INTERNATIONAL AIR-CONDITIONING • HEATING • REFRIGERATING EXPOSITION

AHR EXPO
2012, January 23-25
McCormick Place North & South
Chicago, IL

Co-sponsors:

The Tools of
Visibility and Interaction

9:30 am Tuesday, January 24th

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Managing Principal,
Smart Buildings LLC

- Ken Sinclair Publisher/Owner

www.AutomatedBuildings.com

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Welcome to Chicago AHRExpo

This Unique venue/arena supplied by International Exhibition allows us take our online service/magazine off line and Face 2 Face with you

4 Free Sessions on How to Make Sustainability and Energy Visible

The New Visibility & Interactions in the Building Automation Industry
9:00 am Monday

New Open Source Technologies that are Changing the Industry
1:30 pm Monday

The Tools of Visibility and Interaction
9:30 am Tuesday, January 24th

The Visible Campus – Bringing Sustainable & Energy-Wise Designs to Focus
1:30 pm Tuesday, January 24th

New Visibility & Interactions

"Making the Invisible Visible" is about how we as an industry depict our invisible cornerstones of comfort, energy, and environmental impact.

How can we best show what cannot be seen: Temperature, Comfort, Electricity, Performance and their relationship to sustainability, and the information and interaction to maintain all ?

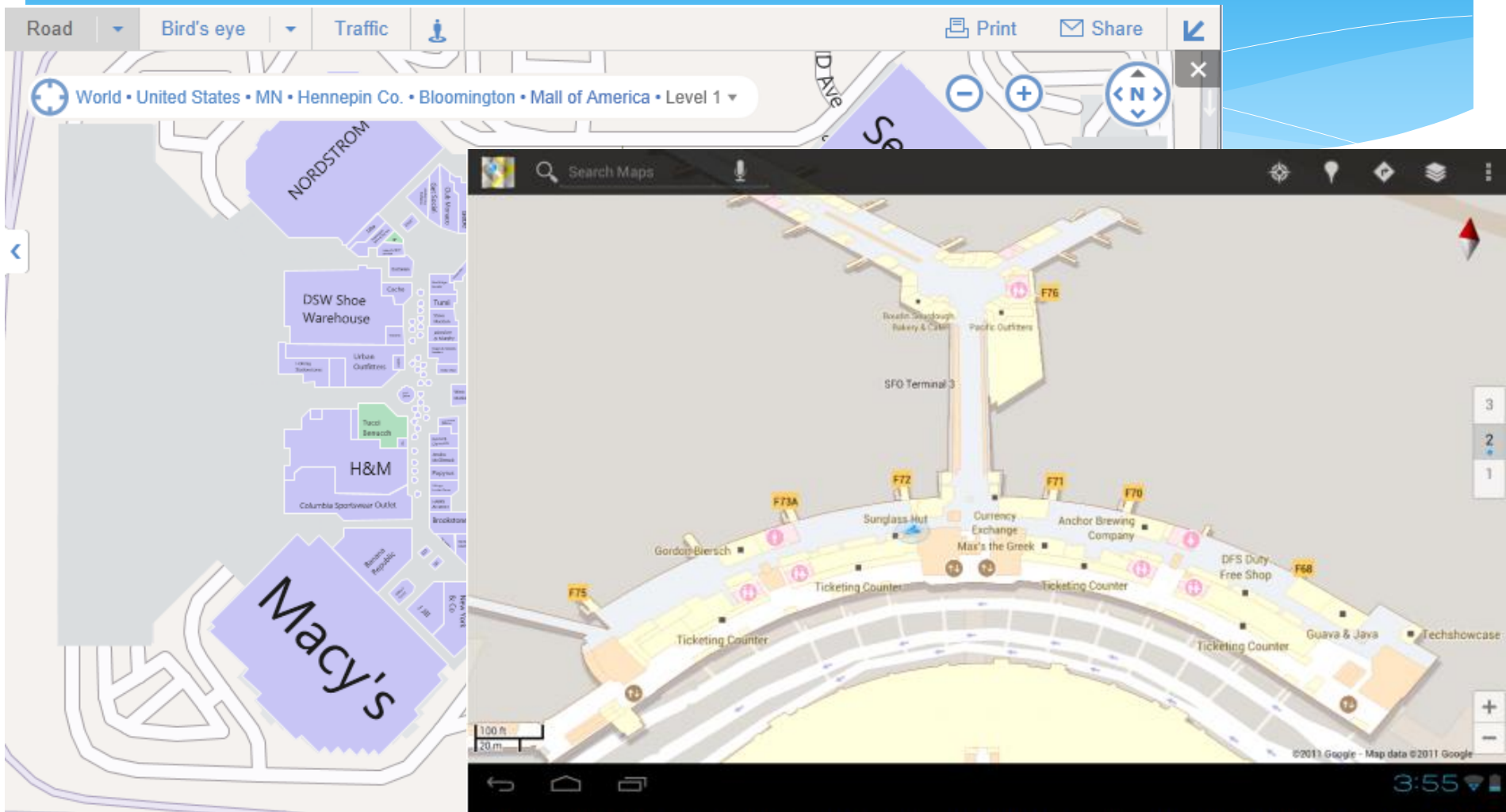# Cloud-Ready Buildings and Open Source
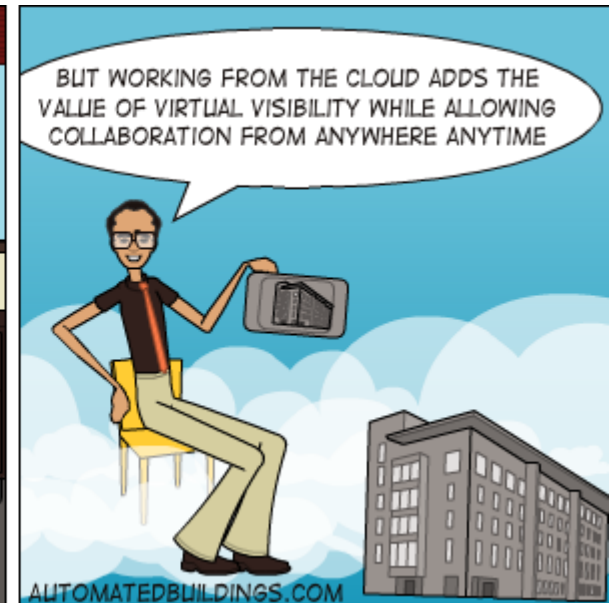
Buildings Becomes Mobile
Any Platform, Any Place, Any Time

