



Intelligent Building Processes for Intelligent Buildings

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OSCRE Workgroup Program Manager

Chair, National Building Information Model Standard



building**SMART**alliance™

OSCRE

Intelligent Building Concepts

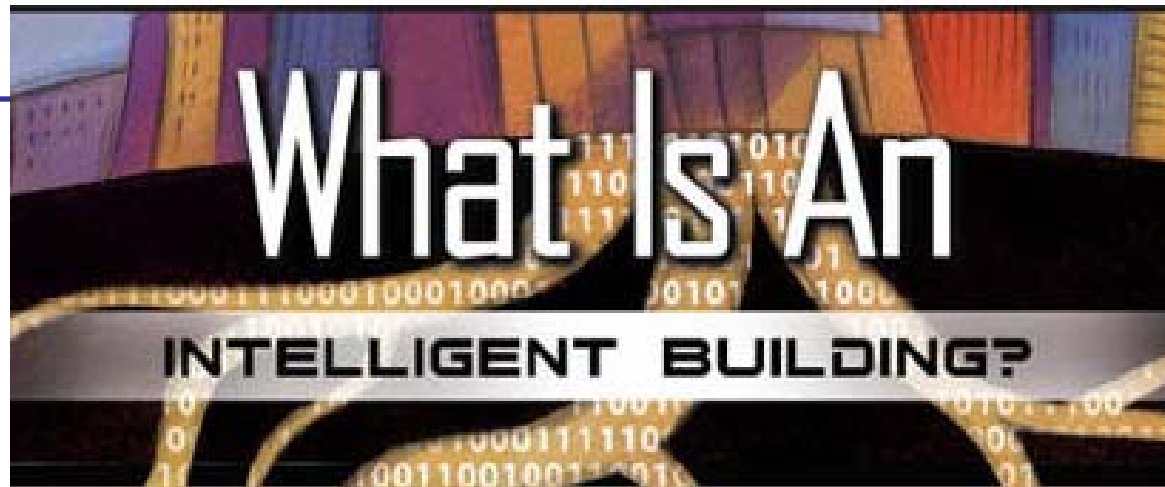
Intelligent Design & Construction Concepts

A ***SMART*** Proposal

Intelligent Building Concepts

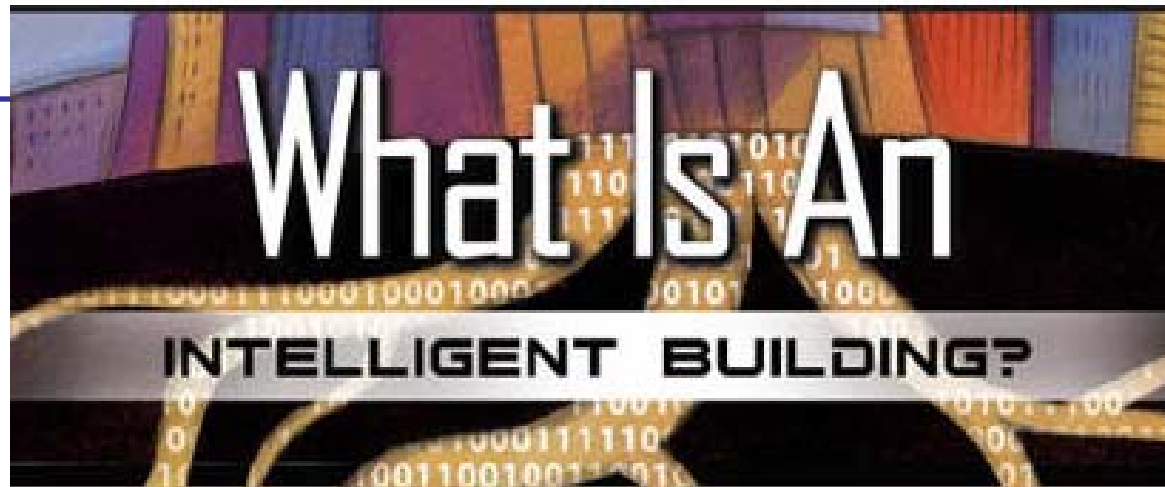
Corporate Real Estate is about creating an efficient, productive workplace that supports business units.

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:

- 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

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:

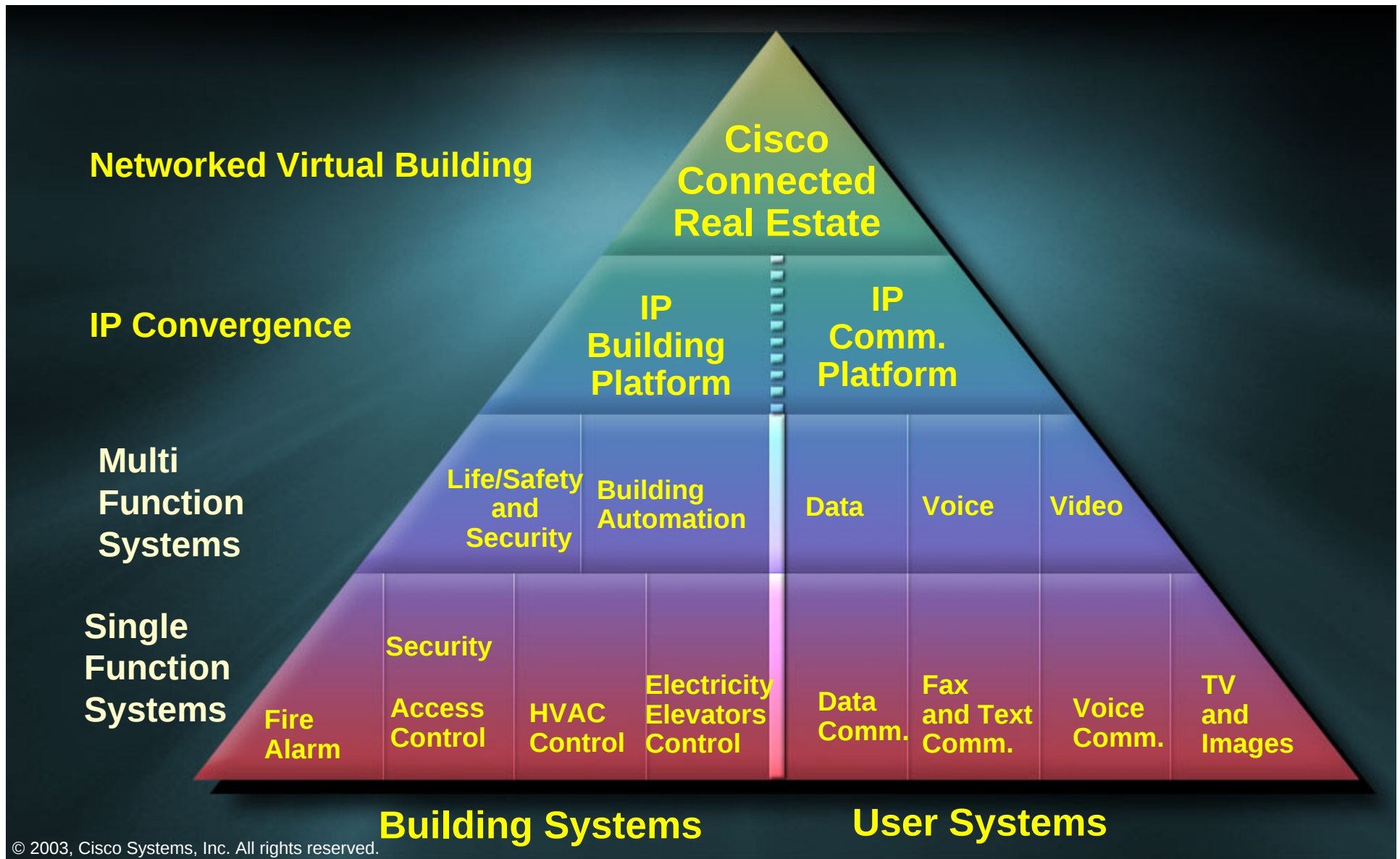
- Energy efficient equipment;
- Thermal storage;
- Combined heat and power;
- Controls optimization;
- Extensive sensing;
- Energy efficiency;
- IAQ;
- Comfort monitoring;
- Internet enabled controls;
- Enterprise integration;
- Water and gas metering, sub-metering.

Electrical:

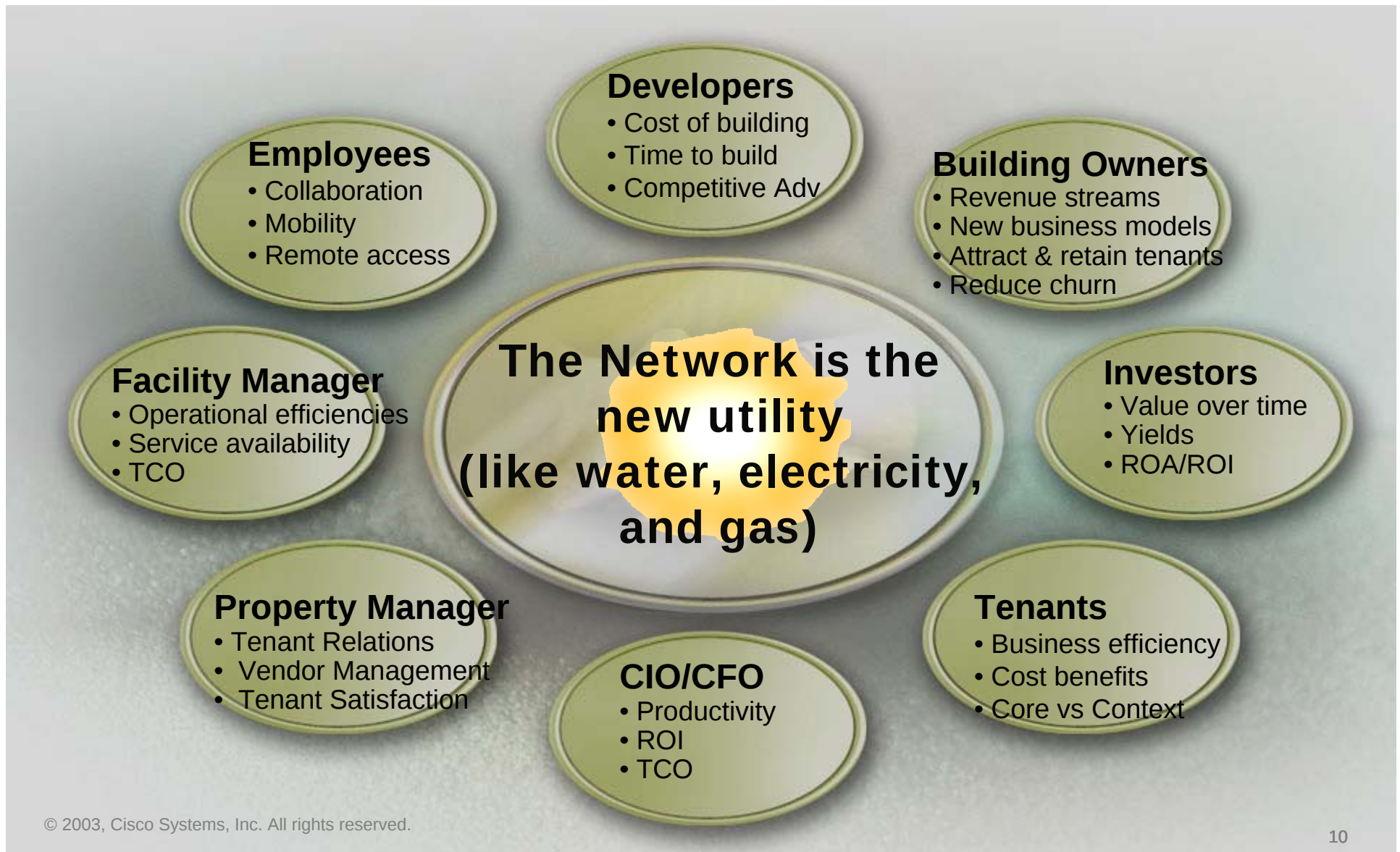
- Energy efficient lighting;
- Lighting control;
- Distributed generation;
- Dual power feeds/emergency power;
- Power quality monitoring;
- Sub-metering/billing.

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

Convergence of IT and Building Systems



Connected Real Estate Stakeholders

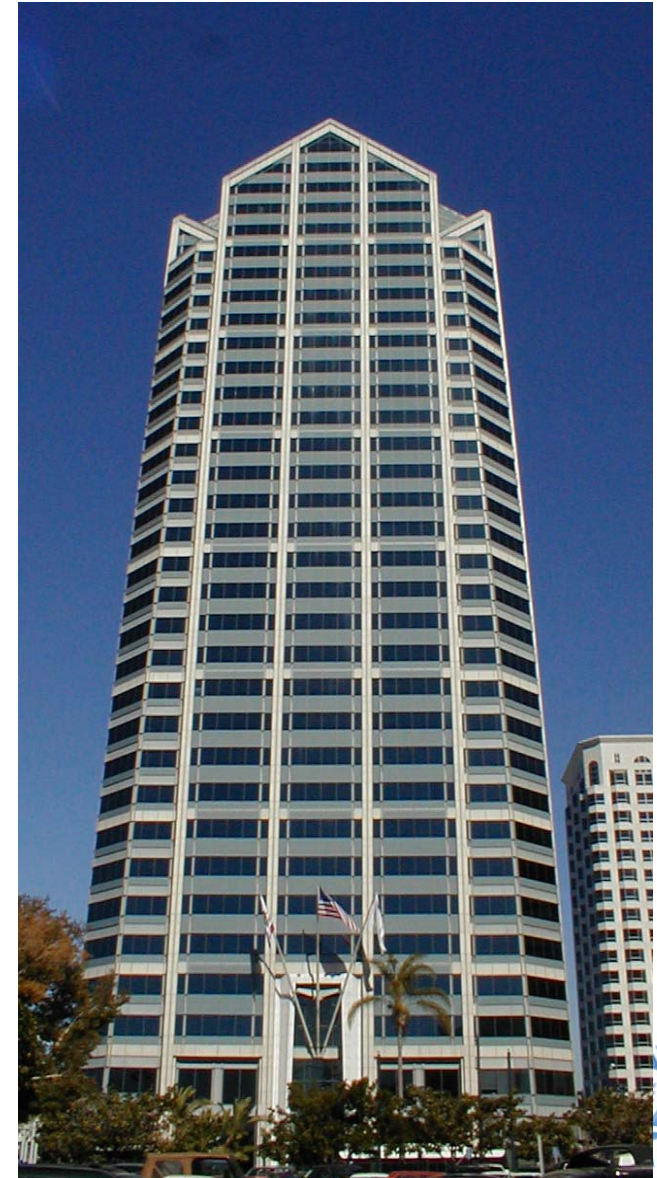


Value Proposition for Connected Real Estate

- 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

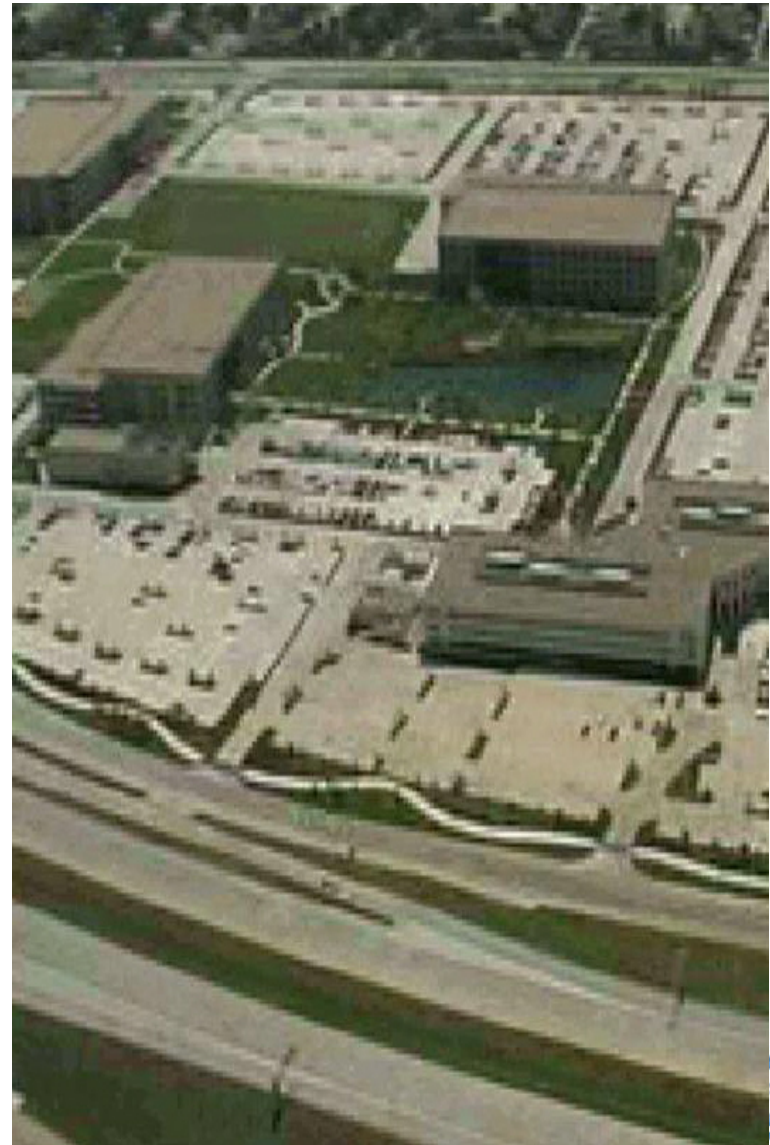
- 34 story, 580,000 sq.ft. Class A office building
- Installed end-to-end solution including routers, switches and wireless access points
- Provided a secure and robust network and high speed solutions to “all” tenants
- Network cost reductions and improved tenant services.
- Provides work order management 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**

Ave Maria University

- **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

Ave Maria University



• ***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.

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

***Intelligent Design
and Construction Concepts***

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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.



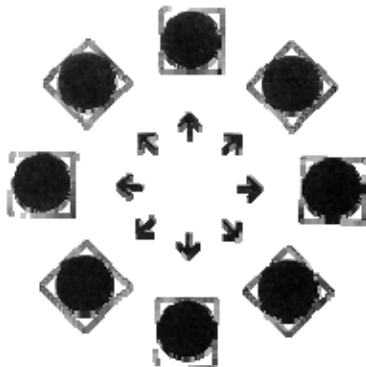
Concept Schematics

building**SMART**alliance™



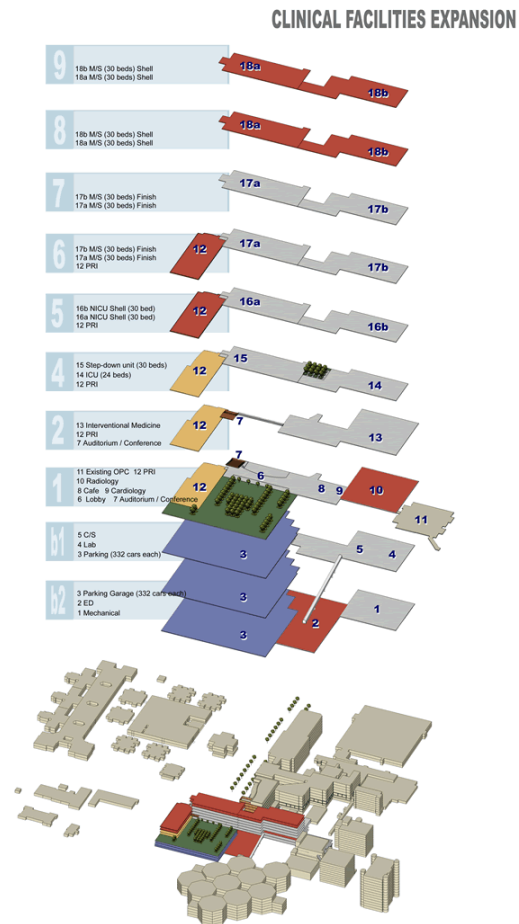
Using Concepts and Schematics to Ensure Intelligence

