Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process

by

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M.S., Computer Science, University of California, Los Angeles, 1975

Submitted to the System Design and Management Program in Partial Fulfillment of the Requirements for the Degree of

Master of Science in Engineering and Business Management

At the

Massachusetts Institute of Technology

February 2002

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Submitted to the System Design and Management Program on January 15, 2002
in Partial Fulfillment of Requirements for the Degree of
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ABSTRACT

Premise of the thesis is that in today’s knowledge economy, competitive advantage comes from effective use of corporate knowledge. This thesis compares and contrasts current practices for knowledge sharing in Xerox with an idealized model of best practices for knowledge sharing. The study explores the hypothesis that stage gates in a product development process are important for sharing corporate knowledge across functions and organizations, and that the product development process itself serves as an infrastructure for knowledge sharing. This study involved an analysis of knowledge sharing practices during stage gates reviews and how they evolved over time after stage-gate reviews.

To develop an idealized model of best practices for knowledge sharing, experts of knowledge management in academia and industry were interviewed, and an extensive literature review was completed. This served as a backdrop for analysis in the case study at Xerox. The case study at Xerox utilized a personal interview approach complemented by a survey through electronic mail, and assessment was done against the idealized model of best practices for knowledge sharing. Twenty-six senior managers at Xerox were interviewed/surveyed. Strengths of Xerox in knowledge sharing and areas of improvements were identified. Using open ended questions, a holistic view for the scope of Xerox efforts, as well as the depth and quality of the best practices during the product development process was compiled. Using Carlile’s knowledge boundary framework and boundary objects, attempt was done to transform engineering knowledge from one domain to another. This framework also served as a basis for suggestions for future improvements in knowledge sharing at Xerox in the areas of improvements identified through the interviews/surveys.

Though any single company has not discovered the mantra for knowledge management and sharing; several good practices, which were consistently enablers
of perceived success, were identified. The effective enablers towards knowledge sharing were a synergistic gathering of “common sense” items such as morale, trust, common goals, value and criticality of knowledge, diversity, and structure, rewards/recognition, support and knowledge initiatives along multiple fronts. It was discovered, that the product managers perceive that Xerox has considerable success in promoting a knowledge culture and has an effective product development process. It was also found that knowledge boundary framework and boundary objects serve as a good vehicle to explain the difficulty of knowledge sharing across functional and organizational boundaries. Engineering tools such as critical parameter management could benefit by a uniform, standardized approach to bringing together subject matter experts from various domains and creating the environment for creating new knowledge and innovations.

Systems processes like the Xerox platform approach, where the systems architecture is composed of common platform elements, and core competencies in the development of reusable components for the platform elements are the basis for the Xerox product development process. Using the knowledge acquired through practical experience and education and taking a holistic view of the product development process as the boundary framework for knowledge transfer, we used the eCPM (Engineering Critical Parameter Management Tool) to translate knowledge from a domain expert in mechanical engineering to a common semantic base for transformation into the domain of software engineering.

Specific tacit knowledge on what makes a parameter critical and how it plays a role in mechanical aspects in the design of Xerox devices, such as the system itself, media and motion path, marker path and the control and image path, as well as how to control these designs is to be transformed into the domain of software engineering. It was found that use of the eCPM tool to develop similar meaning of parameters for tuning software resources such as CPU speeds, memory utilization and performance is possible.

Attempt to create new knowledge in the domain of software will be proceeding with a larger number of domain experts. Specific new knowledge in establishment of which software parameters to be labeled as critical (versus design parameters allocated and controlled via Input/Output/Constraint values), which parameters should be system control parameters (those which span over multiple subsystems, and have latitudes within which to be tweaked in various sub-systems), the failure modes and latitudes for the failure modes will be part of future work. This will be part of a knowledge sharing and management framework proposed in the thesis because of the diagnostic analysis done of the current state at Xerox.

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Acronyms

BP  Best Practices
B2B  Business to Business
CEC  Corporate Engineering Center
CP   Critical Parameter
CPM  Critical Parameter Management
CPU  Central Processing Unit
eCAD Xerox Website for Computer Aided Design Process and Tools
eCAE Xerox Website for Computer Aided Engineering Process and Tools
eTTM Xerox Website for Time to Market Process
eCPM Xerox Website for Critical Parameter Management Process and Tools
ePIM Xerox Website for Parts Information Management Process and Tools
FIT  Functionally Important Topic
KM   Knowledge Management
KS   Knowledge Sharing
PDT  Product Delivery Team
LL   Lessons Learnt
NIH  Not Invented Here
NVM  Non Volatile Memory
OEM  Object Exchange Model
ROI  Return on Investment
SW   Software
TAT  Technical Advisory Team
TTM  Time to Market Process (Enhanced Product Development Process)
TTMDT Time to Market Decision Team
QA   Quality Assurance
QCD  Quality, Cost and Delivery (Metrics)
WWW  World Wide Web
Chapter 1. Purpose of the Thesis

1.1 Introduction

Knowledge management (KM) in today's firms is being attempted in various ways. Some are trying to make their organization a learning organization, some seek to develop expert systems, some make KM as their strategy focus and others resolve to develop knowledge focus as core competencies. Knowledge is in fact the company in an important sense. It is the intrinsic value of knowledge, because what a firm and its employees know is at the heart of how the firm functions. Davenport (1998) quotes former HP CEO, Lew Platt who was echoing a former head of HP Labs, "IF HP knew what HP knows, and we would be three times as profitable". The company, that is able to transfer knowledge of the products it designs, the business environment it serves, as the technologies and people's work scenarios change over time, is assuring its own long term success. A Stanford economist has claimed, "Knowledge is the only unlimited resource, the one asset that grows over time". Knowledge also can be a sustainable advantage.

![Image of corporate knowledge hierarchy]

Fig. 1.0 Corporate Knowledge, its roots and implications

Knowledge and technology are interdependent and one begets the other. However, the values and beliefs probably have more of an impact than information and logic because of power of knowledge to organize, select and judge. Using knowledge to deal with complexity in a complex fashion depicts its value. One thing to note is as an individual’s or firm’s knowledge grows, the individual or firm realizes what it does not know, which can be humbling. In a global economy, knowledge may be a
company’s greatest competitive advantage. In a growing knowledge economy, corporate knowledge will be THE competitive advantage. Corporations must progress crystallizing and filtering along the knowledge spectrum: Data > Information > Knowledge > Corporate Wisdom > Competitive Advantage > Profits as depicted in Fig. 1.0 above.

In a phenomena, which is intuitively reverse, Human knowledge awareness has resulted in replacing assembly line robots with human workers, as NEC in Honjo, Japan, decided that as humans are more flexible and intelligent, they could deal better with change pervasive in today’s economy.

1.2 Assumptions

Importance of knowledge as a competitive edge for today’s businesses will be not be dwelled upon in this thesis. In addition, it will be assumed that the reader has a fair understanding of product development process, the stage gates and the factors associated with the use of them as well as the use of a platform-based approach to develop variant products.

1.3 Problem Statement

We want to study how stage-gates (also known as phase gates) can be used more effectively in increasing the corporate knowledge of the company regarding its products and their development and delivery process.

1.4 Justification for the Study

I saw this footnote under a painting at the Museum of Fine Arts in Boston: *Purpose of Knowledge is to cultivate the human being to evolve from sperm to manifestation of divine*.

We will not use this purpose here as our scope is much smaller, and continuous knowledge creation/capture and knowledge sharing is critical to Xerox’ survival and that purpose is the basis of this study.

This is an attempt to compare and contrast Xerox past and current situation with respect to knowledge sharing versus the role model industry practices. Focus will be on knowledge capture/sharing during stage gates of the product development process. As Xerox has progressed (and in some cases regressed) in the knowledge area, we would like to see the social practices and interactions during stage gate reviews of the product development team by the TAT (technology assessment team) and how these practices have changed over time.

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
1.5 Approach of the Study

We will first understand what constitutes corporate knowledge, how it is created, captured, shared and managed. We will also study the theories about creation of knowledge as well as how different industry groups deal with use of the knowledge. An attempt will be made to compile the best practices of knowledge management, obtained both from industry and academia. We will then study where Xerox is at, both in terms of its strategy towards knowledge sharing as well as in practice. Knowledge sharing during the product development process will be the special area of focus. Information will be obtained using personal interviews / survey of senior product development managers at Xerox. Gaps against an ideal organization with effective knowledge sharing practices will be identified and prioritized. An attempt will be made in recommending a framework as well as specific steps to improve the knowledge sharing within the company through the means of the product development process.
Chapter 2. History and Background

2.1 Definitions

Let us establish some working definitions for the lingo used in this study so that we can have a common syntactic and semantic base:

At the bottom of the pyramid depicted in Fig. 1.0, we have:

**Data**, which can be defined as a set of discrete, objective facts about events. It is the raw material for creation of information. It can be quantitative measurements like cost, speed, capacity or qualitative like timeliness, relevance, and clarity. There is no inherent meaning in data and can be overwhelming if there is too much of it.

**Information**, is the message around a data. It is sent and received by different parties and can be in a form of a document (electronic or paper) or in other multimedia formats such as audio and video. Information transfer within a company can be by hard methods such as e-mail, post mail, satellite, internet, intranet...or via soft methods such as hand-written or typed notes, copies or personal interaction. The receiver of information can qualitatively decide if the message truly informs him or her. Quantitative measures of information are like connectivity; transactions per unit of time and qualitative measures would be like information content, and usefulness.

Information is a necessary medium or material for eliciting and creating knowledge. It can be viewed as syntactic and measured quantitatively in number of units and as semantic and measured qualitatively by its meaning. Both perspectives are necessary to view information.

Information is created using data after meaning to the data has been added. Semantically, one can contextualize data, which relates to the purpose of the data. We can also categorize data into units of analysis or key components. Data can be calculated on in mathematical or statistical sense to develop higher level of information. One can also screen data to remove outliers or errors and increasing its relevance. Information, once condensed, can also be in form of summary of data. One should note that having more technology does not necessarily improve the state of the information; only then access to it is facilitated for future processing.

**Knowledge**, is the ability to act on information as defined by Holmes (2001). Knowledge is closer to action than either data or information. It can also be seen as the first derivative of information with respect to time or space or culture.
Knowledge is a fluid mix of experience, values, contextual information and expert insight, which allows one to evaluate new experiences and internalize new information. In other words, knowledge is information in action or that has the potential to be put in action.

As Peter Drucker (1998) notes that Information is data endowed with relevance and purpose. Knowledge, by definition, is specialized. Previously, knowledge lay with the very top people. In an information-based organization, the knowledge will be primarily at the bottom, again in the mind of the specialists, who do different work and direct themselves.

Nonaka and Takeuchi (1998) define knowledge as about beliefs and commitments. Knowledge is aware of what it does not know. In their opinion, when experts develop a mind-set of refusing to examine their own expertise, then knowledge degrades to dogma or opinion. They further define knowledge as a “dynamic human process of justifying personal belief toward the truth”.

Nonaka and Takeuchi (1998) have taken a step further and defined two different sub-types of knowledge: explicit and implicit. This thesis will use their definition.

**Explicit knowledge, is the knowledge that can be expressed formally.** This can be done using formal language with grammatical statements, mathematical expressions, specifications, manuals, scientific formulae or even software. Explicit knowledge is objective, knowledge of mind, chronological and of clear theory. It is about past events or objects and is context free.

**Tacit knowledge, is the total personal knowledge one has due to experience, learning and is based on personal beliefs, values and viewpoints.** Tacit knowledge is subjective, highly personal, knowledge of mind, immediate, and of practice. It is current, but hard to formalize. It can be viewed in the technical sense, where special hard to pin down skills or crafts are the “know-how”, as well as in the cognitive sense which are beliefs, mind sets, perceptions and intuitions usually taken for granted and therefore hard to articulate.
2.2 Knowledge Creation / Capture

Nonaka (1998) states that in economic uncertain times, knowledge is one lasting competitive advantage.

Knowledge is created by minds at work and originates and applied in the mind. In an organization, knowledge becomes internalized in documents, repositories, organizational policies, processes and standards.

Humans create knowledge again as they transform information by comparing, connecting, serializing and converting information. It is conveyed via documents, personal contacts, conversations, and apprenticeships. Too much knowledge can reduce its value and may have to be degraded to information or data to make any sense out of it. Davenport (1998) quotes Aeschylus of 2500 years ago: “Who know useful things, not many things, is wise”

Knowledge can come in various forms:
- Experience: which allows an individual to view and understand new situations and events, using a historical perspectives. When a firm hires experts, they are hiring experience-based insights.
- Stories: when a human adds meaning to facts in real situations, which are experienced at the ground level. The Army’s AAR (After Action Review) program was one which was focused on what happened versus what was supposed to happen, and learn from the differences once the cause of the differences were identified.
- Judgment: knowledge improves itself as the individual experiences new situations and information.
- Intuition and rule of thumb: flexible guidelines for action developed through trial and error over long experience cycles.
- Compressed Expertise: scripts allowing rapid action through complex situations.
- Values and beliefs: this is what allows individuals to selectively see, absorb and draw conclusions from observations.

Nonaka and Takeuchi claim that Japanese companies have become successful because of their skills and expertise at “organizational knowledge creation”. They define knowledge creation as the capability of a company as a whole to create new knowledge, disseminate it throughout the organization and embody it in products, services, and systems. Using slogans, metaphors and symbols to guide activities, knowledge can be created by continuous innovation. Honda used the “Tall Boy” which represented a goal of creating a spacious (tall) and inexpensive (short) car. This was conceptual knowledge carried through the metaphor of “Automobile
Evolution” and the analogy between a sphere and the concept of “man-maximum, machine-minimum”.

Let us look at some common methodologies used for knowledge creation / capture:

Knowledge is acquired both internally and externally. When hiring consultants, it is important for the firms to have them transfer knowledge to internal resources as soon as possible.

Specific knowledge creation groups, such as research and technology groups, core competency development groups, and business labs generate knowledge, which needs to be captured and diffused throughout the corporation.

When there is interaction at the boundaries of two mindsets, knowledge i.e. innovation is created. When two different knowledge or skill-s sets fuse, new knowledge is created. This also happens to teams who know solutions to different aspects of a problem and can contribute from those perspectives i.e. boundaries; then when a solution is created which did not exist before, knowledge has been created. This can only occur after the team members have had sufficient time to interact, share their own knowledge and have achieved a common semantic base. This is what Carlile would call “pragmatic” level of knowledge creation i.e. when the team members are able to go across their own boundaries into other team members’ and are able to formulate new thought patterns. Effective knowledge seekers almost have to cross-departmental boundaries.

Knowledge is also created when communities whose members share common goals, practices and language share their own knowledge because of “chemical” reaction that takes place when the team members share differences. This is especially true when the groups are informal and self organized without any management direction or agenda. Organizational memory is the network of shared meanings such as corporate goals and strategies.

Knowledge can be created, as information (messages around data) is categorized, described, mapped, modeled, simulated or embedded in roles, responsibilities or methodologies.

Knowledge’s value is more valuable for its relevance than its quantity. More relevant knowledge is more valuable than more complete knowledge.

Tacit knowledge is extremely difficult to codify and only through mentorship, or apprenticeship, codifying tacit knowledge is possible. Western cultures focus on knowledge that is explicit as opposed to eastern cultures, which emphasize tacit knowledge.

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
To convert tacit knowledge to explicit, the essence of the mind is expressed in figurative or symbolic way. This converted knowledge is disseminated and the receiver(s) then using dialog and reflection create new explicit knowledge after dealing with ambiguity, through redundancy of opinions (consensus reaching).

Nonaka (1998) notes that human knowledge is created and enhanced when there is social interaction. He believes that organizational knowledge creation is a continuous and dynamic interaction between the firm’s tacit and explicit knowledge. He explains that the socialization mode starts in an environment where such interaction is possible, once team members share experiences and mind-sets. It is during this meaningful dialog and collective sense-making by the team, a state is triggered, that he calls “externalization”, where team members use metaphors and analogies to explain their mind-sets and share their tacit knowledge which otherwise is hard to communicate. The team has reached the state of “pragmatism” (Carlile 2001) because the team members are into each other’s domains using constructs like metaphors and analogies to cross boundaries.

Organizational knowledge is created as tacit knowledge is drawn out of the individual. The knowledge “spirals” through what Nonaka (1998) calls “four” epistemological dimensions i.e. socialization, articulation, combination and internalization and gets larger in magnitude as it traverses five organizational conditions over time i.e. intention, fluctuation/chaos, autonomy, redundancy and requisite variety. It traverses the organizational levels i.e. from individual to group to organization and eventually to inter-organizational levels crossing unit, department, division and company boundaries. These levels are interdependent and interact with each other continuously.

Knowledge is perishable and therefore needs to have continued focus, support and drive as the firm competes in today’s rapidly changing business and technology environments. Firms need to rely on continuously replenishing their relevant knowledge to stay competitive. Knowledge based innovation needs to be continuously incremental. Organizational knowledge is also highly dynamic compared to individual knowledge, which changes at a slower pace. It is creative and just like a living organism can develop in unexpected directions. According to Davenport (1995) knowledge sharing is motivated by reciprocity, repute and altruism. Experts share their knowledge in order to develop a network, which can pay off in the future, when they themselves are seeking knowledge. They also want to be known and regarded as experts, and feel wanting to share knowledge to keep up and enhance that reputation. Knowledge makes one humble as one discovers how little one knows and develops a “goodness” of the heart to be willing to share one’s knowledge. Some become mentors when they feel the desire to pass on their knowledge to others. As one develops a reputation for sharing knowledge, it also makes them more capable and motivated to seek more knowledge.

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
When knowledge is not complete, or universally available to the organization, or only remotely available, then the firm will be inefficient in its development of quality products and services. Accessibility to knowledge must be made in the easiest and quickest way possible to lower the cost of knowledge sharing.

Nonaka characterized knowledge-creating companies as places where inventing new knowledge is not a specialized activity – it is a way of behaving, a way of being, in which everyone is a knowledge worker. He suggests companies use metaphors and organizational redundancy to focus thinking, encourages dialogue, and make tacit, instinctively understood ideas explicit.

For learning to become a meaningful corporate goal, “learning” must first be understood.

2.3 Knowledge Sharing

According to Xerox, knowledge sharing is the social way and the technical means by which an individual, team, organization and/or community connects and communicates to continually create, innovate, learn and take action.

Knowledge resources within a company have unlimited potential growth. As knowledge is shared, it stays with the giver and enriches the sender thus doubling in size and can grow in a binary fashion on each sharing. It can be a corporate asset only if it is accessible throughout the organization. The advances in communications and database technologies along with lower costs of computing have created a potential pipeline as well as storage medium for global knowledge sharing.

Knowledge management, however, is difficult to understand and implement, because the business process it is trying to automate or make it computer and network assisted, does not yet exist in the industry. Knowledge acquired through experience does not get shared within the company in any formal way. Knowledge gathering, organizing, restating it more relevantly and disseminating among the employees is what constitutes knowledge management and is a necessary enabler for knowledge sharing. Knowledge management is also addressing the critical issues of organizational adaptation, survival and competence in face of increasingly discontinuous environmental change.

Tschiatschian, et al (2000), lists the knowledge management subtasks as

- Identification of knowledge by prospecting, visualizing and assessing;
- Acquisition or conversion from tacit to explicit; distribution; application;
- Storage and renewal of knowledge.

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They describe the Stanford – IBM Manager of Multiple Information Sources (TSIMMIS) that is a system that offers a data model and a common query language to support combining information from many different sources. Before we discuss knowledge sharing, we need to understand the issues that are characteristics of knowledge work.

Knowledge work initiatives have ranged from complete organizational transformation mandated by senior management to grass root efforts in building communities of practice for self-survival. Davenport, Jarvenpaa and Beers (1996) have recommended an intermediate approach which takes into account the type of knowledge work necessary for an organization, its organizational culture and the company’s business needs. They note that after reviewing 435 organizational initiatives, only 4% had redesigned the organization’s Product Development Process (PDP), which is a knowledge work process critical to long-term performance of the company. We can look forward to knowledge being more embedded in employees’ work activities, thereby increasing the need for more personal interaction as well as rapid updates of distributed knowledge.

