Next Generation
LIGHTING SYSTEMS

Lessons Learned from Connected Lighting Installations

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LIGHTFAIR 2018

NGLS Partners

Next Generation LIGHTING SYSTEMS

IES Illuminating ENGINEERING SOCIETY

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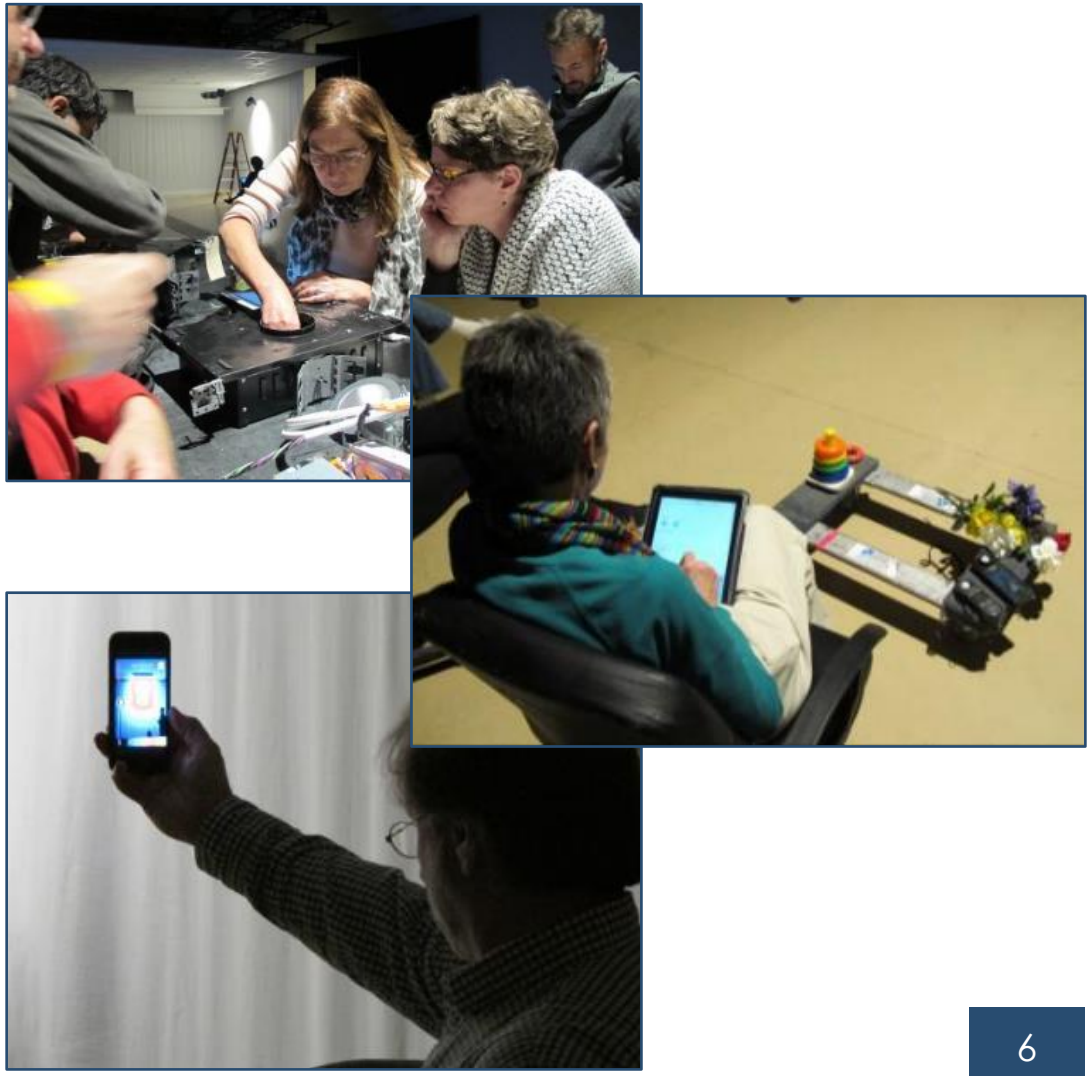
- Gabe Arnold - DLC, NLC
- Dave Bisbee - SMUD
- Peter Jacobson - Con Edison
- Levin Nock - DLC, NLC
- Michael Poplawski - PNNL/DOE
- Chris Wolgamott - NEEA

What We'll Cover Today

- NGLS Background
- Evaluation Framework
- Lessons Learned
  - System Architecture
  - Operational Complexity
  - Configuration Tools
  - Wall Controls
  - Communication
- Next Steps

NGL Background

- First competition in 2008
- 14 Steering Committee members, majority involved for 10 years
- Weekly Steering Committee calls (indoor and outdoor)
- 15 separate judging/evaluation events
- 64 different lighting professionals involved as judges
- Over 1300 products submitted by over 300 manufacturers



From NGL to NGLS

- 2008: Focus on LED luminaires of different types
- 2012: Split into separate Indoor and Outdoor Competitions
- 2015: Focus on controllability and serviceability
- 2016: Focus on specific applications and connected systems
- From **Next Generation *Luminaires***
  to **Next Generation *Lighting Systems***
- **2017: *Exclusively* Indoor Connected Lighting Systems**
- Build on 2016 experience
- Separate into levels of system complexity
- Permanent installations
- Ongoing evaluations

