

# Diagnosing the Costs of Lost Knowledge on Organizational Performance

DAVID W. DELONG

OCTOBER 2005

*Leaders in one state government have recognized that they have an aging work force problem. About 50 percent of their 70,000 employees will become eligible to retire by 2012. The chief human resource officer has formed a task force to address the problem, but she knows she won't get the support of the governor and the legislature to invest in solutions to avert a crisis unless she can develop a solid business case for the initiatives needed.*

*For years, Rolls-Royce maintained the supersonic jet engines used to fly the Concorde. As a result, this UK-based company has the greatest knowledge base in the world about how to maintain these highly sophisticated engines. But many of the engineers with expertise in maintaining supersonic engines are about to retire, and management wants to invest quickly in retaining their knowledge. How can those managers responsible for sustaining this maintenance capability make the business case to the firm's leaders that losing this knowledge would be very costly for Rolls-Royce?*

*The World Bank provides loans, policy advice, technical assistance, and knowledge sharing services to reduce poverty and support economic development to more than 100 developing countries. Since 1996, the bank has been committed to being the clearinghouse for knowledge on leading development practices. And a few years ago, the bank launched a knowledge management strategy to fight poverty by systematically sharing expertise with client countries and public and private partners.<sup>1</sup> But the strategic objective of increased knowledge sharing also made the costs of ongoing knowledge loss more apparent. For example, staff who returned from working in the field offices or who completed special projects had extensive knowledge about how to get things done in local, social, and political settings. Management wanted to create processes for retaining that critical knowledge and making it available to their successors. But how could they justify such investments in knowledge retention initiatives?*

**These are three increasingly common scenarios that are leading managers to confront threats of lost knowledge today.**

## *Looming HR Crisis*

As in the state government example, managers in many sectors recognize that they face a major wave of baby boomer retirements that threaten to devastate certain core capabilities which rely on complex experiential knowledge.

## *Immediate Threat of Critical Knowledge Loss*

Sometimes managers, like those at Rolls-Royce, have already identified specific individuals whose pending departure from the organization will seriously undermine key capabilities.

## *Loss of Expertise Undermines Knowledge Management Strategy*

Initiatives to manage knowledge more effectively, such as those at the World Bank, often make the costs of losing intellectual capital more visible and, thus, demand greater emphasis on knowledge retention. How can sponsors justify these investments?

## The Real Costs of Lost Knowledge

Although the costs of losing knowledge through employee attrition are often intangible and hard to quantify, sometimes they have a serious measurable impact on organizational performance.

*The manager of an oil drilling platform in the Gulf of Mexico must shut down his operation for safety reasons when he cannot readily locate the design engineers who would know how to fix a fracture in a critical pipe. Shutting down the platform costs the company several hundred thousand dollars in lost production.*

*Boeing offered early retirement to 9,000 senior employees during a business downturn, but an unexpected rush of new commercial airplane orders left the company critically short of skilled production workers. The knowledge lost from veteran employees, combined with the inexperience of their replacements, threw the firm's 737 and 747 assembly lines into chaos. Finally, management had to shut down production for more than three weeks to straighten out the assembly process, which forced Boeing to take a \$1.6 billion charge against earnings and contributed to an eventual management shakeup. Lost knowledge was not the sole cause of Boeing's production problems, but it was a major contributor.*

*The central pool in the Fort Worth Water Park, a civic fountain in this Texas city, was designed to be 3½ feet deep when it was built 20 years ago. The fountain was well maintained into the 1990s, when, through a series of retirements and cutbacks in the training budget, the maintenance group lost track of how deep the pool should be. In June 2004, four people—including three children—drowned in the Water Park because the pool was nine feet deep.*

*A veteran chemicals purchasing executive retires with detailed knowledge of supply sources, negotiation histories, contact details, and relationships with key suppliers. His successor lacks the market knowledge to counter 10 percent price increases immediately levied by suppliers.*

*The average age and level of work experience in many oil companies—and other industries as well—is going to drop significantly in the next decade. “We could lose as much as 50 percent of our total work force in the next five to ten years, where the average employee has twenty-five years of experience,” said the senior executive of one major oil company. “And, even if we can hire replacements, in ten years our average work experience will drop considerably, and that probably has an impact on our NPV.”*

Concerns about losing critical capabilities due to staff turnover have gained increased attention, but management's reluctance to address these problems remains surprisingly strong. A major reason for this is the difficulty in quantifying the impacts of knowledge loss on performance, or at least showing the potential impacts on strategic objectives. This paper presents frameworks for identifying lost knowledge threats and linking them to organizational performance. Making these concerns visible and more quantifiable is the first step to gaining strong executive sponsorship and financial support for investments in practical solutions.

There are five reasons why it is essential to make the costs of knowledge loss more visible to your organization before proposing knowledge retention or work force development initiatives, such as new phased retirement policies, broader succession planning and mentoring programs, or installing a lessons learned database.<sup>2</sup>

- No one gets promoted for retaining critical knowledge. There is little psychological incentive to address solutions that just sustain the status quo. Convincing executives to invest in specific retention initiatives is about as exciting as asking taxpayers to invest in replacing water and sewer systems.
- Relative to other investment opportunities, even if specific knowledge or capabilities are

retained, there is often no obvious payback for the investment.

- There is frequently unspoken resistance to making investments designed to avoid problems that may *never* occur.
- Managers will resist grappling with threats of knowledge loss to avoid the sense of powerlessness they may feel in addressing the problems that are uncovered. For example, when a world-class expert in a critical role is about to retire, there may appear to be no practical solution for sustaining this capability.
- Finally, many senior executives themselves are within a few years of retirement. And because knowledge loss issues are complex and difficult, there is often an implicit decision to avoid taking on this problem, which has no apparent short-term payoff.

These five dynamics pose significant challenges for convincing top management that they should invest in knowledge retention and work force development solutions. But they also make a compelling argument that considerable attention must be paid to making the costs of lost knowledge visible, if these barriers are to be overcome. The next section will show you how to begin.

