For publication in *Today's Facility Manager*, June 2006

Planning for Integrated Building Services

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What is an intelligent building?

An intelligent building provides services to the building manager and tenants that may impact the profits of the building owner. Profits are improved by lower operating costs and higher rents. However, the definition and measure of an intelligent building are determined by technology choices, which change over time.

The judgment of what constitutes an intelligent building depends on the era of the building and the technology options. Until indoor lighting was introduced in the late 1800s, large windows were important for delivering daylight and fresh air. The daylight facilitated productivity into the early evening. Fresh air kept employees alert to work longer hours.

In the late 1800s the leading-edge technology was a thermostat. A thermostat replaced banging on the pipes to alert the superintendent in the basement. Now the technologies for building automation span a much larger range. Typical building systems that are automated include:

- HVAC
- Lighting
- Fire/Life Safety
- Security
- Vertical transport (elevators and escalators)
- Energy distribution (backup power)
- Tenant telecommunications
- Public space communications

These automation systems typically operate independently of one another. Additional benefits could be achieved by coordinating control among many of these building systems. HVAC and lighting might be linked to building occupancy sensors to avoid cooling and lighting unoccupied spaces. However, many of these building systems are installed by separate vendors and operated from separate control panels.

Development of the Guide

The Continental Automated Building Association (CABA) and the Canadian government have funded two important projects to foster the growth of intelligent buildings. *The Intelligent Buildings Technology Roadmap* provides a snapshot of the state-of-the-art and directions for the useful allocation of resources. The *Best-Practices Guide, Evaluating Intelligent Building Technologies* is the subject of this article. This Guide builds on the Technology Roadmap by examining building automation subsystem features and the symbiotic benefits gained from networking formerly isolated subsystems. Both documents are available at no cost from www.caba.org.

The Best-Practices Guide assists building developers to select and install equipment that enhances a commercial or high-rise residential building. The term "Intelligent Building" denotes a building where the environment improves the comfort and productivity of the occupants. The Guide defines criteria for an objective evaluation of technology options that can result in optimal equipment choices. Ultimately, this Guide should stimulate interest and market growth in devices and communications networks for intelligent buildings.

Goals of building automation

The sponsors of this Best-Practices Guide decided that the subsystems listed above are central to the intelligent building. A subsystem for monitoring the building structure was added to this list. Building monitoring might include sensors embedded in the materials within the building structure to detect leaks, corrosion, etc. Subsystems for energy metering and water management may be added later.

Traditionally, these subsystems have been designed, installed, and operated independently of one another. The integration of these subsystems, as shown in Figure 1, to form an interoperable building control system is the hallmark of an intelligent building. Interconnection allows for monitoring via a common communications network that links to a central control panel.

With networked building automation, control could be extended to tenants and even to their employees. Productivity may be increased and turnover decreased by providing individualized lighting and HVAC control within offices. Furthermore, networked controls would allow reconfiguration of these subsystems to accommodate office layout changes as businesses undergo reorganization. Thus, tenants may value access to elements of building control enough to warrant premium rents.

Audience for Best-Practices Guide

The selection of building subsystems plus an interconnection network is usually made during the design phase of a building. The primary audience for the Best-Practices Guide during the building phase includes:

- Project leader
- Project manager
- Facilities manager

- Key initial tenants

These persons make choices about the building during the design phase that affect those who will operate and occupy the building. Therefore, the designers need to be aware of their audience. This is especially critical for the consultants and contractors who are usually retained for specialty designs including building automation. They need to understand the daily activities of the ultimate users:

- Building engineers
- Service technicians
- Facility operators / Building managers
- Tenants / visitors.

Ideally, all these interested parties should be involved in selecting the elements of the intelligent building. Where a team approach is not practical, the burden falls on the designers to consider the needs of various categories of building users. Large commercial or residential buildings may benefit from a team effort in the design process that might even include the owners and key tenants.

Overview of the Best-Practices Guide

The criteria for evaluating intelligent building technologies were divided into these three broad groups:

Group 1. Subsystem operation without a network connection

Group 2. Subsystem operation with a building automation network

Group 3. Subsystem business considerations

The Group 1 criteria apply to subsystems individually. Group 2 criteria deal with subsystems that are interconnected via a network. Such a network provides the infrastructure for a Building Automation System or BAS. Non-technical business criteria have been defined in Group 3 because the technical decisions have long-term consequences on costs, convenience, and flexibility for building operation.

A BAS network includes sensors, actuators, user interfaces, and controllers all interconnected via a communications network. Each device on the network is called a node. The network may consist of wires or non-wired media such as radio, infrared, or power line carrier. Power line carrier impresses data on the electric power network. A BAS network is distinguished from a data or telecommunications network that may be operating in the same building.

The criteria constituting the Best-Practices Guide are organized into topics within each group, as listed in Table 1. Selected topics are described in the following three sections of this article.

