

HOW DID YOU DO THAT?

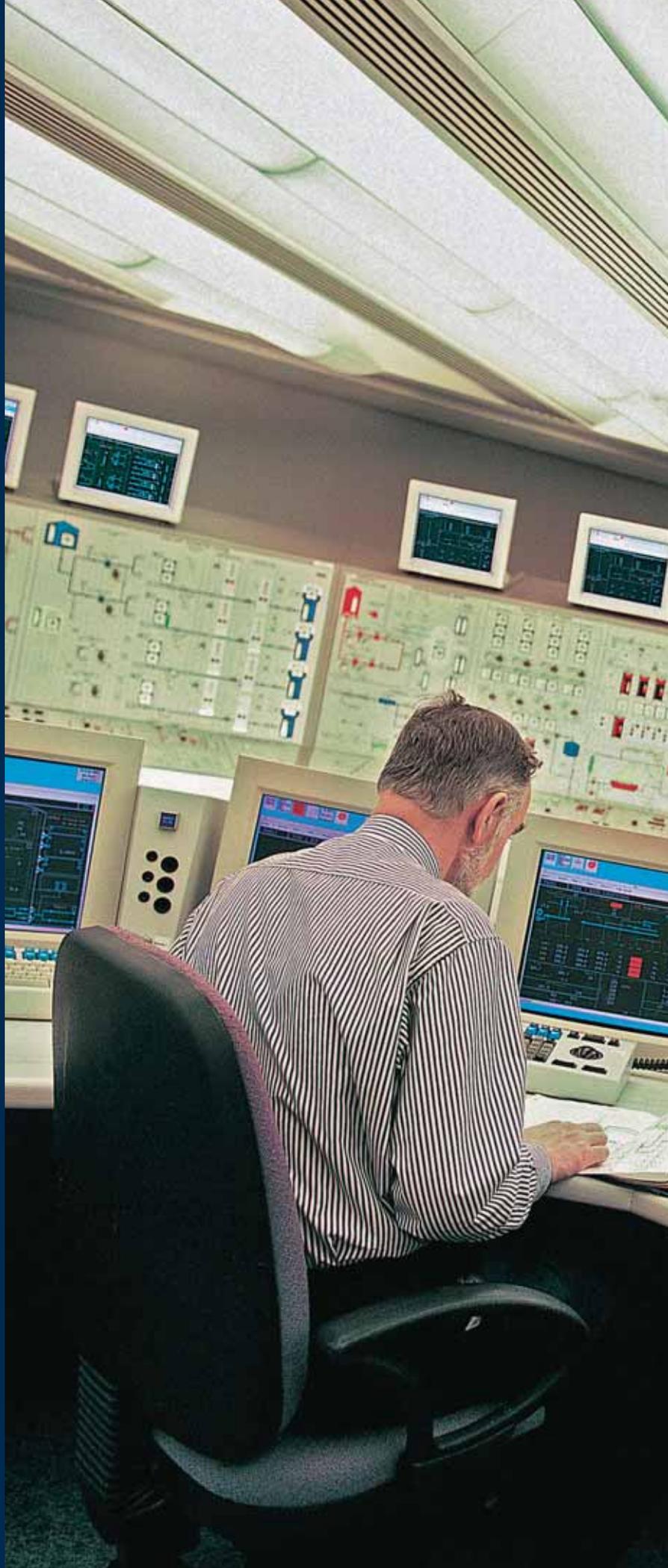
As Baby Boomers retire in ever-increasing numbers, utilities are developing new strategies for preserving and sharing their hard-earned expertise with the next generation of workers.

**BY BRIAN MOON,
ROBERT HOFFMAN, AND
DAVID ZIEBELL**

Know anyone like Bill at your utility? Bill has a solid background in engineering, more than 30 years of experience, and is highly versed in all of the engineering concerns pertaining to maintenance of the powerplant's mission-critical equipment. He also plays a key role in scheduling planned outages and is responsible for documenting how different powerplants are meeting the regulatory requirements of various government agencies.

Unfortunately, Bill also prides himself on keeping everything in his head and is planning to retire in 2010.

