



BUILDING MANAGEMENT SYSTEMS: BEYOND ELECTRONICS

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Building management systems (BMS) have come a long way since their introduction in the early 1970s. Modern systems cost less, are faster and more reliable, offer more features, have a more user friendly interface and are easier to learn and use. They have been installed successfully in facilities of all sizes and types, making them practically an essential requirement to the successful management of operating costs. This article addresses managerial implications concerning the BMS in the building industry.

What do we need to know about (BMS)?

Building Management Systems (BMS) (also called Automation or BAS) are used in buildings for automatic monitoring and control of services such as lighting, plumbing, fire services, heating and air conditioning systems. The term refers to a system that uses sensors, controls and activators. All these use an electronic digital processor to implement control algorithms and have the capability of communicating with other controls. The BMS term covers all control elements, including hardware, controllers, any linking network and central controllers.

Generally, a control system consists of three basic elements: a sensor, a controller and a controlled device. The organisation of these various control elements into a comprehensive BMS is termed the system architecture. Each component in this architecture is connected with each other via a communication system. The communications network is characterised by two essential parts:

- Physical medium - that transports the signals, e.g. wire, optical fibre, radio.
- Protocol - a set of common language rules for the communication signals.

Several protocols have been developed but not all of them have been exploited for use in BMSs. Historically, manufacturers have developed their own proprietary protocols, but there is now a strong move for standardized protocols. A major advantage of using a BMS network with a standard operating protocol is the degree of compatibility that may be achieved between different pieces of control equipment; it is the benefit of using a "single seat workstation". BACnet is one the most high level protocols used in the BMS industry that can be used to integrate building automation and control products from different manufacturers into a single cohesive system [Newman M, 1996].

Primary Functions of Building Management Systems

Building management systems provide a variety of functions. These are listed below:

- **Automatic ON/OFF switching of plant**
This can be based on time, type of the day and/or environmental conditions.
- **Monitoring of plant status and environmental conditions**
Building personnel can be alerted to alarm conditions in time to take remedial action. A good BMS will allow a pro-active rather than a reactive approach to the management of service faults.
- **Energy Conservation Tool**
Along with good building design and efficient HVAC plant, the BMS plays a vital role in the prevention of energy waste and reducing the environmental impact of the building.
- **Building Services Management Tool**
BMS provides a wide variety of summaries, logs and reports. This provides useful information for forward services and costing. This information can also provide value added services to tenants so that the perceived worth of the tenancy is increased. For example, after-hours air conditioning use can be accurately monitored, recorded and automatically invoiced where applicable.
- **Remote Monitoring Capabilities**
BMS provides a building centralised monitoring and control. From a single location one can obtain information such as temperatures, pressures and equipment status, indicating how well the building is running. Moreover, this central location is not limited geographically.



- **Fault Detection Tool**

BMS provides the opportunity to see the big picture of the building systems, which boost faults diagnosing process.

- **Ability to integrate building systems**

In doing so, the facility can run more efficiently, reduce cost and increase the productivity of the facility staff.

Benefits of a BMS

It is necessary to remember that the benefits of a modern BMS are enjoyed vigorously by different users involved with the building. Table (1) lists some of the benefits to be achieved with an effective modern BMS [CIBSE guide (2000)]. These benefits will only be obtained if the system is properly specified, installed, commissioned, operated and maintained.

Table 1: Benefits of a BMS

Building owner
<ul style="list-style-type: none"> • Higher rental value • Flexibility on change of building use • Individual tenant billing for services
Facilities manager
<ul style="list-style-type: none"> • Central or remote control and monitoring of building operations • Low operating cost • Efficient use of building resources and services • High productivity • Rapid alarm indication and fault diagnosis • Good plant schematics and documentation
Building tenant/occupants
<ul style="list-style-type: none"> • Effective monitoring and targeting of energy consumption. • Good control of internal comfort conditions • Possibility of individual room control • Increased staff productivity • Improved plant reliability and life • Effective response to HVAC-related complaints
Maintenance Companies
<ul style="list-style-type: none"> • Ease of information availability problem diagnostics. • Computerised maintenance scheduling • Effective use of maintenance staff • Early detection of problems • More satisfied occupants

Choosing the right BMS

Buying and installing a BMS is a significant investment. Systems are complex and expensive, and installation can cause disruptions to operations. Facility managers can take several steps to ensure that the BMS they buy is the best

system for their facility needs. These considerations are discussed briefly below.

