Advanced School Design and Technologies

Smart Buildings & Controls

December 12, 2003

SIEMENS
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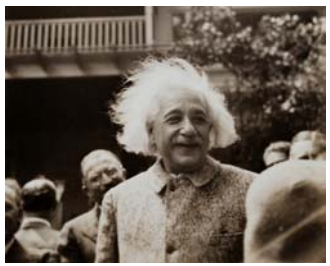
Discussion Agenda

- What is a “Smart Building”
- Management Tools
- Technology Tools

Liberty HS, Hillsboro, Oregon

What is a "Smart School"?

- "It provides broadband internet access to all students."
- "It provides distance-learning, to support the community."
- "It uses structured cabling to support all telecommunications, IT, and facility control wiring."
- "It utilizes wireless networks to support all telecommunications, IT and facility control wiring."
- "It integrates all facility control systems into one seamless network using non-proprietary protocols."
- "It utilizes renewable, or clean power."
- ***It depends on what the definer is selling!***



What is a “Smart School Building”?

- Smart school buildings enable students and staff to accomplish their educational mission...
  - with minimized total life-cycle costs to the community, the users, and the environment,
  - and with flexibility to adapt to new uses, and technologies.

Management Tools

1. Benchmarking
2. Monitoring / Metering
3. Performance Management
4. Financial Analysis Tools
5. Project Financing
6. Building Commissioning
7. Training
8. Purchasing / Procurement Processes

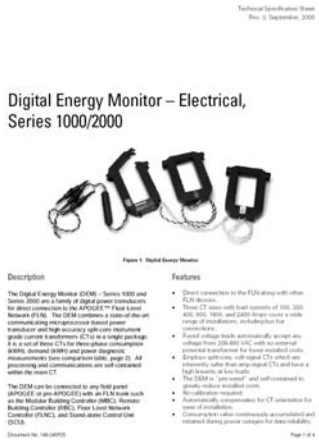
1. Benchmarking

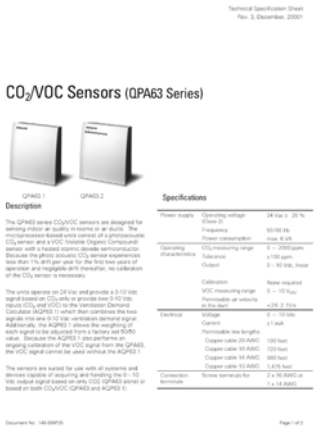
- What is Benchmarking?
  - A comparison of measured performance between similar buildings.
- Measurement Areas
  - Test Scores
  - Avg. Daily Attendance
  - Dropout Rates
  - Facility Construction or Maintenance Costs
  - Energy / Utility Consumption
- Benefits
  - Identify Savings Opportunities
  - Identify Best Practices

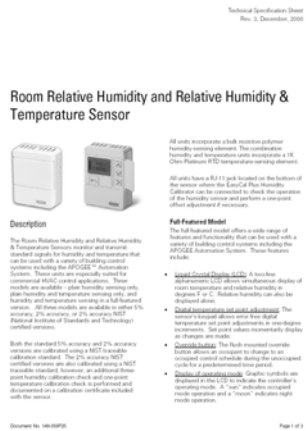
- Sample Sources
  - National Center for Education Statistics **http://nces.ed.gov/**
  - Oregon Dept. of Energy **http://www.energy.state.or.us/sb1149/Schools/index.htm**
  - National Clearinghouse for Educational Facilities **http://www.edfacilities.org/**

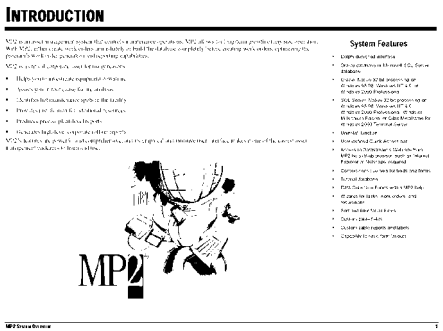
2. Monitoring/Metering

"If you don't monitor it or meter it, you can't manage it."









