Chapter 1
Conceptualizing and implementing knowledge management

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Introduction

Knowledge management (KM), in many ways, is more of an art than a science (Liebowitz, 1999). Knowledge management is the process of creating value from an organization’s intangible assets. Simply put, KM refers to sharing and leveraging knowledge within an organization and outwards toward customers and stakeholders. According to Liebowitz (2004), however, many organizations do not have a systematic approach to sharing and leveraging knowledge internally and externally.

In any growing field, the art often precedes the science until various methodologies, techniques, processes and tools are developed to underpin the field. This has certainly been the case with KM, as there has been a blurring of the true meaning of data, information, knowledge, expertise, wisdom and beyond (Liebowitz, 1999). In addition, the early contemporary works in KM promised improved knowledge-sharing techniques to increase innovation, improve customer service, retain expertise and enhance learning. As a result, many organizations appointed chief knowledge officers or chief learning officers to develop a KM strategy to spearhead knowledge initiatives. Several organizations, such as Dell and the National Aeronautics and Space Administration (NASA), preferred a codification approach, which emphasizes a systems approach to capturing and sharing knowledge, often emanating from their information technology (IT) department. Others, such as Hewlett-Packard,
Hallmark and the US Federal Aviation Administration, felt that a personalization approach to accentuate people-to-people connections was a better fit for their organization (Zack, 1999). Often both approaches have been used by organizations, but one generally dominates.

Knowledge management has such strategic value that organizations should include it as one of the key pillars of their human capital strategy (Liebowitz, 2004). Liebowitz (2004) suggested that KM strategy should be used to complement other strategic initiatives such as competency management, performance management and change management. It has been estimated that about half of the Federal civil servants in the US government are eligible to retire in the next five years, about 71 per cent of whom are senior executives (Liebowitz, 2004). In the coming years in the US government, there will be a severe knowledge bleed effect resulting from retirements. Knowledge management can play a significant role in addressing some of these human capital concerns (Liebowitz, 2004). Knowledge management can help to capture, share and leverage knowledge before it leaves the organization. Newly appointed chief human capital officers in the US government have undertaken the task of developing human capital plans for their agencies (Liebowitz, 2004).

A key question is whether KM will be the ‘management fad of the day’, and fall peril to the demise similar to business process re-engineering efforts. It has been estimated that about 70 per cent of business process re-engineering efforts have been failures in organizations (Love and Gunasekaran, 1997). Many people feel that KM may also become a similar victim if science and rigour in the discipline are not accomplished (Liebowitz, 1999). Knowledge management sceptics believe that knowledge cannot be managed; however, there are those who believe that it is possible to manage the environment in which knowledge exists. Others, such as Davenport and Glasser (2002), have suggested that KM is too amorphous, although it has an excellent altruistic value; however, the returns on investment for KM efforts are difficult to calculate. Liebowitz (2004) has suggested that KM is often viewed as being a ‘no brainer’ philosophy that is adopted by businesses; that is, taking advantage
of learning what others know and have experienced is essential in today’s competitive, fast moving, global environment.

Thus, a mystique of doubt and optimism surrounds KM. Part of this mystique is attributed to the evolution of the field as it develops. Certainly, to convert the doubters to believers, there must be a great degree of rigour imparted into the KM field. This chapter will examine some of these areas, and will suggest how KM can form an integral part of an organization’s fabric and strategy for managing projects.

A knowledge framework

A framework that organizations can use to conceptualize KM is presented in Figure 1.1. Here, data refer to discerned elements, and when processed or patterned in some way, they are transformed into information. Once the information becomes actionable, it is transformed into knowledge. When knowledge is then learned and embedded into individual and organizational processes, the value of knowledge to the individual and organization increases in worth. The environmental factors affecting this knowledge cycle relate to domain context, organizational culture and individual value system, management

![Figure 1.1 Conceptual view of the knowledge framework.](image-url)
initiatives and benchmarking/standards. Knowledge must have context if it is to be useful to an organization. In addition, the promotion or inhibition of knowledge will be affected by the organizational culture, as well as the individual’s value system. How knowledge is internalized and then externalized is related to an individual’s worldviews. Management initiatives and standards will also affect the creation of knowledge in the organization.

Suppose a project manager is currently concerned with testing a satellite that their team is building, for possible vibration problems. The project manager could receive some test data showing the results of the vibration testing experiment. By looking at some of the trends in the data, various patterns could be revealed (i.e. information). By examining these patterns, the project manager decides also to consult an available organizational ‘lessons learned’ database and discovers that a previous satellite experienced the same types of vibration testing problems that their satellite is experiencing. The project manager acts on this new information through their knowledge to determine the criticality of the testing results and what should be done to resolve these problems. At this point, this information is transformed into knowledge. As this knowledge is shared with others, either via word of mouth or through the lessons learned system, this knowledge will be embedded into the working processes of future project teams involved with testing.

