a “simple” Open Office



Lighting Control Complexity is well past the tipping point.

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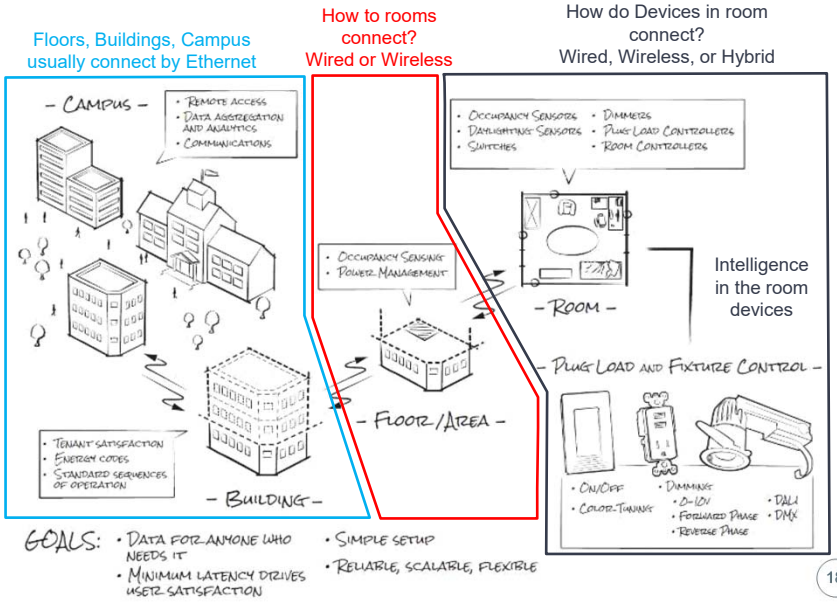
Networked Controls

- Control components in each room allow for “room to room” communication, as well as providing & receiving information from front end devices.
- Networked Controls can be either Distributed Intelligence, Central Intelligence, or a hybrid of the two.



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High Performance => Increasing Complexity

Energy Code Requirements

- Overrides
- Dimming
- Timeclocks
- Mandatory Occupancy Sensors
  - Vacancy
  - Partial On or Partial Off
- Daylighting
  - Smaller Zones, Multiple Zones
- Demand Response
- Plug Load
- Lumen Maintenance / Tuning
- Emergency Power

New Players at the Jobsite

- Owners Reps
- Commissioning Agents
- Acceptance Testers

Complex Systems

- Networking
  - Wired
  - Wireless
- Individual Fixture Control
  - Small Zones
- Power Monitoring
- Data Analytics
- Other Systems
  - Shades
  - AV & Touchscreens
  - Security Systems
- Data Security
- Integration

5. Section [15000 – Integrated Automation] Lighting Control System shall be capable of being seamlessly integrated with the Building Automation System.

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Additional Benefits?

SoO can make evident expected functionality that isn't clearly shown on other documents.

- ASHRAE/IECC and Plug Loads.
- T24: Demand Response / Partial On / Partial Off

SoO should be written so they're clear to owner and owner's representatives, allowing them to understand the intent and the impact on different groups:

- Facility Engineers
- Users / Tenants

SoO can be easily updated based on what's learned at previous sites:

- Occupancy and Daylighting Sensor Technologies
- Desire for data at the Front End
- Training of End Users

Define in SoO or Specification when a technician is needed at site:

- Pre-Install Meeting
- With Commissioning Agent or with other Tradespeople
- After Startup Training Sessions

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Sequence of Operations Formats

Descriptive or Lighting Control Narrative

2. Office: The occupancy sensor 'OS' device shall automatically turn on the lights to 50% intensity using a 1.5 second fade rate when occupancy is detected. The occupant may manually increase or decrease the lighting intensity. The lights may be manually turned off. The lights shall automatically turn off using a 5 second fade rate 10 minutes after the room becomes vacant. If occupancy is detected during the dimming period, the lights shall return to their previous intensity. A 'walk through' mode shall turn the lights off three minutes after the room is initially occupied if no motion is detected after the first 30 seconds. Initially set the PIR sensitivity to 'high'. Change the sensitivity to 'low' if false triggering is experienced. Automatic daylighting control is not required because the zone has less than 120 watts in accordance with Exception 1 to Section 130.1(d)2 of Title 24.

