

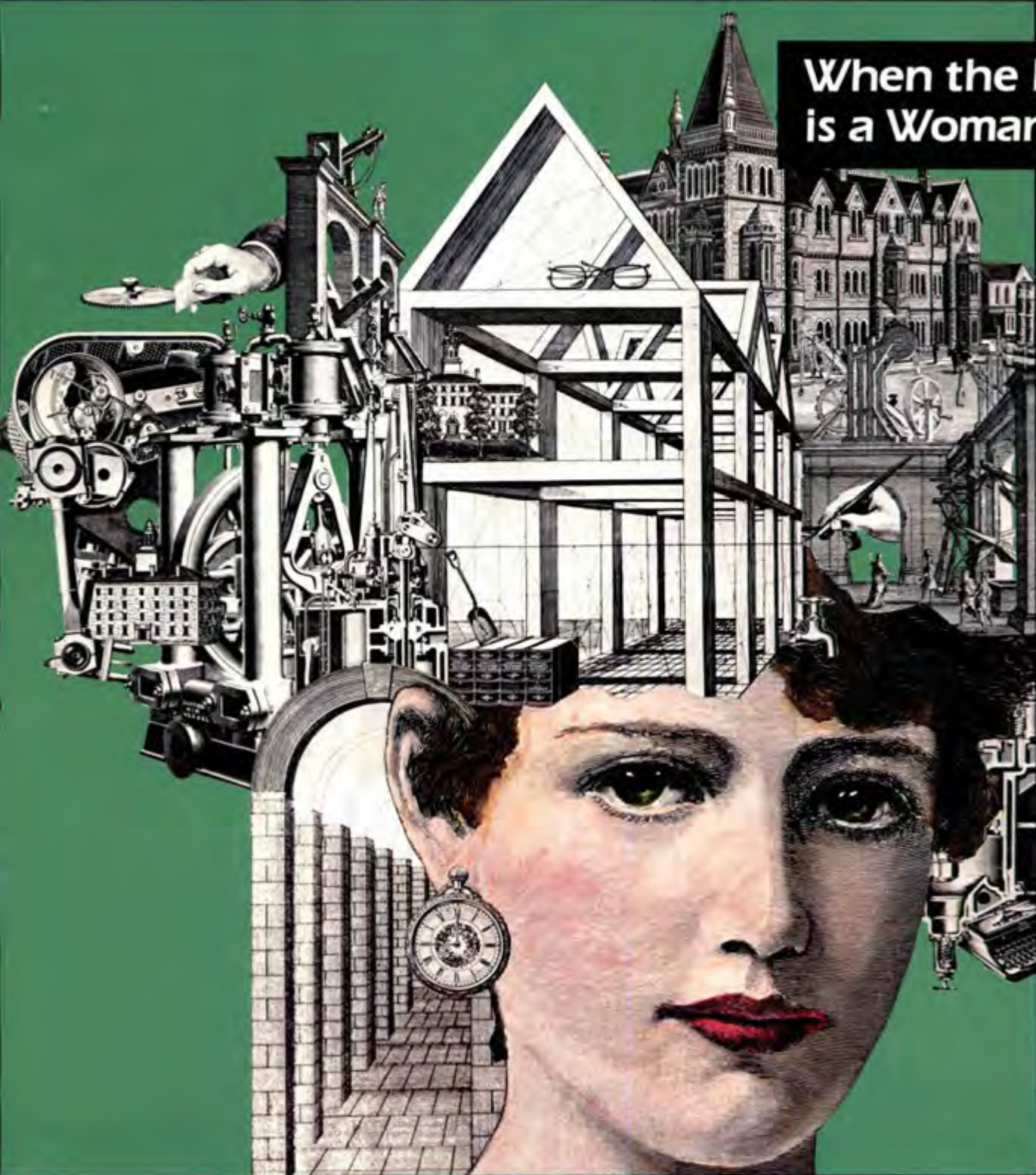
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Administrators of  
Universities and Colleges

# Facilities Manager

Volume 1 Number 4

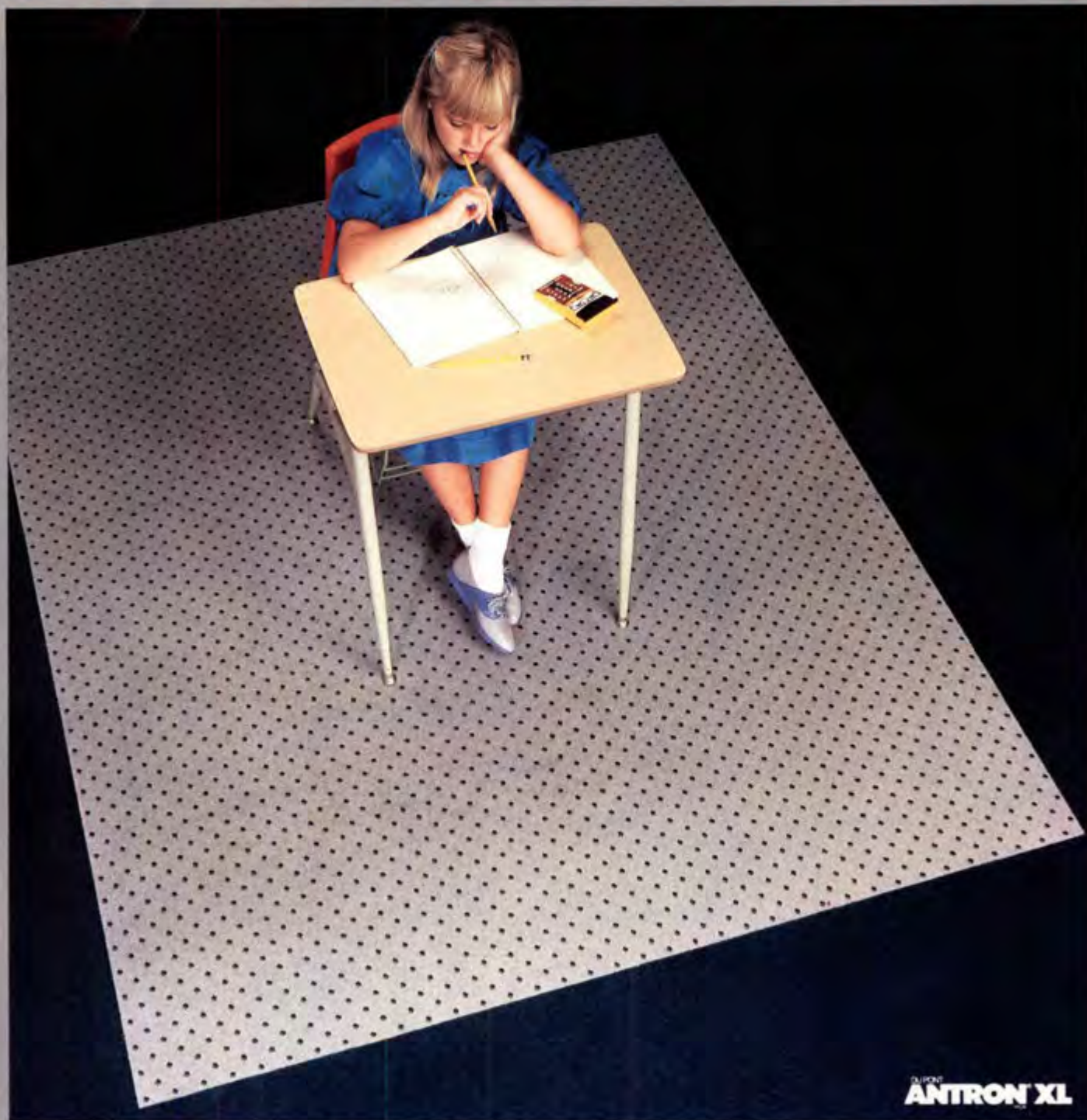
Winter 1985

**When the Boss  
is a Woman**





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**T**here's a saying in some physical plant departments that the "girls" take the messages but the men go out to do the work.

But what if one of the "girls" happens to run the show, handling multi-million-dollar budgets, coordinating ambitious construction projects, and supervising the nearly all-male operations crews?

## When the Boss is a Woman: Women Break into Facilities Management

by Terry Maher

*Shelley Merrill, Iowa State's assistant director of physical plant, reviews budget figures with John Harrod, associate director.*



From California to New York, women are moving into positions of authority in facilities management once reserved solely for men. And they are making a success of it despite the fact that most have no formal technical background and are considered oddities in the virtually all-male world of electricians, plumbers, carpenters, and construction workers with whom they often must deal.

They are still oddities within the Association of Physical Plant Administrators of Universities and Colleges, too, where women represent less than two percent of the membership. Yet, they are making a name for themselves because of their effective managerial styles and their ability to handle the complexities of everything from boiler repair to major new construction.

Why are there so few women? In a field replete with architects and engineers, the answer is simple. "There just aren't that many women majoring in engineering or architecture," says **Carol L. Wooten**, director of physical planning at Brown University. "This really is a man's area, but it's changing."

**"[Facilities management] is really a man's area, but it's changing."**

—Carol Wooten,  
Brown University

The other traditional entry route has been through the ranks of the craftsmen, but this has been virtually closed to women. "How many women carpenters or electricians do you know?" asks **Diane S. Kerby**, Berea College's director of physical plant. "None. I have none, so I can't promote any. Women will start making strides when we have women carpenters and electricians with experience and education. Until then, they must come up through the clerical side."

Kerby should know. After graduating from Berea College ten years ago with a degree in child development, she became a work-order clerk in the physical plant department while job-hunting. "I just kept going back to physical plant," she remembers, "because I really enjoyed the jobs." She eventually rose to student supervisor, housekeeping supervisor, administrative assistant, associate director, and finally, in 1984, to director. "I have grown up here, and people can see what I can do," she says.

**Julia G. Baker-Moffett** also "grew up" with her jobs over a sixteen-year period. She started her climb at the University of Missouri/Columbia in 1969 as an assistant to the campus business officer, who had responsibility at the time for physical plant. She became assistant director for support services in 1982, when physical plant became a separate department.

Despite the fact that she has not yet completed a college degree, her experience has won for her a position that manages everything from custodians to fire protection to finances and payroll. She supervises approximately 200 employees—many with engineering or business degrees—and a budget of \$3 million.

"The biggest challenge is coordinating and communicating with people," says Baker-Moffett, "so administrative expertise is as important as, or maybe even more important than, a technical background. As for my own departments, I must say I'd be at a loss without the managers I have. I was terribly selective in choosing them because of their technical expertise. But I was put in this position because of my administrative abilities."

Other women also have risen through the business-office ranks, such as **Amy J. Blue**, Stanford University's director of facilities and project management. "When I was hired in 1980 as director of project management, I was the first director who wasn't an architect, and that was a conscious decision by the university," she says. "They wanted to focus on management, because no architect they had met could control budgets and schedules. They'd get beautiful buildings that didn't work. They needed to know the money would go into building systems, not only into the aesthetics."

*Carol Wooten, director of physical planning, confers with crew member during a renovation project at Brown.*



*Terry Maher is a freelance writer based in Washington, D.C.*



Blue's background suited her ideally for the position. She first came to Stanford in 1972 and worked in the provost's office, explaining the facilities needs of the academic faculty to those who actually would build the space. "That was my introduction to the technical side," she explains. "I learned about blueprints and floor plans, enough to know if something was wrong."

In 1978 she moved to Ohio State University to manage the business operations of eleven student affairs departments, which included budgeting for facilities needs. In 1980 she returned to Stanford as director of project management representative, and in 1984 she became director of facilities and services. "Physical plant, housekeeping, food service, and facilities and project management all report to me," she says.

What about the director of physical plant position itself? "The director of physical plant should be an engineer," says Blue. "I am not the director of physical plant, nor do I think I should be. When I came the director was not an engineer, and he quickly departed, and I got an engineer. But I would definitely say that on the project management side, management is more important. I probably spend more than 60 percent of my time on personal interactions, and maybe 40 percent on other matters."

Agrees Shelley K. Merrill, Iowa State University's assistant director of physical plant. "The average physical plant manager in a large institution doesn't spend a lot of time on technical matters. It's a lot of public relations work, and handling personnel and budget problems."

No one would contend that technical expertise is not important, however. Brown's Wooten, an architect, sees her expertise as a necessity for the job. "You really need a background in both technical and management areas. There are so many with a technical background who cannot manage, but you must know more than just management—you must understand the technical."

"The biggest challenge is coordinating the thoughts and wishes of the group wanting a building or renovation and translate that to the architect, and eventually to the contractor, to make sure you have the quality."

Contractor John Horton, vice president of a firm that has dealt with Wooten for six years, agrees. "You do need that technical background because



Stanford's Amy Blue, director of facilities and project management, shortly after conducting a steam tunnel inspection with Ralph Buchanan, director of operations, maintenance and utilities (left) and Breck Breckenridge, supervisor of the steam shop.

this is a technical field. That's one of the advantages she has. No one will go on the job and pull the wool over her eyes, and if you don't know the details, you could be made a fool. No one will do that to Carol."

But Evelyn A. Miller, director of facilities at Montgomery College, strongly disagrees. Like many of her women colleagues, Miller rose through the clerical ranks. She started as secretary to the director in 1969 and progressively took on responsibility for writing facilities

specifications for architects, planning the capital budget, and coordinating capital projects for the college's three campuses. In 1982 she became director of facilities for the three campuses.

"You can ask enough questions and find out if you're being lied to," says Miller. "And when we hire architects we make them liable if they make a mistake, if they cause a building to be built wrong. After all, the president of the college doesn't have the technical expertise in everything that goes on

Evelyn Miller, director of facilities, shown with members of Montgomery's grounds crew.





## "The repair and maintenance crew felt I'd never make it."

—Sherry Honeycutt  
Drury College

around here, and neither does the assistant vice president. But particularly in larger units, there's no reason why the technical expertise can't be shifted down one level."

That's been the experience of **Sister Marie Helene Werdel**, director of plant operations and maintenance at Mount Marty College. She had taught grade school for thirteen years for her Benedictine order before she was appointed to her job twenty-nine years ago. During her long tenure she has overseen a major construction program that has included a new convent, student union, dormitory, and a high school, which has now been converted into a library.

How did she do it? "We had a good architect," she explains, "and he followed the job closely. And there were some guys working on the buildings who were very good about calling my attention to things they thought were wrong. It does keep you on your toes, though. You make a few mistakes, but you learn by them."

