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Improving Management Through New Technologies

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Feature

A comprehensive look at the role of technology in today's campus physical plant environment—and the roles technology can take in the future. Also, writers from nine colleges and universities report on how their institutions have implemented successful, efficient programs utilizing available technology. Turn to page 3 for full contents of this special section.

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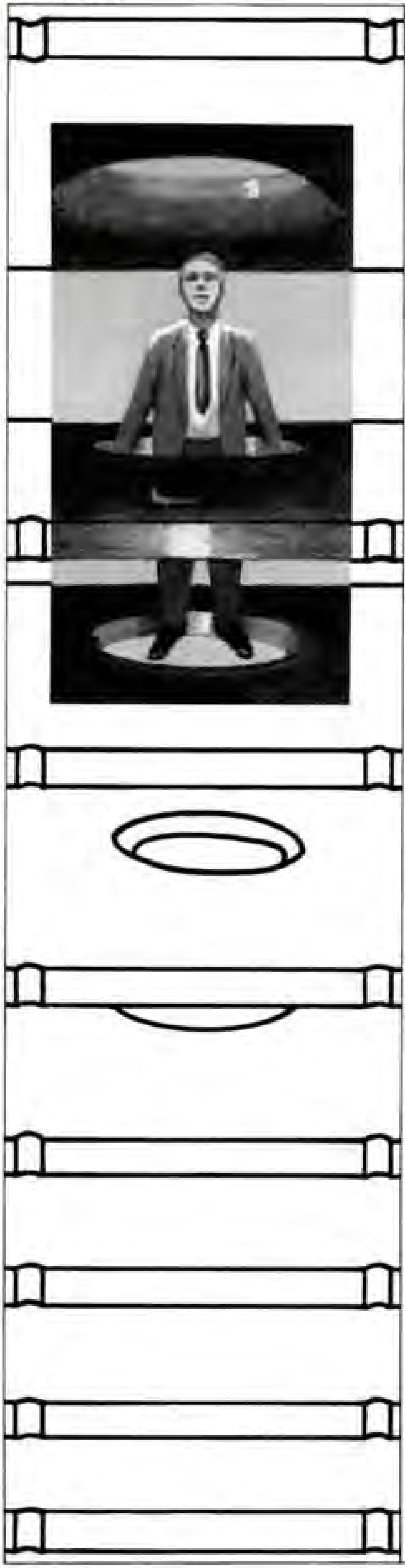


Improving Management Through New Technologies

by the Technology Task Force

This special issue of *Facilities Manager* shares its theme with APPA's 73rd Annual Meeting*, which is being held July 13-16 in Boston, Massachusetts. The three interlocking essays discuss the many applications of technology to facilities management. These are followed by nine institutional reports on specific ways in which computers and other high technology tools have been incorporated into the daily activities of the physical plant. All can be modified to suit any facilities operation.

The Essays

The Reports

*Two dozen speakers will present papers on new technologies and management concerns at the meeting. These papers will be compiled in the *Proceedings of the 73rd Annual Meeting* and available in August from APPA, 1446 Duke Street, Alexandria, VA 22314-3492. The cost is $15/APPA member institutions, $21/nonmembers, plus $5 for shipping and handling. Nonmember orders must be prepaid.

The Technology Task Force is an ad hoc committee of the Association of Physical Plant Administrators of Universities and Colleges. Randall Turpin chairs the task force and is director of the plant operations department at the University of Utah in Salt Lake City. Members of the task force are Mohammad Qayoumi, Ph.D., associate director of facilities management at the University of Cincinnati, and John Heinz, director of the physical plant department at the University of Washington in Seattle.

The Application to Facilities Management

by V. Randall Turpin

A construction equipment dealer in the Salt Lake City area uses the following slogan in his advertising: **You can't do today's work with yesterday's equipment if you expect to be in business tomorrow.**

We in facilities management could paraphrase that slogan when considering the use of technology in our physical plant operations: If we try to manage our organizations today using yesterday's technology, we very likely will not be the administrators in the future.

At the University of Utah we have been firm believers in using computer technology to help us manage our department. So many people are now using the computer to assist them in completing their assigned tasks that I don't believe we could successfully manage our department without this vital tool.

All of us have been faced with the dilemma of shrinking maintenance budgets; this forces us to look continually for ways to stretch our available dollars. If you are still facing the problem of increasing maintenance responsibilities and decreasing or static maintenance budgets but have not considered full use of the computer as an administrative tool, it may be time to take a long, hard look.

My department has a standing annual major objective to find ways to be more efficient, and the use of computer technology has, in fact, allowed us to operate "smarter" and therefore more efficiently. We recently reviewed our current usage level and realized that if the "wicked computer fairy" was to swoop down on our campus and remove the units used to administer our department, we would not be able to deliver support services to the campus. These services range from memos from the director's office and utility interruption notices, to the annual budget request and paychecks for all of our employees, among many other applications.

Mini Computers

To meet our departmental needs, we are using a Micro Data mini computer with nine strategically placed terminals and ten personal computers (seven IBM XTs, two Leading Edge, and one AT&T). The mini computer is the workhorse unit for the department and is operated by our staff support group, the Central Services Division, which handles basic accounting, work planning, payroll, and personnel functions. This division produces the management reports that keep us moving ahead.

The reports produced include weekly and monthly budget expenditure updates, all carefully reconciled to official central administration accounting totals. All project accounting costs are updated weekly and available to the appropriate managers. The project accounting includes all planned and unplanned maintenance work orders and billable work, including invoices for completed jobs. In addition, the computer system is used to produce personnel reports, the bimonthly payroll, activity logs for each operating unit, and daily work orders for all shops, including preventive maintenance work and phoned-in trouble calls. Central Services generates utility interruption notices to appropriate parties via the computer, and they weekly update the capital renewal and replacement, capital improvements, and code compliance data bases. Monthly utility usage and billings also receive the attention of this group and their trusty computers.

These activities are virtually worthless if they don't help your department work with more intelligence, and this is exactly where we feel we have found the key to making technology work for us. The people employed in our staff support unit have the ability to visualize and understand the real needs of our management group. They have taken these administrative needs and found ways to meet them through available computer technology. With the equipment handling our raw data and giving us the desired information in return, we are able to make meaningful and timely management decisions on a wide variety of matters.

Our mini computer serves as our foundation and thus carries the heavy load of administrative demands. This backbone system affords us the luxury of having all of our basic operating data in one integrated data base that can be accessed by remote terminals. This is a great advantage for us, and since everyone is working from the same set of facts, our management decisions can be made at the appropriate level in the various divisions with great accuracy. Misunderstandings are reduced greatly.

An example of this benefit would be when the project data base is accessed by the work planner to coordinate scheduling, the individual shop supervisor to review his or her shop's progress, or the division manager to review the performance of several shops. Everyone can view the same material.

In addition, our mini computer has been made to serve other divisions in the department. Several years ago our custodial division developed a sophisticated standard cleaning program based on the actual cleaning requirements for each individual space within every building on campus. The standards program increased the effectiveness of our cleaning program greatly, but manipulating the necessary data was a tough clerical assignment. By having the mini computer handle this program data, it is now possible to quickly access the data and make intelligent decisions regarding this extremely visible operation.

All of the records for key issuing and building locks are handled by the Micro Data computer. As lock changes are made or keys are issued to campus faculty, staff, and students, the records are entered immediately using a terminal located in the key shop. Again, this data base can be accessed and viewed by others in the department and can also provide the university's Public Safety Department with accurate information when investigations are in progress.

> The annual budget request is now completed on a personal computer and sent to the vice president's office on a floppy disk. We no longer deal with hard copies and hours of overtime.

Vehicle operating cost data is fed into the mini computer daily and results in monthly gasoline and oil billings for campus departments. The manager of our central motor pool can also run a variety of reports to analyze the operation of the fleet. From this analysis he can determine vehicle replacement schedules, vehicles that should be reassigned, and vehicles that are operating efficiently and effectively.

Daily work order information on labor and material fed into the mini allows us to accurately track the costs associated with all of the major pieces of operating equipment in our buildings and utility systems. Management personnel on all levels can access the data to evaluate the performance of a specific component and determine its economical replacement schedule. This data also allows us to make extremely accurate recommendations regarding the future nonuse of equipment or components that have not performed economically or reliably on campus.

Personal Computers

The functions handled by the mini computer are essential to our basic operation, and it is necessary to have these baseline functions centralized for the reasons discussed above. But we also recognize that many functions in the department are unique to a given operating unit and would not be efficient for a mini to handle. This is where the exiting technology of the personal computer (PC) enters the scene. The personal computer complements our basic system extremely well.

Specialized data that does not need to be shared by others in the department can be entered into a personal computer and manipulated by an individual for a variety of effective results. Based on recommendations from the university's data processing department and our own initial usage, we determined that three readily available personal computer programs would enable our people to handle all of their forecasted needs: DataEase (data base management), Symphony (spreadsheets), and MultiMate (word processing). Many other programs with equally reasonable costs are available, but these have worked well for us.

With the "canned" software loaded in their PCs, our people can enter the data important to them and their assigned responsibilities. The data can be accessed to quickly develop planning priorities, produce budget request reports, or examine a variety of "what-if" situations. Because of the decision to use the three basic software packages uniformly throughout the department, we also have the ability to transfer data to other interested departmental personnel if desired.

We are encouraging all of our shop supervisors to jump in and get their feet wet. Some are still wading, but others are becoming competitive swimmers. In any case, all of their efforts are combining to meet our overall objective of becoming increasingly efficient.

It is a unique experience to watch a doubting supervisor remove a file from the trusted file cabinet and begin to enter the data in the PC. Then to see the same supervisor access the data in a PC to quickly and accurately analyze the information to produce a recommendation is exciting. The final touch is for the supervisor to push a button or two to produce the written report or recommendation in time to hand it to his or her manager for a critical planning meeting. The old trusty file cabinet never performed like this.

Externally mandated programs have caused sleepless nights for all physical plant directors. Requirements have been substantial for dealing with PCBs, asbestos, right-to-know ordinances, and, on our campus, backflow prevention devices for our campus-owned and operated water system. The PCs are helping us deal with the special record keeping required by these programs. Once data is entered in the PC, we can easily generate reports or summaries in the desired format to meet the needs of the outside agencies.

Funds for major roof repairs throughout the state of Utah are administered from a central state office. Roofing personnel have entered their roof inspection data into a PC, allowing us to quickly update our roofing data base whenever a change in status occurs. Now priorities on replacement needs can be easily changed and a new listing prepared on a moment's notice.

Currently our grounds crew is using a PC to record data on tree replacements, spraying programs, fertilizer programs, and equipment costs, and to control their automatic sprinkling clocks from a central location. They use their unique data base regularly to develop recommendations for improving our grounds programs and to keep management aware of ongoing activities.

Several of our operating units are using the PC to assist them with the administration of our employee performance evaluation system with outstanding results.

One of our most crucial tasks—the annual budget request—is now completed on a personal computer and sent to the vice president's office on a floppy disk. We no longer deal with hard copies and hours of overtime needed to type and retype budget requests to meet unreasonable time deadlines. Our previous year's budget is now sent to us on a floppy disk. We prepare our request based on guidelines from the budget office. All calculations are done using the PC and our final recommendation is submitted on the floppy disk. This is a huge improvement over procedures used in past years.

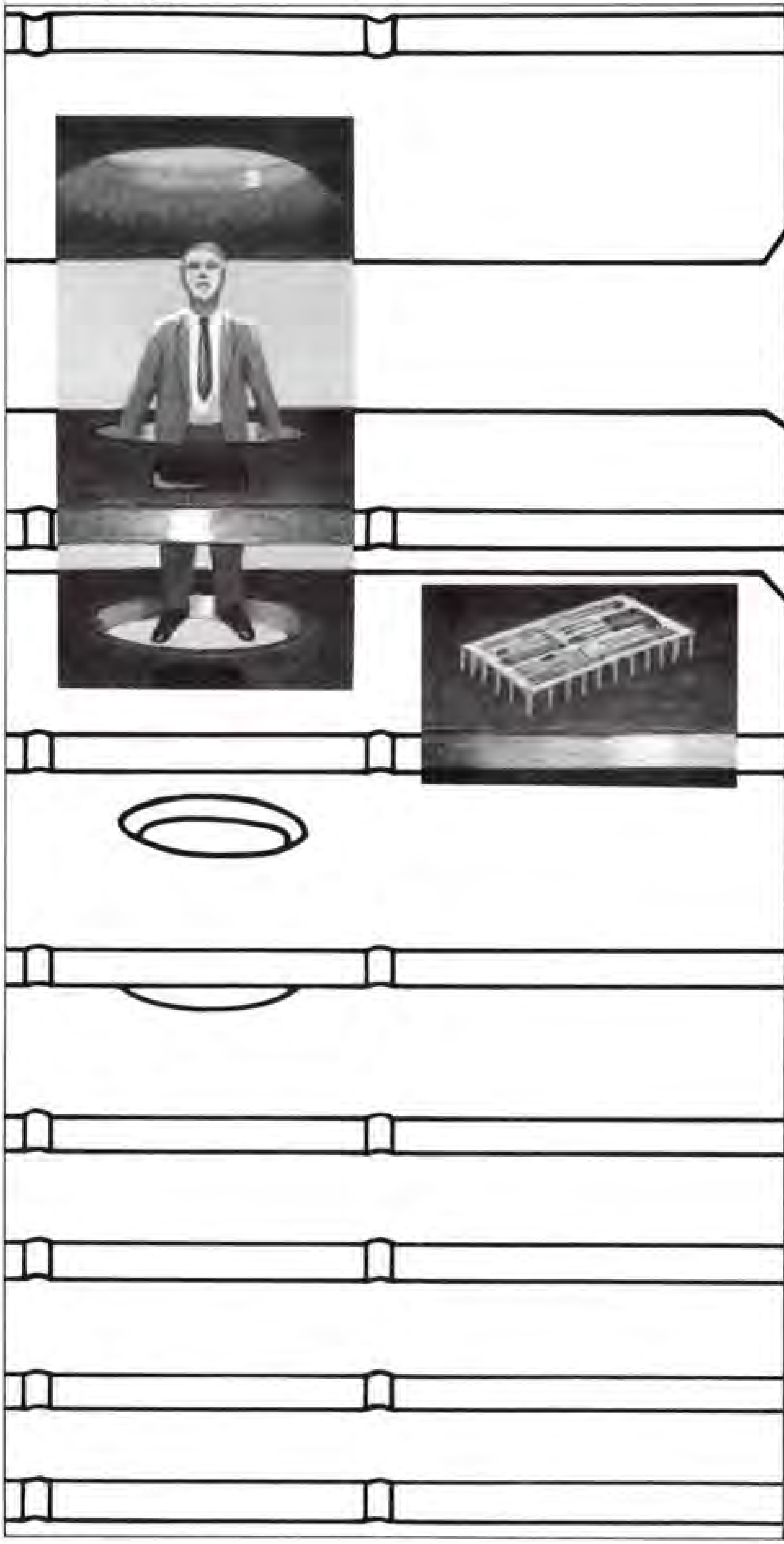
Although the switch in the director's office from typewriter to word processor was a painful one because of equipment malfunction, we are now certain that it is the answer to our correspondence requirements. The features available through the word processing equipment allow us to put out letter perfect, professional work every time with unnecessary clerical effort. This allows my administrative assistant to utilize her management skills to solve department problems. She now has time to work on critical special projects and assist me in solving the many people problems that arise each day.

