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Why Are Our Building So Dumb?

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Who is in Charge of the Technology?

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Building Technology Today

We live in a world today were we hear daily about the multitudes of benefits and efficiencies that technology is delivering to our businesses. But why has this same technology evolution not been embodied in our buildings? We have all these enabling technologies and open control and data network standards that can form the foundation for a highly integrated and intelligent building. Why have the likes of the open control protocols; LonTalk, BACnet, and Modbus not overwhelmed the building automation industry? Why is it that data from these open protocol based sub-systems is not routed onto a corporate or a property management Internet Protocol (IP) based network as a industry standard? Given the prevalence of the Internet, real time data transfer and web browser based user interfaces, why are our buildings managed in a reactive, wait until it is a problem or broken fashion? We see fragments of technology being implemented for individual building sub-systems, but nothing that seems like a well orchestrated plan. Yet even though our buildings are digital silhouettes of what they could be, building owners and developers still insist that their buildings are intelligent.

Besides building sub-system integration and their associated information technology potential, there are other areas of building technology that are often totally ignored. In our current design process, voice and data network infrastructure is often handled by the corporate Information Technology (IT) departments (in speculative office buildings – quite often nobody is responsible). The IT department involvement in the design process is typically limited and major design focus waits until the project is near completion. Thus, the building sub-system contractors must provide their own data network cabling (Category 5 or 6, Fiber, etc.) and hardware. The potential to use wireless networking technologies is not anticipated and is never even given a chance. In cases where the installing contractors desire to share a common building local area network, Information Technology Managers may be reluctant to permit "non-standard" network devices to co-exist on their networks. The cooperation and coordination required to facilitate a shared information highway is difficult at best to accomplish at the end of a construction project.

Another sub-system that often slips through the cracks is Audio – Visual Systems. These have always been viewed a specialty stand-alone system. The components and functionality have been traditionally custom designed for specific applications. However, IP networks and open standards are changing this industry as well and opening up new business opportunities. A -V components are moving to web based controls and user interfaces. Voice over IP (VOIP) technology can be utilized as a central building paging and/or public address system which can be zoned much more cost effectively than its analog predecessors. Properly designed, a VOIP paging system can also be used for emergency voice communication purposes and background music. Digital information displays can be designed to serve multiple building functions; Corporate or public

bulletin boards, video broadcasts (CNN, Weather Channel etc.), stock market information, and to deliver fire, security and life safety messages or videos. The sad reality is that these systems are rarely considered in the conventional design and remodeling of our buildings. Typically, they are stand-alone add-ons that are installed after all the other systems are installed and operational.

With all this wonderful technology and multitude of systems and options why are our buildings are only a fraction better than those delivered only a decade ago?

Existing Building Construction Practices from a Technology Perspective

The method and manner by which our industry designs and builds buildings has not changed much over the last 3-4 decades. Before the advent of digital communication systems, electrical and mechanical engineers where required to develop point-to-point construction documents of the hard-wired, analog electric systems and pneumatic automatic temperature control systems. Ma Bell took care of telephones and building technology was simple and straight forward. With the introduction of digital communication networks, pneumatic automatic temperature control systems evolved to electronic, and about the same time (1984), Ma Bell was deregulated resulting in the building owner/manger being responsible for the horizontal and vertical telecommunication cabling in buildings. Almost overnight, electrical and mechanical engineers were required to become experts in low voltage cabling and digital communication networks! To add to this dilemma, the digital communication standards were in their infancy, so every manufacturer constructed their own products to communicate using proprietary communication protocols. In practice this meant that the manner and methods (number of products, type of media, length of cable, etc.) by which the products communicated were all engineered to be different. As we would later learn, this was by purpose to "lock" a customer into a specific brand of product.

So what did the engineering community do? Migrate to performance based specifications. Not only did this happen, but quite often the engineers would use manufacturers and/or contractors to write the performance specifications around their specific product line. Thus began the process of the building design professionals taking a 'hands-off' approach to building technology while, in the two decades following, significant advances in building system have occurred. The gap between the technology providers and the building design professionals has and is continuing to increase.