## A Framework for Diagnosis

From management's perspective, the loss of intellectual capital, like the loss of any resource, is only relevant in terms of its value to the

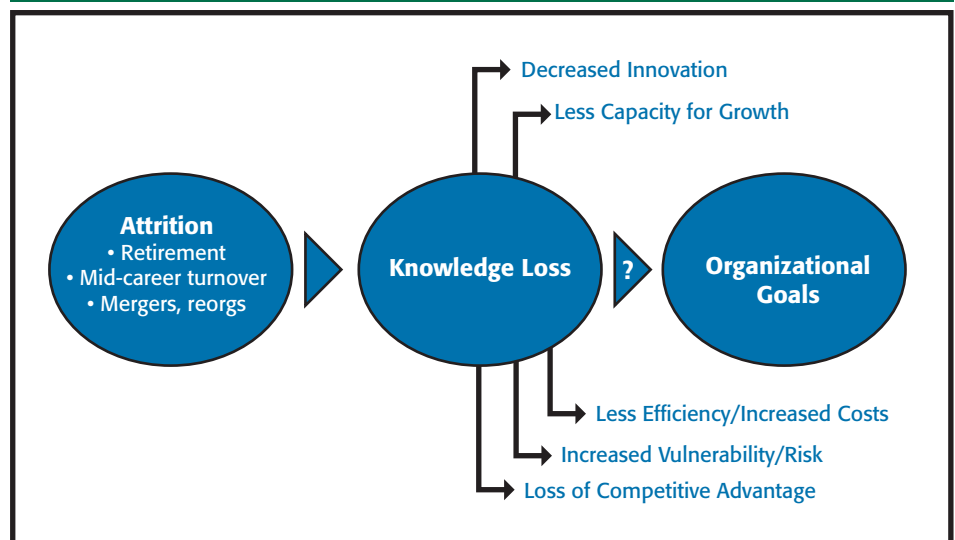
organization. When leaving organizations, people often underestimate the value of the knowledge they are taking with them. But, face it, many others think the knowledge they have is worth a lot more than it really is. They take Eliza Doolittle's attitude, immortalized in *My Fair Lady* when she imagined leaving her demanding mentor: "Just you wait Henry Higgins, just you wait. You'll be sorry, but your tears will be too late." The challenge for managers is to figure out whose knowledge, if missing, will have a serious impact on the business.

Exhibit I summarizes the strategic business impacts that need to be considered.

The best way to start is to have a clear understanding of the business units' strategic objectives, key operating processes, and future competencies needed. For example, a consumer products company

whose focus on an innovative strategy depends on bringing high-quality products to market on time should be much more concerned about losing the knowledge of key research scientists or product development engineers. But a chemical company focused on growing its business by opening new plants in Asia should be more worried about losing the capabilities of the veteran chemical engineers that it needs to launch new operations. Who are the employees or managers whose knowledge is most critical to sustaining your strategic advantage and operational effectiveness? That's what you should be asking. Strategy, core operating processes, and future skills needs must frame any diagnosis of lost knowledge concerns if it is going to get top management's attention.

## EXHIBIT 1: Potential Strategic Impacts of Lost Knowledge



## Where's the Formula for "Turnover Costs"?

More explicit costs of turnover, such as hiring replacements and training, have been discussed in HR circles for years, although surprisingly little research has been done to figure out how to measure these impacts. That is, in part, because figuring out the cost of replacing an employee or executive turns out to be much more complicated than it first appears. Thus, more traditional formulas for determining the costs of turnover have a role to play in building a business case for knowledge retention, but it is relatively limited for several reasons.

First, turnover costs do not always translate into declining performance. Many managers (and researchers) implicitly assume there is a linear negative relationship between levels of turnover and work force performance. That is, more attrition leads to more loss of organization-specific knowledge, which reduces overall performance. The assumption in most "cost of turnover" calculations is that greater turnover always leads to a net decrease in performance, e.g., increased replacement costs and declining productivity. But recent research has challenged this assumption, [for example, see "Alternative Conceptualizations of the Relationship Between Voluntary Turnover and Organizational Performance" by J. D. Shaw, N. Gupta, & J.E. Delery, *The Academy of Management Executive*, (2005) v48 n1:50-68], and some progressive managers are now ignoring standardized formulas for measuring turnover costs. Instead, they argue that these costs are only important when considering the departure of high-performing employees in high-impact roles, such as a veteran R&D project manager or a senior cardiologist in a large hospital. In fact, a growing number of executives argue that turnover actually has considerable benefits because the departure of low-performing employees or older employees in low-impact jobs actually saves the organization money and often leads to improved performance. [See "The Turnover Myth" by F. Hansen, *Workforce Management*, (June 2005), p.34-40; "Recalibrating Turnover-Cost Calculators," by F. Hansen, *Workforce Management* (June 2005), p.40].

Second, attrition costs are only important in certain situations. In most cases, framing increased attrition as a "cost of turnover" problem is an oversimplification. Worrying about traditional turnover costs, such as hiring and training, is only important when an employee's contribution has already been established. Then, adding on these additional costs can be very relevant. But assuming all hiring and replacement dollars have an equally negative impact on performance is misguided. Sometimes these costs should be welcomed, because they will result in a higher-performing and even a lower-cost replacement.

Finally, the focus on turnover costs is also limiting because it puts too much emphasis on the individual employee, ignoring the more systemic impacts on group and organizational performance that can result from the loss of knowledge caused by the departure of one or several people. Often the cost of replacing a key employee does not take into account the larger performance impacts of losing the predecessor's knowledge.

