U.S. GREEN BUILDING COUNCIL

The Intelligent Building: Sci-Fi or a LEED Necessity?

Ira Goldschmidt, P.E., LEED®-AP

Goldschmidt Engineering Solutions, Inc.

What is an "Intelligent Building"?: Some Basic Thoughts

- A single product or system does not an intelligent building make.
  - A variety of products and functions must be uniquely engineered for a given building.
- There is no "litmus test" of functions that a building must perform to be intelligent.
  - Any set of intelligent building technologies can make a building intelligent in "the eye of the beholder".
- Intelligent building technology does not make a LEED building – it makes a LEED building better!

The Intelligent Building: One Person's Definition

A collection of computerized systems (the Technology) that utilize:

- Structured (shared/organized) cabling
- Ethernet/IP communications (intranets and the Internet)
- Data sharing between disparate systems
- Optimization software and/or artificial intelligence

To provide functions (the Processes) that yield significant improvements (above that of the average building) in:

- Energy efficiency
- Building management/operations efficiency
- Occupant productivity and safety

➢ NOTE – Sustainability is an indirect result

The Intelligent Building "Picture"

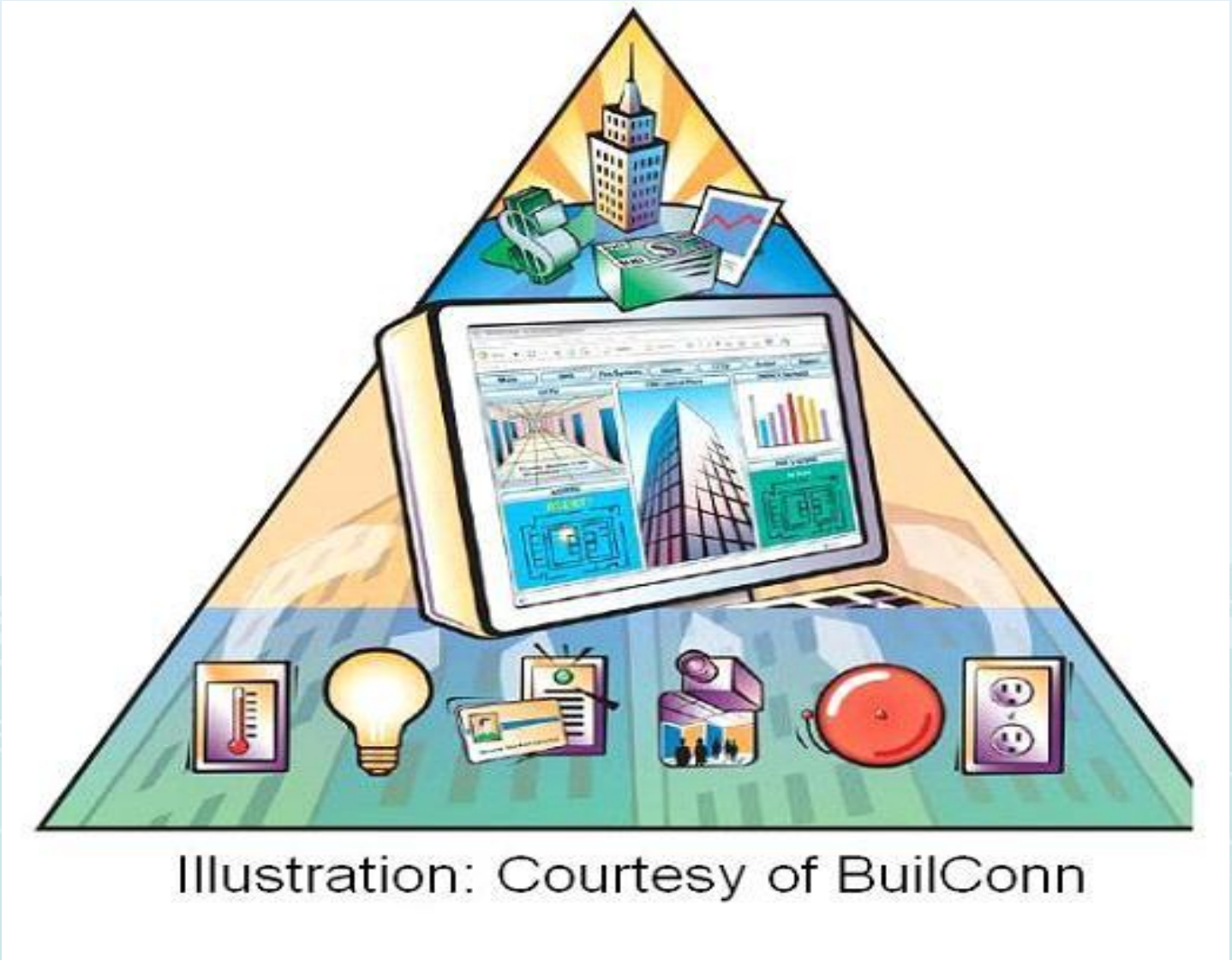


Illustration: Courtesy of BuilConn

The Intelligent Building: The Story Behind the Definition

- Don't think it's just a better building automation system (aka temperature control)!
- The "Technologies" must integrate low voltage building systems and business enterprise systems to provide useful functions ("Processes").
- An intelligent building can only be achieved through more intelligent building design and construction.
- LEED is the most comprehensive program for "transforming the building market" into one which encourages intelligent buildings and design!
- BUT there are other market forces/trends that could contribute to or outpace LEED's influence.

