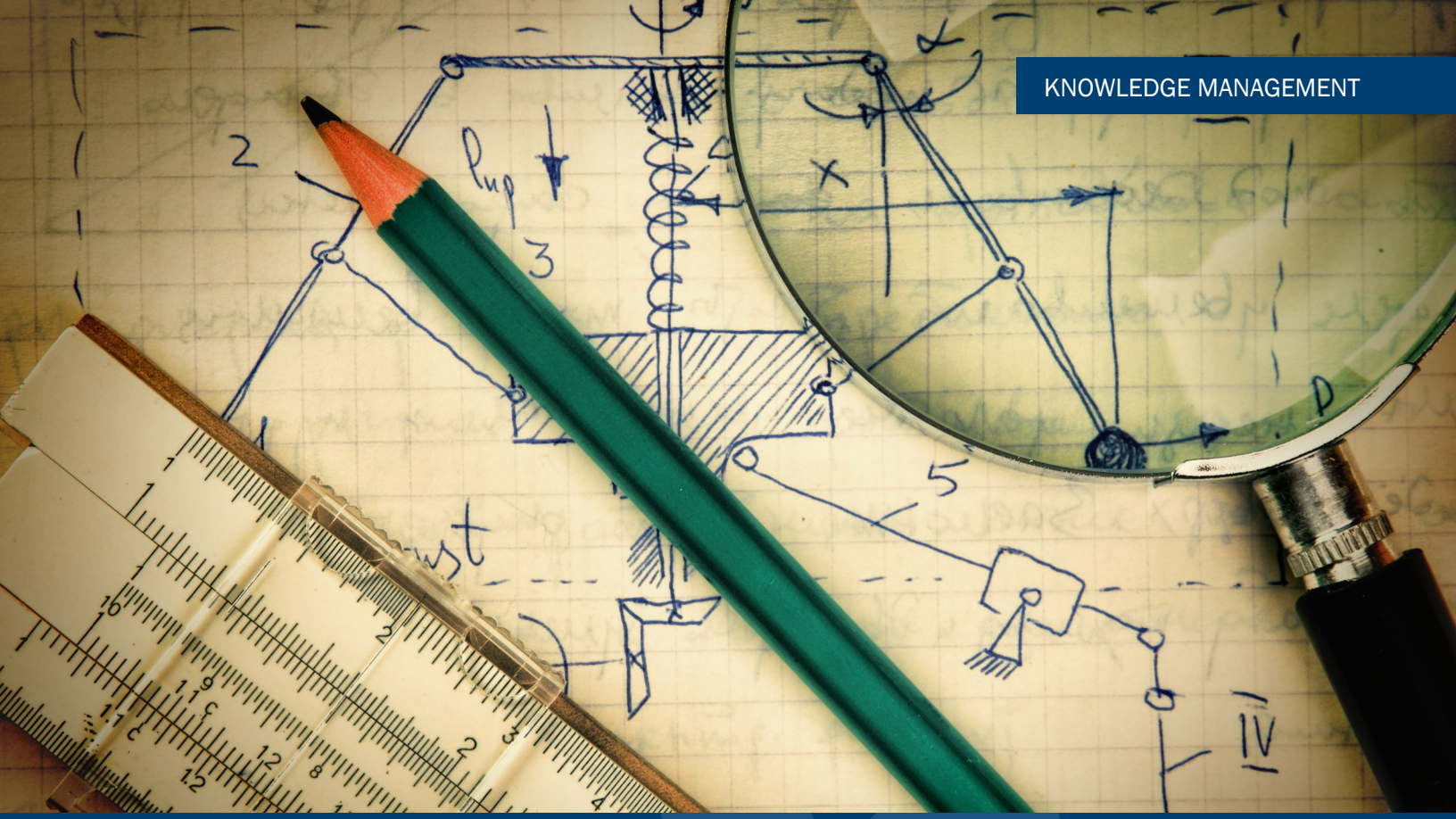


KNOWLEDGE MANAGEMENT

HOW SMART LEADERS LEVERAGE THEIR EXPERTS

Strategies to Capitalize on Internal Knowledge and Develop Science, Engineering, and Technology Expertise

By Carla O'Dell and Lauren Trees

APQC REPORT

APQC
Make Best Practices Your Practices℠

INTRODUCTION

Many industries are contending with shortages of experts in scientific, technical, engineering, and math (STEM) specialties. Rather than revisit the well-known efforts of companies to recruit STEM talent, APQC turned the problem on its ear and asked: How can organizations leverage the experts they have while, at the same time, accelerating the rate of learning for new hires and mid-career employees?

Although training for new hires is critical, our findings suggest that organizations are focusing more attention on newcomers while investing less to develop mid-career professionals than the urgency led us to expect.

To identify needs and approaches, we interviewed APQC members from a variety of industries in organizations with large contingents of scientific, engineering, and technical employees.

Initially we focused our research through the lens of knowledge management (KM), thinking about the role of communities and networks, content platforms, expertise locators, and collaboration tools in leveraging current experts. However, our interviews quickly revealed that these KM approaches were being combined with a host of others—everything from structural approaches (e.g., consolidating senior experts in a regional or global center of excellence) to HR-driven technical talent management[1] and training and development programs.

We then conducted a short survey of APQC's audience in technical and engineering disciplines, business excellence, KM, and HR to get their perspective on the issues raised in the interviews. Clearly we touched a chord: We immediately received more than 750 valid responses, with more than half rating STEM competency and expertise development as an urgent or significant priority for their organizations (Figure 1).

In this first of a series of white papers and research bulletins we present highlights of our findings and invite commentary and suggestions for future research.

Among the big questions we addressed:

1. Where are the expertise gaps faced by scientific, technical, and engineering organizations?
2. What is driving the urgency to close these gaps?
3. How are organizations leveraging the experts they have to close the knowledge gap between experts and mid-career employees?
4. How does this differ from the approaches used to build the competency of novices and newcomers?

We would like to thank executives from the following organizations for being part of our initial round of interviews. Your perspectives helped shape our subsequent research.

Alcoa	*Devon Energy*	*MITRE*	*Rockwell Collins*
Baker Hughes	*Ecopetrol*	*Nalco*	*Schlumberger*
Chief Oil and Gas	*MWH Global*	*NASA*	*U.S. Army ARDEC*
Deere & Company	*Merck*	*Pfizer*	

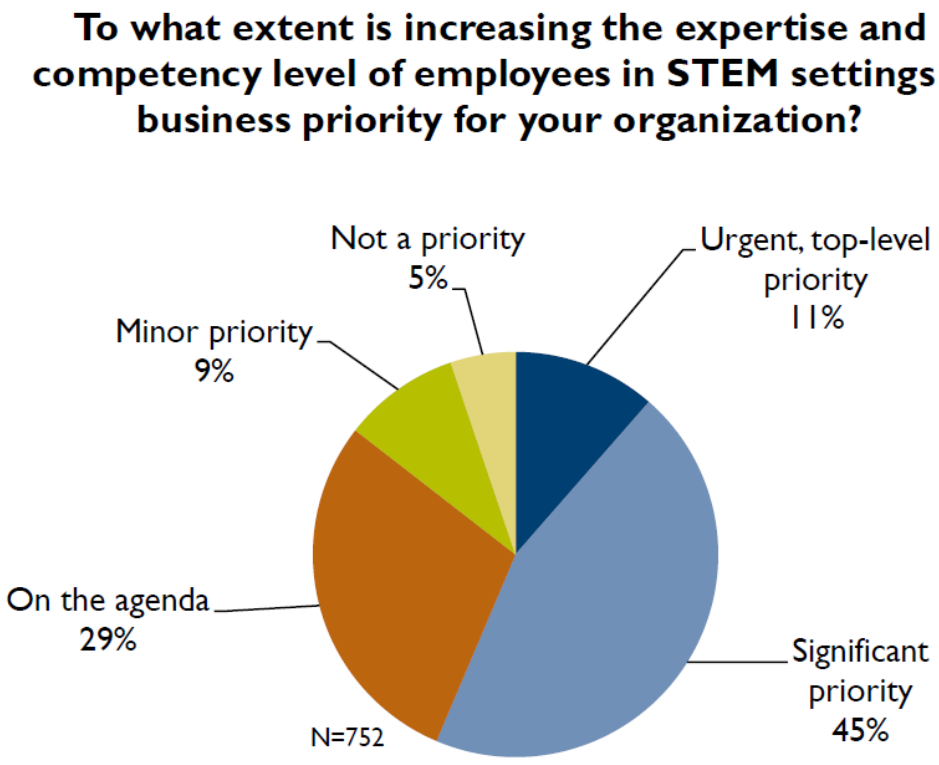


FIGURE 1

THREE CRUCIAL KNOWLEDGE GAPS

Technical leaders told us they are contending with three knowledge gaps needed to meet today's technical needs and tomorrow's growth: one focused on turning mid-career employees into true experts, another on developing novices and newcomers so they can work independently and begin contributing to the organization, and a third related to the speed with which new knowledge is created and applied to emerging challenges and opportunities.

DEVELOPING EXPERTS

At the top end of the expertise ladder, few organizations have sufficient candidates qualified to step into senior roles, whether as technical leaders or subject matter experts. We refer to this disparity between mid-career employees and long-tenured experts as the "expert/nex'pert" gap, borrowing a term coined by Lockheed Martin's KM team.