This study identified four types of lost knowledge which provides a framework for decision making in diagnosing threats. Exhibit 2 shows the four types:

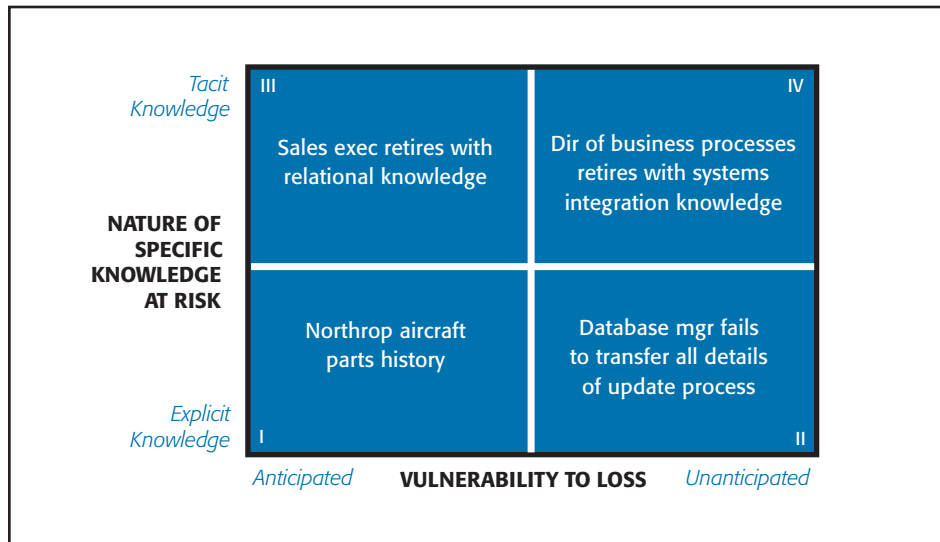
### *Quadrant 1: Explicit knowledge<sup>3</sup> at risk/loss anticipated*

Northrop Grumman knew it could not afford to lose knowledge about the repair history of parts for its B-2 Bomber. These records would be critical for safely maintaining the aircraft over time. This knowledge was carefully documented and its value clearly recognized at all levels of the organization.

### *Quadrant II: Explicit knowledge at risk/loss unanticipated*

When a database manager left his job, he spent six weeks training his young successor. For three years, the veteran manager had been running a complex series of computer programs every month to update 30 million records of his company's credit card customers and potential customers. Even though the departing manager provided detailed descriptions of the computer jobs that had to be run, his successor still could not execute the monthly update correctly because she was missing certain instructions that the experienced manager had failed to document. These breakdowns cost the group \$80,000 and lots of goodwill with its customers in the marketing department. One of the most insidious types of lost knowledge is explicit knowledge that could easily be passed on, if only the need for it was recognized.

## EXHIBIT 2: Four Types of Lost Knowledge



**Quadrant III: Tacit knowledge at risk/loss anticipated**—The effectiveness of an international sales manager at a major chemical company depended heavily on his personal relationships (i.e. social capital) with customers throughout Europe and North America. Thus, before retiring, he spent several months traveling with his successor, personally introducing her to key decision makers to help the new sales executive begin building effective relationships with key customers. The retiring manager knew that the loss of this social capital could have significantly hurt sales for the company in certain product lines.

**Quadrant IV: Tacit knowledge at risk/loss unanticipated**—When the director of business processes for a large West Coast food distributor was encouraged to take early retirement after 20 years, he was the only person who had complete knowledge of how the company's

core systems related to each other. Thus, strategic timetables to integrate departmental systems, such as marketing, sales, and new store development, had to be significantly extended because of the learning curve required for his successor. The new top management team that had taken over recently was unaware this complex process knowledge even existed.

Each quadrant in Exhibit 2 presents different problems that require different diagnostic approaches when defining risks and deciding where to invest. In general, however, it's like fighting terrorism. Defining and anticipating specific threats is the essential first step for determining costs and developing effective responses. Thus, the objective is to surface as many lost knowledge threats as possible from the right side of the matrix so they are moved into the left quadrants.

Where you start depends on your diagnostic objectives, and this is determined largely by senior management's awareness and orientation to the problem. Top management and the organization will be in one of four states when it comes to recognizing lost knowledge threats and their implications for future work force development:

- Unaware of the problem
- Aware of the problem, but no strategy to address it
- Aware of the problem, a few initiatives being implemented to address it
- Aware of the problem, many initiatives under way

If top management is unaware of the problem, or apparently unmotivated to take action, then your initial diagnosis should be focused on bringing sustained attention to the issue. One way to do this is with a brief exploratory diagnostic study, which will be described below. If top management is aware of the problem, but seems unsure how to proceed, then diagnostic efforts should focus on identifying specific lost knowledge threats and linking them to the organization's strategy. An approach used by the Tennessee Valley Authority (see page 7) is one way to start this step.

If there is a shared understanding about where the primary strategic threats are located, the focus turns to evaluating lost knowledge risks and quantifying their costs where possible. The use of real options

theory can be helpful here (see page 13). Each of these steps is a building block that makes threats of knowledge loss more visible and increases the organization's ability to design solutions for retaining critical capabilities.

## Surfacing the Problem— An Exploratory Study

When executives seem unconcerned about the potential impacts of knowledge loss, a small interview-based study is one way to bring attention to the issue and to identify types of knowledge at risk.<sup>4</sup> The focus of the study will depend on whether you are concerned about threats of immediate knowledge loss in a particular unit or a looming HR crisis across a broader work force. The study itself can be based on interviews with a mix of 8-20 people who have recently retired from the company or who are expected to retire within a year. The purpose of the confidential interviews is to identify four things:

### *(1) Critical knowledge being lost and the likely business impacts*

Examples below come from two diagnostic studies conducted as part of this research project. One senior partner in a financial services firm said:

"I've got a hell of Rolodex, and I can still drive millions of dollars of business each year to the firm. I could be a partner on a smaller client, and I could coach younger partners. No one said, 'no' to my part-time idea, but no one said

'yes' either. So I just started to put together my next career."

A recently retired program manager from a large engineering firm reported:

"When you put together a project proposal, you must rely on a strong set of resumes ... The typical problem is that our competition is offering people with 15 to 20 years of experience, and we only have people with 5 to 10 years ... It's hard to win a job without senior technical people. Either they get promoted into corporate, or they get frustrated and leave."

Interviewers should probe as much as possible for examples of where and how critical knowledge is leaving the organization and seek direct connections to significant business impacts. In the examples above, the senior partner was actually taking away the opportunity for new sales revenues. And the program manager argued that an ongoing loss of technical expertise was hurting the firm's ability to win new business.