The buildings, she adds, have had no problems and still are in good condition.

*Diane Kerby, director of physical plant, checks the solder repair of Berea's downspouts.*

Should the buildings develop any problems, however, Montgomery College's Miller has the solution—she's opted to keep an engineering firm on retainer rather than hire a mechanical engineer for her staff. "A mechanical engineer doesn't know enough about electrical or structural engineering; he can only guess," she explains. "But you don't need a structural, mechanical, and civil engineer on the staff. So, we have an engineering firm on retainer who knows what they're talking about without guessing. We go to them like we'd go to a lawyer."

But hire one as a manager? "I've had a couple of arguments with some older directors who say engineers make better managers," she says. "I don't know any engineers who could manage their way out of a bucket. Maybe some could, but most can't. They just don't seem to be people-oriented."

**Sherry Honeycutt**, director of physical plant at Drury College, knows all too well the problems of an unmotivated staff suffering from poor management. She had just gotten her degree in art from Drury when she started work as custodial supervisor in 1979. At the time

she, as well as all the custodial employees, worked for an outside firm on contract to the college.

"Things hadn't gone well at all," she remembers. "They had poor communications with the college and the work they had done was not good, so maintenance was a mess when I started."

Employee relations were so bad, in fact, that her fifteen-month tenure as custodial supervisor was the longest on record. "Not only that," she laughs, "when I had been director here for twelve months, a lot of the employees began to tease me because the last few directors had not been here longer than a year."

Compounding the morale problems was the fact that she was female. "When I started as a custodial supervisor, there was a lot of resentment on the staff because I was twenty-five years old, younger than most of my custodians, who were mostly between 50 and retirement age. They were really mad. They didn't like someone that young coming in, and the fact that I was female really upset them. The repair and maintenance crew felt I'd never make it."

"I think time has proven them wrong. I look at it now, and I don't think it has anything to do with being male or female—it's important to have the employee's respect. I believe I have that; it's obvious I have their respect. I now have one of the best maintenance crews, and I'd put them up against anyone. It just takes time; you must be consistent, firm, fair, flexible, and listen to their ideas and ways. There are times when maybe they have a better idea than you do. And if you're not really committed and dedicated to your employees, if you don't have good employees and a good crew, then you just don't have a department."

Not that she hasn't picked up the necessary technical background. Honeycutt has taken courses in blue-



**"It would be virtually impossible for a man or a woman to come into this field now without a technical background."**

—Sister Marie Werdel,  
Mount Marty College

print reading and ninety-six hours of electricity. But her main tasks involve planning and budget; her assistant plant director supervises maintenance and repair. "I could go out and get a degree in engineering, but I'd still rely on my assistant's judgment," she adds. "He's sixty years old, and he's got all that experience."

That kind of mutually respectful relationship may be one of the keys to

*Julia Baker-Moffett, right, assistant director for support services at the University of Missouri/Columbia, looks at new custodial equipment with staff members Jim Snodgrass, Lynn Wiggins, and Bill Stetzel, from left.*

these women's success. Says Miller, "My employees know I won't play games, that I want a full day's work from them, that I'll stick up for them when they're right, and will come down on them, in private, if they're wrong. But I won't embarrass them. And if they need something, I'll get the tools and supplies they need. Quite frankly, I'm the first to do that for them."

That means a lot to the employees, says Cron Carpenter, general foreman and twenty-one-year veteran of Berea College's physical plant department. "If we've got an idea, or maybe we want to

*Sister Marie Werdel has been director of plant operations and maintenance at Mount Marty for nearly thirty years.*

do something differently than over the years, I'll talk to Diane Kerby. She listens. If she disagrees, she won't offend us or degrade us. I've worked with lots of directors, and it didn't work like that with the majority of them. We're doing more and better work now than we've ever done, and we take pride in our work. It's a good and pleasant atmosphere because she's not someone who will hit you over the head with a hammer. If you do a good job, you'll be recognized, and if you do a bad job, you'll be recognized. She's the best director we've had in the last seven or eight years."

The future for women in the field of facilities management, however, may depend less on their current success as on factors outside their control, such as increased emphasis on an engineering or architecture background. And a college degree now is an unquestioned prerequisite, a problem for some women and men alike.

Joann Gentry, for instance, has no college training but has become manager of building services at the University of Michigan's Dearborn campus because of her on-the-job experience. She started work in 1974 as a night custodian, began assisting the manager in 1982, and became manager herself in 1983. Along the way she has picked up





*Drury's Sherry Honeycutt rose from custodial supervisor to director of physical plant within six years.*



some technical and management know-how from APPA's Institute for Facilities Management, but no college courses.

She now faces the prospect of either going back to school to get a degree or having no prospects for advancement. "If I don't do something about it now, I will be in the same place in twenty years, and I don't want to be."

Should she decide to get a business degree, however, she still might be shut out of some jobs because she'd lack a technical degree. According to Harvey H. Kaiser, vice president for facilities administration at Syracuse University, today's modern buildings, with their complex construction techniques and systems, require facilities managers who

can understand the technical aspects of those systems.

Mark D. Langford, director of facilities management at the University of Missouri, adds, "Being in physical plant in a management position is a technical job. Most departments do design in-house, for instance. You need technical people because you need to know what is happening in the field every day."

Even Mount Marty's Werdel agrees. "I think it would be virtually impossible for a man or a woman to come into this field now without a technical background because of all the technology involved," she says.

But as Iowa State's Merrill puts it, "A woman engineer coming out of school can command much higher salaries than she'll get in physical plant, so she'll go

with the bucks and stay there." That leaves a pool of women heavy in business and management expertise, but lacking Kaiser or Langford's desired technical background.

APPA President William W. Whitman, however, disputes the need for a strong technical background. "A lot of big-school jobs now are asking for an MBA type, so while the field is still dominated by engineers, that will change. You can always hire the technical expertise. After all, at a large institution what you're dealing with is 575 employees and \$25 million budgets. Heck, I don't do anything technical anymore."

But whether their background is technical or managerial, these women have successfully completed ambitious building projects, managed multi-million-dollar budgets, and won the respect of their mostly male employees and their colleagues.

Their success, in fact, may have less to do with their backgrounds than with their sheer tenacity in holding a job in a traditionally male bastion. "I have to do a better job than my male colleagues, or I'll be in trouble—not with my boss, he's very supportive, but with the faculty and peer groups," says Miller. "If I make a mistake, it's because I'm a 'dizzy blond,' not because I'm just a human being. If a man makes a mistake, it's just a mistake."

Adds Drury's Honeycutt, "When I got this job, the president and business manager called me in and said, 'We're not sure you can do this job, but we'll let you try it.' It upset me that they said that, but maybe that's why I stuck with it—to prove them wrong."

### But Sexism Still Remains

It's not all a bed of roses for women in facilities management. One woman, who requested anonymity, left the field because of what she called "subtle sexism, impossible to prove, impossible to correct. For instance, if there were problems in my department, the foreman would be called in, even if I were involved in the project and he wasn't. Anytime I would mention this, I would get the 'you're an emotional little girl' routine."

Even successful women directors, like Diane Kerby, have run into some problems. "The reaction they [the crew] have to me, of course, is different than to my assistant, who is a man," she says. "They see women as not mechanically inclined, and it's almost like I have to prove myself to the male employees. They're often surprised that I know things they think I shouldn't know. It's not automatically recognized, like it would be for a man."

Evelyn Miller, like many others, has had to re-educate her staff about the way they address women in the office. "I would hear a lot of the men talk about 'the girls,'" she says. "I will let them know I don't like it and don't want to be treated like that. It's our job to let them know we want to be treated as equals."

But men had better beware—those 'girls' might just become their boss. "I sometimes get whistles and catcalls on job sites," admits Amy Blue. "We've told the contractors that their workers should be working, not looking at the female students and staff passing by. It's sort of fun now seeing the transformation after I've walked by."

—T.M.



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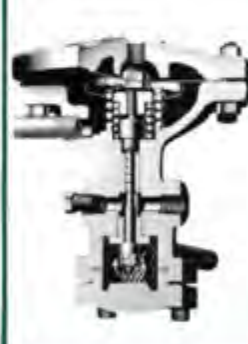
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## Energy Cost Savings Through Planned Maintenance and CAMM

by Christopher A. Kliesmet

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	YTD WO INHOUSE	TOTAL WO INHOUSE	YTD WO	TOT WO	YTD HOURS DOWNTIME	TOT HOURS DOWNTIME
PM	000	0000	000	0000	00000.0	00000.0
REPAIR	002	0002	002	0002	00000.0	00000.0
FAILURE	--N/A--	--N/A--	002	0002	00002.6	00002.6

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A program of planned maintenance can result in substantial cost savings, particularly in the area of energy.

This is the major conclusion resulting from a survey conducted by Johnson Controls in cooperation with the Association of Physical Plant Administrators of Universities and Colleges (APPA) and its members.

This article examines these survey results in detail and discusses how energy savings such as those indicated in the survey can be achieved. In addition, we will consider ways in which a computer-aided maintenance management (CAMM) system can be used to enhance these savings in energy and other areas.

### Survey Background

The purpose of the survey was to determine the perception of planned maintenance among APPA members in terms of usage, effect on expenditures, and areas where savings are most apparent. The survey was implemented by an independent market research firm, which sent questionnaires to 1,300 APPA member institutions in early 1985. To encourage maximum participation among potential respondents, the questionnaires were restricted to one page and designed to require primarily check-off answers. A response of 260 replies, or 20 percent, was anticipated.

### Survey Results

A response of 330 usable returns (25.4 percent) was achieved, ensuring that the sample was representative of APPA membership. Following is a list of survey questions and analyses of the replies.

**Question 1: Do you own, operate, or manage any buildings?** This question was a qualifier. A positive response was required for a respondent to be included in the survey.

**Question 2: What types of buildings?** As expected, large numbers of schools, colleges, and universities were indicated. Surprisingly large numbers of other types of buildings were also indicated.

**Question 3: Total square footage of buildings?** There was a broad range of facility sizes, with the average facility being just under 2 million sq. ft.

**Question 4: Size of maintenance staff?** On the average, survey respondents employed 105.6 full-time maintenance personnel and 15.3 part-time employees who accounted for a total of 19,666 work-hours per month. This total is credible if it is considered that full-time personnel normally would account for 168 hours per employee or 17,741 full-time work-hours (105.6 ×



168) per month, leaving 125.8 hours per employee or 1,925 work-hours ( $15.3 \times 125.8$ ) of part-time work per month. These latter work-hours could also consist of overtime rather than part-time work.

**Question 5: Size of maintenance budget?** The average budget was \$2.3 million per year. Comparing this to the average building size results in an average expenditure of \$1.20 per sq. ft. for building maintenance. This is comparable to the 1984 BOMA Experience Exchange Report figure of \$1.15 per sq. ft.

**Question 6: Over or under budget?** More than two-thirds (67.7 percent) of respondents indicated that they were over budget while only 22.3 percent were under budget.

**Question 7: Type of maintenance activity?** Respondents were asked to indicate which of the following forms of maintenance activity took place in their facilities (more than one form of activity could be selected). The following breakdown resulted:

- 48.3%—Repairs only as needed.
- 63.1%—Planned maintenance—  
in-house manual.
- 31.1%—Planned maintenance—  
in-house computer-aided.
- 28.4%—Contracted to outside firm.

It is significant to note that less than one-third of the respondents indicated that they operated a CAMM system.

**Question 8: Have you seen savings attributable to planned maintenance?** More than three-quarters (76.1 percent) indicated "yes" to this question. Their average savings observed was 9.8 percent of budget. Based on the average annual budget figure of \$2.3 million, this indicates savings of about \$225,000 a year.

### Cost Savings by Category

The next step was to determine specific cost savings in each of the following ten categories:

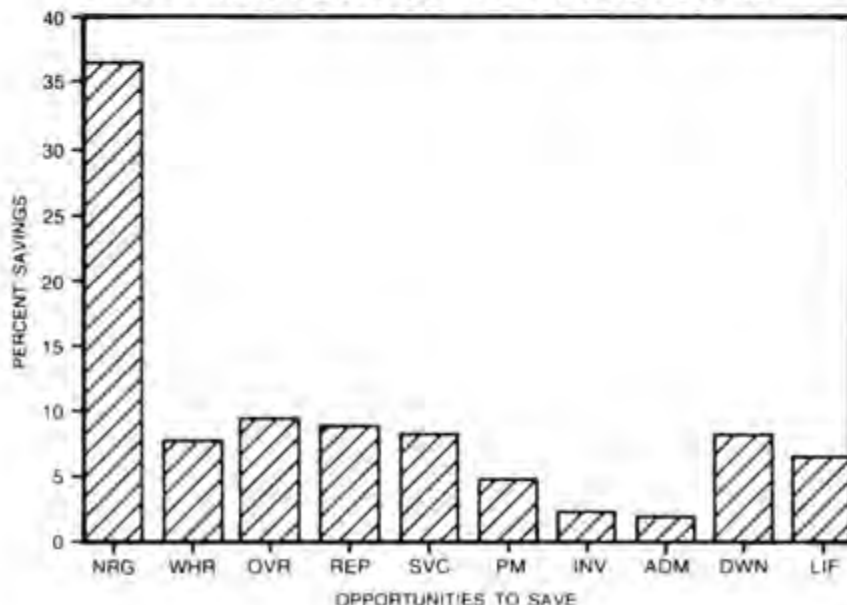
- NRG—Energy savings.
- WHR—Work-hour reductions.
- OVR—Overtime reductions.
- REP—Repair rate reductions.
- SVC—Service call reductions.
- PM—Planned maintenance cost reductions.
- INV—Reduced maintenance material inventory.
- ADM—Reduction in administrative costs.
- DWN—Reduced equipment downtime.
- LIF—Increased equipment lifetime.

Figure 1 shows the distribution of planned maintenance savings as perceived by respondents. Clearly, the

single most significant cost reduction was attributed to energy savings, which accounted for 37 percent of total savings. Personnel-related savings, including work-hour, overtime, and administrative costs, represented another 19 percent. Equipment-oriented savings as a result of increased equipment lifetime and reductions in service calls, repair rates, and equipment downtime contributed 32 percent. Remaining savings were attributed to reductions in material inventory and planned maintenance costs.

Figure 2 shows the distribution of planned maintenance savings in terms of the percentage of respondents who achieved each type of savings. Energy once again leads, with other categories following in the same basic order of importance as in Figure 1.