Google and Bing take street level to our level with evolving standards

Road ▾ | Bird's eye ▾ | Traffic | 📷 | 🖶 Print | ✉ Share | ↙

World • United States • MN • Hennepin Co. • Bloomington • Mall of America • Level 1 ▾

NORDSTROM

DSW Shoe Warehouse

H&M

Columbia Sportswear Outlet

Macy's

Search Maps

SFO Terminal 3

F76

Boudin Sourdough Bakery & Café — Pacific Outfitters

F72 — F73A — F71 — F70

Sunglass Hut — Currency Exchange — Anchor Brewing Company

Gordon Biersch — Max's the Greek — DFS Duty Free Shop — F68

F75 — Ticketing Counter — Ticketing Counter

Ticketing Counter — Ticketing Counter — Guava & Java — Techshowcase

100 ft
20 m

©2011 Google - Map data ©2011 Google

3:55

The new Maps lets airport patrons navigate sites like San Francisco International from the inside. *Photo courtesy of Google*

Our palette also grows larger

Graphics Convey a Message

Make the Invisible Visible

Analytics Systems
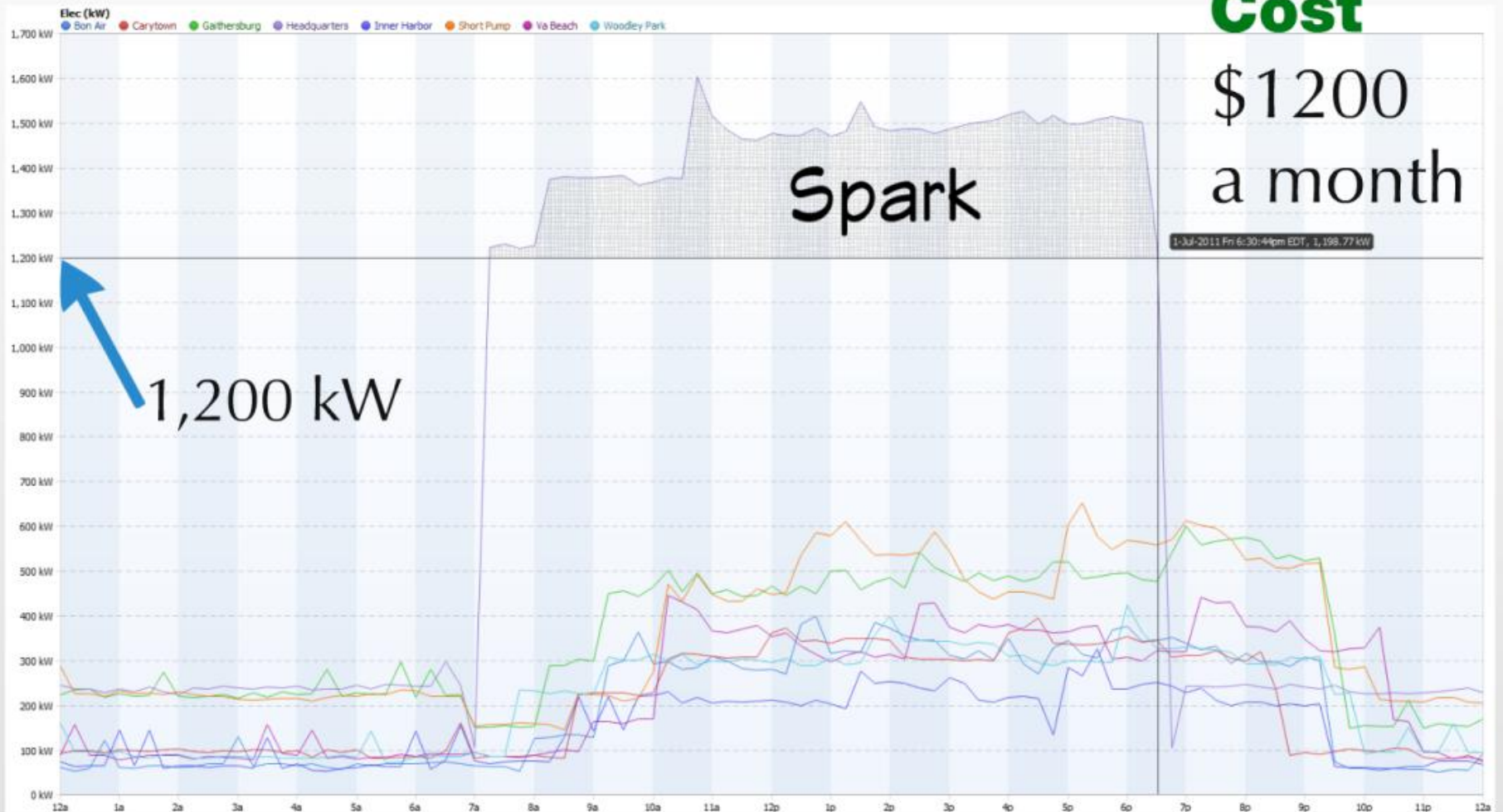
"Open" as a tool

Facets of "Open"

* Device Connectivity
  * Communication protocols – BACnet, LonTalk, oBIX.
  * Enables device connectivity – multi-vendor systems
* Public interfaces – Application Programming Interfaces (APIs)
  * Enables third parties to develop external applications that can access data from the system
* Acquisition – Can I buy it from multiple sources
  * Access to products for initial purchase and system expansion
  * Enough supplier options to create a competitive situation

Examples of Open Communities

* Open source initiative to develop naming conventions and taxonomies for building equipment and operational data

* Define standardized data models for sites, equipment, and points related to energy, HVAC, lighting, and other environmental systems.

* >100 industry experts from around the world contributing to an open source standard

Project Haystack

HOME DOCS TAGS FORUM DOWNLOADS

What is Haystack?

Project Haystack is an open source initiative to develop naming conventions and taxonomies for building equipment and operational data. We define standardized data models for sites, equipment, and points related to energy, HVAC, lighting, and other environmental systems.

Learn More

- Start with the Documentation
- View the Tag Docs

Get Involved

We use the forum to gather feedback and collaborate. If you would like to participate, please signup and let us know how you would like to pitch-in!