### *(2) Retiree's perception of existing knowledge transfer processes*

Interview questions should also probe for an evaluation of the organization's existing knowledge transfer practices. After all, the people being interviewed have just had experiences with these practices, so they are in a good position to evaluate them. It can also be beneficial to interview several recent successors in specific roles to see how they have benefited, or not, from

transfer practices. Here are examples from the two studies:

"Leadership needs to be more intentional in dealing very proactively and aggressively with account changes for both active and retiring partners. Now we have this catch-as-catch-can attitude, which relies on the retiring partner's own desire and skill in transferring knowledge."

"I was planning to retire at the end of the year, but the company asked me to accelerate it by three or four months. Neither the company nor I was focused on debriefing me or extracting knowledge. There was more interest in getting me off the payroll. It can be very demotivating at the end of a career when you feel like you're running into this attitude."

### *(3) Opportunities to leverage veteran employees' knowledge before they leave*

Often these interviews will reveal things that the organization should be doing differently to improve critical knowledge transfer. For example, interviews in both the financial services and the engineering firms revealed that career paths and activities had changed recently, so that veteran managers were now being strongly encouraged to take administrative or corporate jobs. This takes them away from senior line positions where they would be in a better position to share their experiential knowledge about clients and service delivery with younger employees. Both firms may want to

## According to an AARP study, more than 60 percent of companies in the U.S. are currently bringing back retirees as contractors or consultants.

rethink how these career paths could be altered to improve the transfer of knowledge about customers.

### *(4) Opportunities to leverage retirees' knowledge*

Interviewers should also probe for insights that suggest ways the organization could better use the expertise of its recent retirees. According to an AARP study, more than 60 percent of companies in the U.S. are currently bringing back retirees as contractors or consultants.<sup>5</sup> This trend is certain to grow in the years ahead as many companies experience the increasing talent shortage caused by the aging work force. Thus, firms would do well to start now looking for ways to utilize retirees more effectively. A senior advisers program in the engineering firm allows recent retirees to go on part-time employee status, retaining access to benefits but scaling back their workload. Interviews showed this program was very popular with those in it and should probably be expanded. One participant explained, "Now I can phase out instead of going off a cliff. I can pick and choose if I want to do something or not. But when you're full-time, you don't have that choice. It keeps a healthy relationship going."

Once the interviews with near-retirees and recent retirees are completed, a brief report can be generated using the interview data to illustrate consistent themes identified, which illustrate lost knowledge threats and some potential solutions. The report can then be used as a basis of discussion by the executive team to explore the issues in more depth and to suggest potential next steps. One word of caution about this exploratory study: It must be conducted by a highly respected internal consultant or "high-potential" future leader, so that findings carry significant credibility with executives. Using a well-regarded external consultant is another option. But delegating this study to a low-level HR staffer all but assures the findings will have little impact on top management.

### Locate Specific Knowledge Threats

Leaders may be aware that knowledge loss due to an aging work force, mid-career turnover, or recent reorganization poses a serious threat to organizational performance. But they may not know where to focus resources to address the problem. One way to systematically identify where the business is most vulnerable is to use a method developed by the Tennessee Valley Authority (TVA), the largest public power company in the U.S.

TVA has 13,000 employees who operate and maintain 3 nuclear power plants, 4 combustion-turbine plants, 14 fossil fuel plants, and 29 hydroelectric dams. A few years ago, TVA's management realized that up to 40 percent of its work force would be eligible to retire in five years. In implementing a strategy to address this problem, the first step was to identify which positions posed the greatest threat of critical knowledge loss. TVA started by surveying employees in its nuclear operations to find out if and when they were going to retire. Over time, response to what became an annual e-mail survey increased to 80 percent, and management used historical data to provide estimated retirement dates for the balance of the work force.

At the same time, managers and supervisors were asked to rate all of their employees in terms of their "indispensability" on a one to five (most valuable) scale. The result was what TVA calls a "position risk factor," which, when multiplied against the retirement data, creates a "knowledge risk factor." This identified those employees, such as turbine specialists or radiological control engineers closest to retirement, who were also considered most valuable by their supervisors. Using this process helps TVA to identify where immediate knowledge retention interventions are required.<sup>6</sup>

## A Quick Process for Identifying Expertise at Risk

When retirement plans are known, and a specific group of employees can be identified as leaving soon, there is an alternative approach to identifying which employees are leaving with the most critical knowledge. Delta Airlines used this method in November 2001 when 1,200 aviation maintenance technicians accepted an attractive severance package as part of a major reduction-in-force. These mechanics, many with between 20 and 40 years of experience at Delta, would be leaving in less than two months, so management had to quickly identify those with unique expertise. To do this, they asked supervisors a series of questions:

- Is the person leaving an outstanding performer?
- Does he/she occupy a position where there are no other incumbents, or no one has been trained as backup, or there is no documentation for the job?
- Is he/she considered a go-to person in a time of crisis?
- Does he/she have great contacts both inside and outside the company?

Of the 12,000 departing employees, about 108 met this set of criteria. Then, because time was so limited, they were further prioritized as:

Priority #1: "People we must talk to or the company will fall apart." They had knowledge that is critical to the organization, and the loss of this information would have far reaching effects.

Priority #2: "People we would like to capture knowledge from, if time and resources permitted."

In the weeks remaining, the organization was able to interview 85 of those experts who were leaving. In the interviews, they tried to collect whatever insights they could about any processes or technologies their people used to do their jobs. They also asked those leaving who they went to in order to get something done. Lastly, they tried to glean any uncommon knowledge that the experts had developed about the diagnosis of particularly complex problems.

A last-minute interviewing process like this has serious limitations, not the least of which are packaging the insights for reuse and motivating successors to access the information collected. But retaining some critical knowledge is better than nothing, and Delta's process shows one way to quickly determine where to focus when a lot of people are leaving. It is worth noting that this process was only possible because Delta had good long-term relationships with its employees who were leaving voluntarily. If this had been a forced layoff, a knowledge retention program would have been much more difficult.

**It is one thing to identify individuals or groups whose knowledge represents a key asset for the firm, but it is often equally important to show how their value-added links directly to organizational performance.**

Now comes the tricky part. It is one thing to identify individuals or groups whose knowledge represents a key asset for the firm, but it is often equally important to show how their value-added links directly to organizational performance. Making this link can be essential in convincing senior management to invest in and actively support knowledge retention initiatives. Even when leaders don't ask for the supporting business case, it is wise to develop it. That way, when competing commitments arise in the future, as they always do, a practical case can be made for continuing investments in knowledge retention.

