A proposed method for assessing knowledge loss risk with departing personnel

Murray Eugene Jennex
San Diego State University, San Diego, California, USA

Abstract
Purpose – The purpose of the paper is to propose a methodology for organizations to use to assess the risk of knowledge loss should a specific employee leave. The article also proposes actions that can be taken by the organization to capture this knowledge before it is lost.

Design/methodology/approach – Applied research based on the systems analysis approach.

Findings – The paper finds that it is possible to create a system for identifying which knowledge is most likely to be lost and to guide an organization towards the appropriate actions for capturing that knowledge before it is lost.

Research limitations/implications – The process has only been piloted on a single organization and with a limited number of subjects. However, the results are promising, and future research is focused on exploring generalizability.

Practical implications – The paper provides a process that will assist managers in making better decisions when allocating resources for capturing knowledge from departing individuals.

Social implications – The process introduces a new social dynamic in the assessment of individuals which may have an impact on organizational dynamics.

Originality/value – This is a very innovative and original application of traditional risk assessment principles.

Keywords Knowledge, Risk, Knowledge management, Risk assessment

Paper type Research paper

Introduction

Knowledge workers are defined by Davenport (2005) as those who think for a living and whose main assets are knowledge. Reinhardt et al. (2011) differentiate knowledge work from other forms of work through the primary task of “non-routine” problem-solving that requires a combination of convergent, divergent and creative thinking. Knowledge-based organizations utilize knowledge to produce the goods/services that generate their income. Knowledge workers are those workers in knowledge-based organizations who hold, access, create and/or apply knowledge to the generation of value/income. Knowledge workers, while a valuable resource, also exhibit high transience Yigitcanlar et al. (2007). Additionally, by 2010, > 25 per cent of the US workforce became eligible for retirement that would have resulted in a potential worker shortage of 10 million, signifying a tremendous loss of organizational knowledge had not the world economy went into recession (Federal Interagency Forum on Aging-Related Statistics, 2008). Organizational knowledge loss is an unfortunate fact and one that will become a large problem for organizations as the economy improves. 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). As examples, Jennex (2006) discusses how NASA, the US National Aeronautics and Space Administration, was unable to return to the moon (had they wanted to) because they had lost the knowledge of how to build Saturn V rockets and Apollo spacecraft through loss of knowledge workers (retirement and death) and loss of knowledge kept in their repositories. Jennex (2005a, 2008) discuss the improvements to productivity through knowledge use in an engineering organization and how that organization was impacted through reduced organizational capability by a reduction in force caused by the 2001/2002 energy crisis in California.

There is much literature associated with attracting and retaining employees, as it is understood that there are costs associated with replacing workers. Drucker (1999) discusses the high cost of replacing knowledge workers, while TBORG (2011) estimates that it costs the yearly salary of a knowledge worker to replace that knowledge worker; this paper considers this low but can accept it if this cost does not include the cost of initially educating a knowledge worker. For example pilots, technicians, military officers, engineers and managers (just to name a few positions) all have higher training costs than what they will earn in a year. Additionally, neither Drucker (1999) nor TBORG (2011) take into account the cost of replacing the experiential knowledge possessed by departing knowledge workers. What is the value of 10, 20, 30 or 40 years of experience or the experience of working on a strategic project? Can this value be calculated? Do knowledge organizations understand the value of this knowledge? This paper assumes that there is a high cost to replacing knowledge workers and the knowledge they possess, and explores how to assess the risk of losing knowledge by losing experts and/or knowledge workers. The research questions being investigated are how does an organization assess the value of departing knowledge and how can knowledge management (KM) be used to mitigate knowledge loss. The paper uses a risk-based approach to propose a KM-based methodology for doing so. The value to the reader of this paper is in this proposed methodology and in making knowledge worker researchers and managers aware of the risk associated with losing a knowledge worker.

The first part of this paper discusses foundational concepts of knowledge, KM and risk. The next section discusses the applied research methodology used to conduct the research presented in the paper. The following sections identify previous work in the field and the proposed knowledge loss risk assessment process. This is followed by sections discussing the findings, including a pilot project used to evaluate the proposed process, and the conclusions of the paper. The Appendix of the paper contains prospective data gathering forms that can be used to implement the proposed risk assessment methodology.

