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## The Aging Workforce: Electricity Industry Challenges and Solutions

Recruiting and training new workers have become essential skills for companies. As senior workers retire, companies must find ways to keep the essential knowledge for running the company from walking out the door.

Lester B. Lave, Michael Ashworth and Clark Gellings

### I. Introduction

Utility companies invested heavily in human capital in the course of building the highly complex electric power delivery systems that support the U.S. economy today. The intricate relationships between investment, planning, engineering, construction, and maintenance functions required employees who were not only highly trained and knowledgeable but also constantly aware of the needs of retail consumers, regulators, suppliers, and investors. Going

forward, however, the utility success paradigm in the 21st Century is clearly not to be the same as in the 20th Century. Massive changes in the workforce are imminent, technology advances are altering the physical characteristics of electric systems, and regulatory and financial shifts are permanently changing the industry structure. Concurrently, the digital society is demanding reliability from the industry more than ever before. While on the surface these challenges may be no greater than many that have been faced and overcome by the industry in the

past, they still will require innovative and disciplined company responses.

## II. Industry Challenges

The electricity industry is facing an unprecedented array of challenges: (1) the power delivery network is aging and will have to be replaced at great cost, (2) restructuring has forced many companies to reduce cost far beyond cutting off the fat, (3) the public objects to new generation or transmission and distribution (T&D) facilities, (4) new technology promises to make many existing facilities obsolete, (5) environmental regulations are continually being tightened, (6) CO<sub>2</sub> emissions restrictions are likely to come, (7) reliability has become a larger concern, and (8) in many utilities, half or more of the workforce will be eligible to retire within five years.

**W**e report some of the ideas emerging from a workshop that focused on the aging workforce, accounting for the myriad challenges facing electricity industry companies. For much of the past two decades, companies reduced the size of their workforces rather than hiring new workers. The result is a missing group of workers in their 30s and early 40s and a concentration of workers in their late 40s and 50s, half of whom will be eligible to retire within five years. Workers with physically demanding jobs, such as linemen, may not be able to continue

working into their 60s. Failing to maintain the skills of today's workforce by replacing retiring workers with competent substitutes, by training and retraining workers to keep pace with technological change, and by capturing and transferring knowledge more effectively will increase stress to the power systems and could affect the quality of service to consumers.

Despite this threat, we urge

companies not to rush out seeking to clone each retiring worker. The needed skill mix has already shifted and will shift more rapidly in the future. We stress that replacing the current skill mix is not desirable. If, miraculously, all of the workforce were 30 years from retirement, companies would have to undertake efforts to upgrade skills by costly and sometimes fruitless retraining programs or new-hiring initiatives. The point is that the mix of workers needed for the future is not merely a replica of today's structure but rather will depend on the current and future challenges facing each company.

New technology will change the industry's product and production process. The need for new central power plants employing new light water reactor technology or burning coal cleanly while capturing and sequestering CO<sub>2</sub> will require skills not now resident in the industry. The penetration of distributed generation will increase and, if coupled with an inexpensive electricity storage technology, could dramatically level the load duration curve and change the skills needed in planning and operating the power system. In addition, the adoption of new sensors, communications, and computational ability will demand digitally capable technicians. Thus, for many reasons, the electricity industry of 2030 is unlikely to resemble the current industry.

**A**lthough the electricity industry is changing rapidly, the industry in the short term will look much as it does today. The trillion-plus dollars worth of generation, transmission, and distribution facilities and the 400,000 workers who operate them cannot be replaced rapidly. Even marvelous new technologies will take years to displace existing infrastructure. The principal challenge of the next five years will be coping with current problems, including the aging workforce, while integrating new technology into the current infrastructure and minimizing the loss of knowledge of the departing workers.

The concurrence of the challenges makes investment and operations decisions difficult but also offers opportunities. A company should not waste this opportunity by merely replacing existing equipment and personnel. Rather, the need to replace so much of their assets gives a company the opportunity to find and implement better solutions. In other words, the present challenge is extreme and the next five to 10 years will be difficult, but companies that manage to handle these challenges will emerge as the dominant companies in the industry.

The image of today's electricity industry is complex. Some view electric utilities as stable, but slow, steady, and even boring places to work. Yet, even the image of a secure place to work has recently been tarnished with large-scale reorganizations and staff reductions. Meanwhile, today's young workers are much more flexible and digitally oriented and not interested in doing the same job in the same way day after day. To recruit the desired workforce, companies will have to change their public image from one which is static to one which is more dynamic, offering challenging careers in an exciting industry. Many of the jobs will have to be redesigned or equipped with tools to accommodate the physical strength of women or aging workers; the expertise of master technicians and engineers will have to be leveraged to enable a

workforce that has lower skill levels on average to perform well.