3. Restrooms: The occupant manually turns on the lighting using the wall box line

Sequence of Operations Formats

Parameter Schedule

Controller																				
Controller	Circuit	Line Voltage (Volts)	Load	Load Type	Operating Mode	Fade Time (Sec)	Fade Rate	Fade Trip Point Up (%)	Fade Trip Point Down (%)	High Trim Level (%)	Low Trim Level (%)	Sensor Mode	Button Mode	Blink Warn	Grace Period (Min)	Override Time Delay (Min)	Temporary Override (Sec)	Power Up Mode	Transition State	Transition Level
LMCP-48			38[R38]: Load 38	Switched	Normal Hours	2	50	1	0	100	0	Follow Off Only	On and Off	False	5	0	10	Last State	Nothing	25
					After Hours	2	50	1	0	100	0	Follow Off Only	On and Off	False	5	120	10	Last State	Relinquish	25
			39[R39]: Load 39	Switched	Normal Hours	2	50	1	0	100	0	Follow Off Only	On and Off	False	5	0	10	Last State	Nothing	25
					After Hours	2	50	1	0	100	0	Follow Off Only	On and Off	False	5	120	10	Last State	Relinquish	25
			40[R40]: Load 40	Switched	Normal Hours	2	50	1	0	100	0	Follow Off Only	On and Off	False	5	0	10	Last State	Nothing	25
					After Hours	2	50	1	0	100	0	Follow Off Only	On and Off	False	5	120	10	Last State	Relinquish	25
			41[R41]: Load 41	Switched	Normal Hours	2	50	1	0	100	0	Follow Off Only	On and Off	False	5	0	10	Last State	Nothing	25
					After Hours	2	50	1	0	100	0	Follow Off Only	On and Off	False	5	120	10	Last State	Relinquish	25

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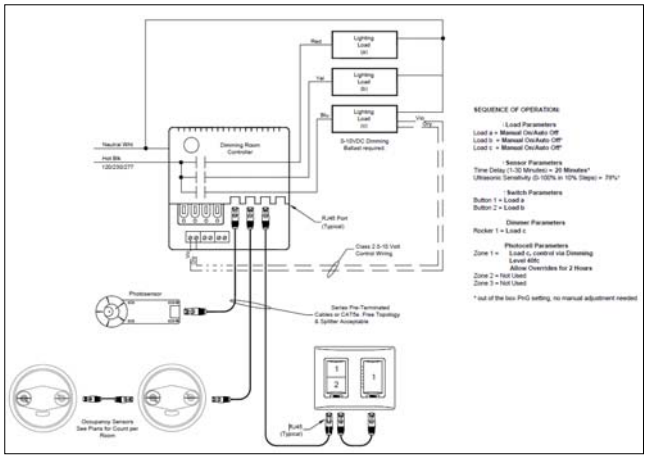
Sequence of Operations Formats

Detail with Notes (Pictorial)



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What Should be Included in a SoO?

Consider the System's **Inputs** and **Outputs**
Consider the **Codes**
Consider the **Owner Project Requirements**
And Consider **Power Outages**

Occupancy Sensors:
- Time Delay, Sensitivity

Loads:
- On/Off or Dimming
- Manual On / Automatic On / Partial On / Partial Off
- Blink Warning

Override Devices:
- Switches / Dimmers: Load Assignments
- Scenes Settings: Table for all Loads

Daylighting
- Type of Daylight Sensors
- Which Loads in Which Zones
- To Completely Off or to Minimum Level
- Overrideable?
- What FC level (assume Electric Lighting Level)

Time Clock
- Time for each Event
- After Hours Time Delay

Plug Loads
- By Time Clock or by Occupancy Sensor
- Overrides

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Format for the Future?

Learn from Others – Mechanical Divisions

- Stanford SEQ2 HVAC Sequences of Operation
  https://web.stanford.edu/class/cee243/Data/Y2E2SequenceOps

Something Similar to the IES Fixture File Format?

XML File

- Standardized Definitions
- Machine Readable
- Human Readable
- Defines what is included, not every possibility
  - Color Changing LEDs

Can be Building, Floor, Area, Room, Fixture

Allows any Energy Efficiency software to incorporate info

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