Leveraging What We Know

NGL Luminaire Competitions

- Subjective designer viewpoint
- Specifier manufacturer communication
- 'Staged' environments
- Difficult controls evaluations

Connected Lighting Systems Program

- Configuration Complexity
- CLTB

The Sweet Spot

GATEWAY Demonstrations

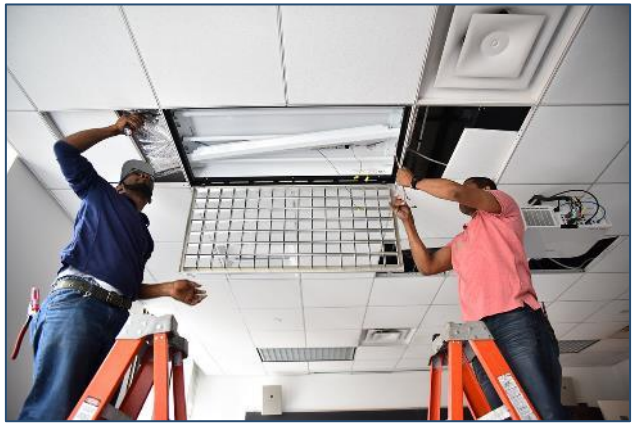
- Real sites and users
- Harsh realities become apparent
- Lessons apply to a more limited audience with similar conditions

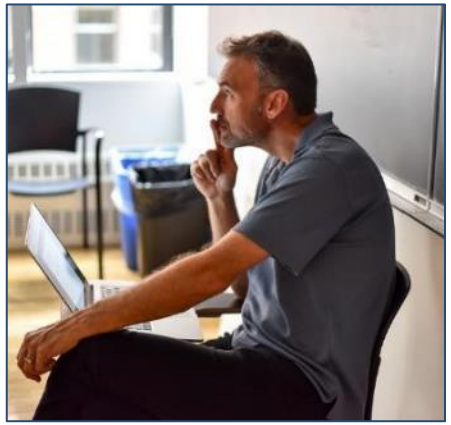
Configuration Complexity

- Complicated systems have historically under performed.
- More energy will be saved if control systems are working correctly.
- For systems to be broadly deployed, configuration complexity must be reduced.

Subjective Evaluations

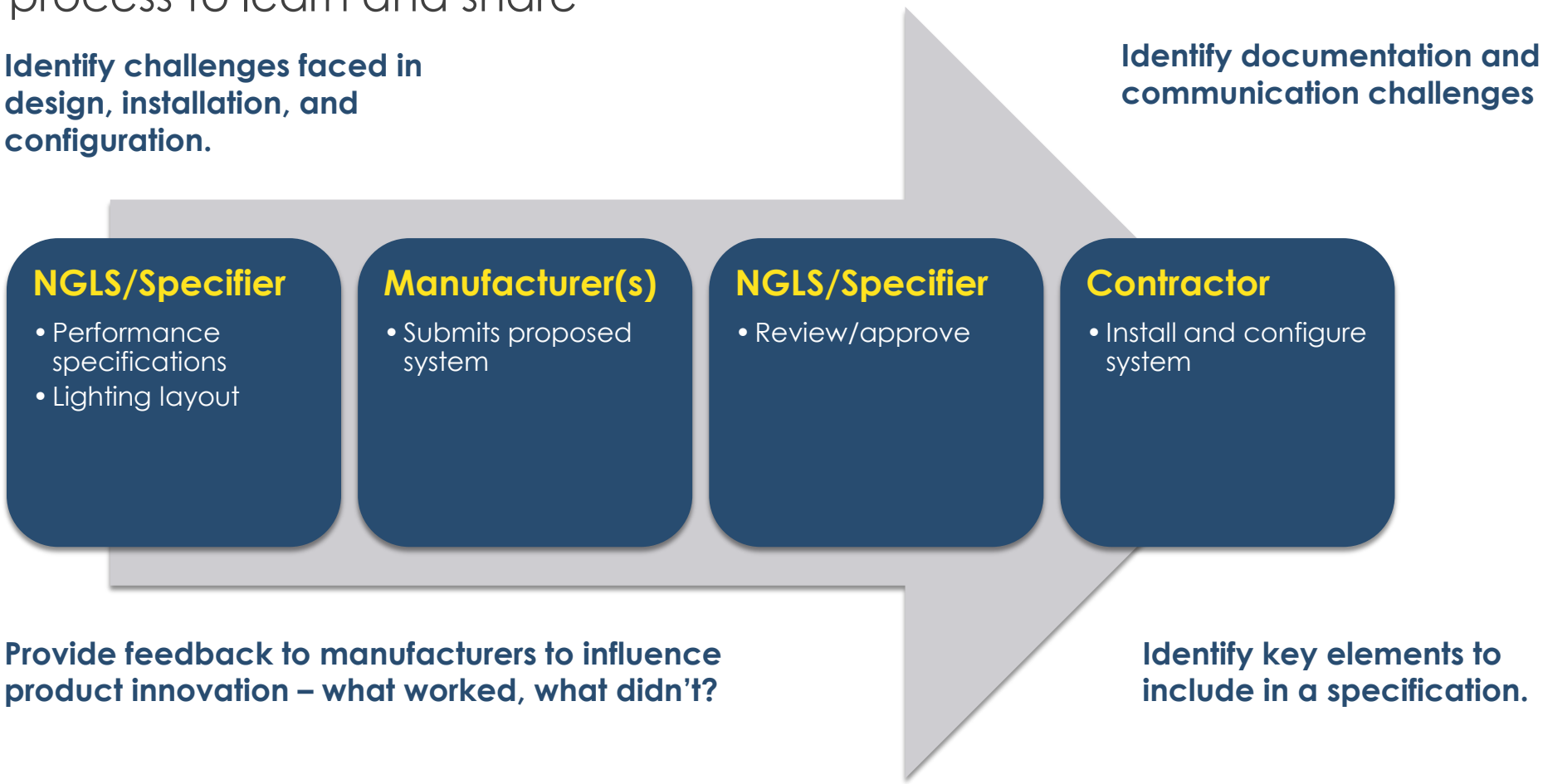
- To find the real 'pressure points', *people* need to observe and evaluate the *people* installing and configuring the system in real time, without assistance - it just can't be done in a demonstration, mock-up, or testing lab.