Most utility stakeholders have become keenly aware of the potential risks and costs associated with the coming exodus of senior workers like Bill and their know-



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ledge. David DeLong, author of *Lost Knowledge* (New York: Oxford University Press, 2004) has chronicled four big costs of this trend—reduced capacity to innovate, threatened ability to pursue growth strategies, increased incidence of errors, and increased number of efficiency losses—and how they will wreak havoc across a variety of industries. While it seems clear that the sheer size of the problem for the utility industry—65 percent of senior engineers will be eligible for retirement within three years—means that some of the costs will be unavoidable, a focused effort toward building a “smarts” grid will not only mitigate some of the costs, but also lead to innovations and efficiencies that could outweigh the losses.

A smarts grid is a series of mechanisms, processes, and organizational designs that help transmit mission-critical expertise from those nearing retirement to those set to inherit their responsibilities. But building an efficient and effective knowledge structure entails numerous perplexing challenges—from capturing tacit knowledge to reducing the overhead in transmitting it. Novel approaches to the study of expertise in the cognitive sciences and knowledge management fields offer some solutions.

Understanding Expertise

Expertise serves the organization in many ways. They provide judgment to speed corporate decision-making in time-critical events, where customer service, individual safety, and large investments are at risk. They provide resilience to company operations by resolving problems, complexities, and disasters; anticipating future demands; initiating plans that work smoothly in the current environment; and acting prudently where others might be impulsive. Often serving as repositories for vast historical information, experts know the rationale behind critical decisions that they and others have made. Experts also exercise effective leadership in ambiguous or complex situations by communicating simple features that other people may not see.

Expertise combines the information people know, the routines and procedures they follow, the repertoire of patterns they learn, the perceptual discriminations they make, and the models they use to explain and predict. When pressured by time, magnitude, and uncertainty, experts often rely on recognitional strategies. Gary Klein, author of *Sources of Power* (Cambridge, MA: The MIT Press, 1999) and *The Power of Intuition: How to Use Your Gut Feelings to Make Better Decisions at Work* (New York: Doubleday Business, 2004), has shown that as people gain experience, they size up situations and evaluate their options serially by mentally simulating how they might play out, rather than selecting and then crunching through analytic

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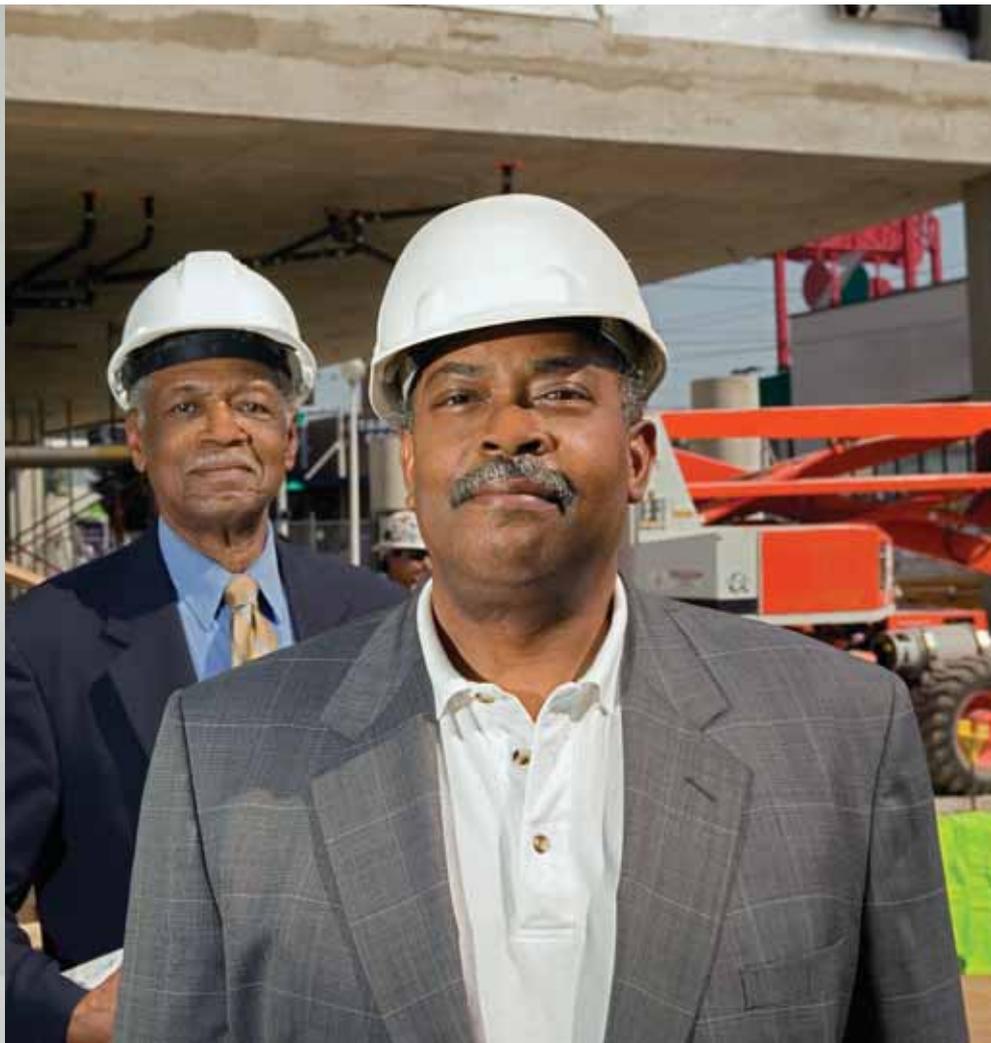
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65 PERCENT OF SENIOR ENGINEERS WILL BE ELIGIBLE FOR RETIREMENT WITHIN THREE YEARS.

