Metrics Guide for Knowledge Management Initiatives

DEPARTMENT OF THE NAVY
CHIEF INFORMATION OFFICER

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This guide presents a practical framework for measuring the value of investments in knowledge management initiatives. This document is designed to be a supplement to the Knowledge Centric Organization (KCO) Toolkit CD produced by DON CIO.

The KCO Toolkit CD lays out the basic knowledge and activities for helping the DON become a Knowledge Centric Organization. This document seeks to guide the reader through a process to design and implement *performance measures* for KM.

This guide is also available on the DON CIO web site: www.don-imit.navy.mil

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1. OVERVIEW

The Department of Navy (DON) Chief Information Officer (CIO) has led the development of an Information Management/Information Technology (IM/IT) Strategic Plan to build a knowledge sharing culture and exploit new IT tools to facilitate knowledge transfer across the globally distributed enterprise. To implement this strategy, DON CIO developed the Knowledge Centric Organization (KCO) Toolkit[1] to assist Navy and Marine Corps organizations in capitalizing on their knowledge assets and begin implementing Knowledge Management (KM) within their organizations. Although several definitions of KM exist, DON uses the following definition to highlight the interplay between human and organizational issues: "KM is a process for optimizing the effective application of intellectual capital to achieve organizational objectives." The IM/IT vision is to transform the DON into a Knowledge Centric Organization where people can make and implement efficient and agile decisions. An organization becomes a KCO by connecting people to each other when helpful and delivering the right information, and only the right information, at the right time to enhance learning, innovation, effectiveness, and productivity.

KM initiatives should continually gauge their progress in achieving their objectives to ensure success. Given the complex and dynamic nature of modern organizations, KM as well as all other organizational initiatives cannot guarantee that plans and strategies will succeed. However, well-designed performance measures will yield insight to help managers understand and adapt their organizations. Indeed, performance measures are so integral to organizational success that the Federal Government has passed several pieces of legislation that specifically call for formal metrics plans, including the Clinger-Cohen Act of 1996 (formerly known as the Information Technology Management Reform Act of 1996).

This guide presents a practical framework for measuring the value of investments in KM initiatives. Since the value of KM depends on each organization's goals and people, it is not a "cookbook" of standard procedures but rather an aid to help you identify and apply appropriate metrics for your initiative. The reader should be familiar with the concepts and approach for KM described in the KCO Toolkit; these topics are not discussed in detail since they are thoroughly covered in the Toolkit.

The measurement process is composed of several steps to clearly identify what should be measured, how to measure it, and how to use the measures. This process is built as a series of questions that help guide you through the decisions of defining, choosing, and using the metrics. However, you should have first identified the business purpose of the KM project and have an understanding how the KM project will enhance your objectives. The questions are:

1. What is the business objective? (answered prior to developing a metrics plan)
2. What KM methods and tools will we use? (answered prior to developing a metrics plan)

[1]Knowledge Centric Organization Toolkit CDROM, available from DON CIO at http://www.don-imit.navy.mil/focusareas/knowledgemgmt/centric.html

3. Who are the stakeholders and what do they need to know?
4. Which framework is best?
5. What should we measure?
6. How should we collect and analyze the measures?
7. What do the measures tell us and how should we change?

The KCO model uses three types of specific measures to monitor the KM initiative from different perspectives. **Outcome metrics** concern the overall organization and measure large-scale characteristics such as increased productivity or revenue for the enterprise. **Output metrics** measure project level characteristics such as the effectiveness of Lessons Learned information to capturing new business. **System metrics** monitor the usefulness and responsiveness of the supporting technology tools.

Three primary classes of business objectives are used to characterize KM initiatives and to help design the proper mix of performance measures:

- **Program and Process Management**: This class includes strategic organizational objectives such as leveraging best practices and transferring lessons learned. Some of the business problems Program and Process Management initiatives are designed to solve include issues such as ensuring consistency across the organization and proactively preventing duplication of effort.
- **Program Execution and Operations**: This class includes objectives such as connecting people with experts, transferring expertise instantaneously, and getting the right operational knowledge to people in the field when they need it.
- **Personnel and Training**: This class includes personnel and learning issues such as acquiring and retaining talent and improving quality of life for employees.

The best approach to determine where to start is to map your initiative objective and type of business objectives with those summarized at the beginning of Sections 5, 6, and 7. When you find a match, go to the appropriate section to learn more about how the sample cases have identified appropriate measures for their initiatives and to read a more general discussion about appropriate measures for that class of business objective. Case studies are included to provide examples of real situations that represent the class of business to the objectives.

2. INTRODUCTION

Knowledge Management (KM) provides a methodology for creating and modifying processes to promote knowledge creation and sharing. These processes are not new independent KM business processes but processes developed by applying the KM methodology to core organizational applications. KM, implemented by and at the organizational level, and supporting empowerment and responsibility at the individual level, focuses on understanding the knowledge needs of an organization and the sharing and creation of knowledge by becoming part of the fabric of the organization.

Connecting people is the primary focus of KM initiatives. Indeed, it is essential to understand that KM is not about simply increasing access to information. On the contrary, access to large amounts of information is good when there is ample time to peruse it, but this access does not provide quick answers. KM seeks to provide these answers through a balance between stored succinct and directly pertinent information and links to other people who are likely to know how to help.

KM provides two major benefits to an organization:

- Improving the organization's performance through increased effectiveness, productivity, quality, and innovation.
- Increasing the financial value of the organization by treating people's knowledge as an asset similar to traditional assets like inventory and capital facilities.

Each of these benefits has distinct qualities that can be measured, such as the effectiveness of sharing and the intrinsic value of knowledge assets. However, since DON organizations execute and support Fleet operations, they are primarily interested in the operational mission performance improvement benefit of KM. Consequently, this guide focuses on determining effective performance measures to assess the organization's current status in becoming a Knowledge Centric Organization. At every stage in the journey, metrics provide a valuable means for focusing attention on desired behaviors and results.

Many of the organizational changes will be intangible characteristics such as how quickly people adapt to new situations, morale, camaraderie, and other important factors that cannot easily be quantified. Performance measures for KM build on the experience in accounting and management for other types of intangible initiatives such as learning and training. Metrics are particularly important to KM because a Return On Investment (ROI) for KM often takes significant time to appear. Putting a KM program into effect will impact other business processes as the organization learns to use and leverage the new KM capabilities. This "acculturation" to KM can take 18 to 36 months in some cases. According to the Gartner Group, "in no case should a KM program (at the enterprise level) be expected to show ROI in less than 12 months."[2]

[2] F. Caldwell. "CEO Update: Measuring the Success of Enterprise Knowledge Management," *GartnerGroup*. December 13, 2000.

Building a Knowledge-Centric Organization: The Role of Metrics

Performance measures for KM have several objectives:

- To help make a business case for implementation
- To help guide and tune the implementation process by providing feedback
- To provide a target or goal
- To measure, retrospectively, the value of the initial investment decision and the lessons learned
- To develop benchmarks for future comparisons and for others to use
- To aid learning from the effort and develop lessons learned

Performance measures should be designed and implemented to reflect organizational goals and objectives. KM is a strategic business process that enables other critical business processes. Therefore, it is important to focus measures (and the entire initiative) on factors that affect the ability to achieve strategic objectives. The Government Performance and Results Act (GPRA), passed in 1993 and enacted in 1997, brought to the forefront the concept of applying performance metrics to link funds availability and program effectiveness in Federal agencies. This legislation requires agencies to develop strategic plans and performance metrics to tie their success in achieving strategic objectives to their Congressional funding. The performance plan must specifically define performance measures, required resources and processes, and how the measures will be used. These measures must directly relate to the performance goals, which are classified as outcome changes in the goal targets, and output changes in the specific activities undertaken to achieve the goal.

Similarly, the KCO model uses three types of metrics to assess different levels of KM impact, namely outcome (enterprise or overall value), output (project or task), and system (technology tool). These are defined and explained in Section 3. However, care must be used to "pick the right measure" just like "picking the right tool," as outlined in the National Performance Review report on performance measures.[3] Based on a review of many high-performing organizations, this report identified several key factors in designing and using performance measures that are just as important to building a KCO, and which we will emphasize throughout this guide. These factors include: using a few focused measures aligned to strategic objectives; measuring critical characteristics of the business processes; and recognizing measures as being only valuable tools and not the products of the project.

The perspectives of the customer, department, organization, and individual in an enterprise are critical to its success and need to be incorporated into that success. The implication of this for KM metrics is critical – when thinking about metrics, it is important to identify who is likely to use the performance measurement information. Potential users include strategic decision makers, special project decision makers, funding and approval stakeholders, Government agencies involved in approval or regulation, or customers. Measures should be in terms that are familiar to

[3] Serving the American Public: Best Practices in Performance Measurements from National Performance Review, 1997.

the stakeholder. For this reason, you may find that there are several different metrics that need to be captured for your initiative. There is no one "right" set of measures for KM initiatives and most KM initiatives will require a combination of measurement types and classes to effectively communicate with the key stakeholders. The measures must reflect the overall mission and strategy of the organization.

What is the Metrics Guide?

This guide describes several types of metrics that have been effectively used in previous KM and other business projects along with suggested applications. These applications differ in how people perceive knowledge and the timeliness with which they need to access and act upon the knowledge. Three primary classes of business objectives are used to characterize KM initiatives and to help design the proper mix of performance measures: Program and Project Management; Program Execution and Operations; and Personnel and Training.

As you begin your KM initiative, peruse Sections 5,6, and 7 for similarities in the mission of your organization and the business class you are focusing on to determine the most appropriate KM metrics to apply. Before implementing the suggestions and examples presented, you should have already determined the KM focus area (an organizational objective or problem) and designed and deployed KM activities to address or solve the KM focus area.

The matrix provided in Appendix A presents a comprehensive summary of potential measures (which have all been "field tested") for KM initiatives. There is no guarantee that these measures are the most appropriate for your project. Remember – these metrics describe what you *can* do, not what you must do or even what you *should* do. Use these as suggestions that may work for you or that may trigger some ideas for more appropriate measures in your situation. Select measures that matter to <u>your</u> stakeholders. Also, be sure to think about creating a balance between the number of measures that you will collect and the value of these measures to the stakeholders. There will likely be things that you *could* count, but it would be overkill to do so. Measurement for KM initiatives, just like KM itself, is not a hard and fast science. You will need to apply your best judgment to determine what is appropriate for your organization.

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3. DESIGNING ACTIONABLE KM PERFORMANCE MEASURES

Performance measures support decision-making and communication throughout an organization to understand the progress, efficiency, value, and strategic alignment of KM projects. One of the most important things to keep in mind about Knowledge Management initiatives is that performance measures are just a starting point; it takes a far more serious, strategic commitment to make organizations truly effective. To achieve the objectives of a KCO, the KM initiative must be continuously assessed at all levels of the organization to ensure that the required actions and changes are being made, and redefined if necessary. This is a continuous process as depicted in Figure 1.

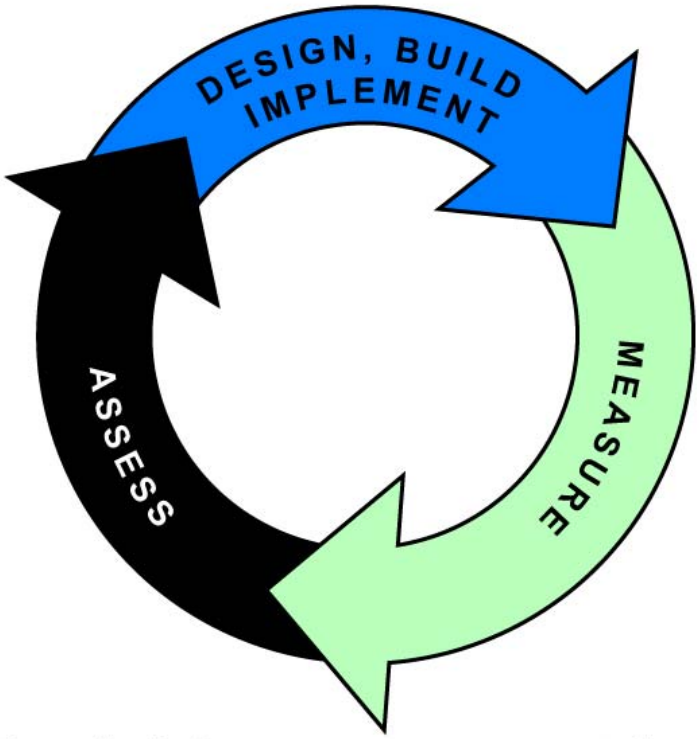


Figure 1. Performance measures are part of a continuous cycle of implementation, measurement, and assessment.

This section presents general techniques to develop measures that are actionable – measures that provide a basis for making decisions, changing behaviors, or taking action. The remaining sections of this guide present specific information on applying these techniques to the three primary classes of business objectives: Program and Project Management; Program Execution and Operations; and Personnel and Training.

The KM Measurement Process

The measurement process is composed of several steps to clearly identify what should be measured, how to measure it, and how to use the measures. This process is shown in Figure 2 as a series of questions that help guide you through the decisions of defining, choosing, and using the metrics. As mentioned in Section 2, you should have already identified the business purpose of the KM project and have an understanding of how the KM project will enhance your objectives. Each step of the measurement process will be discussed separately in this section.

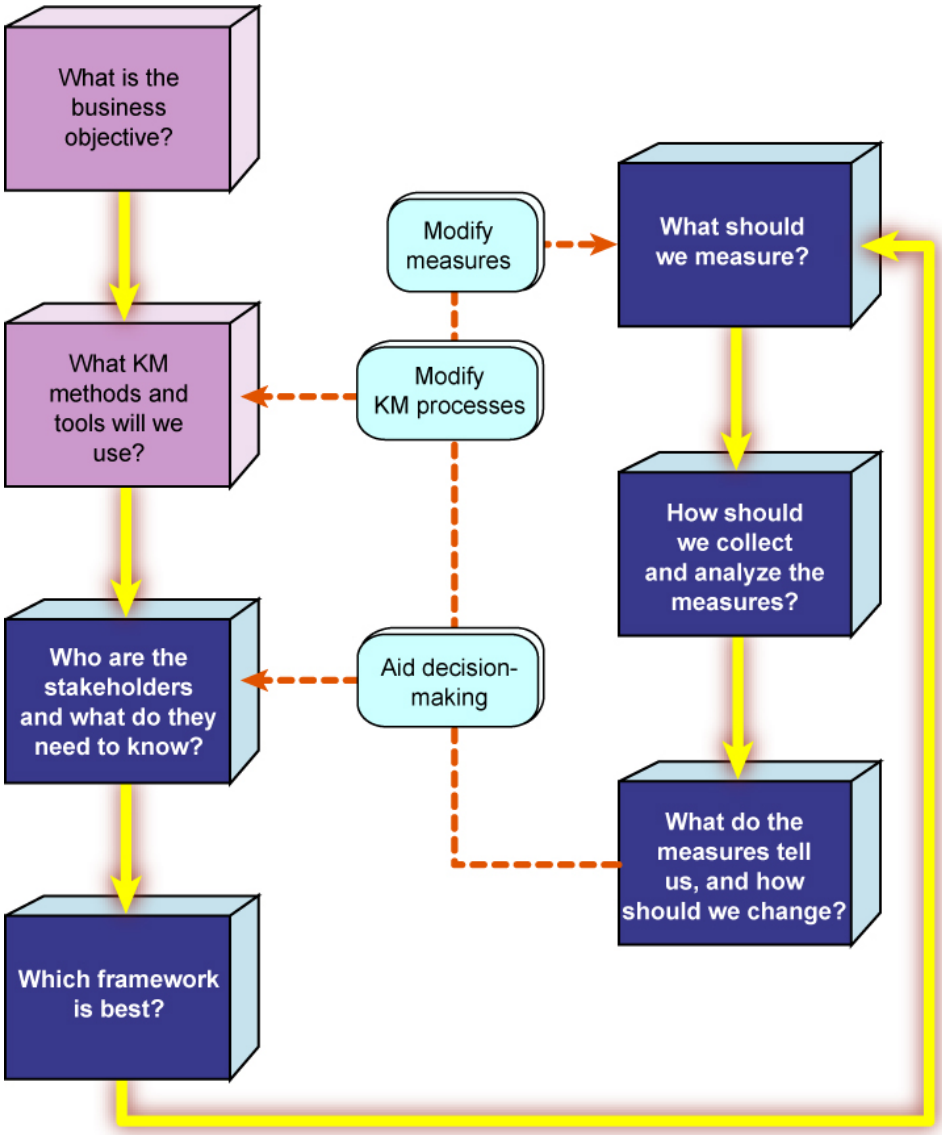


Figure 2. KM measurement process. The first two steps are not part of this guide, but should be completed before implementing metrics.