Why this lack of people with 10, 15, or 20 years of experience ready to take the helm? Many technically focused industries—including oil and gas, engineering, construction, and aerospace—went on hiring binges during high-growth eras, followed by layoffs and lulls in hiring during downturns.

To further contribute to the problem, those laid off may have left their industries or gone to start-ups and are no longer available for rehire. This has created "lumpiness" in the talent pool when it comes to tenure and experience.

Heretofore, this gap had not reached crisis proportions because employees nearing retirement have been induced to stay on longer due to incentives by the firm, declines in their retirement portfolios during the last recession, or both. With the economic recovery, cracks in this stop-gap are starting to

emerge. The current pool of experts is spread thin, and there simply aren't enough mid-career employees ready to step into their shoes.

BRINGING NEWCOMERS UP TO SPEED

The second gap is the need to help novices and newcomers increase their competency, perhaps faster than previously required. Many interviewees report that their organizations have more projects underway than in the past, resulting in a greater need for project management skills and business acumen. Further, they need employees to take on more responsibility earlier in their careers.

The flip side is that many of these newcomers want the responsibility earlier. They're less patient than their predecessors, and they're not going to stay engaged over the long term if they are relegated to an apprentice-style role for years and years.

Based on our data, this second knowledge gap is being addressed more comprehensively and strategically than the first. Fifty percent of our audience reports that their organizations have significant or fully integrated efforts to support learning and development for novices, whereas only 37 percent have similar initiatives in place for mid-career professionals (Figure 2). Many—42 percent—say they see a smattering of activity to develop nex'perts into experts, but no overarching strategy guides and sustains these efforts.

It is possible that the type of specialized knowledge mid-career employees need does not lend itself to an integrated approach. However, we suspect a different reason: Whereas the need to bring new-hires up to competency is a broad, obvious challenge recognized

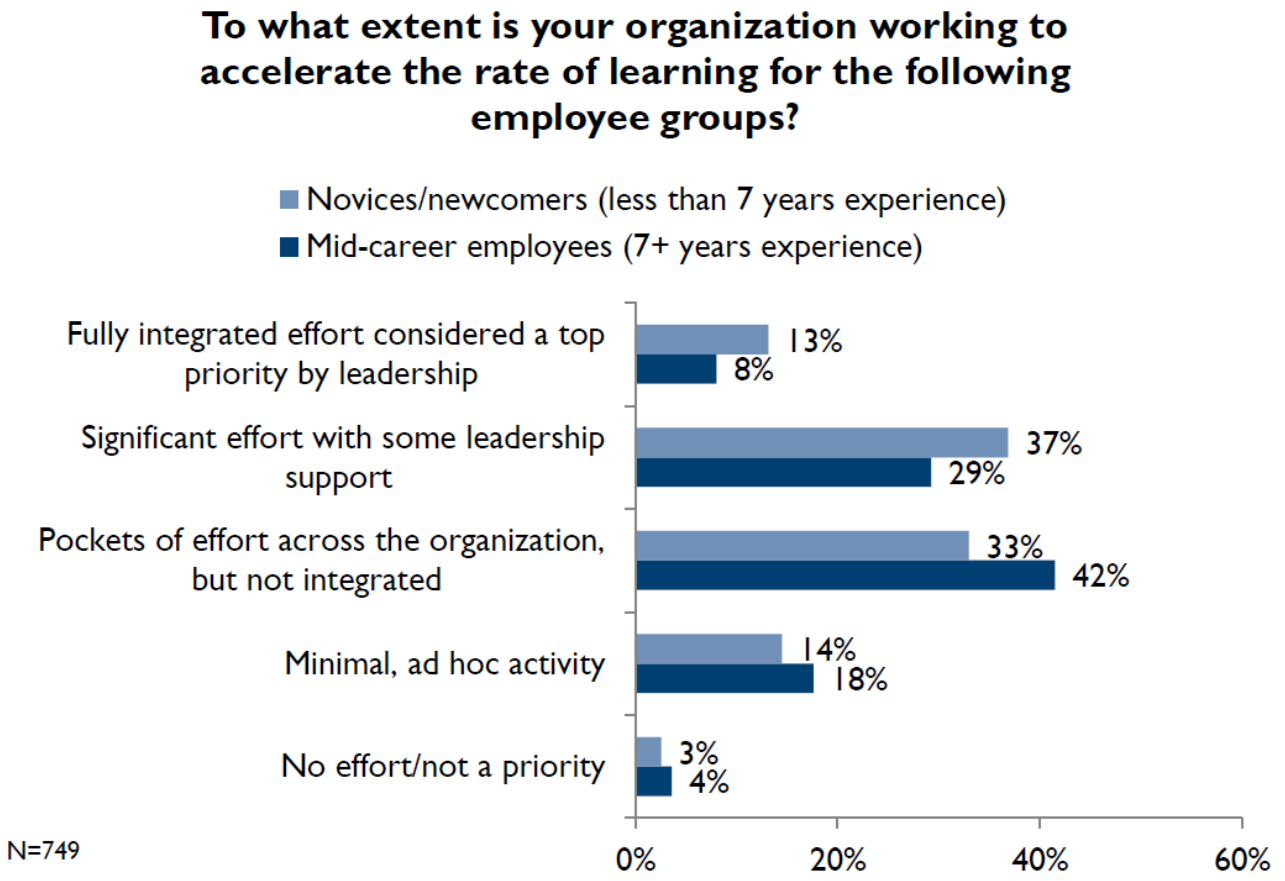


FIGURE 2

by both HR and business leaders, the gravity of the nex'pert shortage is clear only to those who fully understand the knowledge domains and work processes in each corner of the organization.

From the outside looking in, a nex'pert may look prepared to step into a technical leadership role, with the true knowledge and experience gaps becoming apparent only after the long-tenured expert has walked out the door.

ADDRESSING NEW AND EMERGING KNOWLEDGE

The third gap may be the most urgent piece of this problem, and it is not a function of retiring employees or green newcomers. In many cases, technologies and markets are changing so rapidly that it is *new* knowledge and expertise that is in short supply.

When we asked our audience about the reasons behind their need to leverage and grow experts, the most common responses focused on emerging technologies and shifting product mixes—not the aging work force or the requirements of globalization or expansion (Figure 3).

The type of expertise in demand at these organizations cannot be transferred from departing veterans and yet must be developed quickly, sometimes by conscripting talent and content from other disciplines.

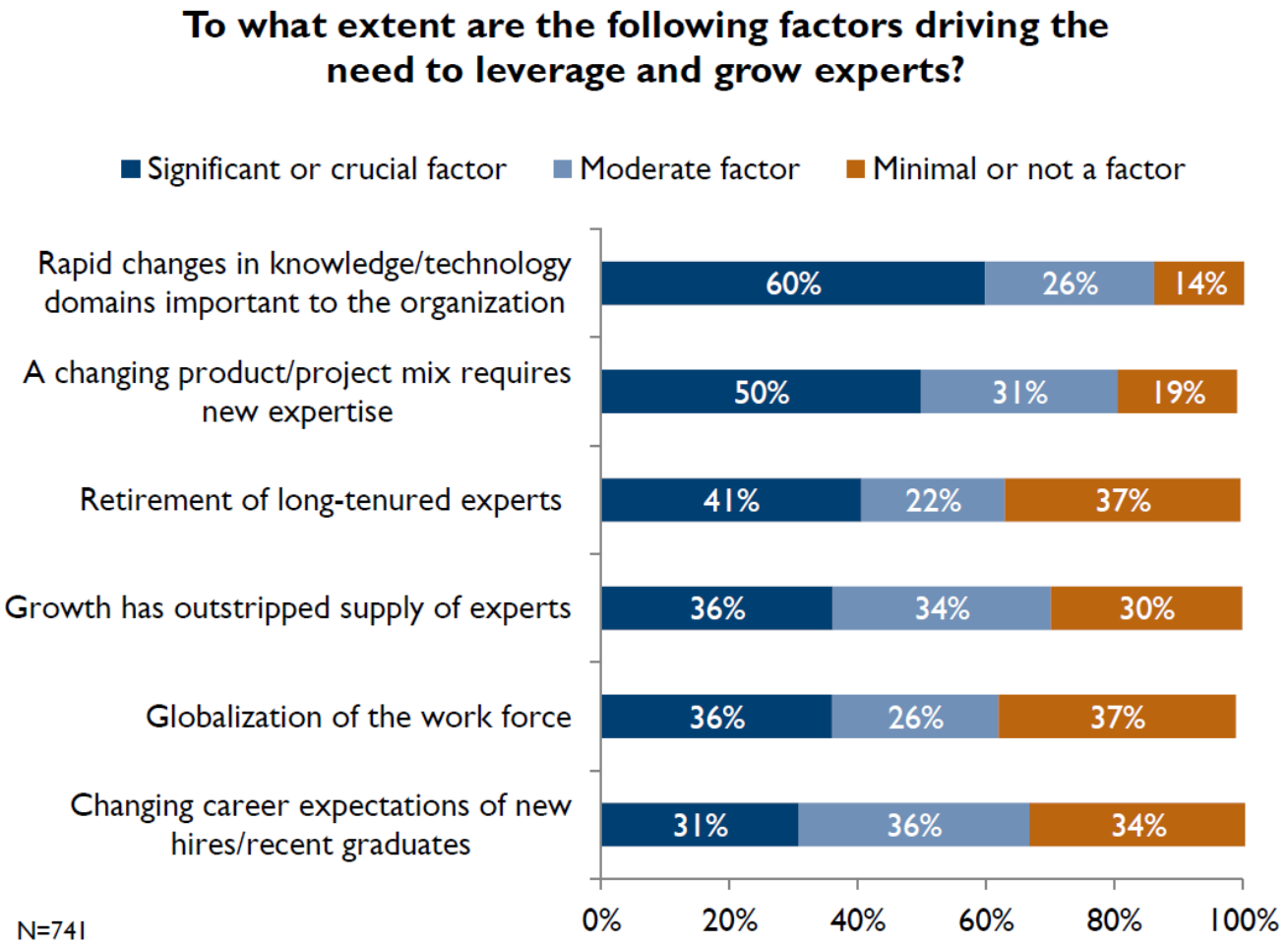


FIGURE 3

WHAT SHAPES AN ORGANIZATION'S APPROACH?