As described earlier, you may be confronted in practice with an immediate threat of knowledge loss, a looming HR crisis, or a knowledge management strategy that needs to improve retention of critical expertise. Regardless of your starting point, you should begin engaging in a kind of dialectical questioning that goes back and forth between the organization's strategic objectives and the four quadrants described in Exhibit 2 to ensure that you consider the impacts of all types of knowledge loss threats on performance objectives.

Starting with the quadrants on the right side, where knowledge loss is

unanticipated, you want to use techniques that can identify human, social, and structural capital that may be at risk. Then pose hard questions about its real importance to achieving business objectives. Your goal should be to continually try to move from a state of chaos (Quadrant 4), where you have no idea how lost knowledge is affecting business performance, to a condition where the complexity of knowledge/performance relationships is better organized and understood. This gives leaders the chance to recognize patterns of knowledge loss, which can lead to greater cause/effect understanding when linked to strategic objectives.<sup>7</sup>

For example, one large international pharmaceutical company had gone through a series of mergers, and its R&D scientists now worked in five laboratories spread across three countries. Executives were no longer sure who their key scientists were and who they were collaborating with. Thus, they engaged a consulting firm to conduct a diagnosis using a social network analysis software tool which collected data from the scientists about who they went to for ideas or help with work-related problems. In the immunology area, the diagnostic revealed ten scientists who, together, held most of the

organization's critical knowledge related to future drug development. Not surprisingly, all of these key scientists, whom others in the organization relied on according to the analysis, were older and had lots of inventions to their credit. Losing them would be a disaster for the company. Making this threat of knowledge loss visible to leadership was the first step in addressing the problem. The network analysis created a detailed picture of where this pharmaceutical firm needed to focus its resources on improving retention.<sup>8</sup>

Another way to facilitate this type of pattern recognition, which shows organizations where to look for lost knowledge threats, is to develop a template of common cause/effect relationships showing where knowledge loss directly hurts business performance. Table 1 on the following pages lists a dozen common patterns to watch for when trying to make connections between lost knowledge and performance impacts. This list is by no means complete, but it provides a place to start. Every organization can add its own unique patterns, which help in identifying and valuing particular lost knowledge threats.

**Table 1: Performance Problems Caused by Lost Knowledge**

	CAUSE OF LOST KNOWLEDGE	KNOWLEDGE LOST	PERFORMANCE IMPACTS
<b>1</b>	Procedures documented incorrectly	Knowledge critical to high-quality outputs	Core processes/operations disrupted, increased costs
<i>Example: After a maintenance technician retired from a plant that produces soybean oil, large batches of oil started to go bad unexpectedly during production. This veteran employee had known the fifty-cent seals on the machines that pressed the oil had to be changed every week, instead of every eight weeks, as dictated by the maintenance manual. It took the firm two years to rediscover this, costing them millions of dollars in lost product and sales revenues.</i>			
<b>2</b>	Inadequate documentation & training	Knowledge about maintaining safe, efficient operations	Increased costs from accidents & operations disruptions
<i>Example: In a chemical company, the expertise in a group that maintained special valves continued to decline as veterans retired and training was not increased. This problem never came to management attention until an explosion in the plant was attributed to a faulty valve that had recently been serviced.</i>			
<b>3</b>	Inadequate filing procedures	Knowledge needed to perform intermittent tasks, trouble shoot & repair equipment, or apply historical assets	Increased costs due to inability to perform standard tasks, diagnose & repair breakdowns, or to perform tasks & limit risks relying on accumulated knowledge
<i>Example: In one major city, a senior industrial hygienist unexpectedly left his government job in the Office of Environmental Health &amp; Safety, giving his colleagues only three days to transfer knowledge about his work. He had files and records of all industrial hygiene work done in his unit for the last seven years. But, in many cases, the paper records had been lost, and the electronic files were unorganized, so only the departing employee knew what they were. Inability to access this documentation only exacerbated the already high costs of worker's compensation claims for this urban administration.</i>			
<b>4</b>	Loss of strong customer relationships developed by departing employees	Social capital reflected in high levels of trust and collaboration	Loss of business revenues, inability to win new business
<i>Example: Because he had been the central figure in dealing with this major client, one veteran sales executive worried that when he retired his firm would lose the master agreement with this large customer, which would cost his firm up to \$10 million a year.</i>			
<b>5</b>	Failure to plan for the succession of highly specialized technical talent	High-level technical knowledge only gained through experience, and dependent on organizational context	Inability to grow or to win and deliver new business because of degraded technical capabilities
<i>Example: A major chemical company's strategic growth plans to expand in Asia are slowed down because the company is losing the veteran chemical engineers it will need to open new plants. It hasn't been able to hire or develop experienced replacements fast enough.</i>			
<b>6</b>	Failure to plan for the succession of highly skilled management talent	Sophisticated management knowledge gained largely through experience and dependent on knowledge of organizational context	Inability to implement complex projects on time and within budget
<i>Example: An engineering company that had once been the dominant program management firm in its field was losing that advantage because it no longer had enough managers with the right level of expertise to win major jobs.</i>			