Process is a specific ordering of work activities over time and place, which starts and ends with clearly identified inputs and outputs, and a structure for action.

There is diversity, ambiguity and uncertainty in all inputs and outputs. Neither the specific methodology of work nor the classification of knowledge exists in real world. It is difficult to partition what is process, what are the outputs and what are the inputs. Metrics pertaining to knowledge do not exist, compounded by the fact that knowledge workers are predominantly self-empowered and somewhat autonomous from the normal command-and-control environments. In addition, there is considerable variability in work performance of individual contributors, as well as over time, as there work is largely inconsistent. Information technology is just beginning to address some of these problems in the knowledge domain.

In the new model of work, employees are expected to make decisions and judgments based on the needs of the specific situations, and firms are responsible for developing such appropriate judgmental capabilities in their employees. Keeping open communications channels to allow free exchange of ideas, and discussion about values so that management does not need to keep monitoring of group’s direction, the team is self-driven by synergy of common values. For physically dispersed teams, occasional face-to-face group interaction to share experience and ideas in person or by video and less preferably by audio or net conferencing is necessary for continued knowledge sharing and peer support.

Knowledge workers can be those who:

- Acquire knowledge from existing sources;

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- Create new knowledge via combining existing knowledge or innovation resulting from personal interaction of employees;
- Package knowledge into repositories or other storage media;
- Apply knowledge such as professionals like designers, architects, engineers, doctors, lawyers etc and those who
- Re-use knowledge such as different functional organizations involved in the PDP process reusing existing components of knowledge.

Davenport (2001) reports that a product development organization was able to reduce its cycle time of its product approval phase, by 70% when it analyzed its PDP process and discovered that two-thirds of people involved in the approval cycle needed to only know about the product and not approve it.

Companies can change knowledge by compacting to its essence, and improving knowledge acquisition process. They can improve their own performance by organizing new structures, new processes or where people work and interact with initiatives, such as collocation. They can improve the effectivity of knowledge work using technology to enable knowledge repositories and using telecommunications and implementing corporate infrastructure to bring different knowledge workers into contact with one another. Companies must manage their two most valuable assets, namely, the knowledge and the people who possess it and are able to create new knowledge.

As for knowledge initiatives, companies need to clearly think out the role of the information technology czar, the knowledge initiative champion, design of the initiative and rationale for radical change.

Knowledge management projects should be started in areas with high value knowledge using a focused pilot project. As the project begins to take hold, more needs will become obvious, which can then increase the scope of the project. It is better to work simultaneously along multiple dimensions such as technology, organization, culture... Knowledge management projects should not be at the expense of other business strategies or business practices.

2.3.1 Knowledge Transfer

Carlile (2001) describes the problem of knowledge transfer across boundaries. As knowledge is localized and within the boundary of a function, it becomes challenging as one tries to use it across the boundary. He uses the concept of a boundary object as part of a framework to explain the states of knowledge and difficulties in its transfer and use, citing the example of knowledge transfer in new product development. He uses four functions within new product development, namely, design, manufacturing, production and sales/marketing to show how inter-
dependent knowledge of the same product components is structured differently in the four domains and how one might be able to transform the knowledge to make better use of it.

Carlile (2001) maintains that, "the characteristics of knowledge that drive innovative problem-solving within a function actually hinders problem solving and knowledge creation across functions". "Knowledge is localized, embedded and invested in practice". This characteristic of knowledge makes it difficult to be used in other functions. Three factors: difference (knowledge perspective within a function), dependence (on knowledge within a function and effecting knowledge outside the function) and novelty (with changes in organizational work effects, new differences emerge) add to the difficulties in the use of cross-boundary knowledge. For organization to innovate across multiple departments, it has to resolve the differences in knowledge across functions. Extending the current theories of syntactic and semantic approaches to knowledge transfer, Carlile proposes the pragmatic approach, supplementing and completing the current theory.

The syntactic approach deals with knowledge transfer across a knowledge boundary once common syntax is shared and stable. One can then proceed with knowledge transfer given the communication channel is stable and accurate, and there is sufficient bandwidth to support the knowledge being transferred. One then needs to only measure the volume and quality of knowledge transfer in terms of transactions and their accuracy. However, a shared syntax or common vocabulary is necessary but not enough. We need to also worry about the meaning of the knowledge. The meaning across a functional boundary can change due to local perspectives of the functions and the environments within which they operate. Semantic view recognizes these differences. Context in which the knowledge is being transferred needs to be considered and "mutual understanding" needs to be achieved by personal interaction of individuals from different functions. Now, to considering the consequences of the differences in syntax and semantics, we need to use the pragmatic approach.

Assuming that differences have consequences, which cause dynamic dependencies, it requires that different functions need to change their own tacit knowledge to account for these dependencies. Carlile (2001) notes that transforming knowledge refers to altering current knowledge, creating new knowledge and validating it within each function and integrating it across functions. According to Carlile, there are three characteristics of effective boundary objects, which can be used by different teams to collaborate and solve problems across their boundaries. First, a boundary object establishes a common vocabulary for different individuals to represent their knowledge. Second, a boundary object provides a process for individuals to specify and study differences and dependencies across a given boundary. Third, the boundary object facilitates a
process for individuals to transform knowledge so differences can be understood and consequences addressed.

A good example of this could be critical parameter management for a system. When one develops a product, which is a system of components, there are system level parameters that will make or break the product’s effectiveness. Examples of system level parameters are performance, cost, reliability, and energy use.... These system level parameters are subdivided into specifications for the subsystems in order to facilitate concurrent engineering. An overall architect or designer overlooks these system level parameters. The localized sub-parameters then become hard boundary conditions for the subsystem and are designed and met at a local level. For functions outside the group, the other functions are seen as “black boxes” with certain input, output and constraint parameters. This precludes any tradeoffs in the latitudes of the local parameters so that between local parameters, the overall system level parameter is achieved at the desired value. Even though the syntax is the same i.e. energy use and units of measurement is the same i.e. watts, the semantics and consequences across the boundaries of the sub-system are different and not being addressed. The desired value of say the energy use is system wide but the solution will always be localized to the sub-systems. Knowledge of the sub-parameters is also localized and invested. To tweak the system level parameter, one has to tweak the sub-parameters where they will meet localized resistance. The pragmatic approach solves this issue, as the knowledge across functions needs to be transformed to the system level, and the issue addressed system-wide.

Higher level of complexity can also be encountered as several system level parameters, which are divided into their individual local allocations in their functions, they have consequences on each other, creating a further challenge on having to transform the interaction between global parameters e.g. cost and performance to achieve product’s value. This becomes particularly difficult if different teams are responsible for achieving optimized cost and performance i.e. across functional boundaries as well, namely, finance versus design and sales. This is where we need Nonaka’s “community of interaction” concept, to achieve mutual understanding by analyzing the consequences across each team’s boundary, and transforming the local knowledge across the boundaries into something new, which deals with both cost and performance.

Successful knowledge transfer often involves the receiving team and the transferring team to spend physical time together. Companies like Xerox use the methodology of having employees from different business functions combined into product delivery teams who share a common purpose, common measures and often cross training on tasks and skills. These teams stay together from the concept phase through post-launch phase of new product development bringing together a synergy of their varied knowledge domains. They are assisted by
technology with document and file sharing, discussion databases, knowledge bases and specialized telecommunications.

Knowledge originates and resides in people's minds and requires trust when sharing. Face to face meetings and other direct personal contacts establish a trust, which can be later, maintained by video-conferencing or email. Value of individual expertise resides largely in subtle nuances and intuitions, which can best be communicated in face-to-face meetings. It is said that two-thirds of personal communications is in means other than vocal communications. Knowledge sharing must be encouraged and rewarded. This requires senior management support and availability of resources as technology enables new knowledge behaviors. Communications media such as video conferencing conveys those nuances and depth of human nature overcoming the inherent, but sometimes financially or physically impossible, desire for collocation of team members.

According to Davenport (1998), knowledge is conveyed via face-to-face meetings or phone conversations two thirds of the time and the rest is transferred via documents. He contends that what sounds like workplace gossip is often a knowledge network updating itself. The firm's knowledge market is founded on mutual trust. A basic tenet of communication theory states that a network's potential benefits grow exponentially as the nodes it can successfully interconnect expand numerically such as each person sharing with one another person can multiply the knowledge to the power of two. Once a company gains a knowledge-based competitive edge, it becomes even easier for it to maintain its lead. Professionals' knowledge is their power base; and strong inducements are necessary for them to share the knowledge.

Nonaka (1998) describes four ways of knowledge transfer:

**Sympathized Knowledge:**

The first one is sharing of tacit knowledge i.e. *tacit to tacit*. He describes the interaction as *Socialization*, where knowledge is transferred via sharing of experiences, mind-sets and technical skills. As individuals with different backgrounds, perspectives and intentions share emotions and feelings; they establish mutual trust, which facilitates the knowledge transfer. Several modes of tacit to tacit knowledge transfers work such as apprenticeships, craftsmanship via observation, imitation and practice. This is a limited form of knowledge transfer and cannot be easily leveraged by the organization as a whole because the knowledge never becomes explicit unless specific next steps are followed. Socialization creates “Sympathized Knowledge” where mind-sets are shared.

**Conceptual Knowledge:**

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The second is conversion of *tacit to explicit* by a phenomenon called *Externalization or Articulation* by Nonaka. Using metaphors and analogies, one can articulate tacit knowledge to become explicit in the form of concepts, hypothesis or models. Metaphor allows one to "translate" one person’s perception or mental image or intuitive understanding by another in a symbolic sense. This conversion of knowledge to a concept can then be the subject of discussion between two individuals, which can then lead to enhancing the concept. Canon built disposable drums for their personal copiers after the team discussed beer cans and were able to develop this innovative competitive edge. Externalization i.e. tacit to explicit knowledge conversion is really knowledge creation as the explicit concepts are new. Nonaka refers to use of multiple reasoning methods such as deduction, induction and abduction (use of metaphors and analogies) to facilitate the conversion from tacit knowledge to explicit. Concepts are created in this phase in a cooperative fashion, as the self-organized team is autonomous and reflective through dialog of the common understanding and intention, used to converge their thinking. Existing premises are reflected on fundamentally. Externalization thus yields “Conceptual Knowledge”

**Systemic Knowledge:**

The third mode of knowledge transfer is that from *explicit to explicit* via the **Combination** method. As different discrete pieces of explicit knowledge are combined into a new whole, then the combined knowledge is new knowledge. The synthesis can take knowledge from various different sources. Justified concepts are converted into something tangible like a proof of concept or a prototype. The building of tangible comes from combining newly created explicit knowledge with existing explicit knowledge and innovating new technology or component. Combination yields “Systemic Knowledge” according to Nonaka (1998). He cites the example of middle managers that play a crucial role in knowledge sharing of the organization by creating new concepts through networking of codified knowledge. Dynamic cooperation is necessary, and diversity and redundancy, facilitate this process. Organizational intent, once again, serves as a tool for converging the various know-hows and technologies into something pragmatic.

**Operational Knowledge:**

The fourth type of knowledge transfer is from *explicit to tacit* via **Internalization**. Once the explicit knowledge is in some document, either hardcopy or electronic, where it can have various forms such as word-processing or spreadsheet files, audio or video or combinations, it easier to convey. It is shared throughout the organization. Others can gain the knowledge by internalizing these documents and learn using it to broaden, extend and reframe their own tacit knowledge. This way different individuals can experience others’ knowledge. Once can also internalize by “learning by doing”. Internalization yields “Operational Knowledge”

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Japanese companies are especially good at developing the exchange between tacit and explicit knowledge and in a knowledge creating company; all four of these patterns exist in dynamic interaction. A kind of spiral of knowledge, which restarts itself all over again at a higher level of understanding, and thus broadening the organization’s own knowledge base. Articulation (turning tacit to explicit knowledge) and Internalization (using explicit knowledge to extend one’s own tacit knowledge base) are critical steps in this spiral of knowledge.

Articulation usually is done by using metaphors and analogies. Metaphor is a distinctive method of perception. Using imagination and symbols and forgoing analysis or generalization, different people with different experiences and viewpoints, can understand via metaphors. Metaphors can facilitate the creative process by letting the different team members reconcile the differences in their own interpretations leading to initiating the convergence of individual tacit knowledge to explicit. Analogy is more formalized than metaphors in resolving differences in opinions. Analogy can be used to harmonize the differences captured by metaphors.

Creation of a model or a prototype, which is more physically possible, allows resolution of conflicts, and concepts become transferable through systematic and consistent logic.

Usage of metaphors, analogies and models are how organizations manage to convert individual’s tacit knowledge to explicit form. Linking contradictory things by metaphors, resolving them using analogies and finally, physically realizing them in a prototype or a model, an organization can convert employees’ tacit knowledge to organizational explicit knowledge, and make it available to everyone.

Knowledge transfer among employees interacting with one another follow the organizational culture. Firms should be encouraged to have teamwork days to allow choice and time for such interaction. It is through extensive personal interaction that tacit knowledge can be transferred. Knowledge sent by the sender has to be understood and used by the receiver to make the transfer effective. During these knowledge transfer efforts, speed of transfer versus the scope of knowledge being transferred, has to be balanced and is not possible to maximize both at the same time.

To be competitive, an organization must make innovative use of the knowledge created and accumulated by its R&D activities and share it across the organization. Nonaka and Takeuchi (1995) note, that an organization cannot create knowledge by itself and new knowledge originates from the tacit knowledge of individuals. Barret, et al (2000) point out that knowledge is not static but fluid and is absorbed by individuals who interpret, modify and use it for their own purposes. Thus, knowledge transfer includes both the transmission and absorption through use.
Knowledge transfer occurs based on personal factors such as proximity, trust and reputation via informal networks.

Dan Holtshouse of Xerox PARC (1999), states that knowledge management is the next “logical” step for particularly those organizations that have embraced quality processes and have downsized, and are preparing and developing future strategies and competencies.

Phillip Murray (2000) has proposed a co-operative project to develop a common classification of Knowledge Management in an effort to develop common syntax and common semantics. He is suggesting classification of knowledge management business functions into component concepts and developing semantic relationships between the concepts. Using a basic model of objects and relationships, he proposed to develop a shared methodology, expertise in knowledge management practices, relevant tools, a board for review and consultation and individual contributors who are subject matter experts in the areas of cognitive psychology, artificial intelligence, expert systems, organizational management, document management, publishing and organizational knowledge. He notes correctly that knowledge management is not a technology (yet) and does not have a historical trail nor does it have any real life artifacts to be used for describing the field systematically.

Phillip Murray offers his company, Knowledge Praxis as a host to act as facilitator and clearinghouse for such a scheme, with its model for knowledge resources and delivery to be used as a starting point and his Media Access Group Website as a cyberspace meeting ground. The project will be used as a sense-making tool for knowledge management concepts, match resources to dynamically changing requirements, develop a practical semantic infrastructure to generate linked internet based documents, meeting ground for subject matter experts, develop metrics and methods to measure and reward knowledge practices as well as measure value of knowledge and interface to key business partner relationships and acquisition of knowledge assets.

2.3.2 Organizational Knowledge

Organizational knowledge is a critical success factor for a firm to maintain its competitiveness through its performance, productivity and innovations. Existing technology is not necessarily a source of lasting competitive advantage, as core technology usually becomes readily available. Knowledge once created or captured can be embodied in products and services as well as disseminated at low marginal costs.

Five phases of process of organizational knowledge creation are:

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Organizational memory is the repository of knowledge of the organization. An aspect of organizational knowledge is the organizational memory, which makes available, recorded knowledge as well as links to the subject matter experts in that knowledge. It consists of the knowledge base valuable to the organization and meta-knowledge on the relevance and applicability of the knowledge. Organizational memory does not need to store all the information that passes through an organization and should be able to provide the knowledge needed with very little overhead. Organizational memory is a prerequisite to organizational learning. It needs adequate social environment and proper tools to enable and support it. Wanda Orlikowski (1992) warns us that, attempts at creating an organizational memory will fail if the employees are not adequately motivated to contribute to it, and the organizational culture does not support knowledge sharing. Accompanying information technology makes organizational memory available to the organization by providing direct access to it or by reports or by pointers such as in knowledge maps or yellow pages. It also links to knowledge sources external to the company.

It is important to codify knowledge such that its distinguishing attributes such as the meta-data are still left in contact but the same time facilities need to be implemented to allow for rapid and flexible changes to those as well. According to Davenport and Prusak (1998), organizational memory such as the repository needs to be placed in between the individual workspaces and long term information sources of the company. This way the organizational memory can have dual roles, of current active memory as well as archived memory, for longer-term renewal of the knowledge. The repository can exist in multiple forms such as paper, electronic, individual’s minds and collective memory. It can store different kinds of knowledge about products, processes, customers, marketing strategies, financial plans and results as well as strategic initiatives.

Organizational learning happens when an organization learn to the extent that it identifies and corrects error. Organizations learn through individuals acting as agents for them. The learning includes knowledge acquisition, information distribution, information interpretation and organizational memory. An entity learns if, through its processing of information, the range of its potential behaviors is
changed. *The rate at which organizations learn may become the only sustainable source of competitive advantage.* Leaders of the organization are responsible for its learning.

### 2.3.3 The Learning Organization

Learning organization is an organization with an ingrained philosophy for anticipating, reacting and responding to change, complexity and uncertainty. Information Technology can support the organizational memory as well as knowledge acquisition, information distribution and information interpretation.

Leveraging organizational knowledge is even better than using documents to control information. Most document management systems make either formal publishing activities or the enterprise work processes more efficient. The latter deal almost exclusively with information rather than knowledge. Tacit knowledge needs to be codified to become organizational knowledge.

Knowledge can be abstracted to become more effective as relationships are more critical than details. Knowledge can be authoritative by being timely, approved and sufficient. Knowledge solves a problem and produces competence leading to effective action. We are moving back to transferring explicit knowledge than supplying large units of information to knowledge seekers. Document management systems will need to learn how to best assign and leverage metadata – information about information.

Organizational learning can usually be traced through three overlapping stages:

- **Cognitive:** members of the organization are exposed to new ideas, expand their knowledge and begin to think differently.
- **Behavioral:** Employees begin to internalize new insights and alter their behavior.
- **Performance Improvement:** Changes in behavior lead to measurable improvements in results- superior quality, better delivery and increased market share or other tangible gains.

Roth and Kleiner (2000) describe the following four forms of learning:

1. Observation – Assessment – Design – Implementation
2. Plan – Do – Study – Act
3. Observation – Reaction – Judgment – Intervention
4. Discover – Invention – Production - Generalization

Garvin (1998) talks about how to build a learning organization. For individuals as well as organizations to perform better, they *must acquire* knowledge. Looking beyond clichés and rhetoric and pontifications, they need to improve the basics.
Garvin looks at three critical issues that need to be addressed before one can become a learning organization.

First, the organization needs to understand what learning is and what meaning is. The definition of learning must be actionable and easy to apply. Second, the organization’s management needs to set clear operational guidelines as well as directions. Third, tools need to be in place to both measure learning as well as validate that learning has taken place. Learning takes place at the individual, the group and at the organization levels.

One can manage learning if one can measure it. In addition, when something is measured, that something being measured also is changed. Learning results when measured process builds momentum, and sustainable results build commitment, which then in turn yields better results.

Edgar Schein (Roth & Kleiner (2000)) of MIT’s Organizational Learning sees any research document about an organization as intervention at the data gathering stage, but then which could be used for further intervention through the active involvement of the organization’s participants as they react to the data being gathered. As they reflect on the data gathered about them, they produce more data via consultation and deepening their own and others perspectives at individual, group and organization levels. This is something this author also hopes to accomplish with this document and to use this thesis as a springboard to launch further initiatives into knowledge sharing at Xerox.

Companies have used the concept of “half-life” curve as a measure, which is the time it takes to achieve a 50% improvement in a specific performance metric. Half-life curves are flexible enough to measure any output, easy to put into action and also allow for measuring between groups.