Design & Installation Process

- Model the process to learn and share



Living Lab

THE NEW SCHOOL
PARSONS

PARSONS
SCHOOL OF
CONSTRUCTED ENVIRONMENTS

NGLS Initial Focus

- Luminaire and control systems that are:
  - Marketed as "easy" to install and configure
  - Intended for contractor setup and configuration without prior training
  - Configurable without manufacturer assistance
  - No lighting designer involved

We had to start with the most basic systems to develop our evaluation protocols and procedures and come away with results and recommendations that are tangible and actionable.

System Requirements

	Evaluation 1	Evaluation 2
Function	Required	Required
Occupancy Sensing	Y	Y
Vacancy Sensing	Y	Y
Local on/off	Y	Y
Daylight Harvesting	Y	Y
Manual Continuous Dimming	Y	Y
High-End Trim/Task Tuning	Y	Y
Zoning	Y	Y
Luminaire Integrated Sensor and Control	preferred	Y
Field-adjustable Control Settings	preferred	Y

Control Performance Requirements

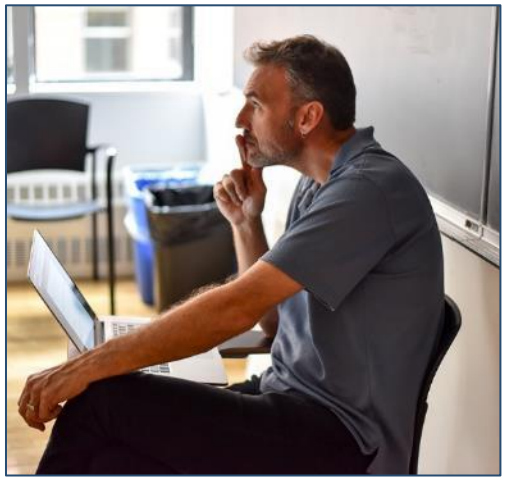
1. **Vacancy control** (manual on/auto off) of two zones with a time out period of 5 minutes.
2. **Manual continuous dimming** of the same two zones indicated in item 1. Minimum dimming level of each zone shall be ≤ 10% of lumen output.
3. **Daylight harvesting** to maintain task plane illumination at the current level provided by the electric lighting (whether full output, task-tuned, or manual dimmed).
4. **Field-adjustable high-end trim** to lower maximum system light output. System shall be delivered with high-end trim set at 100%.
5. Control settings shall be adjustable by the user **without factory assistance**.

Installation Evaluation Process

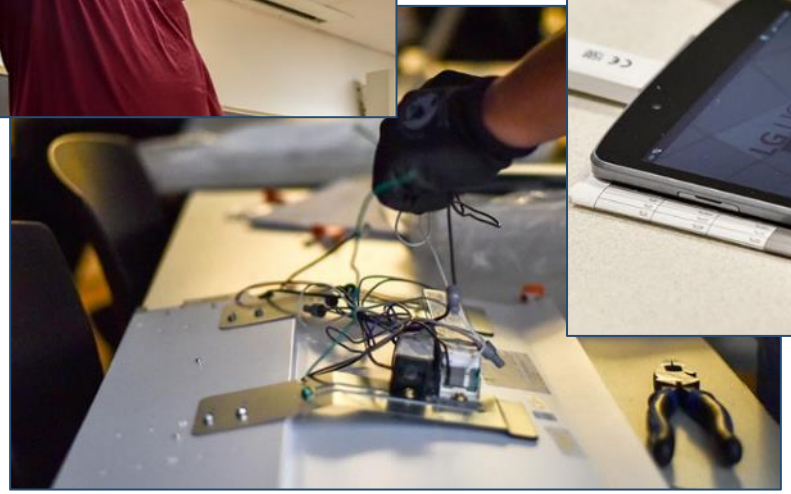
- Three evaluation phases
  - Install luminaires
  - Install and start up controls
  - Adjust control settings
- After each phase, contractor and NGLS judges independently evaluate:
  - Manufacturer's documents
  - Ease/difficulty
  - Strengths and weaknesses
- Conclude with videotaped contractor interviews