Why Do We Need Haystack?

Macro trends in technology are making it increasingly cost effective to instrument and collect data about the operations and energy usage of buildings. We are now awash in data and the new problem is how to make sense of it. Today most operational data has poor semantic modeling and requires a manual, labor intensive process to "map" the data before any analytics can begin. Pragmatic use of naming conventions and taxonomies can make it more cost effective to perform analytics and derive value from our operational data.

Who Should Participate?

Project Haystack encompasses the entire value chain of building systems and related intelligent devices. Owners and consultants can specify that Haystack conventions are used in their building automation systems to ensure cost effective analytics and management of their buildings for years to come. System integrators and manufacturers who integrate Haystack support into their projects and products are positioned for the future of value added services.

Open Source

http://project-haystack.org/

SGIX
Smart Grid Information Exchange

* OpenADR is a tested specification for achieving automated demand response
* Energy Market Information Exchange (EMIX)
* Financial Information Exchange (FixML)
* The OASIS standard oBIX offers an extensible Web Services (WS) framework for communication with building control systems
* WS-Calendar should be developed outside the SG effort as its anticipated uses extend into many business interactions.
* Digital Weather Markup Language DWML is an existing specification developed by NOAA

Existing Open Communities
Quasi Dictatorship? Like Apple?

* Tridium has pioneered "Open" in our industry with the Niagara Framework www.niagarasummit.com and their work with oBix Haystack etc.

* Several vendors build products on Niagara open platform.

* This has lead to several other vendors building product on other platform all IP based.

* All have the goal of collecting data from disparate building systems and creating a single, integrated view of building and system performance.

An overview of Jim's projects and how they use
visibility and interaction.

San Francisco Public Utility Commission Headquarters Integrated Building System (IBS)

* 277,000 sq. ft.