Conclusion

If these few examples of the use of mini and personal computers sound too good to be true, the fact is they are good and they are true! And our people are just beginning to understand the potential of how useful these tools can be to them.

We in facilities management are extremely fortunate to be in the situation where technology is clearly serving us. We have experienced situations in the past where the technology was controlling us, as in the tail wagging the dog. We've all heard the horror stories of computer installations that have actually created more problems than they've solved. It can happen; we know because we experienced some negative results when we first took the jump from manual to computer methods.

The secret is to insist that the technology work for you. Don't become a slave to it. With the wonderful array of available hardware and software at reasonable prices, there is no excuse left for us. The correct use of today's technology can ensure that we will be the physical plant administrators of tomorrow. ■



Total Systems

by Mohammad H. Qayoumi

The 1980s have created new challenges and issues for physical plant administrators. These challenges are in the background of enrollment drop for most of the country's institutions, sharp declines in available federal funds for universities and colleges, maintenance and operation of ever increasingly complex facilities, shorter equipment life cycles, large backlogs of deferred maintenance, and an avalanche of government regulations. In other words, the job of a physical plant administrator has fundamentally changed from what it was thirty years ago. A sizable number of institutions are trying to solve new problems with old solutions and, as expected, are not very successful in obtaining satisfactory results.

At the turn of the century the railroad industry was at its peak expansion period. Every month routes were opened and new services added. Why has this industry declined to a mere fraction of its previous peak size? The answer is simple. The railroad industry thought it was in the railroad business rather than transportation service. As personal vehicles became prevalent and air transportation more economical, the railroad industry's lack of progress caused its decline.

The same analogy can be drawn for physical plant departments. It would be myopic on our part to believe that today's physical plant departments exist merely to fix the leaky pipe and clean the waste baskets. A better answer is that physical plant departments are here to serve a *need*: to provide a safe and comfortable environment in a cost-effective manner for the students, faculty, and the rest of the college or university community. In other words, we are a service entity.

The underlying message is that as the needs of the institutions change, more innovative solutions are necessary. Institutions of higher learning are basically labor intensive organizations, and this is especially true in the academic environment. A professor can only attend to so many students at one time. Any pressure to increase productivity by reducing faculty numbers could result in a compromise in educational quality.

With many universities facing stricter financial constraints a steadily increasing burden is put on the non-academic areas to increase productivity and become less labor intensive. Any significant productivity increase can only be achieved through the use of new available technologies. Therefore, utilizing modern technologies for the above challenges are a necessity for the effective physical plant department wishing to remain so. The following shows how new technologies can be applied in physical plant environments to improve operational efficiencies.

Office Automation

As more and more departments realize the benefits of automation and as hardware costs drop, automation will become more effectively utilized within an organization. Office automation refers to the use of electronic means to store, process, retrieve, communicate, and present information rather than being limited to present office technology. Its use will enhance the people skills necessary to complete these tasks. Office automation does not necessarily mean the creation of a "paperless" office. It means that paper technology plays a supporting role rather than the primary one.

As funds are becoming more and more scarce, colleges and universities are trying to minimize cross subsidization of different cost centers. We are slowly moving from absorption accounting practices to direct costing. For any medium- to large-sized department, the costs of a project can be tracked accurately with an automated cost accounting system.

At most institutions, when a new facility comes on line the department's operational budget is increased based on the average campus-wide cost per square foot for utilities and maintenance. But because modern buildings are more energy intensive, require more maintenance, and have more mechanical and electrical equipment to attend to, the figures will be higher than the average cost per square foot.

Schools that have used this allocations technique have lost ground on their funding levels needed to maintain the facility. A good computerized cost accounting system can give the cost per square foot data on facility types—i.e., classrooms vs. teaching labs vs. research labs vs. offices—and all the related resources needed to maintain a new facility. With this method a physical plant administrator will be able to substantiate the need to secure the necessary resources for these new facilities.

An office automation system provides useful data processing capabilities that were almost impossible and cost prohibitive for a physical plant director to accomplish with a manual system. This means that a lot of quantitative analysis and operations research models used by the industry can now be at the fingertips of the managers.

For instance, applying a queueing model to determine an optimum size of a maintenance crew based on the rate of calls received, the rate they are serviced, average response time per work order, and average completion time are now possible with the computer. The manager can also use network flow models to determine the best route for delivery of maintenance staff or material to the job sites, or PERT/CPM for determining the critical path of multiphase projects.

Electronic processing can help us develop simulation models and perform stochastic analysis on the data. For instance, you could first determine how sensitive utility costs are to weather, fuel costs, labor costs, occupancy, maintained temperature, and equipment efficiency. Then determine the controllable factors from non-controllable ones. Make a plan how to manage the

> Artificial intelligence concerns itself with making computers function like intelligent human beings.

controllable factors and how to account the non-controllable factors. This way the budgets given to administration on utilities will not be a fixed figure but a number of scenarios. The benefit is that the fiscal officer will get a better picture of physical plant problems, and the budget you receive will be based on assumptions that both sides have understood and made *a priori* agreements on.

Another area of concern to physical plant departments is the lack of as-built and up-to-date drawings and specifications on campus facilities and equipment. As the cost of PC-based computer aided design (CAD) packages decreases, it is becoming feasible that campus drawings and specifications be placed onto an electronic storage medium. This will simplify updatings of the drawings which, in most instances, are never totally complete.

Also, it will be easy to make abridged drawings from the engineering drawings that are simpler for maintenance staff to use. Such simplified drawings—*i.e.*, showing main electric disconnects, main water supply value, or the position of smoke detectors and pull stations—would be of immense help when responding to an emergency.

Automating specifications of buildings will have similar benefits. Maintenance supervisors no longer have to contend with thick volumes of specifications that are dusted off perhaps every other year. If the specifications are electronically stored, then every maintenance supervisor can go over them once, determine the important sections for his or her work, sort it the way that is most comfortable, and then make a working subsystem for future use. With a setup like this, design engineering firms may be required to give the institution all drawings and specifications not only on paper but on a magnetic disk medium as well.

Central Environmental Controls

With enhancements in microprocessor technology in the late 1970s, direct digital controls (DDC) came to fruition. DDC replaced pneumatic controls with electronics where the proportional controllers can be replaced with proportional, integral, and differential controllers to be able to monitor the heating and cooling demands of buildings more closely.

Since DDC systems practically have zero drift when comparing them to pneumatic systems, environmental conditions can be maintained more closely, which means better comfort levels at equal or lower energy costs. Also, DDC transformed the central controls to a distributed system, which greatly increased system reliability. If the central unit goes down, the effect on individual buildings is minimal.

Utility plants have the highest energy concentration on any campus. Therefore, any percentage of energy saving there would have significant positive impact on the overall utilities budget. The process controller manufacturers, such as Fisher, Bailey, and Fairmont, offer direct digital controls for combustion optimization as well as operational optimization for multi-boiler operations. Similar comment is true about chillers and central chilling systems.

It is of prime importance to have adequate communication links between energy management systems (EMS) and these units so that both systems share information and establish global optimization. Without it an EMS can only suboptimize and result in lost opportunities for further reductions of energy costs.

This brings us to another important concept. In the early 1970s a central environmental control encompassed energy management systems, security systems, fire alarm systems, etc. Each of these uses had a completely deparate system with no compatibility among them. Now central environmental control systems must be looked at in the context of a "smart" or "intelligent" building. This means that each of these systems are separate and distributed.

But perhaps all of the above utilities use the same broad band cable system, possibly fiber optics, and some degree of communication will exist between the systems—sharing information and using a uniform hardware interface for all utilities. Moreover, the above cable might be used for voice, data, facsimile, and graphics communications in addition to the utilities functions. In other words, the physical plant department of the 1980s is getting into operation and maintenance of telephone systems, data communication, and video systems over and above what had to be maintained in the past. This means that the central environment controls becomes part of a much more comprehensive system.

Artificial Intelligence

It was less than twenty years ago that the movie *2001: A Space Odyssey* and Hal the Computer were considered science fiction and a futurist misconception. In the last five years the interest and developments in this area have increased at an exponential rate. Before discussing application of artificial intelligence (AI) for physical plant environments, it is important to define it clearly. Artificial intelligence as a discipline concerns itself with making computers function like intelligent human beings. In other words, computers should be able to learn, reason, adapt, correct itself, and communicate in human or "natural" language.

There are four areas in which AI is mimicking human reasoning: natural languages, vision and speech recognition, robotics, and expert systems. The development of expert systems to teach machines how to solve a problem in a strictly defined given field is of special interest. The traditional computer programming languages deal with a set of ordered instructions using binary logic. With an expert system, with the help of "fuzzy logic," system designers can accumulate the necessary knowledge in a particular field, reduce it into a series of rules of thumb or heuristics, then synthesize this information for computer use.

Expert systems are considered to be better than human experts because they can examine more rules simultaneously and they never forget any of the rules. This is why expert systems have succeeded where humans failed. The capability to consider mind boggling amounts of data far exceeds any normal human expert. In addition to producing excellent results, expert systems leave a trail of reasoning and can explain why certain alternatives were accepted or rejected. Simply put, unlike a traditional computer program that only follows rigidly defined step-by-step series of commands, an expert system can be programmed to tell the computer what to do without specifying how to do it.

There are a number of ways that expert systems can help the operation of a physical plant department. A few examples follow.

1. Developing emergency procedures for loss of a utility, electrical, or fire emergency. Since the expert system is developed over time under "normal conditions," the field personnel will not have to make rash decisions in the heat of the moment that might be regretted later on. With personnel turnover, less time and resources will be needed to train new employees.

2. One of the problems with temperature control systems is responding efficiently under load changes. I know of at least one temperature control manufacturer who is working toward developing self-tuning temperature control loops with the use of artificial intelligence.

3. Another area where expert systems would greatly help reduce equipment downtime is developing heuristics for trouble shooting and routine maintenance of more complicated equipment.

All routine tasks not automated with conventional office computerization will be automated with the further developments of artificial intelligence. It is essential that physical plant departments apply and utilize these capabilities.

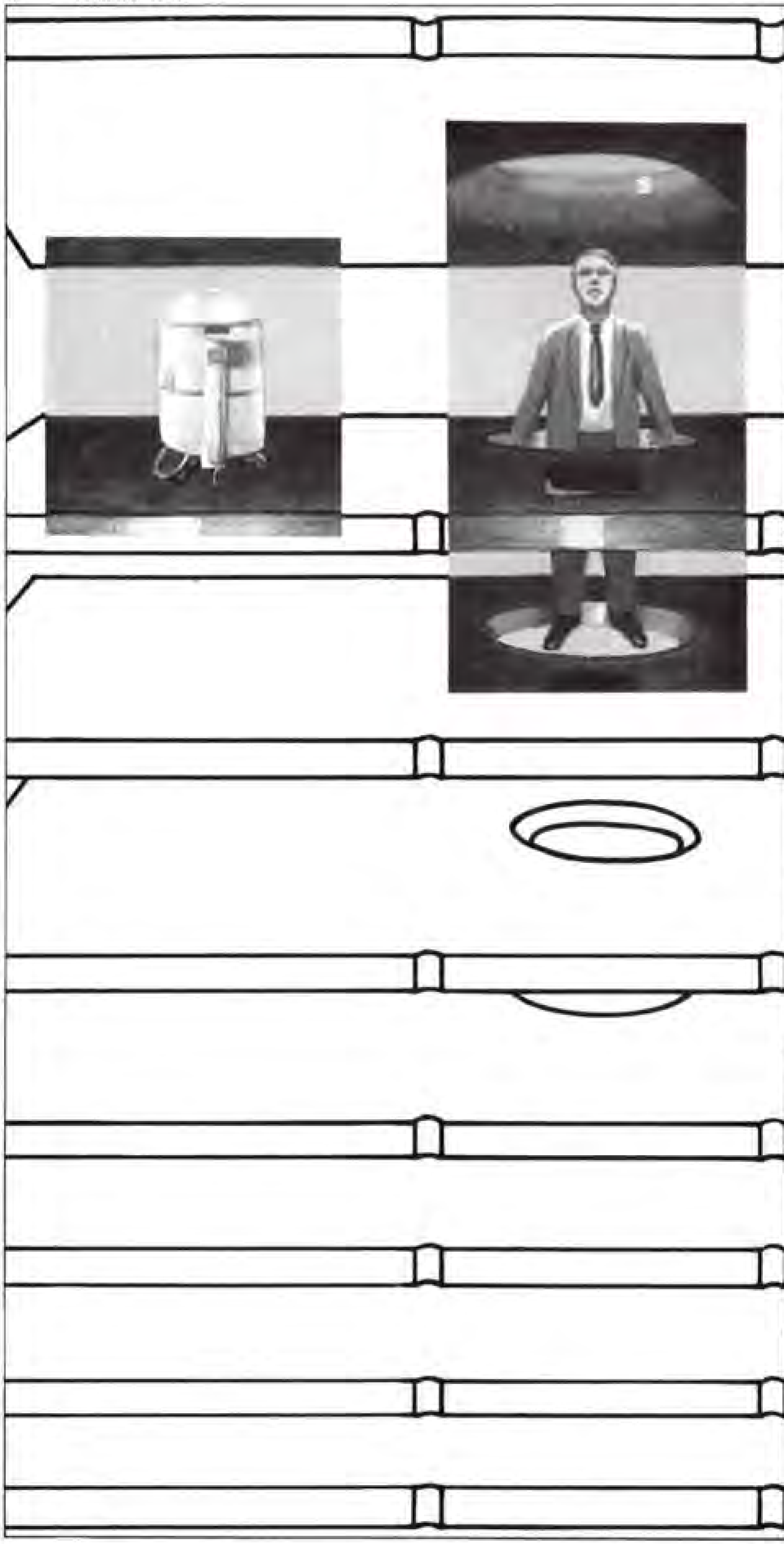
Effects of New Technology

The use of new technology has not been without its problems. If new technology is used with old work flow and processes, "technological tension" is created. Until such tensions are resolved, "technophobia" will remain and the full potential of the new technologies will not be realized. Stated differently, physical plant managers must realize the need to change the old ways and approach new technologies with innovation in a creative environment. This may require an organizational structure different from the hierarchial bureacracies many of us are accustomed to. This could include a decentralized authority, polycentric networks replacing monocentric ones, and job classifications with more fluid boundaries. In order to utilize new innovations efficiently, the organizational structure should promote creativity as the lifeblood of new technology.

Instead of looking at campus buildings as brick and mortar with electrical and mechanical systems, we should look at them as a complex of various utility systems that happen to be housed within a shell of brick and mortar. The use of new technologies is offering an exciting future for physical plant administrators. Now more than ever, human qualities such as originality, intuition, and creativity will be necessary to lead our departments to the twenty-first century.

Physical plant departments have successfully met past challenges and will continue to do so, as long as we are conscious of our fundamental goals in relation to meeting the needs of higher education. In conclusion it might be appropriate to quote T.S. Eliot from his "Little Gidding" poem in *Four Quartets*:

We shall not cease from exploration
And the end of all our exploring
Will be to arrive where started
And know the place for the first time. ■



Maintenance and Operations

by John A. Heinz

It is safe to say that we are all inundated by the high technology environment (perhaps explosion is a better word); it is becoming an integral part of all industries today. In a sense, we are awed by the potential and overwhelmed by the prospects. Not a day passes without a proliferation of mail and vendor inducements to proceed headlong into the abyss of the promised land.

The time is upon us to proceed with caution—but not so cautiously that we do not proceed at all. We do not have to jump into the deep end of the pool. There is a shallow end that can be comfortable for all institutions, large and small, that will meet a large portion of our needs.