Who are the Stakeholders and What do They Need to Know?

The first step in the measurement process is to identify who will use the measures. This can be a KM project champion, officers and managers, participants, funding and approval officials, internal customers, supply industries, and other stakeholders. A useful technique is to brainstorm a list of all possible audiences for the measures and then review the list to remove duplicates and add any positions or organizations not included previously.

However, be careful not to include such a large number or wide range of people that it will be too difficult to accommodate all of their concerns and needs. A key part of defining the business objective and KM methods (steps done before the metrics process begins) is to focus the KM initiative on specific organizational needs. These activities should have identified the primary stakeholders, even if only in a general sense, and this list can help consolidate the final list into stakeholders who are substantially connected to the initiative.

Next, identify the stakeholders' most important questions and the decisions they will make in order to determine exactly what information they need to glean from the measures. They may want to determine how valuable the knowledge assets are to the organization in practice, how effective the KM system is in enabling knowledge sharing and reuse, or both. Thus, measures have to be tailored to each need.

SPAWAR Systems Center Charleston embarked on a project to become a Knowledge Centric Organization (full case study is in Section 5). The project team leader arranged for several workshops to perform the KCO implementation steps to identify critical knowledge assets, who creates them, who uses them, and effective metrics. During the first workshop, the project team listed the obvious stakeholders for their business development focus area, who were the members of the project team, branch heads, and division business development managers. However, after discussing specific scenarios of how the knowledge assets could be used to enable substantial performance improvements, the team realized that there was another set of stakeholders who could potentially reap the most benefit of sharing and reusing the knowledge if the KM processes were tailored to their specific needs. These people were the senior technical staff who spent a lot of time working closely with customers at their sites, and, therefore, engaged in some of the most frequent and important business development efforts. Since they were in a position to build a trusting relationship with their customers, the more knowledge these senior technical staff had about complementary capabilities within the organization, the more they could present a broader range of skills and capabilities to the customer that could garner new and possibly larger programs. The KCO project team used this insight to redefine the details of the KM processes and metrics implemented.

Which Framework is Best?

A framework helps ensure the metrics are aligned to the project objectives and the organization's strategic goals. Indeed, this is one of the key findings of the National Performance Review study of Best Practices in Performance Measurements in high-performing organizations, as shown by the following conclusion:

> "A conceptual framework is needed for the performance measurement and management system. Every organization needs a clear and cohesive performance measurement framework that is understood by all levels of the organization and that supports objectives and the collection of results."

A framework is a more useful way to convey the measures than merely listing them. A framework can show how actions contribute to overall goals, the mechanisms by which actions produce benefits, the rationale for conducting the KM project, and, in some cases, provide an analytical tool for making investment trade-offs.

There are several ways to construct a framework using organization schemes such as a balanced set of measures, benchmarking, target setting, matrices, hierarchies, flow diagrams, and even management systems. The best choice for your initiative depends on which one, or ones, makes it easy for your team to gauge and understand the costs, benefits, relationships, and impacts of the KM processes and measures to each other, and to your business objectives.

The key characteristics of some of these schemes relating to KM initiatives are described below.

- Flow

  A flow framework traces KM activities to impacts and related measures, and is good for showing how KM activities produce benefits. Figure 3 shows an example for one activity in a Community of Practice. A virtual meeting (KM action) produces impacts on the workgroup's process through the exchange of knowledge. The measures used to monitor the performance of this virtual meeting directly relate to the meeting's effect on the participants, but do not indicate the success or failure of the virtual meeting in achieving the business objectives of the KM initiative. For this analysis, the desired impacts at the end of the process are delineated and specific measures defined to monitor them.

- Matrix

  A matrix is good for showing the rationale for prioritizing and selecting among a group of KM projects, and is often used in portfolio management. Matrices are effective for condensing many interdependent factors into a readable format. For example, one matrix can show the relationship among KM activities, Points of Contact, expected results, measures used, actual results, stakeholders, and resource costs.

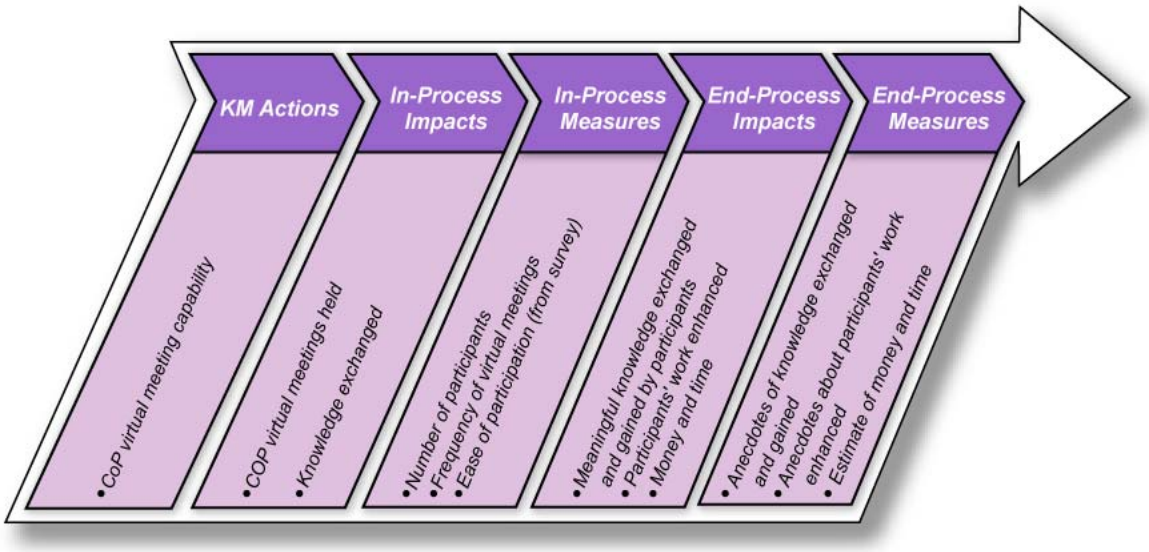


Figure 3. Flow example for a Community of Practice.

- Causal Diagrams.

  Causal loop diagrams show the cause and effect structure of a system through the relationships between its key parts. These diagrams can help you understand complicated relationships where many factors interact and there are few, if any, simple linear cause-effect relationships. Causal loop diagrams were popularized by the Systems Thinking field where they are an important component of viewing an organization as a total entity rather than as independent units. An example is shown in Figure 4 for the Virtual Naval Hospital (case study is in Section 7). The loops show the major aspects of the business problem and the KM initiative. In the left-side loop, ship readiness (one of the business objectives) improves when sailors have a good quality-of-life because they are more effective shipmates. This positive relationship is indicated by the "+" sign which means that an increase in one factor causes an increase in the other factor. A negative relationship is indicated by a "-" sign. Causal loop diagrams also use "s" (same) and "o" (opposite) for these indicators. An external factor, job satisfaction, also has a positive effect on sailor quality-of-life. The KM approach for the Virtual Naval Hospital was to build a digital library that contained validated and focused authoritative medical information organized specifically for the medical problems most frequently handled on deployed missions. Point-of-care authoritative knowledge (business objective) enables better patient care ("+" relationship). In the right-side loop, a validated digital library helps provide the point-of-care knowledge ("+" relationship) although it is adversely impacted by a high information volume that causes people to waste time searching for answers ("-"" relationship). Other factors are also shown in the figure.

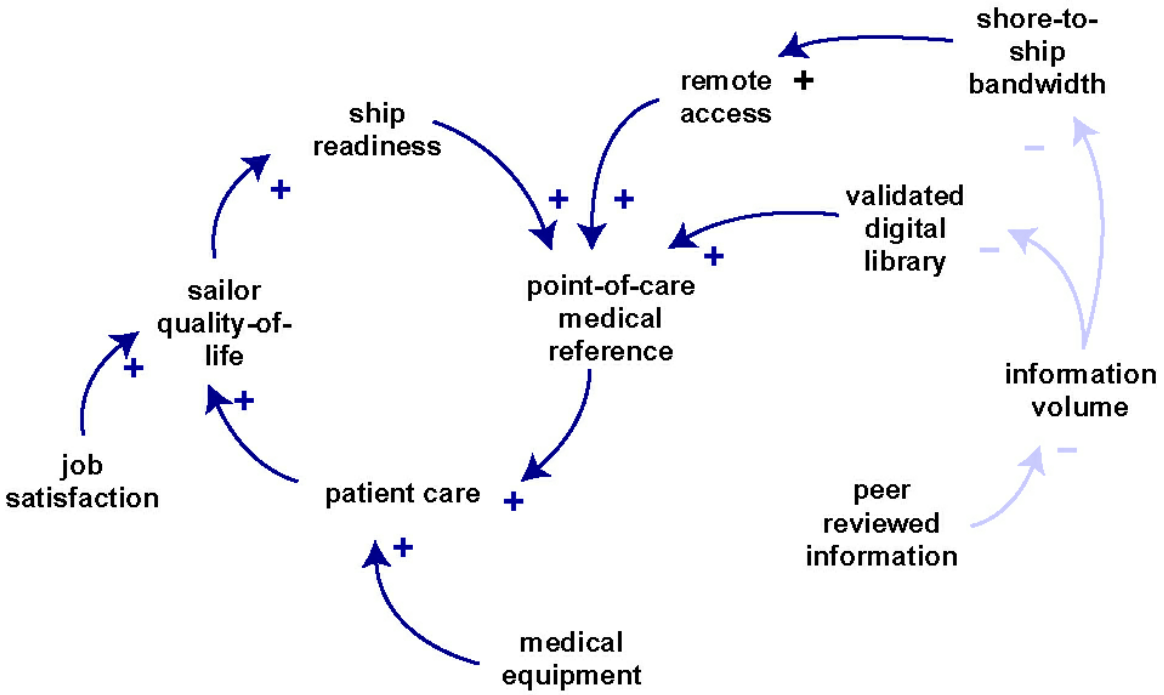


Figure 4. Causal loop diagram for the Virtual Naval Hospital case study in Section 7. Positive cause-effect relationships (increase in factor 1 leads to increase in factor 2) are noted with a + while negative relationships are noted with a –. Better point-of-care medical reference knowledge causes improved patient care which causes improved quality-of-life. However, high volumes of information reduce the quality of a validated digital library by making it harder to quickly get answers since people have to spend more time searching. Also, a high information volume adversely effects transmission by overloading low bandwidth connections.

- Balanced Scorecard

  This provides a view of business performance by combining financial measures, which tell the results of actions already taken, with operational measures of customer satisfaction, internal processes, and the enterprise's innovation and improvement activities – the drivers of future performance. A balanced scorecard aligns measures with strategies in order to track progress, reinforce accountability, and prioritize improvement opportunities. A traditional balanced scorecard integrates four related perspectives as shown in Figure 5. These are:

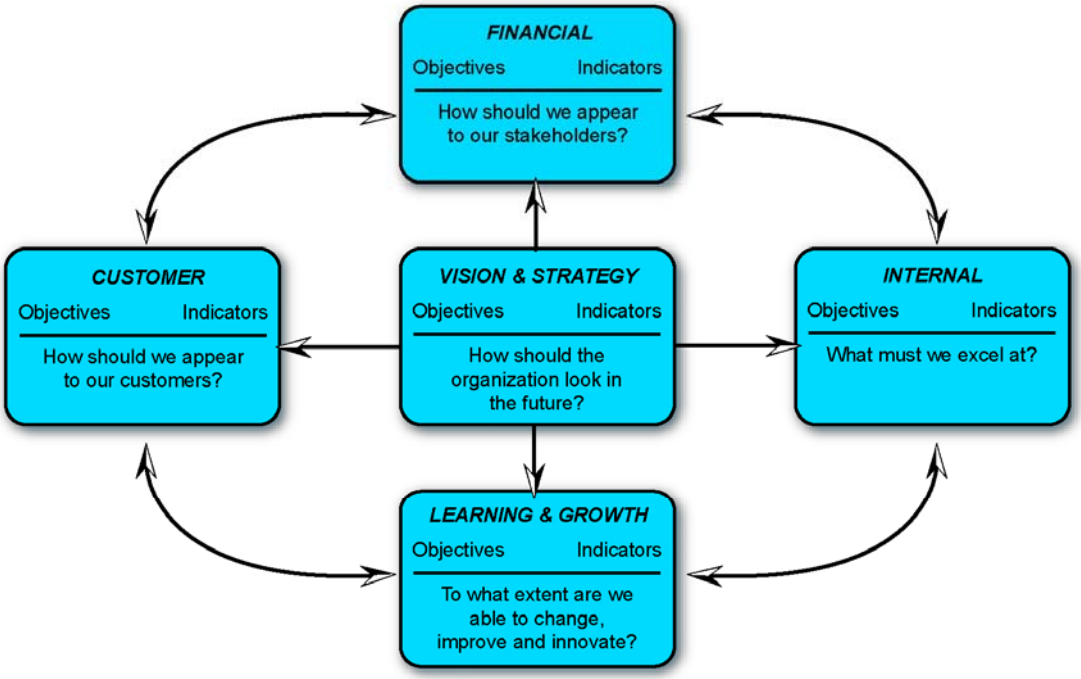


Figure 5. Balanced Scorecard measures.

1. How do customers see us? (Customer perspective) General mission statements need to be made concrete with specific measures of what matters to customers, namely time, quality, performance/service, and cost.
2. What must we excel at? (Internal perspective) To achieve goals on cycle time, quality, performance and cost, managers must devise measures that are influenced by subordinates' actions. Since much of the action takes place at the division and workstation levels, managers need to decompose overall cycle time, quality, product, and cost measures to local levels. That way, the measures link top management's judgment about key internal processes and competencies to the actions taken by individuals that affect overall command objectives.
3. Can we continue to improve and create value? (Innovation and learning perspective) An organization's ability to innovate, improve, and learn ties directly to that organization's value. That is, only through the ability to adapt to evolving new missions, create more value for customers, and improve operating efficiencies, can a command maximize use of existing mission capabilities while meeting the personal and developmental needs of its people.
4. How do we look to stakeholders? (Financial perspective) Ideally, organizations should specify how improvements in quality of life, cycle time, mission readiness, training opportunities, equipment, and new mission directives lead to improved near-term readiness, increased retention, progress in modernization and re-capitalization programs, reduced manning requirements, increased personal or training time, faster skills acquisition, or to reduced operating expenses. The challenge is to learn how to make such an explicit linkage between operations and finance. Financial performance

measures indicate whether the organization's strategy, implementation, and execution are contributing to bottom line improvement. (Typical financial goals have to do with profitability, growth and stakeholder value.) The DON's financial goals are to apply its Total Obligation Authority (TOA) to meet two general objectives: first, to provide appropriately sized, positioned, and mobile forces to shape the international environment, and second, to maintain warfighting superiority through modernization.

These measures can be tailored to your KM initiative. An example of a modified Balanced Scorecard is shown in Figure 6 where new measures are defined for strategic management of information systems[4].

