Often undervalued, experts possess a mastery of their jobs that makes them almost irreplaceable.

The Experts in Your Midst

by Michael J. Prietula and Herbert A. Simon

Tom Bennett, owner of a growing high-tech enterprise with sales of $30 million, has decided to go public. His ratios are right and his product is good, but the fine points of his strategy are not quite in place. Early Monday morning before the regular staff meeting, he sits lost in thought about product image, the state of his underlying technology, and capacity expansion.

A glance at a memo left on his desk late Friday causes him to sit up in his chair. One of his best designers has quit! Tom’s attention shifts immediately to questions about this turn of events. Should they replace this designer? Should they try to woo her back? Does anyone else in the company have her skills? What, exactly, are her skills and how vital to the company are they? Is anyone else in a position to develop these skills without costing the company too much time and money?

Should Tom Bennett be worried? In organizations, employees come and employees go. An important employee quits, and headquarters tries to fill the gap while maintaining business as usual. Some people, however, are worth more than others. The gap their departure leaves can be wide—sometimes wider than anyone expected.

Tom, his reverie about a public offering now entirely dissipated, realizes that he doesn’t really know what this designer did or where she fits in the company’s network of relationships. He recalls that she often seemed to have the right answers, to have a sixth sense about how to tackle new or different design problems. And when she led staff meetings, “things got done.” She had been with the company nearly ten years. She had not moved up the ladder very far, but Tom remembers instances when her problem-solving ability had saved the company time and money. Once he asked her how she had solved a particularly difficult problem, to which she replied, “Well, I can’t really say. It just came to me.” She would be hard to replace not only because of her technical skills but also because of her intuitive judgment.

Tom Bennett should be worried. He has lost an expert. But what, exactly, is an expert? How do people become experts? And why should managers understand the expert’s reasoning process?

Understanding why experts are experts and how they got to be that way can help you spot them and realize their contributions to your business. Pinpointing your experts will allow you to evaluate them, reward them appropriately, and (you hope) retain them. Knowledge of the experts around you can also give you valuable insight into how your organization works.

Expertise may be crucial to your company’s performance. Calls for managerial excellence and the recognition of intellectual capital have helped to trigger a renewed interest in it. And many companies are investigating the opportunities for expert systems—software that mimics the problem-solving behavior of experts.

Expertise, however, involves much more than knowing a myriad of facts. Expertise is based on a deep knowledge of the problems that continually
arise on a particular job. It is accumulated over years of experience tackling these problems and is organized in the expert's mind in ways that allow him or her to overcome the limits of reasoning.

Making Connections

There are three limits on the power of reasoning common to all of us mortals, which years of problem solving can allow us to transcend on the path to expertise.

First, there is a limit on attention. You can focus on only one problem, or make one decision, at a time. You cannot simultaneously review the budget and decide whether to fire an individual—unless, of course, the firing decision hinges on the state of the budget! Often, of course, your attention flicks from one thing to another, as when you’re speaking on the telephone to a friend about restaurant options for the evening while reading a memo on new parking assignments. But more serious matters require your undivided attention.

Related to this single-mindedness is a limit to working memory. In problem solving, working memory is the meeting place for the information you have about the problem, the inferences you draw, and the knowledge you bring to bear to solve it. When you do the budget, setting out the various charts and figures on the desk helps you focus quickly on relevant facts to bring into working memory so that you can muster your powers of reasoning.

Working memory has limited capacity. You can hold only so many pieces of information—psychologists call them “chunks”—in working memory at one time. Trying to juggle any more than about seven of these will impair your ability to reason.

Finally, there is a limit on long-term memory access. You can recall only so much of the knowledge you have stored in long-term memory over years of learning and experience. To what extent you truly forget things is uncertain, but that is not the issue. What is certain is that you lose access to much of the knowledge stored in your long-term memory if you don’t use it regularly.

It’s like forgetting where you left your car in the long-term parking area at the airport. You know it’s there, but finding it turns out to be difficult. Suddenly all the cars in the lot look the same. Now imagine trying to find it if the lot holds millions of automobiles! This capability is important because a large part of problem solving involves accessing relevant knowledge from long-term memory at the right time for use in working memory.

Since we all have these limits, how do experts perform their jobs at a level that distinguishes them from their fellows? That is, how do they overcome these limits? What made Tom’s designer special?

Many organizations have maintenance people who can easily diagnose a malfunction over the phone. In manufacturing facilities, a common phenomenon is the veteran foreman who can walk the plant floor to get a sense of the production situation and then promptly put his finger on any problem areas. Experts appear to absorb and evaluate large quantities of information quickly. In fact, the veteran does not scan the environment and process information any faster than an inexperienced foreman; rather, he (or she) has learned to grasp the meaning of certain patterns of operations and activity on the plant floor. In a sense, the foreman does not need to think about this information; he simply reacts to it.