Conceptual



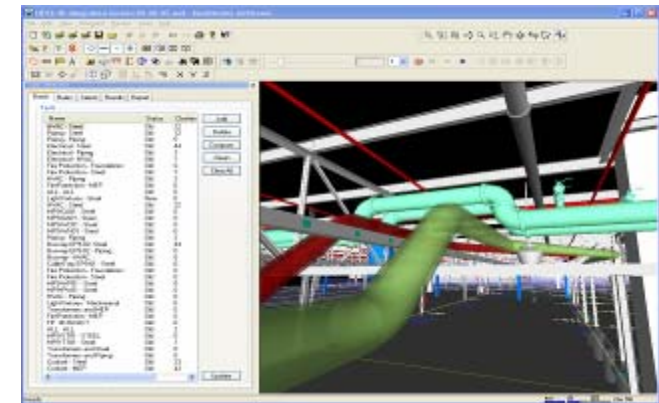
[Analysis]

Schematic



Physical

Modeled



Actual



Domain Concept Library

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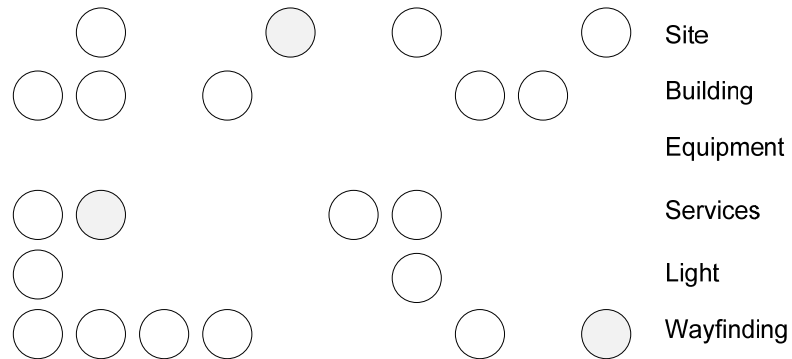
1	2	3	4	5	6	7	8	9	10	
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Site
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Building
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Equipment
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Services
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Light
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	Wayfinding

- Evidence-based
- Conceptual
- Industry-wide domain
-

Domain-Specific Concept Library

Domain Concept Library

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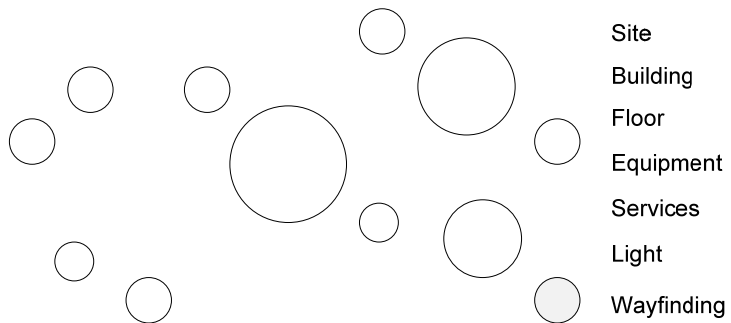


- Conceptual
- Adopted by Organization
- Some not found in Industry-wide library.

Enterprise-Specific Concept Library

Domain Concept Library

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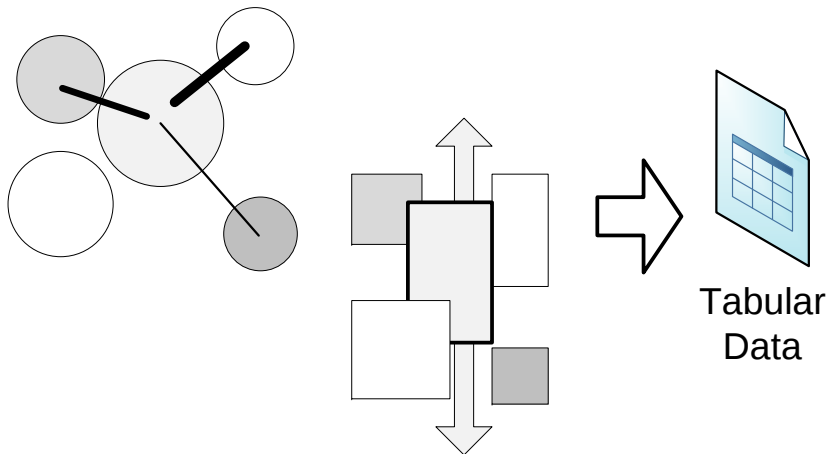


- System-wide
- Schematic
- Carry parameters & constraints
- Not specific to a site/facility or project
-

Non-specific Schematics

Domain Concept Library

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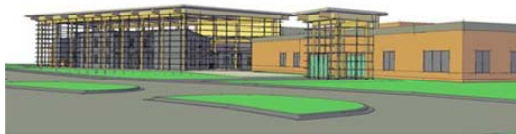


- Specific to a Site/Facility/Project
- Schematic
- Carry parameters & constraints
- Some have wider latitude for localization
- Carry attributes for a specific installation.
- Elements linked to source patterns
- Elements associated with intervention level.

Site/Facility/Project Specific Schematics

Domain Concept Library

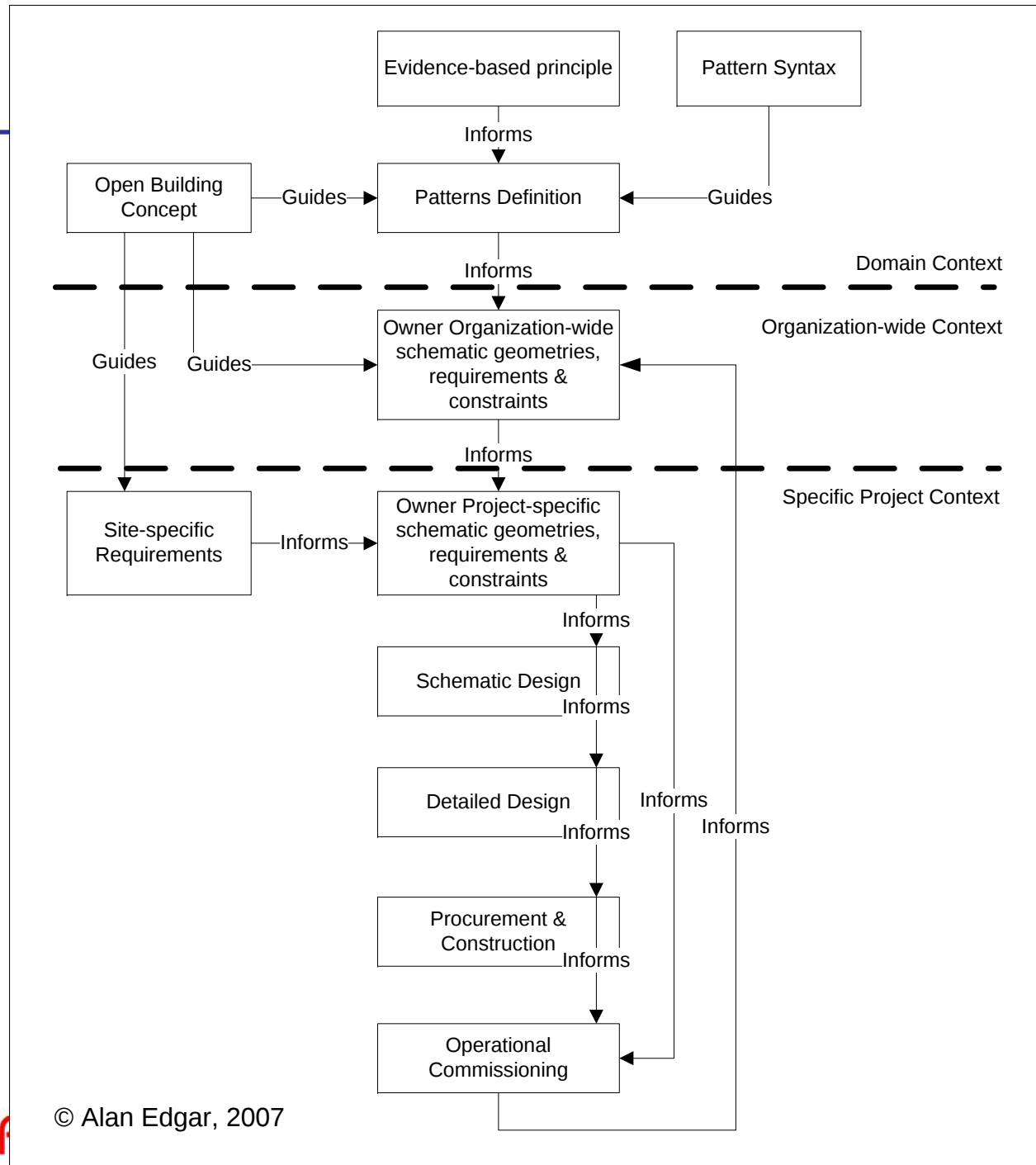
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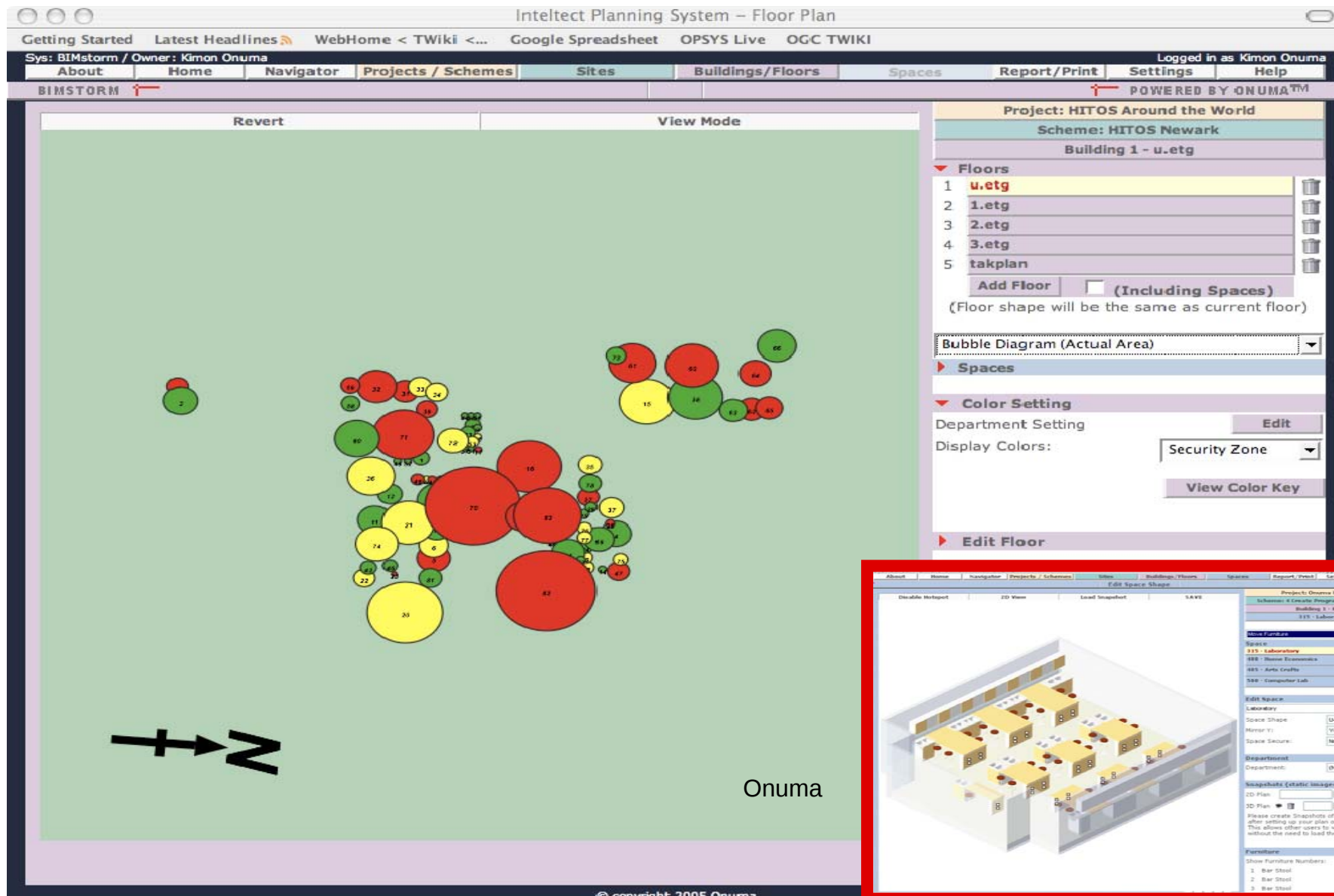
Ged Trias

