Assessing Knowledge Loss Risk

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ABSTRACT
This paper provides a methodology for assessing potential risk of losing knowledge when employees retire or otherwise leave the organization. The methodology is based on the traditional risk calculation compensated for quality. This paper defines a method for scoring each factor in the risk calculation and then assessing the criticality of the risk based on the final calculated score. A discussion is provided on actions that organizations should take based on the criticality of the risk.

Keywords
Knowledge Management, Risk, Knowledge Loss.

INTRODUCTION
By 2010, more than 25% of the entire workforce will have reached retirement age, resulting in a potential worker shortage of 10 million and a tremendous loss of organizational knowledge (Federal Interagency Forum on Aging-Related Statistics, 2008). Organizational knowledge loss is an unfortunate fact. Organizations lose knowledge through the loss of knowledge holders (i.e. experts and knowledge workers), failure to capture critical knowledge, failure of knowledge repositories (this can be failure of electronic, paper, or human storage media), and just plain forgetting (either forgetting the actual knowledge or forgetting where captured knowledge is stored). Jennex (2006) and Jennex and Zyngier (2007) have explored some of these issues. It is the purpose of this paper to explore how to assess the risk of losing knowledge by losing experts and/or knowledge workers. Action research methodology is used to:

• Define what risk is for knowledge loss
• Define the factors that determine the risk of knowledge risk
• Define processes for determining values for each of the knowledge loss risk factors
• Define knowledge loss risk management by defining processes for ranking knowledge loss risks and determining appropriate actions to mitigate knowledge loss risks.

Action research is appropriate as the researcher needed to gather very rich, detailed organizational information and the only way to gain this access was through participation in a project to identify a knowledge loss risk process. Data was collected through several workshops and interviews of project members. The process that resulted was piloted against a selected group of subjects using an expert panel.

BACKGROUND

Risk
The National Institute of Standards and Technology, NIST, defines risk as the net negative impact of the exercise of a vulnerability, considering both the probability and the impact of occurrence. Risk is traditionally represented by the formula:

\[ R(\text{risk}) = p(\text{probability of occurrence}) \times C(\text{consequence of occurrence either represented by some value or by a loss function}) \]

Risk management is the process of identifying risk, assessing risk, and taking steps to manage risk by reducing risks to an acceptable level (Stoneburner et al., 2001). Additionally, Smith et al. (2001) and Aubert et al. (1998) agree that IS managers and researchers traditionally define risk in terms of negative consequences describing risk as the possibility of loss or damage and the possibility of suffering harm or loss. An alternative view by Billington (1997) points out that, when examined closely, ‘risk’ can actually lead to both positive and/or negative consequences.
Viewing risk as something more than a hazard is highly applicable to risk management in KM. Although KM risks can lead to negative results, they can also represent significant opportunities for savings or business development. Uncertainty associated with knowledge use, be it due to rapidly changing technology and storage media, to misuse or new and unexpected uses of knowledge, or to the basic understanding of the captured knowledge is one of the biggest challenges a KM manager faces. However, this paper is focusing on the risk of knowledge loss from a human source. Knowledge loss risk is defined as the expected impact to the organization resulting from the loss of a particular expert or knowledge worker. This is consistent with the NIST risk definition so the NIST risk algorithm will be used as the basis for determining knowledge loss risk.

Current Approaches

The nuclear industry has been conducting research into knowledge loss due to its aging work force. This is made worse by a lack of new/replacement workers since few new nuclear plants have been built in the last 20 years, making this a less attractive career for engineers and other knowledge workers. The International Atomic Energy Agency, IAEA, has led research into methods to mitigate knowledge loss from retiring workers. This research culminated in the publication of their 2006 guide “Risk Management of Knowledge Loss in Nuclear Industry Organizations.” (Kosilov, Mazour, and Yanev, 2006)

The IAEA Knowledge Loss Risk Assessment is designed to identify positions where the potential knowledge loss is greatest and most imminent. It uses ratings based on two factors: time until retirement and position criticality; to identify where steps to mitigate knowledge loss may be needed. The Knowledge Loss Risk Assessment consists of three steps:

- Conduct a Knowledge Loss Risk Assessment
- Determine Approach to Capture Critical Knowledge
- Monitor and Evaluate

The process is consistent with traditional risk assessment processes. However, the process is focused on job positions that are being vacated by retirement. After rating the risk the process uses interviews to determine the scope of knowledge to be captured and the actions that should be taken to capture this knowledge. The third step periodically monitors the knowledge retention program for compliance and effectiveness. This process has been successfully implemented at the Tennessee Valley Authority, TVA, public utility ((Kosilov, Mazour, and Yanev, 2006; Bowman and Landon, 2008) and at Duke Energy (Honeycutt, 2008). Additionally, the Michigan Department of Agriculture has adapted the process (Hainstock, 2008).