Foundations

Knowledge

This paper is about assessing the risk of losing knowledge. First, although what is knowledge and, in particular, organizational knowledge? Davenport and Prusak (1998) view knowledge as an evolving mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information. They found that in organizations,
knowledge often becomes embedded in artifacts such as documents, video, audio or repositories and in organizational routines, processes, practices and norms. Davenport and Prusak (1998) also say that for knowledge to have value, it must include the human additions of context, culture, experience and interpretation. Nonaka (1994) expands this view by stating that knowledge is about meaning in the sense that it is context-specific. This implies that users of knowledge must understand and have experience with the context, or surrounding conditions and influences, in which the knowledge is generated and used for it to have meaning to them. This also implies that for a knowledge repository to be useful, it must also store the context in which the knowledge was generated. Knowledge being context-specific argues against the idea that knowledge can be applied universally; however, it does not argue against the concept of organizational knowledge. Organizational knowledge is considered to be an integral component of what organizational members remember and use meaning that knowledge is actionable. This is an important concept, as it helps explain the problem of capturing knowledge from individuals who are leaving the organization and making it available for reuse to the remaining organizational members.

Knowledge management
Jennex (2005b) utilized an expert panel, the editorial review board of the *International Journal of Knowledge Management* to expand on Stein and Zwass’s (1995, p. 95) definition of an organizational memory information system to generate a definition of KM as the practice of selectively applying knowledge from previous experiences of decision-making to current and future decision-making activities with the express purpose of improving the organization’s effectiveness. Other similar definitions of KM come from Holsapple and Joshi (2004), Alavi and Leidner (2001) and the American Productivity and Quality Center, (AQPC, 2011). These definitions of KM focus on the key elements of KM: a focus on using knowledge for decision-making and processes for capturing, storing, searching and retrieving knowledge. Ultimately, KM is an action discipline focused on transferring selected knowledge to where it can be applied. This is consistent with what Keen and Tan (2007) call a corporatist view of KM in that it is mission-focused on using knowledge as an asset to improve processes. Ultimately, there are two major missions for KM:

1. Leveraging what the organization “knows” so that it can better utilize its knowledge assets.
2. Connecting knowledge generators, holders and users to facilitate the flow of knowledge through the organization.

KM views an organization as any group with a purpose. This means that an organization can be a formal business organization, a governmental organization, a multinational organization or even an informal organization such as a community of practice. In addition, an organization may have a formal command structure, an informal command structure or be leaderless. This is a purposefully broad definition because KM is being applied in all sorts of organizations, as organizations are evolving into a variety of structures with various governance approaches and knowledge needs. Finally, the focus on organizations is a reflection that KM tends to use the resource-based view of the organization (Wernerfelt, 1984) with knowledge as the resource and KM as the process used to manage this resource. KM-viewing knowledge
as a resource makes KM an appropriate tool for attempting to capture and manage knowledge from departing individuals and making it available to the rest of the organization.

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., 2007). Additionally, Smith et al. (2001) and Aubert et al. (1998) agree that Information Systems 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. In any particular initiative, he notes, the risks involved could represent different meaning to an organization. Billington (1997) proposes three dimensions of a risk:

1. a hazard that must be minimized or eliminated;
2. an uncertainty about which path should be taken and which must be studied to reduce the variance between anticipated outcomes and actual results; and
3. an opportunity for growth or improvement, which must be assessed to determine how much innovation, initiative and entrepreneurship should be exercised.

Viewing risk as something more than a hazard is highly applicable to risk management in KM (Jennex and Zyngier, 2007). 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.

A final note on the risk formula shown above is that it is recognized that determining exact probabilities and values for consequence is difficult. An alternative to probabilities and consequence values proposed by Whitman and Mattord (2004) is to utilize relative ranges or scores for the probability and consequence value. When this is done, probability becomes likelihood and consequence value becomes consequence. This paper, as discussed later, uses this approach of utilizing scores and thus uses likelihood and consequence.
Methodology
This is applied research using the systems analysis approach and utilizing concepts from design-science and action research. Design-science research involves the researcher in creating and evaluating innovative information technology artifacts intended to solve significant organizational problems (Hevner et al., 2004). Action research involves the researcher by actively attempting to influence the outcome by applying a cycle comprising diagnosing, action planning, action taking, evaluation and change implementation (Baskerville, 1997). To conduct the research for this paper, the researcher needed to gather very rich, detailed organizational information (access was gained through participation in a project to identify a knowledge loss risk process) and then use this information to generate a prototype process (or artifact). A systems analysis-type approach was used where the problem to be solved was further defined by assessing current knowledge loss risk processes, identifying strengths and weaknesses and then creating an improved process for identifying individual knowledge loss risk and determining actions to take based on the individual knowledge risk. The resultant artifacts were tested through a pilot project. Data for the pilot were collected through several workshops and interviews of selected organizational members and determining individual knowledge loss risk scores. The subjects selected for the pilot were representative of the diversity of the organization in terms of time in the organization, experience with the core work of the organization and skills and capabilities utilized by the organization. The pilot project results were assessed utilizing a table-top assessment involving the three project team members with the resulting lessons learned being incorporated into a final proposed process artifact and a set of data gathering form artifacts. Support for this research methodology comes from Burstein and Gregor (1999) who support the systems analysis methodology for IS research and suggest it may be a form of action research. Additionally Arnott and Pervan (2012) support the use of design science for researching decision support systems (DSS) (KM is a form of DSS). The applied system analysis methodology was neither pure action research nor design science research, but used concepts from both applied with appropriate rigor. The following sections discuss and present the results of this research.

