Getting Ready for Intelligent Building Capabilities
*People, Processes, and Technology*

Greg Sachs, B.S., Building Automation and Data Systems Coordinator, Eastern Mennonite University
Joseph Bocchiaro III, Ph.D., CStd, CTS-D, CTS-I, ISF-C, Principal Consultant, The Sextant Group

March 13, 2019
Why Do This?
• **Altruism/Aspiration**
  - Climate Change, Sustainability
  - Institutional/Organizational
  - Faith-Based Beliefs

• **Mandate: Institution, Government**
  - Organization Guidelines (CSO)
  - Supplement to Codes and Guidelines
    - LEED
    - GreenGlobes
    - IgCC
    - VEEES

• **Financial**
  - Operational Efficiency
  - Return on Investment (ROI)
  - Stimulus Package
  - Future-Proofing: Infrastructure Investment

.........may be all of the above
What’s on the Horizon?
The Internet of Things (IoT) and the Student Experience

DATA CONNECTIVITY
- Alexa
- Cloud-based
- Artificial Intelligence
- Big Data Collection/Analysis

CONVEYANCE
-桂urated Sleep/Scheduled
- Elevators
- Passive Ramps

BUILDINGS
- Energy Consumption
- Carbon Footprints
- Water Conservation

“SMART” BUILDINGS
- Individual Personalization
- Smart Desk
- Occupancy Optimization
- Lighting/Building
- HVAC

LEARNING TRANSFORMATION
- Self-Paced
- Efficiency
- Asynchronous
- Experiential
- Virtual/Extended Collaboration
- Scaffolding Assessment

SOCIAL MEDIA
- Connectivity
- Relationships
- Interdisciplinary
- Authentic

SUSTAINABILITY PARTICIPATION
- OOs: Occupant Commodities
- Awareness
- Optimization

WELLNESS & FITNESS
- Heart Rate
- Blood Pressure
- Blood Oxygen
- Appropriate Exercise
- Artificial Intelligence

APPAREL
- Style
- Indoor
- Outdoor
- Wearable
- Touchscreen
- Smart Codes

MACHINE INTERFACES
- Wearables
- Sensors
- Emotions
- Intentions

SAFETY
- Alerts
- Context
- Emergency Call
- Surveillance

THE MEDIA
- Awareness
- Openness
- Empathy

NUTRITION
- Dietary Monitoring
- Recipes
- Ingredients
- Healthy Eating
- Knowledge

TRANSPORTATION
- Autonomous Vehicles
- Ride Sharing
The Internet of Things in Buildings

Memoori, 2018
What’s an Intelligent Building?
The Smart Building Hierarchy

IBT Task Force 2008-2010

High Performance "Smart" Building

- Business Solutions
- Interconnected Management Applications with Building Systems

High Performance "Integrated" Building

- Building Systems Share Data
- Building Systems Tied to Occupant Calendar
- Unified Sequence of Operations based upon Occupancy
- Energy Use Capture and Reporting
- Building Dashboard
- Demand Response

High Performance "LEED" Building

- Building Systems Work Independently
- Building Systems Commissioned and Optimized
  - Separate Sequence of Operation for each System
  - Occupant Calendar Data Not Utilized for Automation
  - Limited or No Energy Use Monitoring
  - No Tools for Continual Commissioning

Standard Building

- Building Systems Work Independently
  - Building Systems NOT Commissioned or Optimized
  - Limited or no Building-Wide Control of any System
  - Systems NOT designed for energy efficiency
The BICSI Intelligent Building Roadmap

Intelligent Buildings

Initiatives
- Social
- Sustainable
- Purpose

Experience
- Comfort
- Safety
- Security
- Efficiency

Connected Building Systems
- Fire Systems
- AV Systems
- BMS/BAS
- Security
- Elevators
- Wayfinding
- Visitor Info
- Access Control
- Lighting
- Plumbing
- HVAC
- Electrical
- Facilities + IT