■Utilities

Electricity
Gas/Fuel
Water
Sewer

■IAQ

CO2
Volatile Organics
Air Changes
Filters

■Environment

Temperature
Pressure
Humidity
Light Levels

■Maintenance

Labor
Materials
Repair
Downtime

3. Supplier Performance Management

- Performance Management
  - Partner with Key Suppliers
  - Define Performance Objectives
  - Measure and Report Progress Regularly
- Benefits
  - More Control Over Scope and Quality of the Work
  - More Consistent Performance / Better Value
  - Identify New Products and Services

Service Component	Exceeded Requirement	Met Requirement	Did Not Meet Requirement
Responsiveness		✓	
Training		✓	
On-Site Coaching		✓	
Network Analysis and Optimization		✓	
Control Loop Analysis and Optimization		✓	
Software Analysis and Upgrades, Firmware Upgrades and Panel		✓	
Repair & Replacement		✓	
System Documentation Updates		✓	
Quality Assurance		✓	
Energy Monitoring and Reporting		✓	

"The hardest thing in the world to understand is the income tax."
-- Albert Einstein

4. Financial Analysis Tools

- Internal Rate of Return (IRR)
  - Expressed as an interest rate. Useful when a project will generate savings, and the project is to be compared to other savings projects, or investments. **http://www.rebuild.org/lawson/irr.asp**
- Net Present Value (NPV)
  - Expressed as a dollar cost. Useful when comparing alternative designs for a project. Accounts for all costs a.k.a. life-cycle-costs, including interest. **http://www.rebuild.org/lawson/npv.asp**
- Simple Payback
  - Expressed as the number of years required for an investment to be recovered through savings or payments. Only appropriate for very simple projects with even cash flows.

"God doesn't play dice."
-- Albert Einstein

5. Project Financing

http://www.energy.state.or.us/sb1149/Schools/NorthSantiam.PDF

Traditional-Debt Capital	Lease Finance	Performance Contracting
1. Facilities department conceives of project.	1. Same	1. Same + performance contractor involvement in analyzing benchmarks, and targeting the projects.
2. Hire consultants to develop project scope, budget, and savings estimates.	2. Same + identify vendor or leasing company to provide financing.	1. Performance contractor co-develops scope. 2. Performance contractor develops designs, fixed pricing, and guaranteed savings.
3. Submit project for bond/budget approval. Compete with other projects for budget.	3. Submit project as part of the operating budget.	1. Project with fixed price and guaranteed savings is submitted for approval within the operating budget, along with financing.
4. If budget approved, issue plans and specifications for bid.	4. Same	1. If approved, move directly to construction.
5. If bids within budget, construct project.	5. Same	
6. Operate and maintain improvements. Monitor performance for savings.	6. Same	1. Performance contractor takes responsibility for guaranteed savings to ensure finance payments can be met.

6. Building Commissioning

Washington State Department of General Administration
Building Commissioning

- Building Commissioning / Recommissioning
  - A comprehensive process to ensure that building systems are constructed and operated as designed.
- Keys to Success
  - Clear, complete, and current design criteria.
  - Commissioning team must be empowered with:
    - consensus, participation, and authority
    - adequate time & funding
    - multi-disciplinary expertise
    - communication & leadership skills
- Benefits
  - reduced operating costs & risks
  - improved operation and maintenance
  - improved indoor environmental quality

NCBC

Oregon Office of Energy

BUILDING COMMISSIONING ASSOCIATION

PECI

Portland General Electric

Northwest Energy Efficiency Alliance

"Teaching should be such that what is offered is perceived as a valuable gift and not as a hard duty." -- Albert Einstein

7. Training

- Define Goals
  - Job Duties
  - Level of Expertise Required
- Measure Gap
  - Interview Personnel
  - Measure Skills
- Design Program
  - Internal & External Sources
  - On-Line Training
  - OJT
- Funding
  - Construction Projects
  - Service Agreements
  - Internal Labor Rates
- System Design Caution
  - Don't create a training gap!