BAS operation without a network

Building automation subsystems for lighting, HVAC, life safety, etc. should be designed to operate autonomously when not networked to other subsystems. This helps promote reliable and fail-safe building performance. Some functions may be lost when the network fails. However, essential building services should be preserved when each subsystem is operating on a stand-alone basis.

- Features

  The features of each subsystem are generally tailored to the building design. Thus, considerable customization and the issuance of RFPs (Requests for Proposals) to suppliers may be required, rather than purchasing out of a catalog.

- Performance

  Suppliers may offer a range of performance for their equipment. The building designer should specify the precise needs of the building in terms of performance specifications.

- Operating environment factors

  The designer must work with the equipment maker to ensure proper operation in the expected environment of the building. An important consideration is the “greening value” of each subsystem, such as the impact on fuel usage and disposables.

- Failure and emergency operations

  Some other issues to be considered for each building automation subsystem include failure and emergency operation specifications.

- Support and maintenance

  Building operators who do not contract-out support and maintenance need to address issues of BAS configuration, upgrades, monitoring, testing, etc.

BAS operation with a network

- Interaction with other subsystems

  The challenge of interconnecting subsystems is to ensure that they can interoperate. This implies that they all conform to the same communications specifications. Most building automation systems use proprietary communications methods. However, there is a growing trend to conform to public standards, a trend that will promote interoperability. The Interaction criteria deal not only with the internal building automation systems, but also with remote access via dial-in or via the Internet.

- BAS equipment, features, and network management issues

  The BAS equipment includes the operator interface for monitoring and accessing building systems. Related criteria include methods for controlling authorization and access to building automation systems. Network management criteria deal with configuration, expansion, and network security.

- System management issues

  Some of the system management criteria include commissioning the network during construction and tenant move-in, upgrades, maintenance, and usage accounting if tenants are billed for some services.

- Communications protocol issues

  Other criteria relate to communications and may be determined by conforming to a communications standard.

Business considerations

- Subsystem manufacturer

  Information about subsystem manufacturers is important for judging their networking knowledge and willingness to adapt their products to the building environment. The choice of equipment suppliers has important consequences since they usually provide a long-term maintenance contract following the initial installation.

- Documentation

  An experienced manufacturer should be able to deal with codes, contractors, developers, and tenants. The manufacturer should supply documentation for building managers, equipment installers, operators, maintenance personnel, and tenants.

- Cost / benefit issues

  Costs extend well-beyond equipment to include staff training, licensing, royalties, liability insurance, and tenant instruction. Benefits include higher rents and lower turnover because of improved tenant services.

- Training and industry education

  Intelligent building technology is evolving as networks and components improve. Building designers and personnel need continual education about these changes. Manufacturers should provide some of this education or have ties with professional organizations that deliver timely training.

Application of the Best-Practices Guide

The criteria for evaluating an intelligent building apply at various stages of building planning, construction, commissioning, and operation. The project phases defined by Public Works and Government Services Canada are illustrated in Figure 2.

The first considerations in the Planning Phase are the building owners' requirements and range of options. Issues of budgeting, scheduling, and project management are considered. In addition to the detailed design, the second phase includes the securing of funding and regulatory approvals. Contractors are usually involved in the Implementation Phase. The building subsystems are tested and adjusted in the Commissioning Phase. The performance of the building subsystems is established in the Operating Phase, where a preventative maintenance program and operating budget are established. In the final Evaluation Phase the owners determine the conformance of the building to the design in terms of performance and cost.

The Best-Practices Guide explains which of the criteria topics apply in each of the Public Works Project Phases. Some topics impact multiple phases, as shown in Figure 3.

Further development of the Best-Practices Guide

The criteria listed in the Best-Practices Guide cover building automation and communications networks quite thoroughly. The sponsors of this investigation are considering methods for applying these criteria in the design process of an intelligent building. The key is to transform the criteria into an analytic tool that can be applied simply without needing value judgments.

The criteria in the Best-Practices Guides are intended to encourage the adoption of intelligent building technology by streamlining the selection process while ensuring that BAS products are evaluated thoroughly. Inputs from manufacturers are important. They can provide valuable performance data that can be applied to the process of evaluating their products using the Best-Practices Guide.

Building owners see dramatic changes in computer technology, and wonder why their buildings don't have improved features. Changes come to building automation slowly because building automation technologies need thorough testing for long-term deployment. Nevertheless, building designers and managers should prepare for an increased rate of change. Also, manufacturers can facilitate such changes by adopting standard network infrastructures.

Intelligent buildings are becoming part of the selling tools to buyers, tenants, and potentially a source of revenue. The bottom line is improved building performance and rents, a better working environment, and more productive business for the occupants. These goals make for good public policy and are worthy of encouragement by governments and investments by manufacturers of building automation systems.

Dr. Kenneth Wacks is a management advisor on home and building systems to companies worldwide. He has been a pioneer in establishing the home systems industry. Corporate managers depend on Dr. Wacks to identify business trends with clear and practical advice on business development strategies in home and building systems. The Consumer Electronics Association (CEA) chose Dr. Wacks to chair the international committee (ISO/IEC) responsible for world standards in home and building systems. For further information, please visit www.kenwacks.com.