- 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.

Detail Design Authoring & Specification



Schematic Diagramming & Provisioning



Mission Dependency Analysis

Setting Started Latest Headlines WebHome < TWiki <... Google Spreadsheet OPSYS Live OGC TWIKI

Sys: BIMstorm / Owner: Oliver Liao

About Home Navigator Projects / Schemes Sites Buildings/Floors Spaces Report/Print Settings Help

BIMSTORM This is a Published Project POWERED BY ONUMA™

Project: HITOS Steps
Scheme: 2. Space Settings
Building 1 - 1.etg

Normal View
Spaces
Color Setting
Display Colors: MDI View Color Key
Export
Export a site / building / space Export

https://www.onuma.com

Color Key
MDI Color
>0
>40
>55
>70
>85

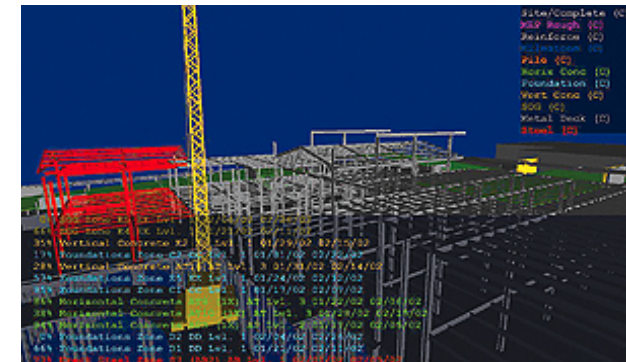
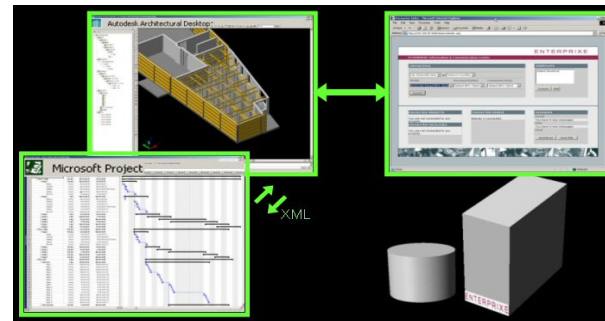
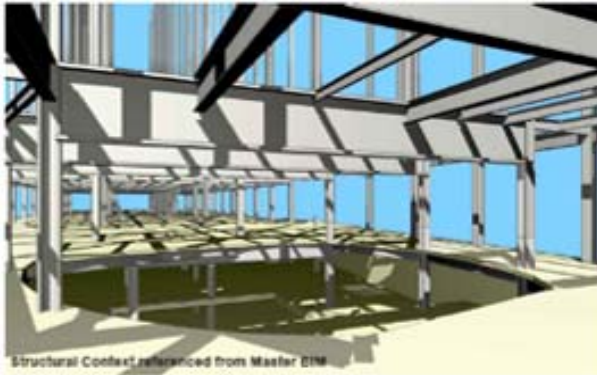
Project Name: HITOS Steps
Scheme Name: 2. Space Settings
Building 1

Indexes

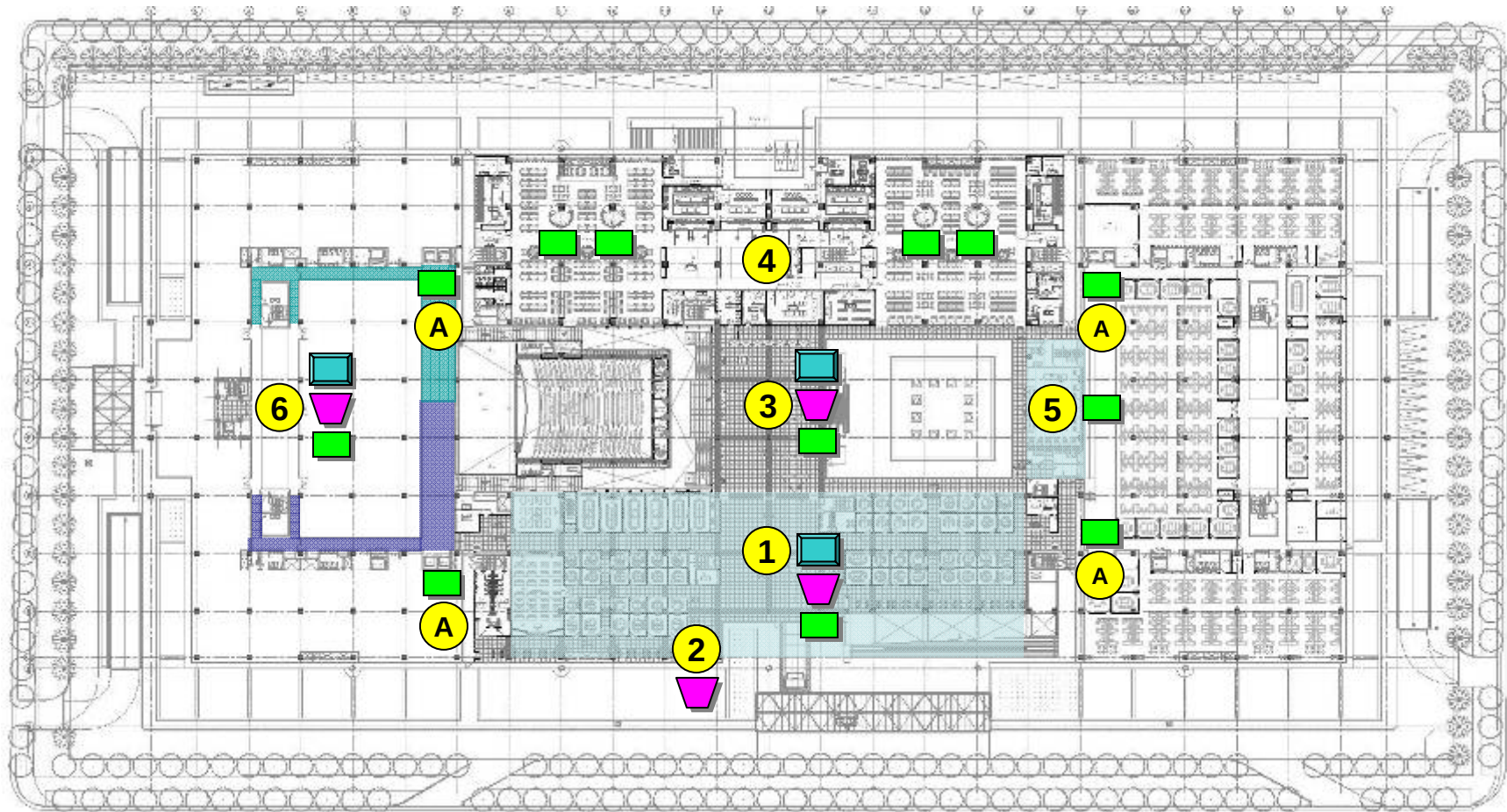
Space Name	SUI	MDI	FCI	No
kjeller	0.80	10.00	0.00	
El:	2.00	99.00	0.05	
Sluse:	0.80	450.00	60.00	
El:	0.00	522.00	0.04	
Telerom:	0.80	22.00	0.04	
Heis:	1.00	39.00	0.10	
Hovedtavle:	0.80	46.00	60.00	
Vent.rom:	1.00	88.00	0.16	
Trapp T02:				
u.etg				
Korridor:	0.80	46.00	60.00	
Lager for renholdsmatriell o...:	1.00	49.00	0.04	
Rom for moppevaskemaskin:	0.80	100.00	0.04	
Varemtak:	1.00	1.00	0.00	
Bro 2:	1.00	10.00	0.15	
Forberedelser/verksted/lager:	0.80	40.00	0.10	
Brief og debrief rom:	2.00	41.00	60.00	
Vask:	0.80	49.00	60.00	
Urinal:	2.00	55.00	60.00	
Prosess og gassteknologi/ la...:	3.00	59.00	60.00	
Mekanisk laboratorium:	0.80	60.00	0.05	
Lager:	2.00	63.00	0.05	
RWC:	0.80	82.00	60.00	
BK:	1.00	82.00	60.00	
Auditorium:	0.00	70.01	0.04	
Seminarrom:	2.00	14.00	60.00	
WC:	0.80	86.00	0.04	
Gard.:	0.80	73.00	60.00	
Gard.:	2.00	12.00	0.04	
Bro 1:	1.00	70.00	60.00	
Korridor:	0.80	71.00	0.04	
Trapp T01:	1.00	70.00	0.10	
El:	0.80	88.00	60.00	
Frys:	1.00	70.00	0.10	
Meieri:	0.80	90.00	0.04	
Min.vann:	0.80	27.00	60.00	
Rens/Grovkj.:	20.00	12.00	60.00	
Kontor:	0.00	70.00	60.00	
Rotfrukt:	0.80	42.00	0.10	
Gard.:	2.00	49.00	0.05	
Lager:	1.00	70.00	60.00	
Verksted, snekker:	0.80	17.00	60.00	