formulas to compare their options simultaneously. That's not to say experts don't use analytic techniques or make calculations. Indeed, in rare or tough cases where greater reasoning is required, their experience informs which method to choose for what task, when the data are imprecise or where to get them, and how best to interpret the results for a given audience.

In support of their recognitional strategies, experts often have and use a wide range of sophisticated mental models to account for interacting and interdependent systems, determine expectancies, and diagnose odd system operations. Experts employ these mental models just-in-time, as in the cases where complicated design changes transition new technologies into legacy systems. They also use a few tricks to hasten performance and validate their diagnoses. And ex-



perts scope problems by knowing when to expand their line of view or hone in on details.

Expertise in many industries is the result of unstructured, ad-hoc sequences of experiences by relatively rare individuals. This rarity probably is the result of being in the right place to experience infrequent and challenging events several times. As a result, typically 20 years or more goes into the making of a recognized expert. Of course, many people in the workforce have 20 years of experience, and most of these become very good at what they do. But only a few are recognized as having expertise that exceeds that of others. Mere time in grade does not enable just anyone to adequately fill a unique and mission-critical function, so we cannot simply use this criterion to identify true experts.

Most senior managers know the “go-to” people who get things done and realize that their experts are an atypical breed within the ranks. Yet they can’t always speak to what makes them special. We’ve identified 14 performance features across domains ranging from world-class musical and sports performance to science and engineering that define what we call superexperts. (See the sidebar, “Are You a Super-

expert?”) It is possible that the achievement of superexpertise, and the high levels of respect and value that accompany it, will take 25-35 years of experience. But it is not inevitable that it will take that long, so identifying the next generation of superexperts early will be a key part of a smarts grid. Capturing what the experts and superexperts of today know will be another.

Mining for Knowledge

In a wicked irony, experts often have difficulty explaining how they do what they do. This is primarily due to the sheer vastness of their experience, which introduces so many contingencies that simple explanation becomes convoluted. Experts sometimes have difficulty expressing their knowledge, and often will just do a task themselves, opting for efficiency over an opportunity to transmit their expertise.

But with “knowledge elicitation,” experts can verbalize their tacit knowledge and express concepts that they had never made explicit before. Knowledge elicitation is the process of extracting information, through in-depth interviews and observations, about cognitive events, structures,

Are You a Superexpert?

The difference between experts and superexperts is really just one of scale. Superexperts possess all of the characteristics typically attributed to experts but exhibit several other features of performance.

- **Living for the edge.** Superexperts recognize that in order to achieve the mission, work needs to be done at the edge of the familiar.

- **Reveling in tough cases.** They recognize the uncommon or irregular.