As an example, for a number of years the physical plant department at the University of Washington has had two PDP 11/34 mini computers and, more recently, added two PDP 11/44 mini computers. While these computers have served us well, the end users have been totally dependent upon a small group of programmers working diligently to develop the required programming. Needless to say, the programmers have been unable to meet the needs of a large number of people who have some unique needs in their specific areas of endeavor. In January 1985 we obtained two dozen Zenith PCs (we now have forty-two) and things really took off in a big way.

It is not enough, however, to simply throw PCs at the troops and let them sink or swim on their own. Concurrent with the PC acquisition we provided all end users with three generic software tools: MultiMate for word processing, Lotus 1-2-3 for spreadsheet work, and dBase III for data management. It is extremely important for all in the department to be using common applications software for the convenience of training and the transferability and sharing of achievements with others.

We hired a trainer to do two things: 1) provide uniform indoctrination training in the use of the PCs and the three generic software tools to all users (in small groups of ten or so), followed by 2) tutoring at the work-station for those who had specific applications they wished to implement fairly quickly. This assured virtually immediate, effective use of the new equipment and brought the intimidated users up to speed in relatively short order.

I have no doubt about the overall benefits of the broadened base of computer power this has achieved for us. We have a number of bright people who are developing excellent special-use applications programs to meet their unique needs. But, as always, there is a price to pay for this expanded capability. The one of primary concern (to the "professionals") is the loss of control—particularly in the area of program operating efficiency and documentation.

My initial reaction was that an inefficiently operating, non-documented program is better than none at all (which heretofore was our only alternative), but I do have to agree philosophically with their concerns. However, I am not willing to let those concerns stifle imagination and creativity. As an alternative I am suggesting that the professionals are going to have to revise their approach to providing assistance to us lesser beings and work with us as facilitators in improving operating efficiency and developing documentation as appropriate. This is particularly true where a local development can be expanded to serve a broader need than originally perceived.

Planning and Scheduling—Maintenance and Alterations

Underlying everything that we should be doing is the fundamental objective of making the most effective use of our resources, both funding and personnel. One umbrella common to all of that is planning and scheduling.

We are under continual pressure, as we should be, to improve the scheduling of our personnel resources. This is the most difficult part of our jobs—integrating preventive maintenance program requirements, repair requirements, trouble calls, alterations projects, assistance with special events, etc., into a cohesive, orderly work program. A major share of the work is predictable but there is a large volume that is not. It is a tough problem that defies simple solutions.

Thus, if we are to improve the overall operational effectiveness of our departments, we have got to become proficient at planning the work and scheduling our personnel. Whereas once we could rely upon the first-line supervisors to do this, the complexity of matters has increased so much that today that is an unreasonable expectation—particularly when multiple shops of specific crafts all must participate.

Further, in order to become proficient at planning and scheduling we must first become proficient at developing work standards and estimating. As an example, last year our department did $6 million worth of alterations projects, averaging about $15,000 to $20,000 each. At the end of the year we found that, in the aggregate, overall estimating was off by only two percent. However, on any given project we might be off by as much as 50 percent. It is totally impossible to schedule personnel resources if you cannot estimate the labor units any closer than 50 percent. Therefore, the foundation requirement is to develop a reliable estimating program. To do so we hired a professional construction estimator from private industry (on a temporary project assignment) to develop a comprehensive estimating program for all of the work performed by the physical plant department.

We knew that we wanted this to be a PC-based estimating program that would be available to appropriate staff. Further, we knew that we wanted it to be convenient to use yet retain central control of the estimating data base, but not be unduly burdened by an administrative hierarchy. Our solution is focused on a floppy disk system and a data base managed by a designee in the design division of the organization.

> Bar coding should save us about $250,000 per year in recording, documentation, and billing work.

The first effort of the professional estimator was to seek out industry software that most closely meets our requirements. After considerable review we have decided to use the TOPS IV program developed by DataTrak. This program provides many features for adjustment and automated grouping that make it easy to do all levels of estimating. Similarly, the PM (preventive maintenance) data base has been augmented with task time units derived, in large part, from the EPS program developed by the U.S. Navy several years ago. Due to our large size, the PM data base must reside in one of the PDP mini computers, but the day-to-day management and application of the data is performed using the PCs in the actual planning and scheduling activity.

It is impossible to have one designee as the "total" expert for the wide-ranging estimating needs of an organization comprising several work centers. Consequently, we have overlayed the classical administrative organizational structure with several functional teams (commonly referred to as a matrix organization), one of which is the estimating team to work closely with the estimator lead to continually refine and update the estimating data base. When appropriate, new "official" estimating floppy disks are distributed to the users to assure the integrity and consistency of the overall estimating program.

This then leads to addressing workforce scheduling. Our discovery has been that software available from industry is totally incapable of accommodating the complexity of the scheduling requirements for so many varied tasks. Thus, we have concluded that we will have to develop our own program, which will be no small task. In the meantime, we are planning to use one software program for PCs that will provide some modest guidance in the scheduling of projects and staff and also provide experience that will be valuable in further defining our specific requirements. This is not our preferred course of action, but trying to live within the constraints of a program that won't do the job is even less desirable.

Planning and Scheduling—Capital Construction Projects

Scheduling capital construction projects is not limited to the construction phase. Of overall greater importance is scheduling from inception through the end of the warranty period. A large institution is encumbered by many steps in the process, any one of which can significantly disrupt the overall schedule if not properly managed.

Briefly, these steps include: project programming, funding request, consultant selection, several design phases, bidding and contract award, owner's reviews, Regents' approvals, etc. And it is so easy to overlook an important step if comprehensive schedules are not developed early on. A promising software program is Timeline from Breakthrough Software. Whereas this software produces good, comprehensive schedules, the shortcoming we have experienced is that it is not possible to superimpose actual progress indicators as an overlay to the original schedule. This would help us to better evaluate where slippage routinely occurs so that future schedules could be developed taking slippage into account.

Deferred Maintenance/Capital Renewal

In the area of capital budget request preparation, probably the most important and often difficult requirement for physical plant directors is the development of the capital improvement requirements as it relates to deferred maintenance, renovation, and modernization. This can be as little as an inventory of needs. We have carried it further and developed a dBase III program (called the PRAM list—Preservation, Renovation and Modernization list) that also includes priority levels (urgency indicators) in five evaluation categories that allow sorting in order of overall total priority (urgency). In addition, the program provides for outputing by generic categorical groupings, or by buildings, etc. This has been exceedingly useful in developing capital budget requests and demonstrating to the administration that considerable thought has gone into request content.

In addition to, and complementary to, the PRAM list is the growing inventory of building statistics, e.g., roof inventory, carpet inventory, building envelope (brick, concrete, glass, etc.), and inventory. We have used dBase III and Lotus 1-2-3 to capture square footages, installation dates, cleaning and tuckpointing dates, and other information useful in determining how long it has been since the last major replacement or maintenance effort. This is coupled with a per-square-footage estimating program to give consistent order-of-magnitude costs to include in the budget requests. All of this improves our credibility with the administration and increases our chances for success in the budget request process.

Bar Coding

Bar coding is another important application of technology, for record keeping accuracy and minimizing time wasted manually recording and transcribing data. We originally bar coded our 6,000+ inventory of portable fire extinguishers and bar coded their installation locations. By use of a portable bar code reader we can quickly visit each extinguisher and read both bar codes in short order. The bar code reader is then dumped directly to a computer data base. We then have a record and verification that on a given date, a specific person visited the specific fire extinguisher stations, and that a specific fire extinguisher was in each station.

A similar method is used when replacing fire extinguishers when they must be sent out for their required hydrostatic pressure tests and when they were returned to stock—essentially the entire life history of a fire extinguisher without ever having to manually write anything down on paper. The time saved and the virtually 100 percent record development accuracy pays for the bar coded investment in no time at all.

This process is expanding. We have about 300 skilled trades personnel involved in preventive maintenance, repair, and alterations project work. All personnel have photo ID name badges that include their unique bar code identification. All repair parts have been provided with bar code ID. We are now getting to the point where all work orders will include a bar code number. It will not be too long that all time and materials will be bar coded against the bar coded work number and dumped directly to the computers at the end of each day. This will be another major saving in time and energy and increase in accuracy. All things considered, this should save us about $250,000 per year in recording, documentation, and billing work.

Robotics

Now for a shift in a somewhat different direction. One of our major work areas these days is the installation of computer cables in the many miles of cable trays, much of which is hidden above suspended ceilings in corridors. To do so often requires extensive removal of ceiling tile, which can be the greater part of the cost for the cable installation. Last year we bought a radio controlled tank from Radio Shack for about $20 to pull the wire in the cable trays. We only have to remove a few ceiling tiles at key locations in order to maneuver the tank, which is pulling a messenger line. The tank can climb over existing cables in the tray and pass under conflicts that usually create problems for people up on ladders to cope with.

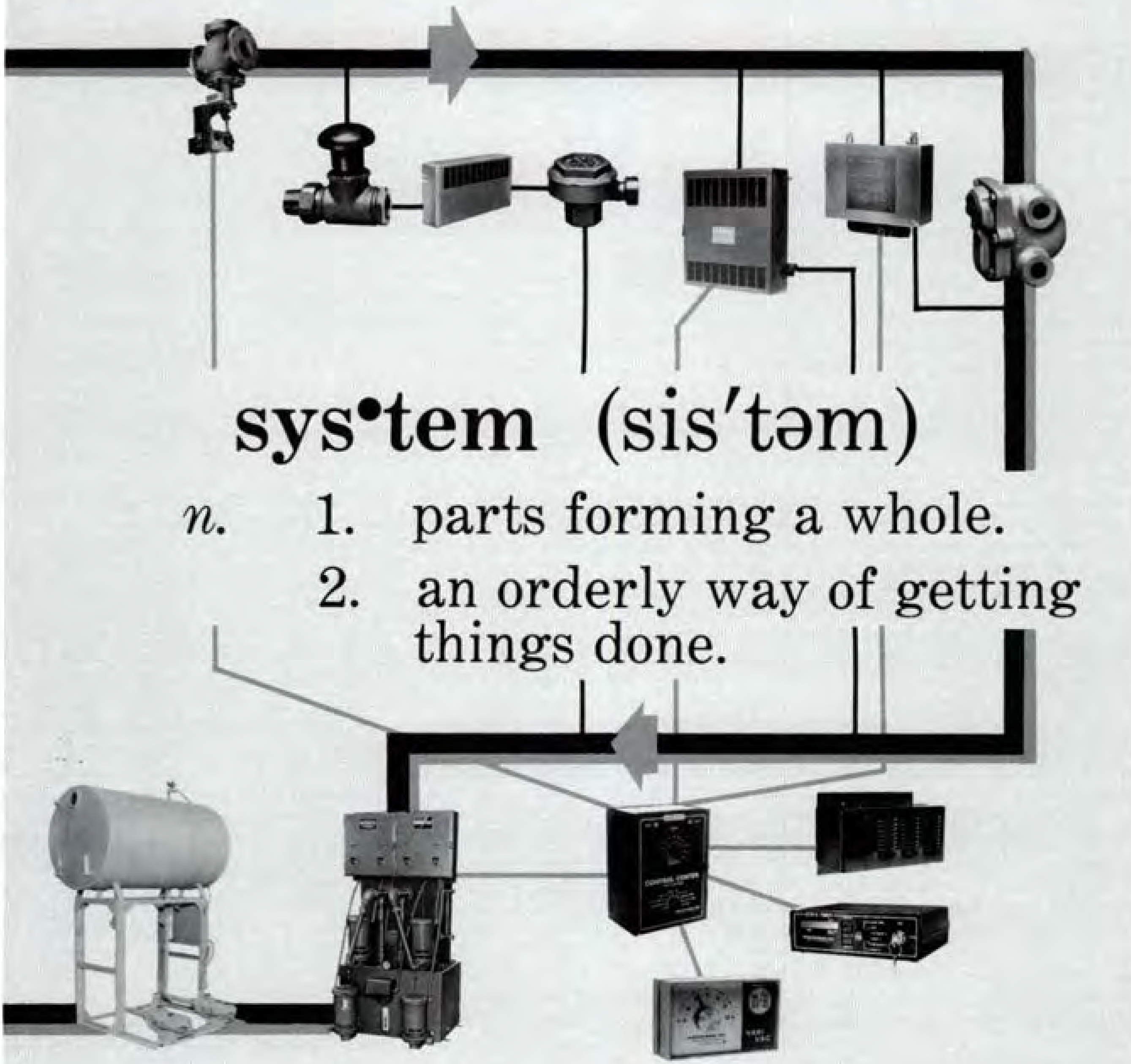
A somewhat similar concept we have been working on is robotizing a floor buffer. I built Radio Shack's Hero robot and "married" it to a standard 1,000-rpm buffer. The buffer was the kind with two free-wheeling guide wheels that we had to retrofit with a drive system for locomotion. That was fairly simply done by our shop people once we figured out a good way to do it. We now have a floor buffer that can buff floors all by itself once it has been started. With its sonar-like sensing devices it will track corridor walls and incrementally reset the distance to the walls until it has traversed 100-foot segments of the corridor. It is obvious that the unit works well as is.

However, it is also obvious that it can be greatly simplified if we had the time to devote to making the refinements. Unfortunately, that is not our primary mission so it is difficult to do that next step. Nonetheless, the equation is simple. It cost about $2,000 to purchase the robot and modify the buffer. If we could do forty of them we would spend about $80,000 and could save about $500,000 per year in annual labor costs. Even in its present condition, this year we plan to put the robot into productive use on a trial basis to develop a better understanding of the potential and possible problems.

Conclusion

Today everyone is preoccupied with looking at the "bottom line." The bottom line for this presentation is simply that there are a lot of relatively simple, easily developed applications for PCs and other things available in this high tech era. Imagination and adaptation are two key words that come to mind in this regard. Our people need to be inspired by us to experiment and explore and not be unduly inhibited by the possibility of failure. In my experience there are many more successes than failures—none of which would have occurred without some degree of risk-taking.

We are in a business where there is a rather conservative fixed expectation and an attitude of "that's the way we've always done it." These molds have to be broken if we are going to produce the best possible results for our institutions. Let's loosen up and get on with it. ■



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Communicating by Electronic Mail

by Jerry W. Segers
Director of Telecommunications and Networking
Georgia Institute of Technology
Atlanta, Georgia

Georgia Institute of Technology began experimenting with electronic mail in the early 1970s. At that time, the user services department in the central campus computing facility operated a "Help Desk" employing primarily student labor. These students worked, attended class, and participated in all other student activities; communications between the students and their manager were difficult at best. One of these students suggested implementing a messaging system on the mainframe computer. This plan seemed feasible since most of the students had access to terminals at home or in the dorm room, and all had access at work. The construction of an appropriate program was undertaken and the experiment was underway.

Several years later one of the professors in the School of Information and Computer Science (ICS) learned of the program and requested that it be made available to all computer users. The computer center staff modified the program for wider use, and the first official electronic mail system was implemented. This system was crude, slow, and generally unsatisfactory by today's standards, but some of the professors in ICS began requiring all their students to pick up and turn in assignments by electronic mail. Thus, the experiment was growing and the majority of participants were pleased with the productivity improvements.

In the early 1980s the experiment was extended to upper management. From the earlier trials it was clear a more sophisticated product was needed, so the All-In-One system was acquired for one of the Digital Equipment Co. VAX computers on campus. This extended experiment was intended for the president, his staff, and the project leaders of major research projects and was funded by the research branch of Georgia Tech. There were significant results of this series of experiments.

