Fundamentals to frontiers

Building automation systems

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The building design and management marketplace is being inundated today by various grades and forms of what have been popularly labeled as Building Automation Systems (BAS). Current generations of these systems virtually all employ as their Central Processing Unit (CPU) digital computers, most of which have functional capacities far in excess of that required by the chores to which they are assigned. Probably the extreme is the case in which a digital computer is assigned the single chore of limiting electrical demand in accordance with a preselected priority input and providing an octal printed output that simply records which loads were trimmed and for what length of time. Such units sense only one element of the building performance, the electrical demand.

The manufacturers of these devices were quick to realize that the CPU had capabilities far beyond this one simple function. Sound marketing policies led to seeking out other uses for the sophisticated hardware. Designers of new projects and the owners and managers of existing buildings are being subjected to extensive marketing programs, the majority of which stress energy conservation as a primary advantage.

Misapplication of both limited capability systems, such as the one described above, and some much more complicated systems has apparently led many systems designers to the conclusion that BAS systems are not an effective tool in energy management. *The paramount cause of the failure is that the systems were installed with little or no understanding of the functional aspects and integrated nature of the systems being "controlled".*

Properly applied, virtually any building automation system can be a valuable energy management tool. Some of the key steps required for this "proper application" are:

- The BAS must not be applied in cases wherein the methods of sensing and transmitting performance data have not been validated regarding anticipated accuracy and repeatability when coupled to the specific model CPU.
- The BAS should be programmable. If the unit cannot be programmed with logic tailored to the specific system characteristics, then its use must be limited to those controlled systems whose logic is recognized in the hardware circuitry. With constraints of finance, energy, performance, machinery availability, etc., the additional false constraint imposed by a BAS program limitation would likely be counterproductive.
- The programming of the unit should be done by, or done in close cooperation with, the systems designer. This involvement on the part of the designer will require additional time (and consequently a higher design fee), but in most cases it will have a very valuable side benefit. When the designer sets out to develop a description of the system operating logic in the rigidly structured format of a computer program, any latent inconsistencies or flaws will certainly be revealed, and an improved design inevitably results.
- Extreme care should be given to the selection of all types of sensing devices and signal transmission. This is the system element that both the unit manufacturers and the systems designers generally relegate to the realm of "nitty gritty". The problem, however, in most cases is that since the sensing devices are small and seemingly simple, efforts at cost control have misled manufacturers of many BAS systems to accept so-called "commercial quality" apparatus. More problems are encountered with analog sensing devices than with binary signal devices, but both require the same attention. As an example, the major area in which the BAS saves energy is that it takes all the slack out of the system operation. If, then, a chiller temperature set point deviates 2 F from that required due to sensing inaccuracy, the resulting deviation will quickly be felt within the conditioned spaces because all other elements of the integrated system are finely tuned. On the other hand, if the same deviation had occurred in a manually controlled system, certain elements of slack in the system operation would generally have been available to compensate. (Many times this was simply due to the logic contribution of the operator.) Binary signals used to sense such functions as air pressures for various logic and alarm purposes, if not almost *absolutely* reliable, provide false inputs that often result in excessive output errors significantly affecting performance.
- Starting procedures for both the controlled systems and the BAS must be rigorously planned and carried out. Trying to achieve that high degree of exactness in operating logic (an inherent purpose of the BAS) is meaningless unless the system being controlled actually performs in accordance with the logic programmed. Such things as inaccurate fluid flow rates (air and liquid), poorly calibrated controls, and the like become extremely significant when the system is controlled by a BAS.
- Management must recognize the need for a well-planned maintenance program for both the elements of the BAS itself and for the controlled systems. Some BAS systems include logic for scheduling maintenance, and the management staff assumes that this ends the problem. If, however, a properly skilled staff is not available to carry out the chores, what has been gained? Poor performance of systems components due to inadequate maintenance attention has the same effect as a system that has not been properly de-bugged. If the BAS itself is not properly maintained, the results are the same. In either case, it will fail to perform reliably, and the personnel responsible for the building operation will lose confidence in its ability and return to manual operation and control procedures. This has happened in a vast percentage of systems, whether controlled by a BAS or other less sophisticated means.