Figure 1 – The Integration of Building Automation Subsystems

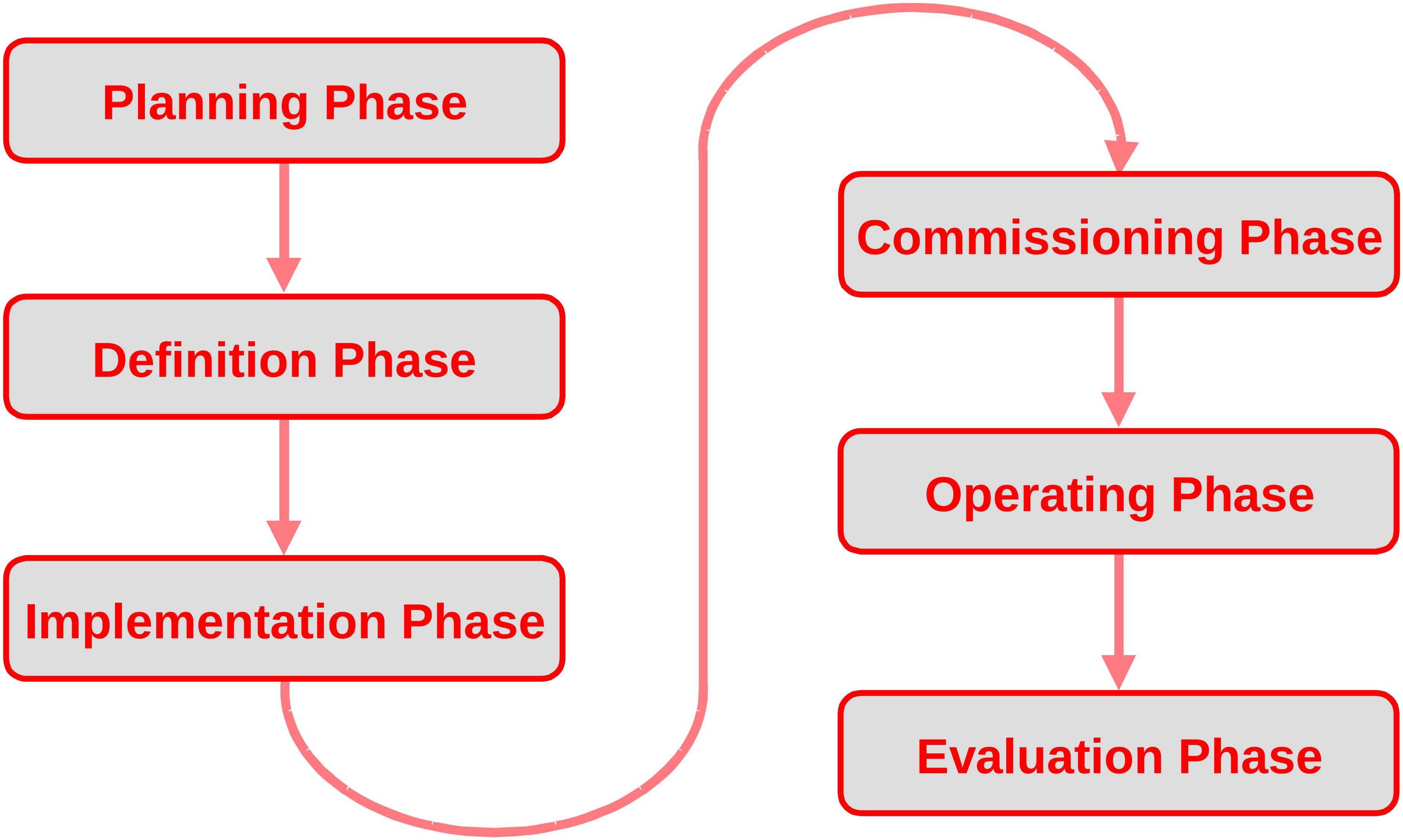

Figure 2 – Application of the Best-Practices Guide

Group 1: Subsystem operation without a network	Planning	Definition	Commissioning	Implementation	Operating	Evaluation
Features	✓	✓	✓			
Performance		✓	✓	✓		
Oper. environment			✓		✓	
Failure / Emergency			✓		✓	✓
Maintenance				✓	✓	✓

✓ = Topic (left side of chart) impacts Project Phase (top of chart)

Figure 3 – Impact on each Project Phase

Group 1 Operation without a Network Connection	Group 2 Operation with a Building Automation Network	Group 3 Business Considerations
Features	Interaction with other subsystems	Subsystem manufacturer
Performance	BAS equipment	Documentation
Operating environment factors	BAS features	Cost / benefit issues
Failure and emergency operations	BAS management issues	Training
Support and maintenance	System management issues	Industry education
	Communications protocol issues	
	Application Layer features	
	Lower Layer features	

Table 1 – Groups of Criteria Topics for Evaluating Building Automation Subsystems