The domain context in this example deals with satellite vibration testing. Certain standards are typically used to ensure the ‘safety and health’ of the satellite. If the organizational culture lacks a pervasive knowledge-sharing flavour, then the creation and exchange of vibration testing knowledge may be at risk of not being codified and transferred to other project teams that need these lessons learned. However, if the organization promotes the active capture, analysis and dissemination of lessons learned, then those project teams involved with vibration testing will be better informed. Coupled with the organizational culture and climate, the synergistic effect of management initiatives could influence how the knowledge is shared throughout the organization; that is, if there are competing management initiatives that shift work priorities on a
frequent basis, then there may be more risk of not capturing and sharing the necessary knowledge with all appropriate project teams.

Knowledge is often gained through experience. Experiential learning typically generates rules of thumb (heuristics). These rules of thumb are pieces of knowledge that can be in the form of lessons learned, anecdotes, cases, rules, guidelines or the like. In the project management or business environment, a general rule of thumb may be to take an estimate for the software development schedule and budget and double it. In the university setting, a rule of thumb is never to miss the first committee meeting. Usually the chair of the committee is selected at the first committee meeting of the year, and whoever is absent is unanimously selected as the chair (mainly because most people prefer not to have that responsibility and added workload).

Knowledge without context is futile. For example, Americans enjoy having a ‘comfort zone’ or personal space when speaking to others. Comfort zone refers to the physical distance between a person and others when speaking at an informal gathering (Kramer, 2001). In Asia and Latin America, the intimate distance or personal space is much closer than that in the USA. These cross-cultural differences influence the universality and generality of applying knowledge. These cross-cultural differences also impact the management of projects in organizations, as international team members must respect each other’s culture and customs, yet are able to move the project along within time, cost and schedule constraints. For example, NASA often works with international partners on space projects, so having the ability to respect each other’s practices is a necessity. Hence, context is an important part in producing knowledge.

Knowledge can be distilled from successes as well as failures. In project management, lessons learned and best practices abound. For example, NASA has a Lessons Learned Information System (LLIS), which has over 1300 lessons relating to project management, systems engineering and other areas. NASA project managers are now required to capture, access and apply lessons learned from the LLIS to their projects. Both successes and failures should populate a lessons learned repository to allow knowledge to be internalized and created in the context of various project environments.
The knowledge management cycle

The KM cycle consists of four major stages, as shown in Figure 1.2, and is used to support the framework presented in Figure 1.1. Knowledge is identified and captured, shared with others, applied in combination with existing pertinent knowledge, and then created in the form of new knowledge, which is then captured and continues as noted in Figure 1.2.

Nonaka and Takeuchi’s (1995) Socialization–Externalization–Combination–Internalization (SECI) model can be included as part of the KM cycle. Once key knowledge has been identified and codified in some way, a socialization effect occurs resulting in knowledge sharing. Knowledge resulting from this knowledge-sharing experience becomes externalized, resulting in an application of the knowledge. This knowledge is then combined with other knowledge that the individual possesses, as well as internalized along with the individual's worldviews and value hierarchy. This should hopefully result in new knowledge being created, which then needs to be preserved as it becomes captured and the cycle begins again.

Figure 1.2 The knowledge management cycle.
Now that a KM framework has been built, we can better understand how to develop a KM strategy and resulting implementation plan. Several researchers and practitioners have been studying techniques and methodologies for developing KM strategies and implementation plans (Apostolou and Mentzas, 2003; Liebowitz and Megbolugbe, 2003). According to Chourides et al. (2003), for KM to be successful, an organization must have a strategy and individuals must be persuaded to contribute to its formulation and implementation. The KM strategic plan has greater focus on the knowledge needs of the organization and an evaluation of capabilities. Apostolou and Mentzas (2003) developed the Know-Net KM approach, which includes the interplay among strategy, assets, process, systems, structure, individuals and teams, across organizations and within the organization itself. They use a systems thinking approach to KM that looks at the interlinking, feedback and control between these areas. Similarly, Sveiby (2001) discusses his knowledge-based theory of the firm and indicates nine important knowledge strategy questions:

- How can we improve the transfer of competence between people in our organization?
- How can the organization’s employees improve the competence of customers, suppliers and other stakeholders?
- How can the organization’s customers, suppliers and other stakeholders improve the competence of the employees?
- How can we improve the conversion of individually held competence to systems, tools and templates?
- How can we improve individual competence by using systems, tools and templates?
- How can we enable the conversations among the customers, suppliers and stakeholders so they improve their competence?
- How can competence from the customers, suppliers and other stakeholders improve the organization’s systems, tools, processes and products?
• How can the organization’s systems, tools, processes and products improve the competence of the customers, suppliers and other stakeholders?
• How can the organization’s systems, tools, processes and products be effectively integrated?