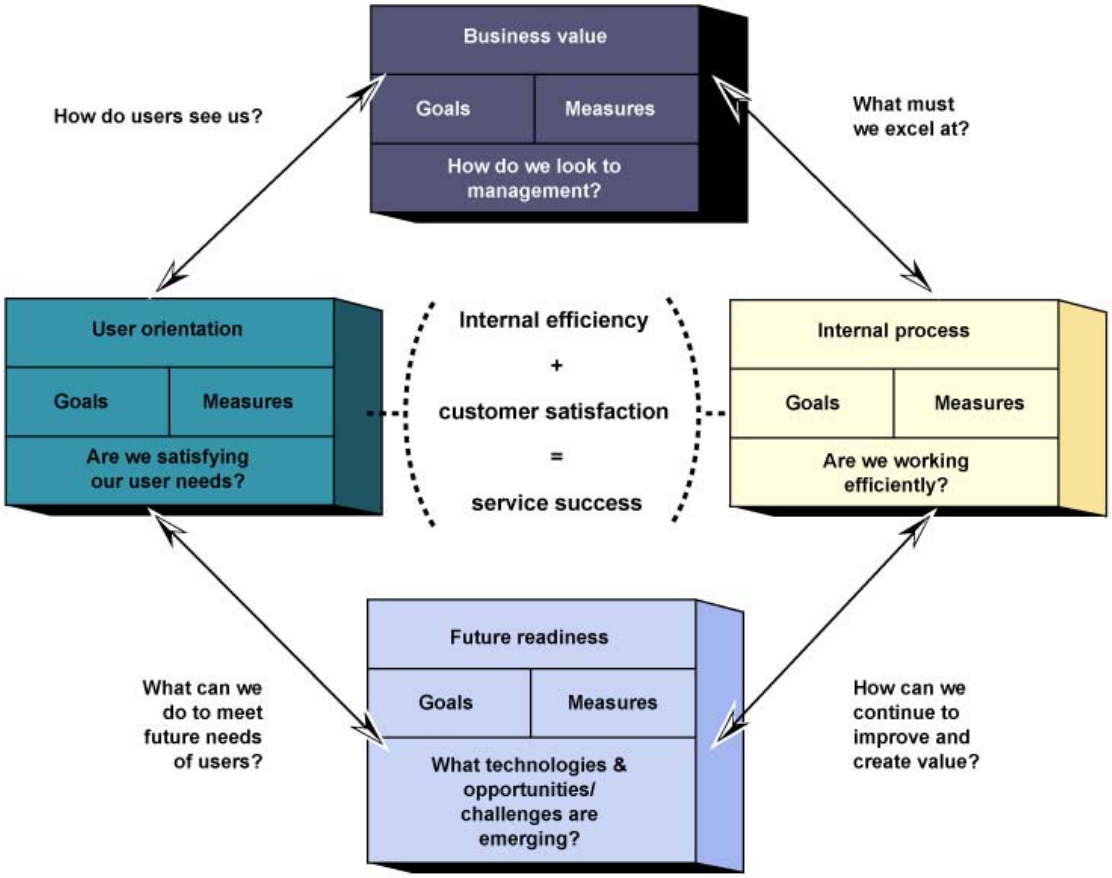


Figure 6. Modified Balanced Scorecard using measures tailored for strategic management of information systems.

[4] M. Martinsons, R. Davison, D. Tse, "The balanced scorecard: a foundation for the strategic management of information systems," *Decision Support Systems*, 25 (1999) 71.

What Should be Measured?

The most important characteristic to consider when choosing or defining a KM performance measure is whether the metric tells if knowledge is being shared and used. For example, a metric for a Best Practices database might be the number of times the database has been accessed. A large number of accesses or "hits" suggests that people are reading the document, but this does not definitively indicate whether it was useful to anyone or whether it improved operational efficiency or quality. A better metric would be to track database usage and ask a sampling of the users if and how it helped them.

Measures should be tied to the maturity of the KM initiative, which has a lifecycle that progresses through a series of phases as shown in Figure 7: pre-planning, start-up, pilot project, and growth and expansion. This figure adapts the recommendations of the American Productivity and Quality Center (APQC). In 2001, the APQC published the results of a benchmarking study on *Measurement for Knowledge Management* that discusses how metrics differ through a lifecycle. In the pre-planning phase, an Integrated Product Team can use its complementary mix of expertise to do process and risk analysis, develop strategies, and predict results. The goals of the start-up phase are to generate interest and support for KM, which creates a higher value on measures that convince people KM is worthwhile, such as anecdotes, comparisons to other organizations, and levels of funding and participation. The pilot project phase concentrates on developing evidence of success and Lessons Learned that can be transferred to other initiatives. In this phase, more definitive measures are needed, such as changes in business costs (e.g., reduced support and resources), cultural changes (e.g., increased sharing among groups), and the currency and usage of collected knowledge bases. For the growth and expansion stage, KM is being institutionalized across the corporation, and therefore measures that reflect enterprise-wide benefits are needed. These include KM proficiency gauged against Best Practices, formal KM elements in performance evaluations, and sophisticated capital valuation calculations.[5]

The Naval Air Station Patuxent River sought to apply information technology to reduce lifecycle costs while managing facilities more productively and efficiently. As part of the Base Realignment and Closure process, the Naval Air Station had to manage 50 percent more facilities space while reducing manpower by 20 percent. The primary metric was time required to perform facilities management tasks. It was used to compare existing processes with modified processes using technology to replace manual tasks. A good direct performance measure was obvious since they were interested in reducing the time required to consolidate data in various facilities management processes. Thus, they measured the time required to collect and process data, both by timing operators during work and by asking experienced operators for estimates. However, a better metric was needed that reflected the relative resource costs to the organization of staying with the existing inefficient system or converting to the new efficient systems. An ROI value was chosen that incorporated the manpower and equipment costs for both options, including depreciation.

[5]"Measurement for Knowledge Management," Released February 2001, APQC. http://www.apqc.org/free/articles/dispArticle.cfm?ProductID=1307&CFID=154242

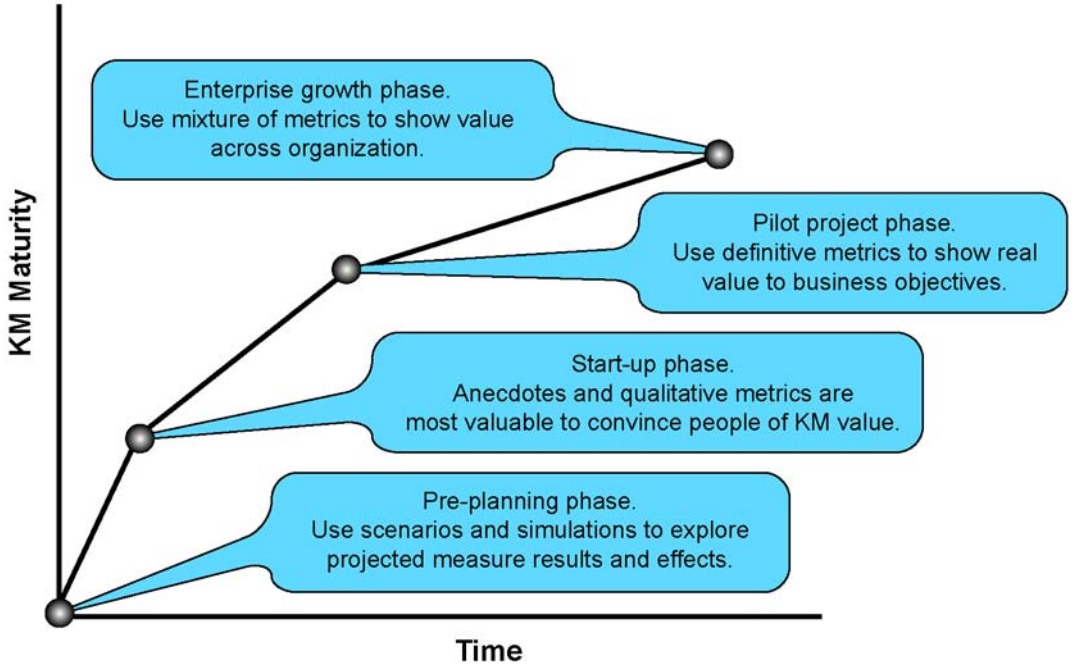


Figure 7. Lifecycle of a KM initiative. The type of metrics needed varies as the maturity of the initiative changes. Adapted from APQC.

Qualitative and Quantitative Measures

Measurements for KM initiatives can be quantitative or qualitative and, in general, a measurement program should include both types of measures. Quantitative measures all use numbers and typically provide hard data to evaluate performance between points (such as last month to this month), or to spot trends. For example, you can collect quantitative data on Web site statistics, the number of hours spent on a particular task, or the percentage of equipment removed from operational status for repairs. Qualitative measures use the situation's context to provide a sense of value and are referred to as soft data. These measures include stories, anecdotes, and future scenarios. When it is difficult to capture meaningful quantitative measures, such as the value to the individual for being a member of a community of practice, a story from a member about how the community helped him solve a critical problem can have as much or more impact on stakeholders. Qualitative measures can augment quantitative measures with additional context and meaning.

A closely related concept to the need for qualitative measures is the notion of tangible and intangible benefits. A tangible benefit is concrete and can have a direct measurement of its value. In contrast, an intangible benefit cannot be definitively described by a quantitative value. For example, the value of a machine can be computed from its production rate compared to its operating costs, while the value of a company's brand image to its profitability cannot be easily

computed. As we will discuss in a later section, quantitative measures can provide an indirect, although uncertain indication of intangible value.

Despite the difficulty of quantifying intangible benefits, many organizations need to evaluate programs and choose strategic directions based on their value. For a KM initiative, people's unspoken "know-how" is one of the largest potential sources of value. This tacit knowledge is an example of an intellectual asset whose value is only realized when it is actually shared and reused effectively. Determining its value and effectiveness is hampered by many unknown factors, such as how people really use knowledge to make decisions, when knowledge sharing is and is not useful to specific tasks, and if people require a prior personal relationship before accepting knowledge as trustworthy. Several new techniques have been developed that attempt to measure the value of intellectual assets and other intangibles. We have already discussed one in detail in Section 3, the Balanced Scorecard method, which used a balanced set of tangible and intangible factors to describe performance. Examples of a few other well-known measurement techniques are summarized below:

- Intangible Assets Monitor

  Developed by Karl Sveiby, this model defines three types of intangible assets that account for the book-to-market discrepancy in the value of many companies: individual competence, internal structure, and external structure. Sveiby believes that people are the only true agents in business and that all assets and structures, whether tangible or intangible, are a result of human actions. You need to have a very good understanding of your corporate goals and objectives in order to apply the Intangible Assets Monitor since the indicators are specifically chosen to have the maximum impact (good or bad) on those goals.

- Skandia Navigator

  The Skandia Navigator, developed by Leif Edvinsson at Skandia Assurance and Financial Services in Sweden, combines the Balanced Scorecard approach with the theory behind the Intangible Assets Monitor. In 1994, Skandia published the results of this framework as the first supplement to their annual report, using the term intellectual assets instead of intangible assets for the first time. The Skandia Navigator defines two components of intellectual capital: Human Capital plus Structural Capital.

- Intellectual Capital Index

  Developed by Johan and Goran Roos, this approach emphasizes the flows of intellectual capital. The Roos index provides a framework for measures in two general categories: Human Capital (competence, attitude, intellectual agility, knowledge capital, and skill capital) and Structural Capital (external relationships, internal organization, renewal and development, strategic processes, flow of products and services).

Another important technique uses modeling and simulation to extract the effect of process changes on an organization. Actual business processes are modeled as thoroughly as possible using quantitative measures and then the effects of a change – such as a Lessons Learned database, a collaboration Web site, or informal knowledge sharing events – are simulated as new portions of the business process. The intangible benefit is assessed by the improvement or deterioration of the organization's overall performance.

A Key Qualitative Measurement Strategy: Storytelling

One of the most popular ways to communicate qualitative measures is storytelling or "serious anecdote management." This storytelling approach was originally identified by Tom Davenport and Larry Prusak (authors of Working Knowledge) and popularized by Stephen Denning (formally of the World Bank) and David Snowden (IBM Global Services). "Serious anecdotes" (a term coined by Davenport) are stories with a measurement "punch line." Stories capture context, which gives them meaning and makes them powerful. In addition, stories are how human beings make sense of things. A story about how knowledge was leveraged in the organization to achieve value does two things. First, it creates an interesting context around which to remember the measure being described. Second, it educates the reader or listener about alternative methods that they themselves might employ to achieve similar results, thus helping to "spread the word" about the KM program and speed up the cultural change. Consider this example from a professional services firm:

> I joined the organization on March 16, 1998 without previous experience. After one week of training, I joined a project team. After one day of training on the project, I was assigned a task to learn a particular technology that was new to everyone on the team. I was given a bunch of books and told that I had three days to learn how to create a project using this technology.
>
> In my first week of training, I remembered learning about the company's expertise database. I sent an e-mail to four people I found in the database asking for their help. One of them sent me a document containing exactly what I wanted. Instead of three days, my task was completed in one-half a day.

This story is compelling for several reasons. First, we can all empathize with the author's struggle. Everyone can identify a situation in which they felt completely overwhelmed and weren't sure they could complete the assignment given to them. Second, we can also sympathize with the employee's distress at being told to figure out what was needed from a stack of manuals! In practice, people rely on a network of relationships for information and advice.

We can also relate to this story because we can see that the KM initiative complemented the natural work pattern rather than requiring a new set of behaviors or tools. Finally, we "get" the value of the KM initiative immediately with the punch line of the story – "I completed a three day task in one-half a day." Imagine the value of completing all three-day tasks in one-half a day and you can start to envision the very large value a KM initiative can provide.

Future Scenarios

There is a special type of storytelling that is particularly useful at the early stages of a KM project. This type of story creates a future vision for the enterprise, a vision that describes how life will be different when the KM initiative is fully implemented. These stories, often called future scenarios, provide a qualitative way of describing the value of a KM investment even before the project starts. Future scenarios are used extensively in the DON for many applications, including wargames of potential geopolitical engagements, acquisition, and strategic planning. The following example presents a future scenario for a research organization in a manufacturing firm:

On May 19, 2001, Angela, a Senior Scientist in the Image Science Laboratory is working on a complex technology problem. She reaches a stumbling point in her analysis and wonders if someone else at the Company might have some insights that would help her with this problem. Angela is new to the firm, having only just joined in March, and she has a limited personal network. Looking for insight into the key areas of resistance, she logs on to "Knowledge-Zone," the company's knowledge portal. Since Angela had previously defined her areas of interest, her personal page, My K-Zone, includes links to two recently published scientific papers and an upcoming conference. She also sees that several other scientists with similar interests are also logged in to the system, but she's got no time for that now – she's on a mission.

Angela begins her search by entering a simple, English-language question to find out if there is any relevant work in the company document repository. She comes across a few papers written on her topic that have "four star ratings" from other imaging scientists. She also identifies a community of interest within the firm on a related subject.

Angela gets a list of the community members from within K-Zone and sees that one of the members works in an office in her building. She also sees that he is online and she sends him an instant message with her question. He has some information that can help her, but suggests that she also launch a question in the expertise profiler. Angela's question is routed automatically, in e-mail, to the 10 scientists who are most likely to be able to answer her question based on their expertise. As it turns out, only 5 of the scientists work inside the firm. The other 5 are part of an extended community that includes some ex-company employees and industry experts. She receives four replies that help her solve the problem and the entire interaction is stored in the knowledge repository so that if a similar question comes up in the future, the answer can be automatically retrieved.

When she completes the analysis she's working on, Angela saves the results back to K-Zone so that it can be shared with the rest of the company. Notification of her contribution to K-Zone is immediately pushed to those employees who have registered an interest in the topic covered by her analysis.

In this future scenario, Angela is able to capitalize on the opportunity to improve the way the company leverages intellectual assets. She shares the best practices of her colleagues; finds information quickly, enabling her to spend more time effectively executing and analyzing her work and end results; easily creates assets for others to leverage; becomes part of a community of practice in her field, and benefits from the knowledge exchanged in a community of practice outside her area of expertise. In short, Angela is part of a knowledge-centric organization, a company where knowledge management is not something extra that she does, it is what she does.

KCO Specific Measures

The KCO model uses three types of specific measures to monitor the KM initiative from different perspectives. Outcome metrics concern the overall organization and measure large-scale characteristics such as increased productivity or revenue for the enterprise. Output metrics measure project level characteristics such as the effectiveness of Lessons Learned information in solving problems. System metrics monitor the usefulness and responsiveness of the supporting technology tools.

- System Measures relate the performance of the supporting information technologies to the KM initiative. They give an indirect indication of knowledge sharing and reuse, but can highlight which assets are the most popular and any usability problems that might exist and limit participation. For example, the Virtual Naval Hospital uses measures of the number of successful accesses, pages read, and visitors to monitor the viability of the information provided.

- Output Measures measure direct process output for users and give a picture of the extent to which personnel are drawn to and actually using the knowledge system. For example, the U.S. Army Center for Army Lessons Learned (CALL) evaluates “lesson re-use” to ensure that the lessons they are maintaining are valuable to users.