Previous work
The nuclear industry has been conducting research into knowledge loss due to its aging workforce. This is made worse by a lack of new/replacement workforce, as few new nuclear plants have been built in the past 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 et al., 2006).

The IAEA knowledge loss risk assessment is designed to identify positions/people where the potential knowledge loss is greatest and most imminent. It includes ratings based on two factors: time until retirement and position criticality and provides focus – identifies “experts” where steps to mitigate knowledge loss may be needed. The knowledge loss risk assessment consists of three steps:
(1) conduct a knowledge loss risk assessment;
(2) determine approach to capture critical knowledge; and
(3) monitor and evaluate.

The process is diagrammed in Figure 1 (Kosilov et al., 2006) and is consistent with traditional risk assessment processes. The process is only focused on job positions that are being vacated by retirement and rates retirees to determine priority for attention. 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 public utility (Kosilov et al., 2006; Bowman and Landon, 2008) and at Duke Energy (Honeycutt, 2008). Additionally, the Michigan Department of Agriculture has adapted the process for its own use (Hainstock, 2008).

Other approaches include that of 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 also assess the
impacts the loss of knowledge in a departing employee has on their work network and consider 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 to do their work) 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 also 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 per cent of the 1,396 human resources practitioners surveyed said attracting new talent poses the greatest threat to competitiveness, followed by the inability to retain key talent (66 per cent) and incoming workers with inadequate skills (34 per cent). However, Parise et al. (2006) 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.

Additionally, Parise et al. (2005) found that the key problem with many retention approaches is that they capture only a small fragment of what made an individual successful and knowledgeable. They also identified two main issues with retention approaches:

1. Simply capturing knowledge and storing it in a database or a process manual is not sufficient to guarantee it will be found, correctly interpreted or given enough credibility to be used outside of the expert that authored it.

2. Retention approaches focus too heavily on a person’s knowledge independent of the network of relationships critical to getting work done.

Massingham (2008) says that knowledge loss from losing an employee has three impacts:

1. Loss of contribution to the organizational memory.

2. Loss of relational knowledge with the internal and external social network (fellow employees and customers).

3. Loss of work performance resulting in decreased organizational productivity (there is a decrease in the organization’s ability to perform the tasks it performed before the employee left).

Eucker (2007) summarizes this by saying a lost employee results in lost know-how, know-who and know-what.

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

- more than just retirees, it needs to also consider employee mobility;
- the impact of knowledge loss on the social network of the lost employee; and
• more than just the position of the employee, it needs to consider what the employee knows.

The nuclear knowledge loss assessment process does not appear to be adequate in doing this, as it focused on the position of the employee and on retirement. The proposed methodology addresses these weaknesses by expanding the evaluation criteria to include looking at these areas and by incorporating an assessment of the social network.

An additional weakness of the nuclear knowledge loss assessment process is that it does not 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. The proposed 1,000-point scoring system is an attempt to provide greater differentiation between assessed subjects. The goal is to provide clearer indication of the truly critical knowledge source employees so that an organization’s limited resources can be more effectively utilized in capturing and transferring critical knowledge. Additionally, the use of a knowledge source quality factor is specifically added to help differentiate between knowledge sources with like experience.

Proposed approach
The basic approach being proposed is similar to the process in Figure 1 but has the key difference of focusing on assessing knowledge loss at the individual level rather than at the position level. This difference is necessary due to most organizations having a project/product/service focus rather than the nuclear industry’s focus on systems. 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. The basic steps are as follows:

• Use the subject’s personnel file and resume (or equivalent) in conjunction with a capability catalog or other organizational document listing key skills, capabilities or knowledge critical to the organization to establish initial ratings for the consequence and likelihood of knowledge loss (ratings are discussed below).
• Determine the level of mitigating actions to be taken (process discussed below).
• For urgent and high-priority subjects, conduct follow-up interviews to refine the risk assessment and to identify specific knowledge to be captured.
• For urgent and high-priority subjects, conduct an organizational network analysis to determine those impacted by the subject in the flow and utilization of critical knowledge.
• Generate a knowledge retention plan (discussed below).
• Monitor implementation of the knowledge retention plans and risk assessment process for overall effectiveness.