Define - Design - Deliver

System Integration - Functionality
<table>
<thead>
<tr>
<th>Systems and Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Access Control</td>
</tr>
<tr>
<td>• Acoustics - Physically Adjustable</td>
</tr>
<tr>
<td>• Asset Tracking</td>
</tr>
<tr>
<td>• Audiovisual Systems</td>
</tr>
<tr>
<td>• Background Music System (BGM)</td>
</tr>
<tr>
<td>• Building Management/Automation BMS/BAS</td>
</tr>
<tr>
<td>• Broadcast</td>
</tr>
<tr>
<td>• Cellular Reinforcement</td>
</tr>
<tr>
<td>• Closed Circuit TV (CCTV)</td>
</tr>
<tr>
<td>• Data Network</td>
</tr>
<tr>
<td>• Digital Signage Distributed Antenna Systems (DAS)</td>
</tr>
<tr>
<td>• Electronic Concierge Services</td>
</tr>
<tr>
<td>• Electronic Medical Record Systems</td>
</tr>
<tr>
<td>• Environmental Sensors and Alarms</td>
</tr>
<tr>
<td>• Fire/Life Safety</td>
</tr>
<tr>
<td>• Guest Services</td>
</tr>
<tr>
<td>• Hearing Impaired/Interpreter Systems</td>
</tr>
<tr>
<td>• HVAC Systems</td>
</tr>
<tr>
<td>• Integrated Control Interface</td>
</tr>
<tr>
<td>• Integrated Operating Room Systems Intercom Systems</td>
</tr>
<tr>
<td>• Intrusion Detection System – Physical</td>
</tr>
<tr>
<td>• Kiosks</td>
</tr>
<tr>
<td>• Lighting Control</td>
</tr>
<tr>
<td>• Mass Notification</td>
</tr>
<tr>
<td>• MATV/CATV/DSS Systems</td>
</tr>
<tr>
<td>• Motorized Shades</td>
</tr>
<tr>
<td>• Multimedia Systems</td>
</tr>
<tr>
<td>• Nurse Call System</td>
</tr>
<tr>
<td>• Occupant Tracking</td>
</tr>
<tr>
<td>• Paging Systems</td>
</tr>
<tr>
<td>• Parking Management System</td>
</tr>
<tr>
<td>• Patient Entertainment / Education Systems</td>
</tr>
<tr>
<td>• Point-of-Sale Systems (POS)</td>
</tr>
<tr>
<td>• Property Management Systems (PMS)</td>
</tr>
<tr>
<td>• Radio Communication Systems</td>
</tr>
<tr>
<td>• Real-time Transcription Systems</td>
</tr>
<tr>
<td>• Robotic Delivery Systems</td>
</tr>
<tr>
<td>• Room Scheduling Systems</td>
</tr>
<tr>
<td>• SCADA/PLC</td>
</tr>
<tr>
<td>• SmartBoard Systems</td>
</tr>
<tr>
<td>• Sound Masking Systems</td>
</tr>
<tr>
<td>• Structured Cabling System</td>
</tr>
<tr>
<td>• Sub-metering Systems</td>
</tr>
<tr>
<td>• Valet Services</td>
</tr>
<tr>
<td>• Visitor Management System</td>
</tr>
<tr>
<td>• Way Finding</td>
</tr>
</tbody>
</table>
SILOED SYSTEMS AT EMU

- BAS
- Room Scheduling
- Student Information System
- Access Control
- Video Surveillance
- Energy Monitoring
- Energy Dashboard
- Email/SMS Notification
- Radio Notification
- Website Notification

Diagram showing interactions between systems.
Open IOT Platform

- Data Visualization
- Building Automation Devices
- Video/Audio Surveillance
- Emergency Notification Systems
- Room Scheduling Data
- Access Control Devices
- Student Information System Data
Who’s in Charge?
Stakeholder Criteria → Value Engineering → Compromise
How Do We Do It?
Design,
Coordination,
Commissioning

CSI Division 25
Specification,
Products,
Functionality

Integration,
Maintenance

- ISA-111: Unified Automation for Buildings
- Enterprise Internet-of-Things (E-IoT) Open Standards
- Master Systems Integrator (MSI) Scope-of-Work?
- Future Standards
• Converged Systems: each technology is on the network: PoE Lighting, Audiovisual, Security, etc.
• Zone Cabling/HCP: Horizontal Connection Points
• Data Closet sizing: IBT components within
• Pathway Sizing/Capacity Calculations
• Shared sensors
• Yet-to-be developed technologies
• Performance and interactions of smart building systems (SBS)
• Impact of smart building systems on the total building performance
• Methods for achieving more intelligent control and operation of building processes
• Four application-focused subcommittees:
  – Building operation dynamics
  – Fault detection and diagnostics
  – Enabling technologies
  – Building/utility interface
Sequences of Operations and Measurement and Verification

– Provide a complete and coordinated written sequence of operations for all controlled mechanical, electrical, lighting, plumbing, and low voltage systems. Coordinate sequences and control diagrams with all parties as needed for implementation and testing. Include control drawings and points lists for all controlled sequences.