- Outcome Measures determine the impact of the KM project on the organization and help determine if the knowledge base and knowledge transfer processes are working to create a more effective organization. Outcome measures are often the hardest measures to evaluate, particularly because of the intangible nature of knowledge assets. Some of the best examples of outcome measures are in the private sector. For example, energy giant Royal Dutch/Shell Group reports that ideas exchanged in their community of practice for engineers saved the company $200 million in 2000 alone. In one example, communication on the community message board led to approximately $5 million in new revenue when the engineering teams in Europe and the Far East helped a crew in Africa solve a problem they had previously attempted to resolve.[6]

[6] Caulfield, Brian, “Talk is Cheap, and Good for Sales Too,” eCompany Now, April 2000.

How Should We Collect and Analyze the Measures?

As you identify the measures that you will use for your KM initiative, you will also need to identify a process for collecting these measures. The important element is to structure information gathering and to probe deep enough to understand how decisions are made and the information that measures can provide to help decisions.

For system measures, look for automated data collection systems, such as tools that measure Web site accesses and "wait times." System performance logs will also provide valuable system measures.

For output and outcome measures, you may end up relying on manual counts, estimates, or surveys. Though surveys are considered a source of soft data because they measure perceptions and reactions, they can be quantitative. For example, a survey might ask the user to respond to a statement using a "1 to 5" Likert scale (where 1 means "strongly disagree," and 5 means "strongly agree"). Survey data can also be useful to capture and summarize qualitative information such as comments and anecdotes. One consulting firm used contests with prizes to encourage members of communities of practice to contribute anecdotes describing how being a member of the community helped them accomplish a measurable objective for the firm (such as saving time or money, or generating new revenue). Surveys can be conducted in person, by telephone, and or in written form. Written surveys can be transmitted by mail, email, or on a Web site. Surveys can have a dual purpose: they not only collect useful information but they also help educate the survey taker by raising their awareness of key issues or critical success factors for the initiative.

Other techniques that can be useful include the following:

- Interviews or workshops

  Stakeholders can be interviewed individually or through a group setting in a facilitated workshop to draw out opinions and generate group consensus. The best choice depends on the people, organizational culture, the information needed, and people's availability. In each case, it is important to structure the sessions proactively. Merely asking people what information they would like is unlikely to yield useful results. Facilitation of any session is recommended to urge managers to talk about the type of decisions they commonly make and what decision-making information would be useful by asking "what if" questions.

- Structured program flows

  Tracing the flow of the program capabilities, the uses of these capabilities by direct users, and the benefits to the end user is another way to identify the information desired from performance measures. This flow tracking technique is particularly useful for programs for which it is difficult to directly identify or calculate measures for the ultimate end user benefits.

- Agency/organization documents

  Documents from the performing agency and stakeholder organizations can contain useful information regarding an organization's goals, priorities, measures, problems, and business operations.

- Meetings involving the performing organization and stakeholders

  Many Government agencies have steering committees comprised of representative internal and external stakeholders. Observing the interchange at meetings can yield the priorities and issues that the stakeholders believe are important.

Once the measures have been collected, they should be analyzed within the framework chosen earlier. This will ensure that the measures are correlated to the objectives of the initiative and aligned with the strategic goals of the organization. In particular, explicitly note whether the measures give a direct or indirect indication of effects so that your team and stakeholders don't misconstrue or have unrealistic expectations of performance.

What do the Measures Tell Us and How Should We Change?

This is one of the most critical steps in the measurement process as well as in the entire KCO implementation process. The complex and dynamic nature of KM makes it extremely difficult to devise a plan in the Pre-planning phase (see Figure 7) that will not later need to be changed. Use the framework to help elucidate what you can discover about the effectiveness and participation of stakeholders in the KM project. Are they using the knowledge? Are people sharing meaningful knowledge openly? Have people participated during the rollout while there was a great deal of fanfare and then stopped? Are there any anecdotes showing that people became more efficient or solved a problem faster because of the knowledge?

For all of these questions and your other indicators, ask *why* it happened or had that response. Even without a firm answer, the search for an answer will most likely yield valuable insights and ideas on how to improve your KM project. Collect and prioritize these new ideas and go back to your original plans and assumptions to see if they need to be changed, as depicted in Figure 2. It is normal that several measures will need to be modified. This is a good time to assemble your team and build a consensus on what should be changed, how to change it, and when to introduce the changes. Also, you should update the measures and framework to make sure they are tightly coupled to your new KM plans.

4. GETTING STARTED

The remaining sections are organized by the general classes of business objectives and problems that KM initiatives are designed to address. These business objectives are grouped in the following categories:

- **Program and Process Management (Section 5)**

  This class includes strategic organizational objectives such as leveraging best practices and transferring lessons learned. Some of the business problems Program and Process Management initiatives are designed to solve include issues such as ensuring consistency across the organization and proactively preventing duplication of effort.

- **Program Execution and Operations (Section 6)**

  This class includes objectives such as connecting people with experts, transferring expertise instantaneously, and getting the right operational knowledge to people in the field when they need it.

- **Personnel and Training (Section 7)**

  This class includes personnel and learning issues such as acquiring and retaining talent and improving quality of life for employees.

Each section includes one or two case studies that provide examples of real situations that represent the class of business objectives. The best approach to determine where to start is to map your KM initiative objective to the type of business objectives summarized at the beginning of Sections 5, 6, and 7. When you find a match, go to the appropriate section to learn more about how the sample cases have identified appropriate measures for their initiatives and to read a more general discussion about appropriate measures for that class of business objective.

The matrix in Appendix A is a comprehensive summary of potential measures (which have all been "field tested") for KM initiatives. There is no guarantee that these measures are the most appropriate for your project. Remember – these metrics describe what you *can* do, not what you must do or even what you *should* do. Use these as suggestions that may work for you or that may trigger some ideas for more appropriate measures in your situation. As suggested in Section 3, be sure to select measures that matter to <u>your</u> stakeholders. Also be sure to think about creating a balance between the number of measures that you will collect and the value of these measures to the stakeholders. There will likely be things that you *could* count, but it would be overkill to do so. Measurement for KM initiatives, just like KM itself, is not a hard and fast science. You will need to apply your best judgment to determine what is appropriate for your initiative and your organization.

The KM objectives define what you are trying to accomplish by investing in the knowledge assets. These will be the basis for deciding which performance measures should be collected and how they will be used to assess the performance and value of the KM initiative. As you review Sections 5, 6, and 7, you will see examples of KM objectives for each group of business objectives at the beginning of each section.

5. PROGRAM AND PROCESS MANAGMENT

This section discusses classes of business objectives that share a common need for understanding the current and future performance of programs relating to their requirements. These requirements span a range of development objectives and milestone dates, financial constraints, resource needs and usage, alignment with organizational strategic plans, and adherence to legal, environmental, and safety regulations and laws. Two case studies are described: a business development project at SPAWAR Systems Center Charleston; and a project to streamline processes in the Pacific Fleet.

Business Applications

The Program and Process Management business area concerns monitoring and guiding business tasks to ensure they achieve development, financial, and resource objectives. In addition, this area includes business development activities where people need to identify and assess opportunities, determine their customers' key interests and funding levels, and obtain business intelligence on competitor capabilities and plans. You should read this section if you are applying Knowledge Management to the following or similar activities:

- Program management
- Project control
- Business Process Reengineering
- Quality management
- Strategic planning
- Policy and standards definition
- Integrated Product Teams
- Architecture design and review
- Plan Of Action and Milestones (POAM)
- Budgeting
- Business development
- Business intelligence
- Enterprise Resource Planning (ERP)
- Customer Relationship Management (CRM)

The primary KM objectives of these types of activities are to:

- Create a consistent understanding across the organization of key issues, such as standardized methods, policies, and goals and objectives
- Improve business development
- Increase effectiveness, productivity, and quality
- Implement Best Practices
- Share and reuse lessons learned

Some examples of KM initiatives for Program and Process Management are:

- Many groups in a Navy engineering laboratory are duplicating effort while writing proposals and spending overhead funds to uncover the same intelligence on the same key customers. Thus, substantial funds can be saved by capturing this knowledge in a Lessons Learned database and distributing it to everyone so they can reuse it.

- Experienced program managers have learned how to substantially reduce the time they spend reporting their programs to different sponsors, each of which has a different format and set of regulations. This knowledge can help junior program managers be more efficient and provide a higher level of service to their customers. A Community of Practice is established to enable junior and senior program managers to informally interact and share information on their projects and methods. A special component is the Mentor's Corner, which includes a series of video interviews in which the experienced managers explain their key insights and methods.

- Near the end of every fiscal year, key leaders must stop working on their daily projects for five days to answer urgent requests for consolidated status reports by Congress. Most of this time is spent finding the proper people who can explain current and projected data. This serious disruption to operations can be reduced to one half day with a current listing of Points of Contact for key projects. Thus, an experts directory that is validated and kept up-to-date is developed.

Performance Measures

KM metrics should be extensively correlated to as many factors influencing the results as possible. Since there are many forces within an organization affecting people's learning, sharing, and efficiency, it is difficult to separate the effects of the KM processes from other processes. The KM measures should be used as a body of evidence to support analysis and decision-making. As much as possible, the KM measures should be related to, or the same as, existing measures in the organization that are used to monitor the success of performing mission objectives.

Outcome measures

Examples of possible outcome measures include:

- Measure the change in resource costs (funds, time, personnel) used in a business process over time. To tie to the KM initiative, gauge this change against when the KM asset was made available and its usage, and to other business processes that are not part of the KM initiative. Also, include surveys of user attitudes and practices. For example, do the groups who regularly use and maintain a Lessons Learned database spend less overhead funds than other groups? Do they say the Lessons Learned helped them?

- Measure the success and failure rate of programs linked to the KM assets over time. For example, has the number of programs completed on time and within cost increased? For all groups, or mostly for groups actively engaged in the KM initiative?

- Determine the number of groups meeting Best Practices criteria, and how long it took them to achieve this status versus the existence and use of the KM system. For example, did any groups entering a new business area reach an expert level much faster than usual by using the collected Best Practices and associated corporate learnings from the beginning of their project?

- Gauge the "smartness" of the organization, i.e., are more customers commenting on the high level of expertise of different groups, or are more industry awards being won? Are these comments based on the ability of individual work groups presenting the capabilities of their colleagues as well as their own? How did these groups get the information?

Output measures

Examples of possible output measures include:

- Conduct a survey to find out how useful people find the KM initiative. How have people used the collected knowledge? Was it valuable? Did it answer their questions and help solve their problems or was it merely another set of information to read and digest? How do they suggest improving the KM system?

- Find examples of specific mistakes or problems that were avoided or quickly solved because of KM. These are typically uncovered by talking to people and collecting anecdotes. For example, did the Lessons Learned database help someone immediately find out how to compute future estimated resource costs according to new regulations?

- Determine how much new business is connected to using the sharing of expertise. For example, did someone win a new contract with a new customer because they watched the video interviews of business development experts in the Mentor's Corner of the Community of Practice?

- Measure the decrease in time required to develop program status reports. For example, do all managers of cross-functional programs have the same information on resource usage and development progress, as well as all problems encountered, with the responsible Point of Contact and its resolution?

System measures

Examples of possible system measures include:

- Measure the statistics from the KM system. For example, how many times has the Web site been accessed? How many times have Lessons Learned or Best Practices files been downloaded?

- Measure the activity of a Community of Practice. For example, how many members are in the community and how often do they interact? How long has it been since the last contribution to a shared repository or threaded discussion? What percentage of total members are active contributors?

- How easy is it for people to find the information they want? Conduct a survey and test the site yourself. Find out how many responses are typically generated from a search. If this number is too high (greater than approximately 50), people may be giving up the search and not making use of the knowledge assets. Are the responses what the user wants to see? Check to see if the site is easy to navigate with an organizational structure consistent with the way users work and think about the information. What is the system latency, i.e., the wait time between a user requesting something and when the system delivers it?

- Measure how frequently the knowledge assets are updated. Are the Best Practices outdated and superseded by new versions? Are the Points of Contact no longer working on the project? Is there a listed update time that has been exceeded? Are a large number of links to experts no longer valid?

Case Studies

SPAWAR Systems Center Charleston (SSC-CHS)

Business Objective	Develop consistent knowledge and understanding of business development Best Practices and the Command's capabilities.
KM Initiative	Collect synopses of projects and expertise from all Branches and make easily accessible from anywhere using a simple Web site, including tacit knowledge of business development experts via videos.
Stakeholders	Workgroup managers (Branch), division managers, Corporate executives. Need a coordinated way to improve marketing quality and efficiency of the Command's capabilities as a fee-for-service facility.
Key Metrics	Outcome: total revenue aligned with corporate and business unit strategic goals, percentage of direct labor. Output: number of successful leads, number of new teams across the organization on new business versus KM usage and time in place, interview statements on avoiding mistakes, developing alternate approaches, creating best practices from Lessons Learned, number of successful business intelligence qualified leads from onsite team leaders versus KM usage/time in place. System: usage of pilot project Web site, ease of navigating Web site (length of navigation time, number of clicks to find information), survey on usability, ease of information entry, currency of information, precision and recall of search engines.
Results	New program. Some usage and usability data on Communities of Practice showed people are too busy to participate unless critical issues are discussed.
Actions	Asked user community to define "hot topics" for Communities of Practice and started one only when a volunteer moderator was identified.

Description

SPAWAR Systems Center Charleston is a fee-for-service engineering center that must market its capabilities to DON resource sponsors. Their customers began changing the way they managed and funded development programs. They were increasingly funding large integrated system level programs instead of individual component efforts that had been the primary type of project SSC-CHS performed.

Consequently, the SSC-CHS management recognized that they needed to change the way they marketed to their customers. Instead of individual work groups marketing their own special expertise, a more coordinated command wide marketing was needed where each group could promote complementary expertise of other groups if the resource sponsor needed it. This was a new business development environment that the SSC-CHS business processes and information systems did not yet fully support. Rather than waiting several years for new processes and tools to develop naturally, the leadership decided to implement the Knowledge

Centric Organization model to leverage existing business development experience, expertise, and knowledge across the enterprise.

The first phase of the KCO pilot project was led by the local KM leader to identify the most valuable knowledge assets. SSC-CHS knew that knowledge assets required a high resource cost to collect, organize, and disseminate, so they had to choose assets that had a very high potential value to many people. Through a set of workshops where the assets were identified, assessed, and prioritized, they determined that their most important need was for a short, succinct statement of each work group's capabilities that everyone could access at any time. It was important that these statements not be too abstract or too detailed. Being too abstract wouldn't tell anyone the key information they needed to present to customers; being too detailed would bog people down with unnecessary information.

Once they had clearly defined the knowledge asset and how, when, where, and by whom it would be used, they conducted additional workshops to identify and assess possible metrics. At first, performance measures were listed that seemed to be linked to the value of the knowledge asset. For example, suggested output measures for Project and Expertise synopses included real time statements and awareness from users such as "this helped" or "it is no good," and surveys of customers and internal people. Similarly, output measures suggested for Business Intelligence knowledge included the number of leads from on-site team leaders, and the amount of new business from current and new customers. Examples of the system measures listed are the number of hits on the Web site, the precision and recall of a search engine, the currency of information in the systems, latency delays in the network, the ease of populating and maintaining repositories, and the number of help desk calls.

Further consideration showed that some of these results could be achieved though other non-KM initiatives. Each metric should allow someone to glean an effect of the KM initiative. Thus, while measuring the number of business leads gained over time from referrals indicates the effectiveness of intelligence gathering, it does not directly indicate how well the organization makes use of this information to win business. A better metric is the number of *successful* new leads over time that can be used to compare the business development performance before and after KCO implementation. This led to the final set of performance measures used in the pilot project. The output measures became the number of successful leads, number of new teams across the organization on new business versus KM usage and time in place, interview statements of avoiding mistakes or developing alternate approaches or creating best practices from Lessons Learned, and the number of successful business intelligence qualified leads from onsite team leaders versus KM usage and time in place. Many of the system metrics stayed the same since they were quantitative measures of network performance and usage. However, several new system measures were added to provide a more direct indication of system effectiveness, such as the ease of navigating the Web site as indicated by the length of navigation time, number of clicks to find information, and surveys on usability.

The SPAWAR Systems Center Charleston project is a new project and therefore has not yet been able to collect and analyze measures. However, their focus on measures has already led them to modify some of the KM processes defined in the pre-planning stage. For example, as

they started collecting the synopses of project and capabilities expertise, they realized that they didn't have an effective way to monitor the currency of the information since this was defined as a key system measure. Consequently, they designed an automatic method to let the Points of Contact know when content needed to be updated even before they launched the Web site containing the knowledge assets.