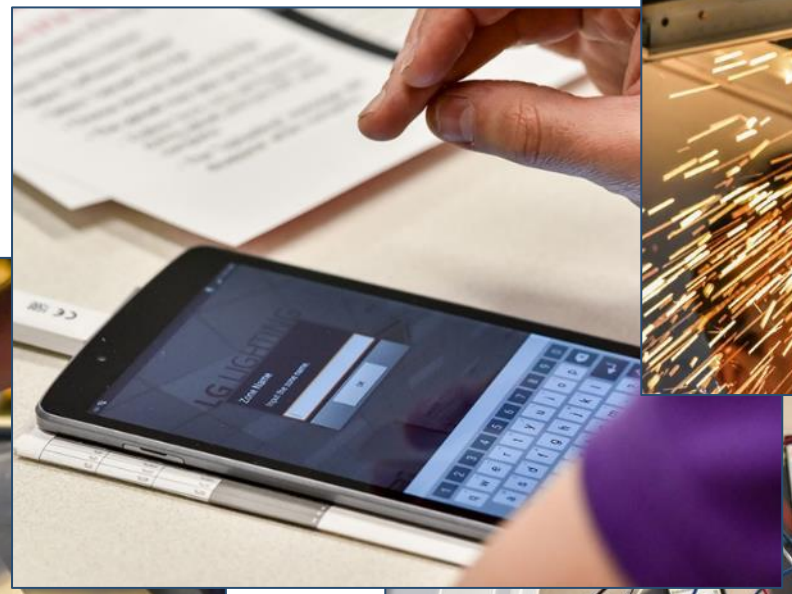
Performance Evaluation Process

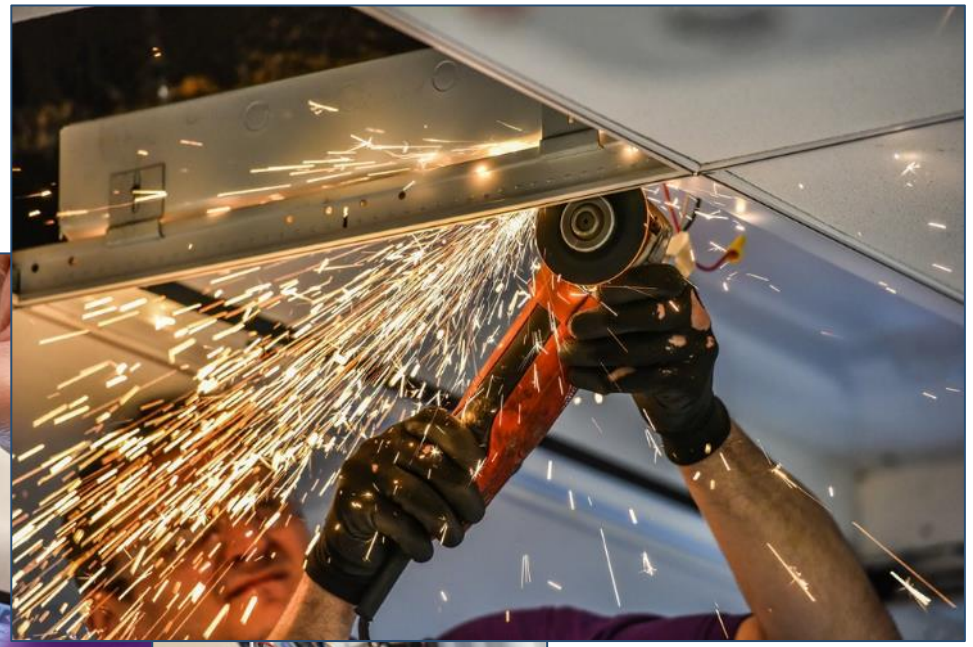
- Lighting Performance
  - Lighting effects, luminaire construction and appearance
  - Measured performance (illuminance, CCT, luminance, etc.)
- Control System Performance
  - Ease of use
  - Measured performance