1. BMS Capabilities

The ability of BMS to control energy cost and to modify the operation of equipment from remote locations reduces energy waste and labour costs, while improving tenant comfort. Also, integrating building functions and operations in one system is one of the most important features of today's automation systems [Piper J, 1998 a].

2. Selecting a system

The selection process of a BMS should be considered in view of the following factors:

- Supplier reputation in similar projects,
- How long the system has been on the market
- Training package provided by the supplier to the operation and maintenance staff
- Supplier after sale technical support and supplier guarantee of spare parts availability for a reasonable future period [Eastwell A, 1988].

3. System limitations

BMS are not the cure-all for operations and maintenance problems. While they can help make operations more efficient, they cannot overcome operational shortcomings, such as lack of preventive and planned maintenance.

4. Identifying automation needs

BMS can identify the shortcomings of the existing operations. Typical deficiencies that motivate facility managers to consider installing a new building automation system include:

- High energy use
- Low maintenance productivity
- Unorganised maintenance activities
- Inability to adapt building systems to changing occupant requirements
- Lack of coordination among various building systems

5. System ability to adopt future trends

Selected BMS should be capable of accommodating future trends in the industry easily, so that facility managers in the future can adopt new features into their systems without facing huge bill. It is simply the ability of upgrading systems.

BMS as a competitive advantage for maintenance companies

BMS provides a rare opportunity for maintenance companies, especially small to medium size companies, to compete aggressively in the building maintenance market. It provides maintenance companies with the following tools:

- The power of information: Maintenance operations will be more closely integrated with the operation of the systems, making information available to maintenance personnel to help diagnose problems, as well as to identify problems that otherwise may go unnoticed
- Effective use of maintenance staff (e.g. remote



monitoring, increase productivity)

- Early detection of faults will reduce maintenance costs, increase system life and allow better maintenance scheduling

In addition the above tools raise the importance of continuous staff training on all new BMS in the market.

Why integrate building systems?

Modern BMS systems provide a single source of enterprise information. One system integrates all subsystems in the building to work in a coordinated manner. Here are seven top reasons why building owners and facility managers prefer to integrate building systems-

- **Site-wide, single seat interface:** Single-seat navigation from a central BMS enables facility professionals to view all systems and facilities from one workstation. Information on any system's performance and varying conditions can be viewed, assessed and processed from one common graphical interface. This helps in running a facility more efficiently and at lower cost, while improving staff productivity.
- **Use the power of information:** Modern technology makes it possible for facility managers to obtain precisely the information they need to achieve a wide range of specific objectives: monitoring, alarming, diagnostics, initial troubleshooting, maintenance, and energy analysis. Shared information between systems means the facility runs more efficiently and at lower cost.
- **Respond to occupant and building needs:** System integration gives the opportunity for building systems to target occupant comfort efficiently and promptly. By making it easier to be more responsive, integrated systems deliver more efficiency and lower costs.
- **Get the most out of what you've got:** System integration extends the BMS' capabilities for data collection, archiving, networking and decision making to other building systems. This allows the BMS to tap into inherent strengths of other pieces of equipment that are often under utilised. The organisation gets more mileage out of its investment in equipment.
- **Do more with less:** Facility professionals are being challenged to do more with the same or fewer resources. eg. staff reduction; a hiring freeze; the need to expand business without increases in staff. The result is that the productivity gains are coupled with operating cost savings.
- **Have vendor independence:** Today's BMS design is based predominantly on open system technology, which means that the BMS can communicate as needed with a variety of other systems and applications in a facility that communicate using different protocols. This gives

the organisation the ability to choose components and system retrofits in a price-competitive environment. Freedom of choice can bring savings on initial and operating costs.

- **Identify single source of responsibility:** For many organisations, this final benefit is the biggest of all. An experienced integrator can put it all together and make it work, from design and installation through commissioning and customer turnover. A single source of responsibility and one point of contact are also valuable assets when a problem arises. A single source of responsibility means a triple play of efficiency, cost-effectiveness and productivity.

Why do some BMS projects fail?

Unfortunately, too many building automation upgrade projects never achieve their full potential. Here are four mistakes in project planning that can ruin the project before it gets started [Fennimore J, 1998].

The benefits of an effective modern building management system....will only be obtained if the system is properly specified, installed, commissioned, operated and maintained.