According to Garvin (1998), learning organizations need to be able to do the following five activities really well:

1. **Systematic problem solving**, where facts instead of opinions are used. Using scientific method to diagnose problems, using data and statistical tools to analyze data.
2. **Using experiments**, to search for new knowledge in an incentive supported environment, which supports risk taking and teaches experimental techniques, and favors action learning i.e. “learning by doing”.
3. **Learning from past experiences**, using tools like the “learning history” described by Roth of MIT (2000), case studies or post-project reviews and lessons learnt.
4. **Learning from others**, using Xerox’s idea of benchmarking which systematically searches for the best practice organizations in areas needing improvement, introspecting own practices and performance, and analyzing.
the results, and developing recommendations to improve organization’s own process to achieve parity with the best practice organizations.

5. Transferring the knowledge quickly and efficiently throughout the organization, either through embedding the learnt knowledge in standard practices, job rotation of individuals within various functions or moving line managers into staff positions to spread the knowledge.

Argyris (1998) states that competitive success depends on learning but most people do not know how to learn. Especially, professionals who occupy key leadership positions are sometimes no longer effective at new learning.

Effective learning is the result of individuals rationalizing their behavior. If defensive reasoning inhibits people to critically introspect their behavior, they exacerbate the problems they are trying to solve. As the employees learn to rationalize their own behavior, the organizational learning can be effective. Organizations find it hard to codify lessons learnt due to natural tendencies to avoid accountability. Learning is a “pull” process, in which the participants need to be drawn into an active intellectual role, as opposed to a “push” process, in which participants remain passive as the lessons are delivered to them.

The social practice of highly skilled people, who work with each other, but are always turning the focus away from their own behavior, makes the organization learning ineffective. People do that to remain in control, to maximize “winning” and minimize “losing”, to suppress negative feelings and to be as rational as possible in evaluating their behavior regardless of achievement. This practice is to avoid embarrassment or threat, feeling vulnerable or appearing incompetent. Management has the formidable task of developing teamwork spirit among individuals who are fairly self-empowered and highly skilled. The defensive attitude prevents individuals in putting forward and validating their assumptions, deductions and opinions that govern their activities and social behavior. They perceive it as intimidation, when asked. Argyris (1998) talks about the “brittle” personalities of many professionals who raise the bar for themselves and are afraid of failure and are also intolerant of others’ misgivings. They need to be taught that to try to understand one’s deductions is an opportunity to learn, and does not convey lack of trust.

Managers can leverage knowledge by encouraging shared interests, common values and going after mutual goals. When team members from different teams are brought together to overlap, the increased contact, or informal information sharing, or joint training, or continuous updating of team members’ knowledge from external sources, keeps the intention of the team well focused. With the use of customers and peers in performance evaluations of the team members, the manager can expect high productivity and creativity from the team.

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Learning organizations also need to cultivate the art of open and attentive listening. Knowledge in an organization comes from collecting the tacit and highly subjective insights, intuition and ideals of employees and making it available for validation and use by the company as a whole. This is enabled only when the employees identify with the enterprise and its mission.

As Quinn, Anderson and Finkelstein (1998) point out that in today and future environment, corporations will succeed more in leveraging their intellectual and systems capabilities than they would from physical assets. Thereby management has to pay close attention to how they manage the human intellect of their organizations. Individuals use their cognitive skills (know-what), acquired through education and training, their advanced skills (know-how) acquired while practicing their knowledge and their systems understanding (know-why) which allows them to have depth in their knowledge of systems (what Peter Senge refers to as systems thinking), enabling them to understand larger issues and making them capable of coming up with solutions to complex problems.

Quinn, et al, submit that individuals also have “self-motivated creativity” (care-why) which combines will, motivation and adaptability for success. This is why, smaller but highly motivated and self-empowered teams can outperform armies of people in larger organizations with much larger financial and physical resources. Quinn, et al, propose that organizations could have an inverted structure, as opposed to the traditional top-down hierarchical one, allowing their professionals to create value in research and development, process and product design, logistics, marketing or systems management. The organizations would have self-organized networks with management playing a support and facilitating role, eliminating barriers, arranging resources and advising team members. Command and control structures were more applicable when organizations were leveraging physical assets as opposed to now, where intellectual assets are the mainstay of the organizations.

Organizations in the new economy environments need to create and apply new knowledge as well as update existing knowledge in the firm.

Information technology’s role in these inverted organizations, would be of helping the organization cope with external rules and regulations, enable achieving cost, quality and delivery schedule (QCD) targets as well as capture knowledge and its dissemination. The knowledge would include customer information, knowledge databases, analysis software, successful examples of projects, lessons learnt and access to specialized domains.

This “care-why” motivation is necessary, without which team members can lose their knowledge edge due to complacency. The “know-what”, the “know-how”
and “know-why” can be embedded in corporate knowledge but the “care-why” can only be found in the corporate culture.

Organizations, which foster care-why, self-motivated creativity and refresh their cognitive skills and systems thinking, will be the competitive organizations in the future. As business environment changes, new technologies become available, new competition arises, and products become obsolete. Companies that are continuously innovating and creating new knowledge and making it available throughout the company will quickly be able to use the same to develop new products and services and continue to stay competitive.

Nonaka and Takeuchi (1998) recommend redundancy of knowledge in the organization to enable consultation and communication around a “common cognitive” ground. This, in turn, enables the spread and internalization of new explicit knowledge. Full access to information, job rotation and moving line management into staff positions are other alternate ways of creating redundancy of knowledge in the company. Employees get to learn to see the business aspects from a variety of perspectives. It also forces the employees to reflect on what they take for granted prompting innovation.

2.3.4 Learning from Experience

Kleiner and Roth (1998) tells us about researchers at MIT’s Center for Organizational Learning, who have developed and tested a tool called the “learning history” which is a narrative of a company’s recent critical event, presented in two columns. One column has the relevant episodes described by the participants, or those who were affected by them or observed them; in the other column, learning historians or outside experts pose questions, identify recurrent themes, and raise “un-discussable” issues. The learning history then forms the basis for group discussion and group learning. The learning history can also be used by another group, who are asked to read the learning history, and then meet in small groups for the second group to gain a better understanding of the critical choices they would face in planning new actions in their own project. The second group would have re-experienced the event together and learned its meaning collectively i.e. creating this understanding of the big picture, issues, actions and consequences of the actions together.

Modeled after the ancient art of storytelling, which is still practiced in rural areas all over the world, learning history enables building of trust among the team members, raises important issues, allows the transfer of knowledge between groups and helps build explicit knowledge about management in terms of lessons learnt, decision making and action planning. The firm is then better capable to react to new situations drawing upon this wealth of knowledge of collective experience.
Before using the learning history the knowledge was tacit and embedded in the participants only.

Trust is built as team members confirm each other’s opinions and collectively reflect on the issues during the discussion of the learning history. Learning history facilitates knowledge transfer, and corporate knowledge is created about successful decision-making.

When there is a significant event, there are disagreements, which may never get voiced unless there is collective group reflection. Learning history discussions brings these “silent” disagreements into focus and with consultation, the differences in opinions are explained and then the group comes to a consensus. It is the sense making of a significant experience, which allows the team members to see the “big picture” and be able to generalize common opinions.

Roth and Kleiner (2000) see the learning history as an artifact and an approach to research and intervention and would like to further study to see if it is innovative with respect to study how researchers and their subjects interact.

2.3.5 Communities of Practice

Communities are informal networks of people who, as a result of working together, come to develop and share ways of doing things, ways of talking, of looking at things and have similar beliefs and values, which can be construed as practices. Knowledge is integrated in the life of communities.

Communities of Practice (CoP) groups, usually self-organized and formed by grass root efforts, use common work practices, interests and goals to interact with each other. A CoP represents a common body of knowledge. These communities of practices are corporate assets and should be supported, protected and encouraged. Even when people work for large organizations, they learn through their participation in smaller communities, made up of people they interact with on a regular basis. CoPs are a group of people sharing their practical experience, specialist skills and intuitive knowledge about a common interest, with each group developing its own social and cognitive repertoire, governing its actions and interpretations. Process of knowledge exchange takes place on an informal basis, and the members of the CoP develop a single identity as well as shared values and knowledge by solving common problems, and becoming involved in sharing mutual everyday concerns. They therefore, exchange knowledge efficiently and directly. CoP participants are linked together socially, emotionally and by recognition. They are an effective and efficient form of knowledge management and cross both hierarchical and functional boundaries. They form sub-communities, as tiger teams to deal with specific situations, and are able to quickly come up with solutions due to the synergy of knowledge present.

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CoPs are a faster path to building competence and innovation due to the combining of specialized knowledge of highly motivated individuals. To encourage CoPs, the firm needs to identify potential CoPs, develop incentive programs and infrastructure to support CoPs, as well as develop metrics to measure the value generated by the CoPs. Organization should provide a knowledge marketplace such as space, services and platforms for knowledge sharing and creation, along with official recognition and time to the CoPs to enable their effectiveness.

Disadvantages of CoPs are that they are self-reproducing and can suffer from tunnel vision, becoming immune to criticism or justification and may isolate themselves from the rest of the company. CoPs also are not easily recognized or rewarded.

CoP distinguishing factors are: transfer of best practices, quick learning curve due to the high knowledge level, subject matter expertise, employee integration and retention, quick solutions to serious issues, development of explicit knowledge by combination, synergy and coordinated activity, and relevant qualitative information.

Information platform for CoPs to function effectively must be centrally available and well structured. The definition of the CoP activities should remain flexible. Strong personal relationships should be nurtured and competence maintained via training. CoP participants will stay linked together socially, emotionally and by recognition.

2.4 Knowledge Management

2.4.1 Value Based Knowledge Management

Tissen, et al (1998) describe a framework for value-based knowledge management. The integrated approach puts together market/strategy with knowledge/systems and structure/processes for people/motivation. Using smart strategies, smart organizations, and smart professionals in an integrated environment to produce smart knowledge. Noting that, as we are in the business of creating value not knowledge, the knowledge management strategy should be to balance knowledge with company’s business strategy.

Knowledge strategy should make sure that creating knowledge map does not capture unneeded knowledge. It should identify the knowledge domains of interest, which will act as a glue to keep related knowledge together, to enable leverage through synergy. The organization needs to create knowledge segments and then develop the business strategy, develop a clear vision and then let the employees own it.
Smart organizations are team-based and are totally process oriented. They do not retain any activity, which does not add value. They tend to be light on resources but heavy on knowledge, and are totally market and society driven. They generate streams of new concepts that add value. They work with organized knowledge that is focused, centralized, easily accessed and easily shared. They have decentralized organization but centralized knowledge. Managers manage teamwork between knowledge professionals who own, create and share most of corporate knowledge. They have a smart corporate center, which transfers meaningful knowledge to the executive board and becomes a clearinghouse for the knowledge for the business centers. The top management directs the contents, the corporate center organizes and integrates the contents and the business divisions provide the contents of the products and services.

Smart organizations are process centric as opposed to the old ones, which were function centric. They have less number of people, but who are high in talent as opposed to large production-focused organizations, which have masses of people with little talent. They have decentralized decision-making as opposed to the old command-and-control structure, which sent status up and got commands passed down. They have a team based horizontal and networked structure, versus the old vertically structured organization. Their product is knowledge embedded in solutions versus tangible goods. The workers retain high amount of knowledge.

Smart professionals are those who are competent along the information, social and cognitive fronts. In the information dimension, they have the sourcing talent i.e. where to look for information, and how to assess its value. They have the sensing talent by knowing what question to ask in their search for knowledge. They have the questioning talent allowing them to convert data into information to answer a question. Asking the right question is 50% of the work.

On the social scale, smart professionals have the networking skills by establishing connections, and contacting people who have the expertise that is required. They have team-working skills to enable them to work together as a team, and create synergy by combining each member’s unique knowledge. They have the interactive skills to allow free flow of meaningful information between a number of people.

Finally on the cognitive side, smart professionals have the ability to create i.e. ability to conceptualize and spawn new ideas, create new applications and solutions. They have analyzing ability, which is the ability to use logic, systems thinking, reasoning and mental modeling. They have the art of reflection allowing them to play back and think about lessons learnt each day.

2.4.2 Virtual Organization

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
Barrett, Lau and Dew (2000) define a virtual organization to be the organization, which produces work deliverables across different locations, at different work cycles and across different cultures.

Peter Drucker (1998) calls it the information-based organization where, in year 2010, he predicts that typical large businesses would be flatter (roughly half as many management levels and with about one-third in number of today’s managers – this in fact, is happening already). He sees middle managers as unnecessary, and as “relays” whose main function is to “boost” faint and ambiguous signals from top management. He also sees staff functions that only advise, counsel or coordinate decrease significantly.

Leonard Straus (1998) describes Pavel Curtis, a computer scientist working at Xerox PARC where he is creating a virtual world for people to socialize in. Curtis is working with an anthropologist to understand how communities form. Using anthropologists and artists working side by side with computer scientists, Xerox PARC hopes to develop the cyberspace interactive meeting ground with a more human touch. The PARC PAIR (PARC Artist in Residence) program is to have computer scientists and artists influence each other’s viewpoints and representations of the world. As Schwartz, Divitini and Brasethvik (2000) put it, moving from physical organizations to virtual ones, relevant knowledge that can be shared and used becomes even more important.

When the work groups are physically separated, they may not even have physical offices and may be transient in form. Once they accomplish a set of goals over a constrained timed period, the team may be disbanded or reorganized. Virtual Organizations are information sensitive and also are Internet dependent requiring a heavy investment in knowledge management. They may comprise of varying degrees of physical separation as well as commonality and coherence among the team members. Dispersion of a virtual organization can be from traditional organizational boundaries to different buildings to different sites within a city to multiple cities to multiple time zones to multiple countries and finally to multiple cultures. This requires excellent IT to support communications and coordination throughout the virtual organization.

Idea of virtual organization has taken favor in today’s business environment where we have rapid changes, uncertainty of future, very intense competition and with the growing middle class outside US, the need for globalization of business and markets.

Issues facing virtual organization includes deciding on core versus non-core activities in a rapidly changing business environment, outsourcing rather than cost control, to improve business performance, and even when it is only just for the short term, dealing with uncertainty of the future versus the normal brick and
mortar business, and maintaining cooperation and collaboration between appropriate systems.

To support virtual organizations, information technology groups must make sure that they are addressing the right needs. The user information requirements are orders of magnitude more complex and most likely to change while solutions to current needs are being implemented. They also need to address communication needs, deal with different languages, cultures, perspectives and different representation models.

Virtual organizations need the flexibility of being able to adapt to changing requirements, partnerships, alliances and appropriate outsourcing arrangements. Other characteristics of virtual team organizations are networked (rather than thick central core competency teams) component based design and implementation, empowered teams, knowledge acquisition and management, decentralized support infrastructure instead of centralized bureaucracy. The can-do attitude of globally dispersed teams and strong information technology supporting the work processes and decentralized teams are also part of the virtual organization landscape.

Management of virtual teams is also different from the usage of normal command and control structure, as challenges of leadership of such teams are orders of magnitude more complex. Companies, using the command and control structure, used immense amounts of data to control rather than to share information. With the new flat, lean and networked structures, the employees have to have skills where they can directly contribute to the value chain of the organization affecting the bottom line. They must be capable and motivated to learn new skills, take change in stride and able to handle ambiguity and uncertainty, by searching for knowledge to satisfy the gaps and striving to meet customer requirements. The decision-making is handed down to the employees who can take appropriate action, and are able to handle their responsibilities without extensive hands-on management. Adjustments to work habits and processes are needed to handle multiple time zones, multiple languages and multiple cultures. Administrative work is done more and more by the employees with appropriate support tools to make things easier and with less administrative staff than normal organizations.

Critical success factors for the virtual organization are a shared purpose (customer requirements focus), trusting relationships, risk taking attitudes and drawing satisfaction in being part of the virtual team, allowing the team members to make adjustments necessary to be successful. Issues of cultural infrastructure and information sharing also need to be addressed with the same urgency as the issue of technology infrastructure.
Virtual Organizations also have a fluid nature to their structure, as they tend to restructure to prepare for a new opportunity, and would seek to restructure at the end of the immediate assignment.

Virtual Organizations require significant investments in knowledge management. Using the Internets / intranets / extranets, the organization can improve its ability to communicate and manage distributed processes. The firm can increase its ability to acquire, store and distribute knowledge. Knowledge management can increase the firm’s ability to be “virtual”, and which, in turn, can then increase its capability of knowledge management, and so on in an ever-increasing spiral.

2.4.3 Best Practices

One best practice is the constant search for best practices. Once a best practice solution has been created, it can be deployed at virtually no additional cost. Best practices are successful if the prerequisites are in place and the employees are willing to co-operate. The best practices need to be intertwined with day-to-day employee activities and require putting people not data into contact, as well as commitment by managers to implement the best practices. Requirements can be used to harmonize knowledge of external best practices, adding value to the company.

Introspection
Like Boeing, Xerox studied its product development process, examining three troubled products in an effort to understand why the company’s new business initiatives failed so often. A complete learning audit is a must, which including measurement of cognitive and behavioral changes as well as tangible improvements in the results.

Benchmarking
Enthusiastic borrowing is replacing the “not invented here” syndrome.

Xerox, the benchmarking concept creator, has applied it to billing, warehousing, and automated manufacturing. Milliken benchmarked Xerox’s approach to benchmarking.

Benchmarking is a disciplined process. It begins with a thorough search to identify best-practice organizations, continues with careful study of one’s own practices and performance, progresses through systematic site visits and interviews, and concludes with an analysis of results, development of recommendations, and implementation. Benchmarking is one way of getting an outside perspective.

Learning Organization
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A learning organization is an organization skilled at creating, acquiring, and transferring knowledge, and at modifying its behavior to reflect new knowledge and insights. Without accompanying changes in the way that work gets done, only the potential for improvement exists. Xerox employs a number of anthropologists at its Palo Alto Research Center to observe users of new document products in their offices.

Garvin (1998) specify these steps to transform a company into a learning organization:

- Foster an environment that is conducive to learning. Make time for reflection and analysis, to think about strategic plans, dissect customer needs, assess current work systems and invent new products.
- Train in brainstorming, problem solving, evaluating experiments and other core learning skills
- Open up boundaries and stimulate exchange of ideas using conferences, meetings, and project teams, which cross-organizational levels, linking company and its customers and suppliers. Boundaries inhibit the flow of information and keep individuals and groups isolated reinforcing preconceptions. Jack Welch of GE made “boundary-less-ness” a cornerstone of the company’s strategy for the 90’s.
- Create learning forums like strategic reviews, systems audits, internal benchmarking reports, study missions and jamborees or symposiums
- Use 3Ms of learning: meaning, management and measurement provide a solid foundation for building a learning organization.
- Encode inferences from history into routines that guide behavior.

Knowledge transfer

Transferring knowledge quickly and efficiently throughout the organization is a best practice. Personnel rotation programs are one of the most powerful methods of transferring knowledge. Rotation between line management and staff positions is another option. They allow experienced managers to distill what they have learned on the line and diffuse it across the company in the form of new standards, policies or training programs.

Peter Senge in his book The Fifth Discipline, defines learning organization as where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspirations are set free, and where people are continually learning how to “learn together”. He suggests use of five “component technologies”: Systems thinking, personal mastery, mental models, shared vision and team learning.

Employee evaluation and promotion are also necessary for incentives to reward knowledge transfer and application of experience.

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
2.4.4 Management and Leadership

Carly Fiorina (2001) in a speech on Future of Technology to the Progress and Freedom Foundation, said the goal of industries and governments should be to spread health, wealth and knowledge around the globe. Quoting Charles Darwin, she also said that it is neither the strongest nor the most intelligent that will survive, but the ones that are most adaptive.

Management needs to ensure that the interactions between their teams are positive for all parties and not confrontational. With appropriate reward and recognition policies, fostering awareness of value of knowledge, and making clear, the team goal as the goal of knowledge sharing, the teams can have productive knowledge sharing.