**FIGURE 1  
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### Survey Conclusions

Various conclusions can be reached as a result of the responses:

- A majority of the respondents uses some form of planned maintenance with manual systems being used by close to two-thirds and CAMM systems being used by less than one-third.

- More than three-quarters of respondents perceive significant savings resulting from the use of planned maintenance.

- These savings average about 10 percent of facility maintenance budgets.

- Energy savings are far and away the most important of all savings resulting from planned maintenance activities.

- Equipment-related savings run a respectable second and, combined with energy savings, comprise the bulk of all savings.

These survey results provide useful insights into the application of planned maintenance. In particular, the finding that planned maintenance can serve as a powerful energy management tool is of great interest, although most should not find this surprising. In any event,

the prospect of achieving energy savings through planned maintenance bears further investigation.

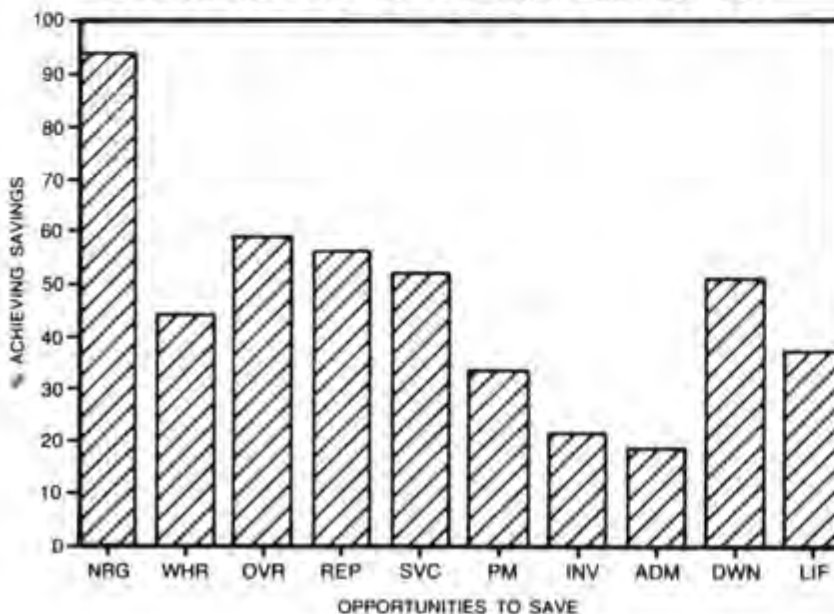
### How Planned Maintenance Creates Energy Savings

The survey results strongly indicate that substantial energy savings can be realized by applying some form of planned maintenance in a facility. This fact is well known to major suppliers of energy management systems (EMS) who frequently contract to make repairs to HVAC equipment before bringing a new system on-line. Furthermore, in every instance where an EMS supplier guarantees energy savings, some type of maintenance package is included as part of the contract.

The point is obvious. No energy management system, regardless of its sophistication, can produce maximum energy savings if HVAC equipment is not properly maintained. Following are examples of problems that can result in increased costs if maintenance is not adequately performed. Note that these problems are oftentimes difficult to detect and provide no warning of impending failure. Consequently, the only way to eliminate them is through a program of planned maintenance based on the use of an effective maintenance management system.

**Filters and Coils** Dirty filters and coils in air handling units impede air flow in variable air volume systems, resulting in energy loss as fans work harder to deliver the required volume of air. Consider the following example in which dirty filters in an air handling unit cause an increase in total static pressure (TSP) of 0.5", resulting in a penalty or need for 10 additional horse-

**FIGURE 2  
DISTRIBUTION OF PM SAVINGS**





power (HP) to achieve the same air flow:

- 90,000 CFM @ 5.0" TSP = 95 HP
- 90,000 CFM @ 5.5" TSP = 105 HP
- 10 HP Penalty
- $10 \text{ HP} \times .746 \text{ KW/HP} \times 8,760 \text{ HRS/YR} = 63,350 \text{ KWH/YR}$

Assuming operation 24 hours a day, seven days a week, this results in an energy loss of 63,350 KWH/YR. Based on a cost of 2.2 cents/KWH, one of the lowest KWH rates available, this results in an additional expenditure of \$1,440 per year in one air handling unit. This figure, multiplied by the number of air handling units in a facility, illustrates that this one problem can cause a major economic loss.

Steam traps are another critical factor in heating coils. A rule of thumb used is that 20 to 30 percent of all steam traps in a facility may be defective if not properly maintained. Faulty traps are such a problem from the standpoint of wasted steam that they prompted a major study by the Minnesota Department of Energy and Economic Development. This study demonstrated a worst-case payback of 2.7 years to repair all defective steam traps in state-owned buildings. Consider the following example of wasted steam in a defective steam trap:

- A defective steam trap with 0.25-in. orifice and 10-PSI inlet pressure can pass 44.6 LBS of steam per hour.
- Based on a standard cost of \$10/1,000 LBS of steam, this results in a loss of:
  - $44.6 \text{ LBS/HR} \times 24 \text{ HRS} \times 30 \text{ DAYS/MO} = 32,112 \text{ LBS/MO}$
  - $32,112 \text{ LBS/MO} \times \$10/1,000 \text{ LBS} = \$321.12/\text{MO}$

This is a significant amount of energy to lose on a monthly basis, but it is only a small part of the story. In the Minnesota study, for example, 31 percent of all traps were found to be defective, resulting in a total monthly cost of more than \$29,000 in one facility.

**Cooling Systems** The major components of cooling systems, including compressors, condensers, and cooling towers, are all candidates for energy losses and failures due to neglected maintenance. Perhaps the most catastrophic failures occur to compressors. Most of these failures can be averted through routine maintenance.

One of the most insidious methods of destroying a chiller is through refrigerant contamination. Condensor tubes, which are either corroded by poor or non-existent water treatment or worn through by poorly-fitted support sheets, allow water to mix with freon, forming acids that literally eat the chiller from the inside out. Eddy current testing performed every several years can detect such failures and eliminate tens of thousands of dollars of capital equipment costs and countless losses incurred by chiller downtime.

Even procedures as simple as periodically testing the oil pressure switch can prevent catastrophic mechanical failures due to insufficient lubrication. In areas where freeze damage is a concern, it is necessary to check flow switches, low refrigerant cut-off switches, and low-suction pressure cut-off switches for proper settings and operation. Easy-to-perform maintenance practices such as these can result in considerable cost savings.

Condensor tube fouling is one of the more common problems causing energy losses in a chiller. Small particulate matter fills tube fins, decreasing heat

transfer. Consider this example:

- A 300-ton centrifugal chiller normally operates under a full load of 244 KW.
- A .012-in. scale increases KW requirements by 11% to 274 KW, resulting in a 30-KW penalty. This results in waste of:
  - $30 \text{ KW/HR} \times .6 \text{ Load Factor} \times 2,100 \text{ HRS/YR} = 37,800 \text{ KWH/YR}$

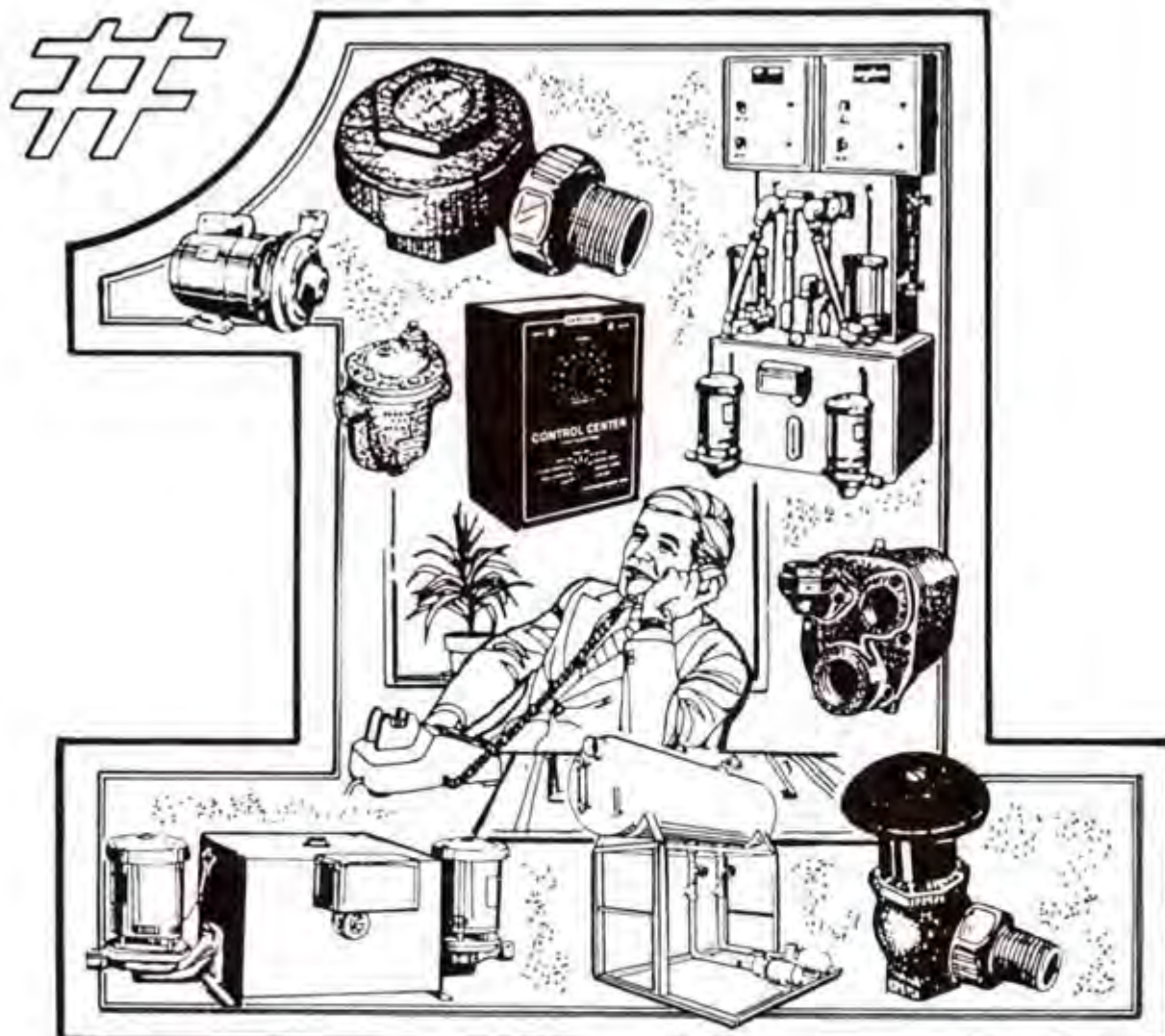
A dirty cooling tower can also cause significant energy losses. Consider this example in which a dirty tower increases leaving condensor water (LCW) temperature by 2.5 degrees:

- Full Load = 244 KW @ 300 TONS @ 95.0° LCW = .813 KW/TON normal
- Full Load = 244 KW @ 283 TONS @ 97.5° LCW = .862 KW/TON dirty
- $300 \text{ TONS} \times .049 \text{ KW/TON Loss} = 14.7 \text{ KW Penalty}$
- $14.7 \text{ KW/HR} \times .6 \text{ Load Factor} \times 2,100 \text{ HRS/YR} = 18,522 \text{ KWH/YR}$

**Heating Systems** One of the major methods of saving fuel and energy in boilers is through the use of routine combustion analysis. In theory, the combustion of oil, gas, or coal requires a certain fuel/oxygen ratio for complete burning and maximum efficiency. The quantity of air that ensures complete combustion must therefore be optimum. If too little air is used, fuel is not burned. But, since air is actually a mixture of roughly 20 percent oxygen to 80 percent non-combustible gases, it is also important not to use too much air. This is because the rate of heat transfer to the boiler is decreased as non-combustible gases take part of the heat to the stack where it is lost to the atmosphere. In addition, there are many other areas in which proper maintenance can improve heating system efficiency while decreasing energy consumption.



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**Lighting** Lighting can typically account for 30 to 50 percent of the energy cost of a facility. As in traditional energy management, there are fundamental maintenance procedures that are necessary to ensure that lighting control systems utilize energy efficiently.

According to the Illuminating Engineering Society of North America's 1984 *IES Lighting Handbook*, loss of light due to the accumulation of dirt on fixtures is one of the most significant factors contributing to lamp inefficiency. When fixtures are not properly cleaned, light output can be reduced by as much as 40 percent. In addition, room surface dirt reduces reflected light and can actually reduce light levels by 17 percent.

Finally, lamps themselves suffer lumen depreciation. A typical fluorescent tube does not maintain a constant output before burnout. After a certain point in a lamp's life it becomes more economical to replace the lamp rather than wait for burnout.

Furthermore, besides obvious energy savings, researchers are beginning to determine the detrimental effects of improper lighting on productivity. These losses could prove to be even more significant than energy-related losses.

There are many other examples that could be cited to indicate the importance of effective maintenance management. Following is a discussion of maintenance management with emphasis on the contribution that CAMM can make in achieving the best possible results in terms of energy and other cost savings.

### Maintenance Management

Maintenance management can be enhanced through the use of computers as a tool. However, care should be taken not to approach computers on the basis of their glitter appeal alone. The operative word is tool. Computers do not replace managers or perform maintenance. But they do make it possible to better manage a facility's maintenance requirements as an integral part of a CAMM system.

A CAMM system must have the "guts" to handle the rigorous task of "true" maintenance management. Properly selected and applied CAMM systems can greatly improve the image of maintenance in general. By organizing maintenance activities, streamlining operations, and providing numerous

insights into a facility, a CAMM system brings ultimate credibility to the maintenance discipline by documenting and filing all pertinent maintenance information. This information can then be recalled to provide detailed reports on equipment conditions and reasons for maintenance decisions.

Selection of a CAMM system requires a clearly defined maintenance philosophy and goals. However, these are the same philosophy and goals that should form the basis of any maintenance management system, regardless of whether it is operated manually or with a computer.

