SMART Buildings: How sensor and information technologies are transforming the built environment

G. Sandy Diehl
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NFPA Research Foundation Annual Conference
Current Reality

Now that smart buildings are leaving the realm of proprietary solutions and moving to a more open architected, interoperable, integrated, IP-centric platform, the need to design the correct network architecture is critical.

This webinar will address issues such as: network design, application segmentation, cable/fiber infrastructure, wireless systems, security, remote access, device connectivity, data normalization, integration strategies, redundancy and other network infrastructure related issues.
Enterprise-Wide Energy Management

Portland Office
- 242,200 kWh
- 1,200 MMBtu
- 1,499,000 gallons
- 105 tons
- 144,000 miles

Rapid City Campus
- 682,403 kWh
- 2,108 MMBtu
- 7,166,667 gallons
- 119 tons
- 240,000 miles

Cedar City Plant
- 496,293 kWh
- 1,159 MMBtu
- 14,333,000 gallons
- 133 tons
- 260,000 miles

Oklahoma City Headquarters
- 620,367 kWh
- 1,265 MMBtu
- 7,883,333 gallons
- 159 tons
- 180,000 miles

Indianapolis Facility
- 558,330 kWh
- 949 MMBtu
- 5,731,000 gallons
- 172 tons
- 200,000 miles

St. Petersburg Office
- 670,332 kWh
- 740 MMBtu
- 8,483,000 gallons
- 244 tons
- 280,000 miles

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Integrated Building System

Electrical Grid
- Meter
- Building Mgmt System
  - Demand Response
- ON-SITE GENERATION

Information Grid
- Router
- HVAC
- LIGHTS
- MECH
- FIRE
- VIDEO
- ACCESS
- ELECTRIC
- ELEVATORS
- IT EQUIP
- FACADE
# Building Controls

## From
- Consulting engineers are the key influencer in purchase decision
- Hardware
- Controls purchased as discrete components (associated with underlying equipment)
- Dedicated Wiring
- Value is in the systems (e.g., HVAC)

## To
- Owners play an integral role in BMS vendor selection
- Software
- Increasing integration of controls de-linked from underlying equipment
- Networked Backbones
- Value is in the controls

### Quotes
- "I care about 2 things – the façade and the BMS.”
  - Building owner
- "I want my BMS to talk to all my systems regardless of brand I choose for each of the key functions"
  - Facilities manager
- "Our control systems have enabled us to become much smarter about how we run our systems"
  - Facilities manager
“i-Building” Concept
Numerous new building user services can be imagined...
Fire Detection and Response

Customer benefits: Reduced damage, minimize tenant disruption, reduce exposure, ability to enforce policies and procedures, audit trail

Integration: Fire panel, Security CCTV, HVAC, BMS, e-mail, enterprise reporting

1. Fire
2. Alarm Activated
3. Text message and automated phone messages sent to emergency response team.
4. Security cameras automatically pan to the fire location.
5. On confirmation of fire, emergency services are contacted.
6. HVAC system set to vent smoke
7. Power in fire location is disconnected
8. Further access to the building is prevented
Early Smoke Detection and Response

Customer benefits: Minimize tenant disruption, reduce exposure, ability to enforce policies and procedures, automated audit trail

Integration: Security CCTV, Fire panel, HVAC, BMS, e-mail, enterprise reporting

Security camera using video analytics detects smoke in the building's auditorium.

An alert is generated causing the centralized monitoring service to assess the situation.

Central command - control integrates information from multiple sources on to one display to enable quick decision making.

Central monitoring operator confirms the event and initiates a local, emergency response.

An alert is triggered to evacuate the local area.

HVAC is set to vent smoke and local power is disconnected.

Problem is able to be resolved without needing to escalate the response and involve emergency services.

Local response team follows automated standard operating procedures to permit the affected area to be reoccupied.