Pacific Fleet Solution Provider Initiative

Business Objective	Improve productivity and knowledge sharing across command staffs and at-sea groups using Web-based information technologies.
KM Initiative	Streamline Web-based information entry and retrieval; develop training programs for users on IT-21 software; staff contact database on SIPRNET; develop and deploy knowledge base with Lessons Learned and standard documentation.
Stakeholders	Program managers in command and Battle Group staff.
Key Metrics	Balanced Scorecard Method. Outcome: Overall rating of effectiveness, usefulness of the information, change in competency, system support and maintenance costs, improved standardization of information and report formats Output: Time spent responding to information requests and preparing information for dissemination, number of databases/information repositories eliminated, hours required to complete tasks, number of steps/tasks eliminated from "as is" processes, time to locate and disseminate information, average timeframe between information need and task completion. System: Relative number of hits over time, number and frequency of contributions/postings, frequency of use, number of users accessing the same information.
Results	Battle Group focus is increasingly on collaboration and knowledge-sharing as important strategies for the future. Greater understanding of how IT-21 enables sharing.
Actions	Continued and regular measurement of performance metrics will occur to identify problems and focus changes.

The Pacific Fleet command started the Solution Provider Initiative (SPI) to streamline processes using Web-based information technologies.[7] The first two phases of this program worked with the Headquarters and Type Commanders staffs. The third phase expanded this program into the operational Fleet aboard the USS John C. Stennis Carrier Battle Group. An important part of the SPI program was reusing existing tools that were installed through the IT-21 program. This allowed the SPI program to concentrate on introducing effective processes and avoid the cost and difficulty of asking the users to learn and maintain multiple Information Technology tools.

[7] Metrics report from PACFLT SPI program.

The primary objectives of the program were to improve Program Management processes within the Carrier Battle Group, provide better access to enterprise information, harness the staff's knowledge, and introduce KM practices to aid decision making and innovation. Metrics were used throughout the early portions of the SPI program, and were redefined for the specific objectives and initiatives at the beginning of Phase 3.

The first step in defining these metrics was to identify the business applications that would be addressed. Five areas were chosen for the program.

1. Technology use
2. Electronic communication
3. Administrative processes
4. Information Warfare knowledge base
5. Learning and innovation

The second step was to define the following ten goals for the initiative:

1. Achieve broad usage of the solution
2. Achieve a high level of user satisfaction
3. Transfer information retrieval and sharing responsibility
4. Free up staff from manual, routine data management tasks
5. Eliminate information stovepipes and duplicate data
6. Provide staff direct access to information
7. Improve the quality and timeliness of information
8. Provide users with the necessary competencies to use tools
9. Capture and share best practice information
10. Increase productivity and streamline processes

A Balanced Scorecard (see Section 3) was used to ensure that the metrics and the focus of the projects did not overly concentrate on any single component to the detriment of the overall effectiveness of the solution. A set of key performance measures was defined for each of the four areas of the Balanced Scorecard and was used for each of the eleven major projects performed during the six-month deployment of the Carrier Battle Group. The performance measures are:

Customer

Goal 1 - Achieve broad usage of the solution provider services.

- Number of hits (percentage of total available users accessing different solution provider initiatives, showing the increase in both the volume of knowledge content and usage of the tools)
- Number and frequency of contributions/postings
- Frequency of use

Goal 2 - Achieve a high level of user satisfaction with the solution provider initiatives.

- Percentage of users who respond as satisfied or above with a range of indicators including: speed of use, ease of use, added value from tool, overall rating of effectiveness, usefulness of the information (application of the tool to job tasks)

Goal 3 - Transfer responsibility for information retrieval, posting and sharing to the user/requester of the information.

- Percentage of information requested the traditional way (pre –SPI) for information/services now accessible through an SP tool
- Ratio of staff updating/inputting data to staff accessing data

Operations

Goal 4 - Free up staff from manual, routine data management tasks to focus on more analytical, mission critical activities.

- Percentage reduction in the time spent responding to information requests, preparing information for dissemination, etc. as a result of the SP tool

Goal 5 - Eliminate information stovepipes and duplicate data repositories.

- Number of existing databases/information repositories eliminated or made redundant due to the solution provider initiative
- System support and maintenance costs saved through elimination of existing databases/information repositories

Goal 6 - Provide staff with direct access to the same information.

- Number of users accessing the same information

Goal 7 - Improve the quality and timeliness of information.

- Cycle time to locate, obtain and disseminate information
- Average timeframe between information need and task completion
- Improved standardization of information, report formats across and between different Commands, e.g., financial reporting

Innovation & Learning

Goal 8 - Provide users with the necessary competencies to effectively utilize solution provider tools.

- Percentage increase in competency as rated through self assessment survey

Goal 9 - Capture and share best practice information.

- Number of best practices contributed/posted and accessed

Financial Return

Goal 10 - Increase productivity and streamline processes by reducing or eliminating non- value added work effort.

- Percentage reduction in manpower hours required to complete tasks impacted by solution provider initiatives (present in monetary terms, e.g., manpower hours presented as a Full Time Equivalent (FTE), 1 FTE = X$ per year)

- Number of steps/tasks eliminated from "as is" processes

In addition to these key performance measures, individual sets of performance measures were used for each of the eleven major projects. As discussed in Section 3, collecting performance measures by themselves is not the point of a metrics initiative. Rather, the measures allow you to analyze and discern critical performance characteristics of the projects that should be used to adapt the projects towards higher success rates and to ensure they are aligned with the business objectives. For example, the complete metrics analysis for one of the projects is listed below showing how the PACFLT SPI team efficiently defined, collected, and used performance measures.

Description of Solution

The Information Warfare Knowledge Base (IWKB) is a Web-enabled database for collecting and disseminating IT-21-related information, including IT-21 Processes, Information Warfare Rules (Business Rules), Technical Guidelines, and Training. It also serves as a portal to the Network Centric Innovation Center's (NCIC's) Knowledge Base, which houses IT-21 Standard Operating Procedures (SOP) and Lessons Learned.

The IWKB has two functions: viewing data and entering data into the database. It houses any information that is generated by the integration of IT-21. The information will be categorized in six different areas as follows:

- IT-21 Process – These processes will be the reengineered solutions that use IT-21 to enhance the performance of an existing process. These will contain metrics to measure the improvement, training material needed to accomplish the reengineered process, and all support documentation.
- IT-21 SOP – The SOP category will contain all of the standard operating procedures that have been created or revised because of the IT-21 systems integration. This information is pulled from the NCIC Knowledge Base via a special Lotus Domino view.
- Information Warfare Rules – These are rules that are created to optimize the use of new IT-21 communication methods (i.e., email, JMHS).
- Lessons Learned – These are lessons learned from the IT-21 integration. This list of IT-21 SOPs is pulled from the NCIC Knowledge Base via a special Lotus Domino view.
- Technical Guidelines – SPAWAR has provided the ship with their "IT-21 SOPs." These are essentially Microsoft's best practices for the configuration of IT-21 equipment. Since this network is afloat, many configurations are not possible. This serves as a reference guide for creating SOPs. The Lotus System's User Manual is also available here.
- IT-21 Training – The training category contains training material for IT-21 applications, as well as for any new processes.

Goals and Supporting Metrics

Goal 1 - Achieve broad usage of the solution

There is currently no vehicle for deployed Battle Groups to share their information gained from the integration of IT-21 technologies.

Goal 2 - Achieve a high level of user satisfaction with the solution

Eliminate redundant initiatives inside deployed Battle Groups as the same solutions are developed and deployed. Provide one central location to review new and revised solutions that have been developed, tested, and deployed by previous Battle Groups.

Goal 3 - Transfer responsibility for information retrieval and sharing

The responsibility of the deployed Battle Groups to administer and maintain databases of this sort should be minimized. NCIC will take over the administration and maintenance of the IWKB after the JOHN C STENNIS Battle Group (JCSBATGRU) deployment. They will act as the central "clearinghouse" for all knowledge sharing among the deployed Fleets. The NCIC will be able to ensure that deployed Battle Groups and land-based organizations are developing process improvements in a collaborative effort.

Goal 4 – Capture and share best practices information

The primary purpose of the IWKB is to provide a centralized, easy-to-use location for the sharing of best practices information. The site contains several types of IT-21-related information, described above. As usage continues to grow, the amount of information housed will increase, and as new ideas surface, the NCIC will sort them and determine best practices.

Baseline Data

There was no process or instruction for the collection of IT-21 integration information. The JCSBATGRU was the first deployed Battle Group with these systems. There was also no central Web-enabled repository to store information. Knowledge sharing was conducted at a very limited level, between Battle Group Intelligence departments. Therefore, there are no baseline metrics from which this Web site will be measured.

Post Implementation Data and Analysis

Since the IWKB is utilized as a knowledge sharing tool, two main functions must continually occur. The first is the population of the Web site in the form of IT-21 integration information being loaded onto the database. The second is the viewing and utilizing of information from the Web site by off-ship organizations.

A survey was distributed to JCSBATGRU personnel at the end of the deployment to gather metric information. The IWKB-related questions were as follows:

1. How many times have you used the Information Warfare Knowledge Base?

- Never
- Once
- 2-4 times
- 5-7 times
- 8-10 times
- More then 10 times

2. Do you feel a centrally managed Web site to share processes and procedures among Battle Groups would be beneficial to the Fleet?
    - Yes
    - No
3. What types of information are most beneficial as components of the information sharing Web site, IWKB? Chose all that apply.
    - Improved Processes
    - Improved SOPs
    - Lessons Learned
    - Communication Business Rules
    - IT-21 Application Training

Goal 1 - Achieve broad usage of the solution

The Lotus Domino Web server allows the STENNIS to utilize the Navy's SIPRNET for greater information dissemination. A database on the Lotus application can be replicated to its satellite replica databases transmitting all design and content changes real time. The content is then resident in every ship and land organization in the Lotus network. Any other Web server can also access the IWKB and download any information.

The IWKB can utilize this system to distribute the IT-21 information gathered from the deployment. The visibility and usage of the IWKB on the STENNIS and the Battle Group was slightly different.

- STENNIS personnel who responded to the survey averaged visiting the site at least once.
- Other Battle Group personnel who responded to the survey visited the site twice as much.

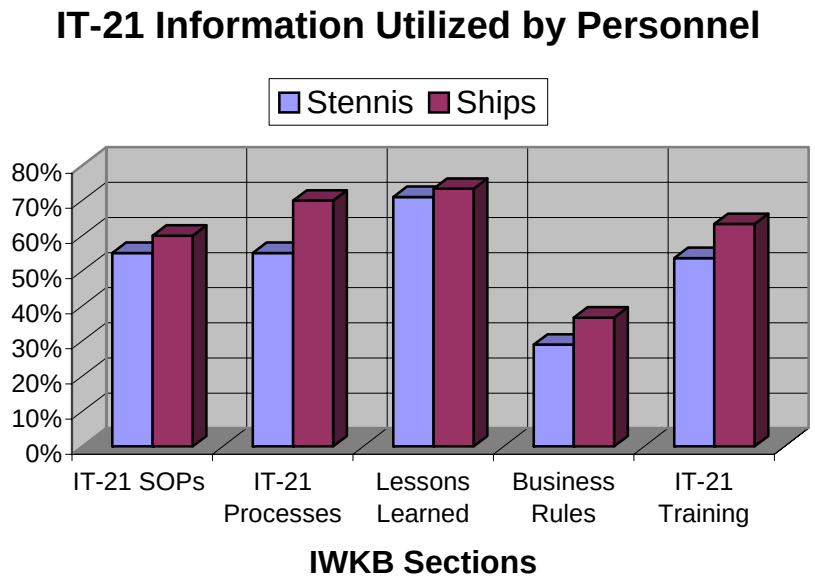
Goal 2 - Achieve a high level of user satisfaction with the solution

The IWKB allows for the central storage and organization of IT-21 information. Having the knowledge in a central location allows for the management of the information to occur on a more efficient basis. Central management can direct the correct information to the personnel or organizations that need it.

The survey asked personnel if they desired the concept of a centralized information repository,

such as the IWKB. STENNIS personnel responded with 87 percent agreeing that the IWKB was desired, while 88 percent of other Battle Group personnel agreed.

The following chart shows sections of the IWKB that are used the most:



Goal 3 - Transfer responsibility for information retrieval and sharing

Transfer of this responsibility to the NCIC has allowed the Battle Group to concentrate on their mission, while assuring that the IWKB is maintained and utilized properly. The level of success of the shore-based management will not be evident for some time. Benefits that have been realized are found in accessing the NCIC's KB larger database for SOPs and Lessons Learned. They have also incorporated the USS CONSTELLATION and USS ABRAHAM LINCOLN into their database. The amount of information in the NCIC database is rapidly increasing with the demonstration of the IWKB throughout the JCSBATGRU.

Goal 4 – Capture and share best practices information

Prior to the development of the IWKB, documentation of IT-related lessons learned was non-existent. Lessons-learned databases were never utilized properly, and ideas spread only through word-of-mouth.

As of late June 2000, 129 entries had been made by JCSBATGRU into the IWKB, broken down

as follows:

Processes	11
SOPs	13
Lessons Learned	2 (in addition to lessons learned included in Process and SOP sections)
Info Warfare Rules	8
Tech Guidelines	75
Training	20

In addition, approximately 85 more SOPs and lessons learned were available on the site through the collection efforts of the NCIC.

6. PROGRAM EXECUTION AND OPERATIONS

This section discusses classes of business objectives that share a common need for efficiently performing work tasks in a timely manner. These tasks commonly require extensive training and experience, are complex, and can be dangerous. Case studies are described for the Naval Surface Warfare Center's Sailor to Engineer program, and a building management project at the General Services Administration.

Business Applications

The Program Execution and Operations business area concerns the activities involved in performing a program's Statement of Work; designing, building, testing, evaluating, installing, and maintaining systems; controlling real-time operations; providing medical services; and other tasks focused on developing and performing tangible products and services. This knowledge must be implementable and practical, and typically includes highly detailed procedures, facts, and analyses. Consequently, this business area involves a substantial amount of tacit knowledge - that is, the unspoken knowledge people build through experience, which is not always easy to articulate. For example, a master electrician knows many characteristics of power systems that a novice electrician does not, making the master electrician many times more productive and efficient on complex tasks. This knowledge is commonly transferred during apprentice, mentoring, and educational relationships. You should read this section if you are applying Knowledge Management to the following or similar activities:

- Maintenance
- Engineering design
- Research and development
- Manufacturing
- Test and evaluation
- Logistics
- Operations management
- Software development
- Hardware and software installation
- Medical services
- Construction
- Demolition

The primary KM objectives of these types of activities are to:

- Increase effectiveness, productivity, and quality
- Implement Best Practices
- Share and reuse lessons learned
- Accelerate learning

- Maintain, share, and leverage expertise
- Facilitate team collaboration

Some examples of KM initiatives for Program Execution and Operations are:

- An aircraft carrier's F18 maintenance crew must reduce their average repair time because mission planners have increased the frequency of operations. With mostly junior technicians, the crew frequently has to send complex systems back to larger shore facilities because they lack the knowledge of how to track down and repair certain intricate problems. If they can find a way to connect the junior technicians to senior experts during repairs, they can fix the complex systems on the ship using electronic manuals, and meet the new schedules. They establish an expertise directory that allows the technicians to interact with engineers and other technicians throughout the DON and to find expert help when they need it.

- An engineering design team includes members from many different contractor and Government organizations located throughout the United States. The entire team is only able to meet in person twice a year at the formal program reviews. In order to avoid redundant efforts and wasting the team's high level of complementary expertise, a distributed collaborative Web-based work environment is created where all project information is posted and informal online work sessions occur with file sharing, whiteboards, video, and speech. Since this is the team's official news source and work center, everyone is confident that they will find valuable information whenever they enter the environment.

- A construction organization is faced with many of their senior members retiring in the next couple of years. A great deal of the organization's expertise and success depends on the workers' knowledge built over their long careers. A Lessons Learned database is created where the senior experts are asked to describe their key thoughts on doing their work. The Lessons Learned are collected in both text and video formats and posted on the organization's intranet.

- A logistics center is developing contingency plans for several possible mission scenarios. They know that some of the details of the supply chain depend on weather, but aren't sure exactly how, for some of the locations they have never worked with before. Using the Instant Messaging system that ties all the primary logistic center managers together, the manager asks other center managers if they have encountered a similar situation. One of them responds with a similar experience and is able to give the manager a link to a joint Weather Service-Federal Emergency Management Agency Web site that has the needed information.