Managers need to be as comfortable with images and symbols as they are with measuring ROI, cost, reliability and schedule milestones. According to Kleiner and Roth (1998), “hard” results such as financial returns or technical milestones are frequently a function of “soft” issues like the company’s culture. Roth and Kleiner (2000) also maintain that the ROI is an out of date ratio in the information age. Organizations focus on cost and reduce investments and expenses while looking to decrement the divisor in the ROI calculations, with initiatives such as outsourcing, and do not take into account the value of knowledge in the people being laid off. Soft measures such as empowerment, job satisfaction, morale and attitudes are difficult to measure and manage.

Education of senior management for organizational transformation is a must, and has to be of the kind which extends vision, rather than “how to” achieve best profitability. Roth and Kleiner (2000) define education as “experience understood in tranquility”. They also maintain that consultants cannot replace internalized ideas and visions, though they can keep a watch on external events for the company.

The most critical success factor is the quality of human interaction in the organization, which often depends on the humility and openness of the manager or the team leader directing the effort. The leaders need to generate the drive among the employees to make their tacit knowledge available for use in the company’s products and services. Ambiguity generates thoughts of alternative interpretations and requires looking at things from fresh perspectives. This generates innovation as new knowledge is created.

Innovation comes out of the interaction of different ideas, viewpoints and methods of analysis. Managers have the challenging task of extracting and crystallizing...
innovation from collaborating team members. When collaboration takes, on what Strauss (1998) calls creative abrasion between different approaches, a successful manager is able to turn that into the innovative process. Individuals differ in styles of analysis such as number crunching, or by intuition, or developing concepts, or experimenting, or doing it alone versus groupthink, or deciphering via deduction or by values. This is why managers need to allow and leverage different approaches and viewpoints, and foster tolerance among the team members of each other’s different style of thinking and working.

If Managers are uncomfortable with clashes in thinking style, they need to learn to manage them, rather than solely value their own approach, or work with only those who have similar viewpoints and skills. Strauss (1998) distinguishes those who are analytical, logical and orderly in their problem solving techniques as being dominant in left-brained activity, versus those who are intuitive, value-based and random, being what he calls right-brained thinkers. Carly Fiorina (2001) talks about how when one finds a thesis, and examines its anti-thesis, one can then innovate the synthesis.

The cognitive differences in gathering and understanding facts, decision-making and interacting with others are real but not necessarily rigid. Given the proper framework, individuals with different preferences can learn to expand their behavioral space, think out of the box, which may be difficult but not impossible. Understanding others’ different style of thinking and acting enables communication and collaboration, and the resulting organization is more innovative than a homogenous organization, because it can draw on various strengths in the team to complement the weaknesses. When communicating, knowledge in the recipient’s syntax and semantics would be better received. In short, diversity enriches the team and its solutions.

Successful managers of richly diverse groups develop the knack of getting the team members to acknowledge their differences, and encourage full participation to enable the “creative abrasion” process of knowledge creation. Motivation of team members to participate in this creative abrasion process should be the intentions of the company, which also should be tied directly to the firm’s customer needs.

Besides having a clear operating guidelines and clear goals, managers also need to allocate time and resources for both exploratory and divergent consultation, to innovate unexpected solutions and to bring the team together in a “consensus forming” selection and planning of implementation of the solution. Innovation needs both brainstorming and action planning activities to happen in full, as innovation comes from cross-fertilization of ideas and collaboration comes from working towards the same goal.
Professionals have a difficulty in agreeing to a unified strategy, because they tend to operate as individuals rather than members of a group. Due to their specialized knowledge, they do not easily subordinate themselves to others or support team goals not completely in agreement with their thinking, and desire to be treated as equal partners rather than someone somewhere in the hierarchy. Their activities are usually directed to becoming better and better at what they do instead of being creative at what they do.

Senior managers use metaphors to reflect company’s business intentions, and direct employees towards innovation, by aiming for the ideal. Middle managers, who are at the midst of flow of information both vertically and horizontally in the company, work towards a compromise between the senior manager’s idealistic goals and the chaotic reality of those in the front lines. Achieving a balance between “what is” and “what should be”, they remake reality according to the company’s vision.

Cusmano (1997) notes that small teams of talented people are better than large teams of average or talented people. He describes how Microsoft has succeeded in making large teams work like small ones, by allowing the team and individuals to be creative and be self-empowered during the creative phase. Microsoft uses the corporate methodology of synch-and-stabilize approach of product development. The teams come together and share their developments into a common pool of features, which then becomes the basis for the next creative round. This accomplishes the task of synchronizing several small teams; periodically stabilizing the overall project and continuously assimilating feature innovations. The activities within the small teams are happening in parallel and avoid the Brooke’s law of “adding manpower to late projects makes it only later” as the manpower can be adjusted within the small teams quite easily.

Key elements of the successful Microsoft teamwork approach are:
1. The project size and scope are bounded achieved by clear and limited product vision, limited personnel and within time limits.
2. Product architecture is divisible as it is modularized by features, functions, subsystems and objects.
3. Project architecture is also divisible as it can be divided among feature teams and clusters with milestones for subprojects.
4. Teams are small and management is limited by dividing the overall project into many small multifunctional teams, with high autonomy and responsibilities.
5. Teams stay in focus, because of a few rigid rules to “force” coordination and stabilization via daily product builds, fast bug detection, fast bug fixes and stabilization in concert with the project milestones.
6. Good communications within and across functional teams via shared responsibility, collocation, common programming language, common development standards as well as open and interactive culture.

7. Ability to switch between process and product focus as the need arises, using product specifications, which are continuously evolving, and allowing the process to evolve over time.

This methodology allows room for changing requirements, as well as leverages learning, as it happens with product development and customer feedback in the rapidly evolving industry.

We must note that mistakes do get repeated but smart decision-making usually does not, and insights are rarely shared openly, which is the challenging issue in front of managers.

Management’s role has changed from “command and control” to “sense and respond”. There is need to emphasize doing the right thing versus doing the thing right. Greater emphasis is also needed on renewing existing knowledge, creation of new knowledge and embodying it in the firm’s products and services. Besides capturing lessons learnt or best practices, management needs to use the same to continuously improve the process and develop better practices matching with the ever-changing business environment. Unless lessons are applied to prevent mistakes, they are really not learnt, are they? Documenting them is only the first step.

From a one-on-one supervision, namely, telling, planning and controlling, we now have the emergence of the team leader who acts as a teacher, a coach and a facilitator. From a work group coordinator, who acted as a resource person, helped several groups and supported groups with technical skills, we now see the advent of the knowledge professional who acts as a knowledge sharing translator, participates and facilitates in knowledge sharing.

As we rethink and unbundle the corporation, John Hagel and Marc Singer (1999) want us to put the spotlight on the traditional organization fault lines, such as

- Focusing on the customer, and identifying, attracting and developing customer relationships (driven by scope);
- Focusing on the employees to conceive and commercialize attractive, new products and services (driven by speed);
- Building an infrastructure to support high volume and repetitive operational tasks of the firm’s operation (driven by scale).

When these three businesses of customer relationships, product innovation and production are pursued simultaneously, as the need forces the organization to do,
the divergent economic and cultural goals end up conflicting with each other. Scope drives relationship management, speed drives innovation business and scale is what drives infrastructure business. To make this happen, a corporation needs to un-bundle and then re-bundle to be able to handle these conflicting goals, by adapting itself to the changing realities.

Nonaka (1998) mentions five conditions necessary for the organization to facilitate effective knowledge sharing:

First, there needs to be clear *Intention* i.e. organizational goal about what knowledge is needed. It is the intention, which is used as criteria to judge created knowledge by. Organization can promote the intention and make it a collective commitment.

Second, all members of the organization should have *Autonomy* in action, to the extent possible. The autonomy enables unexpected opportunities to be followed. The knowledge created is shared within the team and becomes organizational knowledge. Self-organizing teams allow their task boundaries to be guided by the larger intention of the firm. It is desirable that the team members are cross-functional to have diversity of perspectives and opinions.

Third, *Creative Chaos* is necessary to provide motivation and base for the team to interact with the external environment. This chaos allows uninhibited pursuit of knowledge disregarding old habits and narrow perspectives. Industry calls it the “burning platform” which lights a fire under the team to motivate action. Fundamentals are questioned and new thought patterns emerge out of this “crisis” mode and new knowledge is created. Team members are motivated to externalize their tacit knowledge in order to positively contribute to the firm’s intention.

Fourth, *Redundancy* of information facilitates tacit knowledge sharing. The team members or groups interact with others, and start discussing their knowledge and reconcile their differences in perspectives; by helping each other articulate their thoughts on common terms. Sometimes firms intentionally have several teams working similar problems, to create this redundancy of information about business activities. This causes different approaches to the same project, which are at a later stage gate reconciled, and the best approach chosen. Individuals can go across their boundaries into the others’ and consult providing new information from their perspectives. Nonaka (1998) calls this “Learning by intrusion” as efforts to see each other’s viewpoints. Carlile (2001) calls it the “pragmatic” approach to sharing knowledge across boundaries by transforming the knowledge. Redundancy also acts as a self-guide, so that the organization heads in the direction of the intention. Japanese firms call this “rugby” style of development, as players with different roles act as a cohesive unit in carrying the ball to the goal. Rotation of
employees in different functions is another way to achieve this redundancy and well-rounded perspective.

Fifth, Requisite Variety, in other words diversity, is necessary for the firm to match the products and services it develops with the variety in the business environment. To allow the team to effectively compete, it must have access to the widest variety of information, so that it is able to react quickly to changing customer requirements. The team must be able to react to new information in a coordinated way rapidly. Having a flat, networked and flexible organizational structure increases the firm’s ability to deal with change. Sometimes firms tend to change their organizational structure to match external fluctuations, however it has more perils (current Xerox dilemma) than advantages. They switch along the regional (geographic focus) vs industry (business focus) or function vs product oriented organizational structures.

MIT’s Tom Allen discovered that scientists and engineers share knowledge directly proportional to the amount of personal contact, giving heavy weight to the argument of collocation of team members.

Nonaka (1998) in defining knowledge notes that most have a narrow definition of knowledge, and what companies need to do to leverage knowledge. Most companies think of quantifiable hard data as knowledge and see the organization as a machine for “information processing” of the data.

When an organization is information based, the company needs to be driven by goals, which makes management’s expectations of the enterprise very clear, as well as by measures, which compare the performance against the goals. Management also needs to develop and promote special rewards and recognition program to support the drive. In addition, they need to create a unified vision of an organization of specialists and of task forces such as “tiger teams”, as well as support the training and development of team leaders. The organization needs to shift from traditional command and control structure with vertical divisions and to horizontal, flatter and networked departments and to information based organization of knowledge specialists.

Peter Drucker (1998) states that individuals do realize the information needs of others but are not quite aware of their own information needs.

Outsourcing short contracts usually fare better than long term ones. The challenge lies in successfully managing the outsourcing arrangements, or joint ventures, or alliances so that knowledge management within the virtual organization is facilitated and the shared purpose or mission of the virtual organization is accomplished.
We will now discuss a knowledge-sharing framework used by Siemens as described by Davenport (2001) and some of the enablers and barriers towards effective knowledge sharing.

2.5 Knowledge Support Structure

2.5.1 Role of the Internet

Internet does constitute a powerful infrastructure to connect people with the use of bulletin boards, email, shared documents and workspaces. Internet truly has reduced the distance between providers and consumers of knowledge.

Integration of suitable internet, object oriented tools, text analysis and hypermedia technologies, can be used to develop organizational memory and enable distributed knowledge management, as well as allow global access and manipulation of information.

Schwartz, Divitini and Brasethvik (2000) discuss three components for an integrated framework for Internet based knowledge management i.e. Acquire, Organize and Distribute. They are further organized into sub-components, namely, GIVE PARC AID (© timely phrase for Xerox ©):

Acquire – GIVE i.e. Gather, Inquire, Verify, Encode using tools and techniques such as corporate databases, email, policy manuals, interviews, KM, automated information retrieval and acquisition. The Internet enhances implementation of this component. This component addresses the issue of contextualization of knowledge for organizational needs.

Organize – PARC i.e. Profile, Associate, Rank, Classify using tools and techniques such as Indexing, Catalogs, Keyword insertions, Information Retrieval and Combining Knowledge. The Internet also enhances implementation of this component. This component handles the management of knowledge captured by other tools and interfacing with the organizational memory.

Distribute – AID i.e. Awareness, Identification, Delivery using tools and techniques such as email, web-site pull / push, databases, printed reports and querying. Implementation of this component is made much more challenging due to the sheer mass of new and old knowledge available on the web. This supports the need for communication and collaboration of the individuals within the organization.

To support the need for context of knowledge, some options might be to archive all email and videotape all meetings. These activities do not have to be invasive but are difficult to retrieve and probably do not get used at later stages. The company can store meta-data to describe and classify documents. Another way to preserve
context is to keep the content structured within the processes i.e. knowledge is classified and stored according to the activities such as meetings, discussions and communications with reference pointers to the context as well as to the knowledge itself. Audit trails for historical context may also be stored. The knowledge search and retrieval tools should be developed to handle such queries and capable to obtain only the knowledge needed per query rather than all of it. Davenport and Prusak (1998) recommend that contextual meta-data should strive to capture the context of a document by items such as its creator, title, location, modification date and history and hot-link them with other related information objects such as projects, people, teams, events, tasks etc.

To support the need for meaning with the knowledge items, semantic meta-data could be used to classify knowledge, by capturing the description of the intellectual content or meaning of an informational object such as keywords, written abstracts / comments, summaries and attaching links to collaboratively created concepts.

There is need to verify the knowledge, which becomes more significant as it is converted to corporate explicit knowledge. This can be accomplished by interaction of the team members with the knowledge, and having the activity self-adjust rather than employing separate quality inspectors.

Ranking searched knowledge for its relevance when selecting appropriate knowledge to a query, is usually the most visible metric in current interfaces for retrieval of knowledge.

Argyris and Schon (1978) asserted over two decades ago, that knowledge assets and the learning capacity of an organization are the main sources of competitive advantage. This is more true than ever now, and the problem to deliver the right knowledge at the right time to the right person in the right way still remains, considering the socio-organizational, financial, economical, technical, human, and legal dimensions.

Technologies that support are internet/intranet/ extranet, WWW, hypertexting, document management, information retrieval, knowledge representation and computer supported collaborative tools and groupware. Knowledge management tools must be able to support distributed use to make them effective. Document-centric knowledge management tools are designed to make the knowledge buried in documents and relationships among the documents, explicit such that they can be found, accessed and reused in an efficient manner.

There are two dominant approaches to information retrieval on the Web: Directories and Spiders. Directories are static structures to categorize contents whereas the Spiders are free text searches of ill structured information. User query requirements should include:

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Search of all knowledge sources with a single query;  
Compare between knowledge sources, to allow for identification of best single source amongst all sources searched;  
Delve into complex or large knowledge sources to identify potential solutions, and  
Allow user to refine the initial query through the process of exploring potential solutions.

Risk for knowledge management on the intranet is that the knowledge within the system may become dissipated, because search mechanism must cope with larger volume information, the users may be required to exercise more judgment in selection and application of information, and the organization may lose control of the use of the knowledge. Knowledge on the Internet may be distributed in documents and written in languages for the human reader, and thus not easily accessible by computer programs used in knowledge management systems. In order to make the Internet machine readable, information extraction from Web pages is a crucial current research area.

Internet based knowledge items include semi-structured data usually represented as labeled graphs. Object Exchange Model (OEM) is useful for representing semi-structured data. OEM consists of a graph, which has objects such as vertices and labels on the edges. Wrappers are information extraction systems customized for particular sites. Possible methodology could be to use the web as a global source of documents, medium for managing knowledge in these documents, as well as for use of the Internet for worldwide access.

Enablers for using the Internet for knowledge management are:
- Computer networks; the world wide web;
- Optical character reading (OCR) tools and hand-held scanning units;
- Multi-lingual thesauri;
- Text pre-processing tools for machine translations;
- Data mining tools to automatically extract text and information;
- Software agents to extend and monitor large document collections and to analyze and update knowledge;
- Groupware for creating social awareness through event summaries, synchronous and asynchronous notifications, and communication and collaboration between users;
- Semantic nets and ontologies to introduce formal attributes for concepts and specify formal relations between the concepts;
- Concept maps, idea maps and knowledge maps to visually present connected nodes which may be used to organize library of documents;
- Courseware for electronic delivery of training;
- Text analysis tools;

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Automatic summarizing, abstraction and translation tools;
Tools for semantic retrieval use by relations between words or ability to expand queries and filter the results; and
Value indexing tools to qualify knowledge sources and resulting data after successful searches.

Advantages of the Internet are that it is globally accessible for electronic documents and for tools. It has search engines to support detection of new documents such as “What’s new”. It provides infrastructure for both asynchronous and synchronous communication, access control, distributed computing and enables an independent platform. Using the Internet to provide both computational and platform independence, software agents and collaborative tools can be used for distributed teams coming together in cyberspace. Languages for web authoring allow dynamic generation of content, using the hyper-linked structures between concepts and occurrences, and presentations of documents with emphasized or highlighted key phrases.

Object oriented technology supports efficient storage of knowledge items, which can be extracted from documents of various formats. Text analysis techniques support classification of those knowledge items from different perspectives, and hyper-linking enables user-friendly and intuitive graphic user interfaces to store and retrieve those knowledge items as the organizational memory of the firm.

Knowledge items could be stored with meta-data such as the title, description, explanation, link to source of the knowledge, creator of knowledge with time-stamp, who last changed or accessed it again with time-stamp of the event, priority, status, links to other knowledge items such as what it is part-of, and link to other structural models.

Disadvantages of Internet are that contextual information about its users, background, interests and tasks are not readily available, but this is manageable within a company’s intranet, where disclosure of such information could be regulated per session.

Schwartz, et al (2000), describe the enablers for an IT supported KM on the Internet. They are knowledge archives, communication channels, and open and flexible structures to support the evolving nature of information / knowledge space.

Requirements include the recording of asynchronous knowledge distributed in space and time. Communication channels as documents alone are not sufficient for interaction. Distribution including automatic dissemination of knowledge to those who need it, annotation capability, ability to browse, ability to classify using flexible structure, retrieval tools such as intelligent agents which can refine initial

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queries to get to the knowledge needed, navigation tools with context sensitivity and multi-modularity of knowledge are also required for internet based knowledge management systems.

Siemens, as narrated by Davenport and Probst (2001), saw the following forces that will affect success in e-business and its empowerment of customers:

- Unprecedented market transparency – competitive information is very easy to obtain by customers
- Networked business models – new models of networking among companies, partners, suppliers and especially customers, have become the new paradigm. Value chain deconstruction causes formerly integrated value chains to disintegrate into separate value chains. This disintegration paves the way for new alignments for the customer.
- Vanishing boundaries – boundaries that separate the firm from its partners, suppliers, customers and even certain types of employees are becoming increasingly blurred. Locus of knowledge capital shift from within corporate boundaries to customers.
- Increased speed – today’s competencies can become tomorrow’s liabilities at very fast speeds. Corporations must be able to reconsider and often, replace old modes of doing business with new ones on an ongoing basis.
- Knowledge Management as a lever – KM needs to be broadened in scope through the integration of customer knowledge into the organizational knowledge base, and needs to have greater depth to be geared to challenge existing knowledge. **KM becomes the backbone of e-business models.**
- Trust as a key enabler – Strong and trusted brand, widespread accessibility of the Web, coupled with low cost of entry for new competitors, levels the playing field. *Price does not rule the Web, trust does.* Trust also enables authentic collaboration with the customers for the purpose of joint creation of value.

### 2.5.2 Technology and Tools

As we move into the new economy, we are seeing a shift from manual and service workers to knowledge workers in the US. These new breed of workers are enabled by information technology and resist the traditional command-and-control model of management. They tend to be decentralized, self-empowered, highly skilled networks of individuals and teams who use their knowledge as the asset base, and direct and control their own performance.

Peter Drucker (1998) characterizes the future information-based virtual organization to have a set of clear and simple objectives, and an organization that is based on individual accountability, with vision that brings together teams of specialists,
where the management is responsible for the training and development of team leadership. As task-focused teams will largely do work, traditional serial involvement of research then development followed by manufacturing then sales, will be replaced by cross-functional teams who work together as a team from product’s concept phase all the way to putting the product in customer’s hands.

