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So much information, and all of it hard to find

Industry turns to technical knowledge management to harness crucial, hard-to-find information

By Chad Hawkinson

Recently, a European manufacturer was partway through an expensive certification process required to sell a high-end piece of electrical equipment in the United States when it discovered that the company's American unit had already carried out the certification work two years earlier. Another company, a manufacturer of industrial cleaning products, discovered the solution to a tricky engineering challenge lay outside its own four walls, buried in supplier patents.

These two examples illustrate the two sides of the knowledge-management conundrum looming over companies today: The opposite but equal challenges of harnessing internal and external technical knowledge. Within organizations, information is locked inside email servers, individual hard drives, or discrete internal systems for product lifecycle management, document management, or other activities. Likewise, engineers are unaware of both innovations outside their own organization as well as relevant best practices from other industries and technical disciplines. They are also unable to tap into the industry knowledge to be found in a vast array of technical reference resources.

But these examples also demonstrate that companies can address such challenges by implementing a technical knowledge-management strategy that provides a "one-stop-shop" for engineering answers built on a foundation of content, technology, research tools, and process. As our two manufacturers discovered, this approach to addressing technical knowledge management can be a significant driver of both top- and bottom-line business results.

Too much information

The growing difficulties associated with accessing and leveraging technical knowledge are rooted in several ongoing trends. Start with demographics: About half the North American and European engineers in oil and gas, aerospace, defense, and other heavy industries are expected to retire during the next 10 years.

This exodus poses a recruiting and training challenge, but it is also a knowledge-management challenge. With veteran staff leaving the workforce, the remaining engineers can no longer rely on the experience of their senior colleagues to resolve recurring problems. The challenge for organizations in these "graying industries" is to ensure the remaining engineers and incoming generation of technical professionals have access to all the information they require, so they can avoid repeating lessons already learned. Accessing that information is time-consuming and tedious because traditional search technologies are ill-suited for research across the ocean of unstructured data that makes up the vast majority of engineering and R&D content.

At the same time, the technical world is awash in content that is in near-constant flux due to the pace of innovation. Standards, industry publications, technical journals, handbooks, conference proceedings, patents, websites, social media, and many other sources form a tsunami of information that threatens to overwhelm engineers who need precise answers to specific technical questions (see chart on next page). Finding an answer to just one engineering challenge can require information across a dozen different sources or more.
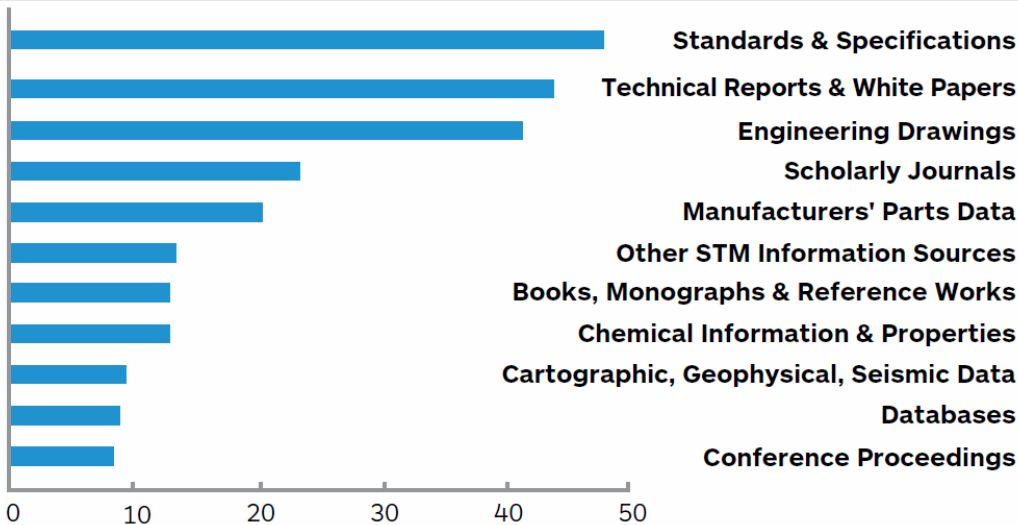
Although much technical content is now available on the internet, it is curated, managed, and published by numerous information providers and vendors, each with its own user interface and often without adequate search tools to help users quickly find pertinent solutions. The best technical information is often protected by subscription log-ins