1) To be effective most members of a peer group must be subscribers to the mail system. Consider the frustration of the initial electronic mail user if no one ever tries to communicate with them using electronic means.

2) Methods of dealing with non-subscribers must be provided. Consider the frustration of a user who receives correspondence electronically but must respond electronically to some and to others by paper mail.

3) Simple, menu driven interfaces are required. The people using this system have much more useful tasks to accomplish than learning a series of "magic incantations" to make the system function.

4) Access must be universal and require minimal effort to start and stop communication. The usual procedure—dial the modem, wait for the tone, place the receiver in the cradle, wait for the connect message, type several lines of magic, etc.—simply do not work for managers, presidents, or secretaries.

Georgia Tech has solved those problems. Universal access is provided by the Georgia Tech Network (GTNet). This 3,200-connection communication network consists of a broadband backbone that enters most of the buildings on campus. In areas of relatively low use, work stations are connected directly to the broadband cable plant. In areas of high use, a baseband cable is installed throughout the building and bridged to the broadband cable plant. Work stations are then connected to the baseband cable. This provides direct access to the electronic mail system from most offices on campus. In addition, each employee is encouraged to acquire a work station for home use, and 120 dial-up ports are provided for access from off campus.

Access to the mainframe has been increased by switching from the All-In-One system on a single VAX computer to the PROFS system on three separate IBM mainframes linked together with RSCS connections. This switch relieved the overloaded VAX so it could be returned to its original duties and placed the load on the more powerful IBM mainframes.

The work station chosen by acclimation at Georgia Tech was the IBM-PC or compatible. This permitted us to choose a commercial software package with sufficient capabilities to permit configurations that require no more than four button presses to establish connection to the mail server and start the mail software. This process provided the required easy startup capability.

Non-subscribers were accommodated by providing an electronic mail box that was copied to a printer and mailed through regular campus mail at least once per day. This operation caused non-subscribers to get the news at least three days later than their peers; thus, peer pressure soon motivated them to increase their participation.

While all these things helped the growth of electronic mail on campus, the most important growth stimulus was participation in the system by Georgia Tech's president. He recognized early in the experiments that he was spending less of his time and none of his secretaries' time sending meeting notices and agendas electronically rather than the usual paper memoranda method. Consequently, he began using the electronic mail exclusively for certain communications with his staff and the vice presidents. When initial misgivings had subsided, usage began to spread downward in the organization. In rapid succession the deans, directors, department heads, and faculty were included in the list of satisfied users. Meanwhile, the older student system was upgraded with a new user interface, and usage of this system by both faculty and students has grown unabated.

After several years of participation in various electronic mail experiments and operation, Georgia Tech has improved communications at all levels of the organization. Work load increases are now being observed with little or no increase in the size of the work force. Top management is better informed, and communications with other organizations has improved through central connections to BITNET and USENET, which provide the faculty with the ability to communicate with their colleagues worldwide.

It is difficult to determine the exact influence electronic mail has had on Georgia Tech, but we agree that the improvements have been sufficiently great to continue the expansion of the system to include all faculty, staff, and students of the institute. ■

Scheduled Preventive Maintenance of Equipment

by Melanie J. Barrier, Management Intern
and Mark D. Langford, Director of Facilities Management
University of Missouri System
Columbia, Missouri

A frequent challenge for physical plant planners and directors in today's tight financial market is to maximize options while minimizing costs. Measures taken to meet this challenge by the University of Missouri Facilities Management group have lead to development of physical plant management software and enhanced office automation.

Preventive maintenance is one of the enhanced automation projects our office is currently designing. Deferred operating and capital improvements projects were automated at the University of Missouri in 1981, and implementation and use of this program continues to be quite successful. Presently, we are focusing on installing a new maintenance program driven by scheduled equipment repair cycles.

Development of the new preventive maintenance approval was propelled by the desire to regulate two elements: 1) routine inspection of equipment, and 2) inventory levels of replacement parts. By putting all equipment and its respective replacement parts on an automated schedule, reports can be generated at the beginning of each week indicating which machines need to be examined and, more specifically, which parts need closer inspection.

Maintenance personnel making their daily rounds can focus on equipment flagged for inspection. Condition of the components can be commented on in the field using the report issued at the beginning of the week.

The philosophy behind the project suggests that physical plants should be proactive rather than strictly reactive to influences affecting their environment. By being proactive, physical plants are able to intercept and reduce machine down time. In addition, preventive maintenance is an excellent device for monitoring stock levels. If purchasing agents know what parts they need to order in advance, they can maintain inventory at a level that minimizes the occurrence of stock outs and overstocked items.

The preventive maintenance program is a small part of a large equipment data base developed at the University of Missouri in 1983. The equipment data base is catagorized into five groups:

1) Electrical distribution
2) HVAC equipment
3) Air handling equipment
4) Elevators
5) Other equipment

This information is maintained on a mainframe and is periodically downloaded to feed the preventive maintenance program, which resides on a local area network. Data elements carried in the equipment data base are coded according to campus within the system, building, type of equipment, equipment name, model number, room number, etc. The data base encompasses all categories of equipment owned by the university and is essential for operation of the preventive maintenance program.

The equipment data base is referenced by the preventive maintenance program as a look-up file. The preventive maintenance program submits a program to the mainframe, which reads only those pieces of equipment the physical plant department is responsible for maintaining. The information is then downloaded into a file on the local area network, which carries the equipment's maintenance cycle.

The maintenance cycle is made up of three fields: the date the part was last replaced, the number of days in the part's useful life, and the next scheduled date for replacement/inspection. Each piece of equipment can have from one to one hundred scheduled replacement parts. Each campus physical plant department is responsible for identifying equipment parts that need inspection and for assigning the part's appropriate useful life.

After select information from the mainframe is merged with the preventive maintenance cycles on the local area network, a report is generated. This report consists of equipment parts due for inspection/replacement. After field personnel complete their examination and make comments, the preventive maintenance file is updated using the same report.

This update does two things: 1) It triggers a mechanism with the physical plant accounting system, which generates a request for parts from purchasing, and 2) it resets the part's life cycle counter.

This is only a brief explanation of a complex mechanism. Other discussions of easily-computerized standards and procedures for preventive maintenance can be found in *Facilities Management: A Manual for Plant Administration* and at the twice-yearly Institute for Facilities Management, both offered by APPA. ■

Automating Lock and Key Functions

by Dr. Charles F. Harrington
Associate Provost
Ohio University
Athens, Ohio

Building security and key holder census were becoming areas of increased management concern at Ohio University in recent years. The previous manual index card record system was unable to facilitate the type of management data needed for policy formulation and evaluation. Thus, we tested the waters of automation in the area of locks and keys. We determined that the impact of success or failure could be limited to this single, small area of plant operations, and we would not need massive commitments of personnel or resources.

Lock repair and installation and the preparation of keys are handled by the lock shop personnel. The issue of keys and the return of keys for departing employees is handled by clerical staff in a different building. Hence, two separate but interdependent systems were needed. However, the planned conversion to a single vendor system and the need to rotate lock cores in residence halls at the end of each academic year dictated that the lock control system be developed first.

The lock shop supervisor played a major role in the design of the key control system. The contents of the data base record layout included fifteen data elements, six of which were formerly maintained on index cards. New information that could be used to cut additional keys for specific locks and an identification code to be used to identify the lock record for specific keys were added.

While the contents of the data records were judged to be important, the major objectives of the system design were ease of use by staff with little computer training, responsiveness to the needs perceived by key shop personnel, and ease of program modification as future circumstances might dictate. To accommodate the latter objectives, all program functions including data entry, updating, indexing, record searching, and report generation were written in separate but integrated program modules, each accessed by a single key stroke from a main system menu screen.

A major strength of the finished system has been the ability to locate any lock record in less than two seconds from a data base consisting of nearly 70,000 records. Lock records may be located and viewed by lock code, core mark, building and room location, or by open lock status for lock cores maintained in inventory.

In addition to viewing lock records on the monitor, the user can produce up to five standard reports including listings by room for each campus building, summary listings of locks in sequence by key code, core mark, or lock inventory status.

Two major changes were made to the lock system after the initial design and installation. The data entry of building names often resulted in misspellings or inconsistent name abbreviations, which made lock record retrieval and report sequencing difficult. A building code file sub-system was developed to permit the key shop staff to enter a four-character building code number used by the system to retrieve a uniform building title for insertion into the primary lock data base.

The lock system is presently maintained on an IBM-XT with a standard ten megabyte fixed disk. During the initial phase of implementation several dual disk IBM-PC systems were used by student employees to enter data. An additional program module was added to the primary system to append lock data prepared on diskettes at several locations. Since lock shop personnel frequently re-key entire buildings at one time, it is possible to take a portable processor to the work site for data collection that can later be appended to the master data base.

The companion key system was designed to interface with the lock application programs and to share the common building name code file. When information is retrieved for specific key holders, if the lock data base is present, data from the corresponding lock record is also displayed along with information contained in the key system data bases. However, it is not essential that both systems be used concurrently or on the same computer system.

In addition to using the building code file to retrieve building name data, the key system consists of two primary data bases that can be accessed concurrently. Since an individual employee may be issued many keys, the personnel information for employees is maintained in a separate employee data base file with a single record for each employee. This avoids duplication of employee data in each key assignment record. The employee record contains employee number, name, office location, telephone number, and departmental affiliation.

Employees may be issued an unlimited number of keys, so information pertaining to each key issued is maintained in a key assignment data base record. Each record contains an employee number to link key records with corresponding employee records, the key code, core mark, the number of copies of the key issued, and a twenty-five character comment field. When the lock system is maintained on the same computer, the core mark and key code provide the links to the corresponding lock records.

In most institutions personnel information for a key assignment system is maintained as part of a larger institutional personnel system. While the key system has the facilities for maintaining personnel information, they are used primarily for adding information for non-university personnel such as vending machine operators and others who have been issued keys to campus facilities.

At Ohio University virtually all of the personnel information used by the key system data bases is downloaded form the central institutional personnel system at the start of each fiscal year when new personnel contracts are issued. The key holder employee data base can be quickly and conveniently created in this way; thereafter, only updates occasioned by office changes are needed. During the development of the key system, we installed a new telephone system and at the end of each academic quarter revised personnel data, including new telephone numbers. These were downloaded with no disruption to the key assignment operation.

In addition to the usual facilities needed to add new information or update existing records for both the employee and key assignment data bases, the key system master menu provides for viewing the data records in a variety of ways. For example, all keys issued for a specified employee may be displayed and the user may "page" through the list using single key stroke menu options. Similarly, all employees issued keys with selected key codes or core marks may be retrieved using menu options.

A report menu permits the user to select from six printed reports, including key holders by key code or core mark, key assignment by employee in sequence by employee number, employee name or by employee name within employee status. Finally, a listing of employees and key assignments by department can be produced and distributed for use by department chairpersons.

While the development of our lock and key systems are not unique from systems in use elsewhere, they have served several unique purposes at this institution. They have served as a vehicle for introducing stand-alone microprocessors into the physical plant operation and the systems were designed and controlled solely by plant staff. These modest applications have also stimulated interest in other areas of computerization by plant personnel. Now spreadsheet and word processing applications abound. ■

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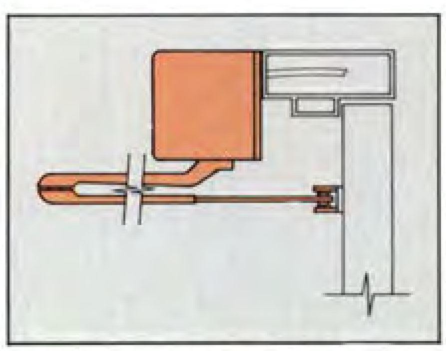

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High Tech Protection of Gas Pipelines

by Fred A. Giles
Director of Physical Resources
Northern Arizona University
Flagstaff, Arizona

Efficient heating is a primary concern at the mountain campus of NAU and has led to the development and operation of one of Arizona's most up-to-date and modern gas distribution systems. NAU has more individual gas related appliances, lab fixtures, and overall footage of gas distribution pipe in the ground than any other state entity in Arizona.

The entire in-ground distribution pipe was replaced in fall 1982. More than eighty individual academic buildings and residence halls were equipped with Fisher type S201 and S202 gas regulators, which typically have industrial and commercial applications. The regulators allow for easy startups and shutdowns when making adjustments on the gas distribution system.

It is extremely important for universities and colleges to meet its responsibilities under the stringent federal codes, because operators who do not comply may be subject to civil penalties. A proper operation and maintenance plan must be established and maintained not only for compliance with federal law, but also as protection and defense against any civil suit that might be filed for damages caused by a campus gas distribution system. The NAU gas department works daily on incoming work orders concerning appliance adjustments and repairs and also on planned preventive maintenance schedules.

In initiating work orders on appliances, regulators, valves, and in-ground pipe lines, it is necessary to have the proper tools and equipment to complete each task. In detecting gas leaks we use the model "400" Flame Pack manufactured by Southern Cross Corporation. The model "400" Flame Pack is a total hydrocarbon detector that utilizes flame ionization as the detection method. The model "400" is designed to be hand-carried as a single unit, thus eliminating shoulder straps, harnesses, interconnecting tubes, cords, and so forth. It is lightweight and small in size. Moving parts, controls, and adjustments are minimal to ensure durability.

The sensitivity of the model "400" is excellent, being capable of detecting less than 1/2 of one part per million of methane in the air. In addition to a meter indicating Flame Pack reading, a high volume alarm is activated at a preset point. The model "400" utilizes disposable batteries and the "standard" 60-40 fuel mixture (40% $H_2 - N_2$ with 5 ppm max). Some of its other unique features include weight (four pounds), reaction time (two seconds), fuel capacity (300 cc at 1,800 psi), and the LED and audible alarm. When unlit, the exhaust gas of the model "400" Flame Pack is a mixture of hydrogen and air and is therefore combustible. *Always exercise caution.*

We also utilize a piece of equipment manufactured by the Goldak Company called the PB-44 "Ferret" receiver. This receiver senses and detects the radio signal emitted by several types of metal pipe and enables an operator to locate the pipe from which the signal is being radiated. The model PB-44 "Ferret" receiver consists externally of a control box equipped with a pistol-grip handle, an extension arm, and a swivel mounted detection rod. The sensing element of the "Ferret" receiver is the directional antenna located in its detection rod.

The control panel of the "Ferret" receiver has a "gain" control, a "tone" control, a phone jack, and a battery test button. The "gain" control regulates the amount of amplification to the received signal. The gain should always be adjusted high enough for a clear response, but not so high as to saturate the instrument with signal. The "tone" control regulates the audible pitch of the tone response. This should always be adjusted to a clear tone that gives clear and sharp response.

The phone jack serves both as a connection part and as an automatic switch. When nothing is plugged into the phone jack, the tone-response is heard from the loudspeaker mounted in the control box. In addition to the audible tone, a visual indication of response-strength can always be seen on the panel meter. When the battery-test button is depressed, the panel meter is disconnected from the response circuit and connected instead to the battery. It then indicates the state of the battery.

NAU also utilizes a small compact hand-held gas "sniffer." This permissible combustible gas detector indicates increasing concentration of potentially hazardous air/methane mixture. It is approved and suitable for use in class 1 hazardous locations. Overall length is sixteen inches and very convenient.

The entire gas line piping system must have cathodic protection in accordance with the criteria set forth in both the Code of Federal Regulations, Title 49, Part 192, Subpart 1 "Requirements for Corrosion Control," and the National Association of Corrosion Engineers Standard RP-01-69. Cathodic protection systems should be surveyed on an annual basis by qualified corrosion personnel who are under the supervision of an NACE accredited corrosion specialist.