Other approaches include Kaplan (2008) who proposes using Communities of Practice, knowledge repositories, and mentoring and intern programs to assist the procurement industry in transferring knowledge from retiring workers to replacements. Parise, et al. (2006) propose using organizational network analysis to assess the impact the loss of knowledge a departing employee has on their work network considering two network roles, Central Connector (those with technical expertise and organizational memory as well as a set of relationships that help many others get information or other resources) and Broker (broad knowledge of how the organization operates and ability to recognize and take advantage of opportunities that require integration of disparate expertise), as crucial roles requiring actions for capturing knowledge. Massingham (2008) supports the need for social network analysis as it was found that while loss of a critical employee may impact the social network by causing a loss of knowledge, it may be mitigated because much of the knowledge possessed by the critical employee was distributed throughout their social network. Only by performing a social network analysis will the organization know which case (knowledge loss or loss mitigation) exists.

Parise, et al. (2006) recognized that while retirement is the most immediate contributor to knowledge loss, other factors, in particular job mobility, are major, continuing contributors requiring a process to capture critical knowledge. Additionally, Deloitte and Touche (2005) found that 69% of the 1396 human resources practitioners surveyed said attracting new talent poses the greatest threat to competitiveness, followed by the inability to retain key talent (66%) and incoming workers with inadequate skills (34%). Parise, et al. (2006) also report that only half of the above surveyed organizations had identified a list of critical skills needed for future growth and more than one-quarter viewed defining critical skills as unimportant. Eucker (2007) summarizes the loss of an employee as resulting in lost know-how, know-who, know-what.

The above suggests that a knowledge retention program needs to focus on:

- More than retirees, it also needs to consider employee mobility
- The impact of knowledge loss on the social network of the lost employee
- More than just employee position, it also needs to consider what the employee knows
The nuclear knowledge loss assessment process is not adequate in doing this as it focuses on the position of the employee and on retirement. An additional weakness of the nuclear knowledge loss assessment process is that it doesn’t provide enough differentiation between employees by only using a 25 point rating system. In a static organization (low turnover) such as nuclear utilities where there is one product in one technical domain this may be adequate. In dynamic organizations (regular turnover) that produce a variety of products and services in a number of different technical domains, this is not adequate.

PROPOSED APPROACH

The approach focuses on assessing knowledge loss at the individual level rather than at the position level. A focus on projects, products, and services causes individual experience to vary widely making it more important to assess the individual rather than the position. Note that this paper focuses on assessing the risk of knowledge loss through the loss of human knowledge sources. Quantifying risk is a difficult task. This paper is not proposing a methodology for quantifying risk but is proposing a methodology for ranking and rating risk so that managers can determine what risks to address first. This is an acceptable alternative per Stoneburner, et al. (2001) and one that will achieve the goal of determining what knowledge sources need to be managed to mitigate the impact of knowledge loss. The approach uses the following risk algorithm:

\[ R(\text{knowledge loss}) = p(\text{loss of human knowledge source}) \times C(\text{loss of perfect human knowledge source}) \times Q(\text{quality of human knowledge source}) \]

Additionally, it incorporates processes for rating:

- Likelihood of the loss of human knowledge source either through retirement or attrition.
- Consequence of the knowledge loss given a perfect knowledge source
- Quality of the knowledge source

And finally, provides processes for:

- Ranking knowledge loss risks
- Determining appropriate courses of action

The following sections develop this methodology.