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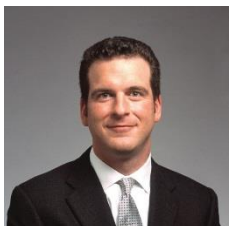
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Searching when they should be innovating

Standards & Specifications	~48
Technical Reports & White Papers	~43
Engineering Drawings	~41
Scholarly Journals	~23
Manufacturers' Parts Data	~20
Other STM Information Sources	~13
Books, Monographs & Reference Works	~13
Chemical Information & Properties	~13
Cartographic, Geophysical, Seismic Data	~9
Databases	~9
Conference Proceedings	~8

Engineers must wade through reams of disparate external data to do their jobs, according to an industry survey

Source: Outsell, Inc.

that popular search engines cannot "see." As a result, engineers waste hours logging into multiple content platforms and repeatedly entering their search strings, only to be forced to comb through long lists of links to documents that may or may not be relevant to the problem at hand. What they really need are precise answers to their specific problems.

It is little wonder that, according to a study by Outsell Inc., a leading information industry research and advisory firm, engineers in all fields spend 13% more time searching for information today than they did in 2002. And yet they still fail to find what they need: A 2011 study by consulting, software, and research company Infocentric concluded that 54% of engineering decisions are based on incomplete, inconsistent, and inadequate information. And according to a 2012 study by market research, analysis, and advisory firm IDC, 60% of manufacturers said they lacked the informed decision-making capabilities necessary to innovate. The financial impacts can be significant: 1% to 2.5% of revenues are lost because of decreased productivity during the learning curve for new hires, according to investment management and investment services company BNY Mellon. In some industries, such as oil and gas, those lost revenues are higher because new engineers take several years to get up to speed, and their mistakes are costly (see sidebar "The Big Crew Change" on page 7).

As these data suggest, corporations are struggling to connect R&D staff, engineers, and product teams to the information they need, and corporate performance is suffering as a result. Ultimately, without a solution to the knowledge management challenge, engineers will continue to waste time and resources, to the detriment of revenues and profits.

### One-stop-shop for knowledge management

Fortunately, companies are learning to capture the value of information residing inside and outside their organizations by embracing a knowledge-management framework. The goal of this type of framework is to enable technical professionals to reduce time spent searching for information and increase the amount of time they spend actually using information. Such a framework comprises a mix of content, technology, research tools, and process (see chart on next page). Let us look at each of these components in turn.

On the content side, companies must ensure their knowledge workers have access to a broad, deep library of technical information, including the tribal knowledge accumulated within the company. After all, an engineer's most trusted source of information is other engineers.

"Engineers in all fields spend 13% more time searching for information today than they did in 2002."