We found that three elements fundamentally shape the approaches used to close these gaps:

1. the nature of the knowledge,
2. the nature of the work, and
3. the nature or style of technical teams.

THE NATURE OF THE KNOWLEDGE

In technical areas, it has become a truism to say that the amount of content is exploding. Deere, MITRE, Nalco, Baker Hughes, and many others cited the challenge of dealing with an overwhelming amount of data and information, housed in multiple locations, and not tagged the same way. Not surprisingly, enterprise content management is a very high priority.

For example, at Deere there are a few hundred types of content a product engineer might need to access. Through the Engineering Knowledge Vault project, Deere is working to categorize and deliver more relevant content from multiple sources to an engineer. "The goal is to focus on the most valuable engineering content and make the right information accessible to the right people at the right time," says Karen Lekowski, KM/IT business process integrator at Deere.

Probing further, we discovered that technical organizations need and benefit from three distinct kinds of expert knowledge, depicted in Figure 4:

- *explicit* knowledge, which includes theories, frameworks, facts, basic courses, techniques, processes, and algorithms core to specific STEM disciplines as well as the results of external research;
- *tacit* knowledge, which is derived from years of hands-on experience; and
- *deep* knowledge, which is organization-specific and cannot be hired from outside.

In addition, firms need to foster more fundamental business skills, such as the ability to manage projects and balance the needs of diverse stakeholders.

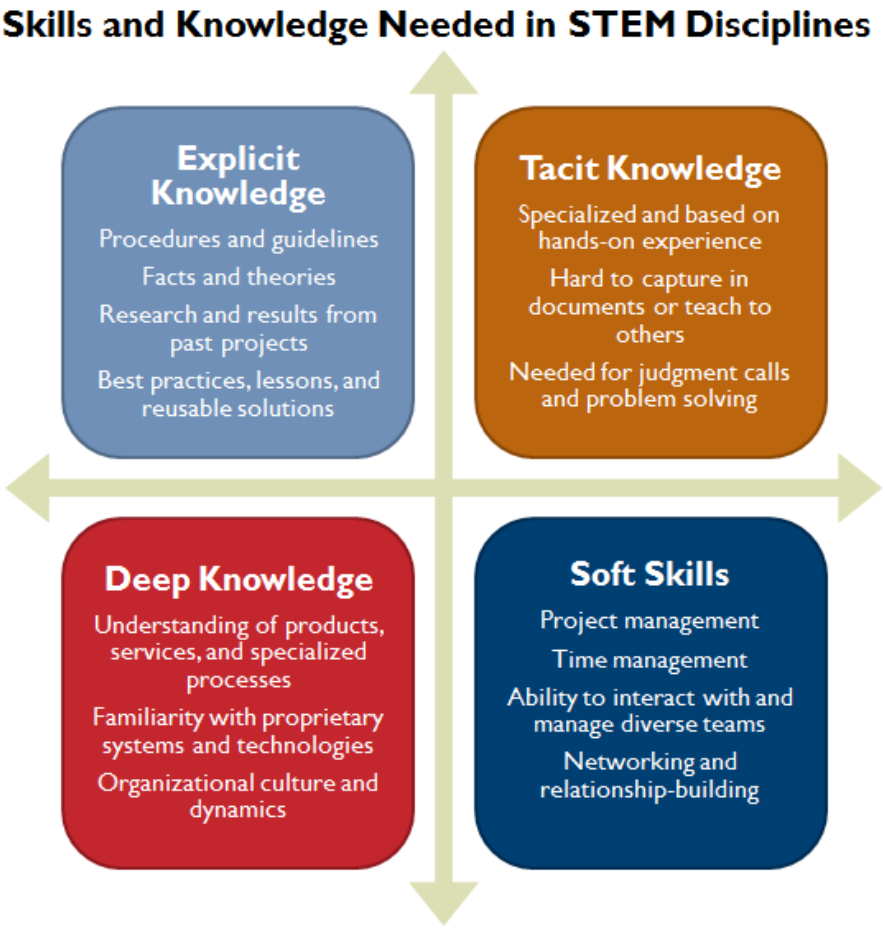


FIGURE 4

EXPLICIT KNOWLEDGE

STEM fields lend themselves to clearly defined knowledge domains, officially designated experts, and career ladders leading to expert status. This makes it possible to "manage" content and knowledge by dividing it up by discipline and assigning accountability to communities of practice and individuals at different rungs on the career ladder (e.g., fellows, experts, nex'perts, high potentials, and novices).

While this division of labor provides many advantages, the compartmentalization can lead relevant knowledge and solutions to be buried in discipline-specific taxonomies and silos—which becomes a serious problem when organizations are faced with emerging cross-disciplinary technical challenges.

Another defining characteristic of STEM knowledge is that it changes with every new invention, discovery, or best practice from both inside and outside the organization. STEM workers need consistent access to experts as well as the latest research and innovations to stay current. MITRE, Merck, and other scientifically focused firms maintain productive and very symbiotic relationships with a larger ecosystem of academic and government researchers for this purpose, and many organizations rely on special libraries to help them manage the flow of internal and external content.

The extended value chain—including partners, suppliers, and customers—represents an additional source of potential knowledge. For example, Merck has 150–200 external partners just in one small area of its business, all of whom have knowledge and experts that Merck wants to tap into. This type of collaboration requires the development of sophisticated business rules and secure technologies.

TACIT KNOWLEDGE

STEM workers need easy access to content to do their jobs, but it is perhaps even more important to give them opportunities to develop deep, experience-based knowledge.[2] However, our interviewees emphasized that many of the tacit knowledge and experience gaps organizations are seeing are not simply technical.

Even eager young engineers can lack business acumen and the ability to balance multiple agendas to get a technical project done. They struggle to adapt what they learned in an academic setting to a work setting where the constraints can be more than technical. What works in the lab doesn't necessarily work in the field. And, like all of us, they don't know what they don't know.

At NASA, for example, employees need a range of

Collaboration Through a Virtual "Handshake"

MITRE Corporation is a private non-profit organization that manages federally funded research and development centers (FFRDCs) sponsored by various U.S. government and military agencies.

To further its mission, MITRE encourages employees to collaborate as broadly as possible, leveraging knowledge and experts from across MITRE as well as partner and customer organizations. Its Handshake business platform is designed to achieve the kind of open collaboration enabled by consumer social networking platforms while addressing security, information-sharing policies, and business function requirements.

Handshake seeks to support valuable relationships among employees, industries, vendors, academia, sponsors, former employees, and other FFRDCs. The tool boosts situational awareness within the organization by enabling users to see an "activity river" of discussion threads or status postings and get insight into who is working on what within the network.

By providing easy access to discussion groups, wikis, blogs, metrics, and more, Handshake simplifies networking and helps people reach out easily and safely to others they may or may not already know.

Transferring Tacit Knowledge at Lockheed Martin

Lockheed Martin employees must learn a lot that is not taught in schools, partly because it is classified and partly because the fields are too specialized to merit college tracks. The organization uses mentoring and on-the-job training to fill in some gaps, but it also supports formal knowledge transfer and technical talent management programs to pass on critical skills and expertise.

A formal Knowledge Continuity process assembles dedicated teams of experts, nex'perts, and more junior employees to identify critical knowledge in a particular discipline, transfer that knowledge in the context of real work, document what was transferred, and then have the nex'perts and novices apply the knowledge with the expert present in order to cement the learnings. Lockheed Martin's business areas have embraced this team-based knowledge transfer process, and the corporate function views it as a competitive differentiator.

Lockheed Martin's Knowledge Continuity Process

skills and knowledge in addition to technical competencies, including project management skills (legacy of excellence at NASA), lessons learned, product knowledge, and an understanding of how to work in complex environments.

NASA CKO Ed Hoffman has a very insightful definition of complexity: The number of knowledge exchanges and the diversity of the participants needing to be coordinated determine the complexity of a NASA project. The greater the multidisciplinary complexity encountered with new technologies and big projects, the more social and organizational skills project managers must acquire and use.

This point was emphasized by many of our interviewees, along with the importance of more classic project management skillsets.

DEEP KNOWLEDGE

To further complicate the knowledge needs of STEM disciplines, a significant subset of the required tacit and explicit knowledge is unique to a particular firm and can take many years to acquire. Michelin North America is a great example of this: No colleges or universities teach tire design, so its tire designers and engineers must be trained internally—a process that takes years if not decades. They also need to learn about Michelin's proprietary manufacturing processes and its supply chain and distribution channels.

Organizations cannot hire this type of knowledge from outside, even by luring seasoned professionals away from their competitors. For this reason, STEM fields have a stronger history of apprenticeship and on-the-job learning, as well as an established focus on learn-do-teach embedded in the career life cycle.