The purpose of the cathodic protection system report is to determine the effectiveness of our system on the natural gas distribution pipeline. During the report a short detection survey is conducted. This allows for additional information to be obtained and, if possible, time to repair any shorted conditions found. We also test and evaluate sub-grade cathodic protection system (zone) isolation flanges. These insulating kits are required to divide the systems into zones so that if a riser insulator becomes shorted, only a portion of the cathodic protection system is affected.

The natural gas piping system at NAU is presently divided into fifteen electrically isolated, cathodically protected subsystems. Attached directly to each of these subsystems, and buried four to six feet underground, are 75-pound magnesium sacrificial anodes. There are two electrodes (used for testing purposes) extending from each anode and running to the surface of the ground through protective tubing. University personnel take pipe to soil potential measurements monthly at selected locations throughout the system. Testing is performed by attaching a electrical potential meter to the test leads, or electrodes, and obtaining a D.C. millivolt reading. These measurements will determine if the cathodic protection system is shorted or operating properly. All natural gas cathodic protection subsystems are electrically isolated from above-ground foreign metallic structures.

It is important that all zones are within the accepted criteria for corrosion control as set forth by NACE. The accepted criteria for subgrade steel structures is a potential of −850 MV or more negative with reference to a copper-copper sulfate half cell. Another thing to look for is the high resistance of the soil. Therefore, the code requirements are greater than in areas of less resistance.

NAU has implemented a gas appliance preventive maintenance program. The procedures contained therein were developed on the assumption that the individual responsible for its implementation will have a good basic knowledge and qualifications of gas line leak detection and repair. This includes repair and replacement of gas appliances such as ranges, furnaces, and hot water heaters.

The implementation of the modern natural gas distribution system, complete with state-of-the-art detection and monitoring instruments, has allowed NAU to heat millions of gross square feet in buildings in a safe, efficient, and effective manner. ■

Innovative Solutions for the Small College

by Raymond A. Jean
Director of Facilities
Linn-Benton Community College
Albany, Oregon

Expectations of our present society demand that information generated by all operations within colleges and universities have the flexibility of diversified information that only computerization can provide. This fact does not exclude the many responsibilities assigned to physical plant departments, especially at small colleges. The problem is recognizing that resources need to be assigned to the physical plant department as well as to other departments—data processing, admissions and registration, science and technologies—for the development of a computerized management information system.

In our tightening economy, waiting for recognition or dollars to materialize will only bring disappointment. Innovation seems to be the only solution. I would like to share the approach our staff used to become "state-of-the-art" in our operation. *Patience* is the key word when computerizing the physical plant of a small college.

We acquired a microprocessor from the data processing department that, for their sophisticated needs, was "obsolete." The price was right: an occasional helping hand for a service they might need. The microprocessor would accommodate us as it had a thirty megabyte hard disk, a new floppy disk drive, enough ports for the terminals we required, and a "canned" WordStar program for word processing. Little by little, we bought the peripheral equipment we needed—terminals, printers, modems—to put our programs online.

We immediately entered into word processing and were elated that we too could put out correspondence that looked professional. You can imagine our disappointment, however, when we found out that programming time would not be available to the physical plant department. Too many other areas on campus had priority.

Overhearing our conversation one day, a workstudy student in our office suggested that her friend, who was taking a computer programming course, might be able to help us. We contacted the business division director and told her of our dilemma. She advised that the individual was quite competent; thus, we had our first programmer.

For nearly three years now we have had at least one second-year student programmer working for us each term, either as a work study or cooperative work experience student. Our office coordinator has now taken classes in programming and monitors the students' work so that we maintain continuity and standardization of our programs. Our coordinator now writes programs as well.

Through these efforts we have developed two on-line programs that any department on campus can view at will. The job-order program shows the status of their work request, and the motor pool reservation program allows them to view vehicles available on any given day. This effort immediately relieved the flak we received for not communicating well.

In addition to a canned program we use for expense accounting, we have developed numerous short programs we call "helpers." We have a program that keeps a record of all typewriters and their repairs for the entire campus, a charge-back program for all postal costs, a parking ticket program, accident and serious incidence program, a vehicle registration program, driver's clearance program, and a time-keeper program.

By using our time-keeper program we have introduced computerization to all personnel in the physical plant and public safety departments. We use our computer program as a time clock, and personnel in these departments clock in and out on computer terminals. Each week, time sheets are printed out and checked for entry errors. This has saved at least four hours per week spent deciphering time cards and calculating hours worked. More than that, however, it has made possible our pride of the programs we use.

We are now working on an ambitious preventive maintenance program and are approaching the entire scheme a phase at a time. The procedure is as follows:

Phase I: Identify every piece of equipment on campus that the physical plant has to maintain and enter this information. Also identify whether each item needs weekly, monthly, quarterly, semi-annual, or annual maintenance. Further identify the extent of maintenance the equipment needs for each period.

Phase II: Assign each maintenance person with an area of responsibility. The program defines an entire week's work. It also rotates the assignments each week so maintenance personnel are not bored with repetitive assignments.

Phase III: Arrange the program so it will account for all cost related to maintenance, labor, materials used, replacement parts, etc.

Phase IV: Write into the program a function that recognizes assignments not completed and flags those uncompleted assignments to see if they will be picked up the following week.

Phase V: Enhance Phase IV to recognize work that has been flagged but not yet accomplished the second time and assigns that task to a deferred maintenance file.

Phase VI: Produces reports to maintenance accomplished, cost of maintenance, maintenance deferred for purposes of control, budgeting, and planning.

Phase VII: Interface the preventive maintenance program with the time-keeper program so that when the maintenance person clocks in on Monday morning the last four digits of his or her social security number triggers the maintenance program to print out the worker's assignment for the week.

We are finding the "surveillance" of the program is already proving to be effective. The maintenance personnel have wholeheartedly accepted the process and are now more conscientious toward their duties. Work not completed is discussed at the maintenance participatory committee meeting each week (this work is reassigned to a different person due to rotation by the program), and plans are formulated to avoid this assignment being deferred again. Our people have chosen to work in teams of two. Since we have instigated this program, deferred maintenance of equipment is almost nonexistent. The preventive maintenance program, for the most part, reflects the input of the maintenance personnel. Therefore, they look upon it as their program and show no resentment toward the process.

The payoff is great. The morale of the maintenance department has never been higher. The equipment runs smoothly and only once in a great while is it necessary to respond to a breakdown. This allows the crew to plan their work instead of being harried by continually "putting out fires."

Incidentally, the campus has recognized that we are a highly computerized department. In the next budget year—when equipment purchases are all but nil for the entire campus—the physical plant has been earmarked for a *new* replacement of its microprocessor. We have come a long way. ■

Housekeeping Management Improvement Program

by Richard S. Sanchez
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Berkeley, California

A common question asked in the housekeeping profession—"How many people do we need?"—motivated me to analyze and measure the large housekeeping function at UC/Berkeley. This activity includes one hundred buildings occupying 7.5 million square feet of floor space. Faced with the inevitable prospect of diminishing resources—including state funding, staffing, materials, and machinery—I decided to direct my attention to improving the methods by which housekeeping tasks were performed.

The result is the Housekeeping Management Improvement Program (HMIP), which is designed to plan, schedule, and control the housekeeping activities of our large and diverse university. This computerized software model allows for a comparative analysis of housekeeping workload standards and assignments by each floor relative to staff/student population in campus buildings.

The key element in this program is its ability to analyze a comparative breakdown between traditional housekeeping workload measures (time standards) versus a designed methodology that combines building population/workload measures which, in turn, determine the appropriate designation of staffing and cleaning frequencies for a large housekeeping function with limited resources.

With this computer model we can explore the weighting of population density and cleanable square footage and devise specific factors for determining work schedules and service levels to accommodate the variety and complexity of a campus setting. The HMIP computer model utilizes the following data:

1) Cleanable square footage by type of space (offices, classrooms, restrooms, laboratories), space unit times (time standards per cleaning task), and frequency of task performances (daily, weekly, etc.); and

FIGURE 1

1 HOUSEKEEPING MANAGEMENT IMPROVEMENT PROGRAM (HMIP)
2 EVANS HALL
3 UNIVERSITY OF CALIFORNIA, BERKELEY
4

	MIN/1000 S.F.	TOTAL	GROUND	FIRST	SECOND	THIRD
5 FLOORS						
6						
7 A.S.F.	28	157,266.00	15,153.00	8,119.00	14,150.00	14,280.00
8 LOBBIES&CORR.	28	53,982.00	5,327.00	2,070.00	4,313.00	4,001.00
9 TOILETS	120	6,662.00	840.00	562.00	490.00	562.00
10 STAIRS/ELEVATORS	20	12,814.00	3,008.00	1,104.00	1,290.00	1,162.00
11 OTHERS	15	38,632.00	7,936.00	16,950.00	1,927.00	723.00
12 TOT.N-A.S.F.		110,110.00	10,106.00	20,686.00	8,020.00	6,668.00
13 TOT.CUST.S.F.		267,376.00	25,259.00	28,805.00	22,170.00	20,968.00
14 #7 FREQ.			0.60	0.60	0.40	0.60
15 #8 FREQ.			1.00	1.00	0.40	0.40
16 #9 FREQ.			1.80	1.00	0.80	1.00
17 #10 FREQ.			0.40	0.40	0.20	0.40
18 #11 FREQ.			0.20	0.20	0.20	0.20
19 #7 MINUTES/DAY		1,888.59	254.57	136.40	158.48	239.90
20 #8 MINUTES/DAY		708.20	149.02	57.96	48.31	44.81
21 #9 MINUTES/DAY		671.47	100.80	67.44	47.04	67.44
22 #10 MINUTES/DAY		70.14	8.06	8.83	5.16	11.06
23 #11 MINUTES/DAY		109.96	8.81	50.85	5.78	2.17
24 TOTAL MIN./DAY		3,456.36	521.26	321.48	264.77	365.38
25 F.T.E.-#14-24		8.86	1.34	0.82	0.68	0.94
26						
27						
28 W.STUD.HRS.		31,664.00	27,179.00	0.00	0.00	4,095.00
29 AVE/HR.		791.67	679.48	0.00	0.00	102.38
30 STAFF		1,346.00	2.00	0.00	115.00	191.00
31 TOTAL POP.		2,137.62	681.48	0.00	115.00	293.38
32 WHAT IF? 350-55K		10.97	7.41	0.52	0.73	1.22

2) Actual staff/student population occupying each floor for each campus building.

A building with 200,000 cleanable square feet that has little student or staff usage would require very few custodians. As the hourly rate and daily population increase to 2,137.62, for instance (as in Evans Hall; see line #31 in **Figure 1**), the custodial workload increases. These analyses will attempt to determine the proper proportions. Lines #28–#32 provide options for such proportions.

The HMIP data listed in Figure 1 is collected for all buildings on campus. For the purposes of illustration we are including data for only four of the ten floors in Evans Hall (ground through third). The totals reflect the entire building, however.

The following are brief descriptions of the work measurement data listed on lines #7–#32.

Line #7—Assignable Square Footage: classrooms, offices for each floor. Time standard: 28min/1000 S.F.

Lines #8-11—Detail by type of Non-Assignable Square Footage space by floors.

Line #12—Total of lines #8–#11, Non-Assignable Square Footage/time standard, lobbies/corridors (28min/1000 S.F., toilets (120min/1000 S.F., stairs 20min/1000 S.F., others (15min/1000 S.F.).

Lines #14-18—Assumed frequencies of service for lines #7–#11: 1.00 equals once daily; .60 equals three times per week; .40 equals twice per week; .20 equals once per week.

Line #19-23—Total minutes/day for cleaning areas in lines #7–#11 for purposes of predicting productive time. A custodial day is equal to 390 min/day based on total applied time minus travel time, clean-up time, breaks, etc., result is a full-time employee per average day in a week. It will be noted that the criteria used herein, the following percentages of total time available for each category of space are as follows:

Assignable Space	51.5
Lobbies & Corridors	23.4
Restrooms	22.6
Stairs	2.0
Miscellaneous	.5
Total	100.0

Your actual experience will differ from the above by degrees still to be determined: for example, it will vary by building and by floor.

Line #24—Total minutes/day of lines #19–#23.

Line #25—Full Time Employee(s) (FTE) predicated on 390 minutes available/FTEs out of an 8-hour day (8.86 FTEs in the case of Evans Hall).

Line #29—Conversion into average hours in building (Weekly Student Hours)/40.

Line #30—Indicating the number of staff—professors, instructors, clerical/administrative—assigned to floors and building.

Line #31—Line #29 *plus* line #30: total population.

Line #32—(What if?) A mathematical factor using 350 population and 55,000 square feet parameters equals a total of 10.97 FTEs required in the building. Note: These calculations are based on normal work week during the hours of 8:00 a.m.–5:00 p.m. Extra hours of operation, i.e., night classes, events, weekend activities, and absenteeism hours, will subsequently be factored in mathematically based on the monitoring of staff assignments by Housekeeping Management.

There are several *objectives* that can be resolved by the use of this data, namely:

1) Accurate assessment in determining a balanced workload for all housekeeping assignments.

2) Providing a framework for accountability and the setting of performance/productivity standards.

3) Capability of adjusting these assignments as budgetary resources change, i.e., lesser or larger funding.

4) The ability to adjust workloads if, or when, the usage of a building changes; for example, changes in occupancy by students and staff, and periodic reductions in staff due to absenteeism.

5) Control over the rational modification of work schedules and frequencies of task performances caused by budgetary, academic, or seasonal factors.

6) Establishes a solid framework of technical data upon which all future budgetary allocations and operational standards necessary for housekeeping functions can be used.

The computerized HMIP program can be readily duplicated for buildings that are programmed with similar data as mentioned above. It can provide housekeeping managers with a viable methodology for determining staffing assignments within the prescribed parameters of their budgetary allocations and housekeeping activities. ■

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Preventive Maintenance: Vehicle and Equipment

by Brad Fahr
Manager, Plant Fiscal Affairs
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Mount Pleasant, Michigan

Approximately two years ago the Central Michigan University physical plant department entered the computer age. We began using Tandy equipment for word processing and have evolved into multi-user systems run on Xenix, a derivative of the Unix operating system.

As time has progressed we have built our own application programs from canned software packages. These applications have allowed us to absorb some of the changeover that facilities experience from time to time. As we became more sophisticated in the creation of our programs, we decided to design a preventive maintenance system for physical plant vehicles as our pilot program.

The preventive maintenance system for vehicles consists of four main data bases (vehicles, vehicle jobs, vehicle parts, and vehicle costs) and one supportive data base (employees). All of these data bases work in combination to generate the information necessary to produce a job order for maintenance on a vehicle. To begin the process a user would type 'PreventMaint' at the prompt to enter the system. Since it is menu-based the main preventive maintenance menu appears, listing the following options: updating preventive maintenance, adjust countdown, update parts, update job description, reports of job descriptions and vehicle parts, vehicles, and output reports.

The vehicles data base is a complete list of all vehicles and major equipment owned by the physical plant department. Data base information includes: 1) the year and make of the equipment, 2) the type of equipment, 3) license plate or tag number, 4) the responsible supervisor's name, 5) account number, 6) vehicle replacement costs, and 7) model or vehicle ID number. This information can be retrieved in individual reports and sorted as needed by management or operations personnel. As the key data base in our preventive maintenance system, it is kept up-to-date with all additions and/or deletions to the fleet on an as-they-occur transaction basis. As this is the first step in our system, it is necessary to be current. The system will ask you whether or not it is an existing vehicle or whether you need to update the data base in order to continue with the program.