* LEED Platinum

* 45% daylight harvesting

* 55% percent less energy

* 32% less electricity demand

* 3 roof tops of solar panels

* Water Reclamation system

* Wind turbines

* 13,500 data points

* 460 Dashboards

* Middleware

Systems and Applications

Building Systems

* Conveying Equipment
* Irrigation System
* Waste Water Treatment System
* Direct Digital Controls
* Digital Network Lighting Controls
* Power Monitoring and Control System
* Communications
* Electronic Access Control & Intrusion
* Digital Video Surveillance System
* Fire Alarm and Detection System
* Solar Energy Collector Metering
* Wind Energy Electrical Power Generator Metering
* Interior and Exterior Sun Control and Window Shade Control System
* Seismic and Weather Station Monitoring System
* Window Washing System
* Water Reclamation
* Domestic Hot Water

Major Applications

* System Scheduling
* Trend Analysis
* Data Archiving
* Energy Management
* Demand Response
* Building Analytics /Fault Detection And Diagnostics
* Energy Information and Public Information Dashboards

Major Healthcare Company

- 150 Sites, 50M Sq. ft.
- Expenditures of over $200M annually on electric power and natural gas
- Goals:
  - Reduce Demand
  - Reduce Costs of Supplies
  - Standardize Operations
- Solution: A Energy Operations Center

EOC Conceptual Network Architecture

SOFTWARE APPLICATIONS

- Energy Management Software
- Alarm Management
- Fault Detection and Diagnostics
- Measurement and Verification
- Demand Response
- Trending

Energy
Operations Center Staff

Operator Terminals

Tablets & Smart phones

Applications

Databases and Middleware

Utilities

Facilities Management System

Work Order System

Preventative Maintenance

Material/ Equipment Management

Business Systems

Asset Management

Purchasing

Capital Planning

EOC IT Network

Network or VPNs to EOC

Building Level Database Servers

Energy Control Systems (HVAC, Lighting, PMCS, metering)

LAN Area

LAN Area

LAN Area

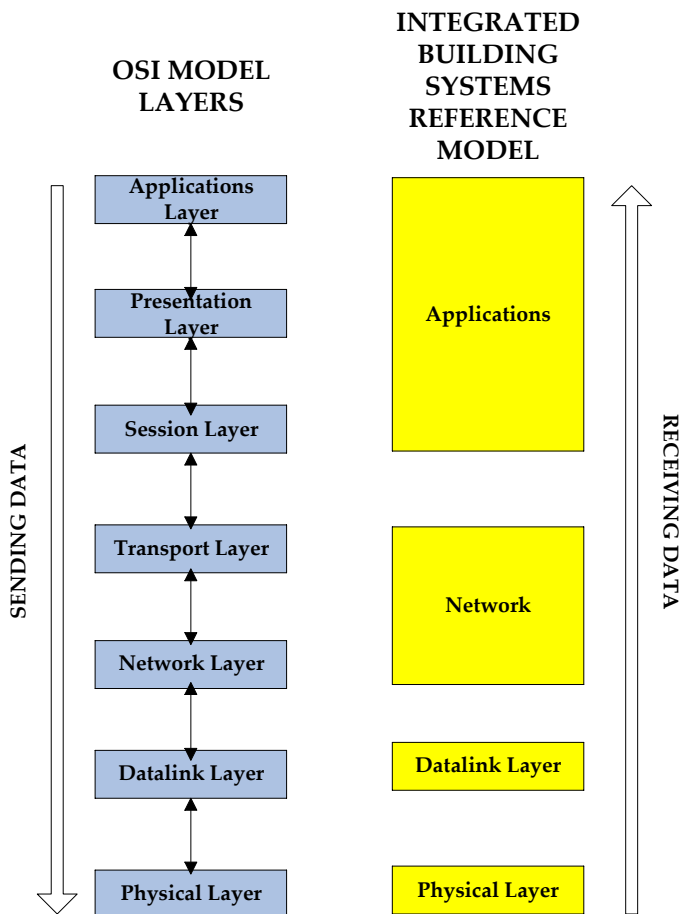| **Smart Buildings, LLC**	
Jim Sinopoli	5/7/2011

Tip #1
Identify The Level of Integration and SOO

System Integration Levels in Buildings

	Description	Protocols	Applications	Communications Integration	Business Information Management Impact
Level 6					
	Level 5 & Full Enterprise Application Data Integration	Level 5 & XML, SOAP, WSDL	Oracle, HP, SAP, Microsoft, other Business Systems	Level 5 & Data Integration to Business Level Servers	Executive Level Sophisticated Software Data Exchange
Level 5					
	Level 4 & Multiple Specialty Systems	Level 4 & OPC, DDE, Server to Server	Specialty Systems for Hospital, Data Center, LAB, etc....	Multiple Network Integration & Multiple Subsystems	Multiple Systems Software, Application Exchange
Level 4					
	Level 3 & IT Wired/ Wireless	Level 3 & SNMP, Wireless	Level 3 & IT Hardware	Integrated IT/ IDF, LAN/WAN Wired & Wireless	Multi-Departmental and IS Information
Level 3					
	Level 2 & Subsystems & IP Network	Bacnet, LON, Modbus	Card Access, CCTV, or Specialty Subsystem	System to System & IP Network LAN	Departmental Information Exchange
Level 2					
	Level 1 & Electrical Systems	Bacnet, LON, Modbus	High Voltage Power Monitoring & Metering	System to System Dedicated Pathway	Facilities Level Information
Level 1					
	Stand Alone Web-Based BAS + Equipment	Bacnet or LON	DDC, Chillers, Boilers, DX Equipment	System to Equipment Dedicated Pathway	Little to None