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Courtesy: Kling



Placement of Interactive Kiosks & Monitors



A Elevator Lobby Display

1 Grand Lobby

2 Visitor Waiting

3 Reception Lobby

4 Employee Cafe

5 Coffee Shop

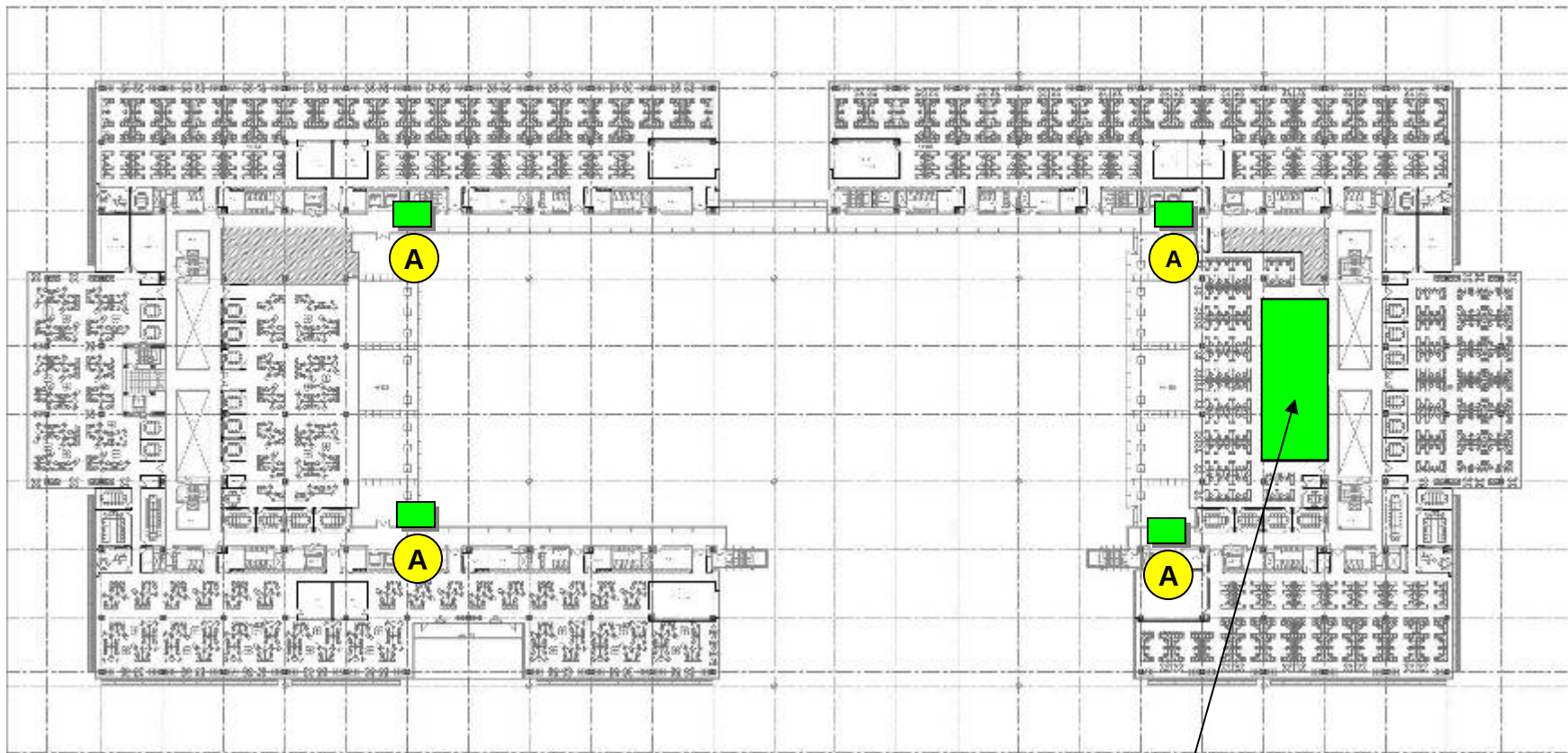
6 Museum

 Interactive Plasma

 Interactive Kiosk

 LCD Display

Placement of Key Spaces



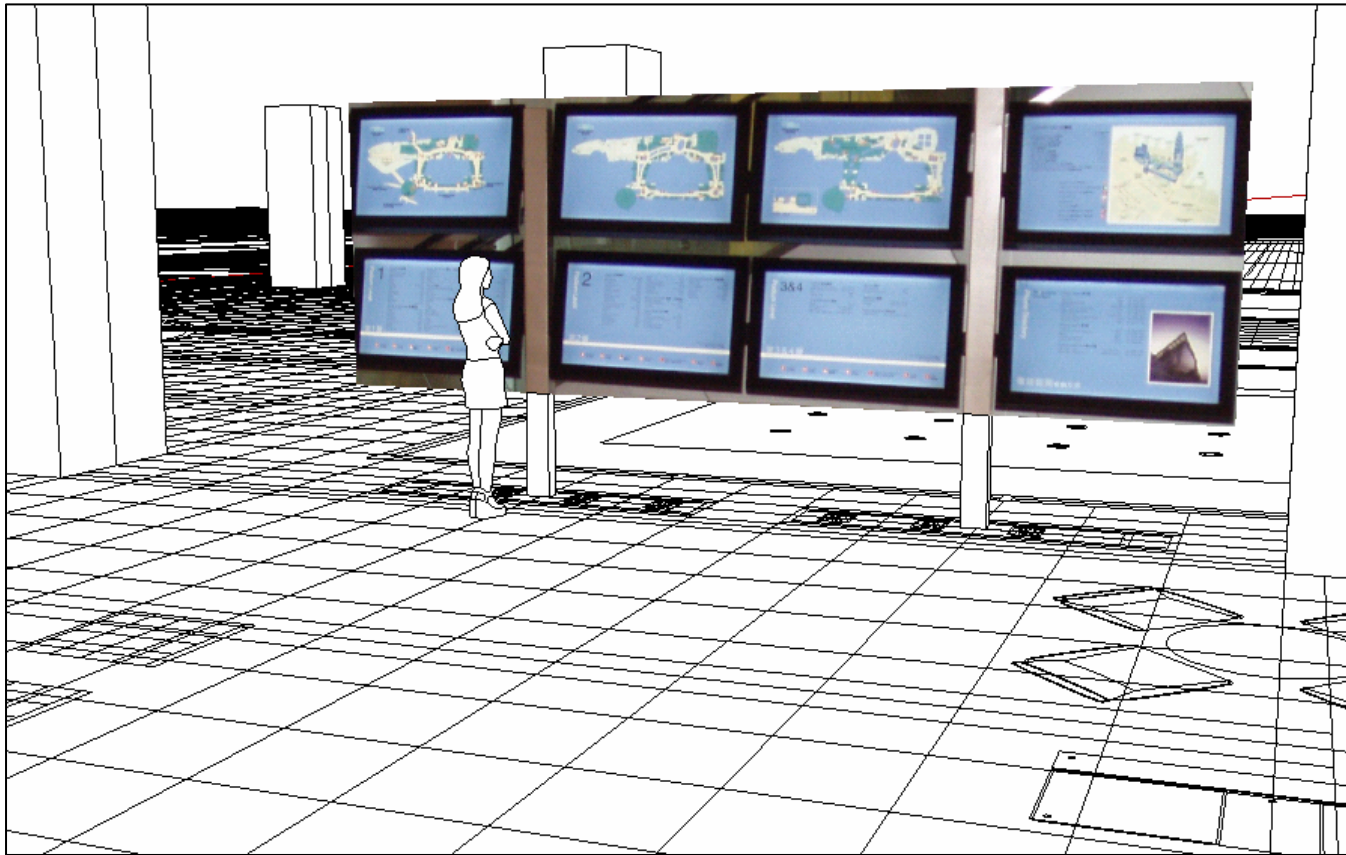
A Elevator Lobby Display

 LCD Display

NOC – Network Operations Center

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

Design Support



Virtual Building Models – Asset Population



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
to the Owner/Investor***

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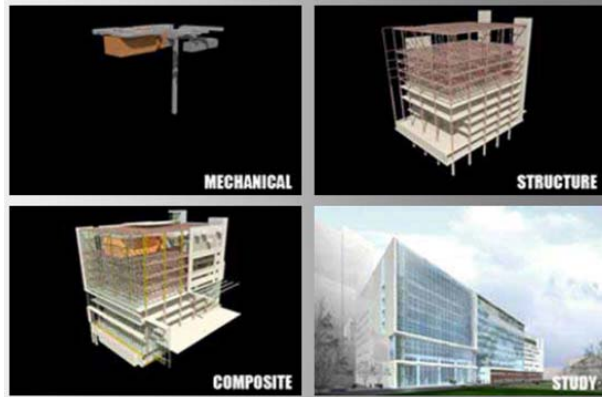
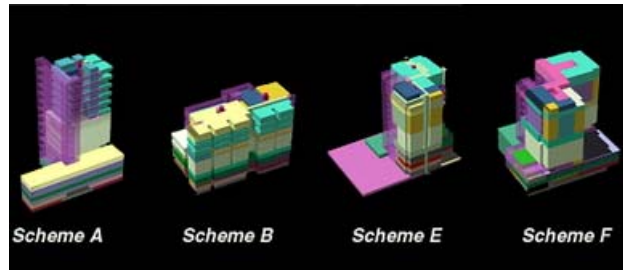