CAUSE OF LOST KNOWLEDGE	KNOWLEDGE LOST	PERFORMANCE IMPACTS
<b>7</b> Inadequate succession planning for complex, hard-to-fill roles	Unique cross-disciplinary technical & social knowledge	Degraded expertise in specialized roles reduces organizational capabilities
Example: Engineering firm client service manager: "If you looked at any one of our top clients, they have very high expectations. And the people in client service roles are seen as having very difficult jobs that not many people want to do. There are several of these roles in our company that are going to be very difficult to replace."		
<b>8</b> Failure to identify & articulate strategic knowledge	Knowledge essential for implementing business strategy	Reduced ability to achieve strategic objectives
Example: The director of business processes for a West Coast food distributor was encouraged to take early retirement, with no attempt to transfer his unique strategic knowledge about the businesses' store development processes. The sudden loss of his expertise was a major contributor to the company missing its growth objectives the following year by almost 25 percent.		
<b>9</b> Critical systems or process knowledge concentrated in one person	Knowledge essential for maintaining or operating key system or process	Quality disruptions, inability to meet customer deadlines, increased costs
Example: A veteran software engineer for a major engine manufacturer was the prime troubleshooter on a manufacturing computer system. If he retired, anticipated disruptions in manufacturing operations would cost more than \$400,000 in the first year.		
<b>10</b> Failure to document how critical cross-functional tasks are performed	Basic knowledge of how to perform key tasks most effectively	Increased time to accomplish tasks, more costly mistakes because new employees have no source of process knowledge
Example: New manager in store operating systems unit doesn't know if he is following correct purchasing procedures because there is nowhere to check what the correct process is.		
<b>11</b> Failure to anticipate impacts of layoffs on long-term skill base	Experiential knowledge needed to deliver high-quality products & services	Quality upsets, increased costs, reduced customer satisfaction, decreased revenues
Example: Boeing offered early retirement to 9,000 senior employees during a business downturn, but an unexpected rush of new commercial airplane orders left the company critically short of skilled production workers. The knowledge lost from veteran employees threw the firm's 737 and 747 assembly lines into chaos.		
<b>12</b> Failure to maintain access with key experts needed to maintain technical operations	Critical technical knowledge needed to troubleshoot and repair system breakdowns	Decreased revenues due to production disruptions
Example: Manager on an oil drilling platform must shut down his operation for safety reasons when he cannot readily locate the design engineers who would know how to fix a fracture in a critical pipe. Shutting down the platform costs the company several hundred thousand dollars.		

Example #4 in Table 1 shows that the loss of employees who have strong customer relationships can reduce high levels of trust (i.e., social capital) that the organization has had with key clients. This can result in decreased capabilities to retain existing business or win new business. Being sensitive to this pattern should lead to questions such as:

- Where could attrition be hurting our key customer relationships?
- Which employees or managers have critical relationships with decision makers on the customer side?
- Given our business objectives, which of these relationships can we least afford to lose?
- What will be the likely cost to the business of doing nothing to transition these trust-based relationships to those remaining in our organization?

Example #8 in Table 1 suggests that failing to identify knowledge underlying strategic capabilities can lead to personnel decisions that directly degrade competencies essential to the business strategy. In the example given, top management in a West Coast food distributor failed to recognize the unique expertise held by the firm's director of business processes. He was encouraged to take early retirement with no attempt to first transfer his essential knowledge about the businesses' store development processes. The sudden loss of his expertise was a major contributor to

the company missing its growth objectives the following year by almost 25 percent. If senior management had a better articulated understanding of the skills and capabilities needed to implement the firm's strategy, they would have probed more to understand where critical knowledge about core business processes resided. Identifying this manager as a resource for this unique knowledge, leaders should have been more careful to invest in knowledge transfer practices before encouraging this veteran to leave.

Of course, no management team is ever going to identify and address all lost knowledge threats before they affect performance. But the goal should be to avoid what Watkins and Bazerman call "predictable surprises," which result in increased costs or lost revenues for which management should be held accountable.<sup>9</sup> It is worth pointing out that losing some knowledge is, of course, a good thing. It opens up the way to innovation and can rid organizations of obsolete capabilities and ways of thinking. But top management's rush to cut costs by eliminating personnel, and its failure to recognize the true value of the organization's knowledge assets, often leads to unintended consequences that can now be labeled "predictable surprises."

Among the easiest of these "surprises" to uncover are those involving explicit knowledge, reflected in quadrant 2 of Exhibit 2. Examples 1-3 in Table 1 all show common ways that critical explicit knowledge is lost. For example, when procedures are documented

incorrectly, successors will inevitably make costly mistakes that can be very hard to diagnose and fix, because the documentation indicates they are performing the task correctly. Thus, when experts are leaving the organization, it is worth asking them if there is any documentation that practical experience has taught them is wrong or clearly ineffective. Of course, you won't uncover all of the disconnects between effective practice and formal documentation of tasks, but just uncovering some of them can save the organization from considerable operational disruptions.

## Valuing Lost Knowledge Risks

Once you have located the most critical knowledge at risk, given your organizational objectives, the next task is to evaluate these risks and decide where knowledge retention initiatives are most essential. A simple way to analyze knowledge at risk is to evaluate it in terms of the matrix in Exhibit 3. Loss of specific knowledge can be evaluated along two dimensions: (1) the probability of business impacts if nothing is done (high/low); and (2) the expected scope of effects on performance (minor/major).

The most challenging decisions will come in situations where the risk of impacts seems relatively low, but the impact on the business would be extremely serious if they did occur. The nuclear power industry faces decisions like this today. Because of its extensive documentation and safety procedures, the risk of knowledge loss

actually creating negative performance impacts seems relatively low. But with 28 percent of its work force expected to retire by 2008, nuclear operators also recognize that the cost of any knowledge loss that contributed to an accident would be extremely high. Thus, this industry is particularly concerned about its aging work force and the implications for knowledge retention.

The other situation requiring obvious attention is when both the possibility and costs of business impacts due to lost knowledge are high. An example of this is the metals refinery that must refurbish its processing tanks every 15 years. Management learned the hard way that failure to retain knowledge of how they successfully brought these tanks back online 15 years ago was very costly. Problems with restoring operations repeated themselves because knowledge had been lost. This cost the firm millions of dollars in lost sales revenues. And the costs are bound to recur the next time, unless

management retains what plant operators learned about how to fix this complex maintenance problem.

Finally, the other quadrant that deserves some attention contains those lost knowledge threats that have a high probability of hurting performance, but overall their costs are relatively minor. For example, the inability to seamlessly transition database update operations from a veteran manager to his successor cost the unit \$80,000 and considerable goodwill with internal customers. Is it worth investing in better knowledge transfer practices to avoid these costs? Every organization is going to have to make these decisions for themselves, depending on their resources, orientation to change, the personalities involved, and the actual cost of implementing specific solutions.