O’Dell et al. (1999) performed benchmarking studies on KM strategies. They found organizations using KM strategies as a matrix of KM as a business strategy, transfer of knowledge and best practices, customer-focused knowledge, personal responsibility for knowledge, intellectual asset management, and innovation and knowledge creation. In project management terms, the work of O’Dell et al. implies that successful project teams need to have a shared vision for the project, as well as a sharing of responsibilities to achieve the project’s goal. Levett and Guenov (2000) developed a methodology for KM implementation that looks at a four-phase approach of case-study definition, capturing KM practice, building a KM strategy, and implementation and evaluation. April (2002) developed guidelines for building a knowledge strategy looking at the interlinking of assets or resources, complementary resource combinations and the strategic architecture of the company. Nickerson and Silverman (1998) examined intellectual capital management strategies and proposed a strategy integration analysis methodology that uses six steps: assemble a multidisciplinary team, identify and select a target market and position, identify investments and technology, identify unique or idiosyncratic technologies that form the basis of competitive advantage by comparing the firm’s technology and intellectual position with that of potential competitors, choose optimal organizational and intellectual capital management configuration based on the preceding four steps, and evaluate expected profitability of this integrated strategy. Other researchers and practitioners, such as McElroy (2003), Liebowitz and Megbolugbe (2003), Mertins et al. (2001), Hult (2003) and Davenport and Probst (2002), have been involved in writing case studies dealing with KM strategy and implementation.

From the American Productivity and Quality Center’s Knowledge Management Benchmarking studies (2000), the
key features of successful implementation of KM are:

- An important senior champion or group saw the strategic value of KM and endorsed what became a significant investment in it.
- Communities of practice are a central part of the KM strategy. Sponsorship, membership, roles and responsibilities, accountability and measurement, and supporting tools are the elements that must be in place to develop and evolve communities.
- Functional silos are the most significant cultural barrier to KM implementation. Solicit senior leadership vision and active support to break down these barriers.
- The importance of making connections – of people to people and of people to information – is the driver to use IT in KM initiatives.
- As KM becomes more structured and widespread, the need for measurement steadily increases.

Seeley and Dietrick (2001) emphasize that building a KM strategy should use the following components: governance, culture, content management, technology, application and measurement. Earl (2001) discusses a knowledge mapping, cartographic approach to KM where knowledge networking and incentives to share knowledge are critical success factors. AT&T and Bain and Company have used this approach. Chauvel and Despres (2002), in their 1997–2001 review of survey research in KM, found that surveys are typically used in KM research. Liebowitz (2004) indicates the importance of KM as a key pillar in an organization’s human capital strategy. Holsapple (2003) talks about the importance of performing a knowledge audit as a first step in developing a KM strategy for an organization.

An essential output of the knowledge audit process is the knowledge map, which provides insights for improving business and organizational processes. A knowledge map portrays the sources, flows, constraints and sinks (losses or stopping points) of knowledge within an organization. Well-developed knowledge maps help to identify intellectual capital, socialize new members and enhance organizational learning (Wexler, 2001). Knowledge maps have been used for a variety of
applications, even for developing a knowledge map of KM software tools (Noll et al., 2002). By developing a knowledge map, the organization can (Grey, 1999):

- encourage reuse and prevent reinvention, saving search time and acquisition costs
- highlight islands of expertise and suggest ways to build bridges to increase knowledge sharing
- discover effective and emergent communities of practice where learning is happening
- provide a baseline for measuring progress with KM projects
- reduce the burden on experts by helping staff find critical information/knowledge quickly.

Some of the key principles in knowledge mapping are: establish boundaries and respect personal disclosures, recognize and locate knowledge in a wide variety of forms, and locate knowledge in processes, relationships, policies, people, documents, conversations, suppliers, competitors and customers (Hylton, 2003). The types of question that should be asked to develop a knowledge map include (Grey, 1999):

- What type of knowledge is needed to do your work?
- Who provides it, where do you get it, how does it arrive?
- What do you do, how do you add value, what are the critical issues?
- What happens when you are finished?
- How can the knowledge flow be improved, what is preventing you doing more, better, faster?
- What would make your work easier?
- Who do you go to when there is a problem?