The next part of the program is used for scheduling maintenance for vehicles. By listing the license number (or equipment ID) it will list related information from the vehicle data base, including model number, model ID, and account number. Next, enter the descriptive code identifying the type of maintenance job desired, and if needed, the number of equipment hours to be used before maintenance would next be required. The system also requests the number of hours the equipment is used in a working day. This allows us flexibility when a piece of equipment is used fewer than eight hours a day.

This screen also contains a section that asks whether to reset the countdown clock. When the number of hours left between maintenance times elapses, the system automatically resets the clock for the next round of maintenance. The clock is listed on the screen and gives the hours remaining until maintenance is required. We can then generate a report that lists the upcoming maintenance schedule.

Our vehicle jobs data base is used when maintenance is due for a particular piece of equipment. All of the options or jobs are first listed by number and can be referred to from the scheduling side of our system. This is a flexible system; at any time we can add new jobs to the data base and/or withdraw jobs if they become obsolete or if the equipment is deleted from our inventory. Each job has an identifier with a corresponding description.

The vehicle parts data base keeps a record by vehicle and/or equipment number. Here we have a list of parts and their identifiers. This data base also includes the model ID number, the name, and the account number to which a part should be charged. If you need to go somewhere outside of the physical plant to get parts that are not available in campus inventory, you would have the information necessary to do so.

The vehicle cost data base does exactly as its name indicates. It keeps track of the maintenance costs of all our vehicles and equipment in order to analyze what each piece costs us on a year-to-year basis. By having this information available we can make management decisions on the replacement of a particular piece of equipment or a vehicle.

These data bases work together to present us a job order when the internal clock expires. The system automatically generates its own job order, which lists the item to be maintained and other relative information. In the case of a vehicle, it would give the license plate number and the job that is to be performed on the particular vehicle.

For example, for an oil change, we get the vehicle number, the number of quarts of oil, and the oil filter number. We also get the same information for fuel filters and other required parts. This job order would be printed in the morning when the operators arrive and is given to maintenance people for execution. Upon completion the job orders are returned to our operations people and the job order data base. From here the computer automatically transfers the information into our vehicle costs data base, thereby keeping the data base up-to-date.

In order to keep abreast of all of the job orders that are pending in the near future, you can request a report that includes a vehicle listing with the number of hours and days left until preventive maintenance is to be implemented. This allows us to schedule our maintenance people and to take on other duties as would be required to facilitate their time.

Each of the data bases effectively work together to provide up a preventive maintenance system for vehicles and equipment in order to make management decisions for the future. This current system is being expanded to encompass all of our buildings and equipment on campus. The primary data base has been left intact with additional fields added in order to facilitate the magnitude of the information available on the buildings and equipment. Preventive maintenance will allow CMU to enhance the useful life of all machinery, equipment, and vehicles on its campus and provide a cost savings for the future. ■

Financial Control for Physical Plant

by Charles N. Moody
Director of Physical Plant
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Las Vegas, Nevada

Think for a minute about your department's work program, budget, and financial control. What does the university community see? The academic community sees it as funding to support their effort, and the business office wants to make sure we stay within our budget. Neither really knows the specifics of our work. Chances are your financial statements are reprints from your controller's office and don't relate at all to your work program or projects. They probably provide a budget figure and detail your expenditures and encumbrances to date. We don't think that's good enough.

As a state-supported university, UNLV's budget is on a one-year cycle with no state appropriated funds carried over. Our accounts are organized along NACUBO standards and essentially consist of a lump sum operating dollar amount for each account: administration, utilities and their maintenance, building repair and improvement, custodial, and grounds. Our other accounts are self supporting and have different budgets. Our main management problems were with state-funded accounts.

When computers first came on the scene, business offices were extremely progressive. They took advantage of the computer's error-free data processing capabilities and installed their own account systems. It is difficult for them to change their special custom-written accounting program, and they often cannot give you what you need in physical plant. Until now you had the miseries and no one understood your dilemma.

Now you have some friends: the little computer on everyone's desk, a hard disk for data storage, a printer, a data base software package, and a spreadsheet software package. That is all you need to make your own budget and control reports the way you want, when you want! Answer questions about purchase orders, project costs, budget projections to year end, PM program costs, cash flow, and much more. You can have the answers *now*, not on the tenth of the month.

Here is what we did at UNLV. First we separated our budget into sub-budgets to more accurately reflect our organization and operation. The utilities account was broken down into Purchased Utilities, Maintenance, Operations, Yearly Contracts, and Projects. The contracts and projects accounts are itemized by specific identification number and description, and an annual budget figure is established—there is space for both an actual figure and the balance. The purchased utilities, operations, and maintenance accounts were done the same way, except the budget is by the month. The building repair and improvement account is set up in a similar fashion.

The administration, custodial, and grounds accounts don't lend themselves to monthly budgeting. Purchases are grouped by an ID number reflecting fertilizer, chemicals, etc.; the operating budgets are smaller and easier to audit.

These budgets are all set up on spreadsheet software; we use SuperCalc III with IBM-XT computers. We start the year with the budget and actual numbers the same, and the totals and balances are calculated from them. The accounts that are not budgeted monthly only post the year-to-date 'Actual' figure when an encumbrance is made.

When the 'Actual' expenditure in Operations is posted, our entire budget is automatically recalculaed and we instantly know our balance. Incidently, the summary report generated is in the same format used to submit our budget to the state legislature. We immediately have justifications should the university wish to divert some of our funds to another activity. It will show if I've saved money in one area to allow a roof repair in another, for instance.

But we need an 'Actual' figure to enter on the spreadsheet. The data base software will let you set up a financial record/reporting system that will outperform the business office run because you can make it do anything *you* want. And if you don't like it, you can change it *now*, not in two months. Our department's financial runs are made using the dBase III + data base software program.

Our data base record has seventeen fields of information, including Account Number, Project Number, Requisition Number, Description, etc. The records can be sorted for any particular entry in any of the fields. We can get all the records for Project #503, or the records for Project #503 only for the month of June. If our superintendent walks into the work control center and asks where the motor is he ordered last month, we can enter his name, motor requested, and month. All the requisitions he entered for motors that month will be printed out. If there is a P.O. number, he also has the supplier; if not, the purchasing department has not yet ordered it.

If we enter the account number, project number, and month, all the records meeting those criteria are accumulated, sorted, and totaled for entry on the spreadsheet.

Your own budget/financial system is within your capabilities, and your imagination is your only limitation in giving you financial, budget, work program, and project control far beyond what others can give you. Remember that physical plant operations must always live by the Golden Rule: "Them that has the gold, rules!" ■

Computer Aided Drafting in the Physical Plant Environment

by Gary L. Reynolds
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Computer aided drafting (CAD) is to drawing what word processing is to writing. A CAD system allows the user to create lines and objects, to move them around, and to change or modify them as necessary. This is done with the same ease that word processing allows in the manipulation of words and sentences. The same reasons that make word processing a viable and cost effective tool are the same reasons that make CAD a useful and valuable aid in managing facilities. The electronic media enhances the facilities manager's ability to maintain consistent, accurate, and integrated information that is compact, flexible, and easily communicated.

CAD has been used by large industrial and design firms for a number of years. More recently the development of powerful desk-top systems has brought the capability of CAD to much smaller firms. In most instances an increase in productivity is the main reason cited for CAD implementation. However, in the physical plant environment productivity, although important, becomes a secondary reason for implementing CAD as the facilities manager tries to respond quickly, accurately, and flexibly to the university's needs. Quite often this response involves a change to the physical plant which in turn requires analysis and changes to the physical plant information base. CAD can be a powerful tool in this analysis and change process.

The CAD systems available today have a variety of features with prices that vary from a low of $10,000 to a high of several hundred thousand dollars. However, many of the features of the high priced systems are not necessary or even desirable in a facilities management environment. Exotic 3-D systems with solids modeling, links to mathematical analysis software, or sophisticated high production input techniques are not features that can be used effectively. Recent advances in computer technology, especially in the smaller systems, have allowed the development of CAD systems in the $10,000 to $50,000 range with features that can provide all of the power necessary for effective use in facilities management.

Physical plant functions vary from institution to institution. As a minimum a facilities manager is usually responsible for the maintenance of the buildings and grounds, including mechanical, electrical, and custodial services. Some facilities managers are also responsible for the architectural, engineering, capital planning, and space utilization needs of the institution. In short, the facilities manager is responsible for the institution's infrastructure and is expected to obtain and maintain information about that infrastructure and be ready to adapt it quickly and flexibly to the institution's needs.

The engineering function is one area that can benefit from CAD. For example, if the floor plans of the institution's buildings are on CAD they can be used as the basis for designing renovations for new teaching or research needs. The basic floor plan can be provided to all members of the design team so that they can get immediately to the design task without copious copying of the layout. Floor plans can be provided in any scale and section: if a large plan is inconveniently spread across several sheets, the CAD system can "glue" them together and "cut out" the appropriate section for use.

Standard details can be developed by members of the engineering and design department for many situations and used repeatedly on various designs. The detail can be sized as needed to fit on a drawing and will be consistently accurate. If a change is required to a detail, the central data base can be modified to ensure that the detail will be correct for future use by everyone. This also applies to the floor plans as renovations are completed and the CAD data base is updated to reflect the new layout.

If not all facilities management functions are under the jurisdiction of the facilities manager, then the consistent and easily transported CAD data base becomes especially useful in assuring that shared information is accurate and up-to-date. For example, if the engineering department maintains an architecture/engineering manual, then standard details developed for drawings can be easily adapted for use in the manual by proper scaling and layout. Changes to any detail can be quickly provided to all manual users. If space utilization planning is separated from facilities managing, then the building plant data base maintained by the facilities manager can be the basis for this planning and ensure that consistent information will be used by both departments.

The ability to quickly edit and represent pictorial information in a number of ways is an important attribute of CAD. In the past, the number of alternatives developed in seeking a solution to a problem was frequently limited because of a lack of time or money. As a result, inefficient solutions were sometimes accepted. CAD overcomes these limitations and enhances the facilities manager's ability to respond quickly and flexibly with efficient solutions.

For example, once a campus map is on the CAD system sections can be enlarged and various landscape layouts developed and examined for landscape planning. Trees and shrubs can be added, moved, or deleted in an instant; entire landscapes can be created, analyzed, and discarded or kept. Site planning for new buildings, athletic facilities, or parking lots can be developed with many alternatives easily prepared and reviewed. The campus map can be scaled for use in brochures, as a cover sheet for project locations, or as the basis for utility distribution maps.

Interior design and space utilization studies frequently require the development of many alternatives. CAD can be especially useful for these studies. Standard furniture symbols can be developed as part of the permanent data base and, as in landscape planning, the furnishings can be added, moved, or deleted in the development of various alternatives. Signage can be developed using various fonts and layouts and presented to the occupant for review. Graphic displays are easily developed, either for communicating information in a signage program or for the presentation of data for financial reports, energy utilization, or personnel reports.

CAD can be used for area analysis and most systems have the ability to calculate square footages. Thus, "net assignable square feet" can be calculated for all buildings and updating of the square footage can be easily accomplished as renovations take place. Space assignments by department or college can be tabulated and updated as space assignments change. Campus area analysis can be used for building siting studies or maintenance assignment planning.

In the last five years CAD systems have matured greatly, both from a hardware and software standpoint. As the professional facilities manager of today searches for new ideas and methods, he or she should consider a CAD system as one available tool to improve the methods of gathering, storing, and analyzing information that is needed in a decision-making process. CAD can greatly enhance the facilities manager's response to the needs of a fast-paced changing environment.

Integration of CAD into the physical plant environment is not necessarily easy. Thought has to be given to personnel and space requirements, applications, data organization and maintenance, hardware and software maintenance, and systems management. Useful output from the CAD system is not immediate; a considerable number of workhours are required before the most basic features can be implemented. However, the rewards include a well organized, maintainable, and flexible data base that will allow the facilities manager to respond to the users' needs quickly with effective solutions. ■

Writing to Win

Data Base Update

Howard Millman

Doesn't nearly all business correspondence fulfill a dual purpose: to inform and subtly encourage a tailored response from the reader? Consider your own correspondence: sure, you want it to be informative, maybe even enlightening. Generally, if it's a financial report such as budget forecasts or cost recaps, that alone is sufficient. After all, reports are just blueprints for displaying numbers and little more.

However, in business correspondence accuracy alone isn't enough—your words must also persuade. Does the correspondence you generate subtly or directly motivate? Does it persuasively present your point of view? In other words, are you really getting your message across?

The key, as Ernest Hemingway said, is in "getting the words right." In the old days, before computers touched everyone's lives, if you wanted the right word you picked through a thesaurus. That is now a tiresome waste of time thanks to lightening-fast random access memory (RAM) resident software.

This issue's column looks at three low cost problem solvers to include in your electronic arsenal. They are easy to learn, easy to live with, and, yes, even friendly.

Word Finder: The Instant Assistant

Word Finder is a charter member in this new breed of high speed software. It's an electronic thesaurus containing 220,000+ synonyms based on 15,000 key words (according to the vendor—I didn't count them).

Word Finder measurably accelerates finding and substituting words that precisely achieve the implied and obvious impact you intend.

It's fast because the program's command portion is memory resident. That simply means the commands, like a faithful genie who only answers when you call, dwells in the ether as it patiently waits to serve. In this case the ether is the high end of your computer's random access memory. Here's the three-step process to summon its magic.

- Load the command file
- Insert the synonym disk in another of your computer's disk drives
- Load your word processor

Now start writing your letter or memo. Whenever you want to replace a word, move the cursor to the intruder and hit your control keys. Within seconds a window full of alternates flash on the screen. I'm willing to bet somewhere in that disk's quarter million synonyms is your substitute. Move the cursor to your choice from the list, press Return, and the unwanted word in your text is replaced. The window automatically disappears and your original document is back on the screen. Simple.

Occasionally the program cannot locate the exact word you're looking for so you're offered thirty words nearest in spelling.

This seek and substitute process takes between two and six seconds depending on whether you have a floppy or hard disk system. Either way, it is light years ahead of thumbing through a printed thesaurus, locating your word, and typing in the replacement.

Word Finder is compatible with nineteen popular word processors. Fortunately, if your word processor isn't among them it also offers a generic mode. This catch-all option is for the adventuresome who want the program's advantages enough to experiment. I did and it works fine with my text cruncher, Textra.

As a further timesaver Word Finder serves as a fast spell checker too. Just call up the synonym list to verify a word's spelling. The instruction manual is thankfully brief. So much so, the essentials are summarized on a double-sided reference card.

Without delving further into the details of this streamlined timesaver, suffice to say it's simple, helpful, and inexpensive. What more could you ask?

RightWriter: The Syntax Sentry

Reach back across time and remember what prepositional phrases, subordinate clauses, and subject-verb agreement are. Besides being the building blocks of sentences they're also the stuff adolescent nightmares are made from.

Well, no one grades your papers anymore, at least not in the sense of returning a red marked copy. Maybe that's because you are usually concerned with accurately transmitting information. If so, then you are passing up an opportunity to persuade and motivate. Too time consuming, you say? Not anymore.

With Word Finder you found the right words. Our second computerized genie is RightWriter, an aptly named style and proofreader program that analyzes documents stored on your word processor disk. Here's the help you need to tie your words together tightly for maximum impact.