Smart Buildings
Principles of Integration©

Methods of Integration

OSI MODEL LAYERS

| Applications Layer |
| Presentation Layer |
| Session Layer |
| Transport Layer |
| Network Layer |
| Datalink Layer |
| Physical Layer |

SENDING DATA

INTEGRATED BUILDING SYSTEMS REFERENCE MODEL

| Applications |
| Network |
| Datalink Layer |
| Physical Layer |

RECEIVING DATA

* **Hard-Wire**

* **Proprietary / Bundled / Packaged Integration**

* **"Dating" Integration**

* **Open Standards**

Implementation Issues with Open Networks

* There Can Be Proprietary Implementations Of Open Standard Network Protocols

* Every Device That Is Part Of A Building Technology System May Not Necessarily Need to Be Networked

* The Network May Be Open But The System Application Software May Not Be.

* Not Every Device May Use Standard Structured Cable

* Data Rates For Some Devices Are So Tiny That IP Enablement Is Overkill

New Energy Systems And Applications FM Will Need To - Manage

* Solar panels
* Geothermal sources
* Wind turbines
* Vehicle recharge stations
* Electrical switchable glass
* Exterior shading systems
* Wireless building systems
* Demand response planning
* Energy Dashboards
* Sun tracking systems
* Personnel RFID systems
* Structural anti-corrosion monitoring systems
* Oxygen depletion monitoring systems
* Personal rapid transit systems

Systems Integration Matrix

Smart Building Integration Matrix

	Data Network	Structured Cable	Grounding System	VoIP	UPS Systems	Video Distribution System	Audio Visual Systems	Access Control Systems	Video Surveillance System	Intrusion Detections System	Wireless Systems	HVAC Man. Control System	Electric Power Man. Control Sys	Lighting Control System	Fire Alarm Systems	Elevator Systems Controls	Facility Management System	Integration of Business System
Data Network		•	•	•	•	•	•	•	•		•	•	•	•			•	•
Structured Cable	•		•	•	•	•	•	•	•		•	•	•	•	•		•	•
Grounding System	•			•	•	•	•	•	•		•	•	•	•	•	•	•	•
VoIP	•	•		•		•		•			•			•		•		
UPS Systems	•		•		•	•	•	•	•			•	•	•	•			
Video Distribution System	•	•	•		•			•								•	•	
Audio Visual Systems	•	•	•		•						•			•				
Access Control Systems	•	•	•	•					•		•		•			•	•	
Video Surveillance System	•	•	•		•			•			•				•	•		
Intrusion Detections System			•		•			•	•									
Wireless Systems	•	•	•		•			•		•								
HVAC Management Control Systems	•	•	•		•		•	•			•			•		•	•	•
Electric Power Management Control Systems	•		•		•											•	•	•
Programmable Lighting Control Systems	•	•	•	•		•	•	•	•		•			•		•		
Fire Alarm Systems		•	•			•		•	•			•		•		•	•	
Elevator Systems Controls			•	•	•		•					•		•	•			
Facility Management System	•			•		•	•	•	•	•	•	•	•	•	•	•		
Integration of Business Systems	•					•		•									•	

Tip #2
Develop A Data Plan

Tip #2 - Data Planning

* Most building operations have never thought of and do not have a data management plan.
  * BMS
  * Limited to just those systems monitored or managed by BMS
  * Setup of the database, the naming conventions formats and structure is left to the contractor
  * Getting the data out of the BMS database can be difficult
* Comprehensive planning means broader look at all the data and information to manage the building's performance.

MANAGEMENT SYSTEM FOR ENERGY

MANAGERIAL

PLAN:
• Policy/goals/targets
• Resources

DO:
• Training
• Communication
• Control equipment systems & processes

CHECK:
• Corrective/ preventive action
• Internal audits

ACT:
• Management review

ACT · PLAN · CHECK · DO

TECHNICAL

PLAN:
• Energy data management
• Assessments

DO:
• Energy purchasing
• Design
• Projects
• Verification

CHECK:
• Monitoring
• Measurement

ACT:
• System performance

Data Management Planning

* Identify the data and information that different people or groups involved with the building's performance need to perform their work.

* Some data may be needed that's in:
  * business systems
  * systems outside of FM
  * outside the organization.

* Identify
  * where the data exists
  * how it will be generated and collected
  * how it will be accessed
  * scale or volume of data.
  * Decide on a data format.
  * Deal with the administrative aspects :
  * user access, dissemination of the data, how data will be integrated, how it will be archived, retention policies, how often the plan is reviewed, etc.