Knowledge Loss Risk

This is the impact to the organization caused by the loss of a human knowledge source, usually an expert, a knowledge worker, or a manager. This impact is assumed to be negative since knowledge is usually viewed as a key asset and loss of knowledge is expected to lower the value of this key asset. It is expected that there will be rare instances where loss of a human knowledge source may actually create a positive impact on the organization (an example is where the loss of a human knowledge source results in the loss of knowledge that is costing more to keep than it is worth, this could occur in the case where the expertise is no longer incorporated in a product of service). Both types of impacts are incorporated into the risk assessment process. Knowledge loss risks will be classified into three categories:

- Immediate action required to capture critical knowledge
- Planned action required to capture critical and/or important knowledge
- No special action required to capture knowledge

Probability of Knowledge Loss

The probability of knowledge loss factor rates the likelihood of a human knowledge source being lost. Loss of human knowledge sources occurs in several ways:

- Retirement – source leaves the company due to advanced age
- Turnover – source leaves the company, probably to join another company
- Disability – source is lost to the company, either permanently due to death or incapacitation or temporarily
- Job Change – source leaves his current position for another position within the company

Factors that influence probability of knowledge loss include age, health, uniqueness of skills and knowledge, demand for skills and knowledge, years of service, and social network.
• Age is a general indicator of experience and a strong predictor of retirement.
• Health is a relatively unpredictable factor but is generally expected to deteriorate as age increases with poorer health leading to disability or retirement. Factors that can contribute to health include travel (accident and general wear), participation in extreme sports (sky diving, mountain climbing, racing, etc.) and life style choices (these will not be considered due to privacy and ethical issues).
• Uniqueness of skills creates a demand for knowledge that can start at any age and which may grow or shrink as age increases. Bleeding edge skills tend to be reflected at early ages with less expectation of being bleeding edge as age increases. Uniqueness as reflected in older sources may be an indicator of obsolescence and less demand for the skill; however, older ages also reflect unique experiences or abilities which may increase demand (i.e. Y2K or other special project experience). Generally, the more unique and newer the skill the greater the likelihood demand will grow.
• Demand for skills and knowledge reflects market needs outside the organization for specific knowledge which can increase or decrease mobility of the possessor. Market needs may be reflected by competitor company needs or by industries unrelated to the subject organization’s core business but which use like skills and knowledge (examples include project management, web services, etc.)
• Years of service indicates an ability to stay with a job or project and reflects experience and responsibility. Generally low and high level of years of experience is detrimental to movement while moderate years of service increase the likelihood of movement. This is generally reflected in many industries (such as the military) in the recruitment of large numbers of entry level positions with rewards given for retention until the source hits the certain years of service (in the military this is generally assumed to be approximately 8 to 10) where the cost of changing positions (such as loss of vacation, retirement benefits, etc.) out weighs whatever benefits can be gained (such as increased salary, change in job responsibilities, change in location).
• Social networks indicate how closely the source is tied to their community. Two major indicators exist: family and home purchase. Having family in the area, especially school age children and/or purchasing a home tend to reduce the probability of leaving the area and mitigate the likelihood of a source leaving the organization.

The above factors can be combined into overall probability profiles and ranked and rated for most likely to least likely. To generate an overall risk score a single value must be generated. Probability of knowledge loss is valued using a 10 point scale that for paper length purposes cannot be included.

**Consequence of Knowledge Loss**
The consequence of knowledge loss factor rates the likely impact of losing a human knowledge source. Factors that impact the consequence of a loss of human knowledge sources include:

• Criticality to Competitive Advantage – source possesses knowledge of processes, products, or services that are critical to current company earnings and/or maintaining/ increasing market share
• Key skill – source possesses knowledge of a skill that is essential to maintaining current products/services or needed to create new products/services
• Key experience – source possesses knowledge through participation or observation of key experiences in company history, these experiences generally led to company learning associated with key events, initiatives, products, services, etc.
• Key contributor – source possesses unique knowledge due to their role in key company events, initiatives, and/or product/service development and/or delivery

There are two factors that mitigate the overall consequence of knowledge loss: ease of replacement and numbers of sources possessing the knowledge:

• Ease of replacement looks at the availability of like qualified knowledge sources that can quickly replace the lost source. Generally the more replacements the less impact the loss has, additionally, if a replacement can be brought in before the source is lost then impact is significantly mitigated.
• Numbers of sources possessing the knowledge assesses if there are others possessing the knowledge within the organization with the expectation being that the more there are who possess the knowledge the lesser the impact of losing the knowledge source. The converse is also true, the more unique the source, the greater the impact.
These factors are combined into overall consequence profiles and ranked and rated from most severe to least severe. To generate an overall risk score a single value must be generated. Consequence of knowledge loss is valued using a 10 point scale (not shown due to length).