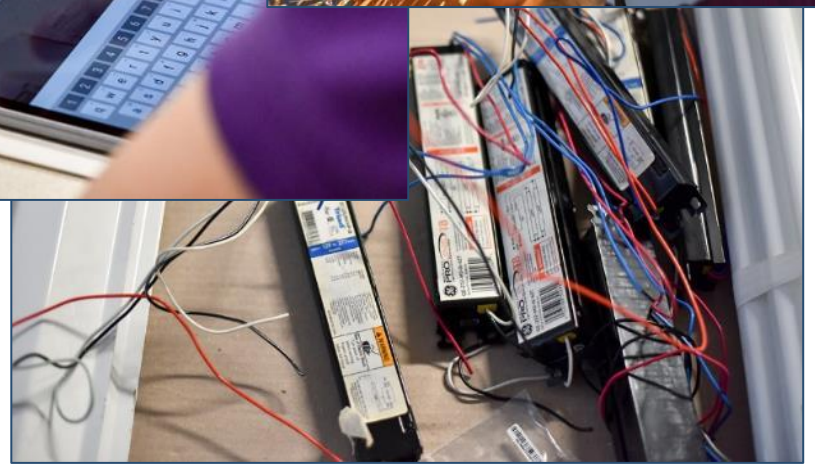


Evaluation Two – Retrofit Kits









Participating Manufacturers

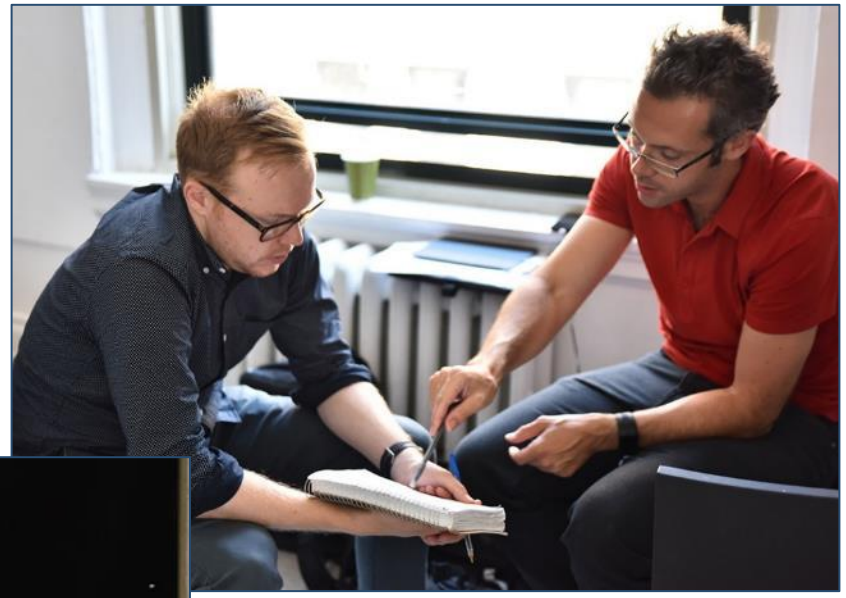
Competition One

Company	Control System	Luminaire
Lumenwerx	Magnum	Reven SIB
Selux	Easy Sense	M36 D-1
Crestron	Zum	Starfire Versalux D-I
Philips Lighting	SpaceWise DT	Sona
RAB Lighting	RAB LightCloud	Swish 2x2
Cree	SmartCast	CR22
Nextek Power Systems	Sky Control	Independence iLED R Series

Competition Two

Company	Control System	Retrofit Kit
Philips Lighting	SpaceWise DT	EvoKit Troffer Retrofit Kit
Lutron Electronics	Vive	Orion Ison Retrofit Modular
Acuity Brands	nLIGHT AIR	BLT Relight Series Kit
Eaton	WaveLinx	Metalux Cruze LED Retrofit Kit
LG Electronics	Sensor Connect	Simple Choice Retrofit Kit

Onsite Manufacturer Participation



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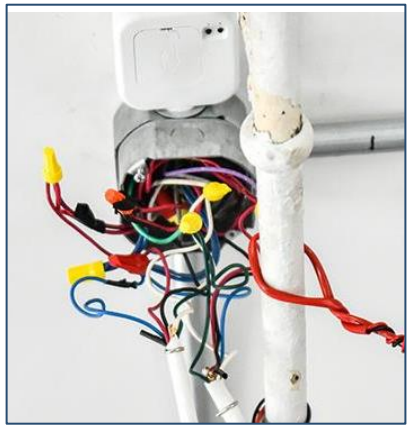
SYSTEM ARCHITECTURE

System Architecture

	Least Complex (7)	Moderately Complex (2)	Most Complex (3)
Components	✓ Luminaire-integrated sensor and control ✓ Wall switch	✓ Luminaire-integrated sensor and control ✓ Wall switch ✓ Local area network device	✓ Remote mounted sensor and control ✓ Wall switch
Connection	✓ Wireless	✓ Wireless	✓ Wired ✓ Wireless ✓ PoE



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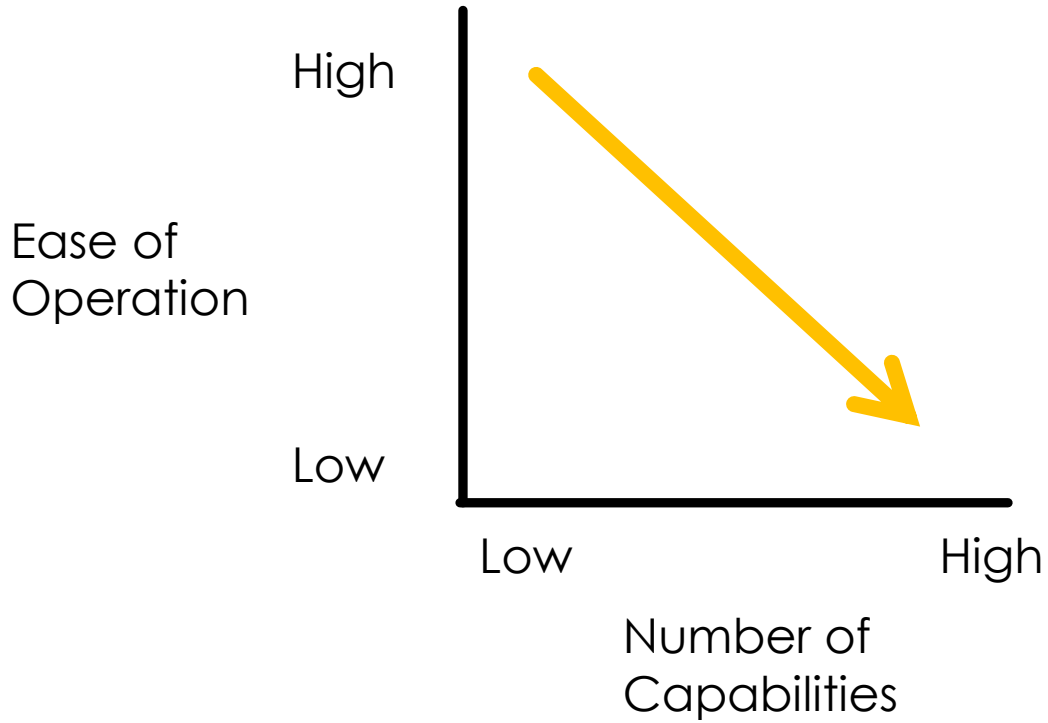
OPERATIONAL COMPLEXITY

