Integrated Systems:

Increasing Building and Workplace Performance

BOMA International Foundation

A Professional Paper

from the BOMA International Foundation

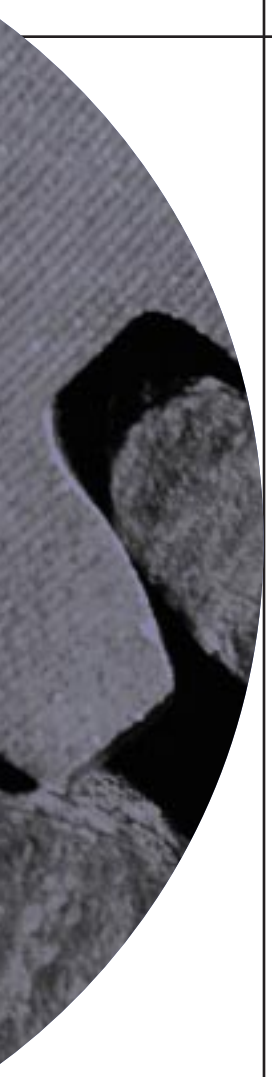
written in partnership with and presented by:

Honeywell International Inc.

Johnson Controls Inc.

Siemens Building Technologies Inc./Landis Division

Buildings magazine/STAMATS Building Group



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Foreword

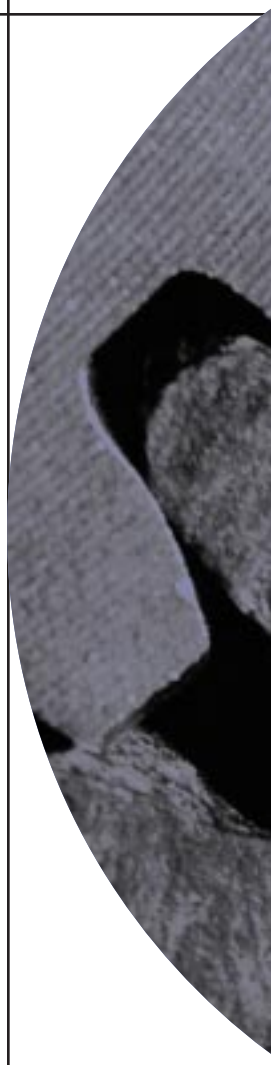
By Stephen P. Hokanson, RPA, CPM, BOMA International Foundation Chair

The technological boom has brought with it advances in every field, including building operations, and has made the role of the property professional an ever-changing one. New technologies are designed to make buildings run more efficiently and to assist property professionals with day-to-day tasks. Streamlined systems – simplified operator access to multiple systems, centralized information and systems that are able to communicate with one another – improve building performance; reduce operational, management and maintenance costs and increase tenant attraction and retention, which, in turn, increases workplace performance.

I am pleased to present this professional paper to the commercial real estate community in support of the work of the Building Owners and Managers Association (BOMA) International under the leadership of President Richard D. Baier, managing director of CB Richard Ellis in Kansas City, Mo.

The BOMA International Foundation is proud to publish the first paper in the series with leaders in systems automation: Honeywell International Inc., Johnson Controls Inc., Siemens Building Technologies Inc./Landis Division and STAMATS Building Group – publishers of *Buildings* magazine.

The BOMA International Foundation welcomes suggestions for future cooperative and partnership opportunities for the development of professional papers.



Mission

The BOMA International Foundation is dedicated to advancing real estate performance and public understanding of the commercial real estate industry through research, education and the dissemination of information.

The value of an integration system is greater than the sum of the parts.

SOURCE: Siemens Building Technologies Inc./Landis Division

Overview

Integration is a complete information delivery system that monitors and controls a variety of systems and functions at an optimal level of efficiency. Simply put, it is the way in which building owners and management professionals can maximize overall building performance, measure the quality of that performance, and then pass the benefits on to tenants.

Research conducted by BOMA International has proven that meeting many of the needs of tenants can be accomplished through HVAC and other building operating systems. Much of this research is found in *What Office Tenants Want* and BOMA's *Strategic Mapping Project*.