Performance Measures

KM metrics should be extensively correlated to as many factors influencing the results as possible. Since there are many forces within an organization affecting people's learning, sharing, and efficiency, it is difficult to separate the effects of the KM processes from other processes. Thus, the KM measures should be used as a body of evidence to support analysis and decision-making. As much as possible, the KM measures should be related to or the same as existing

measures in the organization that are used to monitor the success of performing mission objectives.

Outcome measures

Examples of possible outcome measures include:

- Measure the change in resource costs (funds, time, personnel) used in a program over time. To tie this to the KM initiative, gauge this against when the KM asset was made available and its usage, and to other programs that are not part of the KM initiative. Also include surveys of user attitudes and practices. For example, have maintenance costs decreased and have average readiness rates increased? Do the technicians say that the Lessons Learned database and the Community of Practice help them get answers? How have they used these lessons to affect their work? Remember that collecting these experience stories serves the dual purpose of performance measurement and "advertising" the KM initiative.

- Calculate the Total Lifecycle Cost. Has it decreased more than other projects that are not using KM?

- Assess risk to changes in business environment or mission objectives. Is the organization aware of its risks and does it have contingency plans prepared? Have these included the expertise of the workers as well as management? Have the KM processes and systems helped develop and review these plans?

- Measure the number of cross-functional teams, both formal and informal. Are the teams working together and sharing? Are the teams ahead of schedule and do they have fewer mistakes? What do the team members say about their ability and willingness to openly share critical knowledge? Is there knowledge hoarding because of internal competition?

Output measures

Examples of possible output measures include:

- Conduct a survey to find out how useful people find the KM initiative. How have people used the collected knowledge? Was it valuable? Did it answer their questions and help solve their problems, or was it merely another set of information to read and digest? How do they suggest improving the KM system?

- Find examples of specific mistakes or problems that were avoided or quickly solved because of KM. These are typically uncovered by talking to people and collecting anecdotes. Was a costly or time-consuming manufacturing problem fixed by using the

Lessons Learned database? Have experts been contacted from the expertise directory? Were they consulted during a task to answer detailed questions?

- Measure how quickly and precisely people can find information on the KM system. Do people have to sort through a large volume of information or are there succinct pre-packaged synopses available? Is there active and continuous content management that distills and validates critical information into synopses? Was an engineering team able to find, fill out, and submit all required regulatory forms within 10 minutes, one hour, one day, one week, etc., and was this faster or slower than before the KM system was implemented?

System measures

Examples of possible system measures include:

- Measure the statistics from the KM system. How many times has the Web site been accessed? How many times have Lessons Learned or Best Practices files been downloaded?

- Measure the activity of a Community of Practice. How many members are in the community, and how often do they interact? How long has it been since the last contribution to a shared repository or threaded discussion? What percentage of total members are active contributors?

- How easy is it for people to find the information they want? Conduct a survey and test the site yourself. How many responses are typically generated from a search? If this number is too high (greater than approximately 50), then people may be giving up the search and not making use of the knowledge assets. Are the responses what the user wants to see? Is the site easy to navigate with an organizational structure consistent with the way they do work and think about the information? What is the system latency, i.e., the wait time between a user requesting something and when the system delivers it?

- Measure how frequently the knowledge assets are updated. Are the Best Practices outdated and superseded by new versions? Are the Points of Contact no longer working on the project? Is there a listed update time that has been exceeded? Are a large number of links to experts no longer valid?

Case Studies

Naval Surface Warfare Center (NSWC) Sailor to Engineer Program

The Naval Surface Warfare Center began a Knowledge Management initiative in 1997 called the Sailor to Engineer program to improve delivery of maintenance and testing procedures to the Fleet. NSWC is responsible for developing maintenance procedures for Fleet systems, which are forwarded to logistics personnel to be published as technical manuals.

Business Objective	Improve consistency and productivity of Fleet maintenance by frequently delivering up-to-date validated technical information with a low cost method.
KM Initiative	Gather new and current maintenance procedures from engineers and post in a widely accessible Web-based portal that includes updated documentation, a knowledge base of problems and solutions, access to a Help Desk, and Communities of Practice.
Stakeholders	Fleet maintenance engineers, at-sea technicians, shore-based experts.
Key Metrics	Outcome: time and cost to resolve issues. Output: cost to widely distribute the information in hard copy, time spent gathering information, anecdote collection, usefulness surveys, attrition rate for members versus non-members of Communities of Practice, and the number of apprentices mentored by experienced colleagues. System: Navigation path analysis; average number of visits; average number of requests; daily visit trends; usage by day of week; usage by hour of the day; organizations visited frequently; categories (Combat System Group, Weapons Group, Equipment Group); help desk analysis: ship class, equipment type, mission warfare area, resolution type, source (Email, Meeting, Naval Message, etc.), source of support.
Results	Poor documentation is a primary Fleet maintenance problem, inefficient processes hinder gathering and producing updated procedures, funding cuts impact many programs in addition to the one targeted. Anecdotes from users showing value and most beneficial aspects.
Actions	Processes modified and Web-based system designed to provide rapid access to validated documentation and an integrated team of shore-based experts through Help Desks and Communities of Practice. Program expanded into new Distance Support program.

Existing manuals failed to capture the expertise and knowledge of the Maintenance Engineers who often devised new procedures as they worked on deployed systems. These engineers kept their personally developed procedures in their own notebooks which created a discrepancy in the quality of maintenance depending on who performed the repairs and which manuals they used. In order to improve consistency and productivity, the Fleet needed a way to capture and distribute this information faster while ensuring the same high quality and validity of the technical manuals. In addition, NSWC recognized several other problems, including long lead

times to deliver new maintenance procedures to the fleet, reduced funding for technical manuals despite having to provide the same level of support, and the prospect of losing substantial knowledge as the aging workforce retired.

The Sailor to Engineer program designed a system concept to provide shore-to-ship technical support. The specific objectives were:

1) Provide automated and rapid access to technical and logistics data to sailors
2) Replace numerous contradicting Web sites with a single coordinated site
3) Increase efficiency of support operation to compensate for reduced In Service Engineering Activity (ISEA) funding

The program established ship-to-shore connections to give at-sea technicians direct contact with shore-based experts at SPAWAR, industry contractors, and other waterfront support organizations on key shipboard systems, including MIDS, METOC, submarine ESM, INMARSAT, LINK16, GCCS-M, and ADNS. The ship-based technicians use a Web based portal to request engineering and logistics assistance, use a Fleet Support Help Desk, obtain technical information and logistics data, read Frequently Asked Questions and Answers database, get rapid updates to documentation, and participate in Communities of Practice. The network uses both NIPRNet and the classified SIPRNet over SATCOM, IT21, and regular telephone line connections.

Metrics were used from the beginning of the program and a wide range of measures was defined and collected. The stakeholders wanted the program's primary outcomes to reduce the time and cost required to resolve issues and to capture and share current information from all the subject matter experts. Output measures included: cost to widely distribute the information in hard copy, time spent gathering information, anecdote collection, usefulness surveys, attrition rate for members versus non-members of Communities of Practice, and the number of apprentices mentored by experienced colleagues.

Although technology tools only provide support functions to KM processes, in some cases the processes depend on the tools to enable collaboration among users. This is true of the Sailor to Engineer program that relies on Web-based collaboration and information repositories to connect people. Many system measures were defined and collected, including:

- Website Analysis:
  - Navigation path analysis
  - Average number of visits
  - Average number of requests
  - Daily visit trends
  - Usage by day of week
  - Usage by hour of the day
  - Visit rate by top 20 organizations
  - Categorical analysis (Combat System Group, Weapons Group, Equipment Group)

- Help Desk Issues Analysis:
  - Ship Class Analysis
  - Most frequent type of fleet issue
  - Issues by equipment type
  - Issues by mission warfare area
  - Issues by resolution type
  - Source of issues (Email, Meeting, Naval Message, etc.)
  - Issues by Source of Support

Analyzing these performance measures led the Sailor to Engineer team to realize that there were inefficient processes that hindered information sharing within several organizations. Also, the funding cuts impacted many other programs besides the ones targeted, and poor documentation is the primary cause of inefficient maintenance operations in the Fleet. As a result, they modified the type of information gathered and its organization within the Web-based system.

The success of this KM program led to it being expanded into a new program, the Navy Distance Support Program. Two of the best measures of its success are the qualitative anecdotes described below, which convey the context and benefits of the system while people are working diligently and under challenging conditions.

The effectiveness of the Sailor to Engineer program was vividly shown while testing the Video Teleconference (VTC) connectivity aboard the USS CONSTELLATION. A Sea Sparrow launcher malfunctioned due to a bad cable. The maintenance crew was able to log on to the Sailor to Engineer portal and quickly locate the appropriate subject matter expert who soon joined the VTC from the shore location. At the same time, the maintenance crew made a digital photograph of the cable suspected of causing the problem and loaded it onto the VTC whiteboard. The expert was able to view the cable, identify the problem, and give the ship's maintenance crew the appropriate corrective actions immediately. Consequently, the maintenance crew had the launcher fixed and returned to operational status within three hours.

The USS CONSTELLATION crew utilized the on-line knowledge base to identify and locate the right subject matter expert. The suite of Web-based collaboration tools allowed them to work from geographically distributed locations while viewing and discussing the same technical documentation. This saved both time and cost of repair.

During the Sea, Air & Space Expo held in Washington D.C., the Combat Systems Officer from the USS ESSEX was quoted as saying, "I use the Sailor to Engineer Knowledge Portal all of the time. This is due in large part to the trust and confidence I have in getting the correct information in a timely manner, the reliability of the Help Desk to route me to the right subject matter expert, or the ability to do self-help using the Knowledge that's available on the site."

General Services Administration Public Buildings Service

Business Objective	Improve performance of Public Buildings Service (PBS) by linking funding to performance measures.
KM Initiative	Collect and share Best Practices among regional offices using Website, email, forums, and interviews called "Good Practices" to lower people's hesitancy to share technicians.
Stakeholders	11 regional offices and Good Practices teams.
Key Metrics	Funds from operations; customer satisfaction; non-revenue producing space; operating expenses compared to industry; leasing costs compared to industry; indirect costs as a percent of revenue; data accuracy; security; customer satisfaction; construction and financial impact.
Results	Increased customer satisfaction and survey response rates.
Actions	Planning new projects on: collecting success stories from users; monthly broadcasts of titles linked to Good Practices to all PBS employees; updating and rating the Good Practices database; attending PBS conferences to aid sharing; analyzing performance measures; and disseminating e-bulletins.

In 1998, GSA's Public Buildings Service (PBS) set financial goals to help improve organizational performance. GSA's 11 regional offices compete for bonus funding based on their performance against these nine measures:

1. Funds from operations
2. Customer satisfaction
3. Non-revenue producing space
4. Operating expenses compared to industry
5. Leasing costs compared to industry
6. Indirect costs as a percent of revenue
7. Data accuracy
8. Security, customer satisfaction
9. Construction and financial impact

PBS builds, develops, leases, and manages federal properties. PBS has 7300 employees managing 330 million square feet of space with 1 million occupants in over 8,600 buildings in 11 regions. These buildings include offices for executive agencies, Courts, and Congress.

A key part of the organizational improvement program was sharing performance knowledge and methods so that the best performing regions could help other regions quickly adopt proven techniques. The KM initiative captured and shared practices from around the country based on the PBS performance measures. Good Practices are practices and experiences that have effectively improved performance according to the nine measures. They were collected by a Good Practices team that visited the regional offices and conducted interviews.

This initiative was intentionally called Good Practices instead of Best Practices because they wanted to encourage people to share practices even if they weren't sure if it qualified as a Best Practice. Thus, the KM team made this seemingly small change in language to overcome people's reluctance to share practices because of an unrealistic view of what Best Practices are.

A database of Good Practices is available through a Website to GSA users. In addition, Good Practices are automatically sent to users via several methods. Targeted listservers were used to forward specific practices to people with similar jobs. Also, forums were held for each topic to bring people with similar areas of expertise together.

The performance measures show that the Good Practices program has helped improve PBS's performance across all regions. The largest improvement has been in Customer Satisfaction, which has increased to a high of 85 percent in FY 1999 and 81 percent in FY 2000 as shown below.

Average customer satisfaction scores for the GSA's Public Building Service project to improve building management.

Another area that showed a substantial improvement was in the percentage of users returning surveys, which increased from 34 percent to 52 percent, an all-time high value. This was a result of focused forums on the topic, whose findings were distributed in videos and on the Website.

The Good Practices team is modifying their KM initiative from this experience and is planning several new projects, including: collecting success stories from users; monthly broadcasts of titles linked to Good Practices to all PBS employees; updating and rating the Good Practices database; attending PBS conferences to aid sharing; analyzing performance measures; and disseminating e-bulletins.

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7. PERSONNEL AND TRAINING

This section describes classes of business objectives that share a common focus on helping people coordinate and decide professional and personal issues that effect their income, jobs, careers, retirement, education, and families, and other Quality of Life topics. Case studies are presented for the Navy LIFELines system and the Virtual Naval Hospital.

Business Applications

The Personnel and Training business area concerns activities for Human Resources, continuing education, personal life issues, and quality of life. These applications focus on helping people improve the effectiveness or quality of their work life and helping organizations attract and retain talent. These activities share a common need for people to determine what options are available from various programs, how they impact their personal finances and families, what experiences other people have had (good and bad) with these options, who to contact to make arrangements, and what they are required to do for the programs. You should read this section if you are applying Knowledge Management to the following or similar activities:

- Human Resources
- Distance or e-learning and continuing education
- Change of duty station and PCS orders
- Fringe benefits management
- Career planning
- Employee retention
- Relocation
- Neighborhood services

The primary KM objectives of these types of activities are to:

- Provide retirement, health, and financial services
- Arrange for moving jobs and families to new locations
- Plan career growth
- Enhance learning opportunities
- Improve quality of life
- Retain and attract employees

Some examples of KM initiatives for Personnel and Training are:

- A Marine is processing change of duty station orders and must now coordinate relocating to the new base. Without an opportunity to visit the new location, the Marine's family has to find a home, change banks, arrange for daycare and school, and notify the utility, telephone, and cable companies in both locations. Logging into the relocation Community of Practice Web site, the Marine finds links to local information and directories at the new base, and

suggestions from people who live there on the best places to live, local daycare centers, and how to enroll children for school and how to sign up for utilities.

- Employees are encouraged to take continuing education courses through the Internet offered by several authorized institutions. They can access their personnel records to see what courses they need for various job positions and promotions. As they take an online course, their progress is automatically noted in their personnel records and sent to their supervisor to be included in their performance reviews.

- Employees can access their fringe benefit plans through the Human Resources department's Web site. They can change their options during open season and compare the cost and benefits offered by retirement and health plans using the Web site's interactive feature comparison application. In addition, a Lessons Learned database includes key issues discussed by experts on these plans.

Performance Measures

KM metrics should be extensively correlated to as many factors influencing the results as possible. Since there are many forces within an organization affecting people's learning, sharing, and efficiency, it is difficult to separate the effects of the KM processes from other processes. Thus, the KM measures should be used as a body of evidence to support analysis and decision-making. As much as possible, the KM measures should be related to, or the same as, existing measures in the organization that are used to monitor the success of performing mission objectives.

Outcome measures

Examples of possible outcome measures include:

- Measure the change in resource costs (funds, time, personnel) used in a business process over time. To tie this to the KM initiative, gauge this against when the KM asset was made available and its usage, and to other business processes that are not part of the KM initiative. Also include surveys of user attitudes and practices. Has the cost of administering Human Resource programs decreased? Have user surveys shown a higher level of satisfaction?

- Survey people on their job satisfaction. Are people happy with their health and retirement plans? Do they feel they have good opportunities to learn new skills and subjects? Are they satisfied with their career advancement opportunities? Have these values changed since the KM initiative started?

Measure retention rates and the cost of attracting new people. Are fewer people leaving the organization for other jobs? Are starting salaries stable or are they and other benefits rising to compete with other organizations?

Output measures

Examples of possible output measures include:

- Conduct a survey to find out how useful people find the KM initiative. How have people used the collected knowledge? Was it valuable? Did it answer their questions and help solve their problems, or was it merely another set of information to read and digest? How do they suggest improving the KM system?