This new structure of work will require significant communication and technology infrastructure support to maintain the customer-oriented focus on all of the cross-functional team’s activities, so the product developed meets customer needs and not individual functional needs. Quinn (1998), et al, mention “spider webs” in similar context, what we also call “tiger teams”, that are self organizing network of people, which come together to solve a particular problem, and deconstruct once the mission has been accomplished. Spider webs come into being when physically dispersed specialists with unique knowledge segments need to be brought together to solve a particular problem.

Technology is needed that can bring together highly diverse, intellectually specialized, and physically separated talent. The technology would enable a common language and database for communications, information about external environments and enable team members to seek out knowledge sources and interactively collaborate with each other in the problem solving process. The loss of human contact is to be balanced by maintaining continuous communications using video, audio or net conferencing technologies as well as by holding occasional face-to-face meetings for information sharing and support. Human contact at the workplace is being replaced with increased contact with clients and customers in the field.

Software that can enable distributed teams to connect to each other, interact in cyberspace and collaborate leveraging critical knowledge bases and subject matter experts to achieve a common goal is necessary. This requires access to database technologies, analysis and collaborative software to facilitate the team reach beyond its own capabilities. Challenge is to achieve the synergy of data and information processing capacity of information technologies with the creative and innovative capacity of team members.

Though we are in a knowledge economy, it is difficult to find direct correlation between IT investments and business performance or in the measure of knowledge management. The new world of knowledge-based industries is distinguished by its emphasis on precognition and adaptation, in contrast to the traditional emphasis on optimization based on prediction. There needs to be a continuous redefinition of organizational goals, purpose and an organization’s “way of doing things”.

In the MIT Sloan Management Review, John Sviokia (1996) talks about the need to assemble “constellations” of actions, which need to be considered in the light of
political effects in the firm, manage the momentum of the project and work to achieve economies of scale. As knowledge worker is more autonomous than clerical or physical labor, and as technology approaches doing abstract work by computers such as in artificial intelligence, tools, which support the knowledge worker, are becoming more complex and take on a more active role. Knowledge work is more intensive and specific.

Yogesh Malhotra (1996) elucidates the constraints on IT enabled knowledge management of the dynamic and continuously evolving nature of knowledge, the availability of knowledge in both tacit and explicit forms, the subjective syntactic and semantic basis of knowledge creation as well as its constructive nature making it difficult to develop such capabilities.

The following are some of the knowledge management tools that exist outside Xerox as detailed by Jeff Angus, Jeetu Patel and Jennifer Harty (1998) as tested by Information Week:

1. Wincite 5.0 - This is the most mature knowledge management product, which allows a firm to manage a shared repository of structured data, and delivers it in forms that ease the analysis work using libraries. Its ability to act as a shared repository as well as presentation of knowledge for analysis restricts its acceptability as a full client. Wincite 5.0 is best suited for compiling competitive intelligence.

2. Intraspect 1.5 – This tool is designed for knowledge management. Using user specified maps, it creates a “group memory” by storing the information and communicates the same via Internet, email and networked files. Using a peer-to-peer model, the software uses email and object oriented database it is able to store knowledge items in multiple contexts. Intraspect also tracks a significant amount of meta-knowledge (knowledge about knowledge), which preserves the context. Disadvantage of the package are its inability to retain integrity of the files as they are moved across the cyberspace and the startup can be a significant resource drain, as the tool does not use the network operating system information.

3. Channel manager 2.0 (Beta version) – This tool gathers information from both internal and external sources and disseminates the knowledge to users who need it. Using HTML, it converts documents to hypertext format and assigns a separate (Uniform Resource Locator (URL) tag to each different file. It does require a knowledge administrator for setup of users, groups and information channels. Users can “own” their channels. The tool supports quick spread of organized knowledge with a low cost of ownership. It is able to handle a diverse set of knowledge.

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4. BackWeb 4.0 – This tool can disseminate sources of information to users. It is also designed to collect information from any source and transmit it to users who have specified the need for it. It can handle multiple file formats. The tool supports spread of “channels of information” rather than the information itself. It sorts of connects users to the sources directly using a hierarchical mode of delivery. The tool requires administrators who regulate the channels. It comes with 600 pre-configured channels, which can be added to.

5. KnowledgeX 1.0 – The tool clarifies the meaning of the information and analyzes the information presenting the relationships between facts. It is an analysis-oriented tool, which using a central repository, presents the knowledge in form suitable for further analysis. It has use for very specific applications such as competitive intelligence and for governmental intelligence agencies. It uses the email for its knowledge transfer.

We also have Hoover from Sandpoint Systems (Dun and Bradstreet) and GrapeVINE form GrapeVINE technologies. However searches selected external databases using keywords and deliver the knowledge to the user. HP, Ford and Accenture use grapeVINE.

Neural Networks, provides tools that use data and statistical analysis to assign cases to categories. Their success ratio increases as the sample base increases.

Case Based Reasoning tools, are becoming widely popular in embedding knowledge into specific systems for easy access and used for hot-line support in customer services and for aiding repair in the field.

These tools are used for codifying knowledge and then sharing the databases for wider acceptance and growth.

2.5.3 Knowledge Management Framework

The following framework was used by Siemens Business Group, which served over 30,000 employees in 60 different countries with annual revenues of over 8 billion marks.

Knowledge Management fuses with business strategy:

The firm needs to manage knowledge as a corporate asset. KM strategy should be linked with the corporate business strategy. Intellectual capital should be managed. Management needs to develop a value system for knowledge management behavior. KM initiatives and core competencies need to be developed.

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Knowledge Culture and Organization:
Culture of sharing and trust needs to be fostered along with teamwork and collaboration. Roadmaps with KM objectives need to be developed. Networks of knowledge expertise need to be formed. Communities of Practice established. KM incentive systems need to be implemented. Enablers for knowledge management need to be instituted.

Knowledge Market:
Professionals who become knowledge sellers through personal contacts and networks share their tacit individual knowledge to increase community knowledge. Knowledge brokers who facilitate knowledge sharing and re-use must be encouraged and rewarded. Knowledge buyers should have access to books, repositories, and discussion groups. Explicit knowledge such as processes, methods, business patterns, and design experiences should be accumulated.

Knowledge Content and Structure:
Knowledge Maps, Knowledge Forms and Knowledge Monitors need to be developed

Knowledge Measurements and Metrics:
Need to develop maturity models, knowledge management ROI, Status of communities of practice, Balanced Scorecard.

Knowledge Processes:
Knowledge transfer: creation and harvesting processes need to be developed
Knowledge mapping: codification and coordination strategies need to be developed.

Knowledge Workers:
Establishment of Chief Knowledge Officer (CKO), knowledge architects, librarians, reporters, editors and technologies need to be completed.

Knowledge Technology:
Development of Knowledge libraries, project and document repositories need to be completed along with knowledge mapping of portals, search engines, knowledge maps, yellow pages and skill databases.

Communities of Practice:
Support CoPs with collaboration tools and virtual team tools such as knowledge flow applications like bulletin boards, workflow software and email.

Knowledge Management Strategy:
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Determine critical knowledge and how it will best support the business strategy. Identify where the knowledge is created, when sharing would be useful and how can it be done within the context of the organization. Knowledge management processes must be defined as an integral part of the business processes. *Economic value of knowledge does not lie in possessing it, but in using it.*
Chapter 3. Summary of Best Practices

3.1 Knowledge Sharing Enablers

The following are some of the critical success factors for effective knowledge sharing:

- **Trust** – this should be pervasive, visible to all in the organization and propagated from the top.
- **Morale** – though difficult to maintain sometimes, specially for large organizations, is necessary as tacit knowledge sharing can come only from the heart and cannot be mandated.
- **Common goals** – senior management must set, promote and monitor to build corporate coherence.
- **Culture** – knowledge oriented culture which promotes positive attitudes about knowledge, and removes inhibitors such as “not invented here”
- **Value** – linking knowledge to economic value via visible metrics showing benefits of knowledge.
- **Criticality** - of knowledge to the survival of the company must be recognized.
- **Diversity** – bringing together people with different knowledge and experience
- **Structure** – some structure for knowledge is necessary to show what business goals will corporate knowledge serve, identify existing knowledge in various forms and allowing evaluation of knowledge being added for usefulness, consistency and correctness.
- **Environment** – technical and organizational infrastructure with knowledge oriented technologies. Depending on the size and need of the company, this could include company wide intranets / extranets, repositories, search engines, some approach to managing the “meta-knowledge”, yellow pages, knowledge roadmaps, knowledge facilitators and telecommunication facilities such as videoconferencing and PCs with presentation tools. IT should be supportive and not a bottleneck.
- **Rewards and recognition** – this critical enabler must allow for rewarding those who share knowledge and those who learn. Programs like mentorships, apprenticeships, story telling, lessons learnt conferences, knowledge fairs, personal interaction events must be supported matching the needs and finances of the organization.
- **Support** – senior management promoting the importance of knowledge, making support resource available and making knowledge intention clear. Some firms appoint CKO, chief knowledge officer, who advocates or evangelizes knowledge sharing and learning, includes knowledge as part of the organization’s business strategy, develops firm’s knowledge infrastructure, manages relationships with external knowledge sources

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including research centers and universities, measures and manage value of knowledge, and develops and manages the company’s knowledge strategy.

- **Multiple fronts** – knowledge creation/capture and sharing must be along several fronts so that the company is able to develop a holistic competitive advantage.

Knowledge initiatives begin with a good pilot program, building physical and virtual knowledge structures, and defining the value of knowledge. For teams to communicate across their boundaries, it helps to have a company wide common language, by way of clear intention and knowledge goals.

Technical infrastructure, depending on the company, should allow for both a discussion type of database to store personal comments and sharing of tacit knowledge as well as a formal structure for storing explicit knowledge.

Some steps for a successful knowledge sharing process are:
- Determine the technology to store knowledge
- Create a structure to hold the knowledge
- Persuade employees to contribute knowledge
- Identify, develop and monitor both human and automatic channels for knowledge sharing
- Calculate knowledge valuations
- Negotiate with internal and external holders of desired intellectual capital
- Manage knowledge asset portfolios
- Financially analyze, and work with external vendors of technologies and services,
- Develop different human resource management approaches
- Develop nontrivial motivational aids like a special rewards and recognition program for good knowledge behaviors
- Understand the finer points of organizational learning
- Link to Economic or industry value via benefit calculations,
- Develop a corporate process orientation for organizational learning
- Clarify vision and language, and do not approach it as a culture change

In terms of tools, which can be considered as knowledge sharing enablers, we must note that Lotus Notes and Web Browser/Intranet systems are most common tools for publishing knowledge maps. Notes, has a database engine, supports discussion group creation and management facilities as well as replication capabilities for remote use. The web is ideal for publishing information across multiple types of computer platforms. For multimedia databases and for displaying company’s knowledge that is linked to other knowledge bases through hypertext links. Lotus “Domino” web servers, used by MIT and many other large organizations allow knowledge to be captured in Notes and then distributed over
the Web. Chrysler has successfully used this methodology in its implementation of the Engineering Books of Knowledge.

If one were to combine the time to find a solution with the level of user knowledge required, then the following knowledge tools can be categorized as follows:

<table>
<thead>
<tr>
<th>Level of Knowledge</th>
<th>Quick Time</th>
<th>Medium Time</th>
<th>Long Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Search Engines, email distribution lists</td>
<td>Constraint Based Knowledge Tools</td>
<td>Expert Systems</td>
</tr>
<tr>
<td>Medium</td>
<td>Structured File Servers</td>
<td>Case Based Reasoning</td>
<td>Knowledge Fairs, Teamwork Days</td>
</tr>
<tr>
<td>High</td>
<td>Knowledge Components</td>
<td>The World Wide Web</td>
<td>Lotus Notes (Discussion Forums), Neural Nets</td>
</tr>
</tbody>
</table>

Table 3.1.1 Knowledge Tools Categorized by Level of Knowledge and Time

Human resource assist packages like PeopleSoft and SAP can be used to monetize knowledge by linking compensation to knowledge mapped, as a possible activity for recognizing value of knowledge.

Process wise, knowledge sharing gets a boost when a company makes knowledge management part of every employee’s job. Converting codified knowledge such as IPs and other documents makes the knowledge into corporate knowledge on which a value can be attached.

Company needs to encourage flexibility among its employees so that they can respond quickly to new knowledge in the wake of competitive pressures and new technologies. Enough time and opportunity devoted to knowledge sharing must be allocated for it to succeed.

Other enablers include a change in management style to focus on knowledge sharing and alignment of corporate objectives along those lines. Incentive programs are good for initiating programs but should not be sustained indefinitely and should change their focus with the changing critical areas of need for the company. Existing structures should be fully utilized for knowledge sharing, as it is not always necessary to invest in new structures.

Two Ernst &Young researchers, Dave DeLong and Mike Beers consulting with Tom Davenport (1997) did a study of 31 different knowledge projects in 22 different
firms in a study “Managing the Knowledge of the Organization”. Success was defined as when resources continued to flow into the project, amount and usage of knowledge in the repository was growing and project was generating money or value to justify its costs.

Critical success factors for knowledge management include multiple backers within the firm, senior management support, clarity of objectives and language, strong focus on motivation such as long term aids involving salaries or promotions, knowledge friendly culture which facilitates intellectual curiosity, enjoyment of discussion of knowledge, and pleasure in helping others.

Technology and organizational infrastructures with small amounts of process orientation to the project were necessary, but not sufficient without the others mentioned above.
3.2 Barriers to Knowledge Sharing

Besides the obvious case of having the opposites of, or lack of the enablers already described, the biggest barrier to knowledge sharing is the high cost of search for optimal knowledge. Search engines are not yet quite there in their capabilities to search for optimal knowledge.

Teams should be encouraged to have redundant knowledge and open to sharing their knowledge. Teams who try to protect or hoard their knowledge only hurt the company’s competitive advantage. In the PDP, the barriers arising from disciplinary loyalty to either engineering or to manufacturing, and resistance to sharing across functional boundaries are well documented.

Lack of visible value of knowledge is a barrier. Knowledge is already an intangible asset and when the organization does not show direct correlation with its business bottom line, knowledge sharing becomes more difficult.

As said before, knowledge sharing will not happen if there is a lack of trust among the employees. There is a need to have the organization support face-to-face dialogs, and allocate time for personal interactions to build the trust.

Diversity in the workforce such as different cultures, languages, heritage and upbringing can be a barrier to knowledge sharing, however the organization can turn it around and use it to an advantage by creating common syntax with common goals, training and processes which support education, discussion, teamwork, job rotation. Using diversity to develop solutions and products, which meet the diverse customer marketplace, can then enhance competitive advantage.

To overcome the barriers of lack of time and meeting opportunities, the firm can have special teamwork days, knowledge fairs, talk rooms, special conferences (which also could be web-casted to reach globally distributed teams).

To enable the workforce to be receptive to knowledge sharing, the firm can educate employees and provide time for learning, as well as to recruit new hires based on capacity and openness to new ideas.

Individuals and groups who believe that certain knowledge belongs only to them or avoid learning from others due to the NIH (not invented here) syndrome, need to be coached in desire for ubiquitous knowledge without any hierarchy and reward knowledge workers based on the quality and not on the source of knowledge.

Davenport (1997) had listed the following barriers impeding successful knowledge management:

- Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
First, the assumption that once you have built an information technology base for knowledge management, that it will be enough as an initiative to achieve success. It is not true that if an infrastructure and tool set is implemented, then the employees of the company will use it, i.e. “if you build it, they will come”. This has to be accompanied by addressing the content of the knowledge base, culture of the organization and appropriate reward and recognition initiatives to use the knowledge base and tools.

Second, often companies tend to put up their standard policies like the human resources manual online to start the ball rolling. Davenport’s recommendation is not to put anything in the system except knowledge that would be recognized by the employees as such.

Third barrier is that companies try to camouflage their knowledge initiative, by calling it something else and are afraid to use the knowledge label. This portrays to the employees that senior management is not really serious about knowledge. That management does not realize that employees’ knowledge and learning capacity is more valuable than any other company asset.

Fourth, there is a lack of knowledge workers and managers who support and facilitate knowledge management. Knowledge captured must be harvested and disseminated, which requires setting up and managing knowledge technology infrastructures and tools that need regular maintenance.

Fifth, lack of visibility of value of the knowledge. Until the value of knowledge is estimated, tracked and managed, it will not be recognized as an asset.

Sixth, restricted access to knowledge only makes it difficult for employees to share their knowledge.

Seventh, knowledge management always has political overtones, which can only overcome by visible support and recognition by senior management.

Other barriers such as severe treatment of failures or restricting actions to look for assistance need to be removed by showing acceptance and reward for errors made in quest of creativity, and acceptance for not knowing everything.

Mistrust, resentment of the company and lack of free time are other barriers to be contended with.
3.3 Role Model Industry Examples

Though I have not found any single company that has discovered the mantra for knowledge management and sharing, there are several good examples within the industry that we can learn from. They are across several dimensions and we shall attempt to summarize them here:

Internet and Intranets provide the best examples of repository medium of broad knowledge. With the Web, the issue of localness goes away. Searching of knowledge is facilitated by good search engines, which can search the headers, the abstracts and/or the whole text and giving a relative index with respect to the closeness to the search key, such as relevance. Hyperlinking documents allow documents and subjects to be linked regardless of their physical location or storage media (documents, audio, video, databases).

Sequent developed the SECL (Sequent Corporation Electronic Library), which is an intranet-based repository for all of the corporate knowledge for its employees.

In 1993-1994, Hoffman – LaRoche, Swiss pharmaceutical firm used its knowledge management initiative, to speed up the application process of new drugs through the certification process, by taking advantage of common knowledge in the applications over the years.

In 1996, New England surgeons improved each other’s capabilities by sharing stories of operating room practices.

Hewlett Packard (HP) has used knowledge management in several notable ways:
- HP improved its hot line support by reducing the times of the calls as well as need for extra technical expertise, by embedding the knowledge in an expert system for technical support, using case based reasoning.
- HP IT managers also exchanged knowledge using Lotus Notes, and used the company’s intranet to disseminate that knowledge.
- Using a common repository HP’s ESP (Electronic Sales Partner) storing hundreds of thousands of documents, the computer systems sales force used company’s knowledge via a worldwide intranet. These documents included white papers, sales presentations, technical specifications and links to materials external to the firm. The repository also enabled HP’s employees to submit their own documents for sharing, which were reviewed by a small group. Documents were filtered for uniqueness as well as applicability, and categorized based on type and format of the knowledge. A search engine for queries and which supported automatic archiving supported the repository based on usage history.
- HP’s Connex allows HP employees to find HP Labs experts in specific areas.

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HP is a heavy user of Lotus Notes. Internally, it has developed “Trainer’s Trading Post”, which allows HP employees to share experiences. It also has developed “HP Network News”, where it gets the resellers of HP equipment to share product and service knowledge.

HP’s GrapeVine, disseminates knowledge to selected users, based on content using their profiles which indicate desired categories.

HP’s TelTech is a knowledge-sharing network of external experts, which allows Teltech’s client’s access to technical experts, using online biographies of the experts.

Another firm, General Electric (GE), also has developed a 24x7 hotline. Its Anser Center in Louisville, enables 200 operators to field about 14,000 calls a day. GE developed a database listing 1.5 million problems and possible solutions. Using Artificial Intelligence technology, GE operators are able to diagnose problems within a couple of seconds. The database is replenished with knowledge on a daily basis by four programmers who update the database with solutions developed by twelve specialists on site. The new knowledge is also disseminated to respective divisions every month, so that the business divisions for use in their product updates internalize these new problems and their solutions.

According to Chou and Chow (2000) the trend in both the US and the UK is to direct service delivery via call centers to the Internet. Using a subject matter expert, or specific information channel such as a technical manual, or marketing collateral, or canned responses using Frequently Asked Questions (FAQ), or historical call logs or even a diagnostic interactive dialog using a case based reasoning tool, companies are supporting their customers and reducing their overhead.