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 make better decision when determining
what risks to address first. This is an acceptable alternative as per Stoneburner et al. (2007) and Whitman and Mattord (2004), and one that will achieve the goal of determining what knowledge sources need to be managed to minimize the impact of knowledge loss. The approach uses the following risk algorithm:

\[ R_{\text{knowledge loss}} = L_{\text{likelihood of loss of human knowledge source}} \times C_{\text{importance score of the loss of a perfect human knowledge source}} \times Q_{\text{quality of human knowledge source}} \]

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; and
- quality of the knowledge source

Finally, it provides processes for:
- ranking knowledge loss risks; and
- determining appropriate courses of action.

The following sections develop this methodology.

**Knowledge loss risk**
This paper views knowledge loss risk as 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, as many organizations view knowledge as their key asset and loss of knowledge would be 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 the organization more to keep than it is worth; this could occur in the case where the expertise is no longer incorporated in an organizational product or service). Both types of impacts are incorporated into the risk assessment process. Knowledge loss risks will be classified into three categories:

1. immediate action required to capture critical knowledge;
2. planned action required to capture critical and/or important knowledge; and
3. No special action required to capture knowledge.

**Likelihood of knowledge loss**
The likelihood of knowledge loss factor rates the likelihood of a human knowledge source being lost to the organization. This factor assumes that the knowledge workers basic physiological needs, as per Maslow (1943), are met and that the knowledge worker is being paid adequately. Sources for this section are Josefek and Kauffman, 1999; Sullivan, 1999; Tomlinson, 1999; Regets, 2007; Constantin et al., 2008; Robinson, 2009; Aggestam et al., 2010; Chang et al., 2010. This section was generated by combining these studies into a set of criteria that can be used to score the likelihood of losing a knowledge
worker. Some study results are not used, specifically those that utilize job satisfaction and perceived job fit. These results are not used, as it was not considered ethical to assess knowledge worker satisfaction and perceived job fit for use in determining likelihood of knowledge loss. Additionally, temporary or contract knowledge workers are not considered.

Loss of human knowledge sources occurs in several ways (examples include):

- **Retirement** – Source leaves the company due to advanced age;
- **Turnover** – Source leaves the company, probably to join another company; this can be due to burnout, boundaryless careerists, boredom, returning home, seeking new skills and/or challenges, termination, etc.;
- **Disability** – Source is lost to the company, either permanently due to death or incapacitation, or temporarily due to injury or illness; and
- **Job Change** – Source leaves his current position for another position within the company.

Factors that influence likelihood of knowledge loss include age, health, uniqueness of skills and knowledge, demand for skills and knowledge, dissatisfaction and years of service.

- Age is a general indicator of experience and a strong predictor of retirement. Age is also a possible indicator of a foreign knowledge worker likeliness to leave the organization to return to his/her native country.
- Health is a relatively unpredictable factor but is generally expected to deteriorate as age increases and because of 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 lifestyle choices (these are not 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 (skills/technologies so new that there is risk in implementing them) and leading and cutting-edge skills tend to be reflected by younger knowledge workers with less expectation of being bleeding/leading/cutting-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 of the organization for specific knowledge which can increase or decrease mobility of the possessor. Market needs may be reflected by competitor organization needs or by industries unrelated to the organization core business but which use like skills and knowledge (examples include project management, web services, social media, etc.).
- Dissatisfaction reflects a personal driver for leaving an organization. Most of the measures found in the literature involve measuring fit to the job and/or organization or satisfaction of the knowledge worker. It is considered unethical to
use fit and satisfaction measures for determining likelihood of the knowledge worker leaving. However, it is considered ethical to look at other measures. The measure used is amount of travel. This is used as excessive travel is generally considered a driver for a knowledge worker to consider a different job.

- Years of service indicate an ability to stay with a job or project and reflects experience and responsibility. Generally low and high levels of years of experience are detrimental to movement, while moderate years of service increase the likelihood of movement (reflects boundaryless careers). 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 8-10 years), where the cost of changing positions (such as loss of vacation, retirement benefits, etc.) outweighs whatever benefits can be gained (such as increased salary, change in job responsibilities, change in location).

The above factors can be combined into overall likelihood profiles and ranked and rated for most likely to least likely. To generate an overall risk score, a single value must be generated. Likelihood of knowledge loss will be valued using the following 10-point scale (pick the highest score that applies to the subject (Table I).

### Consequence of knowledge loss

The consequence of knowledge loss factor rates the likely impact of losing a human knowledge source to the organization. Factors affecting the consequence of knowledge loss were primarily determined using Porter (1985) value chain analysis and the knowledge worker productivity model by Jennex (2008). Additional sources used are from Josefek and Kauffman, 1999; Lepak and Snell, 2002; Eucker, 2007; Constantin et al.