- Find examples of specific mistakes or problems that were avoided or quickly solved because of KM. These are typically uncovered by talking to people and collecting anecdotes. Have fewer people needed help properly filing their change orders? Are people able to easily locate new housing and services in their new locations? Are people able to find people through the KM systems to help them with local details?

- Measure the usage of distance learning system. Are employees taking only required courses or courses for career advancement as well?

System measures

Examples of possible system measures include:

- Measure the statistics from the KM system. How many times has the Web site been accessed?

- Measure the activity of a Community of Practice. How many members are in the community, and how often do they interact? How long has it been since the last contribution to a shared repository or threaded discussion? What percentage of total members are active contributors?

- How easy is it for people to find the information they want? Conduct a survey and test the site yourself. How many responses are typically generated from a search? If this number is too high (greater than approximately 50), then people may be giving up the search and not making use of the knowledge assets. Are the responses what the user wants to see? Is the site easy to navigate with an organizational structure consistent with the way they do work and think about the information? What is the system latency, i.e., the wait time between a user requesting something and when the system delivers it?

- Measure how frequently the knowledge assets are updated. Are the Best Practices out-of-date and superseded by new versions? Are the Points of Contact no longer available? Is there a listed update time that has been exceeded? Are a large number of links to experts no longer valid?

Case Studies

LIFELines

Business Objective	Deliver Quality-of-Life services on self-help information, distance education, crisis assistance, on-line access to professional QOL service providers, and access to a full range of on-line business transactions.
KM Initiative	Use a Web-based system to enable collaboration and knowledge sharing with Communities of Practice, chat, experts directory, newsletters, courses, and surveys.
Stakeholders	Deployed Sailors and Marines, Commanders, family members.
Key Metrics	Outcome: Results from electronic surveys and polls, tools available to users at no cost, communications with 24/7 Access. Output: Number of communities of practice established and expanding for sharing information and online resources, potential viewing audiences for each broadcast program, number of internal and external media. articles/broadcast reports on accomplishments, volume/mapping of content contained across all topics and major business areas, number of media options for services delivered. System: LIFELines Services Network activity levels - Monthly Website statistics (e.g. hits, sessions, length of stay, domains, etc.).
Results	Online services are successfully used. Users expect self-help information and community resources to be in user friendly formats. Technology allowed integrating media in cyberspace, and partnerships reduced costs, enabling a wider variety of services.
Actions	Began a new project phase to establish a Customer Relations Management program to improve the system's content, navigation and functionality.

The DON's LIFELines services network (http://www.lifelines4qol.org/) began in January 1999 as a Web-based access and delivery system to provide quality of life (QOL) programs and services. It is built on five core business areas: Web-based Quality of Life (QOL) Network, QOL News Center, QOL Broadcast Network, QOL Business Innovations Portal, and the QOL Gateway. It is available 24 hours per day, seven days per week using six modern telecommunication media - the Internet, Internet Simulcasting, Satellite Broadcasting, Teleconferencing, EchoStar Dish Television, and Cable Television - to deliver a broad range of QOL support services globally to tens of thousands of DON members. These services include: self-help information, distance education, crisis assistance, on-line access to professional QOL service providers, and access to a full range of on-line business transactions.

Deployed Sailors and Marines and family members have access to hometown news and Direct to the Sailor video on demand, plus the comprehensive DoD-LIFELines Gateway database with its thousands of hotlinks to community resources. In addition, users can access national, regional and local QOL community events calendars and self-help materials on a broad range of topics.

The LIFELines KM program focused on providing users with many opportunities to collaborate and share knowledge through the Web-base system. The two biggest projects were building Communities of Practice and knowledge sharing tools. Some of the Communities of Practice are:

- BUPERS
- BUMED
- CHINFO
- Navy Media Center/All Hands Magazine
- Naval Reserve Component/Ombudsmen Program
- Naval Facilities Engineering Command (NAVFAC)
- Naval Supply Systems Command (NAVSUP)
- NAVSEA
- Navy Office of the Chief of Chaplains
- Naval Services FamilyLine
- Fleet and Family Service Center (Naval District Washington)
- Marine Corps Reserve Support Command (MCRSC)
- Marine Online
- Coast Guard (Office of Work-Life)
- DoD Office of Family Policy
- DoD Office of Educational Opportunity
- DoD Quality of Life Office

Examples of the Knowledge Sharing Tools and Capabilities are:

- eBlast (standardized electronic newsletter template/functionality)
- National and Regional Calendars (for promotion of organizational services, events, conferences, and special celebrations, etc.)
- Point of Contact Directory (integrated, searchable)
- Glossary of QOL Terms and Acronyms (integrated, searchable)
- Feedback Function (Customer Ideas, Comments)
- GuestBook Function (On-going Customer Connections and Needs Assessment)
- Frequently Asked Questions (FAQ) Forum
- Secure Hosted Chat Rooms (with a Moderated Threaded Discussion Group Function in development)
- Electronic Surveys and Polls (1-100 question online construction capability, real-time public release and view results options)
- eCourseware Development Capability (e.g. Reserve Component Ombudsmen Training, sponsor training, Suicide Prevention Training, etc.)
- Ask an Expert Function (for access to QOL program managers and policy makers; pre-release version)
- Base Contacts & Happenings (for relocation assistance and healthy lifestyles promotions; pre-release version)

Aware of the need to monitor the effectiveness of this array of services, the LIFELines project team used the following measures to assess LIFELines' ability to meet its goals:

- LIFELines Services Network Activity Levels - Monthly Website statistics (e.g. hits, sessions, length of stay, domains, etc.)
- Results from electronic surveys and polls
- Number of Communities of Practice established and expanding for sharing information and online resources
- Potential viewing audiences for each broadcast program
- Number of internal and external media articles/broadcast reports on accomplishments (keeping people informed of available online resources)
- Volume/Mapping of content contained across all topics and major business areas
- Number of knowledge management tools available to users at no cost to users (cost avoidance)
- Number of communication initiatives moving from limited access to 24/7 Access
- Number of media options for services delivered

These metrics led the LIFELines team to conclude that Sailors, Marines, Command Leaders, QOL Program Managers and family members are using the online services successfully and that they expect self-help information and community resources to be available online in user friendly formats. Also, the champions of various Communities of Practice are gaining valuable experience with LIFELines online tools and are especially excited about using these tools so that they can manipulate data in real-time, without technical assistance or cost. The technology made it easy to integrate media in cyberspace (e.g. television, Internet, wireless applications, push/pull technologies) and gave customers better control over how and when they accessed information. Creating partnerships with other organizations helped reduce costs and enabled a wider variety of services to be offered.

Even with this large list of measures, LIFELines recognized the need to continually assess both the measures used and the effectiveness of its services. Consequently, they began a new project phase to establish a Customer Relations Management program to improve the system's content, navigation and functionality. This program includes:

- Usability Testing Program
- Beta Users Group
- Technical Advisory Group
- Feedback Forum
- Quality Control & Assessment reviews by LIFELines and third parties (e.g. Section 508, Site Access Speeds from around the country/world, functionality checks, firewall problems, software/programming barriers to service delivery, at-sea and overseas issues, etc.).

Virtual Naval Hospital[8]

Business Objective	Provide Point-of-Care authoritative medical information to deployed providers.
KM Initiative	Built a digital library with validated information with user-centered design. Low bandwidth issues: shore server and CD-ROM to all ships, subs, aviation groups, hospitals, Marine battalions. User-friendly: low graphics, simple HTML, problem-based taxonomy. Content: DON & Federal Medical Manuals, peer reviewed Web site.
Stakeholders	Corpsman and medical officers at-sea and in-field. Needs: 80 primary problems and 25 primary promotion topics.
Key Metrics	Content: 1MB, 1 book, 500 links to 80MB, 40 books, 1100 links. Availability: low bandwidth network to server; CD-ROM distribution. Usage: 1250 users/day, 100K pages/month, conflicts (Balkans). Popularity: access top problems and promotions. Demographics: 56% US military, 30% US civilian, 24% foreign. Comments: average of 13/month.
Results	Unmet need existed, especially for those deployed with low bandwidth. Broader array of medical information than ship print library. Rapid updates when needed (chemical warfare in Iraq). Small size important for deployed systems.
Actions	Collect Lessons Learned, improve caching to reduce network connectivity dependence, automate synchronization with central current version.

Health care providers commonly generate questions about their patients but rarely have the time to seek answers to the questions because they lack convenient access to authoritative medical information at the point-of-care. Similarly, patients require health information to live healthy lives and prevent disease, to learn how to access the health care system when they are ill, and to learn about diseases they may have.

DON primary care providers are among the most geographically isolated health care providers in the world, and rarely have convenient access to authoritative medical information. The DON therefore has a strong interest in using information technology to help provide specialty expertise to primary care providers at sea to enhance diagnosis and treatment of complicated medical problems in order to help maintain combat readiness. The Virtual Naval Hospital (http://www.vnh.org) was created to build a digital health sciences library to make the Internet a useful medical reference tool for Navy primary care providers at the point-of-care and a health promotion tool for Sailors and Marines.

The great challenge of this digital library project was to deliver digital library services to a nomadic patron population on the sea, under the sea, in the air, and in the field who have

[8] Excerpts from D-Lib Magazine, May 1999, Vol 5(5), The Virtual Naval Hospital Lessons Learned in Creating and Operating a Digital Health Sciences Library for Nomadic Patrons.

heterogeneous access to Internet bandwidth. The VNH serves the entire DON with a broad range of ages, activity levels, and locations. At the core of Naval medicine are its primary care providers who practice on ships, on submarines, with aviation squadrons, in the field with Marine battalions, and in Naval medical clinics and hospitals. Their responsibilities include primary care as well as preventive, occupational, and environmental medicine. Their medical training varies widely; from corpsmen who undergo 12 weeks of medical training and operate under the supervision of a more senior primary care provider; to the Independent Duty Corpsman, a senior corpsman with several years experience who obtains an additional 12 months of medical training and usually operates as the senior primary care provider on smaller ships; to Medical Officers who are physicians who have completed 4 years of medical school and 1-4 additional years of primary care and specialty training and who are the senior primary care providers on larger ships such as amphibious assault ships and aircraft carriers, as well as for aviation squadrons and Marine Corps battalions.

All Navy ships, aviation squadrons, and Marine Corps battalions, by regulation, are required to have a standard print medical library. In some instances, shortages of space and funding result in incomplete or out-of-date print medical libraries. In addition, this highly nomadic force has heterogeneous computing assets and access to Internet bandwidth in their medical departments. Most medical departments have personal computers with CD-ROM drives, and many Navy primary care providers purchase their own state-of-the art laptop computers and employ this technology while at sea. Today, at one end of the bandwidth spectrum, approximately 24 ships (amphibious assault and aircraft carriers) have reasonably predictable and continuous access to the Internet and Web browsing while at sea. This access is dependent upon operational theater, mission, and command support. This bandwidth is provided by a satellite link and 1.5 Megabits per second of bandwidth are available. Most of the bandwidth, however, is devoted to "line" or operational use, so, at best, the medical department is given access to 128 kilobits per second of bandwidth, and often they are given no access to bandwidth at all. For the remaining 300 ships and primary care providers serving with Marines in the field, access to the Internet and Web browsing is very limited.

Previous work identified a number of barriers to primary care provider use of a digital library. The Virtual Naval Hospital digital library was designed to overcome those barriers by determining what patrons need, building what they want, and delivering a useful tool in a form that nomadic patrons can use anywhere, regardless of their computer or communication capabilities. Consequently, the VNH used a user-centered design method to focus the content and architecture on user needs. A literature review identified the 80 most common medical problems encountered at sea, along with the 25 most important health promotion topics applicable to Sailors and Marines. Interviews with Naval primary care providers were performed to corroborate these findings and add missing topics.

The content for the digital library was obtained by identifying Department of the Navy and U.S. Government medical manuals which covered the previously defined 80 most common medical problems and 25 most important health promotion topics. Because the manuals were all published by the U.S. Government and contained non-classified information, their content was in the public domain. All manuals, in paper or electronic format, were converted into Hypertext

Markup Language (HTML) files. Content for the digital library was also obtained by identifying authoritative and easy-to-use medical Web sites that passed peer review.

Another important quality of the VNH is the problem-based user interface that allows patrons to quickly and easily find answers to their medical questions. A personalized view of the Internet was created for primary care providers by linking the 80 most common medical problems seen at sea to the authoritative medical information in the resources previously cited. The primary care provider's page also contains links to information on health promotion, occupational and environmental health, medical procedure descriptions, MEDLINE, continuing medical education courses and administrative references. A personalized view of the Internet was created for patients by linking the 25 most important health promotion topics to the authoritative medical information in the resources previously cited. The patient's page also contains links to information on first aid and consumer health information references.

The VNH uses open Internet and World Wide Web standards that allow for scalability, interoperability, and modifiability as the information in the Virtual Naval Hospital is expanded and new computer and communications hardware and software technologies become available. All digital library documents are stored as HTML files, and adhere to a uniform style convention that minimizes the use of graphics to ensure that navigation within the digital library is clear, quick, and that patrons may have confidence in the information they are reading. To allow access to the digital library when the patron does not have continuous access to the Internet, a caching strategy was developed that would be technologically durable, readily understandable and easily implementable by patrons who were assumed to have limited computer skills and no access to technical support. A CD-ROM mirror of the digital library was created, which can be used as a locally cached version of the digital library on nomadic patrons' personal computers. Over 4,000 copies of this CD-ROM mirror are produced annually and distributed to every Department of the Navy primary care provider.

As part of a process of continuous quality improvement, evaluation of the digital library is ongoing. Web server log file records are analyzed using the log file analysis programs, Analog 1.2.3 (University of Cambridge Statistical Laboratory, Cambridge, England) and Wusage (Boutell.Com, Inc, Seattle, WA). Patron feedback is encouraged and obtained via electronic mail and an on-line comment form. As part of a formative evaluation, several small groups of primary care providers were surveyed after using the digital library. Strategic planning and operational oversight will be provided by a new review board that is currently being established.

The project began on October 1, 1996. Five months later, after initial research, design, and creation, the operational prototype of the digital library was launched on March 1, 1997. Since inception, the digital library has grown from 1 megabyte of content comprising 1 digital textbook and 525 links to authoritative medical Web sites to its current size of 80 megabytes of content comprising 40 digital textbooks and 1,094 links to authoritative medical Web sites. The digital library and its CD-ROM mirrors are currently available on every Navy ship, submarine, aviation squadron, medical clinic, hospital, and Marine battalion. During recent conflicts in Southwest Asia and the Balkans, the digital library proved critically useful for care of deployed service members.

Overall usage of the digital library has grown at a steady rate since launch and is used by over 1,250 patrons per day, who read over 100,000 pages of information on the digital library each month. Although a broad spectrum of information is accessed, the most commonly read medical reference and health promotion pages in the digital library consist primarily of the most common medical problems seen at sea and the most important health promotion topics. The digital library, therefore, is providing patrons with the information they need. From the server log file data and from analyzing e-mail or to the digital library, we know that approximately 56 percent of patrons are from the U.S. military, 30 percent are U.S. civilians, and the remainder are foreign nationals. The digital library receives an average of 13 comment forms per month from patrons. These contain a mix of questions, corrections, suggestions, and praise for the digital library.

The digital library clearly fills a previously unidentified, and therefore unmet, need for authoritative medical information at the point-of-care. It gives convenient medical information to populations who have traditionally not had access to this information before, such as junior corpsman and, most importantly, patients. The small physical size of the digital library on board ship is an added bonus. More importantly, information can be quickly loaded onto the digital library in times of conflict and rapidly disseminated to the fleet. In the case of the conflict with Iraq in the fall of 1997, when there was again fear of chemical weapons being used against U.S. forces, the relevant medical manuals were quickly digitized and loaded onto the digital library. Finally, the digital library can accommodate a breadth of information that is much greater than that which could be accommodated in the confined spaces of the print library onboard ship. This was brought to light in the winter of 1998 when, again facing conflict with Iraq, Navy primary care providers in the Persian Gulf were able to review Combat Stress Control psychiatric information, which was on the digital library but was not part of the regulation print library, to assist in counseling efforts for Sailors and Marines before they faced combat for the first time.

The following discussion describes the lessons learned in the implementation of the Virtual Naval Hospital. These lessons are categorized as technical, personal, and political.