"Sometimes one pays most for the things one gets for nothing."
-- Albert Einstein

8. Purchasing / Procurement Processes

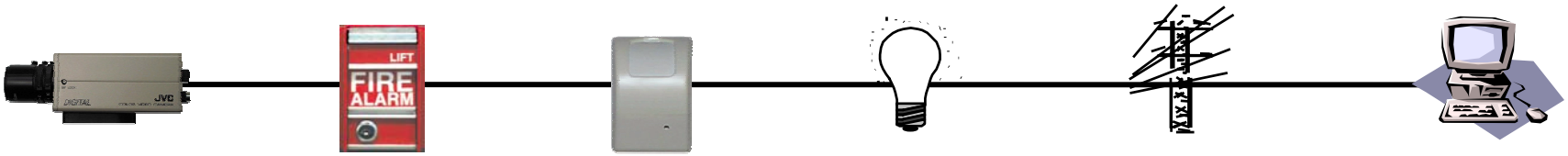
- High Performance Schools use Sophisticated Building Control Systems
- These Systems are More Similar to IT than to Brick and Mortar
- Building Construction is now Commonly Procured via CMGC Instead of Low Bid
- Why Not Procure Building Controls via CMGC or Design - Build?
  - **http://www.agc-oregon.org/public/resource_center/db_whitepaper_final.pdf**
- ORS 279.005 Allows for Selection Based on Price and Qualifications

Technology Tools

1. Integrated Building Systems
2. Internet Applications
3. Structured Cabling
4. Wireless Applications

"The secret to creativity is knowing how to hide your sources." --Albert Einstein

1. Integrated Building Systems



Security **Life Safety** **HVAC** **Lighting** **Power** **Operation and Management**

- Benefits
  - Shared Resources: Networks, PCs, Software, Training, and Parts
  - Functional Integration: Interoperability Between Different Systems
  - Contractual Integration: Single-Point-Contact for Installation and Service, Reduced Procurement Costs

BACnet
ECHELON
OPC FOUNDATION
MODBUS.ORG

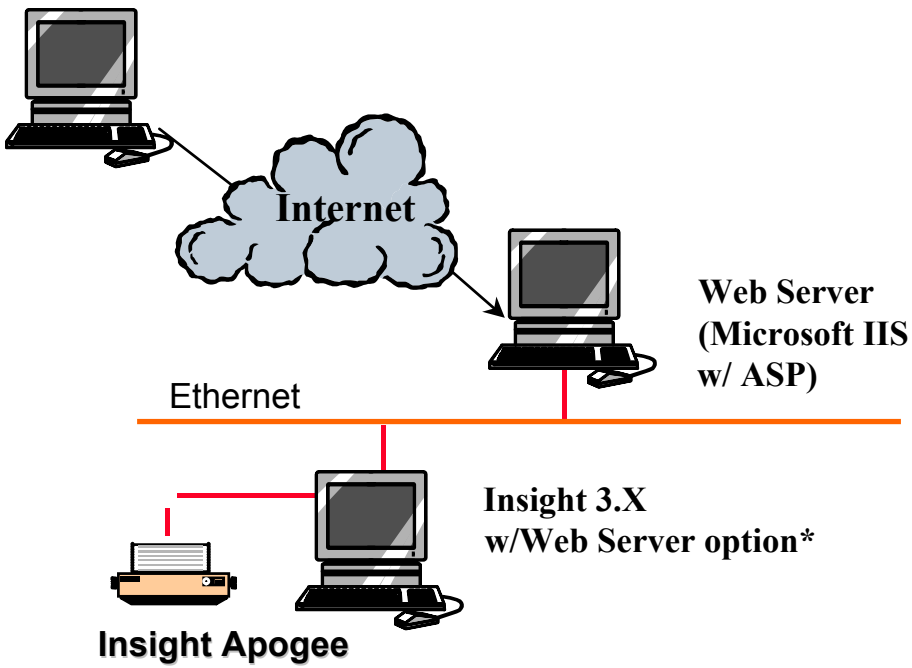
"The secret to creativity is knowing how to hide your sources." --Albert Einstein

1. Integrated Building Systems

- Functional Integration Examples:
  - Window status switch turns off HVAC when window is open during normal occupancy. Generates security alarm when open after-hours.
  - Card access, telephone, or occupancy sensor override of HVAC and lighting.
  - Fan shutdown, purge, pressurization and other smoke control functions based on fire alarm and HVAC control integration.
  - Remote alarm monitoring, override and adjustment of all building functions.