In sum, much of the most valuable knowledge is unstructured, tacit, and based on experience in the context of the organization.

Going Back to School at General Mills

Over the past 20 years, General Mills has developed internal schools to train technical employees in the making of particular products and more generally applicable technical expertise.

Product-focused programs include cereal school, soup school, yogurt school, and bars school, whereas technical training programs include food chemistry, microwave heating, and food polymer science.

These schools also help ensure global consistency of products regardless of the location of the plant. The use of pilot plants allows for a hands-on learning experience.

We say that you have to learn cereal-making through the soles of your feet, so you have to get out of the plant and actually experience it, smell it, and learn how to make it.

— Shari Keivit
Manager, training and development
Innovation, Technology, and Quality

Collectively, the schools are staffed by one manager, who has a technical background and practical R&D experience and who guides the work of the schools. In addition to the manager, approximately 80 subject matter experts provide content development and instruction.

The natural competition that has arisen between experts has generated a spirit of continuous improvement in the schools and helped them become a key tool to transfer deep technical knowledge.

THE NATURE OF THE WORK

Several interviewees made the distinction between the nature of the work in R&D vs. field operations and technical support. This distinction manifests itself in the information and expertise these groups need, the speed with which they need it, and the structure to leverage existing experts.

The "must-have" KM approaches for the two groups differ as well. R&D usually wants a variety of content and expertise, including research from universities and external research labs, and considers technical libraries among its most essential sources of information. Field operations, however, tends to place greater emphasis on connecting people to emerging methods and practices, lessons learned, and experts for problem resolution.

A good example of this comes from Baker Hughes, which makes a clear distinction between the knowledge needed by its technology and operations groups. The technology area, which focuses on R&D, is most interested in the results of previous projects and research (available through communities of practice and SharePoint workspaces), expertise location tools, and external research (available through an enterprise library organization that provides licensed access to journals and industry resources). By contrast, operations gets value from the knowledge and experience of other field engineers, including lessons learned, case histories, and technical support. A controlled repository called the Baker Hughes Operating System provides access to all policies, processes, and the latest operating procedures as well as technical data sheets and specifications. Additionally, experts in decentralized support groups offer on-demand technical support through a centralized software service or portal.

Another characteristic of the work is that, in many of these industries, errors and delays in field operations are dangerous and/or costly, making the need for verified knowledge and expertise paramount. Expert judgment about tolerable risk is acquired over time, making access to a core group of seasoned staff

essential. This is true at Baker Hughes, which places great emphasis on providing operations staff with vetted content and expertise. The organization encourages employees to collaborate with peers, but also to seek out validated answers from designated experts. It is in the process of integrating its communities of practice with its standard operating procedures and technical support platform to make it easier for personnel to move between peer Q&A and validated content and expertise.

THE NATURE OF TECHNICAL TEAMS

All generalities become stereotypes if taken too far. However, there are certain "style points" and cultural issues to be aware of when engaging scientists and engineers in knowledge sharing activities (Figure 5). For example:

1. *There is a low tolerance for what they see as administrative.* People with a technical career path tend to value and identify with their professions, their projects, and their peers. "Initiatives" can seem like a distraction from real work, especially those programs dreamed up in "corporate."

2. *Less experienced people hesitate to "bother" very senior experts with what they fear might be trivial questions or nuisances.* This is a problem if it causes mistakes to be made. There are many ways to overcome this—for example, through communities of practice, repositories of past questions, digital "books" of technical know-how, and targeted checklists. Alcoa has encountered this challenge with its junior engineers and is encouraging schemes that allow mid-level engineers (i.e., nex'perts) to the take some of the load off experts.

3. *Work force expectations are changing.* In some cultures, such as North America, younger professionals want to take on more responsibility, have more autonomy to run projects, and move up the career ladder perhaps more quickly than their Baby Boomer counterparts did. (This is a better problem to have than a work force that *doesn't* crave more responsibility.) Providing these eager beavers with the opportunities they want requires enabling them to be successful, both technically and in the ability to lead diverse, multidisciplinary teams. And helping them grow is essential to retention goals, since newcomers can easily hop jobs if they feel boxed in and stifled.

It is worth noting a contrarian finding that is not new to APQC: The impact of the generation gap between Baby Boomers and Millennials is overblown. When it comes to social technologies—and perhaps new technologies in general—the newcomers may (or may not) be slightly more savvy, but the main issue is that they have a stronger value proposition for participation.

Recent college graduates have high expectations for collaboration, and because they are new to the organization, they are not yet invested in existing tools and processes. When put in a setting where they have few contacts, they immediately perceive the

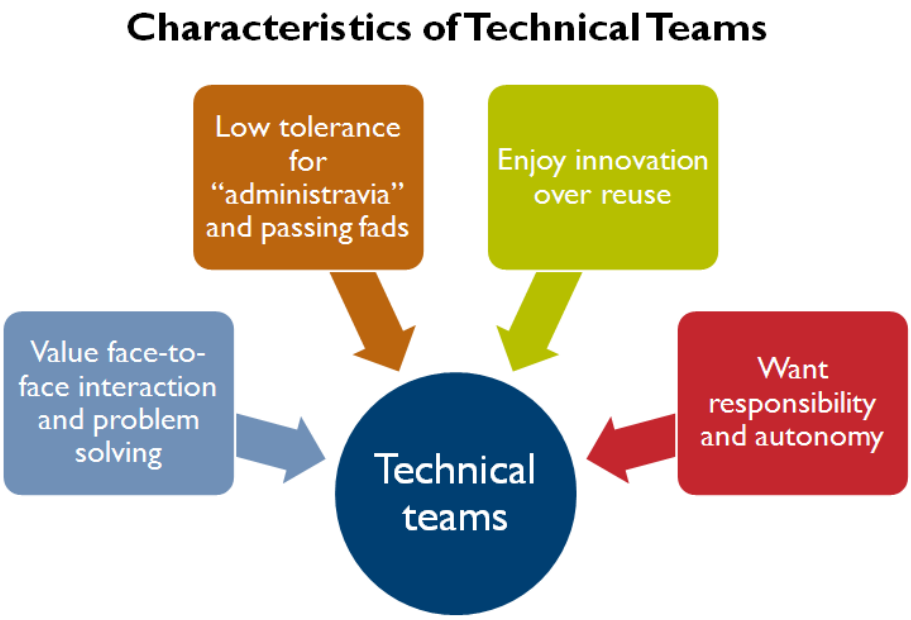


FIGURE 5

benefit of expertise locators and social platforms that help them reach out to experts and form relationships with peers.

On the other hand, long-tenured employees have deep knowledge and established ways of doing things, so when you ask them to try something new, their efficiency will decrease temporarily—even if the new tools or processes ultimately make them more efficient.

An employee who has been building his or her internal network for 20 years is naturally more resistant to transitioning those activities to a new virtual environment. In short, newcomers have more to gain from these tools, and veterans have more to lose.

But these challenges do not represent an inherent generation gap, and they are certainly not insurmountable. When we question successful organizations about the generation gap in KM, they repeatedly tell us that it is not a significant problem for them, or that they have been able to build collaborative cultures by providing the right enablers and incentives.[3]

At MITRE, for example, experienced employees who join the organization are shocked by how open and collaborative the environment is and how fully the multigenerational work force has embraced social tools.

LEVERAGING THE EXPERTS YOU HAVE

The nature of technical knowledge, work, and teams underpins a strong business case to improve access to knowledge and expertise while providing targeted development opportunities for the next generation of experts. And there is no question that stakeholders across technical organizations see a need to close current expertise gaps.

Our research suggests that a majority of technical, HR, talent, knowledge, and content managers see this as a priority and are using the tools in their arsenals (Figure 6) to address the challenge.

Classic solutions like training, technical conferences

Approaches by Discipline

Technical Management	HR and Talent Management	Knowledge Management	Content Management
• Standardized processes and designs • Technical networks • Technical conferences and forums • Mentoring and assignments • Internal technical "schools"	• STEM recruiting partnerships • In-person and virtual training • Dual career tracks • Competency management programs • Programs targeting high-potential employees	• Communities of practice • Profiles and expertise locators • Formal knowledge transfer approach targeting experts • "Books" or databases of critical knowledge	• Enterprise content management systems • Central repositories • Taxonomies • Federated search • Customized views and alerts

FIGURE 6

and forums, content repositories, and mentoring are in place at almost all the firms we surveyed, whereas programs targeting high-potential employees, expertise locators, and formal programs to capture and transfer knowledge from those nearing retirement are slightly less prevalent (Figure 7).

However, we discovered few truly new or emerging solutions, with all the approaches we tested in place at more than 50 percent of the participating organizations.

Even though most organizations gravitate toward the same approaches, their perceived effectiveness varies widely across the survey population (Figure 8).

Training and mentoring receive the highest overall ratings—a testament to the value of in-depth learning. Organizations interested in developing nex'perts *must* engage their current crop of experts in direct person-to-person knowledge sharing, whether one-to-many through lectures and team-based learning or one-on-one through mentoring and apprenticeship.

Unfortunately, mentoring requires a significant time investment from the technical leaders who serve as mentors, and advanced training can be equally high-touch when experts help design and deliver lessons.