PM WORK NOT COMPLETED							PAGE 6
PLANT: MAIN FACILITY							
BLDG: PLANT 1							
SYSTEM: GROUNDS							
LEVEL OF SERVICE: ANNUAL							
TOT	YTD	YTD PM	YTD	YTD PM	YTD PM		
DAYS	DAYS	WORK	STD	WORK	STD		
LATE	LATE	ORDERS	HOURS	ORDERS	HOURS		
		CANCELLED	CANCELLED	NOT	NOT	COMPONENT ID	
				ISSUED	ISSUED	KTREFCOMP0001	
99	99	1	2.0	0	0		
99	99	1	2.0	0	0		TOTALS BY LOS

Sample PM Work Not Complete Report Printout

MASTER EQUIPMENT RECORD AS OF: 6/31/89							
COMP ID:	KT-REF-COMP-0001	PROP ID:	05	COMP:		OFF: 001	
	INHOUSE	TOTAL	ACTUAL	STD/EST			
	COST	COST	HOURS	HOURS			
YTD PM	0000000	0000000	000000.0	000000.0			
TOT PM	0000000	0000000	000000.0	000000.0			
YTD REPAIR	0000384	0000384	000006.5	000003.5			
TOT REPAIR	0000384	0000384	000006.5	000003.5			
	YTD WD	TOTAL WD	YTD	TOT	YTD HOURS	TOT HOURS	
	INHOUSE	INHOUSE	WD	WD	DOAMTIME	DOAMTIME	
PM	000	0000	000	0000	00000.0	00000.0	
REPAIR	002	0002	002	0002	00000.0	00000.0	
FAILURE	N/A	N/A	002	0002	00002.6	00002.6	
PRESS RETURN TO CONTINUE OR ENTER (X) TO EXIT ( )							

Sample Master Equipment Report Printout

REPAIR COST ANALYSIS FOR UNITS GREATER THAN 005 % OF PURCHASE PRICE						
SITE: MAIN FACILITY						
SYSTEM: HEATING						
REPORT DATE: 10/19/83						
PMID: FMCW						
COMP ID: HTAHFMC0001		DESC: FAN COIL UNIT (WINDOW)				
MANUFACTURER: AMERICAN STANDARD		MODEL NO:		WVCS 01		
START EQUIP	HOURS	PURCHASE PRICE	REPAIR COSTS	% OF PURCHASE PRICE		
DATE INSTALLED	OPERATIONAL	PRICE	COSTS	PRICE		
8/30/82	8/30/85	000000	00000378	0000038	010	
PMID: MOTRI						
COMP ID: HTN02MOTR0001		DESC: BOILER FEED MOTOR				
MANUFACTURER: BURLICK		MODEL NO: BURLICK 9622XC1				
START EQUIP	HOURS	PURCHASE PRICE	REPAIR COSTS	% OF PURCHASE PRICE		
DATE INSTALLED	OPERATIONAL	PRICE	COSTS	PRICE		
8/30/81	8/21/81	000252	00000550	0000748	136	

Sample Repair Costs Report Printout

### Philosophy and Goals

A comprehensive planning philosophy is required if CAMM is to achieve the goals of improved maintenance operations and reduced costs. This is because maintenance management, by definition, deals with continuing changes in equipment conditions. It also constantly interacts with people. As a result, maintenance management is a dynamic discipline that requires careful planning if maximum effectiveness is to be achieved.

There is little difference between maintenance management and other forms of management. All use the fundamental iterative management process, which consists of four steps. For maintenance management these steps are: 1) inventorying facility equipment and resources; 2) determining what is to be done from the standpoint of maintenance practices and procedures; 3) keeping histories of all activities and occurrences and analyzing results; and 4) making changes to continually improve maintenance operations, based on the analyses.

Computers are an effective tool for implementing any iterative management process. CAMM can be implemented in several ways. One involves running CAMM on a stand-alone microcomputer in the maintenance department. Another involves integrating it with a building automation system (BAS). Finally, it can be operated on a system in the data processing department.

Most maintenance managers want proprietary, "hands-on" control of CAMM and do not want to rely on personnel and systems outside the maintenance department for its operation. This eliminates the use of a system in the data processing department as an alternative.

Integration with a BAS is a more viable possibility. But a BAS involves realtime processing, while maintenance management is a batch-oriented operation. As a result, this approach requires paying a premium for high-cost, realtime BAS storage that is not necessary. The most economical, as well as effective approach, is to run CAMM on a proprietary microcomputer installed in the maintenance department but still interfaced with the BAS.

CAMM consists of four distinct components: 1) generation of planned maintenance work orders; 2) generation of repair work orders; 3) an equipment

data base; and 4) a maintenance history data base. Each of these components contributes to the iterative management process and to providing sophisticated CAMM features.

### How CAMM Works

The equipment and maintenance history data bases contribute to steps 1 and 2 of the iterative process by making it possible to compile critical information about equipment and procedures. Based on this information, the data bases are used to create an initial maintenance schedule.

Normally, the data bases are structured to permit a phased installation. This means that users need to enter only a small portion of the data base initially. Then, as the need for more sophisticated data arises, additional information is added.

This eliminates the "computer shock" that is sometimes experienced when a CAMM system totally replaces a manual system. Phased installation provides users with an opportunity to become comfortable with the system in small, easily digested portions. Installing a system in phases, in effect, results in maximum comprehensiveness, flexibility, and effectiveness.

Once data bases are installed, CAMM is used to issue planned maintenance and repair work orders. Planned maintenance work orders are issued on a calendar basis while repair orders are created on an "as requested" basis. Using a BAS interface, planned maintenance work orders can be based on actual equipment runtimes rather than the calendar, while repair work orders can be generated in response to off-normal conditions rather than obvious breakdowns.

Although work order generation is the heart of any CAMM system, it is not the soul. CAMM provides a capability for not only scheduling work but also analyzing, managing, and optimizing it. It is this capability that distinguishes CAMM from simple maintenance scheduling.

This leads to step 3 of the iterative process. The maintenance history data base contributes to this step by providing the raw data necessary to perform analyses. For this reason it is important that the maintenance history be as comprehensive and complete as possible.

Standard reports produced as part of this step should be supplemented by

the use of a custom report writer, which makes it possible to obtain data in situations where standard reports do not offer the required information in the desired format. This in-depth reporting capability is essential to the success of the iterative process.

Equally important is the ability to specify unique sort criteria for each report, regardless of whether it is standard or customized. This permits the production of clear, concise reports that can be used with maximum effectiveness in the crucial fourth step of the iterative process during which changes are made based on analyses.

For example, a failure analysis listing all failures over a six-month period is difficult to use if the information actually needed consists of the number and frequency of fan failures in a particular building. The capability to automatically sort this information out is therefore of critical importance if a CAMM system is to maximize the ability to effectively manage and optimize maintenance operations.

### Conclusion

Maintenance management systems are growing in importance today as a way of improving operations while reducing costs. This is supported by the average cost reduction of \$225,000 as a result of planned maintenance reported in the survey of APPA member institutions. Similar reductions, of course, cannot be achieved in every case but they do indicate the magnitude of savings possible.

CAMM can play a major role in energy conservation and should be an integral part of any future or existing energy management or building automation system. In contrast to maintenance scheduling, true CAMM systems provide a creative environment in which the iterative management process can occur. By emphasizing maintenance history, CAMM systems provide useful information in the form of clear, concise reports. The value of these reports is further increased by the ability to sort specific information according to user-defined criteria. For all of these reasons, the use of CAMM will be increasing significantly in coming years. ■



## Establishing Values With Pride

by Robert Saltonstall, Jr.

**W**hat do you do if you have just taken your area of responsibility through a major reorganization and now want to reformulate and hammer home values that will strengthen and unify the department? This is the problem I faced at Harvard University recently, and the solution we developed should be interesting to any executive faced with the need to reinforce and communicate basic core values.

*Robert Saltonstall is associate vice president for operations at Harvard University, Cambridge, Massachusetts.*

I was pleased with the early results from our significant reorganization but felt challenged to improve morale and communications even more. I wanted to know my new team better and felt they'd benefit from knowing me better. I suspected they needed to know one another better as well. I sought a way to focus our individual and group efforts but was reluctant to interfere in decisions. I wondered how to translate our early successes into permanent change. Would my efforts to accomplish this be realized? Yes, I was impatient, but I also saw an opportunity whose time seemed right, and maybe the timing would never be as good again.

### The Reorganization

The Facilities Maintenance Department at Harvard had just completed two years of constant change prompted by voluminous complaints from the faculty about lack of service, poor quality, high cost, low sensitivity, and inadequate accounting. The department is responsible for maintenance and operation of about 300 buildings composing nearly 17 million square feet and related grounds on four different campuses all located in the same urban environment. The annual budget approaches \$60 million, all of which is billed service-by-service to the various faculties.

During the reorganization some 100

*The author, left, leads Harvard University's recent management development program.*



of 400 trades-related employees (seventy-five wage, twenty management, and five clerical) left the university or the department, and many others were now in relatively new jobs or at least adapting to new situations and attitudes. Significant to the reorganization was a move away from centralized decision making by the department's executives to decentralized responsibility and authority.

Instead of serving all of Harvard from three geographic centers tightly con-

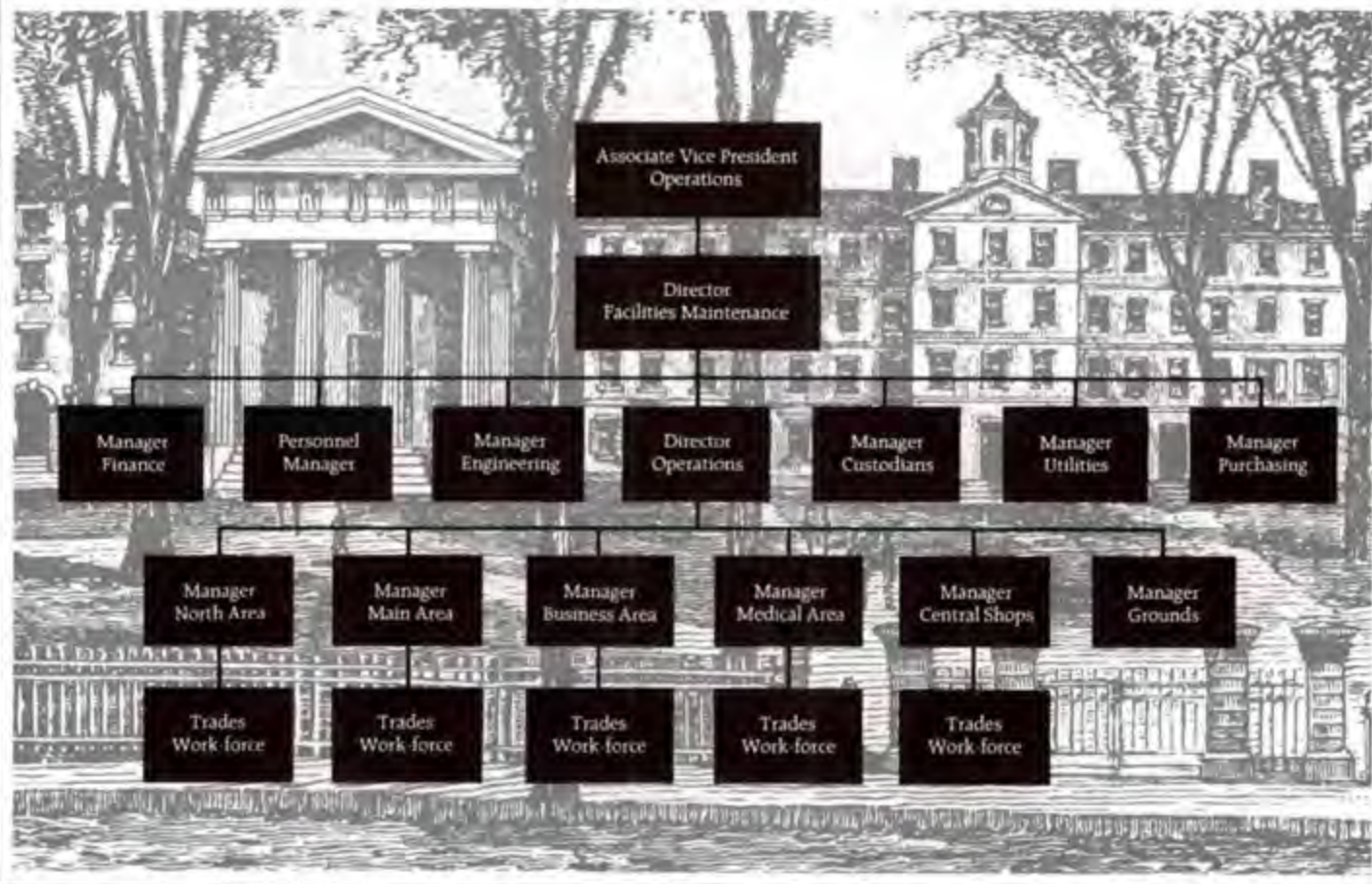
trolled by one executive, the campus was divided into ten six-to-eight-person teams with working supervision and looser control by one of six executives. The small groups were charged to develop a much higher respect for and co-operation with the faculties and departments in their geographic area. They were urged to develop operating procedures appropriate to the local situation, and most department policies were abandoned.

The structure of these changes is

shown before and after in the attached organization charts (Figure 1). A quick glance will indicate three executive positions were eliminated. But more important, the charts illustrate that the area managers before the change reported to two executives before reaching the associate vice president, whereas after the change they reported directly to the associate vice president.

Conversely, staff and various central services lost their prominent position before the reorganization and became

**Figure 1**  
**Organization Chart Before**





centralized under one associate director after the changes. This structural change was important to reinforcing the new philosophy that the department existed primarily to serve the maintenance needs of the faculties. The internal staff needed to learn to support the department's maintenance services specifically, *not* to dictate these services.