Expertise is a mixture of analysis and intuition.

The veteran foreman recognizes and reacts to plant operation patterns by chunking. After being on the job for a long time, the foreman begins to see that all the problems arising in daily operations are not new and independent of each other. He learns to ignore the irrelevant patterns of activity and concentrate on the critical ones. Eventually, he begins to group the relevant patterns together as a chunk of understanding and to link that chunk to others.

Once chunked, the linked patterns are viewed as a single unit (thus taking up less working memory and attention) and as automatically activating any related knowledge chunks from long-term memory for use in working memory (thus alleviating the access problem). Patterns invoke chunks, which invoke chunks, and so forth. Collectively, this rich store of ever-changing chunks forms our data base of knowledge. The chunking process in expert reasoning is extensive. In chess, for example, a grand master must be able to recognize and recall roughly 50,000 chunks, within a factor of two. It is quite reasonable to assume that experts in all walks of life require 50,000 chunks. Or more!

Needless to say, amassing this rich store of chunks takes time and effort—more than 10,000 hours of chess. Research shows consistently that in the most rigorous vocations, like medicine, around ten years of serious effort are necessary before a person can approach levels of performance regarded as expert. How much time should we expect for the development of an expert foreman? Or an expert maintenance person? Or an expert manager?
This interpretation and linking form the foundation for two related types of reasoning used by experts: analysis and intuition. Analysis involves sustained, systematic thought over a substantial span of time [minutes to hours], while intuition reflects timely, and seemingly less deliberate, reasoning that is sometimes referred to as a hunch or professional judgment.

Experts Reason Analytically. Analytical reasoning is typically associated with complex problem solving and consists of gathering information [like the price/earnings multiple and dividend yield], mobilizing relevant knowledge [recalling industry averages or characteristics learned from prior analyses or conversations], making observations about the situation [being above or below industry averages, being consistent with other trends], and proposing solutions [specifying reinvestment strategies for growth].

A chess master may ponder many moves before choosing one, a doctor may request various tests before settling on a diagnosis, and a manager may review several analyses before making a decision. Analytical reasoning takes time and requires extensive use of mental capital.

Experts Reason Intuitively. But sometimes experts generate accurate observations or even solutions without thinking more than a few seconds and without appearing to examine the situation closely. Intuition is a leap, and the person taking the leap generally is not aware of how he or she did it. The phenomenon is the sixth sense that Tom Bennett noted in his designer's make-up.

How does intuition work? Long experience leads to chunking, so that familiar patterns emerging in a situation immediately suggest a possible move [chess], a possible condition [medical diagnosis], a possible fault [electronic troubleshooting], or a possible risk [finance]. Such associations evolve over time and persist because they contribute to success in problem solving. The chunking process reinforces this persistence. Therefore, Tom's designer's intuition is not a magical sixth sense; it is a sophisticated form of reasoning based on chunking that an expert hones over years of job-specific experience.

Intuition grows out of experiences that once called for analytical steps. As experience builds, the expert begins to chunk the information into patterns and bypasses the steps. A pattern of machine tool functioning confusing to an inexperienced foreman, or a pattern of stock market gyrations confusing to a tyro financial analyst, leads to thought of possible causes, which calls for deep analysis.

Eventually the foreman or analyst uncovers the cause. If the same pattern of information is encountered again, it will be less confusing. The person will know what data are relevant and what are not. Possible answers generated from experience will pop up intuitively, thus sparing the foreman or analyst laborious and redundant analysis. Over time, as more patterns are chunked and linked, the hunches become better and better. That is how Tom Bennett's designer developed her valuable intuition.

The ability to generate intuitive responses does not of course mean we are slaves to that sort of behavior. The instant the opponent makes a move, the chess master is aware of several intuitions, but then deliberates for 15 minutes while scrutinizing the situation. From a glance at a radiograph, the radiologist can offer hypotheses on what is going on, but may still choose to review the patient's chart or consult a colleague. The corporate executive may have a 'gut
feel” for the causes underlying unexpected budget variances, but proceeds to confirm or refute intuition through analysis. Tom Bennett’s designer may entertain hunches about a design; nevertheless, she sits down to try them out. Both in the laboratory and in practice, expert intuition and expert analysis combine to produce expert performance.

The Open Organization

How can an understanding of expertise help an organization? What can you do tomorrow with this information? We can offer some suggestions, observations, and warnings.