Another firm, British Petroleum (BP) has had successful knowledge sharing initiatives:

- BP developed the BPX Virtual Teamwork Program for globally distributed teams to collaborate. BP used a non-IT and independent team to develop and coach the company’s employees in the use of communication media for worldwide knowledge sharing. This system allowed the company to repair equipment failure in the North Sea using an expert in Aberdeen, Texas in few hours which otherwise would have taken several days and the cost of using a ship at $150,000 / day.
- BP’s knowledge sharing has succeeded because relationships between the team members were built using virtual and face to face meetings, and the use of technology to communicate and collaborate. The videoconferencing network became BP’s tacit knowledge pipeline. BP’s training focused on goals, and management stressed the importance of new behaviors. At the
start of the project, savings and productivity measures were defined and actually measured against plan during the project.

- BP also propagated the “Thief of the Year” award, honoring the person who stole the most ideas which were useful, thus negating the forces of “not invented here” syndrome.

Siemens’ notable practices for knowledge management were compiled by Davenport and Probst (2001). Siemens is a global company with a highly diverse product and services portfolio, which is mostly IT driven. The organization has transformed itself into a knowledge-based company and is beginning to enjoy a “knowledge synergy” across a highly divisionalized organization structure.

Siemens started supporting middle management’s effort to create knowledge repositories, and recognized the need for a company wide coordinated approach. The scope of knowledge spanned across various content domains, such as best practices, customer knowledge, competitive intelligence, product and financial knowledge. Taking advantage of its extensive relationships with external organizations, especially universities and realizing that hoarding collected knowledge would actually be a competitive disadvantage, the management supported flow of information within and external to the company.

Siemens use the company’s ShareNet (implemented by Siemens Information and Communications Network – ICN) and communities of practice as principal forces in enabling knowledge sharing. ICN is a worldwide organization with 60,000 employees in 160 countries with annual revenues of $13 billion dollars. It had to transit to a decentralized decision-making and sharing its knowledge globally within its organization. While enabling both global networking as well as retaining local relevance, ShareNet linked salespeople of Siemens ICN worldwide, making each salesperson’s accumulated learning experiences available to entire Siemens sales-force, with accompanying documents which included sales proposals, successful project descriptions, presentations, relevant business plans as well as yellow pages with contact information of technical and financial personnel. ShareNet acts a go-between for Siemens employees, using both explicit and tacit knowledge of the employees, project information, component technical information, knowledge about the business environment, and allows sharing of experience-based knowledge.

Siemens realized that it can no longer sell only packaged products and applications, and needed to work with external suppliers to build and operate new businesses jointly with the customers. This required use of both internal and external knowledge. With more awareness of the customers’ economic environment, they sought to work with the customers to look into the future businesses and jointly develop strategies. Being a global company, Siemens also needed to use both its
global know-how as well as personalized local information to maximize its competitive advantage.

Dr. Ronald Coch, CEO of Siemens ICN, believes that their future is dependent on creating a universal net of knowledge for all its employees, balancing growth of explicit knowledge, while allowing room for personal interaction of tacit knowledge. To further knowledge sharing, Siemens opted to give out incentives similar to a frequent flyer miles program. As a sales organization, ICN’s business was dependent hugely on those having direct customer contact. The same contacts were also a source of information for future customer needs. This initiative also resulted in increased customer satisfaction, as the company responded to those customers who shared their future needs, with specific solutions.

Siemens also developed the Knowledge Network using a Lotus-Domino based server, where service technicians shared their knowledge of customer contacts and narrated the activities during installation, setting up customer solutions, hardware and software releases. A small team of experts filtered this knowledge for appropriateness, duplication and quality. The knowledge was then also forwarded to product teams for updating the features of their future products. Siemens also regulated the rewards program so that after a certain critical mass of knowledge captured the incentives would stop. It was estimated that a thousand service technicians would save about 10 million euros per year, in the savings of time searching for knowledge, which now was easily accessible, by the Knowledge Network. The company promoted the knowledge network internally, so that the knowledge sharing would take on an infectious spread. It also provided statistics on the knowledge sharing, as well as allowed feedback by service technicians, about the applicability of the knowledge.

Another tool used by Siemens IS (Industrial Services – another large division of over 22,000 people distributed in over 70 countries) was the Know-How Exchange, an extensive database of practical experiences of various projects by the division. This was another example of enabling local employees to take advantage of corporate knowledge in increasing customer benefit and their process performance. As search engine supported queries for specific know-how and skills as well as facilities for storing one’s knowledge for others. The tool is also available world wide in German, English and Spanish.

Siemens Medical Engineering Group lists the following best practices in knowledge sharing:

- Knowledge once created can be deployed at low marginal costs.
- Multiply existing knowledge to leverage law of increasing returns.

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- Constant negotiation and re-negotiation of what constitutes “best” at all levels of the company
- Barriers such as personal, collective, structural and political, can be turned into enablers.
- Connecting people via employee networks to best practice owners
- Developing a best practice marketplace for exchanging best practices
- Management becoming patrons and sponsors of knowledge sharing
- Mobilizing employees with incentives, rewards and recognition
- Developing a best practice landscape by designing a content structure
- Using facilitators and “best practices” office to emphasize support
- Developing the “Recruiting Network” for practical exchange of knowledge
- Having top management with technical expertise, commitment and leadership
- Identifying experts, coordinating participants, organizing workshops, moderating best practices, and structuring contents.
- Having a network of core experts for knowledge transfer and coaching
- Developing a community of participants with technical leadership, learning and implementing best practices
- Developing a roadmap for best practice network
- Identifying knowledge
- Determining topics for best practice network
- Identification, processing and communication of best practices
- Representing knowledge
- Implementing knowledge transfer by community members which is supported by experts and managers
- Distillation of implementation experience by experts supported by community members

Siemens associated International Neuroscience Institute’s (INI) initiatives for knowledge management are described by Madjid Sammi, as edited by Davenport and Probst (2001).

Observations were that multi-faceted projects require complex knowledge management solutions. New modes of transferring of knowledge should build on existing or traditional methods. INI affirmed that for projects of any nature, customer should always be the central concern. INI also observed that cross-functional knowledge exchange helps creation of new knowledge. They also concluded that not only stakeholders in the knowledge management project benefit, but so do their customers worldwide.

Siemens pursued four objectives for customer empowerment.

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
First, to enable collaboration, they included knowledge sharing and relationship management in extended communities of employees and customers.

Second, they invested in organizational capital that grows with use and endures change.

Third, they provided a convenient portal to knowledge, practices and company ideas and extended this portal to their customers as well.

Fourth, they wanted it to be simple and easy as well as light on administration.

Chrysler Corporation developed the Engineering Books of Knowledge, which contains knowledge acquired (adding value to data) by automobile platform teams in an effort to share and provide a “good start” for newly formed teams.

The Army after the Gulf war, and in attempt to understand the “friendly fire” scenarios, had the AAR (After Action Review) initiatives, where both soldiers and officers were asked to recap their knowledge about a situation, and the decision making process which led to their actions. The study of the relationship between knowledge and decision-making was deemed as an important lesson to be learnt by the Army. The Army believes that the introspection of the outcomes based on acknowledged mistakes provides the highest form of learning. This learning exercise, labeled as “face time” is now planned by the Army.

Senco Products, a Cincinnati-based metal fastener manufacturer, developed a lessons learnt database by archiving a “logic trail” which documented the logic leading to major decisions. Senco, uses this database to understand the gaps in knowledge or logic leading to poor decisions. The data inputted to the database does require high trust on behalf of the employees that this information would not be used against them.

Chaparrel Steel (CS), a mini-mill steel manufacturer, uses a flat organization and has a unique apprenticeship program for all production workers, where risk taking is encouraged and employees are selected for their ability and attitudes about learning. CS’s organizational approach clearly encourages its workers to gain and share knowledge.

Some companies, like Polaroid, record stories and experiences of its senior practitioners before they leave the company.

Walmart has developed a cross-docking competency with knowledge on how to integrate distributor centers, use resources for transport and information systems to aid in logistics.
Massachusetts Institute of Technology Chapter 3. Summary of Best Practices

Electronic Yellow pages are another form of knowledge sharing, which enables Hughes Space and Communications engineers, to locate experts in their companies on any pertinent subject, and seek out knowledge by contacting those experts. Hughes is considering making it mandatory that everyone lists their background, interests and expertise in the firm’s yellow pages. Other firms such as Xerox, HP, and Microsoft are following suit.

Raychem, CA, electronics and telecommunications manufacturer has developed an Internal Information Interview Network, a form of a yellow page database, which lists employees who are willing to meet with colleagues and share information.

Microsoft (MS) has taken the idea of the Yellow Pages a step further. This is a role model example. They have developed the SPUD (Skills Planning and Development) Knowledge Map. This knowledge map is the repository of known skill levels of the system developers, and is used by MS’s Human Resources department to develop training plans, as gaps become visible in the knowledge map. SPUD uses a five-step approach to enhance and keep evergreen the firm’s knowledge level by:

- Maintaining a structure of knowledge competency types and levels
- Defining the knowledge required for a particular job
- Rating the performance of individual employees in particular jobs according to four knowledge competencies as below, as well as specifying explicit or implicit:
  - Basic - Entry level foundation knowledge
  - Working - Local or unique knowledge competency for a particular skill
  - Leadership - Global knowledge of all employees within a function
  - Expert - Universal competency including knowledge of overall business, products, and drivers of industry
- Implementing the knowledge competencies in online system for training
- Linking the knowledge map to training programs

NationsBank has developed another form of yellow pages by the name of Project Agora, for internal knowledge sharing.

Sematech, the Semiconductor research consortium has been much more successful in knowledge sharing compared to its counter part MCC. Sematech developed a specific organizational and human resource structure to facilitate knowledge transfer. Using documents, databases, intranet and groupware collaborative software, and Sematech engineers in face-to-face meetings with other firms’ engineers transferred knowledge. The member firms assigned their engineers to be at Sematech facilities for a fixed period to enable this technology transfer.

Japanese companies have an interesting approach to knowledge sharing. For example, Dai-ichi Pharmaceuticals and other Japanese firms have the so-called

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“talk rooms”. These rooms have green tea and attractive lighting. Every researcher in Dai-ichi has an obligation to spend twenty minutes per day in the talk room. There is no agenda, no presentation, no fixed format, or any organized discussion. The Dai-ichi researchers are encouraged to talk about their day’s work to anyone who would listen. The assumption is that this informal method will induce knowledge sharing and the knowledge will thus diffuse throughout the organization in real time in a kind of Brownian motion. It is also expected that these chats will create value for the firm, once someone’s tacit knowledge is articulated to others.

In another form of informal chats, it is customary for Japanese managers to socialize after work in-group dinners and visits to nightclubs, where they will carry on knowledge sharing in the carefree and hang loose environment. Japanese managers prefer face-to-face meetings to build trust instead of using e-mails.

Sharp has taken the formal approach of making sure that their research is formally transferred to technology groups, who then formally transfer their knowledge to the nine business division’s core competency groups, and the business divisions then take that technology into their labs, and use it to develop advanced products.

Monsanto developed the Knowledge Management Architecture (KMA), which is a repository for corporate knowledge. It uses a relational database to store and retrieve quantitative data in a structured format, and uses Lotus Notes to do the same for qualitative knowledge sharing using a bulletin board like unstructured format.

Minnesota Mining and Manufacturing (3M) has a unique business environment as well as a unique approach to knowledge. 3M believes that technical knowledge belongs to the company and not to the individual or the team who develops it. They sell over 60,000 different products with over 30% of 3M’s revenue being generated by newer products (less than four years old). Researchers are encouraged to spend 15% of their research time in pursuing their own self-interests. 3M recognizes the value of knowledge transfer and fosters such belief.

Another company to be noted is Texas Instruments (TI). TI established the Office of Best Practices to identify and share best practices. This organizational and technical infrastructure facilitated 138 employees to act as Best Practice Sharing facilitators to TI employees worldwide. These facilitators, found and documented best practices in their areas, communicated them via personal interactions and promoted the sharing of common tools. Their intranet website was propagated within the company in their “Sharefair”, where they presented the “Not Invented Here, But I Did it Anyway” awards in 1996 for the first time. They had 52 nominations for the awards highlighting a savings of over 1 billion dollars.

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Two companies noted for measuring value of their knowledge are Skandia’s Leif Edvinsson, who published a comprehensive effort to measure the firm’s intellectual capital and Dow Chemical’s Gordon Petrash, who cites the company’s savings of over 4 million dollars by better managing their patents.

According to Davenport and Hansen (1999), Accenture (formerly Anderson Consulting) started its Knowledge Sharing System in 1991, made its first release in 1993. All consultants were fully enabled by 1996, and by 1999, Accenture had over 100,000 documents in its repository and available for use by its personnel throughout the world. The goal was to enable the consultant to leverage all corporate knowledge available, and present to the client, as if the entire Accenture Company was consulting with them.

Managing an already very large collection of documents, which were being incremented, even further, by an increasing number of consultants, while propagating the use of the existing knowledge, became the main problem. Therefore, Accenture developed the Knowledge Exchange to connect the consultants within the company, as well as allow them to utilize each other’s skill and knowledge, in what Davenport calls “collective empowerment” of the individual. Goal was to have each client be presented the best thinking of the entire company. It allowed the consultants to leverage on the success of their fellow consultants and utilize their proven approaches, as well as be mindful of their lessons learned during their multiple client engagements.

Premise underlying Knowledge Exchange, was that the commonality in client problems and the solutions already provided by fellow consultants, could be combined and used for addressing issues of new clients in a win-win scenario. The consultant was utilizing knowledge beyond him or herself and at the same time the client was receiving service of more than the just the consultant directly engaged.

Anderson’s senior management due to its promise for long-term success quickly supported knowledge management.

Accenture’s Knowledge Xchange was developed on top of the Lotus Notes platform over several hundred servers, with access capacity to over 35,000 consultants in the firm. The databases were shadowed to many servers across the globe each day to enable local real-time access, to the latest corporate knowledge. The firm also developed several customized tools to aid the user such as:

- The Navigator, which listed the most relevant and universal databases (now replaced by Yellow Pages which could point to groups of databases by group or Community of Practice or Workgroups).
- The FrontPage, which allowed the user to personalize their browser entry into the system using headlines, special interests and front pages of Community of Practices.

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Accenture did not appoint any Chief Knowledge Officer, but regarded the heads of industry and competency groups within the company, as Chief Knowledge Officers of their domain. Accenture also had roles defined like Sponsors, who were firm’s partners and had the primary responsibility of creating and maintaining a particular knowledge base. They had Knowledge Integrators, who specialized in content, as well as Knowledge Base Administrators, who performed day-to-day administrative and technical work of managing databases. They also had Knowledge Managers, who managed knowledge. This number amounted to about 200 who saw themselves as full-time knowledge managers.

Accenture did succeed in developing a tremendous repository, however, they were not quite successful in having the knowledge be used, which was the ultimate goal of the system. One cause was information overload. Using incorrect information because of not knowing the underlying assumptions about data in certain cases was another reason. Consultants still used their personal network to identify which documents to use. This did not help the junior consultants, who had not yet formed this informal network.

To make the system more useful, a small group of partners and knowledge managers, started receiving and putting their stamp of approval on the documents, before they were deposited in the system. Unfortunately, this also created another bottleneck, which now had to be managed. Electronic smart agents were added, to search for and make available the best and most relevant documents. To enable the smart agents, it required large set-up and extensive software. To further aid in making the documents more searchable, the firm asked professionals to write summaries of each document, as well the context in which the documents were written, along with recommendations to their best possible categories of use. A new position, Project Knowledge Manager, was assigned to each client service team, to assist the team for Knowledge acquisition.

All these enhancement efforts resulted in their own management challenges but were necessary. Davenport and Hansen, note that when the firm was small like 200 people, knowledge was shared through interpersonal relations and face to face meetings on Saturday mornings in the office, as opposed to now with over 35,000 consultants scattered all over the world, leading them to wonder if they should emphasize strengthening the interpersonal networks, and whether electronic knowledge sharing will ever totally replace sharing via personal interaction.

One example of optimized knowledge sharing is the one by Southern California Edison (SCE), which used an intranet to manage knowledge for a virtual project team as described by Jennex (2000). SCE is spread out over 50,000 square miles, and had to form a virtual team with its leadership team consisting of various roles...
department heads. The virtual team had 150 members and was scattered over 15 different locations. The goal was knowledge management, and used the strategy of bringing in external knowledge for training, reviewing procedures, integrating project management into daily work activities, and providing a intranet website for communication of knowledge and sharing. The team used project guidelines refined with expert knowledge and links to subject matter experts. Included in the activities were proposals and sharing of test plans, as well as results with pointers to external knowledge sources, via industry specific extranet.

SCE virtual team determined what knowledge was necessary for improving project performance. The IT units provided the infrastructure to manage the knowledge. They used an intranet as a primary infrastructure, for organizational wide use and an extranet for access to external interfaces to the industry, and older platforms within the business units. The results were that the virtual team was accomplishing their activities faster attesting to the successful organizational learning. The team used metrics defined by the industry and refined by the project team to measure impact on organizational effectiveness. Team members provided feedback and refined the knowledge used by incorporating new knowledge in the project guidelines, templates, requirements and metrics.

During the formation of the team, the requirements grew for the intranet site to support knowledge sharing from an initial goal of just generating awareness. The intranet site was redesigned to include FAQs, example documents, templates, meeting minutes, physical asset database, guidelines for specific functions including lessons learnt etc. This attests to the need for continuous refinement due to the dynamic nature of knowledge sharing.

Knowledge content of the site was also distributed into other sections of the site and people assigned to manage the knowledge content in specific areas. The intranet site included subsections of major initiatives along with documents, resources and tools, contact information for the various groups including teams and experts; documents with search and access capability; a “What’s new” section to highlight recent changes to the overall site; and hot links to other organizations and sites providing related knowledge; a section for issues and questions where it provided a venue for employees, to pose questions as well receive stock answers from FAQs or subject matter experts, and a physical asset database listing assets for the different projects.

SCE’s extranet was set up to have access to industry members. Knowledge was shared between external sources and internal experts using documents, processes and project management guidelines. The extranet was also used to have a consultation board, where questions were posed and answers posted. Project status as well as test results were shared using the extranet. The website also had links to other relevant sites and references to knowledge sources.
Davenport and Prusak (1998) studied thirty-one knowledge management projects at twenty different firms and came to the following conclusions:

There were several different kinds of knowledge repositories: External, Structured Internal and Informal Internal. Knowledge access and transfer was facilitated by "yellow pages" or "knowledge maps". Projects with multiple facets tended to be more successful, such as firms with initiatives of developing expert networks, internal document repositories, "lessons learnt" databases, high level of knowledge management processes, and where evaluation and compensation systems were used to change behavior.

Unsuccessful projects were in those firms where knowledge management projects were always struggling for resources, or trying to get employees to contribute knowledge into their repositories, or when the project was being championed by single or only a few evangelists.

Twenty-six projects out of thirty-one were about developing some form of knowledge repositories and mostly used structured documents. They describe Microsoft and Hewlett Packard using sales oriented documents including white papers, presentations and other marketing collateral. They also found a dominance of knowledge of insights and observations by employees contained in "bulletin boards", "discussion databases" and in "lesson learnt" type of archives.

Only two of the thirty-one projects looked into the value of knowledge. Companies like Skandia, a Swedish insurance company focused on "intellectual capital", and Dow on management of value by harvesting little used patent and license assets, and decommissioning them to reduce their cost base. Two companies concentrated on knowledge transfer. British Petroleum used a worldwide videoconferencing system for knowledge sharing, and Sematech used both human and technical interaction form of knowledge sharing. One company was involved with improving overall knowledge environment. One company transformed itself from being involved in knowledge management, to becoming an industry leader by employing all aspects of knowledge management.

They found 70% success rate, rating knowledge management projects higher than other change projects, like re-engineering or TQM. However, they did find that most knowledge management projects were not ambitious enough to transform their organizations. Successful projects did result in the organization being transformed in some real way even when operational improvements was constrained to certain function or process.