"I never think of the future. It comes soon enough."
--Albert Einstein

2. Internet Applications

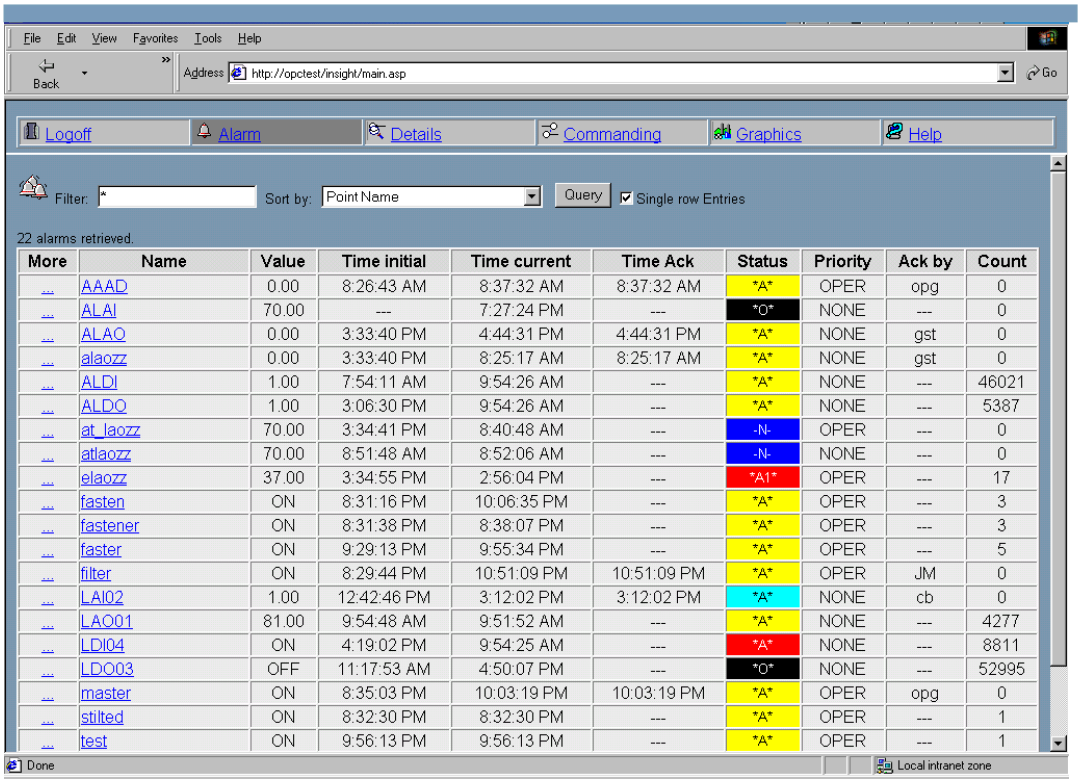


- Facility Management System Remote Access
  - Standard PCs and browser software to access real-time data, and control all building systems.

"I never think of the future. It comes soon enough."
--Albert Einstein

2. Internet Applications

- Functionality
  - Graphic Display
  - Alarms
  - Point Detail and Command
  - Password Security and Activity Tracking
- Benefits
  - Lower First Cost and Upgrade Cost for Hardware and Software