Why, you may ask, does any executive need a style checker? Simply because our correspondence is usually unbearably understated, rife with non-committal phrases and cliches like the following:

- "It is my belief . . ." (of course it's your belief; that's why you're saying it, right?)
- "The undersigned" (I, we)
- "In addition to the foregoing" (also)
- "Reference is made" (regarding)

Unfortunately, the potential pitfalls don't stop there. The list, seemingly endless, also includes incorrect punctuation, passive voice, redundant phrasing, offensive (sexist) terms, and so on. Many seminar leaders make a comfortable living by teaching people to write effectively by avoiding these errors.

Restated, they are showing executives how to communicate. The implication is that to manage effectively you must communicate effectively. Any doubts? Read the help wanted ads (for research only, of course); see for yourself the emphasis on the ability to communicate.

Like Word Finder, RightWriter is simple to use. Load it, supply the document's name to be analyzed, then let the disks spin. When the analysis is completed the suggested corrections are superimposed on a copy of the document. Incidentally, RightWriter doesn't alter your original document, but instead creates a marked-up duplicate.

Keeping It Legal

In the continuing saga of whether to copy protect software emerges the novel approach used in Word Finder. When first booting the program you are requested to answer questions about your computer—and yourself. Thereafter, anyone using the program sees a title screen presenting that information (including your name and address). If you ever give away copies everyone will know their source—you. Sure, there are ways around this elementary system, but why bother?

Look, the vendor is offering a quality product at a fair price. They're counting on your honesty not to pirate the program. So do your part, support the growing industry trend away from irritating and tiresome copy protection by tactfully refusing requests for illegal copies.

—H.M.

All of the suggested revisions constitute improvements and you'll likely include them in your original. Some, for reasons of your own, you'll ignore. Perhaps, at times, you wish to be less forceful in your delivery, preferring the subtler approach. That's fine, because the final decision is always yours.

In addition to the embedded syntax and style analysis, RightWriter's summation employs four other criteria: a readability index (based on education level), a strength index (impact of delivery), a jargon index, and a listing of uncommon words. These features are detailed in the manual.

The instructions are clear and concise, consisting of just three pages. The rest of the manual is devoted to detailing the program's operation. Read through it, if you're curious. The background is interesting but not mandatory.

RightWriter is the kind of program to spawn a flood of "I-need-it-too" requests. Just ask Doug Slauson, a microcomputer specialist at Kirkwood College in Cedar Rapids, Iowa. He originally purchased one copy of RightWriter to fill a departmental request. After the program proved its worth he quickly received six more requests. Not that Doug minds because in less than fifteen minutes he had his users up and running on their own. And, adds Doug, "I've not heard a negative comment."

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With programs like Word Finder and RightWriter you will undoubtedly enhance your command of the written word. But beyond even that, all your communications skills will benefit. Your words, spoken or written, will be potent, polished, and persuasive.

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716/377-0130	813/952-9211	313/769-9088
$79.95	$95.00	$29.95

All three run on I.B.M. and compatibles.

Extra Textra

What use would these worthwhile writing aids be without a word processor? None. So I'll recommend the one I use—Textra, a bargain priced ($29.95!) trim and tidy text cruncher. If you've never heard of it, no wonder. It's published and sold by a relatively small yet talented group called Ann Arbor Software in Ann Arbor, Michigan. Dozens of serviceable word processors line the shelves of software dealers. These programs range, like most everything else, from sorrowful to superb. Textra is nearer the latter.

Textra contains all the right ingredients required to churn out and manipulate text. The latest revision, 3.1A, includes some of the more exotic options too. In many respects Textra's a match for the much costlier well-known programs.

Textra's significant simplicity lies in its easy-to-learn and easy-to-live-with menu format. Additionally, its concise and compact manual is backed by a complete context sensitive Help menu. As if these alone weren't enough, Textra goes the extra yard by offering a "film on disk" tutorial, sort of an animated textbook that turns its own pages.

As an added bonus Textra is compatible with Word Finder as well as RightWriter (even if their publishers say otherwise).

So, if you're in the market for a best buy in word processors, look at Textra. And, by calling on its superb self pacing tutorial, you or your staff will be tapping out polished correspondence in hours, not days.

Coming in Fall

Our next column will examine project management software. Sometimes called management information systems, these programs promise to speed the organizing and tracking of a project's schedules and costs.

If you have any questions about computer applications for the physical plant, write to Howard Millman, Senior Facilities Manager, Columbia University/Palisades, Route 9 West, Palisades, NY 10964. Sorry, the author cannot answer individual inquiries. ■

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Management Resources

Diana L. Tringali

Cogeneration News

The University of San Diego cogeneration facility has exceeded original energy and financial projections. The latest indications are that it will save the school about $400,000 in the next ten years. Currently, the 5,400-student, 176-acre campus consumes six million kilowatts of electricity a year plus 363,000 therms of natural gas per year, for an annual energy bill of $1 million.

A new cogeneration facility is now operating at San Francisco State University. The plant is expected to save the university $270,000 the first year by supplying one-fourth of the campus electricity needs. The system burns natural gas to generate heat and electricity for the three residence halls. Excess electricity will be used by the rest of the campus. The savings is expected to keep housing costs at SF State among the lowest in the California system.

Higher Education-Industry Relationships

Creating an environment to advance technology requires cooperation from many areas. The Cleveland Advanced Manufacturing Program (CAMP) has teamed up with higher education in pursuit of bringing high tech to manufacturing. The two areas of concentration are physical facilities and people. The state has designated six Advanced Technology Application Centers throughout Ohio. Companies participate in CAMP-sponsored research, send personnel for training, and engage in developmental projects at these centers, in addition to designing new facilities to house these projects.

Vehicle Maintenance

Iowa State University has two suggestions for savings on fleet maintenance. The first is to check the oil viscosity grade. General Motors recently announced that they have changed their standard to 10W-30 from 10W-40 motor oil. The reason for change is that fewer deposits build up on pistons and rings, which can cause stuck rings, increased oil consumption, and failed catalytic converters. This change has also resulted in improved fuel economy up to one percent. At Iowa State, this would have saved $1,500 on last year's fuel bill.

The second area is tire management. Pressure above or below a manufacturers' recommendation can result in 0.1 to 0.5 percent loss in fuel economy per psi variance. It also causes accelerated wear. At Iowa State, based on 250 vehicles, 1,000 tires, losses on incorrectly inflated tires would be $150–$750 yearly.

Lighting Projects

Lighting retrofits are a popular target for energy saving strategies. Pacific Gas and Electric (California) and Jersey Central Power and Light (New Jersey) offered their customers bonuses to replace standard fluorescent lamps and ballasts with energy saving equipment. Many utilities and municipalities are switching their street-lights from incandescent and mercury to the more energy efficient high pressure sodium (HPS) lighting, which is easy and relatively inexpensive to replace. Immediate dollar savings and long term advantages of increased life expectancy are benefits.

Other methods of lighting energy conservation include: disconnecting unnecessary fixtures, installing time clocks and other control devices, establishing computerized lighting control systems, and using new technology. Some new developments in the field include improvements in high intensity discharge lamps (HID). Not only has its outside potential been improved but it also has many indoor applications as well. These systems offer the same or better light output for less wattage consumption.

Boiler Technology

The University of Missouri/Columbia has recently installed a circulating atmospheric fluidized bed steam boiler. The new boiler will work in tandem with four existing boilers and four turbines, making the power plant one of the few university systems that can generate all of its own electricity. The project began in September 1985 and should be in full operation by fall 1987. Projections show an expected energy savings of $10 million to $15 million over the next ten years, or $1.3 million annually.

A new microprocessor-based distributed control system in conjunction with the boiler and turbines will produce all of the current electricity needs in addition to 40 to 50 percent of the steam needed to heat and cool the system. The system was installed to meet projected future needs as well.

This system is part of a $40 million project to improve the campus utility distribution systems. Payback is expected in the next few years, and will be reinvested in other upgrading projects.

Roofing Applications

The Sprinkool direct evaporative roof spray system can provide cooling for facilities that are not air conditioned and can reduce interior temperatures by as much as ten degrees. The system uses a rooftop network of copper pipe and sprayheads designed to emit very small amounts of water in the form of fine mist. The mist is controlled by sensors that detect temperature and climatic changes. In retrofit applications it can help improve the efficiency of existing air conditioners and in new buildings it can reduce the air conditioning tonnage required. It is currently being used at United Technologies, General Electric, Firestone, Colgate Palmolive, and Shering-Plough facilities.

Energy Projects

Ball State University invested in new radiator valves to eliminate an environmental control problem. All residence halls are connected to a central steam plant that supplies individual cabinet heaters and finned tube radiators with hand controlled valves. The system is twenty to thirty years old. Students complained of too much heat and valves were hard to reach and difficult to adjust. Windows were left open to cool rooms, causing excessive heat loss.

To solve the problem Ball State installed nonelectric thermostatic radiator control valves. Each valve contains a volatile liquid filling that responds to temperature variations by expansion and contraction. The new valves have helped to prevent fluctuating temperatures, make heating more efficient, and reduce fuel costs.

Energy Strategies

A large shared energy saving project has been undertaken in the New England area by a subsidiary of New England Electric Systems, NEES Energy, Inc. Some of the company's current projects include the following.

The most ambitious project to date has been at the University of Rhode Island. NEES has incurred investment costs of $5 million, and has guaranteed the university a net energy savings of more than $2.6 million during the life of the ten-year contract.

Endicott College in Beverly, Massachusetts is realizing a 20 percent savings after entering into a contract with NEES.

A current project involves twenty-five school buildings in Providence, Rhode Island. The Providence School Department is spending $2 million a year in energy costs with $1.5 million for heating oil alone. NEES invested $3.4 million to install a centralized EMS, twelve new boilers and hot water heaters, replace steam traps and non-electric valves, relamping, and other repairs and maintenance. Over the fourteen-year contract NEES will receive 10 percent of energy dollar savings, which are estimated at 26 percent annually or approximately $494,000 the first year.

Typically a potential energy sharing client has a total energy bill in excess of $100,000 annually and the facility must meet certain energy inefficiency criteria. NEES owns and insures the equipment through the life of the contract, although a building owner can buy the equipment at any time. At the end of the contract it may be renegotiated, renewed, the building owner may purchase the equipment, or NEES will remove the equipment at its own expense.

The Bookshelf

The High Technology of Sunlight

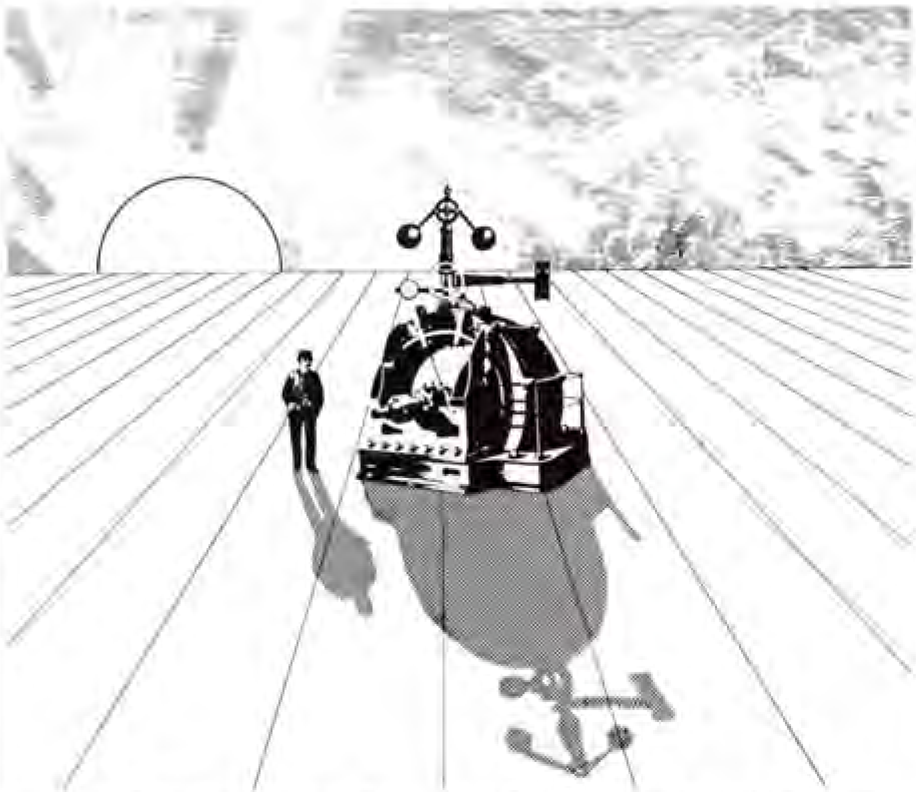
A Guide to the Photovoltaic Revolution, by Paul D. Maycock & Edward N. Stirewalt. Emmaus, Pennsylvania: Rodale Press, 1985. 274 pp. $9.95, softcover.

In nearly the century and a half since the photovoltaic effect was observed, the technology has grown from a laboratory curiosity to a mature science. Based on the absorption of sunlight by solar cells and its conversion to electricity, light drives the process and produces the energy that it translated into electrical energy. As the photons (particles of light) strike an atom in the semiconductor material, they interact with the electrons that surround the nucleus. During this interaction the photon is absorbed. The added energy from this process excites or drives off one of the atoms' outer shell electrons. An electron freed in this manner forms an electric current. This interaction between light and electrons is the heart of the photovoltaic process.

Maycock and Stirewalt carry the development of the process from Becquerel's discovery in 1839 to the present. The greatest thrust in its development was the wide use of solar cells in satellites in the late 1950s. The authors go into extensive detail and explain the photovoltaic phenomenon as well as production of semiconductors from silicon.

The authors point out that silicon is the most commonly used material for making photovoltaic converters because of the arrangement of four electrons in its outmost shell of the atom. The production process for making solar cells is rather complex, contributing to the overall high cost of installation of photovoltaic projects. The cost per peak watt for one megawatt or greater installations was $10 in 1984, $6.10 in 1986, and projected to be $3.10 per peak watt in 1990, all in 1984 dollars. Further cost comparisons indicate residential electricity costs with a photovoltaic system to be $0.18–$0.25 per KWH at peak interest rates and $0.06–$0.08 per KWH at low interest rates, the latter a more easily digested price range. While the sunlight is free and overall photovoltaic systems costs are high, their current cost trend is downward. The authors conclude that by 1990 photovoltaic systems will be able to generate electricity that is competitive with conventionally fueled power in most parts of the United States. A good sign for potential users.

This process has a definite future in today's high-tech environment. The system consumes no fuel, the photovoltaic cells are sealed, no by-products are created, no pollutants are involved in its generative process, and the basic material of most semiconductors, silicon, is readily available. Its product of electricity is clean, there are no transportation or pumping requirements, it is silent and extraordinarily versatile, and is easily converted into heat, light, or motion.



The systems are not only versatile but durable as well, able to withstand the harsh physical rigors of space—high vacuum, radiation, great temperature differentials—as well as the harsh earth environment of dampness, dirt, chemical smog, wind, hail, ice, and snow. Experience indicates the systems can survive in space about twenty years and at least ten years in an earth environment without signs of fundamental failure.

The most important portion of the book is the chapter on applications of photovoltaic energy systems. Large photovoltaic power systems of 60-KW to 6-MW could power communities, university facilities, pumping stations, and grid systems. There are no technical problems associated with multi-megawatt central photovoltaic substations.