Technical Lessons Learned

1. The Primacy of User-Centered Design - In short, if one does not give patrons what they need, a digital library project is over before it begins. The initial needs assessment led to the development of the problem-based interface that allows digital library patrons to change their usage paradigm of the Internet from one of Web surfing to one of problem solving. The information in the problem-based interface is essentially "pre-surfed" for them; thus they are usually never more than three clicks away from the home page to the answer to their question. This feature, that it helps patrons quickly and conveniently find answers to questions they otherwise would not have time to pursue, allows for the seamless integration of the digital library into their work flow and, consequently, gives patrons a compelling reason to use the resource. Knowing patrons' needs initially and keeping in touch with them by feedback, as a form of continuous quality improvement, ensures that the digital library remains accessible to them and relevant to their needs.

2. Digital Library Architecture for Nomadic: Less is More - Once a digital library had been created to which patrons wanted continuous access, the next challenge became how to deliver it to them, given their highly nomadic nature and the heterogeneous nature of the bandwidth available to them. Focus was placed on determining what would be the minimum level of technology needed to support the patrons in accomplishing their mission. The result was technologically simple digital library architecture, using lowest common denominator Internet standards and information architecture style standards. This simple solution, however, is the digital library's true power: the simplicity of the solution allows the digital library to be truly cross-platform and machine-independent. Caching CD-ROM mirror copies of the digital library locally with patrons that can be copied to any other form of magnetic or optical media ensures that all patrons have a baseline level of digital library functionality that can be enhanced as they gain access to communications bandwidth. This ruggedized or "Milspec" digital library can be deployed on any computational platform that has a Web browser and allows for the graceful degradation of a patron's interactions with the digital library. If the patron has continuous access to the Internet, they can access the digital library Web site exclusively; if they have no access to the Internet, they can access the locally cached CD-ROM mirror copy of the digital library exclusively; and if they have intermittent access to the Internet, they have many intermediate options for raising their communications antenna, having a quick look around the Internet for the up-to-date information they need and, once they find it, disappearing again off the Internet, using the locally cached CD-ROM copy of the digital library.

3. From Simple Systems, Powerful and Complex Behaviors Can Emerge - Ultimately, a digital library should be more than an electronic bookshelf. In other words, what one extracts from a digital library should be far different, and better, than what is put into it. Initially, this digital library served as a digital bookshelf, in that what patrons got out of the digital library (i.e., digital books) was exactly what had been put into it. Eventually, through the expansion of the problem-based interface, what patrons began to extract from the digital library was far different, and more useful, than what had been put in. The prime example of this is the Medical Planning and Medical Intelligence section. Today, Navy and Marine forward-deployed expeditionary forces may go into action with very short notice. The Medical Planning process is necessarily compressed, with little time to obtain formal classified intelligence. The Medical Planning and Medical Intelligence portion of the problem-based interface aggregates a large number of informal, unclassified, open source intelligence resources both within and outside the digital library. In many instances, these references are superior in quality and ease of access to their classified counterparts. This simple aggregation of content into a problem-based interface clearly leads to a whole which is much more powerful and complex than the sum of its parts. The value of this content aggregation, the result of careful and considered curatorship, was foreseen in the first article on digital libraries and, with the advent of the World Wide Web, has been rediscovered and reconfirmed.

Personal Lessons Learned

1. Key Intermediary - People, not technology, are the key to making a digital library project work. A digital library project needs a key intermediary to succeed, a "multidisciplinary" person who can interact with the different constituencies involved and translate between them. In this

project, the Digital Librarian-In-Chief served as the key intermediary. This individual's background includes computer science, medicine, and digital library research, coupled with a rich knowledge of the history and current state of the DON. The Digital Librarian-in-Chief was able to quickly assimilate the important issues facing Naval medicine and was able to establish personal relationships with all the constituencies involved. He meets with them regularly, and serves as the single person accountable to them to solve their problems and implement their suggestions.

2. Situated Training - Publicity and marketing is crucial if potential patrons are to learn about the tool built specifically for their needs. Convincing patrons to use a digital library in their daily work is very personal. Once they learn of the digital library, a tour of it should be offered that will serve to guide them through how the digital library works. This tour should function as a situated training exercise, such as a scenario, to emphasize the relevancy of the digital library to their daily work, thus giving them a compelling reason to return and use it in the future. It is always better for patrons to be pulled, rather than be pushed, into the technology.

3. The Long View - At the beginning of a digital library project, most participants do not understand what is trying to be accomplished. Patience is a virtue when trying to convince others of one's vision. What may be clear to you is for others only a hazy light, that with time, will brighten. Therefore, stick to the original ideals and use quality as the guiding principle in all matters.

Political Lessons Learned

1. Autonomy versus Supervision - One of the reasons for this digital library's initial success was that it was started by civilians operating outside the standard military chain of command. These civilians had no knowledge of standard military operating procedure, and had no preconceived notions or prejudices. Because of this, they were perceived as neutral players, and quickly became trusted by all involved. This was extremely helpful in recruiting content providers and reviewers, which turned out to be a highly personal and time consuming task. One of the reasons for the digital library's continuing success is that, once the concept of the digital library was proven, it was assimilated into the standard military chain of command and given appropriate military supervision and oversight, while still retaining some degree of operational autonomy, allowing thinking outside the box to anticipate and quickly respond to new challenges as they arise.

2. Real World Experience is the Best Teacher - It is better to be an operational prototype than a demonstration project. First, much more is learned from real world operations with an uncontrolled, heterogeneous patron population as compared with demonstrations conducted with a controlled, homogeneous patron population. Experience is the phenomena where the test comes first and the lesson comes afterward. Second, it is easier to convince individuals to collaborate and help "do it right from the start" if they see the project has the potential to quickly help a large population, rather than being yet another demonstration that, in all likelihood, will never see the operational light of day.

3. Sensitive, Not Classified, Information - All of the information on the digital library is non-classified. Nonetheless, some of the information, particularly medical administrative information, was never intended for consumption by non-medically trained civilians and may be regarded as insensitive by civilians not familiar with the standard operating procedures of the military. In order to keep barriers to accessing information low and because nearly half of the Navy patrons of the digital library use it from outside the .mil domain, there is no desire to place this administrative information behind a login/password or access control list. One must be cognizant not only of the target audience but also the peripheral audience that may misinterpret information in a digital library. Therefore, such information requires a higher standard of review for clinical quality and accuracy, timeliness and currency, source reputation and, of course, spelling and grammatical editorial correctness; and also for political sensitivity. Multiple reviewers are required to avoid single source bias. Information selection and regular advisory board oversight are major process requirements of site maintenance and sustainment. Finally, a disclaimer that encompasses both legal and public affairs perspectives is imperative.

The methodology used in the creation and operation of this digital library is widely applicable to other constituencies inside and outside of the military and medicine. The U.S. Coast Guard has already adopted this digital library and several foreign navy departments have shown interest in adopting it. Applications in the Merchant Marine would be a logical next step, and the digital library has already been deployed and tested on a commercial cruise line. The University of Iowa's digital library team's next step is, literally, to shoot for the stars and apply the lessons learned in this project to the design of a prototype digital library for use on the National Aeronautics and Space Administration's International Space Station.

Even after continuous access to the Internet is provided to all ships, there may never be enough bandwidth available to the primary care providers at sea; their medical information needs are always secondary to the military operational information needs of the ship, and in times of conflict, such bandwidth may be turned off to reduce the ship's electronic emissions signature. This simple fact leads to a requirement for continuous refinement and enhancement of the caching strategy under the assumption that patrons can only be expected to have, at best in the future, intermittent access to the Internet. The distribution of a CD-ROM mirror of the digital library will therefore be continued on an annual basis, and methods are being developed for keeping the nomadic patrons' local CD-ROM mirrors of the digital library synchronized and more up-to-date with the main digital library Web site. Investigation of the following is also planned:

- A new generation of off-line-browsers which can automatically subscribe to the digital library and pull updates on a scheduled basis
- Push technology which can regularly broadcast digital library updates to subscribers
- A quarterly compressed downloaded archive of the entire digital library which can be manually pulled by patrons into their computers and which turns into a self-extracting copy of the digital library upon downloading.

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APPENDIX A: SUMMARY OF KM PERFORMANCE MEASURES

Common measures: These measures can be used for all KM initiatives:

Outcome
- Time, money, or personnel time saved as a result of implementing initiative
- Percentage of successful programs compared to those before KM implementation

Output
- Usefulness surveys where users evaluate how useful initiatives have been in helping them accomplish their objectives
- Usage anecdotes where users describe (in quantitative terms) how the initiative has contributed to business objectives

System
- Latency (response times)
- Number of downloads
- Number of site accesses
- Dwell time per page or section
- Usability survey
- Frequency of use
- Navigation path analysis
- Number of help desk calls
- Number of users
- Frequency of use
- Percentage of total employees using system

KM Initiative	Key System Measures	Key Output Measures	Key Outcome Measures
Best Practice Directory	• Number of downloads • Dwell time • Usability survey • Number of users • Total number of contributions • Contribution rate over time	• Usefulness survey • Anecdotes • User ratings of contribution value	• Time, money, or personnel time saved by implementing best practices • Number of groups certified in the use of the best practice • Rate of change in operating costs
Lessons Learned Database	• Number of downloads • Dwell time • Usability survey • Number of users • Total number of contributions • Contribution rate over time	• Time to solve problems • Usefulness survey • Anecdotes • User ratings of contribution value	• Time, money, or personnel time saved by applying lessons learned from others • Rate of change in operating costs
Communities of Practice or Special Interest Groups	• Number of contributions • Frequency of update • Number of members • Ratio of the number of members to the number of contributors (conversion rate)	• Number of "apprentices" mentored by colleagues • Number of problems solved	• Savings or improvement in organizational quality and efficiency • Captured organizational memory • Attrition rate of community members versus non-member cohort
Expert or Expertise Directory	• Number of site accesses • Frequency of use • Number of contributions • Contribution/update rate over time • Navigation path analysis • Number of help desk calls	• Time to solve problems • Number of problems solved • Time to find expert	• Savings or improvement in organizational quality and efficiency • Time, money, or personnel time saved by leveraging expert's knowledge or expertise knowledge base

KM Initiative	Key System Measures	Key Output Measures	Key Outcome Measures
Portal	• Searching precision and recall • Dwell time • Latency • Usability survey	• Common awareness within teams • Time spent "gathering" information • Time spent "analyzing" information	• Time, money, or personnel time saved as a result of portal use • Reduced training time or learning curve as a result of single access to multiple information sources • Customer satisfaction (based on the value of self service or improved ability for employees to respond to customer needs)
Lead Tracking System	• Number of contributions • Frequency of update • Number of users • Frequency of use • Navigation path analysis	• Number of successful leads • Number of new customers and value from these customers • Value of new work from existing customers • Proposal response times • Proposal "win" rates • Percentage of business developers who report finding value in the use of the system	• Revenue and overhead costs • Customer demographics • Cost and time to produce proposals • Alignment of programs with strategic plans
Collaborative Systems	• Latency during collaborative process • Number of users • Number of patents/trademarks produced • Number of articles published plus number of conference presentations per employee	• Number of projects collaborated on • Time lost due to program delays • Number of new products developed • Value of sales from products created in the last 3-5 years (a measure of innovation) • Average learning curve per employee • Proposal response times • Proposal "win" rates	• Reduced cost of product development, acquisition, or maintenance • Reduction in the number of program delays • Faster response to proposals • Reduced learning curve for new employees
Yellow Pages	• Number of users • Frequency of use • Latency • Searching precision and recall	• Time to find people • Time to solve problems	• Time, money, or personnel time saved as a result of the use of yellow pages • Savings or improvement in organizational quality and efficiency
e-Learning Systems	• Latency • Number of users • Number of courses taken per user	• Training costs	• Savings or improvement in organizational quality and efficiency • Improved employee satisfaction • Reduced cost of training • Reduced learning curve for new employees

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APPENDIX C: DEFINITIONS OF KEY TERMS

Anecdote Collection	The systematic and organized process of gathering and documenting individuals' narratives about work-related processes. These often refer to short, succinct, "success stories" about how to improve program management, processes or operations.
Attrition Rate	The reduction in numbers caused by individuals leaving a job or an assignment.
Best Practice Directory	A collection of "best practice" approaches related to program and process management. Best practice information can take the form of processes, studies, surveys, benchmarking, and research. For example, a best practice directory could catalog approaches to Government contracting or RFP development.
Collaborative Design System	A tool that allows groups to collaborate on projects, supported by a relational database underneath it. Usually these systems enable chat, broadcast, file transfer and application sharing and are especially suited for complex design and development projects. They support distributed decision-making through the use of tools that enable rating, ranking and voting mechanisms.
Community of Practice (CoP)	A group of individuals who share a common working practice over a period of time, though not necessarily a part of a formally constituted work team. Communities of Practice generally cut across traditional organizational boundaries and enable individuals to acquire new knowledge at a faster rate.
Community of Interest (CoI) (see also Special Interest Group)	Groups or individuals with a common interest. This interest does not necessarily relate to their day-to-day work or current tasking. Communities of Interest share ideas and communicate or collaborate.
Contribution	The act of capturing, codifying, and submitting content to a knowledge base system.

Downloads	The act of transferring data, usually from one large computer or database to a smaller, local computer. The time and effort it takes to transfer data often indicates a higher level of interest in the content by the user.
Dwell Time	The amount of time a user spends viewing data, usually on Internet or Intranet sites. Analysis of dwell time can indicate the level of interest and relevance in the information being accessed by users.
Frequency of use	Indicates the number of times information is accessed within a system.
eLearning	The ability to receive instruction and other learning-oriented content virtually, through the use of Web-based audio, video and print content. eLearning can be transmitted in real time through Web-casts, by storing the instruction material in a central location or by delivering it on an as needed basis. eLearning is attributed with improved employee morale and allows large numbers of employees to improve their professional skills.
Expert System	A computer system designed to emulate a human expert to help knowledge workers solve problems, often based on a set of domain-specific rules. A typical expert system has three main parts – a knowledge base (that contains rules), an inference engine (that interprets the situation against the rules) and a graphical user interface.
Expertise or Expert Directory	A system that captures and categorizes the skills and competencies of employees by organization, region, subject matter or interest area. An Expertise or Expert Directory is useful for identifying and locating individuals with expertise in a given area for the purpose of consultation.
Help Desk Calls	The number of requests for assistance made to technical support personnel. May indicate the stability, value and ease of use of a given knowledge system or the clarity of the content contained in it.
Latency	Assesses how long data or information remains dormant and not accessed by users of the system. May indicate if data or information in a system is relevant or useful.

Lead Tracking System	A system used to capture contact information for potential clients, customers and partners that often includes essential client contact information, a record of when contacts were initiated, associated marketing activities and follow-up actions.
Lessons Learned Database	A database of innovative solutions to common problems that arise from experience in program and process management. An example of information typically found in a Lessons Learned database could include suggestions for avoiding delays in the contracting process.
Navigation Analysis	The process of monitoring user behavior on Web sites that indicates if and where a user clicks on hyperlinks (or executes commands) to access more information. This practice can enable the site administrator to measure the value of the information accessed on the site.
Portal	A Web site that is or proposes to be a major starting site for users when they get connected to the Web or that users tend to visit as an anchor site. There are general portals and specialized or niche portals. Some general portals include Yahoo, Excite, Netscape, Lycos, CNET, Microsoft Network, and America Online's AOL.com. Examples of niches portals include Garden.com (for gardeners), Fool.com (for investors), and SearchNT.com (for Windows NT administrators).
Portal for HR Functions	A Web site about human resources that may contain proprietary organizational information. This information is usually related to personnel policies, compensation, benefits, and employee rights. An HR Portal often includes a search engine, links to useful pages, company news and other services.
Special Interest Group (SIG) (see also Community of Interest)	Groups or individuals with a common interest in program execution or a specific operational area. This interest may, but does not necessarily, relate to their day-to-day work or current tasking. Special Interest Groups often share ideas and communicate or collaborate together.

Searching and Precision Recall	The ability of a search engine to accurately locate information. Searching and precision recall measurement can assess how well meta-tags on data have been designed and how effectively users of the system can find the information they need through searching.
Usability	The ease with which a worker can interact with a system.
Usability Survey	A survey for users of a system to assess its functionality and usefulness. This may include questions related to how well the user interface is designed and how easy it is to search and access information.
Usage	The level and frequency of use made of the knowledge management system by the intended end users.
Usefulness Survey	A survey where users evaluate how useful initiatives have been in helping them accomplish their objectives.
(Corporate) Yellow Pages	A listing of individuals, their expertise or domain, and contact information.