Typically, information is collected for the knowledge map by using the following methods (Grey, 1999):

- conduct surveys, interviews and focus groups
- observe the work in progress
- obtain network traffic logs, policy documents, organization charts, process documentation
- explore the common and individual file structures
- concentrate on formal and informal gatherings, communications and activities
- gather from internal/external sources
- move across multiple levels (individual, team, department, organization).

Knowledge management strategy
implications for projects

Most of the KM researchers and practitioners stress three major components of a KM strategy: people, process/culture and technology. The mantra in the KM field is that 80 per cent of KM is people and process/culture, and the other 20 per cent is technology (Liebowitz, 1999). The technology is used as an enabler for sharing knowledge (the organization’s intranet, lessons learned information system, expert locator system, online communities, etc.), but the tough part of KM is the people, process and culture aspects. For example, why would an individual want to share his or her expertise (i.e. his or her ‘competitive edge’) with others? As a project manager or team member, why should they perform KM as they already have a full plate of other responsibilities?

In both of these cases, it becomes quite clear that the people and process aspects become paramount when trying to build and nurture a knowledge-sharing culture. With respect to the first question of sharing what one knows, there should be a recognition and reward structure within the organization to encourage people to perform knowledge-sharing. The World Bank, for example, has a set of learning and knowledge-sharing proficiencies whereby each employee is evaluated at their annual job performance review as to how well they have achieved these, and other, proficiencies. Knowledge sharing needs to be encouraged and built into the daily working activities. Knowledge management processes need to be embedded into normal work processes so that they do not seem to be a burden on the individual. At NASA, for example, capturing and applying lessons learned is a requirement for all NASA projects. Sharing of lessons learned, mentoring, applying knowledge capture/retention activities, exchanging stories and experiences at staff meetings, and other approaches could be used to help to embed KM throughout everyone’s job.
Ultimately, the goal is to use KM to ‘work smarter, not harder’, and hopefully to stimulate innovation, improve worker productivity, increase customer satisfaction and maximize employee fulfilment.

For KM to work, it must be aligned and integrated with the strategic goals of the organization. If it seems disjointed and not synchronized with the business and strategic organizational goals, then KM will be doomed to fail. The KM plan must also be well-conceived and designed, and should be congruent with the organization’s culture. For example, in the NASA environment, most of the employees were scientists, engineers and technologists. They preferred a codification approach (i.e. systems-orientated approach) to KM rather than the personalization approach, partly because of their personalities, educational backgrounds and technical orientations. Thus, the KM strategy should probably be dominated by the codification approach, as well as applying KM personalization approaches (e.g. knowledge-sharing forums whereby experienced project managers exchange ‘war stories’ with up-and-coming project leaders).

To maximize the effectiveness of KM, senior management support (both financially and morally) must be very strong. Since KM has a long-term vision and deals with intangible assets, some managers may be reluctant to invest resources in this area, especially if budgets are tight and there are more pressing short-term needs. Thus, top management support is critical in paving the way for KM. Various organizations are integrating KM as part of their human capital strategy. In the future, more organizations will probably do the same as KM should be a critical part of one’s human capital strategy. The following case study examines how NASA applied a KM strategy within the organization.

Case study: NASA’s strategic plan for knowledge management

The environment at NASA has a heavy project management-based orientation. As the Columbia Accident Investigative Board’s report (www.caib.us) indicated, the organizational
culture of NASA must reflect the best practices of a learning organization. These practices need to extend to all projects throughout NASA. Knowledge management should be a key component in creating a knowledge-sharing culture at NASA and transforming the agency into a learning, adaptive organization.

Towards making this goal a reality and recognizing the importance of KM, NASA had developed its own strategic KM plan (NASA Knowledge Management Team, 2001). NASA has been active in KM through its work at its ten NASA centres (Liebowitz et al., 2003). The plan reflects three priority areas where KM can help NASA’s ability to deliver its missions (NASA Knowledge Management Team, 2001), which are:

- to sustain NASA’s knowledge across missions and generations (KM will identify and capture the information that exists across the Agency)
- to help people to find, organize and share the knowledge NASA already has (KM will help to manage efficiently the Agency’s knowledge resources)
- to increase collaboration and to facilitate knowledge creation and sharing (KM will develop techniques and tools to enable teams and communities to collaborate across the barriers of time and space).