### Valuing Intangible Risks

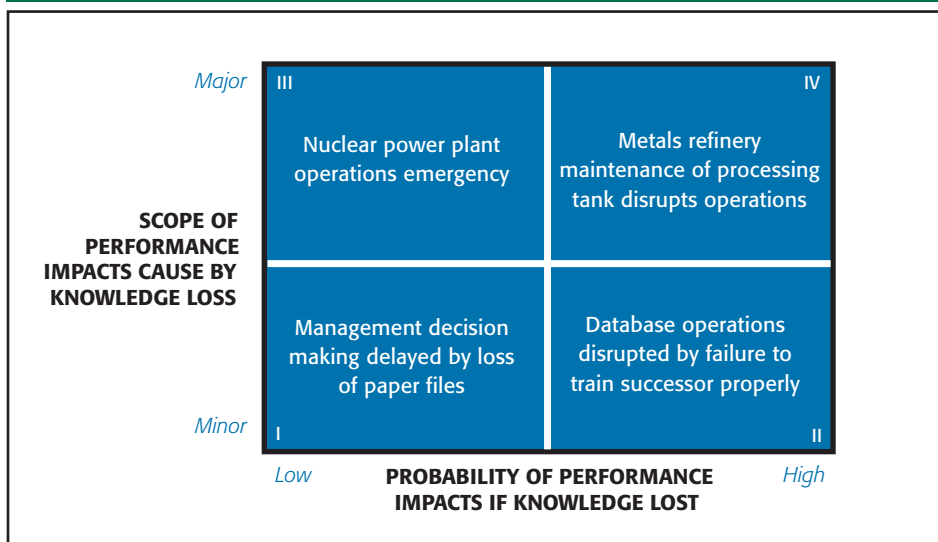
The processes described in this paper can help make previously invisible threats of knowledge loss both visible

and, in turn, more quantifiable in terms of business impacts. But, in reality, there is great uncertainty about the costs and risks posed by many lost knowledge threats. For example, what is the impact of a retiring R&D lab manager on a small vaccine manufacturing business? Or how will the loss of a veteran software engineer possessing unique knowledge about troubleshooting problems with a complex manufacturing system affect downtime? Often it is hard to predict how losing specific capabilities will hurt an organization's performance. It is equally hard to predict how particular knowledge retention investments (e.g., mentoring, succession planning, phased retirement policies, expert locator applications, etc.) will ultimately influence an organization's value. As a result, decision making processes around defining lost knowledge threats and retention solutions are likely to lack credibility because of the limitations of quantitative analysis and high levels of uncertainty about returns. Managers don't trust decisions they are asked to make about knowledge retention investments because inevitable changes in personnel, work processes, executive priorities, and the external market are likely to make these investments obsolete.

### Real Options Approach

Since managers often won't agree on how a lost knowledge threat will play out, deciding to address a specific threat by implementing particular solutions will be more effective if

## EXHIBIT 3: Probability vs. Scope of Lost Knowledge Impacts



the decision is framed in terms of the options it creates. The “real-options” approach can change the way we think about knowledge retention investments. This is important, because if you are unable to tie proposed investments to performance, then decisions to invest in retention solutions tend to be based on emotion or instinct. By explicitly laying out real options (e.g., staging, growth, flexibility) created by particular investments, management can become more disciplined and objective in thinking about how to respond to lost knowledge threats. It can assess each stage of a potential investment on the basis of whether it will further the organization’s performance objectives. This makes the criteria for successive investment decisions clearer, giving managers a more rational review process.<sup>10</sup>

An option is the opportunity to make a decision after you see how events unfold. It creates a right, but not an obligation, to take several possible actions at a future time. For example, if these R&D scientists retire as soon as they are eligible, we’ll do “X.” If they stay with the company, we’ll do “Y.” The option is based on what management must do ahead of time in order to have the chance to do X or Y. Once risks of knowledge loss have been identified, options thinking can be used to proactively design and manage strategic knowledge retention investments.

Given the high levels of uncertainty you face about how your organization’s work force will evolve and what specific threats of knowledge loss will

become most critical, the first thing to do is to begin identifying what options you have to create future flexibility in decision making. The challenge is to identify the full set of options available in responding to a particular lost knowledge threat. Then you must untangle them from each other and determine which are most valuable. Here are some examples of common types of options that might be useful for work force planning and knowledge retention in highly uncertain environments.

#### *Timing Options<sup>11</sup>*

There is an option to delay any investment in knowledge retention or work force development until management learns more about the criticality or market demand for specific knowledge. For example, if the world-class experts in turbo generator design are retiring from Rolls-Royce in a couple of years, there is uncertainty about the market demand for this product and the difficulty in replacing the design engineers’ knowledge. Thus, it may be that the risk avoided by waiting to invest has a greater value than the knowledge that might be lost by waiting to invest in hiring successors today. Very often, there is an option to wait on an investment. Unfortunately, executives often unintentionally choose this wait-to-invest option when it may be exactly the wrong thing to do, because it will greatly reduce their choices in the future.

#### *Growth Options*

Shell Chemical was concerned about having enough well-trained specialists to support its global growth objectives.

Thus, it considered an option to make a large investment in its knowledge retention infrastructure, specifically an organization-wide skills database. This would help assure the availability of the highly skilled work force needed to support growth objectives. The skills database, combined with a proactive career management process, created growth options that had value beyond the returns generated by the immediate investment.

#### *Staging Options*

One VP of HR wanted to roll out a series of programs to support future work force development, which included an expanded succession planning program and new phased retirement policies. But the business benefits of these initiatives remained very uncertain and hard to quantify. The organization had an option to invest in these new programs in stages, rather than all at once. The conclusion of each stage provided further options, such as to expand, delay, or abandon the efforts. All of these options added value to proposed projects.

#### *Exit Options*

Retiring experts are currently taking knowledge with them whose future value is uncertain. The decision to retain these former employees as contractors may be favored over hiring and training replacements because it creates an exit option. The exit option increases the value of the retiree contracting program because it reduces the size of the investment at risk. An alternative would be hiring replacement employees as contractors. The exit option also makes this investment more

valuable, because it is cheaper to end the employment relationship.