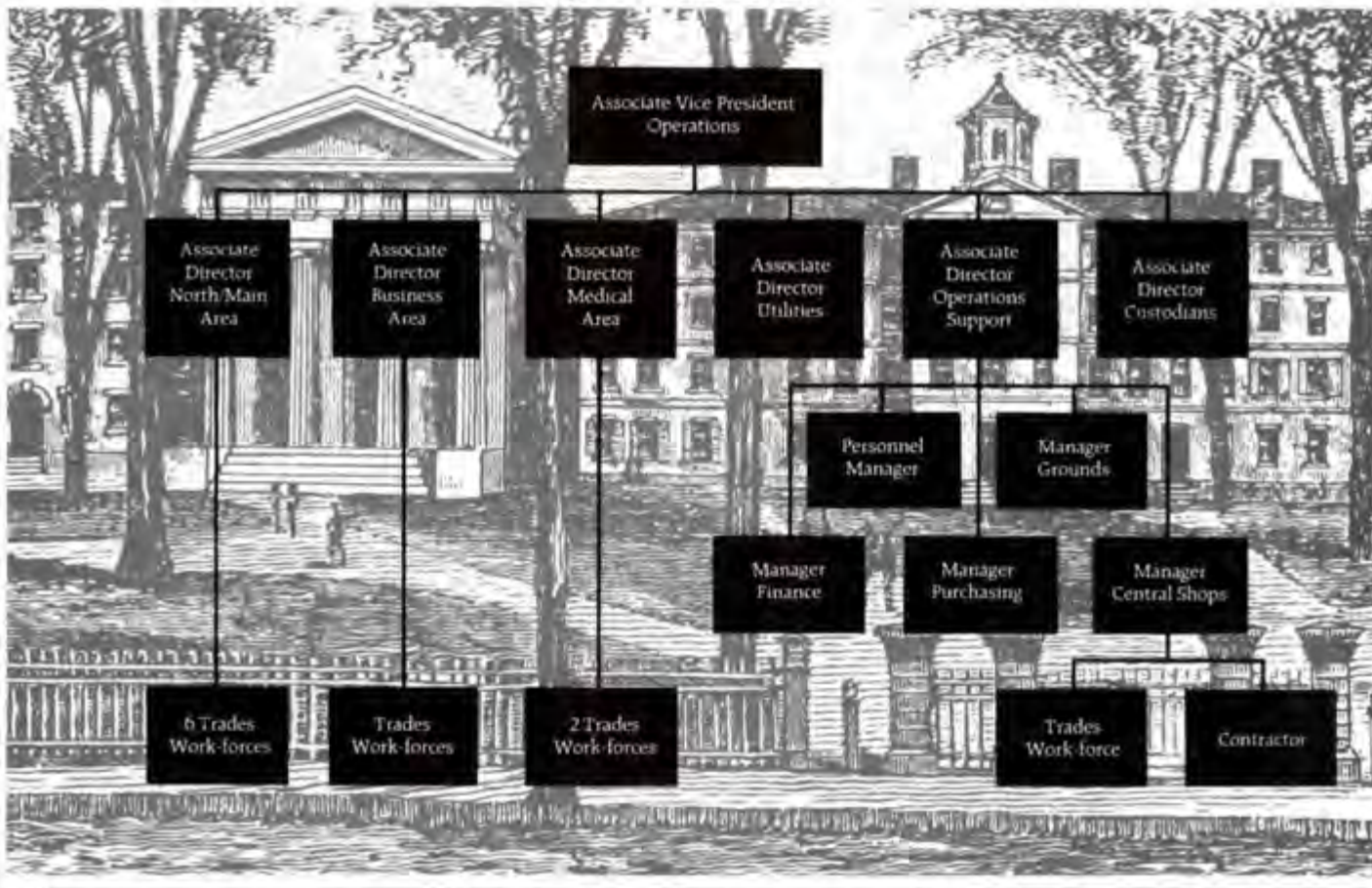
I had instigated these changes, having come to the university a year earlier in the newly created post of associate vice president for operations, and executed

most of them in close cooperation with Harvard's director of administration and employee relations and a faculty committee of facilities' deans. The reorganization itself, coupled with the philosophy behind it, required new thinking for all management personnel. The early stages of this were successful, and we were pleased with our efforts and the department's response to the new situation, but we also sensed the change should not stop yet. After devoting six months to an in-house, casually exe-

cuted development program called PROUD, Facilities Maintenance dug deeper and successfully adapted Zenger-Miller's *Toward Excellence*<sup>1</sup> management development program to accomplish continuing and deeper attitudinal change. Why Harvard selected the program, how Facilities Maintenance adapted it to our situation, and the

<sup>1</sup>*Toward Excellence*, copyright 1983 by Thomas J. Peters and Zenger-Miller, Inc., Palo Alto, California 94301.

**Figure 1**  
**Organization Chart After**



successes we've noted may interest readers.

### Why Toward Excellence?

*Toward Excellence* is a nicely packaged, well-structured management development program featuring Tom Peters, coauthor of the best-selling book *In Search of Excellence*. It develops five subjects using fifteen "mundane" management characteristics of successful companies (see Figure 2). Each receives two to four pages of text, a ten to fifteen minute video piece with Peters, a four-question evaluation of your own organization, six to twelve probing questions for discussion, and a methodology for encouraging quick action. Anyone who knows the book will quickly recognize the basic content. However, the particular program Harvard selected is less important than the fact that the material and the spirit and tone of its presentation matched nicely with Harvard's needs.

For example, coming out of reorganization in a complex institution, Facilities Maintenance wanted to simplify procedures and encourage action to satisfy faculty needs. The program material forced constant discussion of both throughout. We needed to improve

morale and encourage participation from all organization levels, and the program urged involvement of all participants both during the sessions and afterwards on the job. The department was eager to focus its individual and group efforts without much hierarchical decision making, and *Toward Excellence* consistently asked participants for decisions regardless of their place in the organization.

But most of all, Harvard's Facilities Maintenance Department needed to talk about itself in its new environment, to identify its strengths and weaknesses, and to understand its clients.

sult even these negatives became assets once we had determined to move forward with real commitment to this development effort. Without this commitment executives should not anticipate success in developing or strengthening critical values.

### Adaptation Was Important

Harvard's Facilities Maintenance Department had identified its needs and found a way to address them, but we also "cut and fit" some to personalize our approach. Particular aspects of this added significantly to our success.

Zenger-Miller's program is designed

"Quite quickly clients . . . noticed action and change, and detected new levels of leadership."

Figure 2

### Peter's Mundane Characteristics

The mundane characteristics used in the program listed in the order Harvard used them are:

1. Fostering Individual Commitment
  - a) Delegating autonomy
  - b) Sharing information
  - c) Emphasizing training
  - d) Recognizing commitment
2. Getting Back in Touch
  - a) Managing by wandering around
  - b) Simplifying systems
  - c) Chunking
3. Existing for the Customer
  - a) Innovating with customers
  - b) Providing real and perceived service
  - c) Providing real and perceived quality
4. Taking Innovative Action
  - a) Encouraging experimentation
  - b) Sponsoring champions
  - c) Allowing skunkworks
5. Instilling Unique Values
  - a) Clarifying the core value
  - b) Using mundane tools

Zenger-Miller, publisher of *Toward Excellence*, recommends they be treated in the order 4, 2, 3, 1, 5.

The structure and content of the program made it easy to encourage exactly this. Because the program could be led by management, it was flexible enough to allow development of the personalities and desires of the leaders and the group alike, yet it forced enough continuity to accomplish its overall purpose. Certainly its consistency with Harvard's identified need was wonderfully helpful. Others using management development programs should seek similar consistency with their needs especially when treating the kinds of issues Harvard faced.

Of course, not everything seemed right about *Toward Excellence*. However, our concern about the business orientation of the material, that it had never been used in a university before, the time required to complete it, and the purchase cost of the program forced us to make a real commitment to think through the issues carefully and develop a sound strategy for using *Toward Excellence*. Our PROUD program had been too easy to execute and never developed any commitment or followup. As a re-

for a manager's use with those reporting directly to the manager. Harvard used it with its entire Facilities Maintenance Department management group of sixty divided into three random groups, and we encouraged everyone to participate with equal status. Although the groups developed different characteristics and followed different schedules, effectively everyone in management received the same material in the same way at the same time. I was interested that junior managers pressed hard on issues important to them and were successful in drawing new attention to these issues. I was also pleased that several times junior managers summarized discussions better than their superiors. This added considerable clout internally because of the volume of activity and the equality of the program.

It also added impact externally. Quite quickly clients knew what was going on, noticed action and change, and detected new levels of leadership, none of which characterized the old organization. By including everyone we seemed to eliminate the risk associated with



passing information from level to level in an organization. We also gained the involvement of the whole organization. I recommend including the entire management team for training of this sort.

I led the sessions alternately with the university's director of administration and employee relations so that each group had each of us for at least two full days. Although I made most of the critical decisions during the reorganization and continue to do so, implementation frequently involved the director of administration and employee relations.

Neither of us had had group leadership experience, and this created an environment in which everyone had equal access to the top to discuss how to manage better. It enabled all the managers to know their executives much better and vice versa. Both now feel more secure with one another and both understand each other's perspectives better, which was especially beneficial after reorganization. Having done it, I would say that having the boss lead such a program greatly enhances the probability of success.

Facilities Maintenance arranged the opening session to be an overnight away from Harvard. Then we scheduled one full day per month for each of the following four sessions and ended by entertaining participants and spouses at a reception and dinner attended by the president of Harvard. The overnight off-site was specifically intended as a reward, a way to warm up slowly, and a pace setter for the program, and it accomplished all three.

All-day meetings on-site, but away from everyone's office, permitted 100 percent attention to the subject matter, time to be thorough, and also time to deviate if called for. And the reception and dinner was designed not only to recognize the participants who graduated to excellence, but also to recognize the spouses who play such an important role behind-the-scenes during reorganizations and redevelopment. Others should develop their own logistics<sup>2</sup> suitable to their own situation, but these worked especially well for ours.

Relatively frequently we leaders adapted Zenger-Miller's discussion material closer to Harvard's environment.

We injected articles, stories, and examples that emphasized Harvard's surroundings, and we allowed the discussion to deviate such that each group could explore subjects especially important to it. This helped to make the material more useful and fun, but it also allowed the managers to probe their leaders and vice versa. There were discussions on the acceptability of and communication about future management changes, misunderstandings related to new labor classifications, and the merits of external contracting, to name a few topic areas. Interestingly, these tended not to be conclusive.

## Harvard's maintenance managers now understand that they are 'management,' and they actively participate in the 'system.'

Clearly both the structure and the flexibility of the material enhanced discussion, which helped to clarify many issues while also improving understanding and respect among all participants.

On various occasions the program leaders revealed their own failings or insecurities related to specific subjects, particular material, or existing or developing procedure or policy. This seemed to help everyone feel more a part of the organization's destiny and encouraged discussion on how the leader could do better another time. An example was a critique of how the associate vice president had mishandled a customer complaint. This led to a group agreement on how every individual regardless of status should react upon receipt of a complaint. Importantly, these situations revealed different thought processes, i.e., that no one in management is perfect, that everyone has conflicts, that we all try, and we all have a decent rationale for our actions. These discussions were important to

our success, and I would recommend this degree of openness to others.

Finally, the leaders tried hard to urge action subsequent to each session. This is called "next steps" in the *Toward Excellence* material, and the program has a good method for committing every participant to some early action. At the end of each session each participant committed himself or herself to a specific, small action that he or she would accomplish in the next two weeks. A third shift foreman planned to invite the campus newspaper to follow him on the job one evening, a purchasing agent wanted to speed payment to a

supplier, an accountant agreed to explain a new report to several managers, and a supervisor committed to try once more to show his superior why a certain decision was wrong.

The leaders kept their goals specific, timely, and manageable. I recall well the applause after each person in the first group of twenty announced their commitments to be executed in the next two weeks. No one present could miss the potential impact of these actions. Needless to say, this helped to involve everyone and focused attention on action, not just talk. I consider all these actions important to success in establishing critical values. Talk is not enough.

There is no question that Harvard is pleased it offered *Toward Excellence* to the management of its Facilities Maintenance Department. But part of our success was our adaptations: offering the program to everyone at once, urging the department's executives to be leaders in spite of their lack of facilitating expertise, scheduling the logistics care-

<sup>2</sup>This combination of scheduling permitted Harvard to complete the program for \$500/person, about half of which was program costs and half was meals, accommodations, etc.



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fully, letting the program examine the groups' issues, revealing the leaders' shortcomings, and prompting specific actions at the conclusion of each session. Anyone who purchases a management development program should be sure to adapt it to their needs and purpose.

## There Were Difficulties

In accomplishing this management development Harvard's Facilities Maintenance Department encountered only three real difficulties. Most significant was time, which itself had three elements. The first was the extra time required to think through every decision a little more carefully in the context of *Toward Excellence*. Everyone found themselves asking, "Have I communicated this well, am I executing it effectively in the eyes of my employees and my clients?" and so on. This of course was good and proved the program was working, but it added time to every decision. Second, those who were helping the leaders to key the material effectively and to follow up on all the actions spent a lot of extra time in meetings. Some high level managers were kind enough to go to all sessions, and that helped because it assured lower level managers that it was okay to spring into action. And third, the leaders and participants devoted at least five days to the sessions themselves and maybe at least that time again psyching up for them. Certainly time was an issue, but since the executive leaders made the biggest time commitment, everyone found it possible to add their own.

The second difficulty was that the department became increasingly perplexed as to how to handle all the ideas and issues that came up during the sessions. Rather quickly we realized that organizing or acting on it all would be an impossible task. With some misgivings we decided to specifically state that nothing would automatically be addressed. An issue should be raised again and forced to a conclusion by whomever felt it important. This seemed consistent with *Toward Excellence*, but it is too early to tell if it is a satisfactory solution. Anyone starting a similar program should prepare better for this issue than we did.

And thirdly, Facilities Maintenance has not yet resolved how to perpetuate the successes accomplished with the program. The managers want to continue to meet, and we are eager to com-

ply, but we have developed no material or specific plans at this time. We do expect to devote an additional day with top managers to further clarify the department's core values and expect the dissemination and understanding of those will become the basis for additional sessions with all managers. In addition, we certainly should reconvene at least annually to revisit our values. I feel we must do more but hope the focus and leadership will move down in the organization, getting the discussion still closer to the action.

These three difficulties derive as much from unexpected success than failure and so are really happy dilemmas for Harvard—challenges we look forward to facing.

## But Look at the Successes

The overriding success of the program was the three groups' ability to spell out what the critical values should be for the department. To develop these the leaders asked in the final session:

- a) What do you think our clients feel the department's critical values are?
- b) What do you think our operators and mechanics feel our values are?
- c) What do you think the associate vice president's values are?
- d) What do you think our values are now?
- e) What do you think our values should be in the future?

The answers came back easily with good insight and consistency as to where the department currently stands and where it is headed. I was especially pleased how easily the groups visualized my values. Harvard will further refine these, but the groups' ease in identifying them indicated awareness, understanding, and agreement as to what the values are now and should be. This was exciting because I'm sure it could not have happened six months earlier. Like Tom Peters, I am convinced that an organization that can readily state its critical values will be surprisingly successful in accomplishing them.