First, of course, you have to determine the functions in your organization that call for the kind of expert’s input that we have described. And it’s a good idea to jot down the names of the experts in the organization and note what their expertise adds to the performance of whatever they do. You may find some surprises; expertise is often found in lower level people who deal with customers (like the employee on the customer service hotline) and who are in positions where many activities meet (like the person in charge of the parts depot). Expertise often encompasses value beyond the job description, particularly where human dynamics play a role. Think of the nontechnical aspects of being a foreman or plant scheduler. They know you don’t put this job on this machine with this person, or else productivity will drop. They are the people who know the inner workings of the company even better than you.

But there is an important difference between an expert and somebody who simply knows more—that is, has access to more information than others. The latter may be regarded as an expert or may set himself or herself up as an expert, but it is only that person’s access to sources—not the use made of the information—that distinguishes the person from others. The power that this position gives the mock-expert can be counterproductive to the organization that relies too heavily on this “false prophet.”

It is important for organizations to nurture the development of expertise. But it is quite impossible to transfer that type of knowledge to another individual without cost. Any plan to implant an expert’s knowledge in another human or a machine (like an expert system) will be time consuming and expensive—if it can be done at all. Apprenticeship is an age-old method of expertise transfer, but it is neither a shortcut nor a substitute for experience, especially when it comes to developing intuition. The trainee cannot appreciate the subtle cues and discoveries the expert has accumulated over the years. Besides, experts are notably inarticulate about their gift.

Nowadays, organizations are increasingly building expert systems to retain knowledge resources. While we are learning fast how to represent and use certain types of knowledge on machines, we are still faced with the difficulties and inefficiencies of determining what the know-how of the human expert “looks like.” In the parlance of artificial intelligence, this is the knowledge-acquisition bottleneck. Establishing how an expert reasons to the extent required to build a dependable expert system is a serious, ever-present obstacle to overcome.

Even if this hurdle is overcome, there is no guarantee that a usable system can be built. Some kinds of expertise are simply too difficult to replicate. What if the expert needs to see or touch the data? Then there is the person who is a facilitator, the one who gets things done. It may be an integral, but undocumented, part of his or her job. To try to replicate it with a system would be pointless.

Think again of the key role of shop scheduler. An expert scheduler is intimately familiar with the products, resources, machines, and the people who run them. Keeping in mind the subtleties inherent in these factors, an expert scheduler can weave a schedule that optimizes yield and minimizes downtime. An expert scheduler is also one who knows that the “psychology of scheduling” is a vital intangible. This person is a “wise old Turk” to use one observer’s term.¹ Here is intuition at work. Books, lectures, or videotapes couldn’t capture what this expert does. An extended apprenticeship is necessary before a replacement could begin to capture the skills of scheduling without disruption. An expert system would be out of the question.

More amenable to programming are jobs where expertise does not actually exist; that is, where a discrete body of information resides or a separate function lies. In any large organization, there are many of these wads of knowledge that could be fashioned into expert systems.²

In evaluating long-term employees and setting career paths, there is often a fundamental ambivalence

on management's part. The organization that prizes the contribution of the expert (almost by definition a long-term incumbent in the particular job) may also force its rank and file to view moving up the ladder as the metric of success.

The strong correlation that nearly every organization makes among upward mobility, success, and compensation puts great pressure on the employee who wants to become an expert in his or her current post. If the person has not moved up a notch in a few years, he (or she) is viewed as lacking in potential. He may feel like a failure and as a result may become a failure. Though he may be learning to be the best at what he is doing, the reward system does not acknowledge it.

**Experts want recognition; does your organization respect their expertise?**

This situation is heavy with irony, since it's in the corporation's interest to cultivate and retain the talent that is essential for its survival and profitability. But few organizations structure their compensation and reward systems to permit superior performers to become more valuable as they stay put. People should be given the opportunity to become masters of important tasks without feeling that their jobs are dead ends.

It's the organization's responsibility to support these efforts and to look for ways to expand their people's expertise even more. To permit the experts to contribute to the extent of their capability, the organization has to foster an environment in which employees feel free to give feedback to management. Finally, the organization should keep alert to the possibility of automating aspects of the expertise it has for wider dispersion among the ranks.

All organizations, large and small, need product or process innovation. Innovative ideas come most often and most reliably from experts. These experts are not just the engineers, scientists, and other professionals in the hierarchy; in various forms, expertise often exists even in the outlying sections and lowest levels of the organization.

Innovation comes from those employees with extensive job experience and knowledge, good intuition, and the ability (and desire) to see their jobs from several perspectives. To foster innovation, the company has to allow experts to stick with their jobs. They may not hit home runs every time at bat, but for the long term they have the knowledge and insight to generate and recognize opportunities for the organization.

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