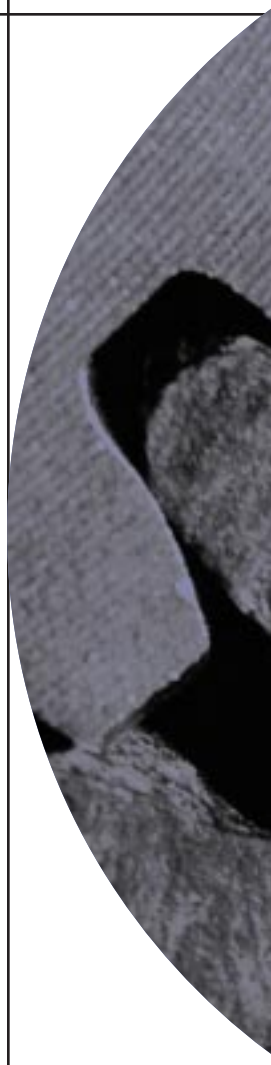
The underlying principle as to why building owners and management professionals should consider integrated systems is based on a measurement of building performance. According to Walter M. Kroner, AIA, professor of architecture at Rensselear Polytechnic Institute in Troy, N.Y., building performance is derived from the following four values:

- **Building response.** How well buildings conform and adapt to the owner/manager's functional, organizational and managerial needs.
- **Building efficiency.** How buildings save money on operations, management and maintenance costs, and how readily it is able to incorporate new, more efficient technologies. Building efficiency also includes the churn rate cost factor — how often the interior, infrastructure and furnishings of a building are replaced by new and different arrangements.
- **Architectural image**. How buildings' aesthetic appeal and form support the image and marketing strategies of the owner or management professional.
- **Exchange.** The ease with which buildings can be sold.

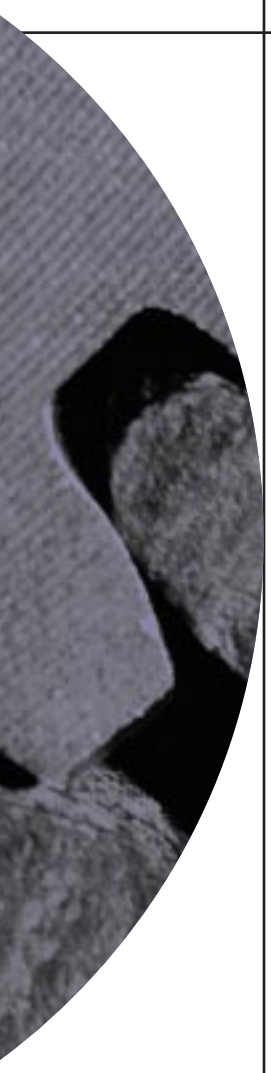
Kroner's theory is that increased building performance ultimately leads to increased productivity.

This paper summarizes the key findings of an industry-based partnership that was formed with the goal of understanding the role integrated systems play in terms of increasing building and workplace performance. This is achieved in the following format:

- Understanding the total building complex by taking an integrated approach to systems efficiency.
- Analysis of a study conducted by *Buildings* magazine/STAMATS Building Group, which details specific trends in systems integration.
- Insight from professionals on choosing protocol, best solutions, freedom of choice and future-proof plug-and-play.



The Decision to Integrate



The design of a successful implementation plan for integrating systems can best be determined by examining the reasons professionals choose to integrate systems. Integration is a basic cause-and-effect scenario. The answer to what causes professionals to want to research and implement the integration of buildings is simple – to increase systems' efficiency, improve workplace performance and reduce operational costs. Integration is a cost-efficient, value-added systems solution. Whether the goal is adding redundancy into an integrated sequence or introducing new components into an established system, weighing all the options is paramount.

Results of the 2000 Systems Integration in the Commercial and Institutional Buildings Market survey conducted by STAMATS Building Group among the readers of *Buildings* magazine found that 50 percent of the building owner respondents had invested in systems integration for at least some of their assets. More importantly, 75 percent confirmed that they had systems integration projects planned for the very near future. Virtually all of the firms that had already invested in systems integration indicated that more projects were planned. Only 50 percent of the firms reporting no integration to date said that systems integration projects were budgeted for the coming months.