Most organizations do not have enough expert

FIGURE 7

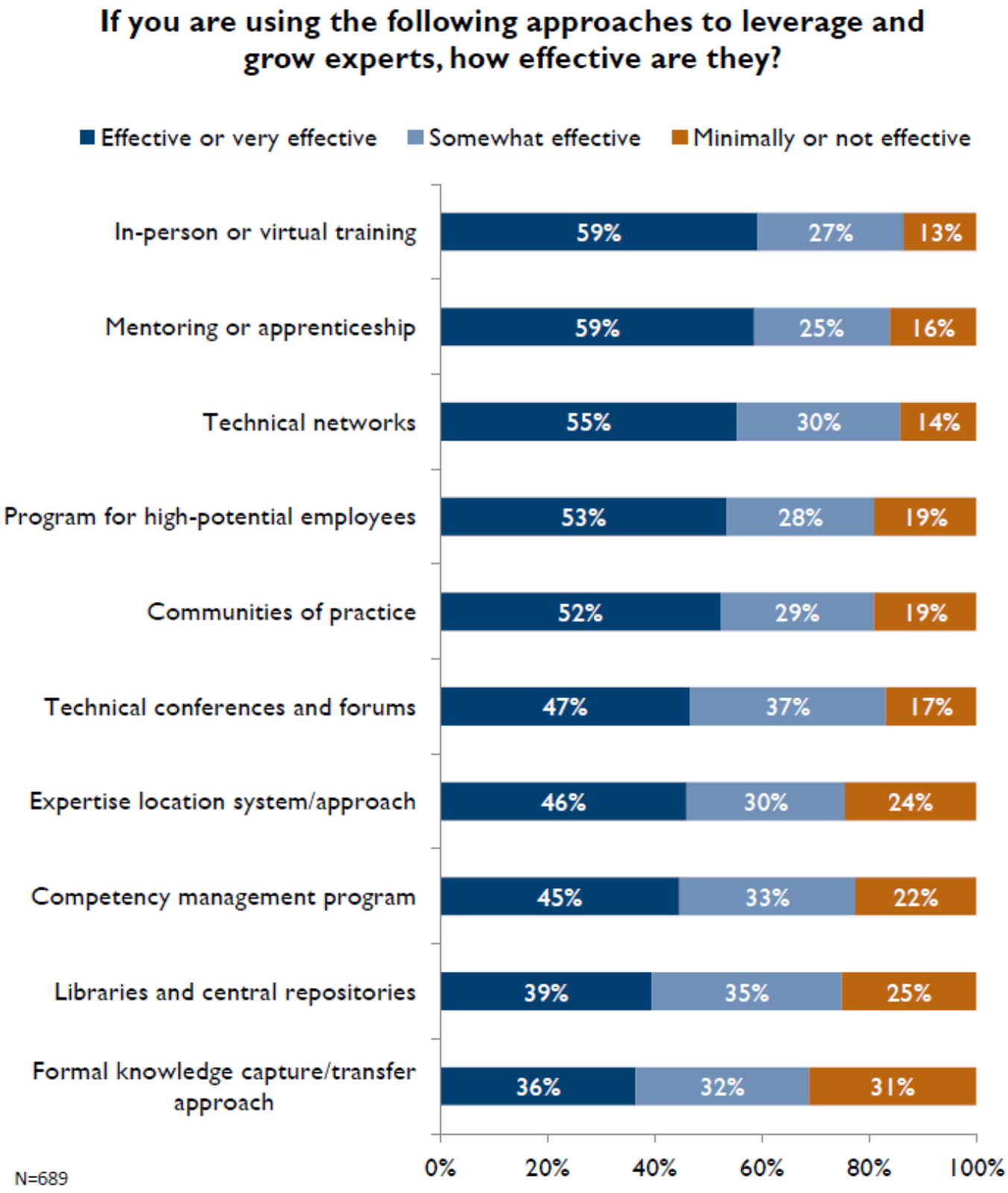


FIGURE 8

trainers and mentors to bring nex'perts up to speed, nor do they have the years to wait for training and mentoring programs achieve their full effect.

APQC recommends several categories of complementary approaches to help address the scarcity of experts and enable nex'perts and newcomers to take on additional responsibility in the short term. These include:

1. *structural approaches*—gathering experts into a center of excellence or allocating them to specific regions or project areas;
2. *knowledge management approaches*—leveraging technical networks and forums, communities of practice, profile-based expertise locators, technical conferences, and formal processes to codify and transfer expertise; and
3. *content management approaches*—improving access to content and learning through contextual search, special libraries, and clear ownership of content.

These tactics can supplement structured and experiential learning by providing access to information and expertise at the moment of need, accelerating self-service competency development, and providing collaborative outlets for employees taking on increased responsibility to get help.

The data suggests that some approaches—such as communities of practice and technical networks—are already providing significant value to organizations looking to leverage experts more effectively and build skills and competencies. Others—most notably expertise location, libraries and repositories, and knowledge transfer approaches—may represent opportunities for improvement.

APQC has seen these approaches provide immense value when properly designed and implemented, so we know the potential is there for organizations rating them as somewhat or not effective to improve their processes and derive additional benefit.

STRUCTURAL APPROACHES

As demand for expertise grows, many organizations are rethinking how they allocate senior-level staff across projects and locations (Figure 9). Experts who used to focus more narrowly are being asked to provide high-level support to a broad array of programs and projects, guiding nex'perts and mid-career professionals on strategic planning and design, reviewing their work at key milestones, and helping any tricky technical problems that arise.

When done right, this approach allows organizations to get the most out of their existing experts while providing valuable development opportunities to those a few rungs down the career ladder.

CENTRAL AND REGIONAL TECHNICAL HUBS

The most comprehensive structural approach to capitalize on a small group of experts involves creating a center of excellence or central team to deliver expertise and technical support. Baker Hughes provides centralized technical support for its operations group, as described earlier. Schlumberger has been using its InTouch system for more than a decade, which integrates access to experts with a large repository of technical content and guidelines.

According to Schlumberger's statistics, InTouch has helped the organization decrease the cycle time to resolve technical queries by 95 percent.

When Schlumberger engineers encounter a problem in the field, they start by searching the InTouch database for relevant best practices, case histories, and solutions. If they can't find an answer among the one million+ knowledge items in InTouch, they reach out to one of 125 InTouch Engineers for personalized support.

The InTouch Engineers are not necessarily subject matter experts, but they have at least five years of field experience and, while in the field, have used the tools for which they are now tasked with providing support. When appropriate, the InTouch Engineers contact appropriate subject matter experts for additional guidance.

In addition, some organizations are exploring the idea of allocating mid- or senior-level engineers to guide their younger counterparts in specific regions or time zones.

Alcoa is interested in this approach to increase newcomers' access to expertise, especially at refineries in remote locations. Regional experts would mentor novices, help them apply their academic training to Alcoa's specialized processes, and support the implementation of best practices.

The organization's evolving approach is a global structure in which subject matter experts and senior-level engineers are assigned to specific regions and focus on supporting those areas of the world. Engineers still have access to global subject matter experts through communities of practice, but regional representatives can build more intimate relationships with newcomers while taking some of the burden off global resources to answer lower-level questions.

FELLOWS PROGRAMS

Another strategy with a long history at technical firms involves designating an elite core of experts as official Fellows of the organization.

At Lockheed Martin, the LM Fellows program recognizes the top one percent of technical experts and makes them available to support programs and supply expertise where it is needed. Any Lockheed Martin program can request a Fellow for a short-term consulting engagement to conduct a technical or risk review, evaluate the overall direction of the program, or help with problem solving. Individual employees can also reach out to the LM Fellows in their technical fields through a networking site and email distribution lists.

LM Fellows collaborate with one another through conferences and virtual forums, some of which incorporate nex'perts for learning and problem solving.

The program allows Lockheed Martin to maximize the contributions of its top experts, rather than siloing them in one program. It also

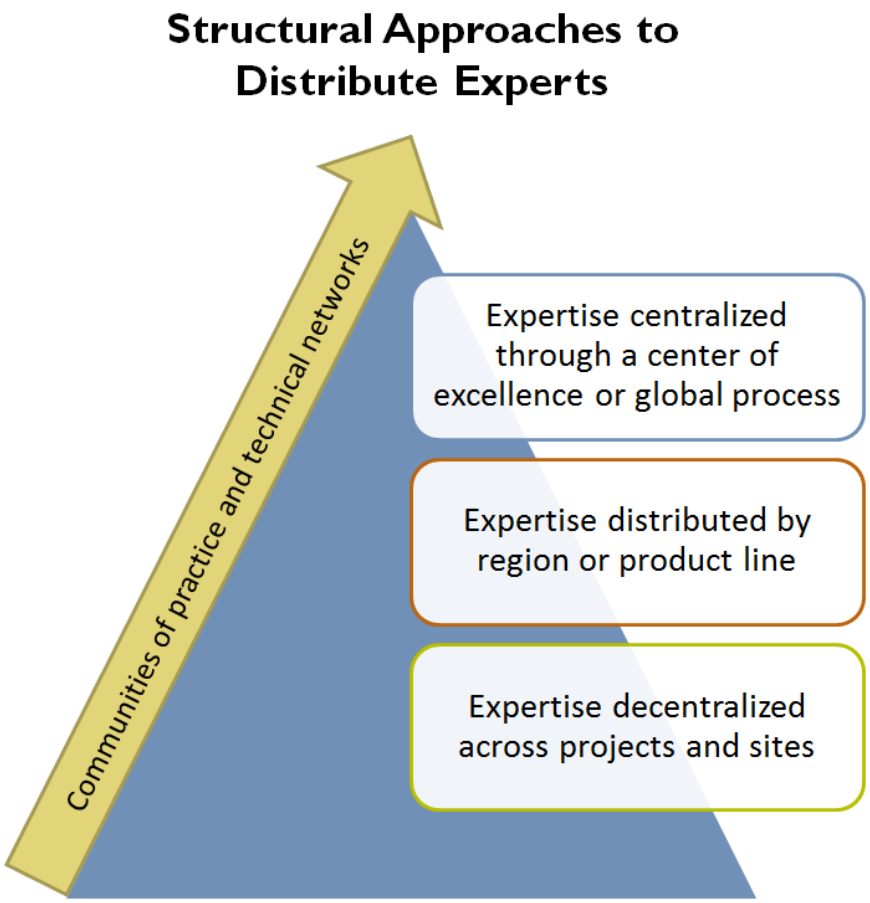


FIGURE 9

brings together the organization's greatest minds and allows them to engage in targeted collaboration around technical and strategic challenges.

