Intelligent Building Processes for Intelligent Buildings

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OSCRE Workgroup Program Manager
Chair, National Building Information Model Standard
Intelligent Building Concepts

Intelligent Design & Construction Concepts

A SMART Proposal
Corporate Real Estate is about creating an efficient, productive workplace that supports business units.

Commercial Real Property is about creating an asset with superior value in the marketplace. Goals are to generate revenue with a minimum of costs and attract and retain tenants.
Buildings Stuffed With Technology?

Paul Ehrlich, Building Intelligence Group, LLC
“Use of technology and process to create a building that is safer and more productive for its occupants and more operationally efficient for its owners.”

Paul Ehrlich, Building Intelligence Group, LLC
Signs of Intelligence

**Design**
- Flexibility – designed to change;
- Energy efficient design (LEED®);
- Complete building modeling;
- Focus on building circulation and common spaces for networking;
- Integration with transportation and surrounding community.

**Construction**
- Sustainable construction practices;
- Electronic project documentation;
- Modeling extended into construction

**Operations**
- Integration of all systems;
- Remote operations and optimization;
- Tenant portals;
- After-hours operation;
- Monitored maintenance management and dispatch;
- Energy information and management systems
- Real-time energy response;
- Continuous comfort monitoring and feedback.

List courtesy: AutomatedBuildings.com, Paul Ehrlich, Building Intelligence Group, LLC
Signs of Intelligence

Tenant Amenities
- Concierge
- Personal Shopping
- Automated Restroom Eq.
- Optimized vertical transport.
- Personal comfort control:
  - Temperature, humidity, lighting
  & Acoustic

Operations:
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Signs of Intelligence

**Networking/Telecom**
- Common network infrastructure
- Structured – maintainable cabling
- WiFi
- VOIP
- Digital signage.

**Security/Life Safety:**
- Digital video monitoring;
- Access control and monitoring;
- Automatic fire suppression;
- Fire detection and alarm;
- Egress support (lighting, signage, smoke control, etc.);
- Contaminant monitoring and containment;
- Proximate security/guard services.

**Mechanical:**
- Energy efficient equipment;
- Thermal storage;
- Combined heat and power;
- Controls optimization;
- Extensive sensing;
- Energy efficiency;
- IAQ;
- Comfort monitoring;
- Internet enabled controls;
- Enterprise integration;
- Water and gas metering, sub-metering.

**Electrical:**
- Energy efficient lighting;
- Lighting control;
- Distributed generation;
- Dual power feeds/emergency power;
- Power quality monitoring;
- Sub-metering/billing.

List courtesy: AutomatedBuildings.com, Paul Ehrlich, Building Intelligence Group, LLC
The network is the new utility (like gas, water, electricity...)

Enhanced value, quality and functionality of the building

Lower CAPEX & OPEX costs over the lifecycle of the building (or portfolio)

Opportunity to develop new business models and create revenue streams

Future proofing the investment

Cisco Connected Real Estate

IP Building Platform

IP Comm. Platform

Life/Safety and Security

Building Automation

Data

Voice

Video

Multi Function Systems

Single Function Systems

Networked Virtual Building

Building Systems

User Systems

Convergence of IT and Building Systems

Convergence of IT and Building Systems
Connected Real Estate Stakeholders

The Network is the new utility (like water, electricity, and gas)
Value Proposition for Connected Real Estate

• Flexible, Adaptable and Sustainable Real Estate
  – Enables Workplace Productivity
  – Reduces Building Lifecycle Costs
  – Improves Safety and Security
  – Generates New Streams of Revenue
High-Rise Building
Sentre Partners, San Diego, California

- 34 story, 580,000 sq.ft. Class A office building
- Installed end-to-end solution including routers, switches and wireless access points
- Provided a secure and robust network and high speed solutions to “all” tenants
- Network cost reductions and improved tenant services.
- Provides work order management and security access applications
- They sold 2 other Hi-rises for the highest value in San Diego history