Technical Knowledge Management Workflow

Effective knowledge management links content, technology, research tools, and process
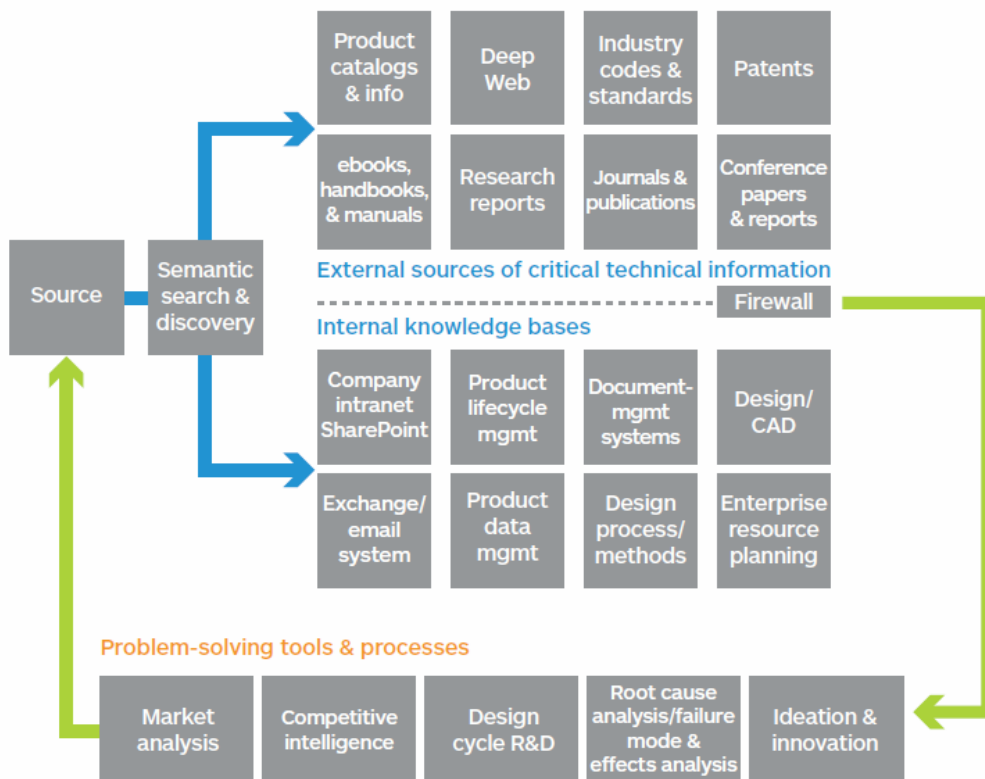
Source: IHS

In terms of external knowledge, a comprehensive collection should include the typical handbooks and manuals one might find on an engineer's desk, plus industry standards, technical journals, scholarly articles, and patents—all kept up to date. Engineers would also have access to "Deep Web" content such as technical articles and reports not generally available through normal internet search tools. The content in this library should be specifically curated to match the evolving information requirements of the company's technical professionals, aligning not only with their industry domain but also with their discipline—such as aerospace engineering, electrical engineering, or material sciences and metallurgy, to name a few. Similarly, the content must be specifically oriented toward an organizational environment that supports practical, technical problem-solving.

All this content may as well be invisible unless engineers are equipped with a knowledge platform that can retrieve the needle-in-the- haystack technical detail that they need. To accelerate research and solve problems better and faster, organizations must provide their an easy way to access internal and external information, along with tools to digest and apply that knowledge to solve their toughest problems.

The good news: A new breed of technical knowledge-management solutions is now available. These solutions, tuned to the needs of engineers and technical professionals, provide one-stop access to the best technical information in the world. Right out of the box, users can access standards, handbooks, journal articles, patents, and other reference works. Advanced search technologies enable users to quickly pinpoint relevant technical answers in prepackaged knowledge bases, as well as their own critical institutional knowledge, housed in a repository spanning hundreds of document types and an infinite number of data sources.

A new breed of knowledge-management solutions provide one-stop access to the best technical information in the world.

World-class knowledge discovery tools enable users to rapidly browse, digest, and understand technical topics. These tools can also dynamically summarize relevant documents, based on an analysis of their contents, enabling rapid review of hundreds of documents in hours, rather than days. Crucially, engineers can use these tools to explore adjacent topic areas. A user looking for information on corrosion prevention, for example, might also need to understand the causes and effects of corrosion to create an effective solution. The new tools facilitate this type of exploration.

Building on content and research capabilities, the one-stop-shop knowledge management platform includes embedded workflows that automate ideation and problem- solving methodologies such as root cause analysis (RCA), value engineering, and failure mode and effects analysis (FMEA).