– In addition to sequences of operations, provide algorithms of optimization and a measurement and verification plan for all energy using systems. Submit Measurement and Verification plan at Design Development. Update the plan in Construction Documents. Measurement and Verification plan covers the whole building and subsystems, defining ongoing metrics and acceptable ranges for fault detection.
00600 C  CONDENSER CHILL WATER PUMP VFD
00610 IF("LAHCHCSIG" .EQ. ON) THEN GOTO 620 ELSE GOTO 690
00620 ON("LAHCWPMP")
00630 "LAHCTTO" = "LAHCTRT" - "LAHCTST"
00640 C LAHCTTO is not a good reference when starting up hot GGS 6/29/2017 LOOP(0,"LAHCTTO","LAHCTLP1","LAHCTDIFF",1000,100,0,1,50,0,100,0)
00650 TABLE("LAHCTFANLP1","LAHCWPMPSPD",5,60,95,85)
00660 C
00670 C SET(100.0,"LAHCWPMPSPD")
00680 GOTO 750
00690 SET(0.0,"LAHCWPMPSPD")
00700 OFF("LAHCWPMP")
00710 C
00720 C
00730 C  SSC CHILL WATER PUMP VFD
00740 C
00750 MAX("LBCWLP1","SSC.MA1.CCOLB","SSC.MA2.CCOLB")
00760 SAMPLE(30) IF("LAHCHON2V" .EQ. ON .OR. "SSC.MA1.CNDPLB" .EQ. ON .OR. "SSC.MA2.CNDPLB" .EQ. ON) THEN ON("LBSSCCWPMP") ELSE OFF("LBSSCCWPMP")
00770 IF("LBSSCCWPMP" .EQ. ON) THEN GOTO 780 ELSE GOTO 850
00780 "LBCWTO" = "LBCWRT" - "LBCWST"
00790 C replaced with 00750, let SSC MA valve positions determine pump speed GGS 6/13/2017 LOOP(0,"LBCWTO","LBCWL1","LBCWDIFF",1000,100,0,1,50,0,100,0)
00800 TABLE("LBCWLP1","LBSSCCWPMPSPD",5,60,95,80)
00830 GOTO 900
Who Will Do The Work?
COLLABORATION BETWEEN FM AND IT

- Construction Planning
- Electrical
- Security
- Mechanical
- IT:
  - Structured Cabling
  - Surveillance
  - Equipment Cooling Requirements
Where do the ideas come from?
Is There an Even Bigger Picture?
The College and University Presidents’ Climate Leadership Commitments
“If we are clever and apply ourselves to the study and design of new sustainable business practices and technologies, sustainable development is both feasible and affordable. Indeed, it is business as usual that eventually would impose the truly devastating costs.”

*The Age of Sustainable Development*

-Jeffrey D. Sachs
3.2 Kondratiev waves

Will/Can People Adapt?
• Public/Occupants
  • Expectations
  • Demand?
  • Accountability?
  • Demand Response, Smart Grid

• A/E/C Community
  • Unified Strategy
  • Clear Responsibilities
  • Trust and Cooperation
  • Cybersecurity

• Occupants
  • Dashboards, Participation
  • Automaxpectations?
  • Big Data Willingness?
  • OCx: Occupant Commissioning
Post-Occupancy: Academic and Operations

- Occupant Commissioning (OCx)
  - Education
  - Personal Data Permissions
  - Information Display
  - Cooperation, Involvement
- Application Development
- Systems Monitoring
- Building Data Analytics
- Iterative Improvements
- Building Automation
What does this look like?
CISCO Digital Ceiling

- Networking: Smart IoT devices and sensors with Cisco PoE
- Lighting: IP-connected (light) endpoints (Phillips)
- Physical Security
- Air handling
- Labor Disruption: Low Voltage Systems
Potential Sensors

- Beacons: NFC feature on smartphones (Near-Field Communications)
- Microphones (level and frequency distribution only)
- Cameras (facial expressions and occupancy counts only)
- Photo Radiometer
- Proximity, Motion
- Brainwave States scanner
- CO and CO2
- Weather
- Vibration
- Others?
The Future
Big Changes to the Status Quo!

– Relationship of Sustainability Consultants scope to Smart Building Consultants scope
– Designing/Specifying Smart Buildings: new and emerging tools and standards
– Systems integration of smart buildings: challenges with Construction Administration/Contractors/Facilities
– Role of the architect in driving smart building initiatives
5G brings three new aspects to cellular communications:

- Greater speed (to move more data)
- Lower latency (to be more responsive)
- Ability to connect a lot more devices at once (for sensors and smart devices)
Artificial Intelligence: Machine Learning
Discussion and Ideation!

www.thesextantgroup.com