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Executive Office Centers

- Fully furnished offices for lease
- Local, national, and international in scope
- Tenants may rent by the hour, day, month or year
- Full office services provided for a fee
- Tenants may rent just the address and phone number (e.g. Rockefeller Center)
- Amenities include full telephony services, video conferencing, secretarial services, copies, fax machines, etc.
- Some tenants rent just the meeting rooms and conference facilities
- Some EOCs provide web-hosting, data center, and remote access services

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Applications & Solutions

- Physical Security and Access
- IP Communications
- Property Management Systems
- Facilities Mgt. and Building Automation Systems
- Wireless Connectivity
- Web Based Tenant Services
- Digital Signage
• University, retail, commercial space, residential condos, entertainment & dining.
• Supports whole life activities.
• Centrally managed BAS. (BOC)
  – HVAC controls, lighting, security and access control, fire alarm system, electrical power, elevators, and other building operations and maintenance functions.
• Unified, IP-based platform - which is monitored and operated remotely. (NOC)
• Consolidated installation, management and operations, eliminated technology redundancy & achieved major cost savings.

Realcomm Advisory: Behind the Headlines at Ave Maria University: Intelligent Building Systems
Darlene Pope, July 19, 2007
• Reduced to just a few, the multiple number of computer systems that usually would control building operational functions in this type of development.

• Integrated building automation system:
  – plant management, operations, and monitoring
  – estimated to lower expenditures for manpower and to provide more efficient utility usage, while saving almost $1M annually.
  – Intelligent building technology provides accurate control of HVAC and lighting, power management, dynamic adjustment to outdoor conditions, demand reduction, minimized run times, and delivers real-time metering and billing information.

Realcomm Advisory: Behind the Headlines at Ave Maria University: Intelligent Building Systems
Darlene Pope, July 19, 2007
Ave Maria University

• Next-generation database and “meta-directory”:
  – integrated with human resources for security, access control, and user identification
  – with communications system for e-mail, internet, and intranet access.

• Centralized network
  – instant access and management of resident and visitor information
  – provides a high level of security and access control throughout the community.
  – voice-over-IP (VoIP) and wireless Internet access,
  – unified messaging, call centers, call accounting, and directory management tools.

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Intelligent Design and Construction Concepts
The Opportunity Exists:

– To harvest business intelligence and operational information to inform strategic planning.
– To harvest building information for use in programming and design.
– To aggregate data from Building Automation Systems with facilities operations to create unique customer experiences, provide analytics and enable high performance buildings.
– To design with computers then provide parameters and constraints to BIM-based rationalization processes.
– To merge geospatial, building and BAS information for planning, development and emergency response.
In many cases Capital Facilities projects create the ‘seed’ data that make these capabilities possible.
Concept Schematics
Using Concepts and Schematics to Ensure Intelligence

Conceptual

[ Analysis ]

Schematic

Physical

Modeled

Actual
Domain Concept Library

© Alan Edgar, 2007

- Conceptual
- Adopted by Organization
- Some not found in Industry-wide library.

Enterprise-Specific Concept Library
Domain Concept Library

Specific to a Site/Facility/Project Schematic
- Carry parameters & constraints
- Some have wider latitude for localization
- Carry attributes for a specific installation.
- Elements linked to source patterns
- Elements associated with intervention level.

Tabular Data

Site/Facility/Project Specific Schematics

© Alan Edgar, 2007
Domain Concept Library

Detail Design Authoring & Specification

- Specific to a Site/Facility/Project
- Virtual Design
- Objects linked to metadata
- Underlying patterns available for reporting
- Object library selections managed by application after System approval
- Objects organized by intervention level.