<table>
<thead>
<tr>
<th>Value</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Employee is definitely at risk of leaving (examples: is of retirement age, is being terminated or laid-off or has been diagnosed with severe or possibly fatal illness)</td>
</tr>
<tr>
<td>9</td>
<td>Employee is considered young, mobile and in demand (example: has five or more years of experience, is &lt; 45 years and possess knowledge/skills that are in demand)</td>
</tr>
<tr>
<td>8</td>
<td>Employee is considered an expert who may be getting bored or who has to travel frequently (example: has 15 or more years of experience and travels 4 or more times a year or was hired as an expert and has five or more years of experience)</td>
</tr>
<tr>
<td>7</td>
<td>Employee is experiencing a forced change in position/career (example: working on a project/product/service that is being phased out, or is completing a degree)</td>
</tr>
<tr>
<td>6</td>
<td>Employee has a history of changing companies (example: is aged &lt; 40 and has worked for three or more companies)</td>
</tr>
<tr>
<td>5</td>
<td>Employee is young (example: is aged &lt; 30)</td>
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<tr>
<td>4</td>
<td>Employee travels frequently (example: employee has six or more business trips in the last year)</td>
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<tr>
<td>3</td>
<td>Employee is in a leadership position (example: employee is a manager, supervisor, project manager, etc.)</td>
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<tr>
<td>2</td>
<td>Employee has many years of experience (example: employee has &gt; 10 years of organizational experience)</td>
</tr>
<tr>
<td>1</td>
<td>None of the above apply</td>
</tr>
</tbody>
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Table I. Likelihood of knowledge loss values
This section was generated by combining these studies into a set of criteria that can be used to score the consequence from losing a knowledge worker or expert.

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 influence the overall consequence of knowledge loss:

1. Ease of replacement looks at the availability of like qualified knowledge sources that can be quickly brought in to replace the lost source. Generally the more possible the replacement, the less impact the loss has. Additionally, if given time and a replacement can be brought in before the source is lost, then the impact is significantly mitigated by having the replacement learn from the source.

2. 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. The caveat to this factor is that it may take significant analysis to determine the uniqueness of the source.

The above factors can be combined into overall consequence profiles and ranked and rated for most severe to least severe. To generate an overall risk score, a single value must be generated. Consequence of knowledge loss will be valued using the following 10-point scale (Table II).

Knowledge in the above table can be defined in multiple ways. First, knowledge can refer to an understanding of concepts or technologies utilized in products or services and are analogous to being a central connector as per Parise et al. (2006). Second, knowledge can also refer to general knowledge of processes and abilities used in the organization and are analogous to being a broker (Parise et al., 2006).

Quality of knowledge source

The quality of knowledge source factor takes into account variables that impact the ability to capture knowledge but which are not reflected in the likelihood or consequence factors. There is little direct literature addressing this factor, as the factor was created for this study to aid in differentiating rankings between equivalent knowledge sources. Key concepts for this factor are knowledge stickiness and the transfer of tacit knowledge. Sources used are Nonaka and Takeuchi, 1995; Szulanski, 1996; Disterer, 2001; Wasko and Faraj, 2005, Parise et al., 2006; Kaplan, 2008; and Aggestam et al., 2010.
This section was generated by combining these studies into a set of criteria that can be used to compensate the quality factor to more readily rate the ability to transfer knowledge from the knowledge worker/expert. The purpose of this factor is to aid in differentiating between potential knowledge losses based on factors that indicate that knowledge transfer from the source is more likely to be successful which include:

- 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 (ethically bad to pursue knowledge capture at a time when the source may be fighting for their life), disabilities limiting the source’s ability to participate (coma, broken bones, crippling diseases, etc.), death, etc. It is noted that health issues may be legally private and protected information, and it is not the intent of this paper to propose that this be ignored; rather, it is included in case the information is available or freely provided by the source.
- 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 the organization recognizes that there may be emotional or legal issues affecting the ability of the source to participate in knowledge capture.

While the above factors can be combined into overall quality profiles, the number of profiles is potentially quite large. Additionally, some of the profiles indicate knowledge capture processes involving the source are not possible. 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 may come from several factors).

Time to loss of knowledge source, deduct as follows:
- One point if within two years to loss.
- Two points if within one 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 is assumed that knowledge capture activities involving the source are not possible, and special actions (capturing email, cloud storage, other external storage devices, 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 > 2 years old.
- Two points if knowledge being captured is > 5 years old.
- Three points if knowledge being captured is > 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 communities of practice and professional or social organizations. Participation can be judged based on postings, presentation of papers or talks, replies to e-mails, 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, presentations, or brown bag presentations) and an analysis of postings or communications.