Tip #3
Bring IT in Early in the Process

IT Role

* SaaS
  * Connectivity
  * VPN
* On-site Servers in IT's Data Centers
* Other Relevant Systems
  * Accounting
  * Purchasing
* Corporate IT Security
* IP Addresses

The Progression of IP Convergence

- Data Network
- VOIP
- Surveillance Cameras
- Card Readers
- IPTV
- Ethernet VAV Controllers
- Wi-Fi BAS Controllers
- BAS Network Controllers
- Servers, databases, workstations, etc.

Assign Temporary IP Address

Access Point Name	WLAN01
MAC Address	00.90.d1.01.6b.9e
IP Address	172.20.161.0
Subnet Mask	255.255.255.0
Default Gateway	172.20.161.1

OK   Cancel

IP, Ethernet and BAS

- IP-based communications reliable and interoperable (LAN & WAN)
- Relatively simple to design, install and maintain
- Scalability: Ease of migration to higher data rates
- Familiar management tools and common skills base
- Provide lower operational and maintenance cost
- Logical and Physical addressing
- Provides enhanced QoS
- Ability to encrypt voice, data and building system data

Tip #4
Standardize Naming Conventions

Naming Conventions

* Standardize what you call things.
* Multiple naming conventions is the largest and most time consuming issue involved with implementing an integrated building management system.
* Coordinate with other corporate systems
  * Asset Management
  * Capital Planning
  * Regulatory Compliance
  * Purchasing
* The format of a naming convention for data and equipment is less important than strict adherence to and enforcement of one standard naming convention.

Tip #5
Use Analytics and Data Mining

Analytics

- Opportunities in gaining insight into their building's performance
- Other organizations and businesses "mine" data
- Data mining very mature
- Predictive value means the organization can be proactive rather than reactive.
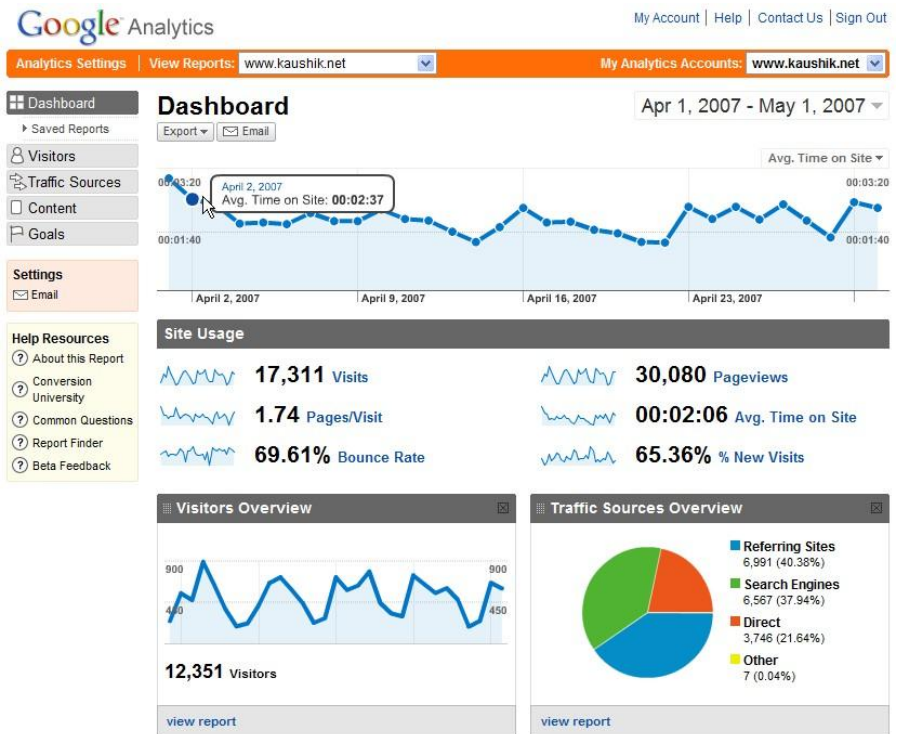
Fault Detection and Diagnostics

* Software tool
* Focuses on HVAC systems.
* Based on research of faults by NIST
* Uses relationships and rules between the different equipment and processes
* Relationships are used to collect fault reports and raw data, and then apply a set of rules.
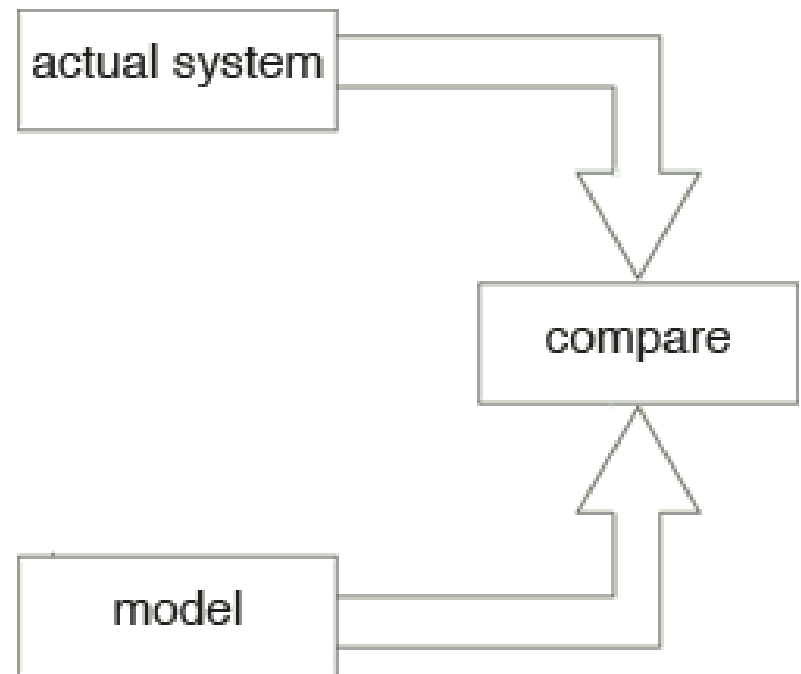
Tip #6
Validate Data