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Evidence-based principle

Open Building Concept

Patterns Definition

Owner Organization-wide schematic geometries, requirements & constraints

Owner Project-specific schematic geometries, requirements & constraints

Schematic Design

Detailed Design

Procurement & Construction

Operational Commissioning

Guides

Inform

Guides

Inform

Inform

Inform
Schematic Diagramming & Provisioning
Mission Dependency Analysis

Metric Data

MDI / SUI / FCI / Security / Other
**BIM-based Virtual Design & Construction**

Courtesy: Kling
Placement of Interactive Kiosks & Monitors

1. Grand Lobby
2. Visitor Waiting
3. Reception Lobby
4. Employee Cafe
5. Coffee Shop
6. Museum
Placement of Key Spaces

NOC – Network Operations Center

Multiple display systems, consoles and status screens in NOC control center associated with integrated systems

A Elevator Lobby Display

LCD Display
Design Support

Kiosk Group B near Waiting Area
Virtual Building Models – Asset Population

Virtual Building Information Models

Building 14 POC
From Quad South
Towards Quad East
**Quantity Takeoff & Cost Estimating**

- Space Layout
- Space Inventory & Allocation
- Component Furniture Layout
- Component Furniture Inventory
- Employee Directory
- HVAC, power, network, telecom loads
- Utility ports inventory and locations
- IT devices & requirements inventory
- Telecom devices and req. inventory
Sources of Value for Building Owner

- Process Differentiation
- Marketing & Sales Enhancement
- Design Support including Quantity Takeoff & Cost Estimating
- Presence & Coordination of Components
- Delivery of Enhanced Service Concepts
- Data Commissioning
- Facility Management & Facilities Services Integration
- Revenue Enhancement – Time-to-Market, Quality
Marketing & Sales

- Showcase Facility
- Unified Model – Design & Views
- Site Planning
- Architecture/Interior Concepts
- Venues & Services
- Tabulations
- Virtual concepts
One project identified 2,500 conflicts, fifty of which would have ended up in significant change orders. They were all eliminated prior to construction saving the customer potentially 10% of the value of the project. The cost of building the model - less than 1% for a net cost avoidance of 9%.

- As-Builts before construction & installation
- Fabrication/Install drawings from the model
# Data Commissioning - CCRE Solution Components

## BIM SOURCE
- Drawings
- Engineering Calcs
- Specifications
- Fabrication Detailing
- Product Submittals
- Installed Systems/Equipment
- Manufacturer’s Operating Manuals

## DATA
- Real Property
- Space
- Personnel
- Organizations
- Equipment
- Utilities
- Maint. Tasks
- Instructions
- Schedules
- Cost
- 3D Geometry
- BAS Points
- IT Assets
- Network Logic
- Client Devices
- Tasks/Procedures

## FUNCTION
- Legal
- Financial
- Bldg. Ops
- Network Ops
- ECQ Ops
- Fac. Mgmt
- Asset Mgmt
- Bldg Svs.
- Security
Facility Management & Facilities Services Integration

Project Phase
- Site Construction
- Building Construction
- Building Fit-out

BIM Info
- People
- Places
- Things

Facilities
- Reporting Billing
- Automated Room Status
- Automated Mini-Bar
- Mobile Com.: Softphone
- Mobile Com.: Voice over Wifi
- Digital Signage
- Conference Calls
- Time & Attendance
- Meeting Center Management

People
- Group and Visitor Management
- Automated Wake-up Calls
- Automated Mini-Bar
- Automated Room Status

Places
- People Tracking
- Conference Calls
- Automated Mini-Bar
- Automated Wake-up Calls

Things
- 33 Utilities
- Transportation
- 34 Transportation
- Reporting Billing
- Automated Room Status

Business Impact
- E-learning
- Web/video/call Conferencing
- Service Request Management

BI & Marketing Intelligence
- BI & Marketing Intelligence

Building Systems
- 33 Utilities
- 34 Transportation
- Reporting Billing
- Automated Room Status

Building Services
- Automated Mini-Bar
- Automated Wake-up Calls
- Mobile Com.: Softphone
- Mobile Com.: Voice over Wifi
- Digital Signage
- Conference Calls
- Time & Attendance
- Meeting Center Management