GLOBAL STANDARDIZATION

A third structural approach involves creating standardized design and operational best practices, embedding them in the flow of people's work, and using these tools to help nex'perts and newcomers work on projects that might once have been the sole purview of experts. This approach is more applicable to some industries than others and is especially suited to repeatable processes performed at multiple sites.

At MWH Global, for example, an official design framework lays out a standard approach to design work and specifies templates that can be used to jumpstart new design projects.

The framework was first developed more than 10 years ago when MWH was involved in a large program of work. The project team recognized that similarities existed across multiple projects and designs and that it could increase efficiency by grouping similar projects together and following a standard process to complete the work.

The success of this initial effort prompted a steering committee to extend the design framework concept to each of three MWH operating regions. Regional technical teams put frequently used designs into the framework, breaking them down into components and analyzing the resources and expertise required to execute each component.

By providing access to this type of information, the framework ensures that project teams use standard, consistent processes and allows the organization to complete projects safely and effectively with lower risk and higher margin.

MWH Global has built similar standardized tools, called mTOOLS™, to support information management and project delivery.

A common activity associated with planning or asset management work is to inspect equipment for safety and reliability. Rather than attempting to place an expert in every location—which would be virtually impossible due to the number of global sites—MWH asked experts to create a checklist for an internal mobile tablet app called AutoForm that nex'perts can use as they inspect equipment. These apps capture MWH knowledge of "how to" deliver work efficiently and effectively by encoding the business rules and best practices in software.

The app-based checklist is updated with new attributes and notes as field personnel ask questions, ensuring it is improved and kept up-to-date with the latest changes and developments. By using the mTOOLS repeatedly and constantly improving on them by driving insights gained into real-time changes, MWH Global has created a mechanism for capturing and deploying continuously improving knowledge into the flow of work in collapsed timeframes.

KNOWLEDGE MANAGEMENT APPROACHES

In addition to structural solutions, organizations are applying a range of knowledge sharing tools and approaches to address expert shortages and promote competency development for newcomers and mid-career professionals.

The most prominent—and, we would argue, most vital—include communities of practice, technical networks, collaboration workspaces for project teams, formal knowledge capture and transfer processes, and tools to help surface experts and knowledgeable people across the organization.

(*Note:* Some of the structural solutions in the previous section could be considered KM approaches, and vice versa. Our intention is not to create artificial boundaries between interconnected tactics, but simply to suggest an organizing framework for how leaders are addressing the need for experts and learning.)

COMMUNITIES AND TECHNICAL NETWORKS

In general, communities of practice,[4] technical networks, and team workspaces serve different purposes. Communities tend to steward content and knowledge related to scientific or technical disciplines, such as reservoir engineering or polymer science, in order to enable professional development and cross-boundary collaboration.

Communities are often built to enable long-standing technical networks, which in earlier times met periodically for brown-bag lunches. Both communities and technical networks are designed to connect people around a body of knowledge, which is what sets them apart from project-focused team spaces like those housed in SharePoint.

Communities and networks are ubiquitous within technical organizations these days: 86 percent of organizations responding to our survey report using both. They are also among the most valuable tools for managing access to expertise and accelerating competency development. Although technical networks have a slight advantage, more than half of organizations with communities and networks consider both to be effective at bridging expertise gaps.

The resources that communities and networks provide to members vary widely, with some focusing on self-service content and learning and others emphasizing collaborative problem solving through technical conferences, discussion forums, and social media.

At Rockwell Collins, for example, most communities combine professional development with opportunities to collaborate. Some are designed to share lessons learned around a particular topic (e.g., the social intelligence community shares lessons around applying social media techniques inside the workplace), whereas others solve real-world problems (e.g., the math community tackles work-related math problems together during meetings).

Communities at NASA

To supplement the rest of its KM infrastructure, NASA has established communities of practice for a number of projects and competencies. These communities disseminate critical lessons learned, provide forums for discussion and Q&A, and help employees find information. Each community has a charter, core team, and human facilitator and is integrated with document management functions.

Some communities at NASA are championed by NASA's office of the chief engineer. Each community is led by a NASA technical fellow who is an expert in the community's topic area. These leaders have oversight responsibilities to help foster community effectiveness, including:

- serving as senior technical experts in support of the office of the chief engineer and the NASA engineering and safety center;
- chartering and leading teams to resolve complex issues;
- serving as independent resources to the agency and industry;
- levying standards and specifications on major programs/projects;
- conducting workshops and conferences to enhance discipline awareness;
- serving as stewards of their disciplines;
- fostering consistency in the creation and maintenance of agency-level standards and specifications, including core standards;
- leading NASA discipline working groups;
- ensuring that lessons learned are identified and incorporated into work; and
- fostering NASA participation in engineering academies.

Among the largest benefits of Rockwell Collins' communities are the camaraderie and networking opportunities they provide.

In many organizations, communities and networks are where people go to search out and talk to technical experts—an approach that tends to work well as long as the experts are engaged and participating. But communities can also help regulate the stream of questions and requests with which experts are bombarded, enabling organizations to make the most of a scarce resource.

At Devon Energy, for example, community moderators act as gatekeepers and buffers between experts and the rest of the community membership. The moderator brings the appropriate SME into conversations when needed, but if a request can be answered easily through existing documentation or solutions, the moderator may redirect the member to other resources instead.

This helps minimize the burden on experts while still ensuring that critical questions get answered quickly and accurately. It also familiarizes newer employees with content and learning resources that may help them with future problem solving.

People Pages at MITRE

At MITRE, a custom tool called People Pages provides expertise profiles for all employees. Each profile includes two tabs: one lists basic HR information along with the person's level, projects, and communities, whereas a second highlights the person's technical skillset, including education, publications, and presentations. Much of the included information was previously available in disparate corporate systems, but the profiles make relevant data available to colleagues in one easy location.

Throughout the development of People Pages, MITRE held firm to its vision that the tool be automated, integrated, and searchable. The KM team designed the profiles by working with employees to determine the attributes that are important to find, describe, and connect people. Once it decided which attributes to include, it scoured in-house systems to find existing data sources that could be used to automatically prepopulate the profiles. For example, MITRE leverages its finance system to fill in the projects an employee has worked on using the charge numbers from their time cards. People Pages also mines SharePoint to determine employees' skills and interests based on the communities they've joined and documents they've published. This automation reduces users' stewardship burden and ensures they are not confronted with a blank form when they view their profiles for the first time.

People Pages are integrated with MITRE's popular employee phone book, which puts the tool front and center for employees and helps integrate it into their normal workflow. A more limited version of the profile system is made available to MITRE's external network to facilitate cross-boundary collaboration and sharing.

EXPERTISE LOCATION

A prerequisite to leverage the experts you have in the organization is to know who and where they are—in other words, you need an expertise location tool. People search is a major objective at many of the organizations we interviewed and applies to the search for both experts and hidden knowledge and expertise.

For novices and newcomers, knowing who to ask for help and advice is often a big problem. Many of the interviewed organizations have identified this as a priority and have adopted technology and other approaches to address the issue. While some have built custom tools, others—including Deere—are using SharePoint MySite as a simple, integrated solution for profiles.

APQC's research on expertise location[5] suggests that the best approaches combine profile-based expertise locator tools with communities of practice, discussion forums, and collaboration sites. Blogs and social networking platforms are also useful in connecting people to experts, but they tend to supplement—rather than replace—other tools.

When it comes to expertise profiles, organizations should import as much data as possible from HR and other systems, limiting the number of fields employees must fill out themselves.

Firms should also answer the "What's in it for me?" question by making it clear that participation is part of people's jobs and tying it to leadership visibility and career advancement.

KNOWLEDGE CAPTURE AND TRANSFER

Along with efforts to connect nex'perts and newcomers to content and expertise, many firms have approaches designed to capture and communicate at-risk knowledge that is essential to strategic objectives and ongoing operations.

In APQC's 2013 *Transferring and Applying Critical Knowledge* study, we observed two distinct strategies at play at the best-practice organizations. Some—including Lockheed Martin, Kraft Foods, and Lloyd's Register—have formal, top-down processes to identify experts with critical at-risk knowledge, pull that knowledge out of their heads, and share it with the next generation of experts coming down the pipeline.

Most of these organizations treat knowledge capture as a project with a defined project plan, clear roles and responsibilities, milestone reviews, and a deadline. They also tend to engage their nex'perts in the knowledge capture process as a development opportunity, asking them to help codify and steward the body of knowledge over time.