- **Desiring unique incentives.** They expect to be compensated, but typical compensation packages are not the only, or even most important, carrots they seek.
- **Having a willingness to improvise.** They know how and when to improvise, particularly when situations go beyond the typical.

- **Being an ad-hoc solution provider.**

By virtue of their continuously demonstrated success, they become the “go-to” pro.

- **Rarely saying, “I don’t know.”** In the occasional case in which they find themselves at a loss, superexperts engage in problem-solving techniques to make sense of a situation.

- **Rarely saying, “This is what I believe.”** They are constantly on the hunt for formal, empirical evidence.

- **Creating comprehensive and thorough mental models.** They anticipate not only consequences throughout a system, but also the collateral consequences to other systems.

- **Using treasure maps.** They develop and use memory artifacts that are unique organizing schemes and reinforce the structure of their knowledge.

- **Causing trauma because of their absence.** For colleagues who rely on superexperts, their absence can be a traumatic event.

- **Seeing other perspectives.** Unlike the expert who may become engrossed in the problem at hand, superexperts have the ability to consider the perspectives of others involved in the situation.

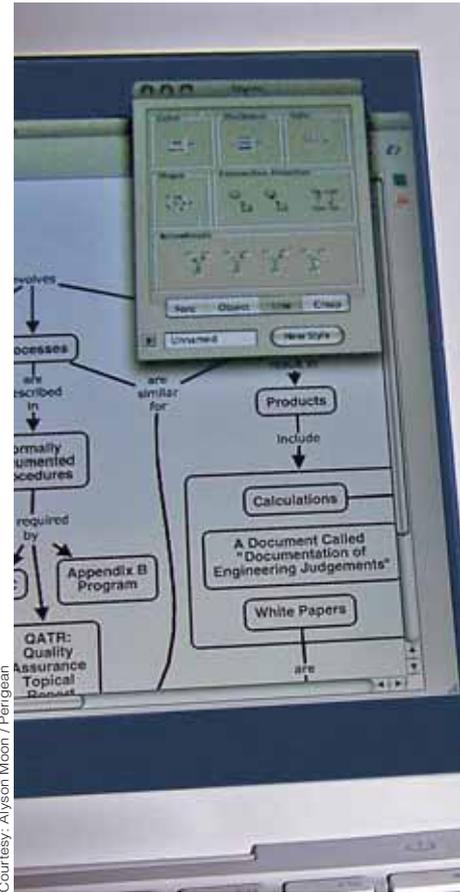
- **Leading, but often only by example.** They have the admiration of their peers and subordinates and develop knacks for employing their special position in furtherance of the mission. While they may find themselves in management roles, they are not always comfortable there.

- **Learning continuously.** They are students of their craft and practice it with zeal. While others may wish to forget about their last fault, superexperts think about their past mistakes, which both gall and intrigue them.

- **Possessing knowledge and skills that may not be recordable.** While we know that an expert’s tacit knowledge can be elicited when experts are given proper structure and prompting using knowledge-elicitation strategies, the challenges of knowledge elicitation from superexperts seem to push the edge of what is feasible.