The first step in meeting this challenge is to define the company's goals and strategies: What does the company want to accomplish over the next decade or two? What is the company's technical strategy and what skills does that strategy imply? Obviously a company seeking to become the largest generating company in the U.S. using

advanced clean coal with carbon capture and sequestration will behave differently than one seeking to provide low-cost, reliable electricity to its traditional customers using distributed resources. We stress the need to clarify goals before getting started, since this is the single most important step.

The second step is assessing assets, customer demand, and the challenges. From this step will follow the number and mix of skills of the desired workforce. We do not imply that either of these steps is easy or even straightforward. However, without accomplishing the two

steps, the company is simply reacting to each challenge and crisis as it occurs, rather than taking advantage of opportunities.

### III. What Is the Right Mix of Skills?

The electricity industry has undergone an enormous restructuring since the early 1990s. Whether companies were in a jurisdiction that restructured competition or not, companies have faced enormous pressure to lower costs and become more efficient. Some heretofore vertically integrated companies sold off their generation. Many companies merged. Reliability became a major challenge. Many companies set up non-regulated subsidiaries that face quite different challenges.

As mentioned previously, even if companies did not have an aging workforce, they would still face critical human resources issues. Many companies have reduced their blue and white collar work forces. These reductions were often prompted by rate caps, earnings pressure, or other regulatory actions. As a result, some utilities have eliminated or dramatically reduced whole classes of jobs such as sales engineers, meter readers, or planning engineers or forced employees to choose which company they wanted to stay with as they sold off assets. Mergers have forced other companies to eliminate duplicative employees and positions.

The industry is likely to change even more in the next 10 years due to competitive pressures, changes in demand, new technologies, expanded environmental regulations, mandated reliability standards, and wildly fluctuating fuel prices. Many coal burning utilities will have to spend hundreds of millions of dollars retrofitting old plants for increased control of SO<sub>x</sub>, NO<sub>x</sub>, PM2.5, and mercury. Finding skilled workers, buying the materials, and doing the engineering will require large numbers of skilled workers. Some firms assume that they can simply hire architect-engineering firms for the planning and layout and construction companies for the actual building. However, the vast number of projects will require more than the existing capacity of engineers, construction companies, skilled workers, and supply of materials. A firm that is not explicitly considering these shortages will wind up with rapidly escalating costs on projects with long completion delays.

Thus, the aging workforce offers both problems and opportunities. Many of the existing workers are not the best ones for the challenges that companies face. Having them leave voluntarily frees the company from having to fire them or engage in costly, perhaps ineffective, retraining programs. Rather than starting with the notion that a company must scramble to replace the retiring workforce, we urge companies to start first to define the workforce that they will need in five to 10

years. They should then identify the gaps between that workforce and the one they have, accounting for expected retirements over the next five to 10 years.

#### IV. Pre-Recruitment Actions

Young workers have been drawn to "attractive" industries – e.g., aerospace, chemicals, and

computers – in different eras. The electric utility industry has not enjoyed a glamorous reputation. During no part of the post-World War II period have young workers regarded the electricity industry as "cool." Rather, the industry was seen as offering safe, steady, rather dull employment. As the industry now seeks large numbers of new workers, particularly highly skilled workers, they will need to attract workers who have not found electricity firms attractive in the past. While offering higher salaries is a necessary component of this recruiting effort, it is unlikely to succeed – at least not

for salaries that the companies can afford to pay.

Electric companies, like other industries, face a demographic challenge. The age distribution of the population has shifted dramatically as the baby boomers reach retirement, and the reduced birth rates of the past 30 years further lower the number of young men and women in the labor force. Even the reduced numbers don't tell the whole story, since fewer individuals seek jobs doing hard physical labor outdoors and fewer college graduates major in engineering.

The companies need to build a large base of possible recruits; they need to convince young workers that the industry is a desirable one to work for. They need to show that the industry makes a product that is essential to society, that they are environmentally responsible and are working toward sustainability, that the jobs are stimulating and attractive – and that they pay well. The straightforward way of doing this would be to talk to high school vocational counselors, perhaps make visits to schools at all levels, and to work with state and private employment agencies. Visiting schools is likely to be most successful if all grades are visited, from first grade through community college. The students can be shown the importance of electricity, the nature of environmental and safety programs, and the kinds of jobs that are available.