Respondents in the study cited savings in the form of reduced operating costs as the No. 1 reason they chose to integrate certain systems. Also in the top five were:

- Savings in the form of lower maintenance and repair costs.
- Better tracking and managing of systems including event management.
- Improving employee/tenant comfort.
- Capability to avoid major system failure through event management.

The top five reasons given for not implementing some form of systems integration were:

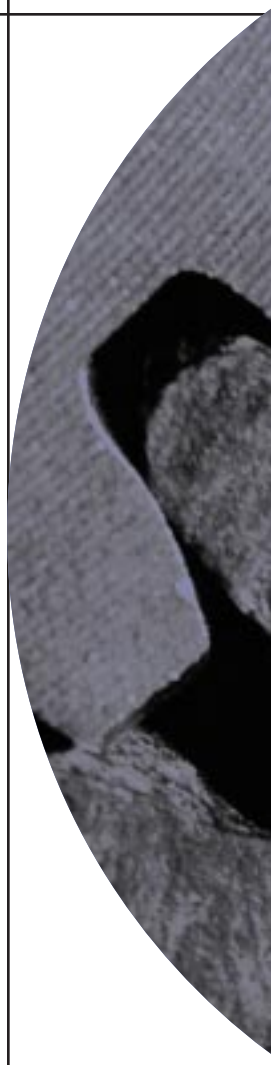
- High cost of installing the system.
- Lack of cost-justification.
- High cost of integrating systems.
- Lack of available funding.
- Lack of awareness.

Also noteworthy is the fact that those firms not yet implementing any form of integration, on average, owned significantly fewer buildings – an average of eight – compared with an average of 51 buildings for those firms that have already invested in some level of integration. In both instances, cost was listed as the No. 1 reason for, or against, any type of integration. Owners with smaller portfolios of buildings were more concerned with installation costs, whereas owners with larger portfolios of buildings were more concerned with the reduction of operating costs.

The Decision to Integrate

The BOMA International *Experience Exchange Report* is a survey of building operating costs and is completed on an annual basis. It is the benchmark used by building owners and managers to determine how well their costs compare with the competition. The success of this publication clearly indicates the concern owners and managers have with the reduction of operating costs and building efficiency.

It is important to recognize that truly intelligent buildings are those with applications that take advantage of information exchange. Information integration is generally centralized to a single location, thereby empowering professionals to make better, more informed decisions concerning the total cost of ownership of a single building or an entire portfolio of buildings.



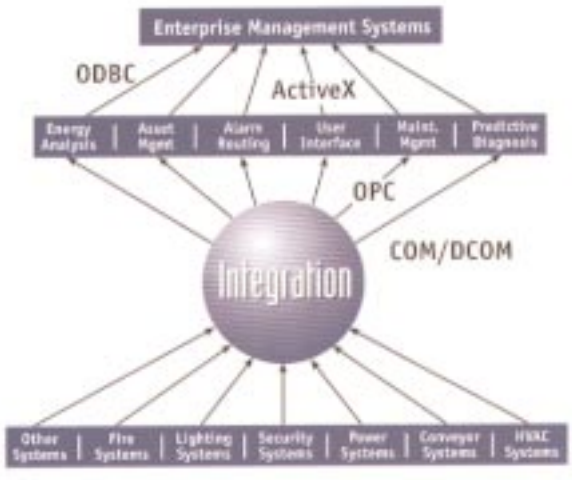
Effects on Integration

Integration is a logical deduction of the theory that access to information and controls from any single point improves the efficiency of the involved systems and the workplace performance of persons involved in the processes. The measurable effects of integrated systems are immediate and notable in five primary areas:

- **Site-wide user interface.** Offers single-seat operation, eliminating the cost of duplicate front-end equipment. This increases workplace productivity by simplifying operator access to multiple systems, thus reducing operator-training costs.
- **Information integration and management.** Centralizes information at a single location and combines information for analysis and reporting of energy usage, equipment operation and temperatures.
- **Interprocess integration.** How one system affects another creates the smart building, whereby a time-of-day (TOD) schedule synchronizes lights and heating, ventilation and air-conditioning (HVAC) systems; the security system allows entry and signals the building maintenance system (BMS) to turn on HVAC and lights; and usage information is recorded for tenant billing.
- **Increased information access.** Including diagnostics and maintenance points.
- **Lower installation costs.** Realized by using existing wiring, redundant instrumentation, checkout documentation and recorded current and future changes or additions.

Choosing which systems to integrate requires an understanding of how each of the systems communicates with another. Imagine systems integration as the hub to which all other building systems report data. The top 10 systems that building owners and management professionals choose to integrate first are:

• HVAC	91%	• Life safety	36%
• Fire safety	77%	• Lighting controls	36%
• Electrical monitoring/management	50%	• CCTV	27%
• Access control	45%	• Lighting management	27%
• Power consumption	45%	• Vertical transportation	18%



SOURCE: Johnson Controls Inc.

Establishing Systems Integration

The problem with the word 'integration' is that there is no universal definition of the term. In its most fundamental meaning, integration refers to the individual components of a system. These components – though they do talk to each other – do not exemplify the extent of the capabilities of a truly integrated system.

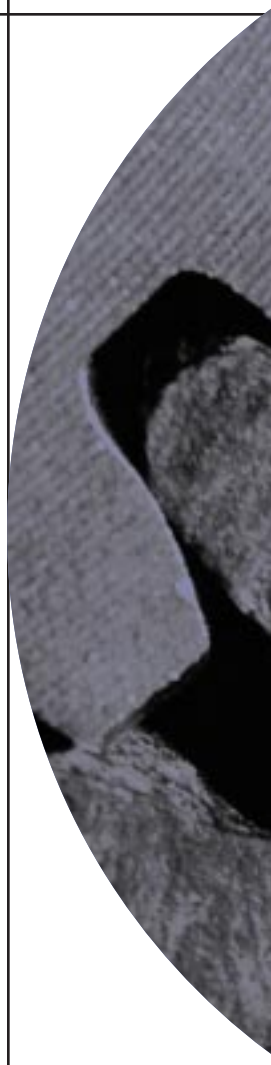
- **Hard-wired integration.** Linking systems using hard-wired connections is typically the least expensive way of incorporating dissimilar system information into a building management system (BMS). This method is used to some extent in almost every case.

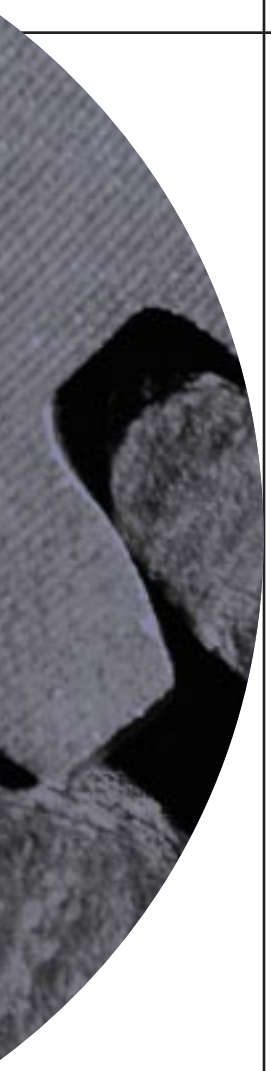
- **Individual controls electronically communicating data within systems.** Also in existence for a number of years and present in most projects, this method started with the ability of a few manufacturers to provide communication between their different components – usually based on proprietary controls – for the beginnings of integrated controls solutions. Although it offered significant cost savings to end-users with good functionality, it increased the technical demands on controls contractors who had to deal with systems and software from a greater number of manufacturers, each approaching the challenge differently.