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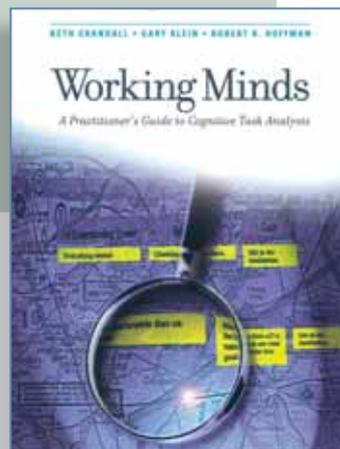
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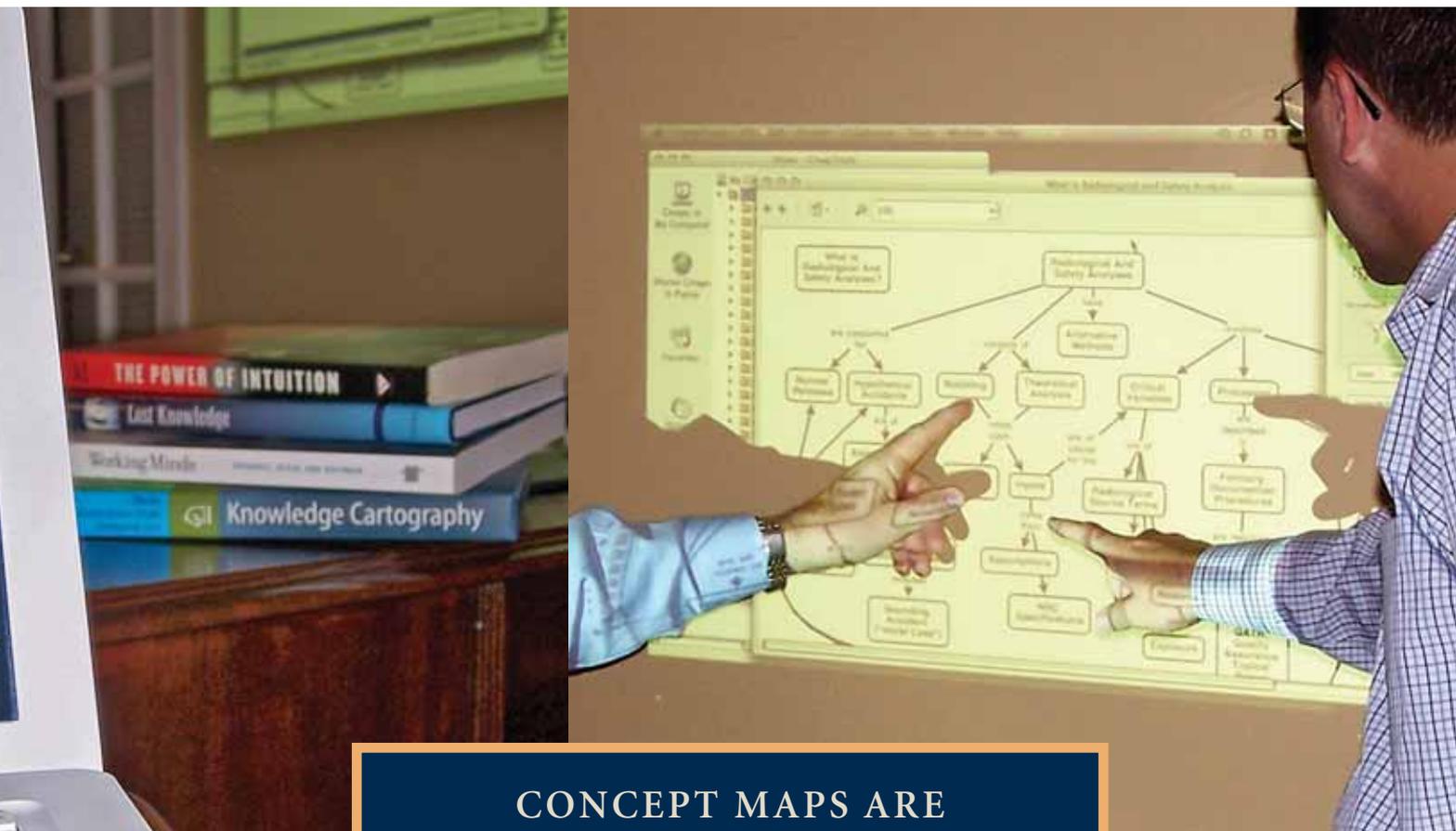
to shift experts from an operational account of an incident to a description of their thinking processes. An interviewer starts by reviewing some challenging cases that resonate for the expert. Next, the interview identifies the critical points of decision in the case, followed by deeper probes into each point. Experts are asked about the critical cues that made them aware of the situation, the models they drew on to diagnose what was happening, how they interacted with others involved, and the mental simulation they conducted to consider their options. The outcome of a CDM session, which can run upward of two hours and be captured as a written, audio, or video record, is a rich description of the toughest cases and how the expert dealt with them.

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or models. There are several well-established approaches for capturing expertise—you can find a survey of them in *Working Minds: A Practitioner’s Guide to Cognitive Task Analysis* (Cambridge, MA: The MIT Press, 2006) and the Electric Power Research Institute’s (EPRI’s) report, “Real-Time Expert Knowledge Acquisition and Transfer.”