Other best-practice organizations have more organic approaches to capture and transfer critical knowledge. They provide infrastructure to support transfer, but they do not dictate how and when transfer occurs to the same degree. Instead, they rely on the knowledge-sharing approaches mentioned in this white paper—communities of practice, expertise location systems, and technical forums along with social media and wikis—to surface the right experts and knowledge and make them available when needed.

Wipro Ltd., for example, has opted not to vet experts in certain fast-moving fields. Instead, employees register themselves as topic experts in the organization's technical Q&A system, and the KM team looks at whether experts are effectively answering queries to decide whether they should be included in search results for colleagues seeking expertise.

Our research suggests that an organization's approach to knowledge transfer depends on a number of factors—most importantly the knowledge itself, how easily it can be translated into documents and instructional content, and how fast a particular discipline is evolving.

Based on the high number of organizations citing rapidly changing knowledge domains, technologies, and product/project mixes as key drivers of their need to grow and leverage experts, we expect the less structured knowledge transfer techniques to become bigger players over the coming years. This does not mean that organizations will stop formally codifying expertise, but it may impact the tools and processes used for that purpose, especially in rapidly progressing industries.

CONTENT MANAGEMENT APPROACHES

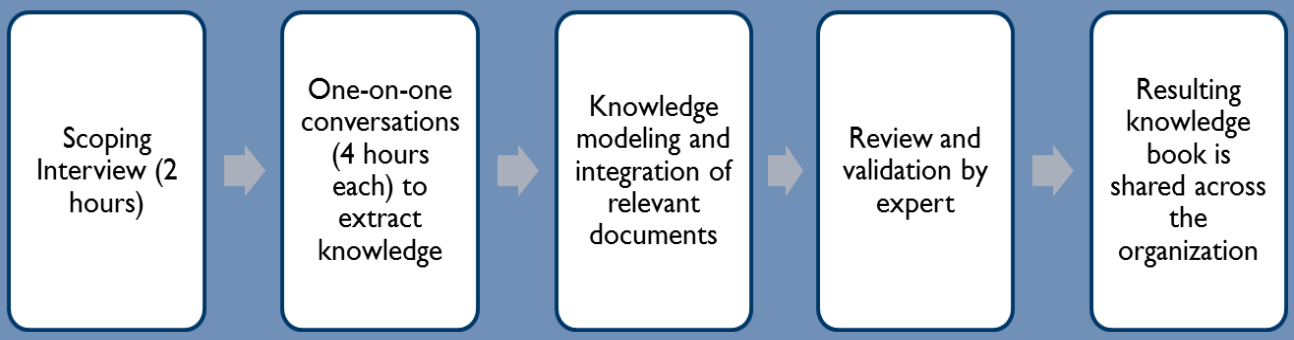
Knowledge and content management are often intertwined, but we have opted to separate the two in order to highlight content management as an urgent need.

Knowledge Books at Kraft Foods

Kraft Foods R&D's formal knowledge capture process is adapted from the Method for Analyzing and Structuring Knowledge (MASK), which was developed by Jean-Louis Ermine while working for the French Atomic Energy Commission. Using the MASK techniques, Kraft undertakes a step-by-step process to elicit knowledge from subject matter experts and translate it into written knowledge books representing in-depth information and expertise on particular fields of knowledge. To date, the organization has created more than 20 knowledge books, with most focused on the knowledge of experts who are nearing retirement or at risk of leaving the organization.

Many aspects of MASK require a facilitator who can ask questions and capture the elicited knowledge. As a first step, the facilitator conducts a scoping interview with the expert whose knowledge will be captured to determine what topics will and will not be included. Based on this interview, the facilitator creates a scoping document that is approved by the expert, his or her manager, the knowledge book champion (a senior leader who provides high-level support), and the recipient (the person who is next in line to take over for the expert and who will be responsible for maintaining the knowledge book in the future).

Steps to Create a Kraft Knowledge Book



Once the scoping document is approved, the facilitator conducts a series of conversations with the expert to bring forth the relevant knowledge. The facilitator can talk to the expert as many times as necessary to get through the items outlined in the scope, with each conversation lasting up to four hours. The facilitator takes detailed notes during the conversations and also records the sessions for reference.

After each conversation, the facilitator translates the elicited knowledge into a series of visual models. The focus is on capturing the expert's unique knowledge and thought patterns for decision making, as well as incorporating supplementary documents provided by the expert. In creating the knowledge book, the organization uses the expert's exact words as much as possible, which makes the final product more conversational and less like a dry textbook.

Once the draft of the knowledge book is complete, it is passed back to the expert to answer any questions and edit, add to, and approve the content. The knowledge book creation process ideally takes three months from start to finish, although some books take longer due to the experts' availability. The end result is an interactive PowerPoint slide deck that knowledge seekers can navigate to learn about the field of knowledge and its various components.

Many of the organizations we interviewed, including Deere and MITRE, cited access to internal and external content as a key success factor for operating with a limited pool of experts and supporting learning and development.

In most cases, content—whether in documents, videos, blogs, wikis, discussion threads, or social media feeds—is the first line of defense when a nex'pert or newcomer has a question. If the answer isn't documented, or if the seeker can't find it, then he or she has to either stop and ask someone or move on with the information available, potentially leading to an error or misjudgment.

A rich collection of well-structured, easily accessible content helps less experienced people get up to speed and reduces the burden on experts to answer common questions. It also helps nex'perts and experts stay on top of developments in their fields, whether that means keeping up with external research and trends or learning about best practices and lessons learned from inside the organization.

OPEN SHARING

For many firms, the first content management hurdle is creating an environment where scientists and engineers feel comfortable sharing content in a central repository or another location where it can be indexed for search. STEM work often touches upon intellectual property, trade secrets, and proprietary processes, so the inclination is to lock everything down and throw away the key. However, the most successful organizations make open sharing the default, restricting access only when there is a specific need to do so.

For example, Lockheed Martin guides teams to share the content they create in the least restrictive environment possible, taking into account any constraints attached to their projects and programs. Obviously teams working on classified programs aren't able to contribute much, but they are encouraged to think through what can and can't be shared, rather than holding everything back as a matter of course. When employees are educated about the value of sharing and how to balance that with the requirement to protect proprietary information, organizations are in a much better position to benefit from their own collective knowledge.

SEARCH AND FINDABILITY

The next challenge is to make content as easy as possible to access. Sometimes, the tactics are as basic as choosing the right format. For example, Kraft Foods R&D releases key expertise content in PowerPoint because employees are comfortable with the technology and do not feel like they are being asked to use something outside their normal workflow. However, the biggest concern is making content visible to employees when they have questions or encounter challenges.

Search is the most obvious solution, especially as algorithms improve and are able to return results from diverse repositories. At Baker Hughes, MITRE, Schlumberger, and others, federated search functions are able to crawl multiple systems and return integrated search results that combine content from centralized content repositories, community sites, SharePoint project sites, and other sources.

However, top firms combine search with a range of other tools and enablers, including taxonomy, opt-in alerts, customized views based on an employee's role or past history, and data on how popular or well-rated a particular content item is. Many also use communities, networks, and social media to help nex'perts and novices cut through the noise and lay their hands on the most applicable content at a given moment.

SPECIAL LIBRARIES

Several organizations we interviewed also emphasized the importance of special libraries and librarians to facilitate use of external research and information. Given the pace of change, it is impossible for STEM

Enterprise Taxonomy at Baker Hughes

Baker Hughes' enterprise taxonomy is designed to standardize technical terms and definitions across the organization. Prior to its development, different divisions had their own acronyms and terminology, which made it difficult for them to work together. The current system provides a common language that helps employees from different parts of the organization collaborate to deliver cross-product solutions to customers.

Baker Hughes has integrated the taxonomy into its other content and KM tools so that policies, processes, and procedures as well as documents, wiki pages, and discussion questions are tagged with the appropriate terms. This means that, if an employee is interested in a particular topic, he or she can use the taxonomy to filter or drill down to the relevant content in search results across multiple formal and informal repositories. The ability to make content more visible and improve enterprise search were key to the taxonomy's value proposition and to obtaining buy-in from both leadership and the work force as a whole.

workers—even full-blown subject matter experts—to keep up with trends and developments on their own. Librarians not only manage subscriptions and ensure access to the latest information, but they also perform targeted searches on employees' behalf and help them filter through published research to identify breakthroughs and trends with implications for the business.

Schlumberger has a particularly robust initiative to provide access to external research. Its Tellus program offers employees online subscriptions to hundreds of technical journals that would typically be available only through a university library.

In a typical year, the program records tens of thousands of publications downloads from the Society of Petroleum Engineers, the Institute of Electrical and Electronics Engineers (IEEE), the American Chemical Society, and hundreds of other journals. Tellus also offers access to company librarians for research purposes and, in a year, about 5,000 articles are provided by librarians.

The Tellus program is extremely popular with the technical work force, which sees the information as critical to their development as individuals as well as the creation and application of new knowledge.

APPROACHES TO CREATE NEW KNOWLEDGE

The structural, KM, and content management approaches discussed above are vital to operating with a limited pool of experts and preparing the next generation for technical leadership roles.

However, our survey suggests that some of the biggest challenges organizations are facing are less about a shortage of experts than about how experts can help leaders respond to rapid changes in technical disciplines, technologies, and markets.

In addition to making experts available for sharing and learning, firms need experts and nex'perts from different domains to put their heads together to develop new ideas and ways to apply emerging knowledge to strategic goals.