- **Individual controls electronically communicating limited data among systems.** This method of integration has existed in various forms for the past three to five years and is estimated to be present in less than 20 percent of buildings. As the traditional HVAC controls market matured and manufacturers expanded product lines to include fire management, smoke management, laboratory controls, access controls, and more, the cost savings became less attractive and single-source maintenance cost became exorbitant.

- **Various building systems communicating electronically with a management system.** Sometimes known as front-end or gateway integration, this type of system has been enabled by the adoption of semistandards such as Modbus, DDE and Windows within building systems, thereby offering a common denominator for the interconnection and transfer of selected information between substations. This allows for a number of proprietary systems to work independent of each other, but still share a common set of operator workstations and some limited data. This system is prevalent in many of today's buildings because of the attractiveness of lower initial costs, as well as providing competitive control over vendor options in the future.

- **Systems electronically communicating facilities information enterprise-wide.** This system provides an open and competitive environment for future expansion, while relying on network skills common to all experienced network controls system integrators. Relatively new to the industry and made possible through the development and mass adoption of open building industry communication standards and the development of networking and integration skill among the controls contracting industry, this method of integration enables cost-effective, manageable and maintainable integration among inherently different systems.





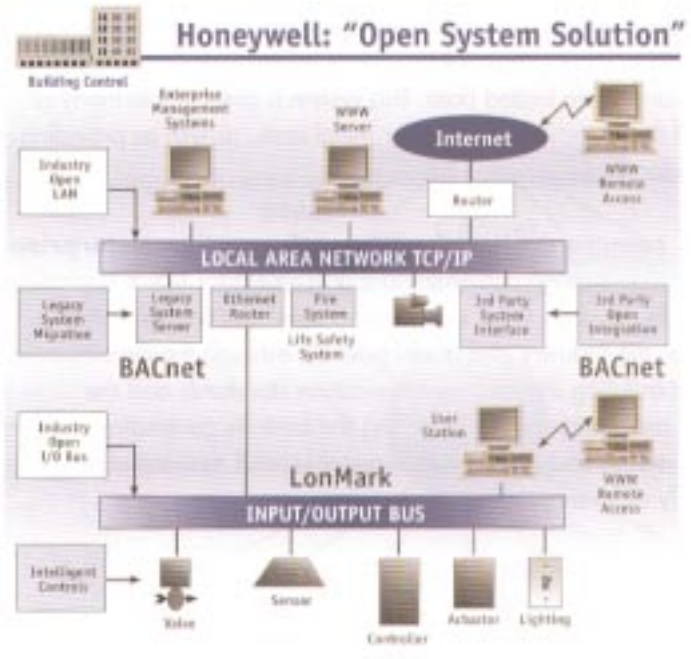
The Language of Interoperability

Perhaps one of the most confusing aspects of integration protocol is the operating language of building systems. These languages are proprietary to specific types of systems – HVAC, lighting, software and programming. BACnet, Ethernet, Arcnet, Novell (IPX), LONWORKS and Java are among the most common types of protocol. Each protocol is categorized into one of three proprietary systems:

- Single standard or open protocol.
- Multiple proprietary gateway.
- Single proprietary protocol.

Under the rules of a single proprietary system all changes, adds and moves of systems and/or equipment must be made by the proprietary controller/manufacturer of the system. Under the freedom of the single standard or open protocol environment, all changes, adds and moves can be made by trained in-house professionals. Systems are thereby able to freely talk to each other without fear of negative interprocess integration. An example of this is the Internet, whereby single proprietary systems communicate through Internet accessible software. By moving from a proprietary environment to an open environment, facilities professionals can expect:

- More product availability from a variety of different suppliers.
- More sources from which to purchase these products.
- A choice of installation, service and maintenance providers.
- Single-line integration.



SOURCE: Honeywell International Inc.

The Language of Interoperability

It is possible that there will always be a separation of proprietary controls – particularly in the areas of fire and life safety. These are usually single proprietary platforms due to the critical nature of the system. Although there is no open platform for these types of systems to talk to other systems directly, there are alternatives – through the Internet or an intranet.