Reason for leaving the organization, deduct as follows:
• No deduction if leaving voluntarily under good terms (manager would rehire) or retiring at 55 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.

Assessing 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 1,000.

The approach uses the following risk algorithm:

\[
R_{\text{knowledge loss}} = \frac{L_{\text{likelihood of loss of human knowledge source}}}{1005} \times \frac{C_{\text{importance score of the loss score of perfect a human knowledge source}}}{1003} \times \frac{Q_{\text{quality of human knowledge source}}}{1003}
\]

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. This process is designed to assist in performing steps 2-5 of the proposed knowledge retention process (discussed earlier). It is expected that users of this process will use the results to prioritize knowledge capture actions for the remaining steps of the proposed knowledge retention process. The more important use of the value is to classify knowledge loss risk into knowledge capture action categories (Table III).

Pilot project
The knowledge loss risk prioritization process was piloted within the supporting organization, a US defense contractor. The pilot was performed using a team of three for knowledge assessors (the author and the two members of the organization’s project team). The first step was a table-top walk-through of the factors using the previously presented scoring tables. The second step was to apply the scoring criteria to six purposefully selected subjects from the organization using personal knowledge and the organization’s databases and web systems to collect data on the subjects. The purpose of the second step was to see if the knowledge loss risk value would assign the appropriate priority to the test subjects. Of the six subjects, subject A was a senior technical expert, subject B was an expert who had just retired (chosen because the knowledge retention process was developed for him), subject C was a knowledge engineer, subject D was a young system engineer, subject E was a new employee hired for her expertise and subject F was a long-term department administrator. These
subject were chosen, as they represent the breadth of the types of personnel expected to be assessed once the program was approved. Table IV reflects the consensus values assigned to them.

**Pilot project discussion**

The pilot project results were discussed shortly after the project was completed to see if they made sense and to gather initial impressions from the assessment team. Further reflection was conducted over the next few weeks and resulted in the generation of a report to the organization on the process. Below summarizes the findings from the evaluation phase.

The observation is that the process seems to work. Subject B, already identified as a knowledge loss risk, was identified as urgent through this process. So were Subject A, the technical expert, and Subject C, the knowledge engineer, but for different reasons. Subject A

---

**Table III.**

<table>
<thead>
<tr>
<th>Knowledge capture action determination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk value</td>
</tr>
<tr>
<td>≥ 700</td>
</tr>
<tr>
<td>300-699</td>
</tr>
<tr>
<td>&lt; 300</td>
</tr>
</tbody>
</table>

**Special cases**

This is the preserve knowledge artifact category. Actions are taken to preserve paper and computer files and capture e-mail. Analysis and organization of these artifacts are performed by HR with assistance from the replacement (if appropriate) and knowledge engineering.

---

**Table IV.**

<table>
<thead>
<tr>
<th>Knowledge loss risk pilot results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
</tr>
<tr>
<td>Likelihood</td>
</tr>
<tr>
<td>Consequence</td>
</tr>
<tr>
<td>Quality</td>
</tr>
<tr>
<td>Risk value</td>
</tr>
<tr>
<td>Priority</td>
</tr>
</tbody>
</table>

---
had the top value for consequence and quality with a lower likelihood of leaving. Subject C had a higher likelihood 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 Subject C had a higher value than Subject A which will be discussed later. Subject D had a high priority based on being young, mobile and talented. Subject E had a low priority based on being in demand but with little organization-specific knowledge. Subject F is one of those that the process is meant to catch; she did not have critical skills but had been present and worked through many critical organizational projects and events making her a repository of organizational history and potentially a treasure trove of “why we did this” and “who did what” knowledge.

The key lesson learned was to provide very objective criteria/guidance for selecting appropriate values for each variable in the risk calculation. The assessment team interpreted the criteria differently and while concurrence on what the scoring criteria meant was reached during the walk through, it was felt the tables needed to be supplemented with specific forms that guided assessors to appropriate scores. The final phase of the project (the evaluation and subsequent reflection) produced these forms for future use. Lack of refined criteria for taking the value definitions and determining the appropriate value was the biggest problem encountered. The forms generated are presented in the Appendix.

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 Subjects A and C were used as an example, as the assessor team agreed that Subject A was more important to the organization than Subject C, but the scores did not reflect it. However, the knowledge risk value is not meant to be a measure of knowledge worker/expert worth. The knowledge loss risk value provides a value rating the likelihood that the subject will cause the organization to lose knowledge when he/she leaves. It is not a rating on how important the individual is to the company and having a high value is not necessarily a good thing. For this particular case, Subject A had a greater consequence value than Subject C as expected but a lower likelihood of leaving. Given the individuals, it was agreed by the assessor team that this would be the case, Subject C would be much more likely to leave than Subject A, given that Subject 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.