The Intelligent Building: The Conclusion to the Definition

- An intelligent building is not the sole province of the “MEP Engineers”.
- The Owner/Developer and Architect must be an active proponent and participant in the goal of designing and building and intelligent building.
- Once again…sounds like a LEED building!

The Technologies

- Low Voltage Building Systems:
  - Building Automation (aka EMS, DDC, TC)
  - Lighting Control
  - Fire Alarm
  - Security
  - Telephone/Data
- Data Sharing Protocols - BACnet® and/or LONMark®
- Utilizing a common structured IP cabling system

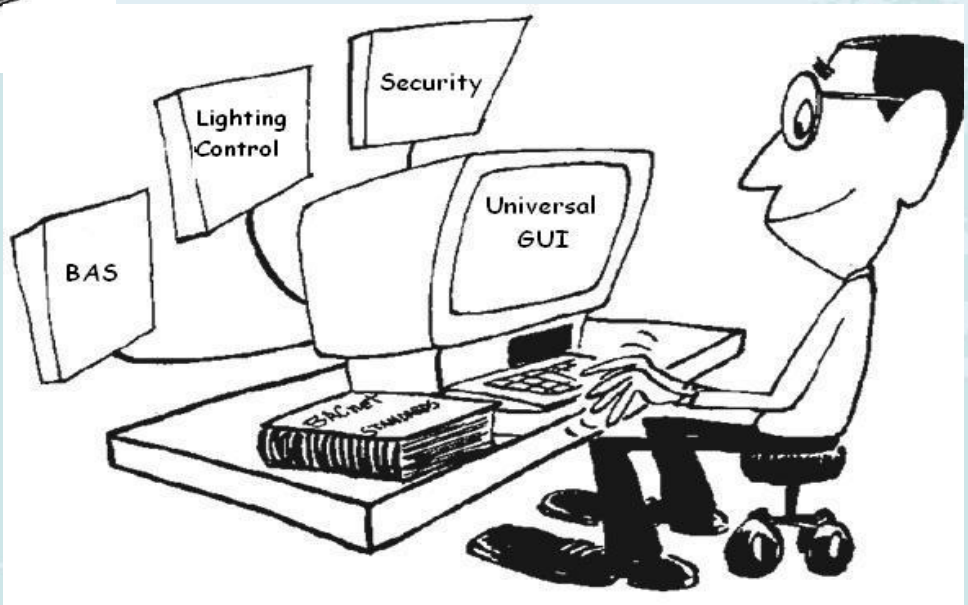
More on the Technologies

- Middleware
  - Maintenance Management
  - Facility Diagnostics and Optimization
  - Energy Tracking & Utility Price Control
- Enterprise Systems
  - Accounting
  - Hotel Check-in
  - Hospital Patient Status Information
  - Tenant website
- IP data sharing using XML (and probably BACnet/XML or oBIX)

Examples of Functions: Lower Levels of "Intelligence"

- Advanced temperature control strategies
  - Central plant optimization based on real-time energy usage
  - Air handling capacity based on load
  - Adaptive loop tuning
- Demand controlled ventilation (CO_2 control)
- Lighting control based on occupancy schedule in BAS
- "Single-seat" interface to all low voltage systems

Single-Seat Interface?



Examples of Functions: Higher Levels of Intelligence

- Hotel HVAC control based on check-in status and occupancy sensing
- Occupancy sensors in conference rooms for lighting control and to set HVAC to unoccupied when unused
- Building maintenance based on BAS run time, vibration sensors, and “facility diagnostics” middleware
- Equipment maintenance using RFID and handheld internet device
- Tenant website for after-hours occupancy, maintenance requests, etc.
- Security sensors also used for lighting and HVAC control
- Building control based on real-time utility pricing and utility capacity

Now for a bit of Bad News

- It is more difficult to design/specify intelligent building technologies due to the current practice of construction project bidding
- Hopefully LEED's transformation of the building industry will include that needed to solve the above through encouraging:
  - A separate low-voltage system design specialty (to also design IT, data, telephone, etc.)
    - A "CLA" consultant
  - The creation of a systems integrator contractor.
- A graphic might help…

The Intelligent Building "Bid Day Dilemma"

These are the low-bid intelligent building system providers:

BAS Manufacturer	Lighting Control Manufacturer	Security System Manufacturer	IT & Structured Wiring Contractor
Brand A	D	G	J
B	E	H	K
C	F	I	L

Will this combination work as specified/intended and without additional cost?