As a multiple proprietary gateway, Internet-based integration offers a viable extension to single protocol. The intranet is a private or internal gateway usually requiring a password log-on to allow access to protected files and controls. The Internet is a public access point that allows widespread access to these same controls. The ability to make necessary adjustments is protected again by password security.

Communication gateways	1999	2000
• Public Internet	20%	41%
• Private intranet	37%	51%

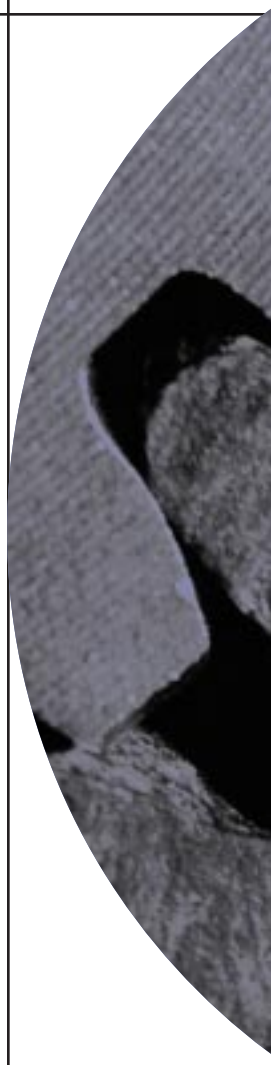
SOURCE: STAMATS Building Group

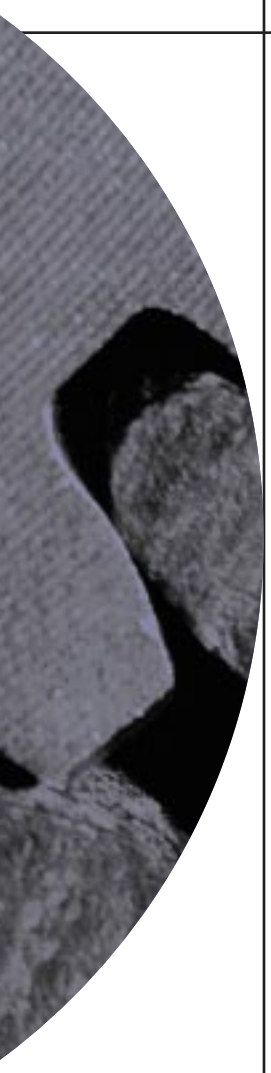
Another commonly used term, interprocess integration, refers to instances when applications from one system affect another. This is the foundation for the premise of smart buildings. If all building systems speak the same language, is the building more intelligent? Can the building begin to operate in a more productive manner? Ideally, a fully integrated building would begin with a security system that, with a swipe of an identification card, turns on office lights, starts up heating and ventilation, and boots up a computer terminal – even after hours and on weekends. In addition to these functions, the system will track the usage information and bill the tenant at the end of the cycle.

Controlling the costs associated with installing systems integration begins with choosing the systems protocol that best suits the needs of the organization. According to the aforementioned survey, building owners and management professionals indicate that a single standard/open protocol system is the preferred choice for systems integration. This type of system can reduce installation costs through the use of an existing infrastructure, which when combined with the ease of training, makes this an attractive alternative to single proprietary protocol.

Protocol preference	
• Single standard or open protocol	55%
• Multiple protocol with gateways	31%
• Single proprietary protocol	14%

SOURCE: STAMATS Building Group





Flexibility, Scalability and Maintenance

To offset some of the costs of installation, building owners and management professionals should consider whether or not the integrated system has the flexibility to use existing standard computer processors and operating systems. Some other considerations in evaluating which system best suits a specific application are:

- System scalability and expandability.
- Availability of standard user interfaces.
- System architecture based on open standards.
- Standard networks, cabling and media.
- Use of a standard protocol.

There are three criteria specific to selecting a building automation controls system: product quality and reliability, after-sale service and support and experience with integration. Desired features of an automation controls system are optimal start-and-stop, central plant optimization and night setback functions. These are also the three most important criteria for specifying energy management systems. The top five considerations in choosing integration systems software are:

- Easy to use/intuitive to use.
- Microsoft Windows-based.
- Universally understood graphics.
- Password protection.
- Alarm-response capabilities.

