Knowledge Management Magazine
Cover Story
Feature: The cost of Lost Knowledge

The Cost of Lost Knowledge

We may have forgotten how to send astronauts to the moon, but with new software systems, lost knowledge needn't be a lost cause.

KNOWLEDGE MANAGEMENT:
The Cost of Lost Knowledge

From Stonehenge to moon walks,
great deeds become great mysteries.
Can we preserve today's knowledge
for tomorrow's ventures?

By Geof Petch

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Illustration by Patti,Oleon

Once upon time we put a man on the moon. It was July 1969. Just eight years earlier, JFK had pointed to the outfield like Babe Ruth, and the U.S. summoned all of its intellectual and industrial muscle to knock one out of the park. And what a home run it was. More than 400,000 of the country's best and brightest engineers, scientists, technicians, and management - united in the largest scientific and industrial achievement in the history of mankind, invested their lives and $150 billion to turn the dream into reality.

Then, three and-a-half years after Neil Armstrong first kicked up moon dust, two other astronauts parked their lunar rover in a four billion-year-old lava-flooded valley southeast of the Sea of Serenity, climbed into the Apollo 17 lunar module, secured the air latch, and blasted back to earth. Back to the laboratories, the factories and the new opportunities launched a result of the investment in putting man on the moon.

Today, 26 years later, that investment in space is lost in space. The terrestrial side benefits remain, but today we can no longer put a man on the moon.

We forgot how.

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In all the time since, no other set of Saturn blueprints has ever been found.

A few miles from Mission Control in Houston stands a warehouse the size of a stadium, where shelves climb 30 feet off the floor under the cool blue flicker of exposed fluorescents. There, like the crated relics consigned to history in the last scene of Raiders of the Lost Ark, the documents of the Apollo mission wait for eternity. Reduced to microfiche, millions of pages of plans, specifications, reports, notes, correspondence, and test results-boxed and shelved according to no plan whatsoever and with no automated system for retrieval - collect dust.

Thought to be missing from this vast storehouse is a critical set of plans. It seems that 25 years ago, on a day thought unremarkable at the time, someone threw away a set of blueprints for the Saturn booster, the only rocket with enough thrust to send a manned lunar payload on its way. Apollo missions completed, the job was thought done and project directors were moving ounces. Attention turned to designing a bigger rocket to put man on Mars. The Mars mission was never funded, however, and that bigger rocket was never designed.

The original Apollo workforce is long since retired or scattered to the winds. The crews and mission directors no longer solve day-to-day operational problems. What they reamed-the 78 percent or so of enterprise knowledge that employees carry in their heads-is lost forever. Even if we could launch the Saturn again, we wouldn't remember how to fly it. This, too, is buried in the documents left behind in storage. The documents endure, but they are as devoid of meaning and human context today as the rocks of Stonehenge. Useless.

Reconstructing context

Into this world of forgotten knowledge strides Dr. Richard Ballard. Like Indiana Jones, Ballard is a unique kind of archeologist. He probes the labyrinths of organizations as complex as NASA and the Department of Defense looking for the lost, buried information essential to the future and useless if left to history.

Nine years ago, Ballard's Knowledge Research Group, located in Huntington Beach, Calif., excavated the Apollo program's documentary remains to uncover critical knowledge gaps that would have to be replaced if a manned Mars mission was ever to be attempted.

"Companies want to retain raw data, but raw data isn't the most important thing to retain. Not forgetting what the data means to a process or a function is what's important," Ballard

said. "We need to learn how to use technology to mine not data, but the rational structure that pulls the data together. "

A physicist by training and computer scientist by vocation, Ballard has been working on the problems of information structure and efficiencies for knowledge storage since 1984. His theoretical framework separates problem solving, with its dependence on data, from problem management, with its much greater emphasis on, the rational component.

"Managerial problems are mostly about the how and why of things, and rarely about information per se," he explained. "They are about having the knowledge to reduce the options for action before taking action. Simply put, knowledge is anything that reduces uncertainty."

In discussions with NASA, administrators said, "Well we can't go back to the moon right now, but if we did we probably wouldn't want a three - stage rocket, but a single stage. And we probably wouldn't want all of it to be man-rated, but parts of it robotic," Ballard recounted. "What they did was then ask for each set of questions that had a 'probably' in it: Can we get guidance from the things that exist and how well do the things that exist guide us? What are our constraints and where do we have empty holes of knowledge that we had assumed were full?" From these questions, Ballard constructs a concept-centric, not data-specific, knowledge base for problem management.

Ballard's product is a computerized knowledge base that imposes a rational structure on existing sources of knowledge, then automates the capture and communication of future textbased knowledge. It differs in representational modeling and use of semantic networks from commercial document management systems and is intended for a different use. These knowledge bases use universal formats and methods that reveal and use every detail of rational structure and empirical dependency, but remain identical in form and function through time, independent of the subject.

The intensive development period to construct this type of knowledge base generally confines its use to complex projects. These are projects where the cost of lost knowledge could be staggering, sometimes going beyond economics and into the realm of national security.