**Quality of Knowledge Source**

The quality of knowledge source factor takes into account variables that impact the ability to capture knowledge from the source. This factor aids in differentiating between potential knowledge losses where mitigation actions are more likely to be successful. These include time to loss of knowledge source, current health of the knowledge source, time since knowledge was acquired by the source, ability/willingness to share knowledge, reason for leaving:

- **Time to loss of knowledge source** recognizes the “retired on duty” syndrome and that the closer the departure date the less likely the source is to discuss events, initiatives, products, services, etc.
- **Current health of the knowledge source** recognizes that the source may not be in a condition to assist with knowledge capture activities. Examples include cancer treatment, disabilities limiting the source’s ability to participate, death, etc.
- **Time since knowledge source acquired knowledge** recognizes that memories fade affecting the accuracy of recalled knowledge.
- **Ability/willingness to share** reflects that some sources may not want to participate or may participate grudgingly.
- **Reason for leaving** recognizes that there may be emotional or legal issues affecting the ability of the source to participate in knowledge capture.

The approach taken for this factor is to assume all knowledge sources start with a quality of knowledge source value of 10 with the below analysis used to compensate this value (i.e. deductions/additions may come from several factors).

**Time to loss of knowledge source**, deduct as follows:
- One point if within 2 years to loss
- Two points if within 1 year of loss
- Three points if within one month of loss

**Current health of knowledge source**, deduct as follows:
- One point if loss of source is due to health problems in the family
- Two points if loss of source is due to disability
- Note that death, terminal illness, or a disability that renders the source unable to participate do not have deductions, however, it assumed that knowledge capture activities involving the source are not possible and special actions (capturing email, computer contents, files, etc.) should be taken instead.

**Time since knowledge source acquired knowledge**, deduct as follows:
- No deduction if knowledge needing to be captured is from current position or within the last year
- One point if knowledge being captured is over 2 years old
- Two points if knowledge being captured is over 5 years old
- Three points if knowledge being captured is over 10 years old

**Ability/willingness to share**, deduct as follows:
- One point if the knowledge source has a hard time expressing themselves or expresses concerns about being interviewed
- Two points if the knowledge source is reluctant to participate or is continuously having trouble making time for interviews
- No deduction if knowledge source refuses to participate, however, special actions (capturing email, computer contents, files, etc.) should be taken instead.

Additionally, ability/willingness to share can be assessed or the deductions mitigated through a preliminary social network analysis:
• Add two points if the knowledge source is an active participant in one or more internal communities of practice and external professional or social organizations. Participation can be judged based on postings, presentation of papers or talks, replies to emails, phone calls, etc.

• Add one point if the knowledge source is an active participant in a community of practice or a professional organization.

• Deduct one point if the knowledge source willingly participates in the interview but is not an active participant in communities of practice or professional organizations.

Membership in communities of practice and professional organizations can be determined via resume review. Amount of participation can be determined based on a combination of resume review (for papers or brown bag presentations made) and an analysis of postings or communications.

Reason for leaving, deduct as follows:

• No deduction if leaving voluntarily under good terms (manager would rehire) or retiring at 62 or older

• One point if leaving due to issues with manager or coworkers

• Two points if leaving because of poor reviews, lack of promotion, or poor job fit

• No deduction if leaving due to being terminated, however, special actions (capturing email, computer contents, files, etc.) should be taken instead.

Ranking Knowledge Loss Risks

Once values have been determined for each of the factors in the below algorithm, a knowledge risk value can be calculated that will be between 1 and 1000.

The approach uses the following risk algorithm:

\[ R(\text{knowledge loss}) = p(\text{loss of human knowledge source}) \times C(\text{loss of perfect human knowledge source}) \times Q(\text{quality of human knowledge source}) \]

The higher the knowledge loss risk value, the higher the priority for mitigating the risk and this value can be used to rank all knowledge loss risks.

Determining Appropriate Courses of Action

While the knowledge loss risk value can be used to rank risk, it is not really the intent of the knowledge loss risk value. The more important use of the value is to classify the risk into knowledge capture action categories: (Table 1)