Also significant in terms of success was the increased understanding everyone developed about the mysterious "system" and undefined "management" that inhibit action in every organization. Harvard's maintenance managers now understand that they are "management," and they actively participate in the "system." If something is wrong they are each part of that wrong and responsible for making it



right. During the program managers learned in all kinds of ways they had far more influence than they ever thought. We very much hope to perpetuate that success. Any organization with bureaucratic tendencies would be proud to have managers such as we've developed.

In addition, everyone including the leaders came away knowing one another better. Almost everyone added some new successful actions to their career records. Some had a chance to shine, like the night shift supervisor who best summarized one day's discussion, and the second shift supervisor who unexpectedly gave his crew Thanksgiving turkeys as thanks for their continuing good work. Most everyone developed deeper understanding of various controversial decisions and sensitivities. Without question, communications did improve and should continue to do so.

These I attribute to our management development effort. Coincident with this, faculty complaints about lack of service, poor quality, high cost, low sensitivity, and inadequate accounting have truly gone away. When a complaint occurs now, the manager responsible directs immediate attention to it so that complaints are not requiring resolution by executives, now the faculties and Facilities Maintenance are actively discussing mutual opportunities for continuing improvement, and there is clearly mutual respect for one another's point of view present in these discussions.

This is an unusually successful example of reorganization supported by management development. The department's performance is significantly improved, management morale is better, and communications are smoother. We all know one another better, and I am confident we'll all focus our individual and group efforts more easily by agreeing on our basic values. And highly important is that we reached everyone to some degree and that real change has taken place.

#### Is There More We Can Do?

As the reader might have guessed, this success has whetted our department's appetite to go further. A staff (non-exempt) employees' development program has started with the urging of all the managers. The program was designed by a committee of staff personnel, and the schedule offers duplicate

times every month for each subject so that no office is depleted of staff all at once. Transportation is also provided to encourage participation. The early response to this has been outstanding.

The department is also committed to offering some similar development to wage personnel during fiscal year 1986. The purpose and implementation scheme are not defined, but we anticipate it will be a derivative of the critical values that are now in place. In fact, one sub-department has taken part of *Toward Excellence* to its total work force and is reporting good results. If our success continues all of Facilities Maintenance will be bursting with excellence one year from now.

No manager can abandon persistent pursuit of improvement, so even these projects will not be the end either. The *Toward Excellence* effort has contributed a lot in the last six months, and I am confident Facilities Maintenance is a much stronger organization for it.

#### Summary

This paper has highlighted how Harvard University's Facilities Maintenance Department has particularly strengthened itself after a difficult reorganization. Management clearly perceived a need and noted opportune timing. It was able to acquire a structured development program that uniquely fit its management philosophy, yet was easily adaptable to take on Harvard characteristics. And Harvard executed it with commitment, being careful to recognize needs unique to the situation.

Others should feel no special inclination toward Harvard's specific implementation, but you may be able to capitalize on some of the decisions made to bring improved understanding of critical values and better management to your physical plant departments. Don't feel you have to reorganize to start the process, because that's not fun. But do think about the strength of having your whole organization knowing and working against the same critical values. We believe it's worth a lot and urge others to develop an effort such as ours. We stand tall with pride for having done it ourselves! ■

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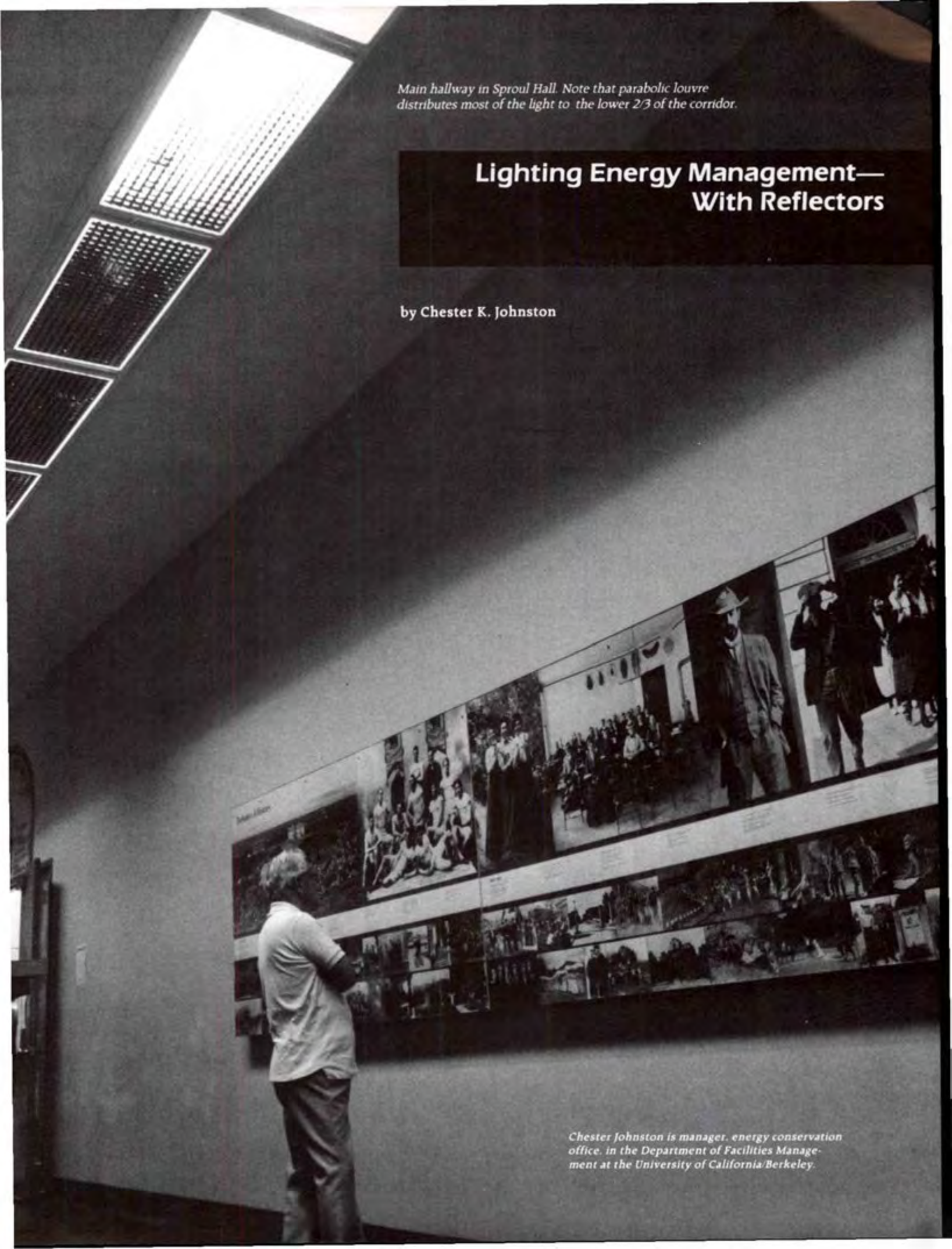
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*Main hallway in Sproul Hall. Note that parabolic louvre distributes most of the light to the lower 2/3 of the corridor.*

## Lighting Energy Management— With Reflectors

by Chester K. Johnston

*Chester Johnston is manager, energy conservation office, in the Department of Facilities Management at the University of California/Berkeley.*



The University of California/Berkeley's Energy Conservation Office (ECO) has begun a massive lighting retrofit program that will save more energy—and money—than any other conservation program conducted so far on campus. By installing special reflectors in fluorescent light fixtures, the ECO expects to cut its annual electricity bills by 10 million kilowatt-hours and \$700,000.

The ECO, a division of Cal's Department of Facilities Management, has already cut campus energy consumption by 20 percent since 1974 by replacing incandescent bulbs with fluorescent tubes, removing excess fluorescent lamps, and operating a computerized energy management control system that selectively shuts heating and ventilating machinery at night and on weekends. Installing light reflectors is a relatively new conservation strategy, but the ECO wanted to give it a try.

In November 1983 the ECO installed a test system in room 306 Lewis Hall, a typical chemistry laboratory full of benches, sinks, chemical racks, and fume hoods. Fifteen three-tube fluorescent fixtures lit the room. They had white porcelain reflectors, no lenses, and were equipped with pre-heat ballasts.

Each fixture received an energy-efficient, rapid-start ballast and two energy-saver lamps. One lamp was removed completely. Since the fixtures' electrical use (and subsequent light output) would be cut in half, a silver reflector installed behind the lamps would make up the difference. This custom-designed aluminum sheet was mounted with sheet metal screws to the existing ballast housing.

The results were impressive: the lamps used 57 percent less energy and gave from 14 to 19 percent more light. After eighteen months the lamps seemed to be degrading no faster than their less efficient predecessors.

UCB purchased a silver optical reflector using a 1.5 mil specular silver film, which is bonded to a separate aluminum substrate. As one reflector manufacturer says, "The film is an optically clear polyester similar to the type in use on over two billion square feet of windows in the United States. Elemental silver is impregnated into the back of the polyester, which is DuPont Mylar. This surface is then coated with a pressure-sensitive adhesive which is protected by a plastic overlay until the lamination

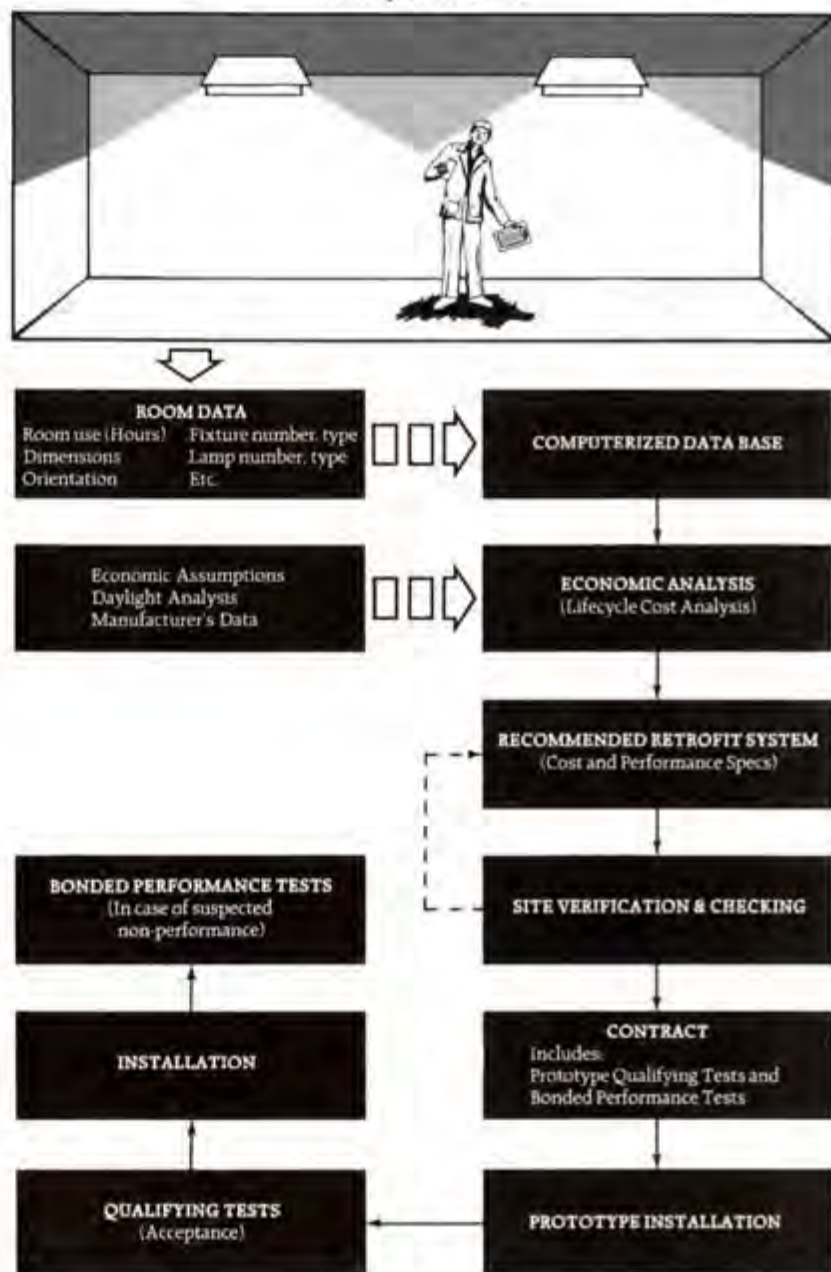


Close-up of fixtures in 306 Lewis Hall with silver reflector. Note the two lamps and four reflected lamp images.



Close-up of Sproul Hall fixture with silver reflector and parabolic louvre.

**FIGURE A**  
**UCB RETROFIT LIGHTING EFFICIENCY IMPROVEMENT PROGRAM**  
Survey Flow Chart





process (onto aluminum) is completed. The finished film is semi-opaque. There is no chance of oxidation since the silver is sealed from any exposure to the air."

The reflectors enable the fixtures to provide 65 to 90 percent of their original light output with one-half fewer lamps, or 85 to 100+ percent light output with one-third less lamps. The reflectors are expected to last as long as the fixtures; their acrylic surface will keep the silver from deteriorating, and the wipe of a cloth will keep them clean. However, not all fixtures or building areas are suitable for reflectors.

The question of UL listing or labeling always comes up because of the potential fire hazard and possible insurance avoidance. One manufacturer presently utilizes three UL labels for its reflectors. One concerns the fire hazards of the plastic laminate, the second concerns assembly procedures when reflectors are added to fixtures in the manufacturing plant, and the third concerns field installation procedures (e.g., required types of mounting hardware).

Fire marshals in numerous locations have also given their approval to projects. Consult your local fire marshals about the effect on fire ratings, insurance premiums, and coverage. Also, the original UL label on a fixture is concerned primarily with heat production by the ballast(s). Adding a reflector in no way negatively affects this. (If anything there is an improvement, because one ballast is disconnected.)

Cal was one of the first institutions to use reflector retrofit technology and in 1984 won a \$2,500 prize from the National Association of College and University Business Officers/United States Steel Foundation for this innovative project. The money helped ECO engineers retrofit forty-three more fixtures in Sproul Hall, the university's central administration building.

So far, the ECO has installed a total of 378 silver reflectors in five buildings and expect annual savings from \$24 to \$40 per fixture. Since the retrofit costs from \$60 to \$90 per fixture, the new system should pay for itself in less than three years.

The ECO is also testing anodized aluminum reflectors in Barrows Hall and have installed 120 in classrooms there.

While silver reflectors must be laminated, aluminum is reflectorized by



Aluminum reflector III cross section.