Survey results indicate that 85 percent of the respondents recognized the importance of having local technical staff available. In addition, a large percentage of respondents also listed the need for locally available parts for equipment repairs and 24-hour technical support as being critical to the efficiency of the system.

Essential local service and support offerings:

- Local technical staff 85%
- Local availability of parts for repairs 77%
- 24-hour technical support 66%
- Experienced factory-trained specialists 65%
- Local applications support 50%

SOURCE: STAMATS Building Group

When choosing maintenance management software, respondents indicated that vital interface functions of the software should offer: performance diagnostics, runtime-based work orders and alarm-based work orders.

Conclusion

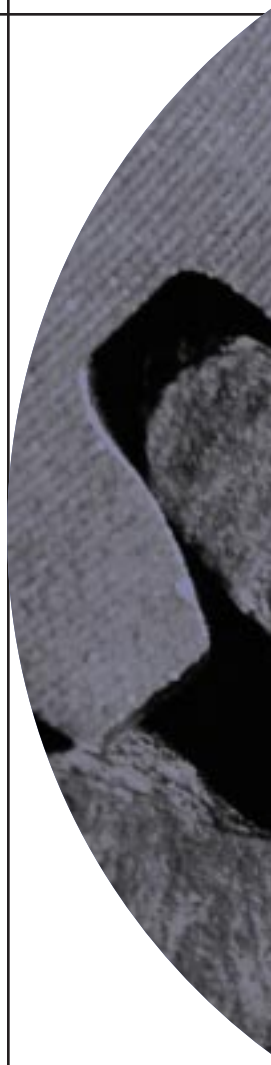
New technologies, standards and open protocols all help businesses become more efficient. Integration helps building owners and management professionals adapt to a rapidly changing, technology-driven business environment. Building owners and tenants are closer now through the use of globalized Internet, e-mail and video-conferencing. Having an integrated building management system in place that facilitates improved communication, productivity and efficiency serves everyone well.

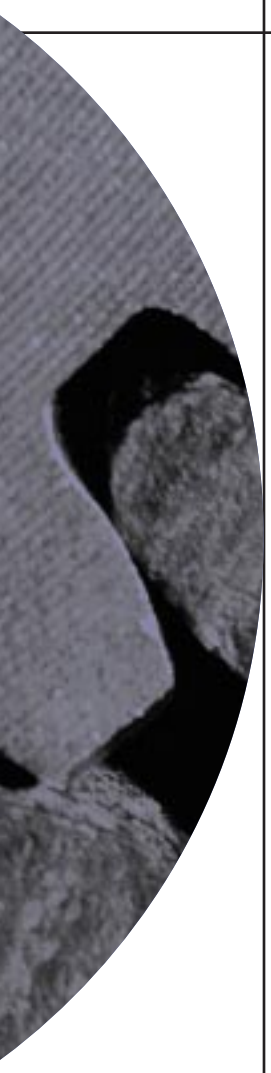
Integration began in the manufacturing arena as a way of increasing productivity, quality and system efficiency while reducing production costs, inventory and amount of rework required. Today's building owners and management professionals are applying the same automation principles to tenant environments through advances in technology and the desire for more efficient buildings.

To achieve true integration, it is important to understand what the level of expectation is for any integration project. Begin with the four-step rules of organizing an integration program:

- **Define your integration expectations.** Balance high expectations of what a system should do with the practicality of what that system can actually accomplish.
- **Communications between vendors.** Determine who is going to coordinate, and who is going to be available to do which tasks. Do all systems providers need to be present when wires between the various systems are connected, or can one person do it all?
- **Joint commissioning.** Successful integration really comes from proving that the information is flowing back and forth.
- **Comprehensive training.** Have a proper understanding of the capabilities and limitations of a newly integrated system, and keep up-to-date on technological advances as they occur.

Following a few steadfast guidelines, doing a little research, asking questions and having reasonable expectations will help ensure successful systems integration. With costs of installation and maintenance available for almost any budget, clearly now is the time for building owners and management professionals make the choice to integrate – HVAC, lighting, security, life safety – whatever the desired system may be.