Companies need to use current workers, unions, high schools,

community colleges, employment agencies, and other institutions to tell potential workers about the nature of the jobs. In many cases, companies are competing with the Army and other armed services for workers. The companies are offering much higher pay and better careers. They can also recruit soldiers being discharged from the military.

Companies need to reach out to nontraditional electricity company workers, including minorities and women. For example, women are performing many jobs that were thought to require more strength than a woman has. If need be, the equipment assisting workers could be changed to reduce the level of physical strength required.

The jobs need to be examined carefully to see what skills are required. This includes not only strength, but knowledge and communication skills. If there is a lack of highly skilled workers, the jobs could be changed so that less skilled workers are each in contact with skilled ones so that they can ask questions and perform at higher levels over time.

Another recruitment device is plant tours. High school students or others might be offered plant tours designed to show them how vital and attractive are the jobs. For more serious applicants, summer internships can give information on the individual as well as recruiting them.

A more imaginative approach would be an offer to sponsor a TV

series featuring heroic actions of electricity people. It could portray people solving problems and helping people without electricity or figuring out where a problem occurred and how to fix it. If properly framed, the material here could be just as interesting as courtroom or police dramas, and it is fresh. There is certainly enough material for a few seasons or even for a reality show focused on an electricity industry

company or team. That could do a great deal to recruit quality workers.

## V. Recruitment

Companies in the "rust belt" face a very different situation than companies in rapidly growing areas. The former areas have more workers than good jobs. For various reasons, workers don't want to leave the area. In these locales, electricity industry jobs are especially attractive. They are jobs in the community that have high pay, a career, and chances for advancement. One company

noted that it is able to persuade young people to sign up for and take two-year community college courses that essentially reduce training time by two years. The company does not pay these individuals or even offer free books. The company offers summer internships to many of the students but gives no guarantee that they will hire workers after they graduate.

In contrast, a company in the Northwest reports that it has to hire workers and pay them during the first two years of training. There are so many opportunities for young workers that it believes it would attract few workers to these programs without paying them.

While not all areas fit into one or the other of these extremes, there is a continuum of incentives that companies can offer. For example, they can offer screening to young people thinking about a community college program. They can offer free books and a summer internship for all students who maintained a certain grade point average. They could even guarantee full-time employment for students who complete the course with satisfactory grades and who did a satisfactory summer internship. They could also offer a "work-study" program where the students spend a certain amount of time working for the company and a certain amount of time taking classes. This program would be less expensive than hiring workers, since they would not have to be paid as much; it



would give the company ample time to evaluate the potential of these individuals as workers. The point is that there are many steps between hiring workers and sending them to community college and simply urging young people to take the course with no promise of any kind of employment. Companies need to be flexible and experimental in finding the program that achieves the desired number and mix of workers.

## VI. Training

Historically, the electricity industry has offered superior opportunities for skilled blue collar workers. The future will require a smaller set of even more highly qualified people who expect that they will have to upgrade their skills continually. Technology and performance-based requirements and expectations will require aggressive and sometimes creative training programs to keep employees prepared throughout their careers. Thus, training should be an integral part of employees' career paths.

As technology advances, fewer workers will be needed, but those who are required will need to have stronger analytical and mathematical capability, spatial awareness, computer proficiency, and problem-solving skills. For new hires, the initial challenge is qualification. Existing tests are used by many companies, but

most complain that pass rates are unacceptably low even though the tests are very basic. This suggests that utilities need to standardize testing at the industry level and then partner with local high schools, community colleges, and unions to help bolster curricula aimed at helping those interested in potential electricity industry careers to pass entry tests. Simply playing the "blame game" by

laying responsibility at the feet of elementary and high schools or other educational institutions – however accurate or well-meaning – will not solve the problem. Companies need to be proactive. They can then use test-preparation initiatives as outreach programs in conjunction with "get-the-word-out" campaigns designed to excite young people about careers in the industry.

Companies need to begin now to engender worker "ownership" of their own training. For new and existing employees, this means that continual training is not merely

an expectation for advancement but a fundamental requirement for keeping their jobs. New employees must expect increasing levels of cross-training and multi-skilling as job requirements, although research is needed to understand the limits of the applicability and value of excessive levels of cross-training in high-reliability environments. In situations where existing bargaining agreements prohibit or limit cross-training, companies and unions should work toward modifications that reflect the realities of the changing workforce. Company-sponsored training or re-training could reduce resistance to such initiatives. In addition, companies can experiment with reinstating some form of apprenticeship. In most cases, five-year apprenticeships are unnecessary, particularly if new hires have two-year degrees, military experience, or other substantial experience. Yet some form of on-the-job training, even if limited to a year or two, may still be desirable or even critical for many positions. Companies should try different combinations of pre-hire training and certification with a balance of post-hire online, classroom, and hands-on training to provide solid foundations for job preparation and continuing education.