For example, the Gulf War consumed the remaining service life of a large number of aircraft and shortened the expected life of others that were no longer in production. Almost all of these were strike warfare classes like the F-111 or F-16. In response, the Department of Defense initiated a rush project to find mature designs and technologies that might be shared in constructing three completely new aircraft. The initial budget was $3.8 billion and the projected total future value with foreign sales was estimated at around $1 trillion.

The tricky management problem that emerges for such projects is their duration. Aircraft designs created before 2000 will be deployed no earlier than 2030. Engineers designing the original specifications likely won't be active when other engineers complete their work a generation later, or when contractors are midway through the construction phase, yet a further generation out. A computerized

knowledge base needs to be devised to sustain the rational structure of underlying project knowledge throughout the project life cycle, without prior knowledge of what may be important in the future.

Properly implemented, Ballard believes that a knowledge base constructed around problem management, as different from problem solving, enables an enterprise to "acquire back the knowledge lost, and do so out of regular operations."

Not gone but forgotten

Ballard's salvaging of lost knowledge to apply to current and future organization problems and opportunities begs a very real question of economics not limited solely to government projects: Can an enterprise afford to forget anything?

On a global basis, the cost. of lost knowledge is staggering. Technology transfer broker BTG PLC estimates that productive technologies worth $115 billion sit idle today. BTG's research indicates that technology is forgotten when managers promoting new technologies are reassigned, or technologies are simply not identified after a merger or disposition of enterprise assets. In these cases, the knowledge that is lost is not visible: The consequence is not known but the impact is profound.

The first time modem enterprise visibly has faced the quantifiable consequence of lost knowledge is the problem known as "Y2K." Forgetting that the year 2000 has four digits is like forgetting how to put a man on the moon. It doesn't seem plausible. Nonetheless, these are the four digits that the Gartner Group predict will wind up costing business worldwide $1 trillion to correct. As we enter the next millennium, the four digits have forever changed the role of information services in the enterprise, are influencing the course of the global economy, and have created an entirely new category of angst.

It isn't, of course, that programmers forgot the number of digits in the year. Storage space memory was expensive and they just didn't think about the future impact of using two digits. No one envisioned that source code written in the late 1950s would still be in use at the turn of the century, and no one kept a record of the location of the now errant code. No one thought that any of this would be important and now the original programmers are gone from the scene and unavailable to give guidance to their replacements about what they had done. This is strikingly similar to the lost knowledge problems faced by Ballard's clients.

Today, combing through lines of code for remediation may run $1.50 a line-when you still have access to the source code. Unfortunately, source code is frequently unavailable. It may be archived and moved off site to be forgotten; it can slip through the cracks after a merger or reorganization; or it can disappear quietly when a worker resigns or is dismissed. The Gartner Group estimates that as much as five percent of source code is missing at any given time. And the chore of rewriting lost source code can cost between $25 to $100 a line.

Whatever the dollar amount, the true cost to business is the cost of lost opportunity. The imperative imposed by Y2K may slow investment in new systems

that drive top-line revenue issues, exposing the enterprise to erosion of competitive market position. Ballard identifies this relationship between lost data, forgotten contexts, and missed opportunity as the process of an enterprise unconsciously "liquidating knowledge assets, with the same potential effect as liquidating hard assets- bankruptcy."

Plugging the leaks

Combining data retention with contextual relationships that provide meaning to information may well stop the liquidation of knowledge assets, prevent future lost knowledge, and provide above-the-line profit opportunities. Commercial work in this area, initiated by Ballard and others on large government and intelligence community projects, is starting to appear in product. Pivotal Software's Relationship 98 is a comprehensive infrastructure for managing data, workflow, and transactions in customer relations. Embedded in its enterprise repository is a "corporate memory" that automatically captures all interactions with customers, prospects, and employees.

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This new category of product, corporate or group memory, is also represented by standalone offerings from KnowledgeX (recently purchased by IBM for integration with its business intelligence solutions) and Intraspect Software. Like Ballard's pioneering work, these products center on the importance of context and create a common repository that becomes the sweet spot of enterprise knowledge. While they do not attempt to recover lost knowledge, they are affordable and scaleable out-of-the-box.

On a practical level, group memory is implemented as a system that integrates collaboration, information search and retrieval, groupware, and database technology. Soon, such technology will become embedded with other enterprise business intelligence tools, as well. According to Tom Gruber, chief technical officer of Intraspect, "Group memory is at the intersection of what humans and computers respectively do best. Humans do knowledge work. Computers remember it, in context, and then communicate it when called on. It's an organizational intelligence plus a memory for the enterprise."

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Through evolving organizational intelligence and enterprise memory technologies and applications, our next moonshot may actually occur right here on Earth. But it might as well be 1961 as we just now realize the scope of the problem, the nature of the challenge, and the devastating impacts of the threat if we do not succeed in preserving knowledge that may otherwise become lost. For knowledge archeology, time may be running out.

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