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...	ALAI	70.00	---	7:27:24 PM	---	*O*	NONE	---	0
...	ALAO	0.00	3:33:40 PM	4:44:31 PM	4:44:31 PM	*A*	NONE	gst	0
...	alaozz	0.00	3:33:40 PM	8:25:17 AM	8:25:17 AM	*A*	NONE	gst	0
...	ALDI	1.00	7:54:11 AM	9:54:26 AM	---	*A*	NONE	---	46021
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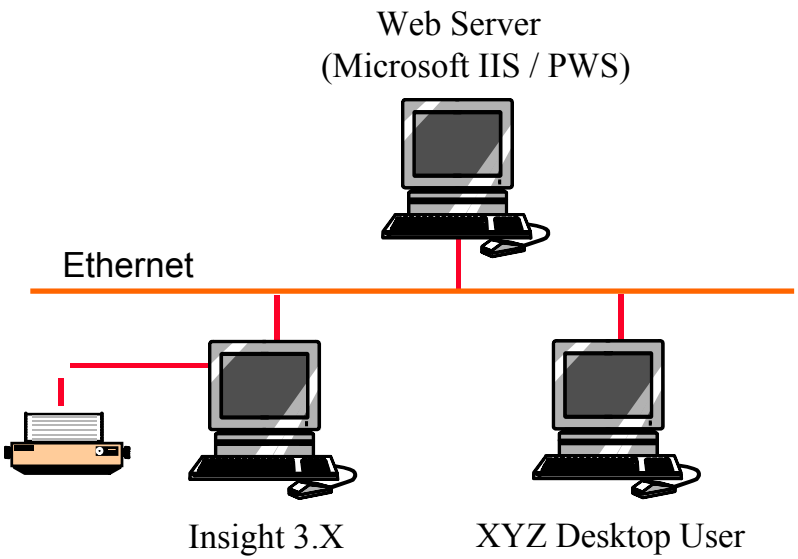
2. Internet Applications