Initial Startup Approach

• Pre-configured out-of-the box operation	• Onsite pairing of luminaires to wall switches • Factory-set default operational settings	• Onsite pairing of luminaires to wall switches • Various additional steps • Factory-set default operational settings	• Onsite pairing of luminaires to wall switches • Onsite configuration of external daylighting and occupancy sensors
(2)	(5)	(3)	(2)

Operational Complexity

- Clear relationship between system capabilities and ease of operation;



Need appropriate balance between simplicity and functionality for each application!

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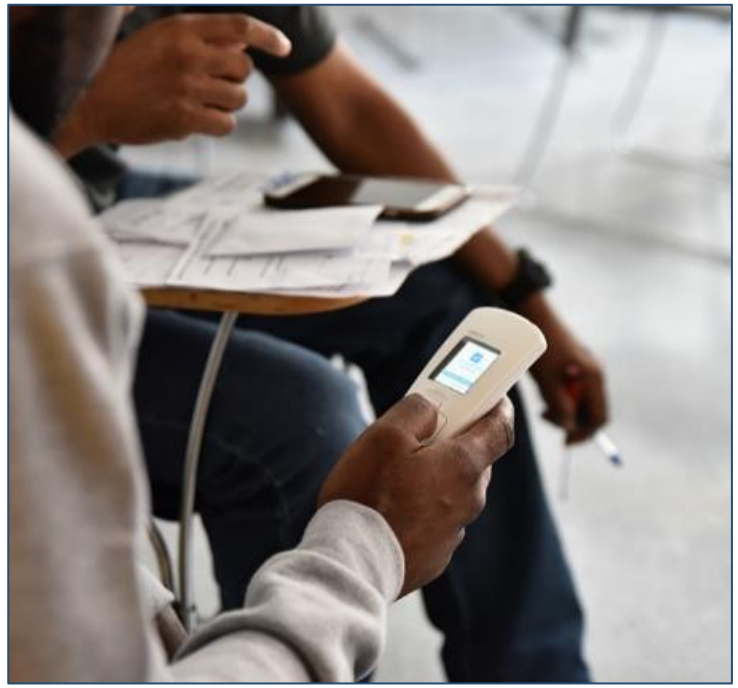
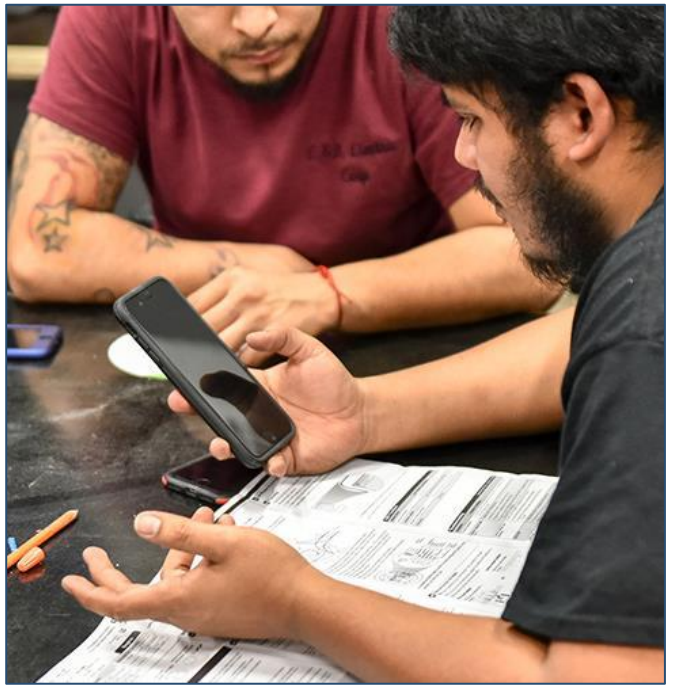
CONFIGURATION TOOLS

Configuration Tool Categories



Handheld Tool
(1)



Phone App
(8)

Computer Front-end
(3)