Sources of Value for Building Owner

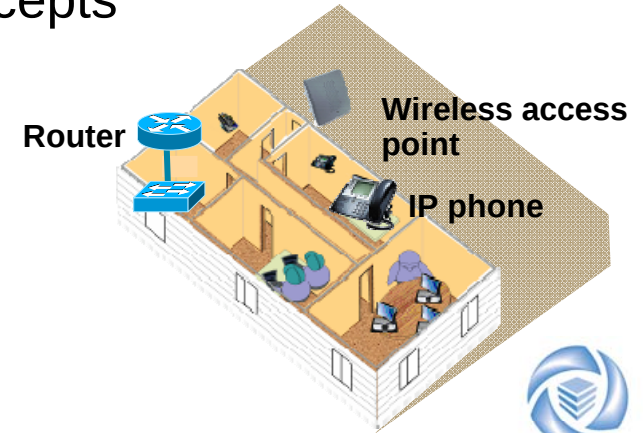
- Process Differentiation
- Marketing & Sales Enhancement
- Design Support including Quantity Takeoff & Cost Estimating
- Presence & Coordination of Components
- Delivery of Enhanced Service Concepts
- Data Commissioning
- Facility Management & Facilities Services Integration
- Revenue Enhancement –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

Marketing & Sales

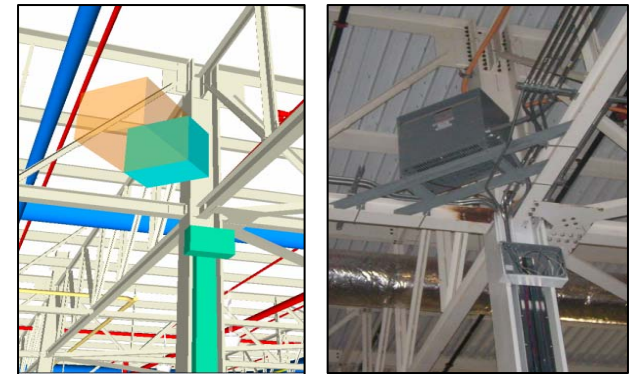
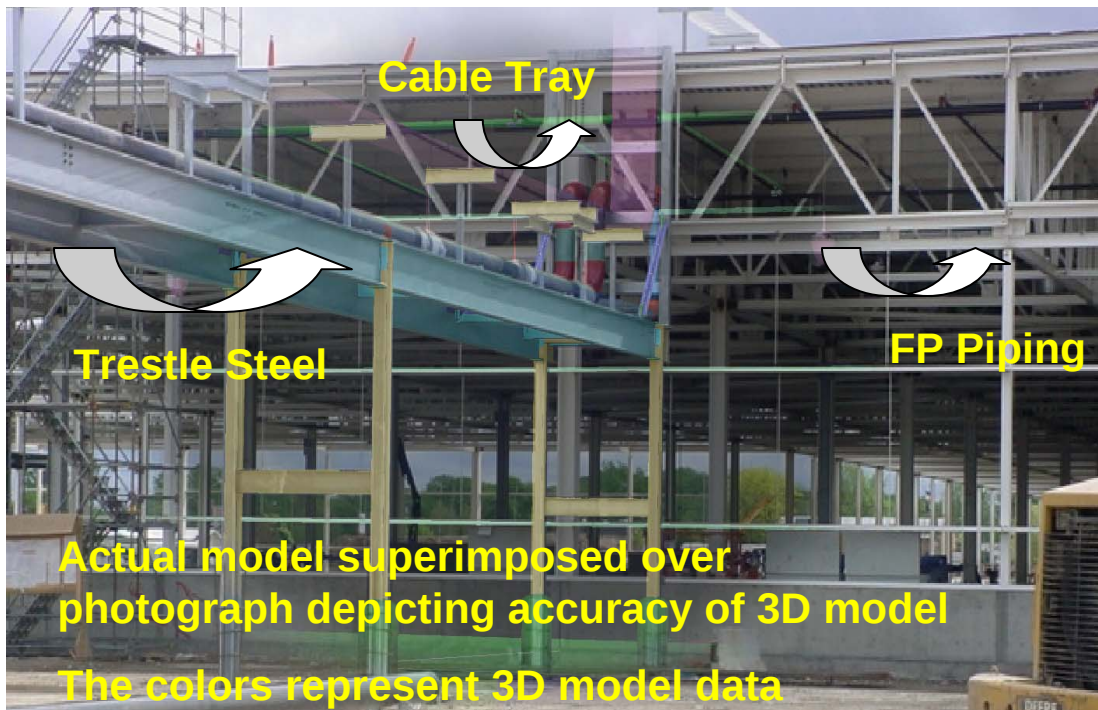


- Showcase Facility
- Unified Model – Design & Views
- Site Planning
- Architecture/Interior Concepts
- Venues & Services
- Tabulations
- Virtual concepts

ITEM	NO.	DESCRIPTION	PART NO.	36. LEG BRACKET	40160
1. SCORECARD HOLDER	21180	31. SCREW	54211		
2. PENCIL HOUSING	21913	32. SIDEWOOD PLUG	60063		
3. RUBBER TO FIX MARKER	22914	33. SCREW	24510		
4. SCREW	25516	34. SCREW	54530		
5. PARTS TO FIX SCORECARD HOLDER	21182	35. WHEEL AXLE TUBE	60064		
6. PVC COVER	21183	36. STEEL BASKET	60061		
7. HAND GRIP	15280	37. SCREW	54510		
8. HANDLE TUBE	09000	38. STEEL BASKET SHEET	60062		
9. UPPER BAG	14800	39. KNOCKLE(S)	60060		
10. WEIGHT STABILIZER	60060	40. KNOCKLE(S)	60067		
11. PVC UPPER BAG PLUG	14001	41. BALL BEARING	63000		
12. PIN CHAIN	14802	42. WHEEL	39370		
13. BALL BEARING	63001	43. SCREW	54415		
14. SIDEWOOD PLUG	60060	44. WHEEL CAP	40370		
15. SCREW	24520	45. WHEEL AXLE	41160		
16. POLYURETHANE MAIN BODY	67001	46. LOWER BAG BRACKET	16130		
17. SCREW	24555	47. FRONT WHEEL SHEET	58080		
18. NO. WHEEL NUT	25500	48. SCREW	24530		
19. HANDLE TUBE TIE SUPPLY	67000	49. NO. NUT	25541		
20. FASTENER LEVER	67003	50. SIDEWOOD	08230		
21. RIVET	26200	51. SCREW	54540		
22. IRON WASH	27914	52. IRON WASH	27511		
23. RIVET	26200	53. IRON WASH	27505		
24. TOOTH PLATE	67002	54. IRON WASH	27110		
25. MAIN FRAME	11900	55. FRONT WHEEL AXLE	50061		
26. WHEEL BOLT	67004	56. FRONT WHEEL PLUG	50062		
27. WEIGHT STABILIZER	60064				
28. SCREW	54540				
29. NAIL	41101				



Presence & Coordination of Components

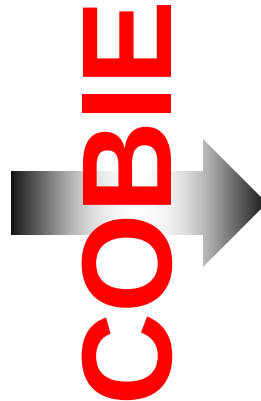


- As-Builts before construction & installation
 - Fabrication/Install drawings from the model
-
- One project identified 2,500 conflicts, fifty of which would have ended up in significant change orders. They were all eliminated prior to construction saving the customer potentially 10% of the value of the project. The cost of building the model - less than 1% for a net cost avoidance of 9%.