<table>
<thead>
<tr>
<th>Risk Value</th>
<th>Knowledge Capture Action Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;=700</td>
<td>Urgent/immediate action category. Critical knowledge loss is imminent. Implement the Knowledge Retention Process immediately. Consider high priority scheduling of time and resources to pursue video interviewing, preserve knowledge artifacts such as email and computer and paper files using the source to help organize them into topics. If possible and with source’s consent incorporate into an active knowledge contact bank.</td>
</tr>
<tr>
<td>300 to 699</td>
<td>High priority action category. Critical knowledge loss is likely but there is time to plan for an orderly knowledge capture process. Schedule implementation of the Knowledge Retention Process when convenient. Consider finding or hiring like replacements so they are available and allow for sufficient time to conduct a turnover with source and replacement should the source decide to leave. Encourage the source to organize their knowledge into topics and capturing critical artifacts. Video interview as necessary to capture oral history before memories fade. As deemed appropriate and with the source’s consent incorporate into an active knowledge contact bank.</td>
</tr>
<tr>
<td>&lt;300</td>
<td>Low priority action category. No foreseen loss of critical knowledge, work with source to capture and organize knowledge artifacts. Conduct exit interview within one month (if possible) of leaving to capture unexpected knowledge. Maintain contact information for future contact if</td>
</tr>
</tbody>
</table>
Jennex Assessing Knowledge Loss Risk

Special Cases

Table 1, Knowledge Capture Action Determination

<table>
<thead>
<tr>
<th>Factor</th>
<th>Source A</th>
<th>Source B</th>
<th>Source C</th>
<th>Source D</th>
<th>Source E</th>
<th>Source F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability</td>
<td>7</td>
<td>10</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Consequence</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>7</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Quality</td>
<td>10</td>
<td>9</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Risk Value</td>
<td>700</td>
<td>900</td>
<td>720</td>
<td>630</td>
<td>288</td>
<td>315</td>
</tr>
<tr>
<td>Priority</td>
<td>Urgent</td>
<td>Urgent</td>
<td>Urgent</td>
<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

DISCUSSION/CONCLUSIONS

There are two points to discuss, the first is will it work and the second is what does the calculated knowledge loss risk value mean. Will it work was determined through a pilot exercise that generated some values that will help in the discussion on what the knowledge risk value means.

The knowledge loss risk prioritization process was piloted using a team of three knowledge assessors looking at six purposefully selected sources and using personal knowledge and the corporate databases and web systems to collect data on the sources. This paper reflects lessons learned from this pilot project. The purpose of the pilot was to see if the knowledge loss risk value would assign the appropriate priority to the test subjects. Of the six sources, source A was a recognized expert, source B was an expert who had just retired, source C was a knowledge engineer, source D was a young system engineer, source E was a new employee hired for her expertise, and source F was a long term department administrator. Table 2 reflects the values assigned to them.

<table>
<thead>
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<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>

The first observation is that the process seems to work. Source B, already identified as a knowledge loss risk was identified as urgent. So were Sources A and C, but for different reasons. Source A had the top value for consequence and quality with a lower probability of leaving. Source C had a higher probability of leaving, a top value for quality, but a less than top value for consequence. Discussion found this to be a reasonable finding although concern was raised that Source C had a higher value than Source A which will be discussed later. Source D had a high priority based on being young, mobile, and talented. Source E had a low probability based on being in demand but with little organizational knowledge. Source F is one of those that the process is meant to catch; she didn't have critical skills but had been present and worked through many critical projects and events making her a repository of organizational history.

The key lesson learned was to provide very objective criteria/guidance for selecting appropriate values for each variable in the risk calculation. Additionally, calculation support forms and logic were requested. This was the biggest problem encountered, taking the value definitions and determining the appropriate value.

The biggest question raised was what the knowledge loss risk value actually means. The concern is that employees would view the value as a measure of importance and that to be credible it needed to reflect the real value of the employee. The values for Sources A and C were used as an example as the assessor team agreed that Source A was more important than Source C but the scores didn’t reflect it. The key to this question is that the knowledge loss risk value provides a value rating the likelihood that the subject will cause a loss of knowledge when he/she leaves. It is not a rating on how important the individual is to the organization and having a high value is not necessarily good. For this particular case Source A had a greater consequence value than Source C as expected but a lower probability of leaving. Given the individuals it was agreed by the assessor team that this would be the case. Source C would be much more likely to leave than Source A given that Source C’s skill set is in demand by a very wide range of companies and his Web 2.0 skills are more likely to be in demand.
by other companies. This means that the knowledge loss risk value is correct as it is, but it may need to be managed and explained to employees so that it is not misused as a measure of employee value.

The conclusion of this paper is that knowledge loss risk from employees leaving the organization can be assessed so that the organization can plan and apply resources to capturing critical knowledge before it walks out the door. This is an important finding for applying KM in an organization.

REFERENCES