LEED-NC
Intelligent Building Ideas
(updated for ver. 2.2)

NC: Sustainable Sites

Credit 4.3 Alternative Transportation:

- Internet connection from alternative fueling station to fuel provider
- Monitor fueling station via BAS for leak detection and usage
- Integrate fueling station to Security system for accessing fuel and share billing informationwith property management accounting system.
  - ➢ That's a building showing intelligence!

NC: Water Efficiency

- In General:
  - Use the BAS w/ flow meters, soil moisture sensors, internet-available weather data, and “Facility Diagnostics” middleware (or common sense) to ensure that systems are operating as expected.
- Use BAS to control irrigation, rainwater reclamation and graywater systems to provide “Single-seat” operation.
- Using rainwater/graywater as cooling tower makeup water to help meet WE Credit 3 (potable water use reduction) would be sign of greater “Building Intelligence”.

NC: Energy & Atmosphere

- An intelligently designed BAS is a vital tool involved in possibly 12 points in this category.
- Prerequisite 1 – Without a well-designed BAS, commissioning is more difficult.
- Credit 1 - Optimize Energy Performance (10 points):
  - Intelligent building technology can be the “icing on the cake” for HVAC, DHW & lighting energy savings.
  - However, getting the points is somewhat hindered by computer simulation (e.g., DOE-2) controls modeling limitations
- Credit 5 – Measurement and Verification
  - Permanent monitoring (e.g. by a BAS) is not required but is that the intelligent building approach?
  - If you anticipate EB….

NC: Materials & Resources

Any Ideas?

NC: Indoor EQ

- Credit 1 (now called “Outdoor Air Delivery Monitoring”) is where Demand Controlled Ventilation is inferred (HUH?)
- Credit 6.1 (Controllability of Systems - Lighting)
  - A lighting control system would provide this and contribute substantially to EA Credit 2 (Energy Performance)
- Credit 6.2 (Controllability of Systems – Thermal Comfort)
  - Requires a high level of occupant control over lighting, heating/cooling and/or ventilation (incl. operable windows)
  - An intelligent building future might provide an integrated occupant interface (perhaps via a website) to reduce the cost of this requirement
  - How does this impact building energy usage?
- Credit 8 (Daylighting) definitely encourages intelligent building control and can be made more intelligent with:
  - Automated blinds
  - Automatically adjusting light shelves/reflectors and light piping systems

LEED-EB
Intelligent Building Opportunities

LEED-EB

- The opportunities are similar to NC, BUT…
- The major advantage of EB is that the EA Energy Performance credit uses ENERGY STAR - this recognizes any innovative control strategy that truly saves energy (vs. only those that can be modeled by computer simulation)
- EA Credits 3.3 and 5, and EQ 7.2 essentially requires the BAS to provide monitoring and M&V of systems' operation
  - LOTS of monitoring points: temperatures, CO_2, all utility meters, VFD operation, chiller/boiler efficiency, etc.)
  - Facility diagnostics middleware can perhaps be used to analyze this data "overload"

LEED-CI

- LEED-CI is in many ways a subset of NC with some EB credits added
- So the intelligent building opportunities are largely a composite of NC & EB: Daylighting, Use of a BAS for monitoring and M&V, Demand controlled ventilation, Occupant control….
- Some unique opportunities
  - EA 1.3 Option A requires “Appropriate” zoning of terminal HVAC equipment
    - This will allow intelligent control be more readily applied at the zone level
  - Tenant sub-metering of energy use

Innovation in Design: Intelligent Building Opportunities

- Techniques discussed above that are not necessary for attaining the credit are untapped opportunities for innovation
  - Many have not been used for this purpose
- Demand limiting is not covered by any credits but is popular for innovation credits
  - True building intelligence would involve demand limiting through real-time utility communications
- Energy-saving control strategies that cannot be adequately modeled by computer simulation (NC)
- What about arguing that structured wiring and/or wireless devices is “green” design (e.g., resource conservation)?
- How about defining innovative roles for a CLA consultant and/or Systems Integrator contractor?

Closing Remarks: Will LEED Provide More Incentive for Intelligent Buildings?

- LEED-EB really rewards the use of intelligent building technology, but can the costs be justified?
- Unfortunately LEED-NC provides less incentive for intelligent building technology
  - New construction is the best time to make a building intelligent
  - New construction is also the most challenging paradigm for intelligent building technology
- LEED will spur the development of more cost-effective monitoring devices (e.g., combined temperature, occupancy and CO_2 sensors), BUT…

Final Question: Will LEED Recognize More Intelligent Building Technology?

- Will LEED-NC require the use of permanent monitoring for achieving the M&V credit?
- Structured wiring and wireless sensing is a great addition to the sustainability suite of LEED – it should be encouraged.
- Will interoperability with enterprise systems become an explicit part of LEED (e.g., w/ hotel check-in, preventive maintenance, etc. systems)
- Will it encourage the use of the internet to provide occupants more control?
- **Will LEED and/or the building industry recognize that intelligent building design is a specialty and encourage the use of qualified consultants and empowered sub-contractors for the execution?**

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THANK YOU!

Questions?

Ira Goldschmidt, P.E., LEED®-AP
Goldschmidt Engineering Solutions, Inc.
ira.goldschmidt@comcast.net