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

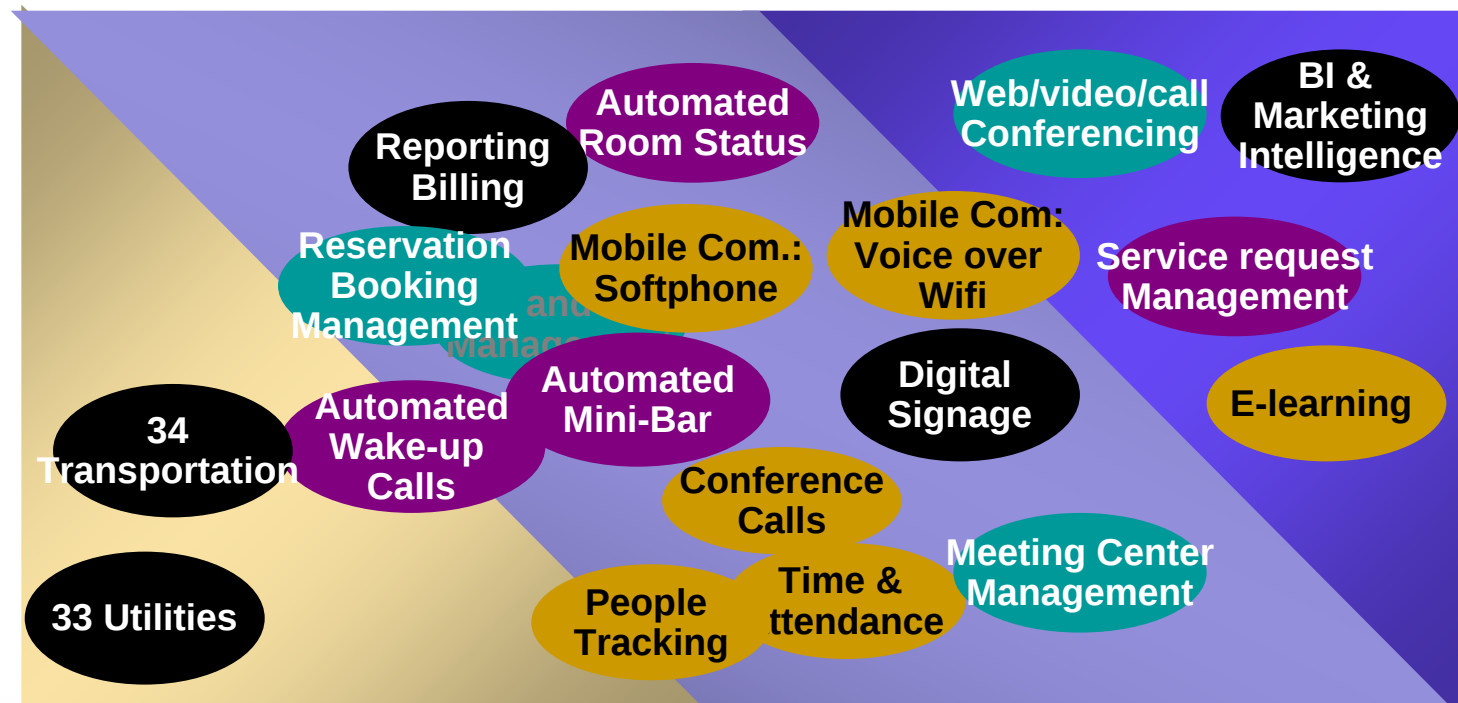
Building Fit-out

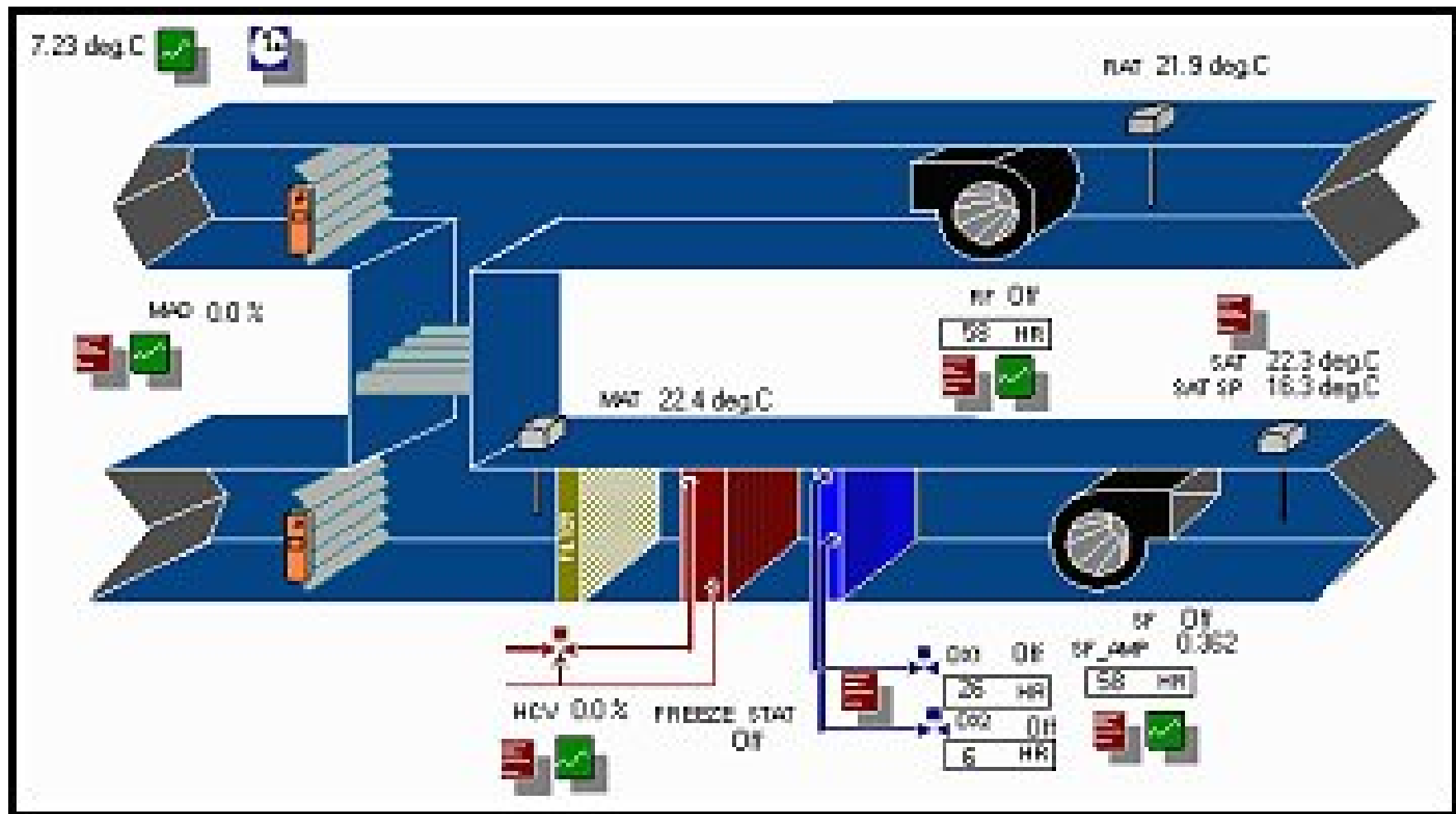
BIM Info

People

Places

Things





Data Commissioning Systems & Equipment (BAS Roadmap)



Div	Title	Examples
10	Specialties	Displays, Kiosks, Directories
11	Equipment	Appliances, Parking & People Control
12	Furnishings	Window Blinds, Artwork
13	Special Construction	Sound, Vibration, Seismic Controls
14	Conveying Systems	Elevators, Escalators, Lifts
21	Fire Suppression	Fire Suppression Instrumentation & Control
22	Plumbing	Gas & Vacuum Systems
23	Heating, Ventilating & Air Conditioning	Instrumentation & Control for HVAC, Facility Fuel Systems, Ext. Sun Control Devices
25	Integrated Automation	Energy Management, Water Management, Business Continuity Planning
26	Electrical Systems	Instrumentation & Control for Electrical Systems, Lighting Systems
27	Communications	Data/Voice/Video Communications
28	Electronic Safety & Security	Electronic Access Control and Intrusion Detection, Electronic Surveillance
32	Exterior Improvements	Irrigation Systems
33	Utilities	Instrumentation and Control for Utilities, Alternative/Renewable Energy Sources
34	Transportation	Transportation Signaling & Control Equipment

- Open Building Information Exchange
- Connects intelligent building systems such as BAS sensors and controls over converged TCP/IP networks
- Replaces embeded, proprietary, non-compatible digital controls
- XML & Web Services
- Professionals from security, HVAC, building automation, open protocol & IT disciplines.
- NBIMS & oBIX can enable continuous commissioning.