**Table 1**  
**Before and After Data (Also 18 Months Later)\***  
Room 306 Lewis—Fixture Retrofit with Silver Laminated Reflectors

Ballast	Lamps	Fixture Input Watts	Power Factor	Illumination levels, footcandles	
				Under Fixtures	Between Fixtures
Before: Preheat	3-F40WW	170	95.5%	58	54
					(with 3 lamps)
G.E. #89G776	(40 Watts each)			40	39
					(with 2 lamps)
After: Rapid Start	2-F40WW/E	75	97.5%	66	64
					(with 2 lamps)
G.E. #8G1024	(34 Watts each)				
Net Change:	- 1 (- 33%)	95 Watts (- 57%)	+ 2.0%	+ 8 fc (+ 13.8%)	+ 10 fc (+ 18.5%)
*18 MONTHS LATER:					
	Before relamping:			55 fc	51 fc
	After relamping:			65 fc	60 fc

**Table 2**  
**Sproul Hall First Floor Corridor**

Location:	Sproul Hall
Fixtures:	Number & Type: 41 2-lamp fluorescent; 8 300w-incandescent
Reflectors:	Silver Laminate
Ballasts:	New energy efficient core and coil type with current limiters to reduce wattage by 50%
Lens:	New parabolic louvers to replace old opal lens
Other:	Replaced eight 300w incandescent lamps with 44w fluorescent lamps
Illumination Levels:	Before: 17 fc Average After: 22 fc Average
Estimated Energy Reduction:	82 watts per fixture (avg) 718 Kwh/yr per fixture 54 \$/yr per fixture (\$.075/Kwh) 8760 operating hours per year
Installed Cost:	\$5,800 (\$2,700 contract + \$3,100 in-house costs) \$118 per fixture*
Payback Period:	2.2 years

\*Per Fixture Cost Explanation: The unit cost is much higher than other reflector projects due to the use of a more expensive parabolic light diffuser to replace the original opal lens. This added about \$40 per fixture to the project cost.



anodizing, a three-stage electronic and mechanical process. First, coils of flat aluminum are unwound, then directed over and under a series of rolls into tanks containing etching, cleaning, and rinse solutions. According to one manufacturer, "The anodizing itself occurs when aluminum (the anode) is made the positive terminal of a direct current, electrical circuit. After pre-treatment, it is immersed into an electrolytic bath, usually of dilute sulfuric acid." Electric current in the bath causes the aluminum to collect oxygen molecules, and metallic aluminum is converted to aluminum oxide. This aluminum oxide film "grows" into the metal. It has millions of microscopic pores; when these are sealed, the aluminum is ready to be cut and shaped into reflectors. For those interested in researching the above process more thoroughly, write to Kingston Industries Corporation at Sullivan International Airport, Kingston Way, White Lake, New York 12789. They manufacture the polished aluminum sheets or coils.

Both anodized aluminum and silver laminate reflectors are formed on computer operated brakes (a machine for bending metal sheets), which offers precision bending and a high production rate. Electronic computer programming also helps keep the reflector price reasonable.

ECO engineers inspected the silver reflectors in room 306 Lewis Hall on July 1, 1985 and found bubbles forming on their plastic laminate, just above the fluorescent tubes. These are allegedly caused by heat generated from the tubes but did not appear to affect the quality of reflected light (see Table 1). Since installing the reflectors in November 1983, the manufacturers have changed the type of silver-sprayed plastic laminate they use. They claim that their new plastic will not bubble, peel, or yellow over time. However, except for yellowing, recent off-campus installations do not confirm this claim. New reflectors will be carefully inspected for deficiencies and monitored after installation; contract performance specifications will include these observations.

The debate continues about which of the two metals makes a better reflector. Aluminum reflectors cost somewhat less than their silver counterparts, but aluminum is less reflective than silver. Silver redirects 91 to 94 percent of light striking it (depending upon its purity),



Integrating sphere used to measure light output of a fluorescent fixture fitted with various reflectors.

**Table 3**  
**General Assignment Classroom Retrofit**

<i>Location:</i>	1st floor of Barrows Hall
<i>Fixtures:</i>	Number & Type: 120 4-lamp fluorescent
<i>Reflectors:</i>	Anodized Aluminum
<i>Ballasts:</i>	New energy efficient core and coil ballasts
<i>Lens:</i>	Acrylic flat lens to raise efficiency
<i>Illumination Levels:</i>	Before: 43-45 fc After: 37-42 fc
<i>Estimated Energy Reduction:</i>	80 watts per fixture 320 Kwh/yr per fixture 38,400 Kwh/yr \$24/yr average per fixture (@ \$.075/Kwh) 4000 operating hours per yr
<i>Installed Cost:</i>	\$70 per fixture
<i>Payback Period:</i>	2.9 years

compared to aluminum's 90.6 percent. But aluminum's reflectivity is built into the anodized metal and is not likely to degrade. Aluminum's hard surface also makes it more resistant to heat generated by the fluorescent tubes. ECO engineers are still evaluating the two reflector types.

By the end of 1985 the ECO hopes to install, in approximately 2,000 2 ft. x 4 ft. fixtures, anodized aluminum reflectors in Barrows Hall, an eight-story classroom and office building, and in roughly 4,000 1/2 ft. x 4 ft. fixtures, silver laminate reflectors in Moffitt Undergraduate Library. These retrofits will bring an estimated annual electrical savings of almost \$200,000. In each building a test area will be retrofitted with reflectors. If the test reflectors meet contractual performance and workmanship standards, the contractor

will proceed with the balance of the project.

The ECO is also conducting a campuswide light fixture survey. Teams of student engineers record the dimensions, window locations and detailed information about existing light fixtures in nearly 10,000 classrooms, offices, lounges, laboratories, and other workspaces. The information is being entered into a computerized data base, which will help the Energy Conservation Office staff decide which of several different lighting retrofit systems will work best in each space. The possibilities include: occupancy sensors that will turn off lights in vacant rooms, photocells and dimmers that take full advantage of available daylight, reflectors, solid state ballasts, and assorted lenses.

The university estimates spending



one-quarter to one-third of its \$7 million annual electrical bill on lighting. A campuswide retrofit would cut the university's light costs by 30 to 50 percent, reducing the total bill by 10 percent of \$700,000 per year. Since Cal uses 100 million kwh of electricity annually, a 10 percent savings—10 million kwh/yr—is enough electricity to power 2,600 average Berkeley homes for a year.

### Summary

The results of these projects at Cal have shown that a reflector retrofit can be an attractive cost-cutting measure if properly applied. Both aluminum and silver reflectors have performed successfully. Comprehensive illuminating sphere test data will soon be available, which should demonstrate the relative performance of the two materials. Longevity of the materials is still questionable—several years of service will be required to analyze the performance of the reflectors.

Some of the problems associated with any reflector retrofit installation are as follows:

1. Light distribution to the work area may be concentrated or dispersed. Users must specify their needs.
2. The fixture may require numerous modifications to accommodate the reflectors such as relocation of the fluorescent lamp sockets, making the project labor intensive.
3. Substitution of inferior grade of reflective material rather than what was specified.
4. Installation of the reflector closer than 1/2 inch to the fluorescent tube may cause electrical grounding or less efficient lamp operation.
5. Some fixtures which appear identical may not be, thus requiring different reflector designs.

Project specifications can anticipate such problems and make the retrofit a smooth and incident free experience.

### Acknowledgment

The writer wishes to express his appreciation to his staff for their professional efforts, especially to Paul Black, senior engineer, Jeffrey Kessel, assistant engineer, Richard Wang, senior engineering aide, and Shannon Hickey, editor assistant, for many effective suggestions and proof-reading. ■

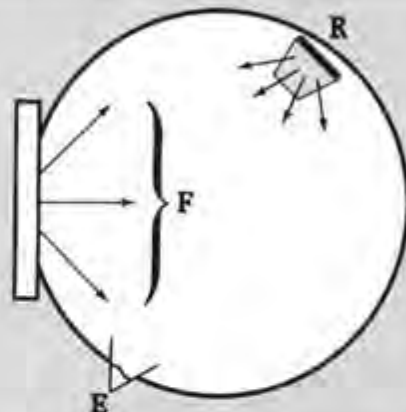
FIGURE B

### Integrating Sphere

A 2' x 4' fluorescent fixture (delamped from 4 to 2 lamps) was placed over the entrance port of a six foot diameter integrating sphere, having a white interior surface of high diffuse reflectance. Measurements of the light level (illuminance) within the sphere were taken alternately for reflectors of different shapes and materials. These measurements were proportional to the total light output from the fixture.

The figure illustrates flux  $F$  leaving the fixture and entering the sphere. This flux strikes the sphere wall and is diffusely reflected throughout the sphere (shown for a typical reflection  $R$ ). A sensor located in the sphere wall, and shielded from direct view of the fixture, measures the illuminance ( $fc$ ) of the wall. Photometric theory shows that the illuminance  $E$  is proportional to the entering flux  $F$ . Thus the relative light output of a fixture equipped alternately with reflectors A and B can be determined from two measurements,  $E_A$  and  $E_B$ :

$$\frac{F_A}{F_B} = \frac{E_A}{E_B}$$



Flux  $F$  leaves the fixture and enters the integrating sphere. A typical diffuse reflection from the sphere wall is shown at  $R$ . A sensor, shielded from direct view of the fixture, measures the resulting illuminance  $E$ .

### Major Suppliers of Fluorescent Reflectors\*

Allen Power and Energy Corp., 6515 Corporate Drive, Suite A, Houston, Tex. 77036

Barney Roth Co., 4150 Kensington Ave., Philadelphia, Pa. 19124

Brayer Energy Management Co., 286 12th St., San Francisco, Calif. 94903

Broadway Maintenance Inc., 1271 McCarter Highway, Newark, N.J. 07104

Capri Lighting, 6430 E. Slauson Ave., Los Angeles, Calif. 90040

Diamond Energy Controls, 2400 Main St., Irvine, Calif. 92714

Energy Control Products, a division of 3M Co., 3M Center, St. Paul, Minn. 55144

Energy Design Inc., P.O. Box 34160, 1756 Thomas Road, Memphis, Tenn. 38134

ESC Measurements Co., 1611 Borel Place, Suite 227, San Mateo, Calif. 94402

JLG Manufacturing Inc., 2450 West 500 South, Salt Lake City, Utah 84104

Kendrick Energy Company Inc., 709 Lingco No. 106, Richardson, Tex. 75081

Kingston Industries Corp., Kingston Way, White Lake, N.Y. 12786

Maximum Technology, 60 Industrial Way, Brisbane, Calif. 94005

Mor-Lite Inc., 1979A Sherwood St., Clearwater, Fla. 33575

Nova Energy Control Products, 35 Thurber Blvd., Smithfield, R.I. 02917

Reflector Associates, 4825 S. Avalon Blvd., Gardena, Calif. 90248

Retrocon, 2014 Market St., Oakland, Calif. 94607

Scott Co., 1919 Market St., Oakland, Calif. 94607

Solar Kinetics Inc., 10635 King William Dr., Dallas, Tex. 75220

Specuflex Inc., 680 Beach St., Suite 496, San Francisco, Calif. 94109

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## Energy Savings

Rhodes College is using ice to fuel its air conditioning system. The Tennessee Valley Authority has given a \$24,900 grant to Rhodes to study the feasibility of using ice to cool its buildings. The grant also covers the design of an ice generation and storage unit. The system will be used to supply 70 to 80 percent of the peak demand and should pay for itself in electric cost savings within five years.

SUNY/Buffalo in New York has instituted a number of energy saving measures. Installation of a separate computer cooling system in two buildings; saving \$20,000 a year. Replacement of recessed incandescent lights with fluorescent fixtures and photocells to keep indoor lights off when daylight provided adequate illumination; saving \$1,000 a year in one building. Decommissioning unused fume hoods in laboratories by disconnecting them from the exhaust system; saving \$30,000 annually. Replacing incandescent lights outdoors with high pressure sodium lights; saving \$12,000 annually.

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## Management Resources

Diana L. Jeffery

We are pleased to introduce a new column to the readers of *Facilities Manager*. Management Resources will be a regular feature in the magazine, but its success depends on you. We need your contributions: money saving ideas, personnel management tips, new projects on campus, suggestions for improving the image of the physical plant. Get some well-earned recognition for your school. Call or write Diana L. Jeffery, APPA, 1446 Duke Street, Alexandria, VA 22314-3492; 703/684-1446.

Closing all vertical blinds in offices at 5:00 p.m. during cold weather, reducing heat loss by 30 percent; saving \$400 during heating season. Turning off computers and printers at night and on weekends; saving \$1,400 annually.

### Campus Appearance

Improve grounds appearance and educate the community by establishing an arboretum on campus. Cedar Crest College has 1,000 students and 1,000 trees representing 140 varieties on its 88-acre campus. In "Introduction to Biology" each student is assigned a tree to study and report on at the end of the semester. About 25 U.S. colleges and universities have arboreta registered with the American Association of Botanical Gardens and Arboreta. The designation indicates that the property is a place where trees or shrubs are grown for study and labeled and maintained for public enjoyment.

### Staff Successes

Facilities operations garage personnel have saved the University of Kansas \$260,000 over the past two fiscal years by reconditioning university vehicles instead of purchasing new ones. The reconditioning projects are done when garage personnel are not busy with regular maintenance work on university vehicles. The target is to keep a vehicle

were laid off during recent budget cuts because the crews were kept busy with these projects while saving the university substantial sums of money.

The "Working Smarter" program at Southern Methodist University paid off with the receipt of first prize in the 1985 NACUBO/U.S. Steel Foundation Cost Reduction Incentive Awards Program for its use of hand-held computers to issue parking tickets. The initial annual savings is reported to be \$21,000. The program encompassed other projects as well as employees were encouraged to seek improvements in productivity and reductions in cost in all areas of facilities work.

### Student Power

Hiring students to supplement the professional security staff on your campus is an easy and relatively inexpensive way to increase human resources. Several students can be hired at the cost of one professional security guard, and more personnel means better coverage of facilities during peak use. Students also set a good example for their peers. The program requires little training, a minimal budget, and may even qualify as a work-study program.

Student volunteers at Brigham Young University are taking part in "Operation Facelift," a project designed to clean, paint, and fix the exteriors of campus buildings that could not be included in the budget. More than 800 students volunteered, enabling the number of projects to be increased from fifty to seventy-five.