Conclusions
This paper investigated the research questions: how does an organization assess the value of departing knowledge and how can KM be used to mitigate knowledge loss. The result is the process outlined. The pilot project used to test this process shows that the process appears to work. This satisfies a real need within organizations for a process that will aid the organization in identifying its greatest risks of knowledge loss through the loss of knowledge workers and/or experts. The final process, as discussed in this paper and implemented in the forms in the Appendix, is a viable process for assessing this knowledge loss risk and aiding organizations in prioritizing their knowledge capture efforts. This process should be incorporated as another tool for the organization’s KM program.
Implication for practice is that there is a systematic approach to assessing knowledge loss risk. Scores for knowledge loss consequence, likelihood of knowledge loss and quality of knowledge source can be generated using previous research and as captured in the scoring tables provided in the paper. Ultimately, managers are provided a tool that assists them in making better decisions as to where to apply resources to get the greatest return on attempts to capture critical knowledge. Additionally, it provides managers a tool to help them assess which knowledge is the most critical to the organization. This should result in better overall organizational decision-making. Finally, this paper provides risk managers with a tool to assess risk in an area that was previously difficult to measure.

Implication for research is that research into knowledge transfer between individuals can be applied to predicting the ability of a knowledge source to transfer knowledge before leaving an organization. Previous research has focused on how to improve knowledge transfer; this paper suggests that there are situations where knowledge transfer cannot be improved but simply needs to be recognized as a practical measure and input into decision-making.

Limitations
This research has a limitation in that it has only been pilot-tested using a limited number of subjects from a single organization. This suggests a limitation on generalizability to other organizations.

Areas of future research
Additional research needs to be performed to improve the generalizability of the knowledge loss risk assessment process. This research needs to perform studies in more organizations. Subjects need to be selected from a wide range of age groups and also from different cultures.

References


Knowledge Roundtable, The Network Roundtable at the University of Virginia, Charlottesville, VA.


Further reading

## Appendix

### Knowledge Loss Risk Data Worksheet

<table>
<thead>
<tr>
<th>Employee Name:</th>
<th>Title/Position:</th>
<th>Age:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Years of Service:</th>
<th>Years of overall experience</th>
<th># Business trips over the last year</th>
<th>Reason for leaving company</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Advanced Degrees Earned or in progress</th>
<th># of Communities of Practice employee is a member of:</th>
<th># of papers presented before a professional organization:</th>
</tr>
</thead>
<tbody>
<tr>
<td>_ Ph.D._</td>
<td></td>
<td></td>
</tr>
<tr>
<td>_ Masters _</td>
<td></td>
<td></td>
</tr>
<tr>
<td>_ Bachelors _</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>List Certifications (ex: PE, CISSP, CPA, PMP, etc.):</th>
<th>Skills (from Capability Catalog)</th>
<th>Competencies (from Capability Catalog)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Are any of these skills or competencies critical or vital to the organization? | | |
| _ _ yes _ _ no                                              | | |

| Was Employee hired as an expert? | | |
| _ _ yes _ _ no | | |

| Is Employee a senior leader? | | |
| _ _ yes _ _ no | | |

<table>
<thead>
<tr>
<th># of Communities of Practice employee is a member of:</th>
<th># of papers presented before a professional organization:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Is Employee a senior leader?                          | # of Professional Organizations active in: |
| _ _ yes _ _ no                                        |                                            |

<table>
<thead>
<tr>
<th>Organizational Projects/Services/Products worked on:</th>
<th>TOTAL DEDUCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

### Knowledge Loss Risk Quality Factor Worksheet

<table>
<thead>
<tr>
<th>Employee Name:</th>
<th>Date Assessment Performed:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Overall Quality Score = 10 – Total Deductions (as calculated below) + Additions (as determined below) – Note that if the above is less than 1 then use 1 for the Quality Factor**

**Deductions**

<table>
<thead>
<tr>
<th>Score:</th>
<th>Expected departure date:</th>
<th>How long is this date from today:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>_ Months   _ Years</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Score:</th>
<th>Reason for Leaving (Pick only one)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deduct 3 points</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Deduct 1 point</th>
<th>Deduct 2 points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Score:</th>
<th>Freshness of knowledge (Pick only one)</th>
<th>How long has it been since the employee used these skills/capabilities or since they worked on the listed projects or experiences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deduct 1 point</td>
<td>Deduct 2 points</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Deduct 3 points</th>
<th>More than 10 years</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Score:</th>
<th>Willingness and ability to share (use all that apply)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deduct 1 point</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Deduct 3 points</th>
<th>More than 5 years</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Sum above:</th>
<th>(This represents the total Deductions)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