The case with the telecommunications systems is different. The telecommunication industry early on determined that voice and data networks needed to be defined to the extent that 3rd party contractors could be trained and be trusted to install quality cabling plants for buildings and building tenants. Out of this initiative the Electronics Industries Alliance (EIA) and the Telecommunication Industries Association (TIA) developed numerous design standards to define how to design and install flexible and effective cable infrastructures for buildings. Along with these new standards the computer industry saw the rise of IEEE 802.3 (Ethernet) as the new defacto local area network standard. Thus the design and build of voice and data infrastructure (now also include video in the mix)

became the realm of the EIA/TIA industry with networking hardware being provided by either tenant or corporate Information Technology Staff. The role of the building design professional evolved to being limited to providing equipment space for the incoming service; vertical raceways (usually in the form of floor sleeves); and intermediate distribution closets or rooms equipped with plywood backboards.

In summary, here is what has transpired and resulted in our current technology delivery failures;

1. Design professionals do not design building technology
2. Design professionals use prescriptive – performance specification as their preferred means of procuring technology.
3. Technology is extremely fragmented and covered in various specification Division, 13, 14, 15 and 16. Voice and data networks often are not even included.
4. The real engineering is provided by the installing contractor (often low bid). This takes place during construction and the details of which are covered in the shop drawing process.
5. The general contractor has no technology documents to supervise and manage the installation of products and cabling. Each technology contractor essentially does their own thing.
6. Remove a ceiling tile in one of our typical buildings and observe the end product we have created. Low voltage cabling installed in random fashion, undocumented, proprietary and now by NEC requirements – required to be removed (essentially because it is worthless – has no residual value)
7. System are stand-alone and non integrated
8. Multiple - single purpose graphical user interfaces are required for each sub-system. Even with open standards, it is difficult to obtain an integrated – common graphical user interface due to our industry requirement for competitive bidding (in other words – how can contractors price integration when the individual sub-system technologies are unknown?)

What can we do to Change our approach to the Design and Build of Building Technologies?

Our industry is stuck in a paradigm where building technology is basically ignored. The owners and developers of buildings do not pay for expanded professional services to cover building technology, nor do the design professionals have the technical expertise to provide these expanded services. Thus we are in a vicious cycle where even if the design money were made available by a new building developer to employ a design professional to supervise and engineer the building technologies, who would they hire? The design professional must be able to remain actively involved through the construction process and provide management oversight of the installations to make sure that all trade contractors involved understand and acknowledge the overall technology design goals and functionality.

It is has recently been proven through several industry outreach seminars that went to numerous cities in the United States, that the mechanical and electrical consulting engineering community do not have the desire to step up to the plate and assume full responsibility on their own based on simply the fact that it is huge gap (and opportunity) in our overall delivery process. It is clear that unless there is immediate financial return, (i.e. paying clients) the consulting community will not educate themselves on their own.

With this being the case, the focus must be placed on the development, corporate and institutional building owners to ask for, and insist on design professionals that can provide planning and engineering of all the building various building technologies. Not only should these services be required, but adequate design fees should be appropriated. Many building owners and developers will take the position that they already pay for quality services and the additional fees required for these services are difficult to justify. This is simply not the case, and after review of the following cost justification explanation, it will be hard not to justify doing building projects any other manner.

The Value Proposition of Planning and Engineering Building Technology

Intuitively most building owners and developers will agree with the concept that accurate and timely information regarding their building sub-systems would be a valuable asset. This is analogous to the leap of faith many of us old timer made back in the 1980's when it was hard to cost justify networking our personal computers. We had the proverbial 'sneaker net' (a.k.a – running across the office with a 5-1/4 inch floppy disk) which in many cases was a faster way to share data than saving files over the network.

Likewise, structuring the low voltage cabling in an organized and flexible fashion would seem to be good planning sense. Heck, everything else in the building is organized and engineered to be flexible, expandable and service the building until the system components become worn out. This may seem like common sense and consistent from a service stand point, however, few buildings, if any are given this luxury. We have more options than ever to transport data and some wireless options may displace wired networks. However, the decision to use wireless networks can not be made effectively in a vacuum.