Valid Data

* There's no point in collecting inaccurate data.
* Check the calibration of sensors and meters.
* Building spaces or uses may change; the effect is that while you can confirm or validate the design parameters, for example 54° air being delivered by an air handler, the space may have changed and have a different cooling load, and may not need 54° air from the air handler.
* Systems may need to be adjusted in order to reflect current conditions.

Calibration of Sensors

- Sensors and meters should be regularly calibrated, both the device itself as well as the communication between the device and its controller.

- Inaccurate sensors may provide a false sense of complacency and more importantly waste energy and money.

- If you have a temperature sensor that is 2°off, showing a discharge air temperature of 55° when its actually 53°; this two degrees may trigger extra cooling and additional power consumption by the chiller and air handler or reheating of overcooled discharge air which obviously wastes energy.

Tip #7
Organize Your Document Management

Document Management

* A significant portion of relevant FM information is likely to be in other formats; hard-copy drawings, submittals, O&M manuals, photographs, contracts, faxes, forms, etc.,

* Electronic files in Word, PDF, Excel and Autodesk

* A document management system should be implemented to scan the paper documents into an electronic format and store all of the electronic files.

Tip #8
Understand the Psychology and Purpose of Dashboards

Tidbits

* 50% of the processing in our brain is related to our vision

* We read at the same rate people did 100 years ago.

* No multi-tasking regarding attention - sequential

Model of Situation Awareness

- **Perception of important information**
  - Failure to perceive important information leads to the formation of an incorrect picture of what is going on.
- **Comprehension of the perceived information with regard to their specific job tasks and goals**
  - Failure to accurately comprehend what is happening can lead to reasoning with an incomplete or inaccurate picture of what is actually happening.
- **Projecting where the situation is going**
  - Failure to accurately predict what will happen can lead to initiating the wrong corrective actions.
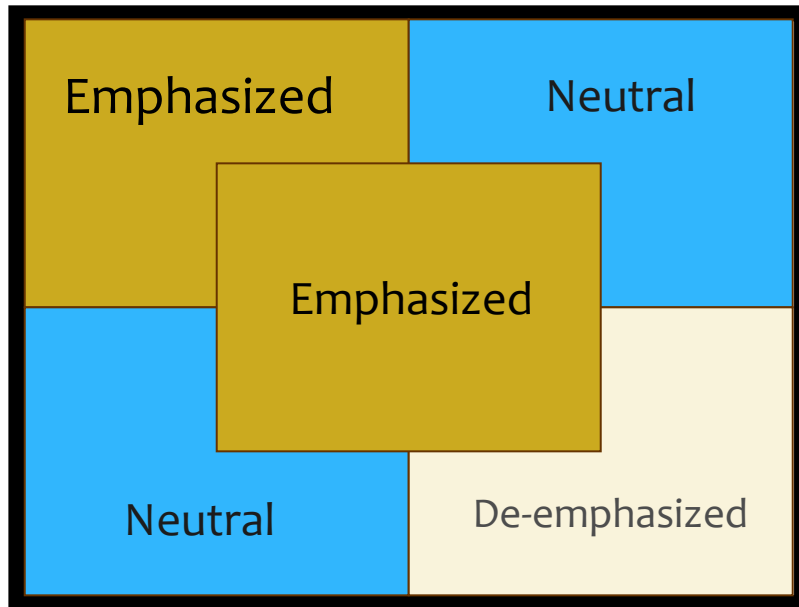
Enhance Attention and Perception

- Use visual display attributes to engage pre-attentive processing to emphasize innate and learned pattern recognition, such as:
    - Color
    - Shape
    - Orientation
    - Layout