These workflows help engineers and other knowledge workers define and analyze opportunities or problems, understand product requirements and issues, transform requirements into design-intent models, and drive breakthrough solution strategies.

Finally, organizations must consider whether they have the processes in place to enable technical professionals to take advantage of the content, advanced search technologies, and workflows we have discussed. Engineers are inherently problem solvers, but the problem solving inherent to innovation is not explicitly taught in engineering schools. Moreover, few organizations have a culture built around a systematic, repeatable process of problem solving, including upstream innovation research activities.

A robust knowledge-management platform can mitigate this situation by providing a framework—a built-in interrogative process, underpinned by the embedded workflows and methodologies discussed above—that walks an engineer through the steps necessary to obtain the answer to a technical issue.

Companies can also engage with third parties to help them learn the innovation process (and then carry it forward independently) or to actually run the innovation process—backed up by the necessary content and technology to ensure its success.

How investment in knowledge management pays off

The return on investment in the type of technical knowledge-management platform described here comes in many dimensions, ranging from consolidated research spending and productivity gains by engineers, to faster new product introductions and increased use of information, greater market insights, and reduced risk. (See sidebar "Calculating the ROI of better knowledge management" on page 8.)

In terms of spend consolidation, a single source and price for all outside technical information reduces the cost of administering supplier relationships and eliminates the greater cost of buying information piecemeal. The right single source will also ensure every staff member has access to the latest version of standards, regulations, handbooks, and other critical technical reference works.

Reducing disparate sources of information—each with a different log-in and interface— to a few, or even one, cuts total search time. Giving users a single source with one log-in, one entry point, one user interface, one search protocol, and one training routine—then leveraging it across dozens or hundreds of engineers—can shrink the time engineers spend looking for answers and increase the time they spend applying the knowledge they have acquired. The effect is to accelerate problem resolution and shorten design cycles, enabling companies to bring new or revised products to market faster, win more business by responding to bids quicker, and reduce iterations and unneeded redesigns. (See chart on next page.)

A single source for internal and external aggregated technical information leads to higher adoption and more use of sources. Improved access can expand the knowledge base for the entire company, giving engineers better awareness of industry trends, best practices,

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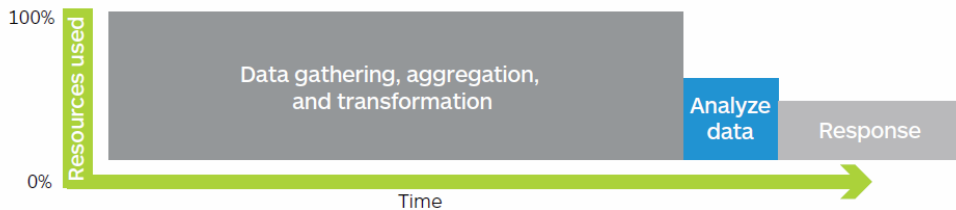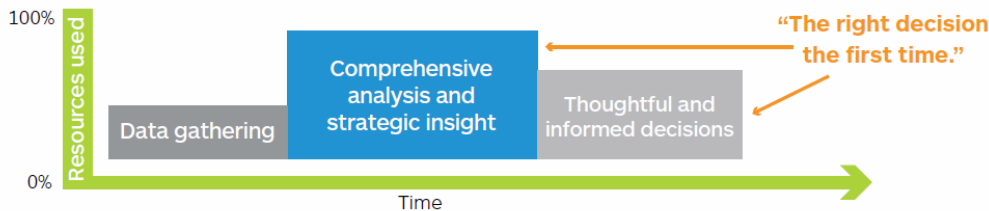"The return on investment in a technical knowledge-management platform comes in many dimensions."