Two methods that have proven particularly useful for understanding and eliciting expertise are the critical decision method (CDM) and concept mapping. CDM uses probing questions to uncover the kinds of knowledge and experience on which decisions are based. It allows interviewers





CONCEPT MAPS ARE GRAPHICAL TOOLS FOR ORGANIZING AND REPRESENTING KNOWLEDGE.

Concept maps (Cmaps) are graphical tools for organizing and representing knowledge. Whereas CDM gets at expertise through tough cases,

concept mapping directly elicits the structure and content of expert knowledge on a more day-to-day basis. To that extent, concept mapping can be highly efficient and easier to apply to situations. They consist of concepts (usually represented within boxes or circles) connected by lines that explicitly but briefly state the nature of relationships. The concepts and links form propositions, which are arranged hierarchically. This structure is purposeful, as it builds on the biological structure of knowledge within the brain, where hierarchical memory cell clusters enhance and grow throughout life and, in turn, can be graphically depicted in Cmaps. The simplest Cmap consists of two concepts connected by links representing a simple proposition such as “utilities produce electricity,” but they can also become intricate as knowledge grows.

As described in *Knowledge Cartography: Software Tools and Mapping Techniques* (New York: Springer, 2008), concept mapping is used worldwide, with applications ranging from teaching to business management, and even operational use in the government and military. A primary application for

concept mapping in corporate environments is the preservation and transfer of expertise. Simple Cmaps are easy to create, but they can

become complex quickly. In facilitated concept mapping sessions, knowledge elicitors interview industry experts, prompting them to articulate their deep knowledge in the form of a Cmap. This reflective activity often is marked with insightful moments, prompting the expert to profess “I’ve never really thought about it in quite this way, but now that it comes up...” and extend the Cmaps in ways that aren’t possible with more structured approaches.

Using “CmapTools,” software developed by the Institute for Human and Machine Cognition, practitioners can link sets of concept maps and associated digital resources (documents, photographs, applications, diagrams, and video interviews), organizing the materials to form knowledge models. At NASA’s Glenn Research Center, for example, concept mapping knowledge elicitation sessions were conducted with a retiring senior engineer who specialized in the Delta rocket motor. The resulting knowledge model of 11 Cmaps and 140 other resources thoroughly expressed and organized his deep knowledge.



As a virtual table of contents for expertise, knowledge models are essentially historical in nature, but their application is geared toward future performance improvement. One of the most important benefits of capturing expertise in Cmaps stems from the subsequent efficiency of transfer. When properly structured and resourced with the essential documentation on which experts rely, knowledge models are a gold mine for training new and even experienced workers in the nuances of superexpertise. There is no intervening step between modeling and transferring—the browsable and searchable knowledge models are the transfer mechanism. Most important, knowledge models can be revised as future knowledge and procedures morph.