To some extent, companies need to realize that one consequence of focusing on performance rather than entitlement is reduced loyalty of employees. Even immediately

after completing a long training program, employees may leave the company for a competitor. Offering employees forgivable loans to enable them to complete a training program is one way to retain skilled workers or have other companies pay to lure them away. Recognizing this reality would be an important first step in promoting greater standardization across utilities to facilitate portability and mobility. Today's workers increasingly go where they are paid well for their performance and their skills match their job assignments. Companies need to organize training programs, whether at their facilities, universities, or at other companies. Online training is useful for introducing basic concepts but is limited in bringing workers to a level of proficiency needed for most positions. Thus, online programs must be coupled with hands-on training and mentoring to be effective.

**A**dvances in generation, transmission, distribution, control, and even administrative technology will be accompanied by decreased training times and faster learning curves for many industry functions. Training on the use of such technology can be shared with local or national educational institutions. Small-scale versions of the same technology used by utilities need to be on-site at universities and technical schools so that students coming out of professional or vocational programs will have been exposed to real-life equipment. In technical and

professional ranks, co-op programs can provide current value to the company while offering utilities a peek at students' long-term potential. For craft employees, summer internship programs for high school students provide similar advantages. Companies could offer six-week "school-to-work" programs where they bring in students and sponsoring teachers with the intent to get students

interested in an electricity industry career while in high school. In cases where training is especially costly and generally applicable, training contracts could be set up so that people have some incentive to stay for at least four or five years. Costs can be further mitigated by getting taxpayers to help. Programs available through the Department of Labor can be structured to help pay part of training in-house or in community colleges. Companies should focus part of their lobbying efforts at both state and federal regulatory levels on providing funds for training and re-training programs.

Collaborating with other companies in regional educational institution efforts may also facilitate greater risk-sharing.

## VII. Retaining Aging Workers

A recent industry survey conducted by Carnegie Mellon University found that even as total electricity industry employment has fallen over the last decade, the largest age category has moved from the age 35 to 44 cohort to the age 45–54 cohort. One of the outcomes of such an age shift is a swelling number of employees eligible for retirement. According to the CMU survey, in the next five years alone, up to half the workforce will be eligible for retirement. At many companies, 15 to 20 percent of employees are already eligible for retirement.

In thinking about hiring, the very employees who have retired or are eligible for retirement may be excellent candidates for bridging the transition to a new workforce. According to a recent study by the American Association of Retired Persons (AARP), 70 to 80 percent of Americans plan to work in some capacity after retirement. Companies can capitalize on this trend by making creative use of programs to rehire their own or other companies' retirees as contractors or on a part-time basis.

Such "retire/rehire" programs can be useful, but implementing

them may also require companies to embrace part-time and flexible schedules as part of hiring and retention practices. Another option is phased-in retirement, permitting employees to reduce working hours and begin collecting partial retirement benefits. Ensuring the success of retire/rehire programs or phased-in retirement programs requires that companies take closer looks at enabling flexible hours, acquiring equipment to lower physical job strain, and reducing requirements for mandatory overtime.

Unfortunately, many existing policies on mandatory overtime make workers anxious to retire, exacerbating the problem rather than promoting a potential solution.

Utilities that offer these types of solutions will also have to navigate carefully through provisions of the tax code, Employee Retirement Income Security Act (ERISA) and the Age Discrimination in Employment Act (ADEA). Retaining the experience of longer-tenured workers especially through periods in which newer workers are learning their jobs, is important. In addition, utilities expect a continued shortage of employees in mid-career due to downsizings and the lack of hiring in the 1990s, stymieing internal leadership development. Having the benefits of experienced workers either as contractors or part-time employees can help fill this vacuum until leadership

candidates can be identified and positioned in their new roles.

### VIII. Retaining Knowledge

While retaining aging workers may help bridge the transition to a new workforce, these workers will retire ultimately. They will take valuable knowledge with them unless companies develop

appropriate retention practices. Retaining knowledge can be accomplished in two broad approaches: (1) not letting the knowledge “escape” in the first place, and (2) minimizing the loss of knowledge that can escape.