Two of best practices in supply chain management are the development of tiered supplier partnerships such as Visteon and the other is the enabling of the supplier.
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HPM was a supplier consortium, with the vision to be a high performance and world-class consortium of independent suppliers of quality products and services, who compete and win against the world’s best. They described their mission to work together, allowing each member to optimize their competitiveness in a win-win environment, using shared resources and experience. HPM was a series of small networks, with common learning objectives enabled by a strong but informal communication link. Using a facilitator to assure continuous information flow, it acted as a clearinghouse with promotional material, newsletters, weekly updates and book reviews. The facilitator also integrated the consortium, to make sure that learning and expertise acquired is leveraged, by disseminating it to the larger group for further exploration.

Stuart, et al (1998), describe the learning network, as one, which emphasized organizational learning within the supplier firms, where the performance became an outcome once learning had been achieved. This is a win-win situation for the buyer, who may not have the necessary resources to provide that training to the suppliers.

Challenges facing such supplier consortium are perceived inequities in members’ commitment and effort, which can be addressed by making learning efforts to be required. To address power localizing in some members, the consortium needed to emphasize consensus and equality. To prevent the buyer from gaining advantage, the learning network needs to be broad in its learning, and not specific to current buyer needs. Effectiveness of the consortium relies on the facilitator, who must be able to assess the needs and ensure that topics being presented are relevant.

Leveraged learning network fosters cross-fertilization of ideas and is better able to develop technological innovations. It also needs to have a long-term orientation, as well as appropriate telecommunications and technology infrastructure, to be able to deal with geographically distributed knowledge.
Chapter 4. Sensemaking of Knowledge Sharing Practices

4.1 What, Why and How of Knowledge Sharing

4.1.1 What is knowledge?

Using the simple definition of knowledge being the ability to act on information, we can surmise that for companies to act on the corporate information, it first, needs to be drawn out from the minds of the individual employees and other sources, and captured as explicit corporate knowledge.

Besides putting emphasis on converting individualized tacit knowledge to institutionalized explicit knowledge in our efforts to capture the corporate wisdom, we need to be cognizant of some of the difficulties we will encounter:

- First, knowledge is perishable and needs continuous renewal.
- Second, if it is not used it does not add value. Relevance of knowledge is the key and should be demonstrated by attaching strategic business value metrics to knowledge and making those metrics universally visible.
- Third, we should consider the three type of differences in knowledge between individuals and groups (Carlile 2001): syntactic, semantic and newness.

Difference in syntax can be addressed by using same language or framework, which allows the transfer of the knowledge from one boundary to another. Using metaphors and/or analogies, we can translate the knowledge between individuals/groups, to address the issue of the same knowledge having different meaning to different people. Newness of knowledge can be overcome if we transform the knowledge to the others’ boundary space. The last is easier said than done as we later find out.

The dynamic nature of knowledge requires us to establish a common semantic and syntactic infrastructure using a common language and framework, and a data model enhanced with corporate slogans, metaphors and analogies.

Explicit knowledge is created, as team members within and across departments interact with different knowledge, and as their different skill sets fuse, including the exchange of cross functional knowledge, while seeking to achieve common goals of the firm. The explicit knowledge captured is reflected in established methods, business patterns and processes, and supported with a repository of design experience of the firm. Innovation is incremental and continuous, as the employees consult and communicate using a common cognitive ground, and seek to resolve the ambiguities and differences with diverse ideas, analytical methods.
and viewpoints through consultation. The corporate knowledge needs to be spread and internalized by the entire firm to gain competitive advantage.

Initiatives in knowledge capture and sharing need support from management in terms of leadership, sponsorship, and commitment, in addition to making appropriate technical expertise available to the employees.

Identification of corporate knowledge needs to take place, such as establishment of best practices network, which includes developing a roadmap, determining topics, as well as identification, evaluation and communications of best practices.

Knowledge transfer includes active involvement of all the community members, guided by the management, and should include the distillation of implementation experiences of the experts within the company.

Relevant representation of knowledge, along with linking the knowledge model to the company’s training program, supported by specific organizational and human resource structure to facilitate knowledge transfer, are some of the enablers required for successful knowledge sharing. Companies need to take leadership in coordinating development of a community of employees, which thrive on technical leadership and learning, combined with implementing best practices, and supported by identified experts participating in organized workshops.

Summarizing key points in the understanding of knowledge are:

- **Understanding the complexities of successful creation, capture and sharing of knowledge**
- **Initiatives to share knowledge must include establishment of common syntactic, and common semantic basis for communication, in a continuum of consistent and incremental learning of relevant knowledge.**
- **Active leadership, by senior management in organizing frequent cross-functional team interaction events, designed to capture explicit corporate knowledge, culminating in recognition of those who share and acquire knowledge.**
- **Shared repository with best practices, business processes, design experience and access to experts and knowledge sources**

### 4.1.2 Why and how should knowledge be shared?

It is absolutely essential, that there is trust between the employees, which is pervasive, ubiquitous, visible to the entire organization and propagated to the top management.
Senior management has the obligation to set, promote and monitor corporate coherence to common goals, by clearly specifying the firm’s objectives. In addition, development of common syntax by establishing common processes, supplemented by allocation of time for learning through education and training, knowledge can then be extended within the company. In addition, knowledge sharing can also be enhanced by arranging frequent discussion events, joint teamwork and job rotation programs.

Continuous knowledge management and sharing must be part of the company’s strategic goals. In addition, criticality of knowledge in the company’s survival also needs to be recognized. This can be done by tying the benefits of knowledge directly to the business’ bottom line, by use of special metrics, which measure the value of knowledge, and correlating them with the other economic values of the company.

Though morale is difficult to maintain in large organizations, it is absolutely required as tacit knowledge sharing comes from the heart, and cannot be mandated. It can only exist in a supportive environment, which encourage knowledge oriented culture and diversity in its structure and has a strong reward and recognition program for good knowledge behaviors.

Effective knowledge sharing of both tacit and explicit knowledge needs appropriate tools and a conducive knowledge environment, for collective sense making, along with facilities for easy acquisition of knowledge from outside sources and consultants. Besides careful introspection of the company’s own product development process, the company needs to exhibit hunger for acquiring knowledge and be a proponent of enthusiastic borrowing of ideas.

Organizational knowledge is accumulated by sparking the knowledge creation process among its employees, and creating an excited mood in the employees who continuously participate in a company wide virtual team effort, using the intranet as the backbone and as the pipeline for knowledge storage and traversal. Suitable disposition of the employees, would cause the employees to contribute their knowledge into corporate repositories without encouragement, and knowledge sharing would gain momentum in the form of increased, both, human and technical interaction.

Successful knowledge sharing projects are characterized by initiatives along multiple fronts, such as development of expert networks, internal document repositories, lessons learnt databases, establishment of high level of knowledge management processes as well as active use of evaluation and compensation systems to change behavior, to improve the overall knowledge environment. Other key factors include championing of the value of knowledge by many instead of isolated single individuals. The company must be ambitious enough to transform
the organization, and management needs to ensure that knowledge projects are never struggling for resources. Availability of resources is one significant show of support by senior management with respect to the value of knowledge.

If the need exists and if financial conditions are favorable, a global company should invest in a worldwide video conferencing system, supplemented with separate audio conferencing and web casting facilities, as more than 70% of information exchange during personal communications is in non-verbal movements.

In order to establish a successful knowledge sharing process, it is required that we work with external vendors of technologies and services, to establish the appropriate information technology approach. We also need to develop specifically focused human resource management initiatives combined with non-trivial motivational aids, such as special rewards and recognition programs. The next step is to develop the infrastructure to support organizational learning, accompanied by a corporate orientation process to explain the finer points of knowledge sharing, including the link to economic or industry value via benefit calculations of the value of knowledge.

It is extremely important that clarity of vision and language is present for the knowledge initiative. It should not be approached as a culture change but as a proactive step to ensure survival. The firm should work to enable collaboration for knowledge sharing, as well as manage the relationship between its employees and extended communities, such as customers.

Value of knowledge must be calculated and analyzed financially, and the knowledge asset portfolios managed as other company assets. This would include negotiation with both internal and external holders of the desired intellectual capital.

Then, channels for knowledge sharing need to be enabled supporting both human and automated interaction, and exchange of knowledge between the various individuals and groups within the company. Specific channels need to be identified, developed and monitored for continuous improvements for effectivity. Time and space allocation for use of the channels need to be actively pursued by management.

The next step is to select the technology to store knowledge, and create a structure to hold the corporate knowledge.

Management needs to clearly articulate to the employees that knowledge management is every employee’s job, and persuade the employees to contribute their tacit knowledge into the corporate repository, supported by appropriate incentive mechanisms.

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Next step is to give careful consideration in developing the knowledge infrastructure for the corporation.

- Establishing knowledge processes including those for the creation of knowledge, facilitating knowledge transfer within the company, and harvesting knowledge to provide the most value. Integrating the knowledge processes into the business processes of the firm will require active and visible participation by the senior management of the company.
- Developing measurements of knowledge, and using company-wide visible metrics, which validate that learning is taking place, and to the extent of knowledge sharing as well as the value of the knowledge. The economic value of knowledge is not just having it, but also in using it to affect the bottom line of the company, again recalling that knowledge being the ability to act on information.
- Putting method to the process of transformation of the company would include development of knowledge strategies to enable the use of knowledge. Mapping the knowledge sources within the company, codification of knowledge including conversion of individualized tacit knowledge into corporate explicit knowledge, and coordinating the knowledge sharing need to be planned and executed. Determination of critical knowledge and its active use in business strategies also needs to be carefully planned and exercised.
- To allow quick and efficient use of knowledge, the knowledge needs to be classified and stored as it is accumulated, in such a way that the art of product development can become more scientific in nature, and relies more on facts rather than just opinions.
- To enable the knowledge strategies, specific support would be needed such as availability of knowledge architects and librarians, as well as knowledge repositories with various perspectives from the project point of view, shared document structures and communities of practice. Support will also be needed in making tools to interact with these knowledge repositories and to make better use of knowledge.
- Knowledge infrastructure to be used should be developed along four dimensions, namely, the process, the content, the technology and the organization. Small amounts of process orientation along with a landscape for best practice sharing should be among the ingredients of knowledge sharing. Use of the existing structure supported by new formal structures to store explicit corporate knowledge, as well as new informal structures to allow discussion and sharing of tacit knowledge, and personal comments is advisable. Identification of existing knowledge in various forms followed by knowledge evaluation with respect to its usefulness, consistency and correctness, as well as identification of which business goals are served best by which corporate knowledge, is necessary.
We note the following enablers as we glean the “how” to’s for effective knowledge sharing:

- Visible, ever-present and infectious trust among the employees, with the management and human resources department
- Clear, actionable and commonly understood intentions aligned with the business strategy of the company
- Active sponsorship and support of continuous knowledge sharing by senior management
- High morale within the company and desire to share knowledge with other employees to achieve critical business goals together
- Initiatives to instill knowledge sharing along multiple fronts and with active championing by many leaders within the company seeking to transform the company and supported by strong incentive programs
- Adequate personal collaborative tools, technology and infrastructure
- Knowledge accepted by everyone as a critical asset of the company with visible metrics illustrating the value of knowledge
- Established knowledge creation, capture and sharing processes using common repositories and infrastructure supported by knowledge facilitators, database and communications technologies

4.1.3 Looking through the strategic lens

The company needs to realize that its long term success will not be determined by its technical or intellectual strengths but more so due to its ability to adapt to changing requirements in the dynamic business environment. The competitive advantage will be its ability to use its corporate wisdom about its strengths and weaknesses, and knowledge on how to use it to improve the bottom line. It will depend on its roadmap of knowledge management objectives and its rate of knowledge based organizational learning.

Competence and innovation will be the outcomes, if formal and informal communities of practice take hold within the company, driving for the three orthogonal business requirements, such as customer relationships, developing innovative products and services and establishment of the infrastructure to deliver the value created. Scope of the problem solution space defines the customer relationship, speed drives the innovative process and scale directly impacts the infrastructure.

For an information intensive organization, heavy investment in knowledge management along with reliance on the Internet as a communication backbone are must-haves. The organization itself, would be flatter with less command and
control and rely more on teams of knowledge specialists, who would innovate in the atmosphere of creative abrasion, motivated by clearly specified intentions of the company, and with a thorough understanding of the company’s customer needs. To guarantee success, special incentive programs as part of the reward and recognition, which change focus to critical areas of need, are required. Recognition of good knowledge practices by using metrics and by methods, which measure the learning, the value of knowledge and knowledge management behaviors. Value of knowledge must be measured in terms of alignment with business strategies, and value of products measured on the knowledge embedded in the solutions solving customer problems, or making customers’ business processes more efficient.

Management needs to strike a careful balance between the knowledge management strategy and the company’s business strategy. It also needs to make sure the two are in constant alignment, and with visible focus on knowledge management, the corporate objectives are in clear sight. For the employees to be fully aware, establishment of a portal to company’s knowledge, business practices, company ideas and even extending the visibility into company’s customers is necessary.

The knowledge sharing initiative must be along multiple fronts, and should include company’s key business partners with established focused interfaces. It also must be a company wide coordinated approach supported by multiple backers within the company rather than by a single champion. Establishment of long term motivational aids, such as rewards for knowledge behaviors, in salaries and promotions are needed. Company’s e-Business model should use knowledge management as a backbone. Trust over price rules in strengthening customer relationships. Customer must, therefore, be always the central focus.

The management style that will work well, will be the one with a clear vision, composed of cross-functional teams who value leadership, with clear and simple objectives, and with individuals who are task-focused, who received proper training and development and demonstrate individual accountability. Management, with a decentralized organizational structure but centralized knowledge, which is totally process oriented, market and society driven, and focused on identifying, attracting and developing business relationships, will thrive.

The team based structure which is light on resources but heavy on knowledge, needs to work in an environment, where knowledge management is fused with the business strategy and the valuable corporate assets are the employees, company knowledge and organizational capital. The employees are the ones who conceive new products and services. The corporate knowledge is supplemented by meta-knowledge of relevance and applicability. The organizational capital is what is enduring change and grows with use. Support for access to knowledge can come

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in forms of company’s Yellow Pages, which can locate experts in certain fields, and seek out employees with desired background, interests and expertise.  

It is important that goals of knowledge sharing are aligned with business needs in the ever-changing business environment, where the company is constantly seeking better practices and continuously improving its processes to stay competitive. Measurement should be comparing the performance against the goals and have the final word.

Management needs to facilitate dialogue and focus the employees thinking, in the effort to convert individual tacit knowledge into explicit corporate knowledge. An example of this is how the Japanese firms establish talk rooms where the employees are required to spend some fixed amount of time per day. The talk rooms have no agenda, no presentation, no fixed format and no organized discussion, but helps diffuse knowledge throughout the organization.

Establishment of a company’s Chief Knowledge Officer (CKO), who advocates knowledge sharing and learning, and assists in including knowledge strategy in the company’s business strategy. The CKO also develops the firm’s knowledge infrastructure, manages relationship with external knowledge sources such as research centers and universities, measures and manages value of knowledge taking care that only relevant knowledge is recognized as company’s asset. The CKO also develops the company’s knowledge strategy and evangelizes it without camouflaging it as something else.

Senior management’s responsibility is to promote the importance of knowledge, making adequate support resources available, make the company’s knowledge intentions very clear, and show visible support and recognition of knowledge management, in addition to engaging patrons and sponsoring knowledge sharing.

Companies successful in knowledge sharing have rewarded and recognized those who share and those who learn, with incentives like frequent flyer programs for knowledge sharing. Reward is based on quality and not on source. Personal interaction events such as team building, knowledge fairs; sharefairs, which recognizes reuse, are encouraged. Strong mentorship and apprenticeship programs along with lessons learnt conferences and story telling gatherings are some of other successful steps a company can take.

In summary, some of the strategic enablers are:

- Clearly established knowledge management roadmap and a desire to adapt
- Three pronged approach at increasing customer relationship in scope, execute innovative process with speed and scale the knowledge infrastructure to fit the needs

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- Internet used as a backbone, with visible value of knowledge aligned with the business strategy and recognition for good knowledge behaviors.
- Knowledge portal with access to company’s business practices, corporate knowledge and company’s customers
- Knowledge initiative along multiple fronts facilitated by multiple champions
- Clear vision and objectives, visible support for knowledge management, and establishment of cross-functional teams who are heavy on knowledge and light on resources.
- Knowledge recognized as a valuable corporate asset like the employees
- Encouragement of good knowledge behaviors and support for personal interaction events, strong apprenticeships and mentorship programs

4.1.4 Culture and the Environment

Besides the process of knowledge sharing and the company’s strategy, we must consider the culture and the environment in which the employees are expected to share knowledge. It is important to understand how the organization is set up to create, acquire and transfer knowledge between its employees and modify its own behaviors to learn new knowledge and insights. The environment for the employees needs to be conducive to learning. Active stimulation of interactions is achieved by opening up boundaries between groups for knowledge exchange that will create chaos and eventually result in innovation of thought, as knowledge workers interact to resolve their differences in thinking. Innovation thrives when team members attempt to understand reasons behind the differences in thinking and come to a common understanding by explaining their tacit knowledge to narrow the gaps. Collaborative behaviors and understanding different styles of acting also has positive impacts. Sharing knowledge, allowing and leveraging diversity in approaches and viewpoints, are enablers in improving the quality of interaction and should be nurtured by management with humility and openness.

Peter Senge’s view of the learning organization requires that the company culture should nurture and reward new and expansive patterns of thinking, such as out of the box thought patterns, and set free the collective aspirations of the employees. Continuous learning by encouragement of learning together should be encouraged. Senge had recommended developing skills in component technologies such as systems thinking, personal mastery of a subject, shared mental models and vision and team learning to enable the learning organization.

Fostering of tolerance enhances trust between employees, which is yet another key enabler. As shared interests, common values, mutual goals and knowledge sharing are encouraged, so should be re-use of knowledge via application of lessons learnt, mentor-ships and apprentice-ships. Doing the right thing by renewing existing knowledge, creating new knowledge and embodying it in products and services

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needs to be emphasized by management, along with making learning a goal while doing it.

Good teamwork flourishes in the presence of:
- Clear and unified product vision,
- Appropriately allocated personnel and time,
- Modularized product architecture, which can be partitioned among the team members as features, functions, sub-systems or objects for implementation, using concepts of sub-projects with clusters of activity, and
- Visible milestones supported by feature teams who are multi-functional, have high autonomy and responsibilities.

Coordination and synchronization is forced by management processes and supported by good communication across and within teams. Team members also should be able to switch between product and process focuses as the need arises.

Hunger for knowledge is created by establishing a knowledge oriented culture by encouraging coaching by subject matter experts, acceptance of errors made by employees in quest of creativity and for not knowing everything. Support by management for free flow of information both internally and externally rather than censorship, and encouragement of risk taking by experts in sharing tacit knowledge. In addition, knowledge oriented behavior includes positive attitudes, facilitates intellectual curiosity, gives enjoyment to those who engage in the discussion of knowledge and feeling pleasure in helping others.

The knowledge behaviors described are more prevalent in work environments, which have less hierarchy, have pervasive and ubiquitous knowledge and an atmosphere of discouraging NIH (not invented here) syndromes. Companies who flourish have knowledge which is organized, focused, centralized yet distributed throughout the company through its different locations across different work cycles (“sun never sets on the project”) and cultures, and is easily accessible and sharable by the employees. Features are continuously innovated in small network teams, working on pieces of the project in parallel, and periodically synchronizing with each other enabling the stabilization of the overall project.

Teams should be able and want to transfer knowledge quickly and efficiently throughout the organization, by using new processes in systematic problem solving, using experiments, learning from past experiences and from others. This can only be enabled by open communications channels for information and support via video, audio and net conferencing punctuated by periodic face-to-face meetings. This environment is to be built on the corporate infrastructure with full use of information technology enabling access to books, knowledge repositories, external knowledge sources and discussion groups.

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Knowledge management initiatives and development of core competencies supported by specific incentive systems produce meeting grounds for subject matter experts and informal networks which thrive on team members’ proximity, trust within the team members and establishment of the reputation of subject matter experts.