### Additions

<table>
<thead>
<tr>
<th>Score</th>
<th>Social Network Addition (pick one if it applies)</th>
<th>Add 1 point</th>
<th>Add 2 points</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Member of only one community of practice or professional organization</td>
<td>Member of more than one community of practice or professional organization</td>
</tr>
</tbody>
</table>

---

**Figure A1.** Form 1 – Knowledge loss risk data worksheet: used to gather data about the knowledge source

**Figure A2.** Form 2 – Knowledge loss risk quality factor worksheet: used to guide assessors in generating the quality factor score
### Knowledge Loss Risk Likelihood Worksheet

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
</table>
| 10    | Employee can retire __ yes __ no  
|       | Employee has reported a severe medical condition __ yes __ no  
|       | Employee is being laid off __ yes __ no  
|       | Employee is being terminated __ yes __ no |
| 9     | Years of experience are greater than 4 __ yes __ no  
|       | Age is less than 45 __ yes __ no  
|       | Has at least one critical/vital skill or competency __ yes __ no |
| 8     | 15 or more years of experience in a project/product/service __ yes __ no  
|       | Has more than 4 business trips in the last year __ yes __ no  
|       | OR  
|       | Employee hired as an expert in a critical/vital skill/competency __ yes __ no  
|       | Has less than 5 years of service __ yes __ no |
| 7     | Employee is working on a project/product/service that is being phased out OR  
|       | is completing a degree __ yes __ no |
| 6     | Employee has worked for 3 or more companies __ yes __ no  
|       | Employee is under 40 __ yes __ no |
| 5     | Employee is 30 or under __ yes __ no |
| 4     | Employee has had more than 6 business trips in the last year __ yes __ no |
| 3     | Employee is a manager, project manager, or project lead __ yes __ no |
| 2     | Employee has 10 or more years of experience or service __ yes __ no |
| 1     | Apply if none of the above criteria apply |

---

**Figure A3.**
Form 3 – Knowledge loss risk likelihood worksheet: used to guide assessors in generating the likelihood score
## Knowledge Loss Risk Consequence Worksheet

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
</tr>
</thead>
</table>
| **Employee has a skill/competency critical or vital to XXX** yes no  
If no jump to Section B below |
| 10 | Using the Capability Catalog there are no personnel with like skills/capabilities and/or degrees and certifications yes no |
| 9 | Using the Capability Catalog there are personnel with like skills/capabilities and/or degrees and certifications but none are available to be transferred prior to the employee leaving yes no |
| 8 | Using the Capability Catalog there are personnel with like skills/capabilities and/or degrees and certifications and at least one is available to be transferred prior to the employee leaving yes no |
| 7 | Using the Capability Catalog there are personnel with like skills/capabilities and/or degrees and certifications and two or three are available to be transferred prior to the employee leaving yes no |
| 6 | Using the Capability Catalog there are personnel with like skills/capabilities and/or degrees and certifications and four or more are available to be transferred prior to the employee leaving yes no |
| **Section B, Employee has no skill/competency critical or vital to the organization** |
| 5 | Employee possesses knowledge of key organizational events, initiatives, and/or projects yes no  
Employee is a manager or key contributor for products or services offered by the organization yes no  
Employee is an organizational Fellow or other honored rank yes no |
| 4 | Employee possesses a skill in demand by the organization yes no |
| 3 | Employee has 20 or more years in the organization yes no |
| 2 | Employee has 5-20 years in the organization yes no |
| 1 | Apply if none of the above criteria apply |

---

**Figure A4.** Form 4 – Knowledge loss risk consequence worksheet: used to guide assessors in generating the consequence score.
<table>
<thead>
<tr>
<th>Knowledge Loss Risk Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Employee Name:</strong></td>
</tr>
<tr>
<td><strong>Likelihood Score:</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Knowledge Loss Risk Score</th>
<th>Priority</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>700 or greater</td>
<td>Urgent – take immediate action</td>
<td>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>300-699</td>
<td>High Priority – Prepare and implement knowledge capture plan</td>
<td>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 between 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>Under 300</td>
<td>Low Priority – Capture Knowledge through routine KM activities</td>
<td>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 needed.</td>
</tr>
<tr>
<td>Special Case</td>
<td>Preserve Artifact – Knowledge source is unavailable for knowledge capture</td>
<td>Actions are taken to preserve paper and computer files and capture email. Analysis and organization of these artifacts are performed by HR with assistance from the replacement (if appropriate) and knowledge engineering</td>
</tr>
</tbody>
</table>

**Corresponding author**
Murray Eugene Jennex can be contacted at: mjennex@mail.sdsu.edu

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