Free education for free labor was the bargain struck between the University of California/Santa Barbara and the California Conservation Corps. The fifteen corp members provided labor on landscaping and other outdoor projects that the university could not afford; the estimated value of their labor was \$31,000. In return, the university provided an intensive reading and writing program for the corp members aimed at making these skills fun and attractive. The corp is a state job training program for young people eighteen to twenty-three years old who are not illiterate but who rarely use their reading and writing skills.



## Exchanging the Blue Collar for the White

**From Technical Professional to Corporate Manager: A Guide to Career Transition**, by David E. Dougherty. New York: John Wiley & Sons, Inc., 1984. 279 pp. \$19.95, hardcover.

For an engineer to succeed in the corporate environment, he or she should learn and understand fundamental principles of financial analysis, marketing, and management, according to David Dougherty in *From Technical Professional to Corporate Manager*. If you are that engineer, looking to move into a management slot, Dougherty also suggests that you establish meaningful and realistic goals for your career, and within those guidelines look for jobs that you will enjoy doing. This way you will have a positive attitude toward your job and can attain the maximum amount of experience. The keys to success are perseverance, enthusiasm, and innovation.

Some people confuse innovation with invention. Therefore, do not only concentrate on the technical aspects of your job, but be creative and channel that to satisfy your customers' needs. If you feel that you don't meet the corporation's mold, then you should leave; wasted time leads to wasted careers. It is more fun to have satisfying work than alienated labor.

One of the problems that most bright people face is becoming overconfident and lazy. This leads to inadequate preparation for presenting ideas to the upper administration and can lead to failure of securing the resources that one was trying to get. Many engineers get so involved with the technical aspects of their projects that they assume that others are as well-informed. They become disappointed when upper management does not demonstrate the same level of enthusiasm. In most of these situations the blame lies with the engineer because senior administrators are not as technically inclined as the people working on the project. Besides, it is the responsibility of the engineers to communicate their ideas to a non-technical audience.

Office automation has probably not proliferated to its potential because computer experts have been preoccupied with computer jargon and buzzwords and have failed to communicate effectively to upper manage-

## The Bookshelf

ment. Engineers also have problems writing a report using good English. This does not mean that a technical report must be a literary piece, but it should be free of spelling, grammatical, and punctuation errors. Misuse of English offends many people and is not indicative of high standards.



Because many senior administrators will not read a report more than one page long, it is essential to write concisely without eliminating the essential facts that you want to convey. In most situations your report might have a lot of supporting data; these could be added as appendices, which should be written in a way that can be easily followed and related to the report. Relevant information such as cost, sources and uses of funds, schedules, advantages and disadvantages, and the financial

reasons for the project should be in clean, specific language without using technical jargon. *Do not take essential data for granted.*

Another key to success is keeping abreast of technical enhancement and other developments within your company and the field. It is essential, therefore, to read professional journals and attend technical seminars and conferences. To be informed of other essential news, make a habit to read business publications such as *The Wall Street Journal*, *Forbes*, and *Business Week*. Follow up any congressional bill, state legislation, or local ordinances that could affect your company or the industry you are in.

Successful executives have one common trait—they sell effectively. Selling a project successfully is a science and an art, and an effective presentation is a must. The major ingredients of a successful presentation are:

- Sensitivity to the needs of the audience
- Adequate preparation and rehearsal
- Facts that help decision makers make the right choices
- Logic (but don't overlook emotional impact)
- Visual displays
- Specificity (don't rely on generalizations)

In short, diplomacy, sensitivity, and preparation.

Moving up to a successful managerial position is dependent less upon your technical ability than your ability to work with people and motivate them. Supervisors must be positive and enthusiastic about their jobs. They should be good communicators and able to develop a good working environment among their subordinates.

Dougherty presents these concepts as imperative for an individual's success in an organization. The material is expressed clearly, which makes *From Technical Professional to Corporate Manager* an easy text to follow. The author is a patent lawyer and nearly half of the text relates to patent information that is not relevant to the facilities environment. Nevertheless, there is much valuable information to help physical plant staffs develop a plan of action to meet their career goals. Most of the text is written in a manifesto style with many "do's" and "don'ts." I do recommend the book because it has a lot of useful information.



Near the end of the book Dougherty discusses how to look for the type of desired job, write a resume, and prepare for an interview. He also recommends that you research an organization before interviewing to know whether it has the kind of environment that you will feel comfortable with. Do not just make a lateral move for more money, because it can be a short-run motivator only. Look for advancements in your career instead.

Ultimately, the author is saying that the key to success in any organization does not necessarily lie in some fancy high-tech solutions, but instead lies in returning to some basic principles. This reaffirms my belief in the saying that "common sense is normal and enough of it is genius."

From *Technical Professional to Corporate Manager* is available for \$19.95 from John Wiley & Sons, Inc., One Wiley Drive, Somerset, NJ 08873.

—**Mohammad H. Qayoumi**

Assistant Director, Facilities Management  
University of Cincinnati  
Cincinnati, Ohio

## Nontraditional Work Arrangements

**Alternative Work Schedules: Selecting, Implementing, and Evaluating**, by Simcha Ronen. Homewood, Illinois: Dow Jones-Irwin, 1984. 255 pp. \$25, hardcover.

*Alternative Work Schedules* is a comprehensive and well researched review of the literature on options to the traditional Monday through Friday, 8 to 5 management controlled work style familiar to us all. The book is readable, clear, and complete. No one option or set of options is presented as

the cure; instead, the author urges a firm or department to consider its unique properties before any change is made. Sufficient information is given to prepare a proposal for change. Although the case history information is from private industry, the ideas and options presented are applicable to college and university settings. Physical plant, housekeeping, and grounds operations have many characteristics favorable to the implementation of flexible scheduling, part-time employment, and job sharing.

The book describes in detail the conditions that led to consideration of alternative work schedules. Changes in the makeup of the work force, inclusion of people with special needs, congestion of public transportation, lack of support facilities during peak periods of the day, and the need to spread out equipment use are some of the areas that will benefit from scheduling changes. Some forms of alternative scheduling can be used to reduce layoffs during retrenchment, while others increase direct expenses that must be offset by increased productivity of the employees.

Four main types of alternative schedules are explained in detail: compressed work week, flexible working hours, part-time employment, and job sharing. Compressed work week refers to any schedule allowing the standard number of weekly hours to be accomplished in fewer days. Employees increase their number of leisure days by simply working more hours each day of work. A common example of a compressed work week is working ten hours per day, four days per week, to earn a three-day weekend.

Flexible working hours refers to a variety of possibilities that transfers



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some control over arrival and departure times to the employee. Possible options vary from flexibility in arrival and departure time on a given day, to contracting to work a specified number of hours during a weekly or monthly period at the employee's convenience.

Part-time employment recognizes that a large percentage of the work force does not wish to work a full forty-hour week year round. A significant portion of the work force is being overlooked and those talents are going to other organizations if no possibilities for part-time work exist. Included in part-time alternatives are less than eight hours per day, less than five days per week, and less than nine months per year.

Job sharing is a special subset of part-time employment where more than one individual fills a position that must be covered full-time. Two or more people work on a buddy system where responsibility for coverage is shared between the people, shifting concern for scheduling from the supervisor to the employees. Depending on the job constraints, the people may overlap

during peak periods or share communication on projects and activities in progress.

Selecting an appropriate alternative scheduling plan requires a review of the conditions and constraints in the individual firm or department and the legal restrictions that may apply. Savings and increased productivity are common benefits of implementation. Consideration must also be given to the supervisory and equipment usage changes that will occur with schedule changes. Alternative mechanisms for consistent communication must be developed in advance since the core time that all employees are available will be reduced. Support from management and discussion at all levels in advance of implementation is strongly encouraged. Pre-implementation measurement of absenteeism, turnover, training time, productivity, tardiness, and equipment down time will allow for comparative measurement with the new program.

Implementation should include as many employees in a selected area as possible. An explanation should be

clear and readily available for any employee who cannot be included in the program. Consideration should also be given to the inclusion of supervisory personnel and exempt employees. A pilot program of three to six months is recommended by the author. Based on the outcome of the pilot study, wider adoption can be considered. In addition, a pilot program allows for improvements to the system, working out bugs that may occur, and gathering employees' perspectives on the project.

Evaluation criteria must be developed in advance and agreed to by management. It is essential to implementation that all parties concur on the definition of success. External and internal factors that will be affected by the change must also be explored. Service to users must be considered as well as employee convenience. A listing of possible measurements and criteria for evaluation are given in the book.

Numerous possible applications for alternative scheduling exist in college and university physical plant settings. Many areas of physical plant work can be more quickly accomplished at non-

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traditional work hours. Access to limited equipment is increased by staggering employee working hours. In addition, the organization and the employees stand to benefit from alternative scheduling.

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*Alternative Work Schedules* is available for \$25 from Dow Jones-Irwin, 1818 Ridge Road, Homewood, Illinois 60430.

—Kate Fenton

Dean, Support Services  
Kenai Peninsula Community College  
Soldotna, Alaska

## In Brief

*Environmental Systems Technology*, by W. David Bevirt, P.E. Vienna, Virginia: National Environmental Balancing Bureau, 1984, 760 pp., \$78, hardcover.

*Environmental Systems Technology* is a comprehensive textbook for those who need and use extensive information on HVAC systems for background, reference, and practical application. The material covers the fundamentals; engineering principles; design; system components; testing, adjusting, and balancing; and interrelationship of each of these elements within a system. It also features an historical account of industry developments, pictures, tables, charts, and practical examples.

Chapters include the following: psychrometrics; building heatflow; comfort factors; air distribution systems; hydronic

systems; HVAC systems and equipment; electrical systems; HVAC control systems; refrigeration systems; combustion equipment; energy recovery systems; new technology; and HVAC acoustics.

*Environmental Systems Technology* is available for \$50.70/NEBB members; \$58.50/MCAA members, architects, engineers, educational institutions, federal and local government agencies, and \$78/others. Order from the National Environmental Balancing Bureau, 8224 Old Courthouse Road, Tysons Corner, Vienna, Virginia 22180; 703/734-3840.

The *Directory of Energy Software for Microcomputers* lists microsoftware programs available for energy applications. Programs relate to electric power, load forecasting, cogeneration, coal, solar, energy management, energy accounting, scheduling, etc. Includes four indexes that cross-reference entries by subject matter, hardware compatibility, vendor, and title. Names and addresses of more than 100 energy software vendors are provided. The directory is available for \$68 (plus \$1.97 shipping & handling) from Government Institutes, Inc., 966 Hungerford Drive, #24, Rockville, Maryland 20850; 301/251-9250.

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## Letters

### To the Editor:

"The Future of Campus Facilities Management" [Spring/Summer 1985, p. 3] identifies pertinent issues, but the lead statement says it best: "The basic problems of the campus facilities manager have changed little over the past seventy-five years." H.C. Lott related common concerns that every facilities manager has. Hiring, training, supervising, motivating, and managing the human resources needed are basic tasks of not only facilities management but almost any other type of management. To these tasks we should add the needs of planning, programming (on allocation of resources), and budgeting.

The application of these human and financial resources to the facilities problems—be they in a 1900 vintage classroom building or a 1995 biomedical research laboratory—requires that the manager have the requisite technical background. In addition to the basics noted, I would add that the more successful facilities managers have imagination in utilization of scarce resources and the drive to follow through with a set of goals. Without imagination or creativity in the use of resources, many opportunities are missed. Without the drive needed for goal fulfillment, discouragement takes over and stagnation sets in.

L.F. O'Neill, P.E.  
Administrator, Physical Facilities  
Washington University  
St. Louis, Missouri

### To the Editor:

I was somewhat disappointed by "The Future of Campus Facilities Management," because it appeared to be more of a restatement of some of the existing problems rather than a view into the crystal ball. In my opinion, facilities management will witness major changes in the coming years, and unless we are prepared for these changes we will be left behind. The shortage of funding mentioned by several managers is a contributor to the upcoming changes. The computer and

changes in building materials are other contributors.

The article missed the need for facilities managers to constantly look for new ways to solve old problems. We will need innovations in finances, procedures, practices, and use of materials. The most successful managers will be those who looked for and found better ways to solve old problems.

On the other hand, the article on financing energy modification ["State Policy Initiatives for Financing Energy Efficiency in Public Buildings," Spring/Summer 1985, p. 24] begins to show the innovative thinking needed by the future facilities managers. We need to use this same type of thinking on solutions to some of our non-energy related problems.

Richard A. Eustis  
Associate Vice Chancellor for Facilities  
University of Maine  
Bangor, Maine

### To the Editor:

We of the Physical Plant Division of Auburn University applaud your first issue of *Facilities Manager*. It is a much needed addition to our article library because of our common plight with other colleges and universities. "The Future of Campus Facilities Management" is especially interesting to us in that the concerns identified in the article are in many cases the same concerns contributing to a reorganization of our division.

Our program appears to be on a technical par with most other universities of similar size. We are attempting, however, to implement a program that we hope will spread the word about what we do and how we do it. We are taking every opportunity to involve our administration, schools, and those in the departmental offices in our program. One example of their participation will be completing questionnaires about our job performance on work orders and the condition of their facilities.

It is not a new approach, by any means, but we believe it will be effective.

The data generated should help us develop favorable media coverage to draw attention to how we are answering the needs of the university.

All the technical changes in the world will not be effective unless they meet the needs of the educational process. Efficient and effective implementation of programs to fulfill these needs together with comprehensive accounting methods will prove the validity of our programs and provide us the support and justification needed to favorably influence required funding.

Don Brumblow  
Project Coordinator  
Auburn University  
Auburn University, Alabama

### To the Editor:

I enjoyed reading Ed Schon's "Systems Analysis Approach to Work Control" [Fall 1985, p. 10]; however, one clarification to the appendix needs to be considered.

The memory "space" on disks, etc., is typically expressed in terms of bytes, not bits. There are 8 binary bits in a byte. Therefore, following the author's example:

1. A 128K memory represents 128,000 bytes.
2. There are 8 binary bits in a byte.
3. Therefore, there are 1,204,000 bits in a 128K memory.

Pete van der Have  
Central Services Division Manager  
University of Utah  
Salt Lake City, Utah

Readers wishing to respond to articles in this issue should send their comments to Letters, FACILITIES MANAGER, 1446 Duke Street, Alexandria, Virginia 22314-3492. All letters should be typed, double-spaced, and no longer than 500 words in length. Shorter letters have a better chance of being published, and the editor reserves the right to edit for clarity or brevity.



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