Automated audit report generated.
JCI’s Panoptix Application Suite

- EnCenter - Analytics for Submetering
  - T4G
- Enterprise Services Manager
  - Johnson Controls
- Tenant Bill Generator
  - Johnson Controls
- Energy Efficiency Tracker
  - Johnson Controls
- Total Energy ERP
  - EnergyPoints
- Remote Building Analytics
  - FirstFuel
- Portfolio Manager by BuiltSpace
  - BuiltSpace
- Proteus MMX Asset Manager Free Edition
  - Eagle Technology
- Proteus MMX Asset Manager
  - Eagle Technology
- Predictive Energy Optimization by BuildingIQ
  - BuildingIQ
- Building Dashboard Network
  - Lucid
- Building Dashboard Kiosk
  - Lucid
Purchasers and Users

Total respondents surveyed
N = 1273
- China: 14%
- India: 8%
- US: 79%

Respondents with integrated controls
N = 385
- China: 35%
- India: 15%
- US: 50%

Topics covered in survey

Respondent background
- Geography
- Company, position, and industry
- Role in purchasing or using controls
- Building characteristics

Type of controls system
- Brands used
- Integrated vs. standalone
- Functions controlled
- Capabilities available

Purchasing process (buyers only)
- Decision-makers and influencers involved
- Functions and capabilities offered
- Reason for purchasing
- Customer satisfaction

Day-to-day use (users only)
- Frequency of use
- Operating savings realized
- Customer satisfaction

Prevalence of Integrated Controls

% of customers with controls systems

<table>
<thead>
<tr>
<th>All respondents</th>
<th>% of customers with controls systems</th>
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<tbody>
<tr>
<td>N = 127</td>
<td>Centralized controls: 38%</td>
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<tr>
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<td>No Centralized controls: 62%</td>
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% of controls customers with integrated controls

<table>
<thead>
<tr>
<th>% of controls customers with integrated controls</th>
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<tbody>
<tr>
<td>Single function: 21%</td>
</tr>
<tr>
<td>Integrated across functions: 73%</td>
</tr>
<tr>
<td>Not integrated, option to integrate exists: 6%</td>
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</table>


1 Defined as BMSs that allow users to view and control multiple functions from the same application
2 Defined as BMSs that are not integrated but that give users the options of doing so—e.g., JCI Metasys software that is only being used for HVAC

US

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<th>N = 100</th>
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India

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China

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New vs. Retrofit

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<th>HVAC</th>
<th>Lighting/energy mgmt</th>
<th>Fire/security</th>
<th>United States</th>
<th>India</th>
<th>China</th>
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<td>Single function only</td>
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- HVAC: Heating, Ventilation, and Air Conditioning
- Lighting/energy mgmt: Lighting and Energy Management
- Fire/security: Fire and Security
## 6 Emerging Trends

<table>
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<tr>
<th></th>
<th>Emerging Trends</th>
<th>Implication</th>
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<tbody>
<tr>
<td>1</td>
<td>Increased pressure on building operating costs</td>
<td>Customer need for single “platform” that enables control room consolidation and increased control over energy users</td>
</tr>
<tr>
<td>2</td>
<td>Key players going to market with standard integrated offering</td>
<td>Integrated systems are becoming “industry norm” (especially in developing markets)</td>
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<tr>
<td>3</td>
<td>Strong demand for integration in emerging markets</td>
<td>80% of building controls sold in China/India will involve integration across 2 or more functions</td>
</tr>
<tr>
<td>4</td>
<td>Increasing growth of advanced lighting controls</td>
<td>Advanced lighting controls becoming increasingly attractive market</td>
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<tr>
<td>5</td>
<td>Need to communicate with closed protocols in retrofits</td>
<td>Large market potential for integrated solutions (e.g. Tridium)</td>
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<tr>
<td>6</td>
<td>Increased access to data creating new markets</td>
<td>Advanced capabilities (e.g. demand response) critical going forward</td>
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</table>
Voice of Customer Summary

Key findings

The area of *Situational Awareness* has very high attention and importance

Pervasive interest in sustainability by large customers

Customers want mobile and scalable solutions that can be easily updated

Product must be open architecture

Multi-vendor solutions will be favored (vs. one integrated system)

Growing awareness of network and BAS convergence
Challenges

- Silos within building industry
- Customer ROI expectations
- Customer bandwidth
- Retrofits are difficult
- Codes
- Data overload