Technical disciplines already have a range of tools to address these issues, from dedicated innovation labs to crowdsourcing and open innovation[6] programs (Figure 10).

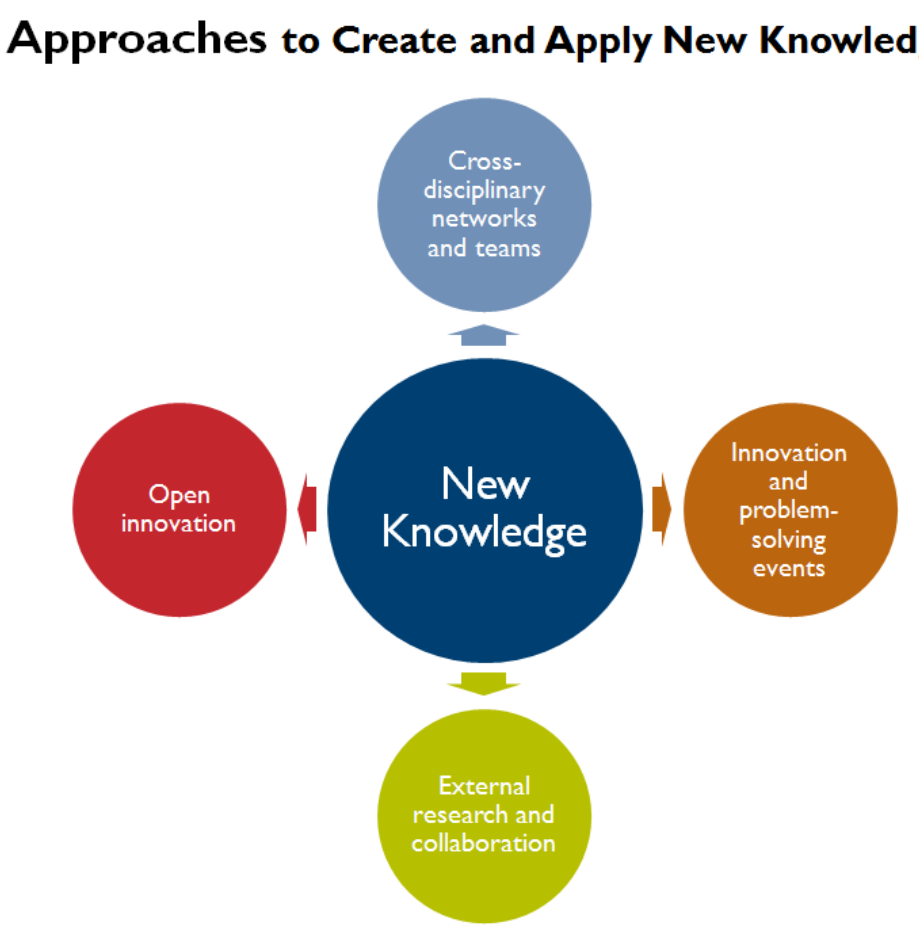


FIGURE 10

Special libraries also play a role by streamlining access to external breakthroughs and developments. However, KM teams can support these efforts by supplying tried-and-true collaboration solutions, especially when the goal is teamwork across different parts of the business. In fact, some of the same KM approaches used to support access to content and experts can be adapted slightly to facilitate cross-disciplinary innovation and the creation of new knowledge.[7]

For example, Ecopetrol gathers experts from various disciplines into communities of practice and networks to shepherd emerging technologies and solve problems. The focus of the networks is determined during tactical sessions where technical leaders identify key knowledge challenges. In some cases, the innovations developed by these communities have led to significant productivity gains and cost savings.

One Ecopetrol community focused on well stimulation, a cross-functional process that traditionally lacked clear ownership. The community was able to examine the process holistically and make recommendations leading to year-over-year improvements in oil production. Another community saved Ecopetrol approximately two million dollars per year by standardizing the well abandonment process, eliminating the need to hire external vendors to perform this procedure.

Similarly, Lockheed Martin uses its LM Fellows Program to give experts and nex'perts opportunities to explore emerging fields and tackle cross-program challenges.

All the LM Fellows are invited to attend an in-person conference every 12 to 18 months, and they are encouraged to invite rising technical talent in their areas to attend as their guests. The conferences feature collaborative meetings and workshops where attendees brainstorm on topics important to the organization, including both technical issues and strategic ones such as affordability and program sustainment.

Fellows and nex'perts are also encouraged to participate in LM Fellows action teams, ongoing

groups that meet virtually to explore subjects ranging from systems architecture to fluid dynamics. Usually, when a conference workshop or virtual meeting leads to the development of a new idea or solution, the LM Fellows involved are invited to present those findings to organizational leadership.

While some industry leaders are already taking advantage of communities and collaboration tools to support cross-disciplinary innovation, we believe this represents an untapped opportunity for many technical firms.

Activities where experts push the boundaries on collective knowledge and nex'perts participate as learners and secondary contributors have the potential to address both innovation *and* learning and development objectives.

And as an added bonus, they tend to be more appealing than traditional knowledge-sharing and mentoring structures, garnering improved engagement and participation from all levels of the work force.

A MORE COHESIVE, INTEGRATED APPROACH

Our research has revealed many organizations that are successfully harnessing the tools at their disposal to address expertise shortages, accelerate learning and development, and encourage the co-creation of new knowledge.

However, the effectiveness statistics on key approaches—everything from communities of practice to expertise locators and knowledge transfer programs—suggests that a large percentage of firms need to rethink, redesign, or reemphasize the techniques they are using to bridge the expertise gap. In addition, technical leaders are still grappling with ways to address rapid change and build the knowledge and expertise needed for the future.

Although most of the approaches we have cited can be implemented on their own, we recommend looking at the issue more holistically and purposefully combining techniques from executive management, HR, KM, content management, and the technical disciplines themselves.

Important problems often require cross-functional solutions, and our data suggests that the degree of integration among multi-disciplinary approaches is positively correlated with their effectiveness, both individually and in totum.

Even organizations with mature knowledge and talent management programs may benefit from more inclusive strategies to address expertise gaps and accelerate time to competency—especially for the mid-career professionals in which some firms appear to be underinvesting. >>

An Integrated Strategy at Schlumberger

As an oilfield services company, Schlumberger's value proposition to customers hinges on the technical expertise of its people, so it has a continuing need to develop technical talent at all levels.

The organization offers a robust dual career ladder so employees who enter as field engineers may, after a period of development, either advance into management or opt to become technical experts.

The technical career ladder includes six distinct levels. Experts who reach the top level of the career ladder, called Fellows, are hand-selected by the CEO and CTO and are acknowledged as experts not only within Schlumberger, but also by the wider industry.

An Integrated Strategy at Schlumberger (cont.)

Schlumberger develops nex'perts and newcomers through a range of HR and KM approaches, including:

- a competency management system that outlines the required technical competencies for each position and helps identify gaps in each individual's skills or knowledge;
- InTouch, which integrates technical content with access to live support;
- 150 Eureka communities of practice boasting 31,000 members enterprise-wide that support collaboration and learning through online bulletin boards, webinars, and face-to-face workshops;
- Career Network Profiles, online resume profiles that allow employees to find and connect with other technical experts when they need help with a technical review or problem; and
- the Tellus program, which provides access to technical librarians and journals.

Eureka Statistics and Successes

In 2013 Schlumberger celebrated the 15th anniversary of its Eureka communities. Communities and other knowledge sharing approaches remain very popular: For example, the organization's Career Network Profiles receive seven million views per year, and employees post more than 90,000 messages to its community bulletin boards annually.

When asked how Schlumberger has sustained this activity over time, Director of KM Susan Rosenbaum cites the integration of technical talent management with KM into one functional group and the close ties between knowledge sharing and career advancement. "To move up our technical career ladder, employees have to illustrate that they are active in sharing their technical knowledge within the company," Rosenbaum explained. Employees must submit written descriptions of their KM participation as part of their applications, and the committee takes this into account when determining whether someone moves up. "And as you move up the ladder," Rosenbaum explained, "the knowledge sharing has to become broader and broader to show that your level of technical leadership is ever-expanding."

As a result, the organization's top experts are active participants in Eureka, giving technical webinars, answering questions on bulletin boards, and sometimes even leading communities. Employees see knowledge sharing as instrumental in helping them advance their technical competencies and establish themselves as technical leaders within the organization.

ENDNOTES

Page 2

1. See APQC's *Technical Talent Management: Sourcing, Developing, and Retaining Technical Talent* best practices report to learn more about effectively managing technical talent across the employment life cycle.

Page 7

2. See APQC's *Transferring and Applying Critical Knowledge* best practices report to learn more about strategies and approaches to identify, capture, transfer, and apply tacit knowledge.

Page 11

3. See APQC's Building a Collaborative Culture in Your Organization content collection to learn more about creating an environment that promotes and rewards collaborative behaviors.

Page 17

4. See APQC's *Sustaining Effective Communities of Practice* best practices report to learn how to design, implement, and maintain effective communities.

Page 19

5. See APQC's Trends in Expertise Location: How Organizations Connect Employees to Experts and Knowledgeable Colleagues content collection to learn more about ways to surface and connect people to experts and expertise.

Page 22

6. See APQC's *Open Innovation: Enhancing Idea Generation Through Collaboration* best practices report to learn more about open innovation trends and practices.

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7. Additional examples are available in APQC's *Putting Knowledge in the Flow of Work* best practices report.

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