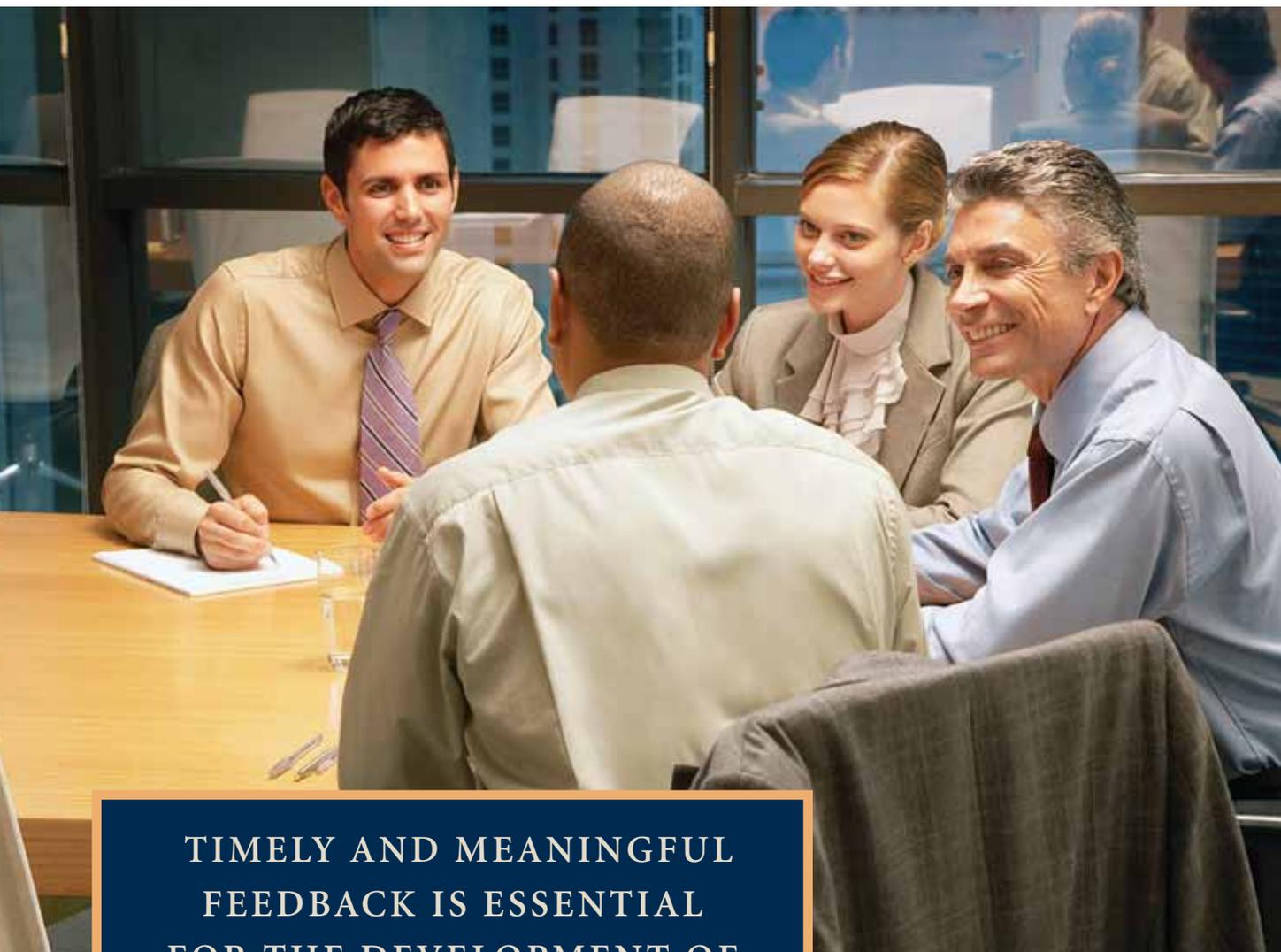
The action of preserving expertise has collateral benefits. A major one is that management gains real insight into what the expert does on a day-to-day basis. This improved understanding of job responsibilities can help management formulate a better succession plan than they could have otherwise. Once elicited, expertise must be transformed by a smarts grid in order to serve its customers—the next-gen-

eration workforce. Developing mechanisms to efficiently re-integrate expertise back into already oversubscribed work routines will be a major challenge for a smarts grid.

Four Transformers

Whether through existing training programs, regulatory activities, or routine tasks, you can transmit expertise without much additional overhead. Here is some advice to consider.

Train in the way experts work. Traditional training regimens start simple then add complexity only after achievements are made. The development of expertise, however, is marked by a constant stretching of the skill against difficult challenges and practice that simulates real work—the challenges, contexts, and duties of the job—to the extent possible. While basic training will be a requirement for any job, quickly moving learners into decision-making exercises or simulation-based training that build upon the toughest cases (captured via CDM, for example) and provide immediate, expert-based feedback that will enable them to develop a “feel” for what it’s really like when the going gets tough.



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**TIMELY AND MEANINGFUL
FEEDBACK IS ESSENTIAL
FOR THE DEVELOPMENT OF
EXPERTISE.**

Preface on-the-job-training. As much as 60 percent of all training is on-the-job-training (OJT) because it is the first, and sometimes only, strategy corporations rely on for learning. New performers shadow experienced performers, learning how to accomplish tasks as they come. Invariably, many learning opportunities are missed as the critical mission changes or turnover occurs. More problematic, mentors and those being mentored typically lack the abilities to assist and support knowledge transfer. By prefacing OJT with a program that shows experts how to train and educates apprentices on the best ways to learn, OJT can effectively serve to transmit expertise.