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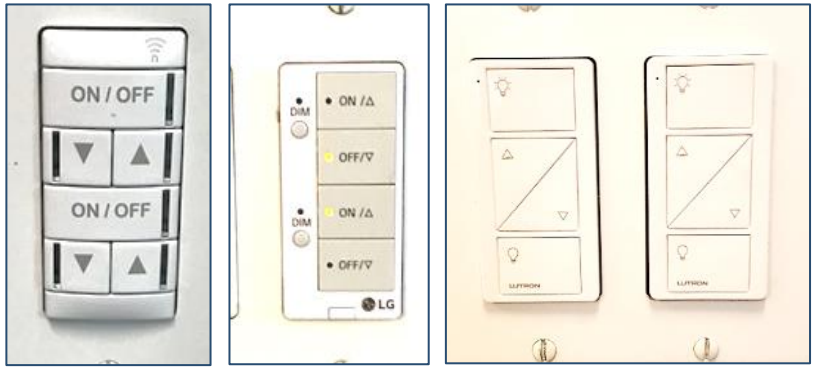
WALL CONTROLS

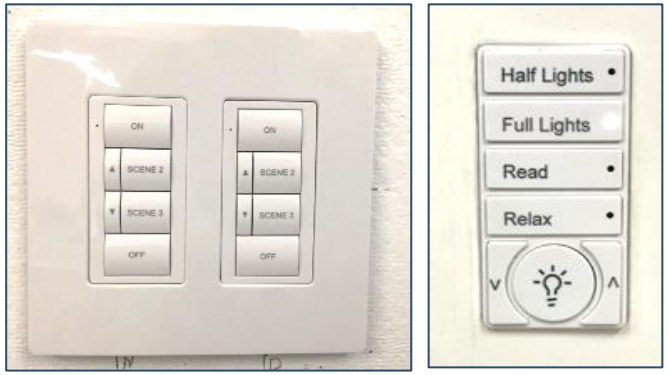
Wall Control Categories

Pre-configured Rocker Switch
(4)



Pre-configured Multi Button Switch
(3)

Site Configurable Rocker Switch
(2)



Site Configurable Multi Button Switch
(2)

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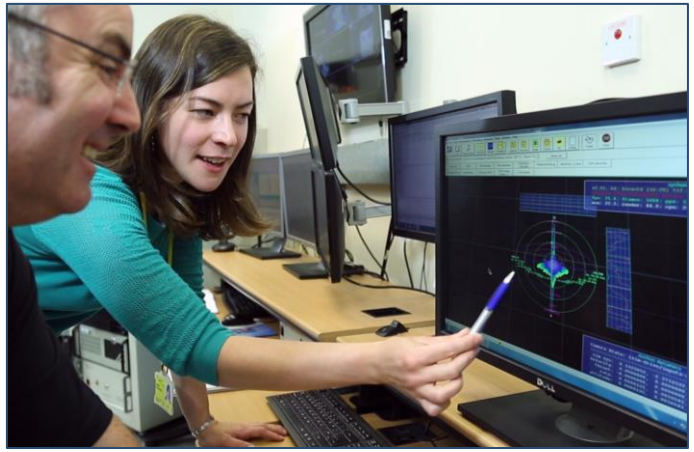
COMMUNICATION

The single biggest problem in communication is the illusion that it has taken place.