To keep knowledge embedded in work units, semi-autonomous team structures should be duplicated across similar environments. Task-specific “communities” within those units should be formed that link similar communities within the same unit or across shifts and locations. Workers may be parts of several such “communities” whose primary function is to share

knowledge, reflect on current and future task states, and increase awareness of “who knows what” to facilitate problem solving. Procedurally, team members should be rotated periodically to a different shift or team or assigned to a short-term project with members of other teams or shifts. Cross-training can be useful, but expecting workers to be “experts” in multiple disciplines they don’t practice routinely is not only ineffective but also potentially dangerous. Rather, cross-training should be limited to areas that are complementary. Companies can get more mileage out of cross training by having workers target a specific procedure or set of procedures in which to be cross-trained rather than training them on an entire new discipline. Once training is complete, workers would be periodically assigned to work with more experienced team members on those limited procedures so that “knowledge depreciation” does not set in. Successful implementation of cross training requires more than a one-time investment in training; it demands supervision and management that keeps the training alive, relevant, and safe for workers.

Technology also has a place in helping retain knowledge. Specifically, using technology and documentation processes, companies can capture and disseminate collective knowledge more easily. Knowledge management systems may include a team or process-level intranet site layered on top of the



company's existing intranet, offering point-and-click access to division, team, or "task community" news, a work space for collaborative projects, and a central repository for internally generated forms and memoranda. Processes that are documented would be accessible as well. Some companies are experimenting with mobile handheld devices linked to such knowledge management systems. While this could prove revolutionary, there are still thorny issues (such as trying to view large drawings, or even small sections of drawings, on a handheld size screen) that limit the applicability of such systems.

**E**ven with structural, procedural, and technological initiatives to retain knowledge, the departure of key or experienced people can still result in loss of critical expertise. Minimizing this loss requires the adoption of policies and procedures designed either to document or transfer such knowledge before it "escapes." For example, prior to retirement, workers could be assigned to review and update existing work procedures and to develop procedures where needed. Companies might appoint a "knowledge management czar" to work with units on documentation plans and develop templates to be used in procedural documentation efforts.

To help meet the challenges of procedural documentation, EPRI has conducted extensive research into capturing such knowledge

and making it available to other personnel when needed. This research was field-proven in nuclear generation facilities and is now being applied in power system engineering. This knowledge capture methodology is based on learning principles that focus on transferring knowledge to individuals using language and examples that are familiar to them based on their prior knowledge and experience.

In addition to documentation efforts, companies' employee replacement policies should be revisited in light of impending losses of experienced workers due to retirement. For example, most companies wait until a worker departs before hiring a replacement. Especially for craft workers, this creates an instant gap in knowledge transfer, as it takes a minimum of three to five years for workers to gain a solid footing in their respective areas of expertise. Companies could ameliorate this policy by hiring replacement workers at least three to six months ahead of expected retirements of existing workers. Regulators in

some jurisdictions have already begun funding such advance hiring initiatives. Companies in less sympathetic jurisdictions should focus lobbying efforts on exposing the risks associated with losing large numbers of experienced workers without opportunities for ramping up replacements or transferring the knowledge of retirees to knowledge management systems and new workers.

Another strategy is to hire replacements with a mix of experience levels. Replacing retirees with new or completely inexperienced people is costly in terms of lost knowledge for two reasons. The first, as mentioned earlier, is that there is an instant gap of three to five years in terms of knowledge transfer. Workers with some experience, even if only in a suitable skill practiced in a different industry, will pick up relevant knowledge faster than complete newcomers. The second reason is that older workers will relate more to employees who are not as markedly different in age as a recent high school or community college graduate. An "old-timer" who is paired with someone with a bit more experience and less dramatic age difference will be more likely to share information, and the new worker in such a case will be more effective in asking for and absorbing advice.

## IX. Conclusion

The electricity industry faces greater challenges now than at

any time since it was founded. The aging work force is a challenge requiring immediate action if companies are to keep the lights on as workers retire over the next five to eight years. Rising to this challenge requires dealing with many other problems since the workers hired today will be the ones solving these less immediate challenges. Workers will be called upon to implement

and operate new technologies to provide more reliable, higher-quality power to more varied customers. They will be required to learn more jobs and keep up with constant changes in their jobs. Recruiting and training new workers have become essential skills for companies. As senior workers retire, companies must find ways to keep the essential knowledge for running the

company from walking out the door. Dealing with these challenges individually as they occur is likely to lead to the demise of some companies. Planning for them and taking steps that handle several challenges simultaneously will allow some companies to flourish, providing better service to their customers and better returns to their owners. &