Technical knowledge management speeds decisions

Window of opportunity

Without an effective technical knowledge-management platform

Resources used (0%–100%)	Data gathering, aggregation, and transformation	Analyze data	Response

Time →

With an effective technical knowledge-management platform

Resources used (0%–100%)	Data gathering	Comprehensive analysis and strategic insight	Thoughtful and informed decisions

"The right decision the first time."

Time →

Source: IHS

innovations, and cutting-edge technologies. Increased use also contributes to reducing rework and the number of design iterations. It means consistency throughout the company because engineers work with the same source of truth.

Measurable benefits also include insights into market and technology trends, an understanding of the competitive landscape, and consumer sentiment as expressed in social media and on the web. With these insights, engineers and product managers can find new markets and make smarter product roadmap decisions. Finally, closer adherence to regulatory requirements reduces liability and warranty costs as well as non-compliance fines. Improved quality and compliance reduce plant or asset downtime, maintenance costs, and lost revenues or fines caused by a failure to meet supply contracts or the inability to get products to market in time.

Seizing the challenge

The factors outlined above provide a framework for how senior executives can think about the return on investment in a technical knowledge-management platform. Simply measuring the amount that any single information source has been used, as a corporate librarian might do, will fail to fully capture the value this type of platform can deliver. The fact is, a technical knowledge system will contribute to revenue, profit, and market share.

Consider the European manufacturer of big electrical equipment mentioned earlier. When it decided to enter the US market with one of its premier products, it had to certify that the equipment met various US regulatory and other standards. This required shipping two of the expensive units to the United States for testing. The company envisioned a six-month timeframe with a $5 million price tag, written off as the cost of entering a new market.

At the time it began the certification, the company installed a knowledge platform with advanced search capabilities. Once it was plugged into all enterprise sources, the European team discovered that its US business unit had taken the electrical equipment through the certification process two years earlier. The discovery saved millions of dollars and valuable months.

Following this episode, the company embarked on an effort to roll out and use the knowledge platform broadly throughout the company to better manage knowledge-capture and use, to identify and create cross-company communities of expertise, and to create a new culture of knowledge capture and sharing.

"A technical knowledge system will contribute to revenue, profit, and market share."

Capturing innovations already achieved outside the company is yet another challenge. The manufacturer of industrial cleaning products mentioned earlier was overhauling its commercial detergent and sanitizer dispensers to improve performance, safety, and ease of use, and to reduce packaging waste. The manufacturer's engineers were stymied by the dispenser's check-valve element, which was collapsing at high back pressures. Pressed to find a solution quickly, the engineers needed to know if one existed outside the company. Using a knowledge-management platform with advanced search capabilities and problem-solving workflows, the team was able to understand the contextual aspects of the problem they were trying to solve and then research suppliers' patents. Eventually, the engineers identified a promising check-valve technology, which led to a licensing agreement. The company launched the industry's first maintenance-free dispenser, which reduces user costs as much as 80% and is 100% recyclable. The dispenser generated tens of millions of dollars in incremental revenue in its first five years on the market.

As these examples illustrate, today's technical information and knowledge-management challenges can be turned into opportunities if companies set themselves the goal of doing so. The overall goal of knowledge management in this engineering context is to compile authoritative content that brings all relevant industry knowledge and best practices to users' desktops; to use advanced research capabilities to pinpoint answers within oceans of internal and external data; and to apply problem-solving tools to speed answers to the toughest problems in key workflows. All these efforts must be built upon a sound knowledge-management framework. Only with a solid foundation in place can companies expect to survive—and thrive—in the midst of today's information tsunami. ●

"Today's technical information and knowledge-management challenges can be turned into opportunities."

The Big Crew Change

Any industry in North America or Europe heavily staffed with Baby Boomers is about to encounter a brain drain. But according to T+D magazine, 44% of organizations have no knowledge transfer process in place and no plans to create one.

Without efforts to capture what senior engineers and other technical professionals know before they retire, these companies will find themselves repeating lessons learned but not recorded for future use.