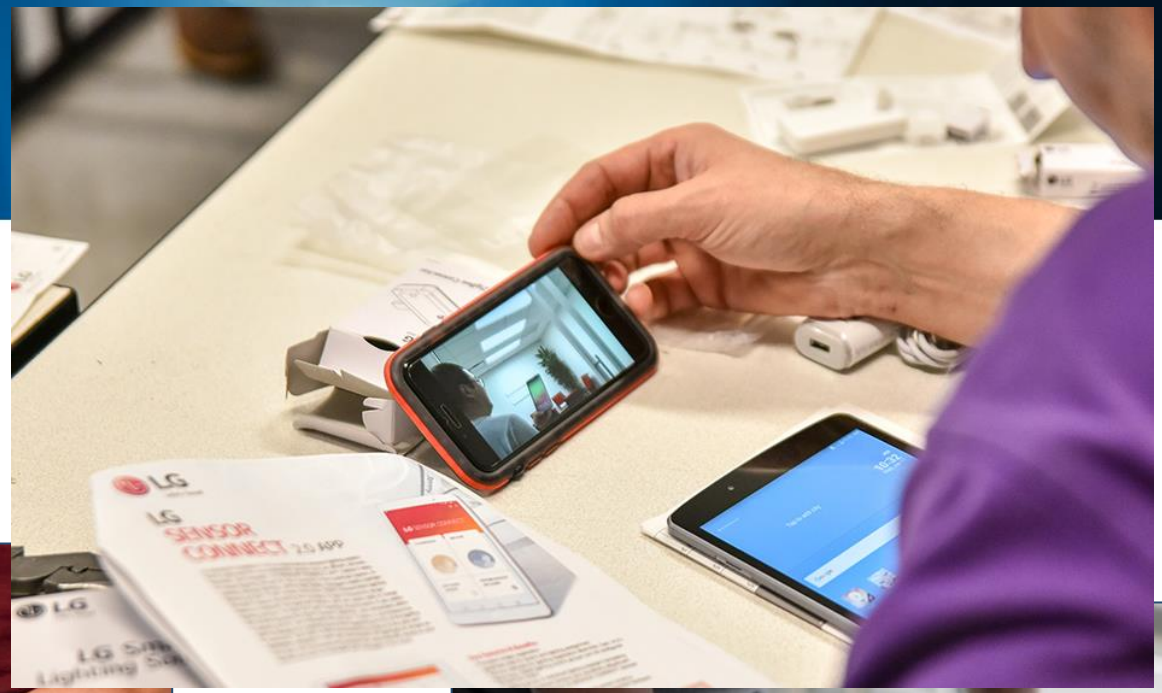
George Bernard Shaw

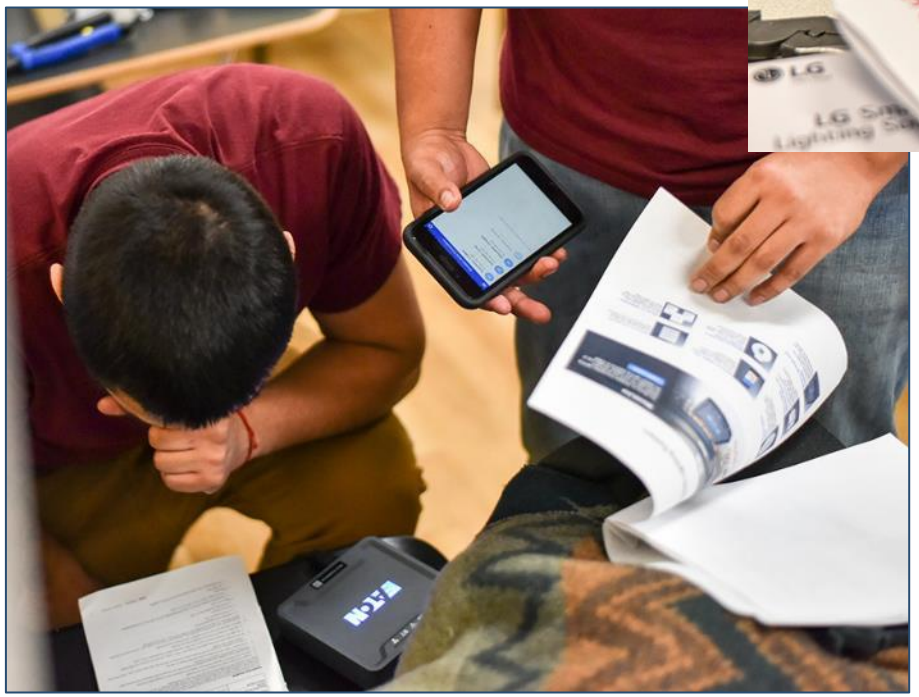
Vocabulary

- We all speak a different language
  - Designers
  - Product & IT Engineers
  - Contractors



Documentation





How We Plan to Release Findings

- Conference presentations
- Feature articles in target publications
- NGLS website
- One pagers by topic and audience

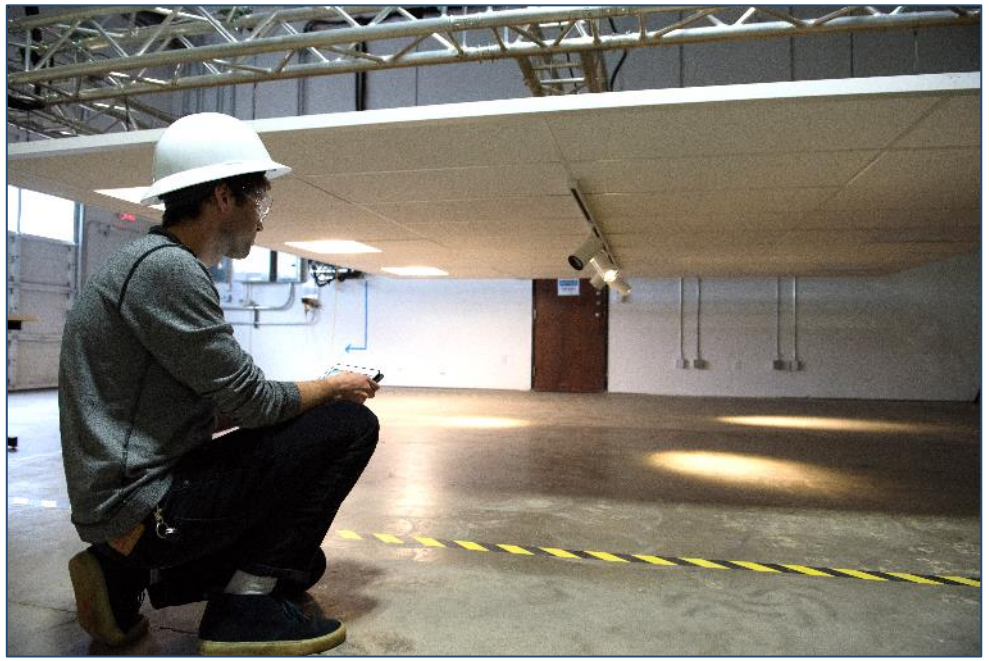
ACEEE
American Council for an Energy-Efficient Economy

LEDucation

LD+A
The magazine of the Illuminating Engineering Society of North America

Next Steps

- If there is consensus that things should be done the same way – work on standards
- If there are multiple ways to do things – work on templates or models
- If there is no consensus – conduct more studies to figure it out



2018 Outdoor Evaluations

- Virginia Tech Transportation Institute
- VTOLL – Virginia Tech Outdoor Living Lab - collaboration with other VT activities
- Parking garage/lot connected lighting focus – informs other applications
- Coordination with DOE Connected Lighting Test Bed in Portland

Thanks!
Questions?