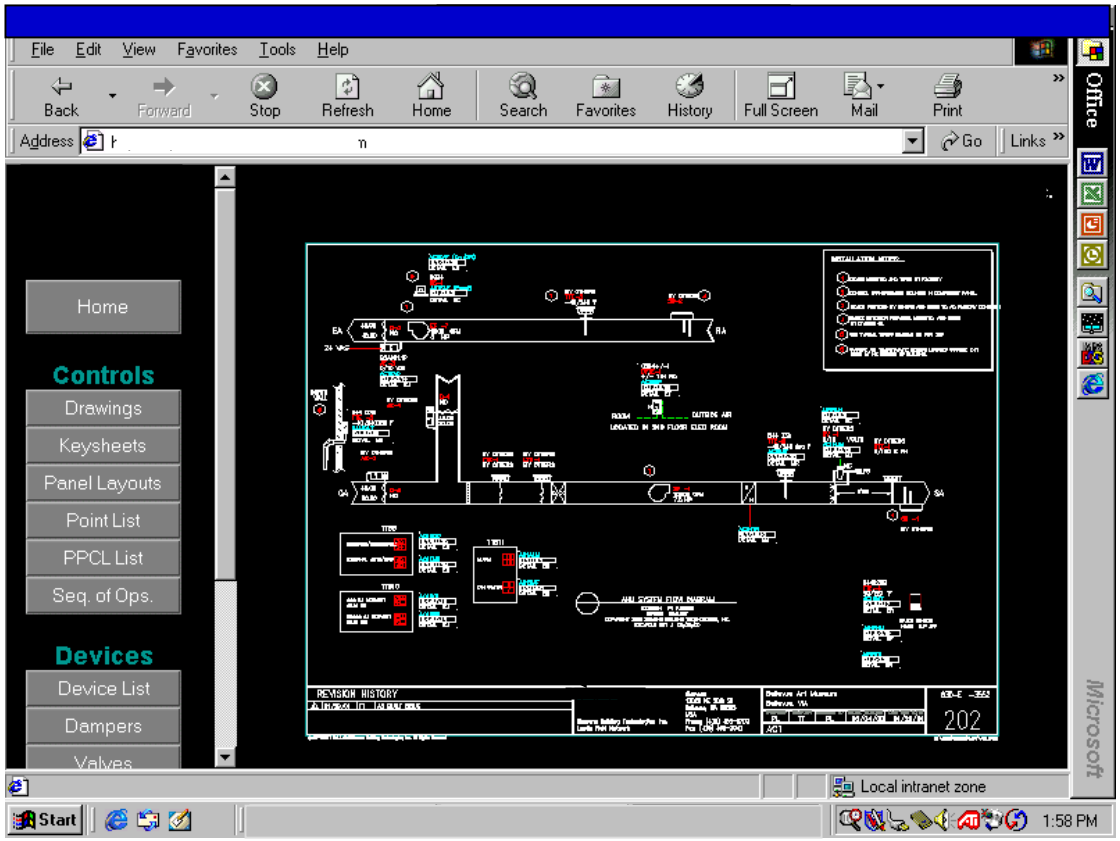


- As-built and O&M Web Access
  - Standard PCs and browser software to access as-built drawings, and operations and maintenance data for any system.

"I never think of the future. It comes soon enough."
--Albert Einstein

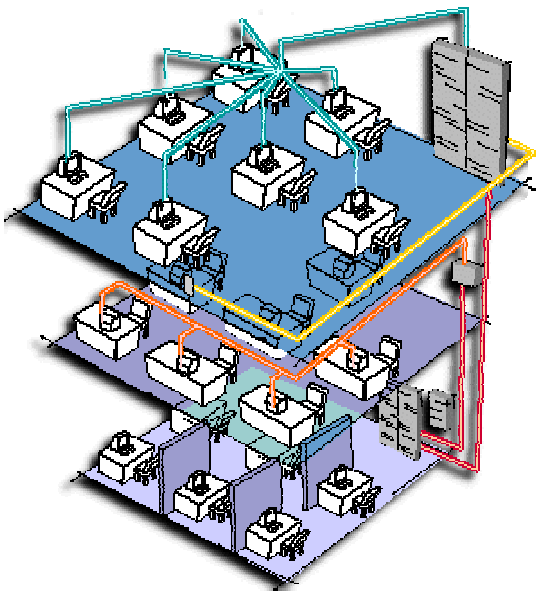
2. Internet Applications

- Functionality
  - View AutoCad
  - View Submittals
  - View O&M Bulletins
  - View Operations Manuals
- Benefits
  - Eliminate Lost, or Inaccurate Documents
  - Save Space
  - Easier Access to Data (Remote)



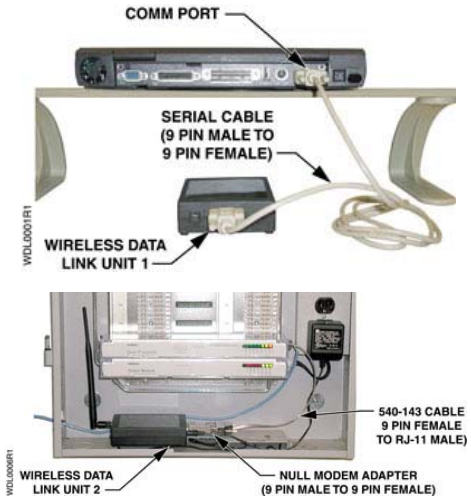
"If I had my life to live over again, I'd be a plumber."
-- Albert Einstein

3. Structured Cabling



- A set of cabling and connectivity products to integrate the cabling of voice, data, video, and facility management (FMS).
  - Most effective in carrying FMS network traffic, not sensor/field device signals.
  - Requires comprehensive analysis and design.
  - Use caution in applying to life safety and security systems.
- Benefits
  - Cleaner Installation
  - Lower first cost – depends on size/scope
  - Lower life cycle costs – depends on amount of flexibility required

4. Wireless Applications



Wi Fi
The Standard for
Wireless Fidelity.

Wireless Space Temp Sensor

Lower installation cost

Remodel-Proff

Wireless Commissioning Tools

Lower labor cost

Panel Location Flexibility

Wireless Networking

Lower installation cost

Supports Ethernet connection up to 300 feet indoors

Wi-Fi standard is helping to lower cost

Thank You For Your Participation!

- A smart school building enables students and staff to accomplish their educational mission;
- it does so with minimized total life-cycle costs to the owners, users, and the environment,
- and it provides flexibility to adapt to new uses, technologies and economies.