Incorporate expertise into feedback and planning processes. Timely and meaningful feedback is essential for the development of expertise. Annual performance reviews, while perhaps useful for documenting career progression,

rarely provide the insight necessary to drive the achievement of expertise. The military often uses after-action reviews to provide a shared understanding of how a team handled challenging incidents. More important, the military spends time teaching its leadership how to effectively conduct these reviews and not let them turn into blame games.

Another approach that has gained favor among military and corporate leaders alike is the premortem method, developed by psychologist Gary Klein. A simple technique to implement, the premortem is the hypothetical opposite of a postmortem (where everyone but the patient benefits). Unlike a typical critiquing session in which team members are asked what might go wrong, the premortem operates on the assumption that the “patient” has died and asks what did go wrong. The team members’ task is to generate plausible reasons for the project’s failure. In describing weaknesses that no one else has mentioned, team members learn from others what might go wrong and are sensitized to pick up early signs of trouble once the project gets under way. Adding experts to

a premortem can help others begin to build a repertoire of expectations and patterns.

Codify expertise into knowledge models and memory aides. Superexperts develop and use a variety of memory aids, including what we call treasure maps—individual ways of organizing materials and key information that might range from the simple arrangement of sticky notes to more sophisticated tracking and filing systems. Codifying these treasure maps from the perspective of the superexpert is a low-effort, high-payoff strategy for transfer. Also, mnemonics, those short poems or special words many of us learned in childhood that continue to help us remember information to this day, are experiencing something of a renaissance. The U.S. Army has experimented with using pictorial mnemonic devices to facilitate the recall of uncommon, unfamiliar terms and phrases in complex aviation emergency procedures. Results showed that the devices helped bring a population of novices to a level comparable to that of highly experienced pilots in just one week, prompting funding for similar programs for other knowledge bases such as first aid.

Champions Needed

The utility industry is clearly responding to the labor challenge. A 2002 EPRI survey of managers representing 21 elec-



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tric utilities found that 92 percent believed that loss of expertise would pose a problem within the next five years but only 30 percent indicated that a planning effort was in place to retain knowledge. Since then, major initiatives to mitigate the consequences have been underway or are planned, many of them focused on the influx of new workers. For example, Public Service Enterprise Group created the Energy Utility Technology Degree Program, to develop a continuous pipeline of diverse talent for employment in entry-level, technical trade positions at the company. And the Center for Energy Workforce Development, formed in 2006, teams with secondary and post secondary educational institutions and the workforce system to create workable solutions to address the need for a qualified, diverse workforce.

But it takes upward of 20 years to achieve expertise, as experts must get exposure to critical events and meaningful feedback. Even with an investment of hundreds of thousands of dollars in training, there are no guarantees about who will emerge as the experts of the next generation. Any years or dollars that might be shaved off by



THERE ARE NO GUARANTEES ABOUT WHO WILL EMERGE AS THE EXPERTS OF THE NEXT GENERATION.

identifying candidates early and transmitting true expertise would represent a significant savings and a lessening of an organization's risk.

The smarts grid is a means to this end, but without a champion it is just an idea. Building a smarts grid within

an organization requires champions for expertise, as well as decision makers who understand its importance and seek its preservation and transmission. Champions can seize the opportunity, sensitize others to the importance of expertise, help identify experts and superexperts, develop programs to pre-

serve expertise, and introduce better transmission mechanisms. Internal knowledge management practitioners can help guide the effort by providing training techniques or even outsourcing elicitation.

Each utility will need to consider its own capabilities and needs, but building a smarts grid today will go a long way towards preparing the workforce of tomorrow. ♦

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what will you do when your
“go-to” people ...



GO ▶▶▶

Expertise drives mission-critical work, but most organizations don't feel its true impact until it is gone. Perigeon Technologies LLC can help your organization protect itself against the hidden costs of lost expertise. We help assess, capture and organize expertise, so that it remains when people go.

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