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Glossary of Terms

Architecture: how a system is designed and how the components of the system connect to and operate with each other. The ability of the system to carry narrow, medium and broadband signals. Includes voice, video, data and text.

BMS: building management system.

CAD: computer-aided design.

CAFM: computer-aided facility management.

Category 5: most commonly installed cabling for LAN connectivity or other voice and data applications.

Category 5E: nonstandard cabling system intended to be manufactured according to tight specifications in support of signaling rates up to 200 MHz over distances up to 100 meters.

Connectivity: the property of a network that allows dissimilar devices to communicate with each other.

DDE: dynamic data exchange.

Enterprise Network: an enterprise-wide network covering an entire corporation. Includes local PBXs, LANs and Internet-working bridges.

Ethernet: a local area network used for connecting computers, printers, workstations, terminals and servers within the same building or campus.

FDL: facilities data link.

Gateway: an entrance and exit into a communications network.

HVAC: heating, ventilation and air-conditioning.

Infrastructure: a collection of telecommunications components and equipment that together provide the basic support for the distribution of all information within a building or campus.

Integration: a complete information delivery system that monitors and controls a variety of systems and functions at an optimal level of efficiency.

Interface: a mechanical or electrical link connecting two or more pieces of equipment together.

Internet: a computer network joining two or more computers together in a session. Carries electronic mail, video images, voice communications and anything that can be digitized, placed in a packet of information and sent.

Interoperability: the ability to operate software and exchange information in a heterogeneous network, i.e. one large network made up of several different local area networks.

Interprocess Integration: the capability of programs to share information – applications for one system that effect another.

Intranet: a password-protected, private network that uses Internet software and Internet standards.

LAN: local area network. A short-distance data communications network used to link computers and peripheral devices such as printers, CD-ROMs and modems.

MAC: moves, adds and changes.

Microprocessors: an electronic circuit, usually on a single circuit that performs arithmetic, logic and control operations with the assistance of internal memory.

Monoholistic: proprietary.

Multiplexer: electronic equipment that allows two or more signals to pass over one communications circuit.

Network: computer networks that connect all types of computers and computer-related equipment – terminals, printers, modems, door entry sensors, temperature monitors, etc.

Open Network Architecture: a public switched network, value-added telecom business for voice mail, electronic mail, shopping by phone, etc.

Open Protocol: systems/software interoperable with a variety of protocols, i.e. the Internet.

PBX: private branch exchange.

Platform: a software operating system.

Proprietary Standard: restricted system requiring a certified professional to maintain.

Protocol: a set of rules governing the format of messages that are exchanged between computers and people. A language discipline.

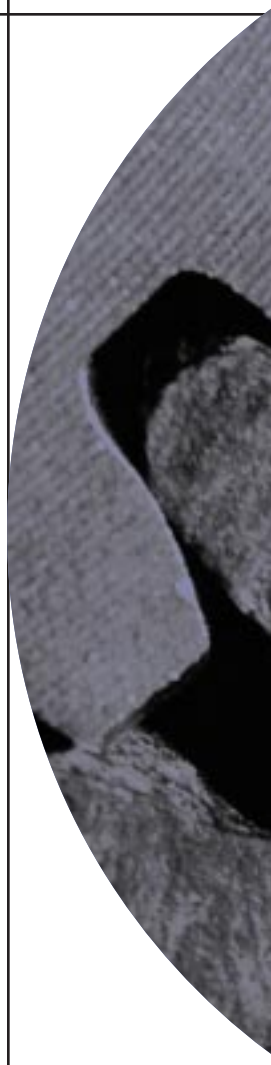
Router: the central switching offices of the Internet and corporate intranets and WANs.

Single Proprietary Protocol: systems restricted to a single language.

TCP/IP: transmission control protocol/Internet protocol. A networking protocol that provides communication across interconnected networks between computers with diverse hardware architectures and various operating systems.

UPS: uninterruptible power supply.

WAN: wide area network.



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