Noting the large, successful central plants in operation, one could relate many similar instances where photovoltaic applications may be appropriate in the university/college environment. Keep in mind that any power excess to institutional needs can be "sold back" to the utility company. Several applications quickly come to mind: student housing and union buildings, power for remote research facilities, irrigation systems, radio stations, classroom facilities, office buildings, studio facilities, individual campus residences, shop areas, farm/barn areas, covered parking facilities, plus many other campus facilities requiring electrical service.

Maycock and Stirewalt have put together an interesting text that contains many facets associated with the photovoltaic industry in thorough appendices. It is easy reading and a good brush-up on your physics. One point I do not agree with is the title; it is not quite a "revolution" yet.

A Guide of the Photovoltaic Revolution is available form the Rodale Press, 33 East Minor Street, Emmaus, PA 18049; 215/967-5171.

—T. Dan McCrary
Director of Physical Plant Operations
Virginia Commonwealth University
Richmond, Virginia

The Philosophy of Technology

The New Liberal Learning: Technology and the Liberal Arts, by Robert P. Lisensky, Allan O. Pfnister, & Sharon D. Sweet. Washington, D.C.: Council of Independent Colleges, 1986. 68 pp. $10, softcover.

TAKE TEN! During a brief break one can read this provoking set of monographs on liberal learning, which stresses the need for technological literacy in order to understand the world we live in, as it is, and the predictable future. Essays by Lisensky and Pfnister present the viewpoints of distinguished scholars in a succinct, logical summary of the issue of, and need for, technology in the liberal arts curriculum.

The authors summarize technology as "a social process that employs scientifically- and empirically-based tools, techniques, knowledge, resources, and systems to affect the human environment and its organization." They draw together the best thinking on the subject from many sources and provide a comprehensive bibliography. They also surveyed small liberal arts colleges to assess programs that emphasized technology.

Traditionally, liberal arts colleges attempt to "prepare students for meeting the problems and concerns of their world" through historical, sociological, economic, and ethical perspectives. That is no longer sufficient in the light of the impact of technology on our lives and thinking. Technology has extended our capabilities far beyond our mental and physical limitations. Technology calls for intervention to meet a need or correct a problem. It is action-oriented. Technology is involved with organ transplants, genetic engineering, nuclear power, atomic waste. If students are to deal with social issues intelligently and knowledgeably, they must understand technology as a social process. Technology will soon be included as an arm of liberal arts, along with the natural and social sciences and the humanities.

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More than 700 liberal arts colleges were asked to identify courses of technology in their curricula. Based on responses from 195, it is apparent that technology is now part of the curriculum in these schools but does not stand alone as a separate course. Further, the inclusion was generated by individual faculty members who recognized a need rather than by conscious direction of the institutions.

The monographs present a clear outline of the requirement and need to teach technology in the liberal arts—not from a technical point of view, but from a social point of view—and provide a convincing argument that a true liberal education in today's world must include technology.

This book is recommended to facility managers and their staffs as a means of keeping abreast with changes in academia, the function they support.

The New Liberal Learning is available from the Council of Independent Colleges, One Dupont Circle, Suite 320, Washington, DC 20036.

—Jerry Boyea
Facilities Management Consultant
Hendersonville, North Carolina

Cogeneration Technology

The Cogeneration Sourcebook, ed. by F. William Payne. Atlanta: The Fairmont Press, Inc., 1985. 290 pp. $36, hardcover.
Planning Cogeneration Systems, by Dilip R. Limaye. Atlanta: The Fairmont Press, Inc., 1985. 246 pp. hardcover.

Cogeneration has been defined as the sequential production of useful thermal energy and shaft power from a single energy source. A "conventional" system would include a high pressure steam boiler to serve a steam turbine-driven electric generator. After producing electricity, the steam exhaust from the turbine, still at a relatively high pressure, can be used to satisfy conventional space heating, domestic hot water heating, or process steam requirements. Conventional cogeneration systems were prevalent in this country in the first quarter of this century, when industrial plants were forced to produce both their own electricity and steam for heating or process work. Gradually, however, these systems became obsolete as relatively cheap electricity became available from utilities. By 1970 cogeneration systems produced a negligible amount of electricity in the United States. In Europe, where energy costs were always relatively high, cogeneration systems continued to produce significant amounts of power.

In 1978 the National Energy Act defined for the first time a comprehensive national energy policy for the United States. Part of the Public Utility Regulatory Policy Act (PURPA) provided incentives for cogeneration, since this concept was perceived as a significant potential energy conservation technique for which technology was already known and proved. The incentives involved tax credits for industrial and private institutional cogenerators. Since these credits are generally unavailable to public sector institutions, "third-party" ownership/operation arrangements for plants were developed for public institutions. PURPA also required utilities to purchase power from cogenerators under certain conditions, a situation that was not universally hailed or honored by utilities. In addition, "non-conventional" cogeneration devices, such as natural gas turbine generators, or natural gas or diesel engine-driven generators, were developed and promoted.

Now there are commercially available packaged cogeneration systems, or components to erect large systems, which can be applied to any size institution, provided the necessary economic conditions are present. The potential savings in fuel costs could be significant for colleges and universities, and each institution should investigate this method. Since cogeneration plants are capital-intensive projects, it is important to estimate projected fuel and operating costs as accurately as possible so that a life-cycle analysis of the proposed system reflects reasonable predictions on which decisions may be based.

Both *Planning Cogeneration Systems* and *The Cogeneration Sourcebook* provide valuable perspectives on the economic and technical problems associated with cogeneration. *Planning* provides the reader with practical information concerning feasibility assessment, analytical methods for technical and economic feasibility evaluation, computerized system designs, and conventional and non-conventional cogeneration technologies. Each of the fourteen chapters is written by a different author and covers a specific topic. The chapter on system application considerations, by J. M. Kovacik, is an excellent overview of the various fuels and processes available for cogeneration systems.

Sourcebook is similar to *Planning* in that its nineteen chapters are written by separate authors covering different topics. However, *Sourcebook* places more emphasis on newer areas of cogeneration, including prepackaged and small-scale systems, and emerging technologies such as solar systems, fuel cell systems, and other renewable energy systems. The chapter on industry prospects, by K. M. Clark and D. E. Criner, gives excellent background data and design parameters for systems applying gas turbines and waste heat boilers.

These two books complement each other—*Planning* is directed to present technology, while *Sourcebook* is future oriented. Both books are written more for the industrial than institutional clientele. In spite of this the information presented is clearly applicable to colleges and universities of all sizes. Both books will be invaluable to all institutions interested in exploring cogeneration systems.

The Cogeneration Sourcebook and *Planning Cogeneration Systems* are both available from The Fairmont Press, Inc., P.O. Box 14227, Atlanta, GA 30324.

—John M. Casey, P.E.
Manager, Engineering Department
University of Georgia
Athens, Georgia

[*Ed. Note:* Also available on the subject is *Cogeneration: A Campus Option?* by Robert Goble & Wendy Goble; $17.50 ($12.50/APPA members) + $5 shipping/handling from APPA, 1446 Duke Street, Alexandria, VA 22314.]

Expanding Our Approach to Training

Training for Tomorrow—Distributed Learning Through Computer and Communications Technology, by Greg Kearsley. Reading, Massachusetts: Addison-Wesley Publishing Company, Inc., 1985. 113 pp. hardcover.

A recurring problem in physical plants is the management of staff training and development—how to train, retrain, and update the skills and knowledge of your staff in a cost-effective manner. A typical approach is to send people to seminars (when travel can be afforded), buy training materials (which may or may not be read), sponsor in-house classes, or rely on one-on-one training (supervisor to employee, journeyman to trainee).

In *Training for Tomorrow*, Kearsley presents an alternative to this traditional approach. He suggests using the new technologies of computers and communications to help meet our ongoing training needs.

The purpose of the book is to introduce the reader to the new instructional trends and computer/communications technologies that are making distributed learning a more viable training option. It reviews the design, implementation, and evaluation of distributed learning systems as well as the advantages, disadvantages, and costs. Kearsley covers videoconferencing, videodisks, and communication networks, but focuses primarily on the use of computer-based instruction.

This type of instruction is somewhat similar to the text-based "programmed learning" concept popular in the 1960s, only it uses computers and graphic enhancements. The subject matter is broken into modules, and the student develops his path through the material based on what he needs or desires to learn. The computer can track progress and provide testing. It offers the advantages of being timely, highly interactive, standardized, customizable, and effective. Unlike classroom training, the success is not contingent upon the quality of the teacher.

Possible applications of computer-based learning in physical plants include many of our recurring training needs. These are the formal learning portions of apprenticeship programs, technology and code updates for professional staff, custodial methods and products training, and the use of computer packages and programs. Kearsley does state that there are some training topics dealing with interpersonal skills or creativity that cannot be easily learned in this format, and that in-person meetings could never be completely replaced by technology.

There are several drawbacks to these new learning technologies that make it difficult for the average physical plant to use on its own, the largest being high development costs. Unless many employees will use the program, the cost is prohibitive. Another drawback is the level of user sophistication required. Our largest training need in terms of numbers is custodial training; we need to make sure the training doesn't require higher cognitive skills than the job itself. Use of video technology may be a better approach in this case.

A more viable way for physical plants to take advantage of these new technologies would be for our various professional associations to pinpoint ongoing training needs, bear the development costs, and market the product. It would be a good supplement to sponsoring seminars. Computer-based instruction could easily be developed for code/legislation/technological updates and basic concept instruction (e.g., many of the APPA Institute for Facilities Management topics). Rather than sending one employee to a week-long school, a physical plant could spend the same or less money on a computer-based training program or videodisk and have several staff members benefit. The computer training could be supplemented by a one-day meeting or teleconference for clarification and experience exchange.

Organizations such as TPC could improve the effectiveness of their materials by moving from text-based instruction to a multimedia approach, and some are doing so. The possibilities for the future are fun to consider. Kearsley suggests that distributed learning can be enhanced by providing the students with incentives, such as attending a group meeting after a certain number of individual learning sessions have been completed.

Training for Tomorrow is short, concise, and easy to read. Kearsley accomplished his basic purpose of sparking the reader's imagination rather than trying to provide a technical operational discussion. The major points of the book can be gleaned by reading the introduction and chapter summaries, as the author is good at telling you what he is going to say, saying it, and then telling you what he said. It is a good book to skim if you are responsible for the training programs and strategies for large groups of people, or if you just want to check out what the future may bring.

Training for Tomorrow is available from Addison-Wesley Publishing Company, Inc., Reading, MA 01867.

—Shelley K. Merrill
Assistant Director, Administrative Services
Iowa State University
Ames, Iowa

Space Management

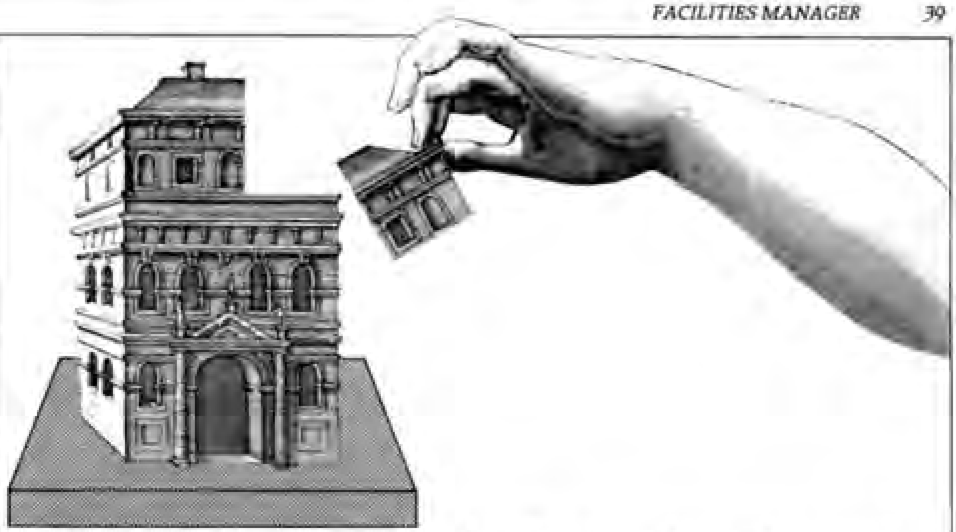
How to Manage Space, by R. B. Cavanaugh. Winchester, Massachusetts: R. B. Cavanaugh Publications, 1984. 105 pp. $7.95 (+ $1 for shipping & handling), softcover.

How to Manage Space is a small, privately printed manual on the administration of space in the academic environment. Although Cavanaugh's suggestions have validity in almost any setting, they are intended primarily for large institutions where the results of poor space administration might be hidden and the problems more complex and difficult than on a small campus. The book attempts to be a straightforward and pragmatic guide in what the author feels to be a neglected field. It is principally written for those who must deal directly with the frustrating task of linking the right people with the right space amid conflicting demands and priorities.

Cavanaugh's main premise is that an institution must acknowledge that space administration, although deceptively simple, requires care and attention. He suggests that only when the upper echelons of management are directly involved can space administration have the resources and authority to be truly effective. The author thinks space is best managed by a committee composed of upper level administrators in facilities, personnel, and finance, as well as several of the deans. Here Cavanaugh tends to be idealistic in thinking that such an exalted group would take the time to gather to decide the supposedly mundane question of where people should be located.

How to Manage Space is a guide to achieving clearly articulated and formalized administrative procedures. In that vein it lists six essential conditions of good space administration. The administrator must: 1) bring to bear as much information about the change as possible, 2) consult with all interested parties, 3) see that the proper authority is implemented, 4) maintain an updated file of space resources and standards, 5) promptly advise concerned parties of the disposition and progress of a request, and 6) establish procedures to ensure consistent responses to space requests.

All of which is excellent advice. The practical suggestions with which the author supports these steps bear close attention by anyone seeking to avoid the pitfalls of this emotionally charged issue. Certainly, questions of status and programmatic emphasis inherent in space administration require careful and deliberate judgment. However, it is possible that such a formal approach, with its long lead times and lengthy forms and procedures, might invite shortcuts or special deals outside of the formal space administration. Political pressures can force administrators to shortcircuit careful procedures, leading to the very errors those procedures are designed to avoid.



The author effectively summarizes twenty years of hard-earned practical knowledge in this volume. It can be read with profit by anyone closely involved with the administration of space. *How to Manage Space* is packed with practical information, including excellent sample forms and procedures. Rather than theorizing, this book takes the process from beginning to end, supplying examples, standards, and procedures as needed—in effect, leading the administrator step by step through the potentially thorny maze of space management.

Though some things might appear self-evident, Cavanaugh succeeds in presenting an in-depth picture of the space planning process, and he reminds us of the constant need for accuracy, fairness, and communication in every aspect of space management.

How to Manage Space is available from R. B. Cavanaugh Publications, 15 Grove Street, Winchester, MA 01890.

—John Rolle
Superintendent, Buildings & Grounds
Pacific School of Religion
Berkeley, California

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Meetings

Institute for Facilities Management, August 10-15, 1986, Burlington, Vermont. $675 ($575/APPA member institutions). To register or to receive a program brochure, contact APPA, 1446 Duke Street, Alexandria, VA 22314-3492; 703/684-1446.

APPA REGIONAL MEETINGS

Rocky Mountain—August 24-27, 1986, Montana State University, Bozeman, MT.

Pacific Coast—September 14-17, 1986, University of Idaho, Moscow, ID.

Midwest—September 27-October 1, 1986, Grand Valley State College, Allendale, MI.

Central States—September 28-October 1, 1986, University of Oklahoma, Norman, OK.

Southeastern—October 4-8, 1986, The Citadel, Charleston, SC.

Eastern—November 9-12, 1986, Washington, DC.

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