NASA’s KM strategic plan is built upon three key areas: people, process and technology. In terms of people issues, some of the following desired attributes of the ‘new’ environment would be encouraged (NASA Knowledge Management Team, 2001):

- recognize the value of both generalists as well as experts
- reward people with bonuses or awards for broadly sharing or making knowledge reusable by others
- create or augment position descriptions for people whose job is primarily to share or distribute knowledge
- institute ground rules (procedures) for sharing discoveries so that professionals can feel secure in getting proper credit for their contributions
- help people to maintain and disseminate corporate knowledge through informal and formal methods
• publish and recognize successes in KM that help to increase mission success or create expectations of sharing
• encourage collaboration and sharing across centres.

In terms of process, KM can contribute towards NASA’s strategic goals by (NASA Knowledge Management Team, 2001):

• developing a set of collaborate tools for virtual teams and communities to share information and knowledge
• applying KM services to help to capture and manage scientific and engineering knowledge as it moves from one researcher to another
• using KM to disseminate knowledge across internal and external audiences
• embedding KM into the daily working activities of the NASA employees.

Learning from successes and failures is also a critical part of KM activities at NASA. The NASA LLIS (http://llis.nasa.gov) serves this purpose in providing over 1300 NASA-related lessons in project management, systems engineering and other areas (there is even a public version of the LLIS called ‘Public Lessons Learned System’ at http://llis.nasa.gov). There is a user-profiling feature that allows the user to indicate his or her areas of interest, and as new lessons are entered into the LLIS and fit the user’s interest profile, these lessons are sent via e-mail to the user showing URL links to the lessons. In addition to the LLIS, lessons learned must be captured and used throughout the NASA project life cycle, as indicated in NASA Procedures and Guidelines 7120.5B: Program and Project Management. In this manner, project teams will become accustomed to accessing and capturing lessons learned during their project’s life cycle. Pharmaceutical companies are also very interested in learning from past projects as the drug development process can take twelve to fifteen years, and few researchers are involved from start to finish so staff turnover can complicate the management of knowledge (Zimmermann, 2003; Schindler and Eppler, 2003).

With regard to the technology component in NASA’s KM strategic plan, the thrust is to use technology as an enabler to
sharing knowledge. Web portals, lessons learned databases, document-sharing systems, expert systems, intelligent agents, data-mining tools, collaboration tools, improved intranets, expertise locator systems, web-based online searchable video repositories and other technologies should be applied to improving knowledge capture and sharing at NASA.

In terms of implementing KM initiatives, many organizations typically try in the first year to educate people on KM, develop some quick-win KM pilots and build the technology infrastructure to enable knowledge sharing to take place. In the second and succeeding years, the organizational infrastructure to support KM is further developed (such as having knowledge stewards or knowledge capture managers on key projects), the KM pilot efforts expand into full-length projects, processes are established to embed KM into daily work activities (e.g. capturing and applying lessons learned, starting each staff meeting with five to ten minutes of ‘storytelling’/knowledge sharing and developing a formal mentoring programme), and the recognition and reward structure is adjusted to incorporate learning and knowledge-sharing proficiencies.

For example, when Liebowitz (2002) was the first knowledge management officer at NASA Goddard Space Flight Center, a knowledge management working group was established, comprised of representatives across all directorates, human resources, IT, library, public affairs and selected others. The first year was devoted to creating an awareness of KM throughout the organization, via briefings, tutorials, quick-win pilot efforts, knowledge-sharing forums and online communities, and using creative learning groups to improve connections between people. The technology infrastructure, specifically the intranet, was being revised to improve the look and supporting functionalities for information and knowledge sharing to take place. At the end of the first year, a new position, the knowledge capture/retention manager, was established on two major projects. This individual was responsible for promoting a knowledge-sharing environment, through codifying key expertise and processes, developing lessons learned, establishing knowledge-sharing forums where experienced project managers would meet up-and-coming project leaders and exchange their ‘war stories’, and initiating other KM activities.
Towards the beginning of the second year, KM was being considered as a key component of the organization’s human capital strategy, processes were being developed to facilitate KM as part of everyday working life, and the recognition and reward system was being reviewed, possibly to include learning and knowledge-sharing proficiencies as part of everyone’s annual performance plan.

Conclusions

Knowledge management has a critical role to play in project-based environments. This chapter described some conceptual frameworks behind KM, and discussed some KM strategy and implementation issues. NASA was used as a short case study to demonstrate how KM can be applied in a project-based environment. The use of lessons learned, capturing and sharing key knowledge, and providing mechanisms to encourage the management and sharing of knowledge are important elements that can enhance project management and systems engineering. In the years ahead, those organizations that apply the tenets of KM should be able to increase innovation and customer satisfaction, while improving the retention of expertise and strengthening a sense of community among employees, project teams, customers, suppliers and other stakeholders.

References

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Management of Knowledge in Project Environments

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