HMI Examples
More May NOT Be Better

Salience

Emphasized	Neutral
Emphasized	
Neutral	De-emphasized
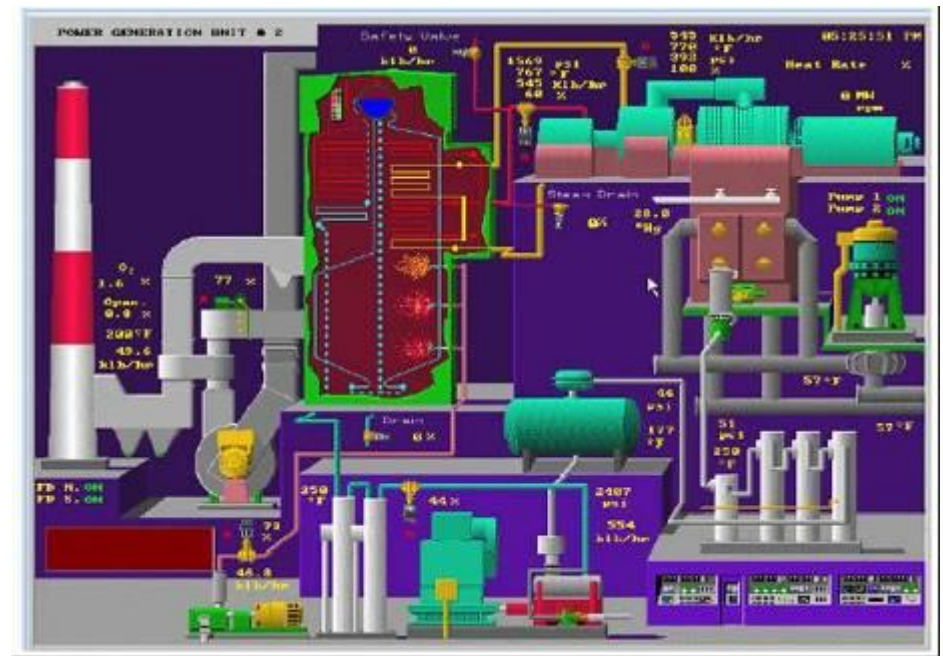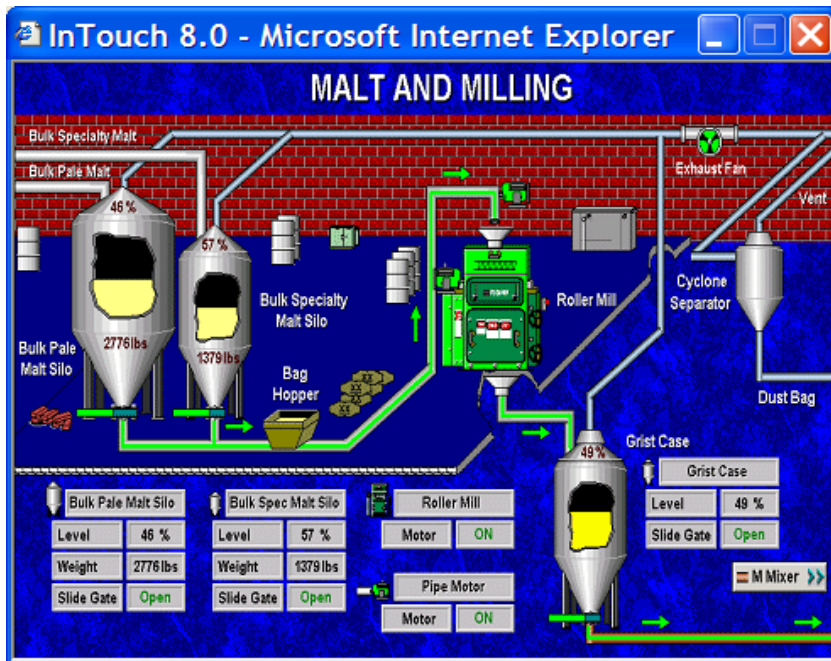
- Information can be emphasized or de-emphasized by its position on a display
  - Function of culture of reading from left to right
  - Visual dominance of center of display

Data Presentation

Are any of these measurements normal or abnormal?

Measurement	Result	Unit
Flow1	75.7	Mg/h
Pressure	2013.3	kPa
Temperature1	245.1	C
Speed	28,265	rpm
Density	68.4	kg/m**3
Flow2	95.6	Mg/h
Temperature2	125.3	C

The answer for each data point requires:

• memory for normal range

• cognition to determine relation to normal range

Information Presentation

Are any of these measurements normal or abnormal?

Measurement	Result	Unit	Reference Range	Indicator
Flow1	75.7	Mg/h	60.0 - 85.0	
Pressure	2013.3	kPa	1800.0 - 2200.0	
Temperature1	245.1	C	175.0 - 250.0	
Speed	28,265	rpm	27,000 - 35,000	
Density	68.4	kg/m**3	65.0 - 85.0	
Flow2	95.6	Mg/h	60.0 - 85.0	
Temperature2	125.3	C	100.0 - 150.0	

The answer for each data point requires:

- perception to scan for data points to the right or left of normal

Gridwise Education Sessions

11:00 am Monday

Smart Grid, Building Automation and Interoperability. How you can benefit.

11:00 am Tuesday

Electricity Markets and HVACR with DR, ESCO 2.0 GridWise™ Architecture Council (GWAC)