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

Yesterday – No UIDs

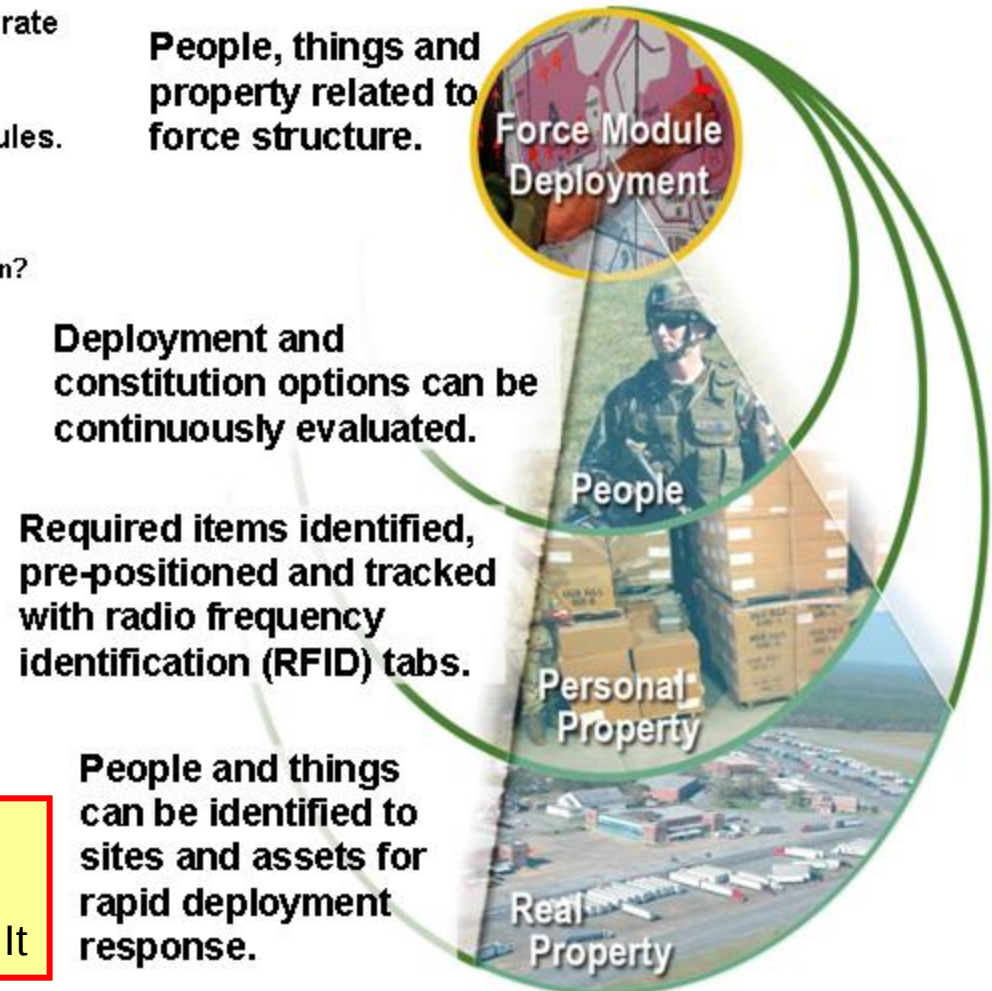
No integrated planning view



Questions

To-Be State — UIDs

Integrated planning view

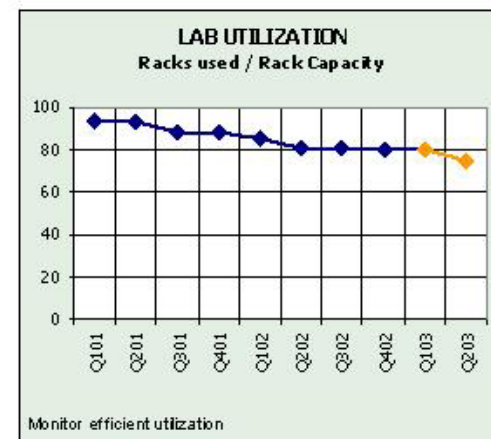
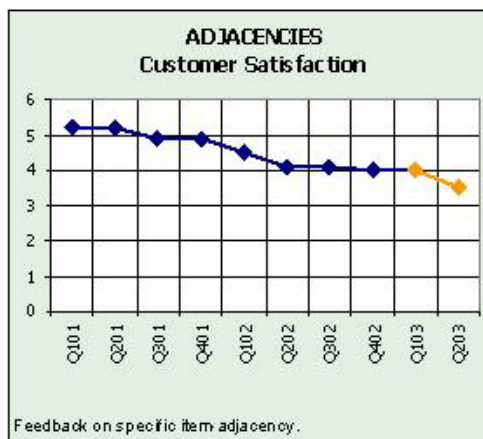
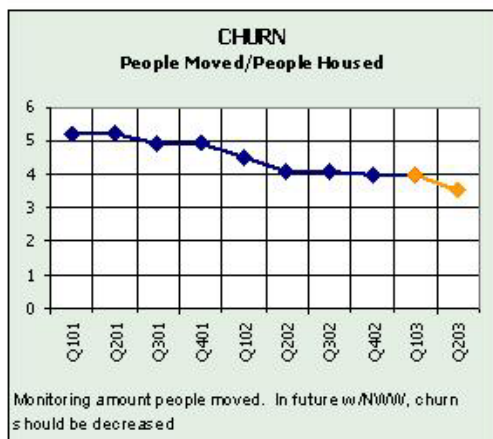
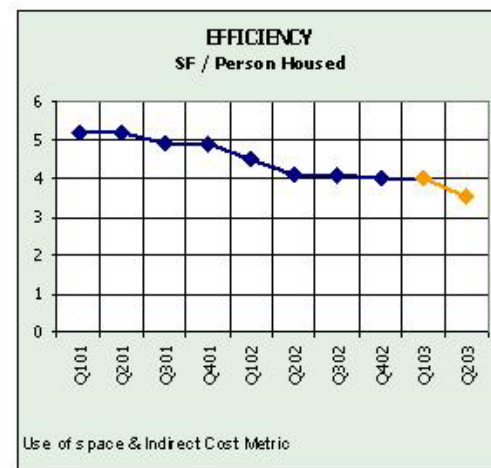
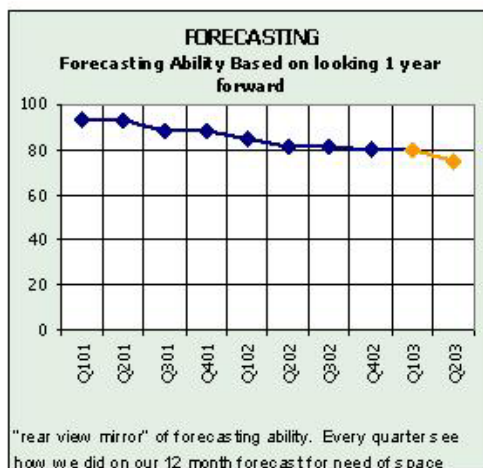
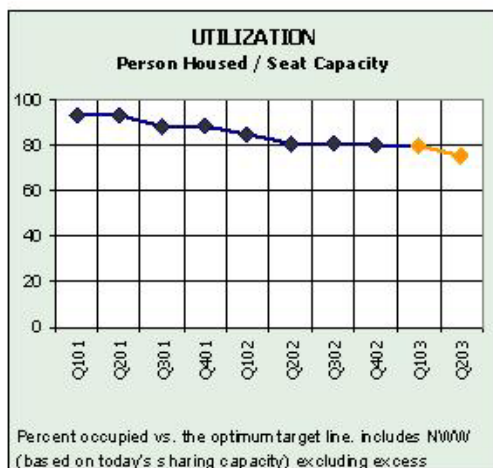


Questions answered

Enable Performance Metrics

WORLDWIDE PLANNING

Space Management Metrics



Abstract blue geometric shapes, including a series of stacked, slightly offset rectangular blocks on the left and two large, curved, petal-like shapes on the right, all in various shades of blue.

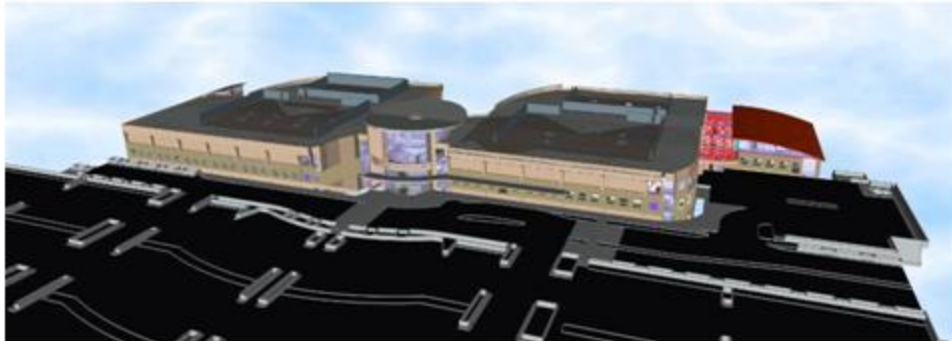
Savings from Intelligent Processes

building**SMART**alliance™



Capital Projects – Virtual Design & Construction

Camino Medical Office Building

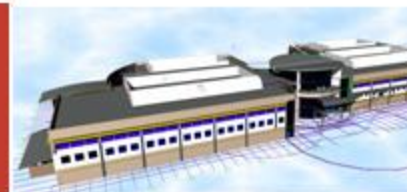


- 250,000 sq.ft. Medical Office Building (MOB)
- Parking structure for 1100 cars
- \$94.5 M construction cost
- 73% Work completed
- Project Completion March 2007

HAWLEY PETERSON & SNYDER
ARCHITECTS



EFFICIENCIES AND COST
SAVINGS OF DESIGNING
AND BUILDING VIRTUALLY



BUILDING
GREAT
THINGS
COLLABORATIVELY

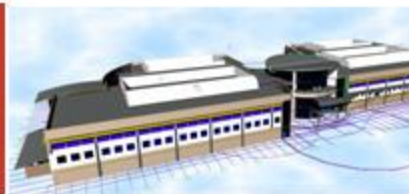
Cost Savings from...

- 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

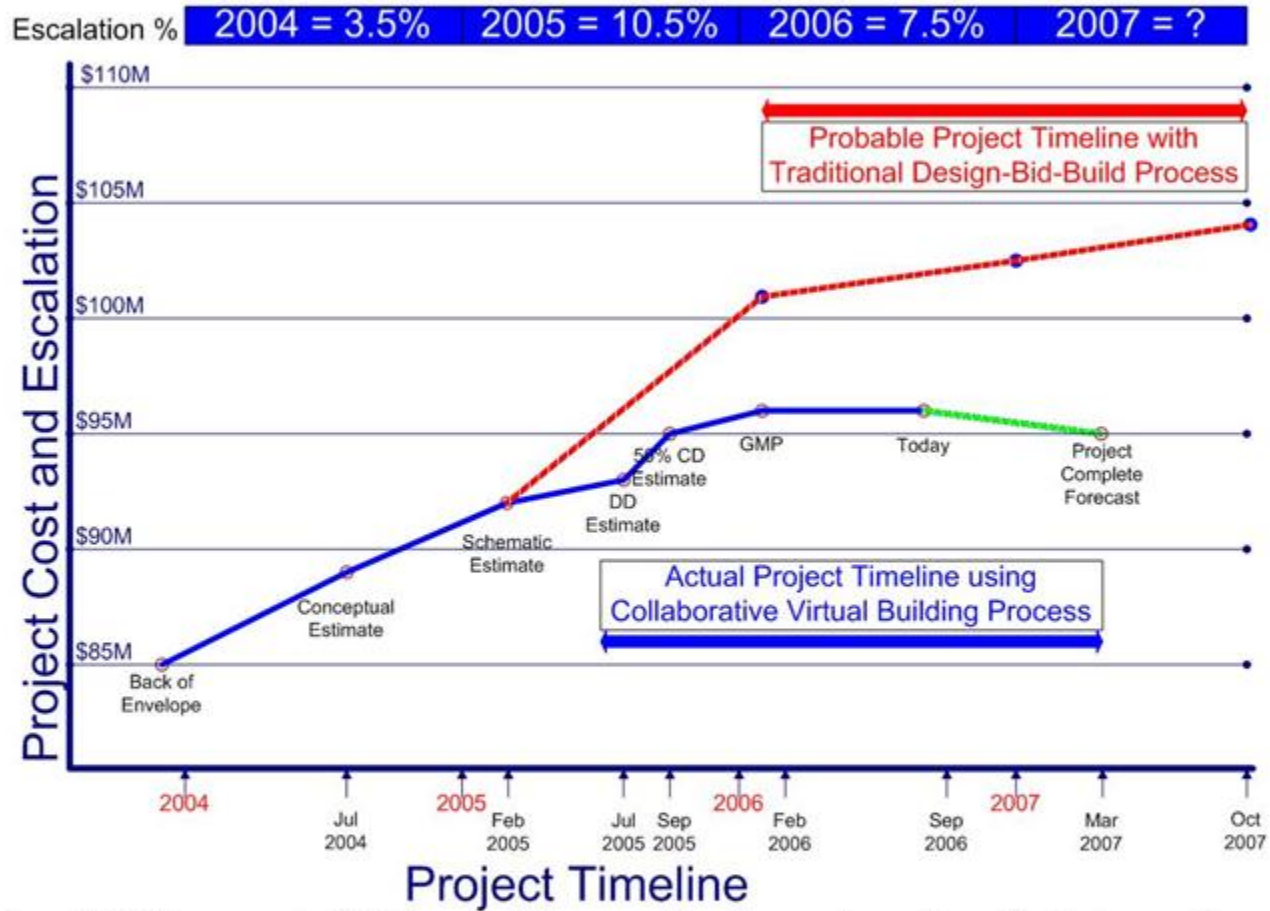
MEP Savings

- 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

HAWLEY PETERSON & SNYDER
ARCHITECTS



EFFICIENCIES AND COST
SAVINGS OF DESIGNING
AND BUILDING VIRTUALLY





Funding Transformation

building**SMART**alliance™



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.

Presenter Contact Information

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