### Flexibility Options

A retiring program manager in a major engineering firm trains two successors, even though it is cheaper to train only one. Preparing two successors creates a flexibility option for restructuring the region or growing it faster, given market demand. The value of being able to respond to the market created by this option outweighed the cost saved by training just one successor, even though it meant developing some excess capacity. When business markets are volatile, the value of excess capacity can sometimes exceed its costs.

### Operating Options

A firm may decide to outsource an aging unit of special experts because it makes economic sense and gives the company more operating options. A large chemical company, which had traditionally designed and built its own plants, considered investing in this option when retirements made it increasingly difficult

to maintain this design expertise in-house. Outsourcing what had traditionally been thought of as a core capability would give the company the option not to spend money for this expertise during slow periods and the option to use more of it in periods of high demand. The value of these options adds to the value of the outsourcing investment, although there are other important trade-offs in locating a sophisticated resource like this outside of the company.

### Conclusion

Defining and making investments in strategic options for knowledge retention is only the beginning. Once you have made the investment, or the decision to wait, these options must be maintained and frequently re-evaluated due to potential changes in individual retirement plans, regulations governing retirement options, the employment market, and the organization's future skill needs, given market opportunities.<sup>12</sup> Each time you re-evaluate, you will have the opportunity to create new options to change your approach, intensify your focus, or

abandon a retention investment because of changing conditions.

Identifying, maintaining, and creating new options takes considerable time and resources. Thus, you need to focus this approach on sustaining core capabilities. Given current demographic and workplace trends, losing knowledge has become a fact of organizational life. But just because something has become a chronic problem doesn't mean we stop trying to address it. The approaches presented in this paper can help you take a proactive approach to diagnosing lost knowledge threats. If nothing else, you should begin by asking new types of questions that attempt to link lost knowledge to potential business impacts. That is the first, and most important, step in limiting the costs of this growing problem.

*David DeLong is an adjunct professor at Babson College, a research fellow in the MIT AgeLab and a consultant to corporations on knowledge retention issues. He can be reached at [dwdelong@verizon.net](mailto:dwdelong@verizon.net).*

### Endnotes

<sup>1</sup> William Fulmer, "The World Bank and Knowledge Management," Case No. 9-801-157 (Boston: Harvard Business School Publishing, 2001)

<sup>2</sup> For a detailed discussion of knowledge retention "solutions" see *Lost Knowledge: Confronting the Threat of an Aging Workforce* by David W. DeLong, NY: Oxford University Press, 2004.

<sup>3</sup> Knowledge that is "explicit" is easily codified and can be shared independent of its human source, or it can be embedded in processes or systems. This type of knowledge is often captured, stored, and shared in electronic or paper documents. "Tacit" knowledge, on the other hand, includes cognitive skills such as images, intuition and mental models, as well as technical skills such as know-how. Tacit knowledge is often described as what we know but cannot articulate, the classic example being how to ride a bicycle.

<sup>4</sup> Although the general term "knowledge" is used throughout this paper, in fact, there are at least three types of knowledge continually interacting. For a more detailed explanation, see DeLong, 2004. For the purposes of this paper:

*Human Knowledge* constitutes what individuals know or know how to do. Human or individual knowledge is manifested as skill (e.g., the ability to develop a marketing plan, give feedback to subordinates, or program your wireless phone) or expertise (e.g., deep

understanding of complex chemical reactions, the limitations of specific networking software, or the complexities of policy implementation). Human knowledge is generally described as either explicit or tacit knowledge.

*Social Knowledge* is knowledge that exists only in relationships between individuals or within groups. It is often called "social capital." An executive with an extensive network of personal relationships with clients or a high-performing team of research scientists both reflect the presence of social knowledge embedded in those relationships. Its presence is reflected by high levels of trust and an ability to collaborate effectively.

*Structured Knowledge* is knowledge that is embedded in an organization's systems, processes, tools, and routines. Knowledge in this form is explicit and rule-based.

<sup>5</sup> Study cited in William B. P. Robson, "Aging Populations and the Workplace." British-North American Research Association, A BNAC Statement 20. [Online] October 2001. Available: [http://www.cdhowe.org/pdf/BNAC\\_Aging\\_Populations.pdf](http://www.cdhowe.org/pdf/BNAC_Aging_Populations.pdf) [June 20, 2005].

<sup>6</sup> A detailed description of methods and practices for retaining knowledge can be found in *Lost Knowledge*, DeLong, 2004.

<sup>7</sup> My thinking about the dynamics of pattern recognition has been influenced by C.F. Kurtz and D.J. Snowden, "The New Dynamics of

Strategy: Sense making in a complex and complicated world," *IBM Systems Journal* U 42 N3 2003.

<sup>8</sup> A more detailed description of the use of social network analysis to support knowledge retention initiatives is found in *Lost Knowledge*, DeLong, 2004.

<sup>9</sup> See "Predictable Surprises: The Disasters You Should Have Seen Coming," by Michael D. Watkins and Max H. Bazerman, *Harvard Business Review*, March 2003: 3-10.

<sup>10</sup> Ideas about "real options theory" come from *Real Options: Managing Strategic Investment in an Uncertain World* by M. Amram & N. Kulatilaka, Boston: Harvard Business School Press, 1999; "Disciplined Decisions: Aligning Strategy with Financial Markets," by M. Amram & N. Kulatilaka, *Harvard Business Review*, January 1999: 95-104; "Strategic Options in the Digital Era," by N. Kulatilaka & N. Venkatraman, *Business Strategy Review*, Winter 2001, v12 n4:7-15; and "Capabilities as Real Options," by B. Kogut & N. Kulatilaka, *Organization Science*, November 2001, v12 n6: 744-758.

<sup>11</sup> The description of these types of options was adapted from Amram & Kulatilaka, *Harvard Business Review*, January 1999.

<sup>12</sup> "Uncertainty: The New Rules for Strategy," by M. Amram & N. Kulatilaka, *Journal of Business Strategy*, May 1999:25-28.



BABSON PARK, MA 02457-0310 USA  
PHONE 1-800-882-EXEC OR +781-239-4354 FAX +781-239-5266 E-MAIL EXEC@BABSON.EDU  
[WWW.BABSON.EDU/BEE](http://WWW.BABSON.EDU/BEE)