Building Information
- BIM Info
- Project Phase
- People Places Things

buildingSMARTalliance™

OSCRE
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<td>Transportation</td>
<td>Transportation Signaling &amp; Control Equipment</td>
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- Open Building Information Exchange
- Connects intelligent building systems such as BAS sensors and controls over converged TCP/IP networks
- Replaces embedded, proprietary, non-compatible digital controls
- XML & Web Services
- Professionals from security, HVAC, building automation, open protocol & IT disciplines.
- NBIMS & oBIX can enable continuous commissioning.
Web-Centricity
Data Aggregation
Find Information – Don’t Create It

Context: Unique Identification (UID) —
Integrated Situational Awareness of People, Places and Things

Yesterday – No UIDs

No integrated planning view

Requirement: Capability to integrate force structure planning for identifying and constituting deployable combined force modules.
- Who is available?
- With what equipment?
- Where are they now?
- How long can we support them?

To-Be State — UIDs

Integrated planning view

People, things and property related to force structure.

Deployment and constitution options can be continuously evaluated.

Required items identified, pre-positioned and tracked with radio frequency identification (RFID) tabs.

People and things can be identified to sites and assets for rapid deployment response.

Questions

Questions answered
Enable Performance Metrics

WORLDWIDE PLANNING

Space Management Metrics

- **Utilization**: Person Housed / Seat Capacity
- **Forecasting**: Forecasting Ability Based on looking 1 year forward
- **Efficiency**: SF / Person Housed
  - "year view mirror" of forecasting ability. Every quarter see how we did on our 12 month forecast for need of space
- **Churn**: People Moved / People Housed
  - Monitoring amount people moved. In future we’ll/NIW, churn should be decreased
- **Adjacencies**: Customer Satisfaction
  - Feedback on specific item adjacency.
- **Lab Utilization**: Racks used / Rack Capacity
  - Monitor efficient utilization

building SMARTalliance™
Savings from Intelligent Processes
Capital Projects – Virtual Design & Construction

Camino Medical Office Building

- 250,000 sq.ft. Medical Office Building (MOB)
- Parking structure for 1100 cars
- $94.5 M construction cost
- 73% Work completed
- Project Completion March 2007
Cost Savings from...

- More pre-fabrication
- Just-in-Time delivery
- Fewer RFI’s and Change Orders
- Smaller crew sizes
- Higher field productivity
- Less rework
Capital Projects – Virtual Design & Construction

MEP Savings

- More confidence in pre-fab due to accurate 3D modeling
- Right material at the right time
- 50% more plumbing pre-fab than conventional
- 73% of MEP in place
- Zero RFIs for conflicts between systems modeled in 3D
- Only 6 Mech & Elec conflict RFIs related to MEP/FP systems conflicting with other systems
- 30% fewer sheetmetal workers than estimated
- 55% fewer pipe-fitters than estimated
- 20-37% higher productivity
- Re-work only 43 hours out of 25,000 hours
- HVAC Contractor projecting over $400K of labor savings on $9.04 Million GMP contract
- NECA 1 represents the Highest Productivity in Electrical Estimating
- Camino MOB is 15% better productivity than NECA 1
Beating Escalation

Collaborative Virtual Building – vs – Design-Bid-Build Process

- Camino MOB saved $9M and 6 months by using the Collaborative Virtual Building process as compared to traditional Design-Bid-Build process.
Funding Transformation
A Culture of Investment

1. Implementing integration in homogenous, proprietary teams with ‘lean’ aims. Gaining benefits from BIM tools and methods used in project-specific scope. Pocket benefits.

2. Same as #1 but pocket most benefits and use some to fund interoperability development and industry adoption.

3. Implement interoperability across greater scope of lifecycle in heterogenous, project-specific and ‘loose’ federations. Gain greater benefits from higher use of BIM tools and methods. Pocket greater benefits and continue to use a percentage of gains to fund more transformation.
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