Unfortunately, even though engineered, integrated and intelligent buildings can be justified by our intuition, faith in technology and common sense, this is not enough to stem the tide of our current building delivery process. Clearly, one could say that the building industry is saying to us technology professionals – Show Me the Money!

The CABA Integrated and Intelligent Building Council Task Force No. 3 – Defining the Life Cycle Costs of Integrated and Intelligent Buildings plans to deliver qualified data to the design professionals regarding the costs of owning and operating various automated building sub-systems. The Task Force leadership has recently been awarded to Reed Construction data. Reed Construction data already has an extensive database regarding building system costs, so we are eagerly anticipating the results of their work in the Task Force. Look for a draft Life Cycle Cost tool mid-year 2006. In the mean time, is there

any other cost justifications that can be easily understood by building owners and developers?

The answer is yes but it involves dissecting and understanding how construction costs are allocated in our conventional construction process. It is easy to overlook the fact that when performance based specifications are used to procure building technologies, the successful contractor must include considerable engineering fee in his bid to engineer his specific product line to suite the performance specification requirements and the building constraints. Depending on the complexity of the systems and building the fee can vary from 5 to 15% of the bid price. If this engineering could be accomplished at the front end of a project along with other building design disciplines by using open protocol based products and communication networks, could this not be justified by simply transferring construction funds for engineering over to the design team? The degree of detail on the construction documents would dictate how much or less of this funding is transferred. The more detailed the construction document design is the overall solution approaches a design – build approach. There are examples of this approach at work today[1]

However, if a design professional is tasked with oversight, planning and engineering all the building technologies required for Integrated and Intelligent Building, the collective sum and transfer of the engineering fees from the construction trades would not be adequate to cover the oversight and planning aspects of a sophisticated building project. These services might be worth an additional 3 -5 % of the total cost of the combined technologies involved. Many of the skeptics reading this article are already saying to themselves – I told you it was going to cost more.

What if the total cost of traditional system components and networks installed by these higher quality documents costs 10 – 20% less than their conventional contractor designed counterparts? BiCSi, the organization that is dedicated to the telecommunication cabling industry claims based on various pricing studies that integrated and structured cabling systems can save 25 -30% on the total cost of the low voltage cabling plants. This cost saving can be attributed primarily to the huge labor savings involved with having a single bid package being developed for the collective low voltage cabling systems, resulting in a single low voltage installation contract. Depending on the complexity of a project and whether the interior spaces are fitted out right away, a conventional construction project could have up to 10 individual low voltage electrical contracts.

Summary – We are Smart After All aren't We?

Let's summarize what we have learned about our own instincts and some basic construction cost economics.

1. Integrated and Intelligent Buildings do cost a little bit more to design.
2. The additional cost is marginal all things considered
3. This additional design fee can be justified through the following:

[1] Teng has demonstrated the effectiveness of this approach on numerous projects for the General Service Administration and the Echelon World Headquarters Building

- Development of real technology construction documents whereby the low voltage infrastructure can bid as a single bid package
- Construction cost savings up to 20% that actually pay for this and then some.
- Systems that are engineered to be integrated, open and flexible.
- System deigns that involve the owner in the decisions and cost trade-offs.
- System designs that embody allow for changing technology and advancements.
- System designs with cabling plants that can adapt to changing standards and maintain long term value.

Notice how some of the fancy stuff that we often hear about was omitted. These are things like; intelligent building applications integrated, door access control, lighting and HVAC control, etc. If an owner is willing to spend more money then a lot of flash can be cost effectively added to properly engineered building. Let's first start with the basic technologies and communication infrastructures that always go into our buildings and make our standard buildings considerably better and smarter than they currently are.

Its time to get our industry to step up to the plate and quit wining about how we are losing our edge to our foreign neighbors. This is not rocket science but the application of common sense and good design and construction practices – al beit – different than our current standard practices. We have found the need for a Chief Technology Officer (CTO) in our internal businesses; it is time to secure the services of a professional that can serve in this capacity for our buildings.