A closer look at the oil and gas industry illustrates the brain drain challenges all these industries face. It is focused on recruiting, training, and developing a new generation of petro-technical professionals, and it has made capturing the knowledge of senior professionals a priority. It is also focused on the relatively younger engineering workforce in Asia and on bringing them up to speed. The Baby Boom brain drain is mainly a problem in North America and Europe. But what a problem it is.

Currently, about 50% of American oil and gas engineers are eligible to retire. In one recent year, the flow of younger petro-technical professionals into the industry reached about 17,000, compared with about 22,000 leaving, according to Schlumberger Business Consulting (SBC). Petro-technical professionals include geologists, geophysicists, petro-physicists, and petroleum engineers with expertise in reservoirs, drilling, completion, and production.

On average, it takes a new engineer 8.2 years to gain sufficient experience to make nonstandard, original technical decisions, according to SBC's 2012 human resources benchmark study for the oil and gas industry.

"The Value of Competent People"—by J Ford Brett, managing director of oil and gas training company PetroSkills—documents typical costly mistakes by novice engineers: Perforated wells with reduced production; increased nonproductive time in drilling operations; and less success with exploratory wells. Some of these mistakes can cost up to $500,000 each, Brett estimates.

Calculating the ROI of better knowledge management

Companies that invest in a one-stop-shop approach to technical knowledge management can achieve significant top- and bottom-line returns on their investment. The specific benefits vary depending on the type of organization, the size of the knowledge workforce at the company, and the types of projects where the knowledge management solution is applied.

Results from manufacturing companies that have deployed this approach for new-product development reveal significant efficiency gains:

- A 20–30% reduction in engineering time spent locating relevant technical knowledge, curating information (researching document currency, procuring outside documents, accessing documents referenced within specifications, and maintaining paper copies), and sharing information with other colleagues

- A 50–75% reduction in time spent reviewing and understanding relevant technical knowledge

- A 20–50% reduction in time spent on ideation, including analysis, problem solving, and decision making

In terms of dollar savings, the estimated annual cost reductions for an industrial manufacturer with 500 engineers, each earning an average fully burdened salary of $93,000, range from $7.6 million to $13.4 million (see table at right). Of course, these figures reflect only the time and dollar savings of the engineering staff. Additional benefits include a reduction of as much as 50% of the time spent recreating work already carried out elsewhere in the organization. There are longer-term benefits as well, such as the value of creating a 100%-reusable audit trail of all research and problem-solving efforts.

Based on company case studies, benefits from improved technical knowledge management have been shown to provide additional competitive advantages:

- Accelerating time to market of new products by an average of two-and-a-half to four months

- A 1–5% improvement in manufacturing yield

- A two- to five-fold reduction in product/process defects and failures

- A 5–10% reduction in manufacturing costs, including materials savings, energy savings, and process improvements

- A 5–10% increase in intellectual property royalties

- Intelligence around competitors, consumer sentiment, industry and patent trends, technology trends, and more

- Better capability to strategically develop product road maps

A costly paper chase			Baseline projected savings			Stretch target savings (engineers)		
Activity	% time spent	Hrs/wk	Reduction with KMP*	Total hrs	Total/yr	Reduction with KMP*	Total hrs/wk saved	Total saved p/yr for all
A	25%	10	20%	1,000	$2,325,000	30%	1,500	$3,487,500
B	15%	6	50%	1,500	$3,487,500	75%	2,250	$5,231,250
C	20%	8	20%	800	$1,860,000	50%	2,000	$4,650,000
Total	60%	24		3,300	$7,672,500		5,750	$13,368,750

A Researching, finding, curating, and providing relevant technical knowledge
B Reviewing and understanding relevant technical documents
C Ideation (analysis, problem solving, and decision making)

KMP knowledge-management platform

Source: IHS

Analysis of total potential savings from deployment of a technical knowledge-management platform at an industrial manufacturer employing 500 engineers

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