- **Not doing the homework:** Failing to examine information on product offerings and features available from different manufacturers and talking to other competitors to find out what they have found that works well.
- **Not doing the numbers:** Failing to calculate actual savings gained from such systems, considering the fact that each building may result with small benefits. Management also, needs to have a solid understanding of the costs and benefits of the project.
- **Keeping it secret:** Building engineers must be a part of the planning team for the project to succeed. No matter how good the end product may be, operational staff not involved in the process may become resentful, feel threatened, complain and avoid using the new equipment. The involvement of building engineers in the project is very important.
- **Ignoring the real world:** It is absolutely necessary to ensure what you see on the computer screen is what you get in the real world.

BMS Future Trends

There are several trends that significantly affect the present revolution or rapid evolution of large buildings automation as explained over the page. /



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• **World Wide Web:**

The internet allows BMS to become integrated with enterprise functions, eliminating geographic restrictions, easing access to all data from any site and, accordingly making it easier to use and support building systems operation.

• **Wireless Revolution:**

There is a great potential in the wireless technology e.g. wireless sensors, wireless monitoring. Field service technicians will be able to take advantage of this technology through handheld computers wirelessly connected to the Internet.

Moreover, a wireless approach has the advantages of allowing the comfort system to follow occupants through the building and to automatically adjust occupancy, ventilation, lighting and thermal levels to meet personal preferences wherever the occupant travels through the building [Hartman T, 2001].

• **Componentisation of the Control of the HVAC Industry:**

For building HVAC systems, field devices that were traditionally supplied by the control vendor are now appearing as component controllers as part of each HVAC device. The

lower cost and increased functionality of combining powerful DDC microprocessors with standard communication protocols is resulting in the componentisation of controls for the HVAC industry.

• **“Enviromation”:**

This new word describes the radical, exciting changes that are occurring in the integration of communication and automation with our green building environment. Office hotelling has allowed the sharing of expensive office buildings with an increased number of telecommunicating occupants. To effectively manage this phenomena, coordination of everything is required, i.e. phones, workstations, data links, security access etc. The greenest of buildings extends beyond sharing office space; it includes sharing the total transportation and support infrastructures while making home units more efficient [Sinclair K, 2001c].

• **Interoperability Standards:**

One of the most significant recent developments in the BMS field is the implementation of interoperability standards. Two standards to govern how systems communicate between devices are in place: ASHRAE's BACnet **, and LonMark's LonWorks ##[PKB1]. Managers who buy a system that conforms to one of the standards no longer are locked into one manufacturer for components and devices. There is huge competition and development between manufacturers in this area [Piper J, 1998 b].

** For more information about BACnet refer to www.bacnet.org

For more information about LonWorks refer to www.lonmark.org

• **Systems Integration:**

Buildings now use a number of independent systems, including energy management, fire safety, security, lighting, and maintenance management. There is often a need to share information between the systems. Sharing information through systems integration will reduce installation and operating cost, improve building efficiency, and the productivity of facility staff will increase. Integrated and interoperable systems are the wave of the future [Sullivan E, 1998].

• **Software Development:**

The most significant changes taking place in the BMS industry are software related. Manufacturers are seeking ways to use wide range of information now available within the systems. Also, the user interface will continue to become easier to learn and use. Future systems will be even more graphical and intuitive than presently available [Piper J, 1998 b].

• **Expert Systems:**

It is an automated diagnostic process. Following known facts or occurrences, an expert system can guide the user through a series of procedures to solve the problem.

Conclusions:



With the advent of microprocessors, computer-based control systems have become the rule in most commercial and industrial buildings, generating significant energy savings while improving system performance, operability and reliability.

No doubt Integrated and interoperable building systems are the wave of the future. The next decade will bring more integration to all building systems and not only for the HVAC systems. It will also include lighting controls, security, elevators and even fire safety. The Internet will further play a significant part in this process.

Now is the time to begin preparing for an interoperable future, which will create the communication infrastructure that features open-architecture and standard-protocol as much as possible. This open platform for systems to communicate on will open the doors for the intelligent building age.

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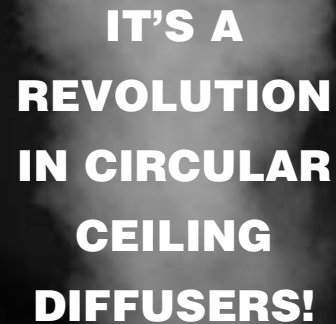
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