Tools, which measure learning, validate learning and enable distributed knowledge management, also need to be put in use. Supportive environment also includes assignment of knowledge facilitators, availability of optimal knowledge enabled by low cost of search (in time), and electronic smart agents which search and find the best and most relevant documents when requested. The same electronic agents can also be used to automatically disseminate new knowledge to selected users based on their desire profiles. Access to internal and external experts to the company via the company intranet/extranet is required. Knowledge oriented technologies need to be applied both in technical and organizational domains within the company.

Companies also should build up diversity in its employees to match its customers and marketplace. This can be accomplished by hiring new talent, which is open to learning and with capacity to learn, developing globally distributed teams. This will achieve diversity in products and solutions for diverse marketplace with different experiences, different perspectives and different segments of knowledge among the employees.

In summary, the following enablers are needed in terms of the environment and culture:

- Knowledge oriented culture with employees who value acquiring and sharing knowledge and are continuously collaborating and learning
- Good teamwork and team members who can focus on either the products or the process as need be
- Free flow of information supported by knowledge infrastructure facilitating access and sharing of knowledge
- Availability of experts, knowledge tools, communication and collaborative technologies, and intranet/extranet resources
- Diversity in employees matching the marketplace and customers

4.1.5 The Human Aspect

Employees in developing the products and services for the company apply their knowledge. According to Nonaka (1998), the “know-what” is applied using their cognitive skills acquired through education and learning. The “know-how” is applied using their advanced skills learnt by their practice of their knowledge. The
“know-why” is used through their systems understanding through their depth in systems knowledge. The “care-why” is self-motivated by their will, motivation and adaptability for success.

Communities of practice are formed usually through grass-roots efforts. They are self-organized teams of members, who share common work practices, common interests, common goals and a common body of knowledge seeking a single identity with shared values and common problems facing them.

Selection of new employees should bias selecting those who are eager to learn and show the capacity to learn. Employees should be in well-focused teams with clear common intention, with some overlap of knowledge who through increased contact, will continue to have informal information sharing. Teams who go through joint training develop team skills such as brainstorming, problem solving, doing and learning from experiments, and pick up other core learning skills. Their knowledge needs continuous update from external sources with the help of networks of knowledge experts.

New knowledge behaviors include teams, which are self-organized, and self-directed informal groups who identify with the enterprise, its different business perspectives, and its mission. The team members develop mutual trust as they share their emotions, feelings, and their different backgrounds, different perspectives, as they converge to a shared meaning. Informal information sharing between the team members comes through increased contact resulting in overlap i.e. redundancy of knowledge and common group intention.

With globally dispersed teams, virtual teams act as catalysts for worldwide knowledge sharing. Team members draw satisfaction in being part of virtual teams bonded together due to their risk taking attributes, developing trusting relationships and shared purpose helped by the shared customer focus.

Collective sense making among the team members is accelerated by use of collaborative and analysis software tools, database technologies, and active participation by subject matter experts. Team members share experiences and mind-sets, utilize critical knowledge bases to work towards common goals. Highest form of learning is as teams introspect the outcomes of their efforts and acknowledge their collective mistakes.

In summary, the enablers for effective knowledge sharing along the human dimension are:

- Motivation of employees to increase active learning and knowledge sharing
- Encouragement of “grass roots” collaborative team-work towards common company goals

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- Improvement of teamwork skills and knowledge friendly behaviors with focused training and allowing opportunities for interaction like team-work days
- Development of virtual teams to support physically separated teams
- Making available and encouraging use of information technology such as specialized collaborative, analysis and database tools augmented by knowledge sharing repositories

4.1.6 The Implementation Aspects

Shared knowledge repositories should be centralized and mirrored, which are automatically synchronized around distributed locations for globally dispersed companies, and include items like Yellow Pages (references to subject matter experts and data sources), knowledge maps (skills and areas of expertise of different individuals, teams and communities of practice), hyper-linked relevant documents, white papers on subjects critical to the company, sales presentations, technical specifications, links to knowledge sources outside the firm, best practices, customer knowledge, competitive intelligence, product knowledge, financial data and business cases, successful project presentations and relevant business plans.

Knowledge maps contain skills databases, which can include knowledge competency types and levels of individuals, knowledge required for certain position, level classification such as implicit and explicit, description of basic knowledge for entry level foundation, working knowledge minimal for local or unique skills, leadership knowledge for an entire functional level and description of expert level which is universal knowledge of the overall business, products and industry drivers.

One effective way of using the knowledge in those repositories is by developing personalized knowledge portals, which can display headlines in specific desired subjects and interests, and links to relevant communities of practice. Complex search engines for document and knowledge retrieval usually support these portals.

Organizational knowledge of the company can include access to FAQs (frequently asked questions), on specific subjects which give stock answers supplemented by response from experts, examples of relevant documents, company knowledge templates, meeting minutes of relevant initiatives, access to physical asset databases, guidelines for specific functions, lesson learnt databases and major initiatives within the company. Relevant documents, pointers to resources and tools add to these organization knowledge repositories. The Yellow Pages provide contact information for teams, experts. Documents deposited are supported by a “what’s new” search engine for employees to keep themselves up to date on the dynamically changing company knowledge. Hot links to other organizations and
sites are also part of this organization knowledge repository. The repository can also act as a forum for discussion of issues and submittals of questions to experts.

Knowledge transfer happens as critical spirals develop among the employees, as they try to articulate and combine their individual tacit knowledge into organizational explicit knowledge, and then internalize the corporate explicit knowledge to enhance their own tacit knowledge. It is important to reach a balance in the scope and the speed of knowledge transfer. Knowledge transfer would spiral from the project to the division to the entire company as employees share their tacit knowledge via socialization, articulate tacit knowledge into explicit knowledge using analogies and metaphors, combine the different explicit knowledge into a cohesive body of corporate knowledge and then turn to internalize that explicit knowledge into their own expanded tacit knowledge.

Some of the examples of corporate explicit knowledge are the lessons learnt, decisions made and actions planned, risks mitigated and the correlating end results. Effective knowledge sharing increases as the members gain autonomy, understand the company’s clear intentions, and are motivated by the creative chaos generated by sharing of divergent tacit knowledge. Enablers for tacit knowledge sharing are redundancy of knowledge among the participants as well as their physical proximity to each other. Diversity in the employees’ experiences enhances the company’s ability to develop solutions matching the diversity in business environments as well as in the customer needs. Knowledge grows as each sharing between two individuals doubles its size. Mutual trust between employees develops during face-to-face meetings, as important issues are raised and learning history analyzed through introspection. Knowledge sharing also increases with appropriate rewards and recognition given to those who transfer and apply their experiences.

Senior management’s responsibility to make sure appropriate resources and technologies are available and that team members have physical time together for transferring and receiving knowledge.

Knowledge is shared by experts for reciprocity, keeping their reputation and from the goodness of their heart.

Re-use of knowledge occurs as it is gathered, organized, restated in common terms and disseminated within the organization.

Organizational learning occurs as the organization identifies its errors in the past and corrects them for the future such as the application of lessons learnt. Individuals learn with easy access to long-term informational sources. Knowledge is acquired as information is distributed and interpreted by the individual employees. Organizational memory only occurs in an adequate social environment.
supported by appropriate tools and infrastructure, and powered by relevant information technology. Meaning of information is gleaned as individual employees adopt an active intellectual role in a pull process.

Understanding that there are several forms of learning will help firms support organizational learning:

- Usage of observation, assessment and then designing solutions is one way.
- Planning, acting and then studying the results is another.
- Observing events, reacting, judging and then intervening is another way of organizational learning.
- Innovation via discovery and inventing then reproducing the invention and then generalizing for larger scope also is an effective of learning.

Results are measurable using both cognitive and behavioral skills as firms internalize new insights and make performance improvements in their operations. The new knowledge captured is then disseminated at low marginal costs compared to the cost of original learning.

Some of this sharing is done during stage gates of the product development process and diffused into the firm’s work activities and embodied into the products and services. Community knowledge is then increased via the individual tacit knowledge sharing. The tacit knowledge gained during the learning activities is thus drawn out and codified as corporate knowledge, which becomes a corporate asset. Accessibility to this corporate knowledge should be at the lowest cost. Longer-term renewal of knowledge in the corporate archived memory can then continue from the current active memory of the work community.

Summarizing the implementation enablers of effective knowledge sharing, we have:

- Shared corporate repositories providing easy access to company, outside knowledge, and subject matter experts
- Personalized knowledge portals on individual desktops to allow quick access to relevant and desired knowledge, supported by complex search engines
- Active learning within the company via different methods converted to organizational memory stored in the repositories by modified work processes
- Senior management supporting and facilitating the organizational learning

4.1.7 Tools and Support

With respect to tools, there is need for replication capabilities for the repositories to enable remote use as well as distributed current knowledge within the company. Repositories, which have file and document sharing capabilities backed by database engines, contain knowledge sources such as skill databases of employees with certain training, experience and skills, and yellow pages to quickly find specific
knowledge experts and sources. Powerful search engines, which make seeking knowledge very painless, are also part of the tool kit needed.

For other tools to support the sharing of knowledge, some companies use tools like Lotus Notes and similar collaborative software to help with discussion of topics and sharing of tacit knowledge by experts. Collaborative tools also include workflow software to automate data sharing as well as email for event notification and group sharing. Web browsers and intranets allow company-wide publishing and updating of information, as well as supporting multiple client workstation platforms and use of multimedia databases. Company knowledge is linked with external sources via extranets.

Web browsers also enable knowledge monitors and portals. Tools like Lotus notes support bulletin boards and discussion groups. Knowledge maps include meta-data about the knowledge contained in terms of creation, modification, access date and time-stamps, along with knowledge about when sharing that particular knowledge would be useful, including possible audience to receive it and the context of its usefulness.

The knowledge tools allow gathering of information from both internal and external sources, analyze meaning of information, present relationships between facts, store meta-knowledge to preserve the context of the original knowledge and help disseminate knowledge throughout the company.

Companies can thus form group memory to store and communicate knowledge and deliver information in a form easy for analysis. The managed shared repository now becomes a valuable corporate asset and a key item in the company’s competitive advantage.

The knowledge in the repositories and in people’s head has to be mined by the company. It can use knowledge facilitators as a catalyst. Inhibitors to knowledge sharing can be phenomena such as group disciplinary loyalty, as in engineering and manufacturing. NIH (“not invented here” or “my way is better than your way”) feelings, which can be between functional, organizational, geographic or cultural boundaries, are to be discouraged in favor of company loyalty. Knowledge intensive gatherings, as more free time is promoted for personal interaction and knowledge sharing, allow face-to-face dialogs. Other facilitators like frequent and periodic knowledge fair days, team-work days and talk rooms as well as special conferences which are web-casted to support globally distributed teams are also desirable.

The company needs to enable full access to its knowledge to the employees and both product and process knowledge to its customers using a direct service delivery method like a hot line support service or an active website.

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Telecommunication facilities like audio, video and/or web conferencing enable worldwide knowledge sharing, complemented by occasional face-to-face meetings, and in conferences for building and strengthening relationships. This conferencing capability becomes the firm’s tacit knowledge pipeline. Individualized PCs with collaborative and presentation tools make up the environment landscape for globally distributed or physically separated teams.

Specially assigned knowledge facilitators such as knowledge integrators to collect specialized knowledge, knowledge base administrators to manage the repositories for day to day and technically administering, and managing the databases also can be utilized as needs grow and the finance of the company allows. Knowledge managers who manage knowledge, make knowledge redundant and facilitate individuals and teams to be open to knowledge sharing also are utilized.

Internal experts share their experiences, their product knowledge and service knowledge, with employees as well as with the company’s customers through active website or hot line support. They also take active part in coaching other employees. Similarly, external experts are made available to employees by similar means.

Knowledge reviewers aid in reviewing documents for sharing for their uniqueness, applicability and quality. Sometimes the reviewers are asked to summarize documents in abstracts or manually edit automatically generated abstracts for correctness and comprehension. They also establish the context for the documents for the user of the repository. In addition, they categorize the knowledge according to its type and format.

In summary, the tools and support needed are:

- Knowledge repositories, which have corporate knowledge and links to internal and external experts, discussion databases and external knowledge sources.
- Tools such as powerful search engines, collaborative tools, workflow software, automatic translation and summarization software and other knowledge tools.
- Intranets, Extranets and public Internet along with personalized knowledge portals and generalized web browsers to access and use of the knowledge.
- Tools for searching, accessing and disseminating knowledge with its context.
- Telecommunications and conferencing technology along with individual PCs instrumented with presentation and collaborative software.
- Knowledge helpers to integrate, review, categorize, contextualize, administer, manage and facilitate knowledge storage and retrieval.

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
4.1.8 Role of the Internet

Extranets (specific corporate portals to the public Internet, and in some cases, specific two way communications and file space electronic link between two partner companies) are necessary to hook up the firm’s remote users, partners, suppliers, customers, external knowledge sources, universities and other research centers. Customized pair-wise inter company links can be used to post key partnership project status, and test results.

Knowledge sharing between external sources, internal experts and the knowledge seekers via direct pair-wise communications or through questions posted on consultation boards can also be supported by extranets.

Intranets (specific internet capabilities restricted to employees only and available within the firm’s communication links) are used to disseminate knowledge. Intranets enable a firm to multiply its existing knowledge and incur only the low cost of deployment. Intranets are also used to exchange knowledge via use of tools like Lotus Notes where sharing of experience based knowledge, best practices and creating a knowledge marketplace is possible. Experts can recap their knowledge by sharing the decisions they make and explaining the rationale behind their chosen decisions. The database can also store the logic trail leading to that decision. Intranet can also facilitate a type of recruiting network to seek out company’s subject matter experts. Similarly, powerful search engines allow the employees to seek out knowledge of local relevance within the company’s global knowledge bases while supporting access to the company’s entire knowledge.

Intranet facilitates the acquisition of knowledge, which includes the gathering, evaluating, verifying and codifying knowledge. It allows the company’s management to organize corporate knowledge by profiling it, associating between specific knowledge sources, evaluating knowledge and ranking its relevance and classifying it for easy search. Intranet supports the increasing the awareness of the knowledge, identifying it for easy search and delivering it to those who seek it, or have expressed desire to receive specific knowledge as it becomes available.

Delivery of knowledge using the intranet is done with bulletin boards, company wide email, shared documents and workspaces, and use of meta-data of knowledge for use by search engines and knowledge tools.

The public Internet is a global source of documents and can serve as a medium for managing knowledge for consumption by those outside the company. It allows worldwide access and modification of information. The Internet can also raise the social awareness through distribution of the events summaries.
Thus the evolving knowledge space consists of knowledge archives with open and flexible structures supported by communications channels of the Internet, intranet and extranets.

Tools supporting these communications channels include directories of experts in terms of yellow pages, spiders and other search mechanisms which go out to search for knowledge sources over the web, OCR (optical character reading) tools and hand held scanners which help in acquisition of knowledge from hardcopy. Multi-lingual thesari allow translation of language into multiple languages for global distribution. Data mining tools seek out the knowledge and text analysis tools automate generation of abstracts of the sought out knowledge for quick review and initial dissemination. Other automatic summarizing tools and value indexing tools help in qualifying and rating knowledge sources. Semantic retrieval tools, object oriented tools and other hyper media tools help find knowledge, which is relevant, and meeting the need specified by the query. Automatic translation tools help sharing the knowledge globally.

Enabling these tools, we have groupware software, which allows the work community to access, retrieve, analyze and update corporate knowledge. Other groupware supports the extension and monitoring of large document collections. Notification of events can be done synchronously as well asynchronously. Groupware also enables communication, interaction and collaboration between users. Other groupware enables electronic delivery of training.

Summarizing the enablers for knowledge sharing via the Internet are:
- **Extranets to support knowledge sharing with partners, suppliers, customers, external knowledge sources, universities and other research centers.**
- **Intranets to support internal tacit knowledge sharing, discussion of knowledge as well as storage and retrieval of corporate knowledge**
- **Knowledge tools and software for access, modification, analysis and dissemination of knowledge and collaboration by team members**

### 4.2 Ideal Organization with Effective Knowledge Sharing Best Practices

Revisiting the critical enablers, filtering and seeing through the strategic, political and cultural lens, we can summarize the following key enablers, as seen by management, investors, and other key stakeholders - the employees, partners, customers and social communities of the organization:

#### 4.2.1 Looking Through The Strategic Lens

- **Understanding the complexities of successful creation, capture and sharing of knowledge**

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
Initiatives to share knowledge must include establishment of common syntactic and semantic basis for communication in a continuum of consistent and incremental learning of relevant knowledge.

- Shared repository with best practices, business processes, design experiences and access to experts and knowledge sources
- Clear, actionable and commonly understood intentions aligned with the business strategy of the company
- Adequate personal collaborative tools, technology and infrastructure
- Established knowledge creation, capture and sharing processes using common repositories and infrastructure supported by knowledge facilitators, database and communications technologies
- Using Internet as the backbone, visible value of knowledge aligned with business strategy and recognition for good knowledge behaviors.
- Knowledge portal access to company’s business practices, corporate knowledge and company’s customers
- Knowledge recognized as a valuable corporate asset along with employees
- Availability of experts, knowledge tools, communication and collaborative technologies and intranet/extranet resources
- Improvement of teamwork skills and knowledge friendly behaviors using focused training and allowing opportunities for interaction like team-work days
- Development of virtual teams to support physically separated teams
- Making available and encouraging use of information technology such as specialized collaborative, analysis and database tools augmented by knowledge sharing repositories
- Shared corporate repositories providing easy access to company’s and outside knowledge and subject matter experts
- Personalized knowledge portals on individual desktops to allow quick access to relevant and desired knowledge supported by complex search engines
- Knowledge repositories, which have corporate knowledge and links to internal and external experts, discussion databases and external knowledge sources.
- Tools such as powerful search engines, collaborative tools, workflow software, automatically translation and summarizing software and other knowledge tools
- Intranets, Extranets and public Internet along with personalized knowledge portals and generalized web browsers to access and use of knowledge
- Tools for searching, accessing and disseminating knowledge with its context
- Telecommunications and conferencing technology along with individual PCs instrumented with presentation and collaborative software
- Extranets to support knowledge sharing with partners, suppliers, customers, external knowledge sources, universities and other research centers.

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
Intranets to support internal tacit knowledge sharing, discussion of knowledge as well as storage and retrieval of corporate knowledge. Knowledge tools and software for access, modification, analysis and dissemination of knowledge and collaboration by team members.

### 4.2.2 Looking Through The Political Lens

- **Active leadership by senior management** in organizing frequent cross-functional team interaction events designed to capture explicit corporate knowledge culminating in recognition of those who share and acquire knowledge.
- **Active sponsorship and support of continuous knowledge sharing by senior management**
- **Initiatives to instill knowledge sharing along multiple fronts** and with active championing by many leaders within the company seeking to transform the company and supported by strong incentive programs.
- **Knowledge accepted by everyone as a critical asset of the company with visible metrics illustrating the value of knowledge**
- **Clearly established knowledge management roadmap and desire to adapt**
- **Three-pronged approach at increasing customer relationship in scope, innovative process with speed and knowledge infrastructure scaled to fit the needs**
- **Clear vision and objectives, visible support for knowledge management, establishment of cross-functional teams who are heavy on knowledge and light on resources.**
- **Senior management supporting and facilitating the organizational learning**

### 4.2.3 Looking Through The Cultural Lens

- **Visible, ever-present and infectious trust among the employees, the management and the human resources department**
- **High morale within the company and desire to share knowledge with other employees to achieve critical business goals together**
- **Encouragement of knowledge behaviors and support for personal interaction events, strong apprenticeships and mentorship programs**
- **Knowledge oriented culture with employees valuing acquiring and sharing of knowledge and continuously collaborating and learning**
- **Good teamwork and team members who can focus on products or on process as need be**
- **Free flow of information supported by knowledge infrastructure facilitating access and sharing of knowledge**
- **Diversity in employees matching the marketplace and customers**

**Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process**
• Motivation of employees to increase active learning and knowledge sharing
• Encouragement of “grass roots” collaborative team-work towards common company goals
• Active learning within the company via different methods converted to organizational memory stored in the repositories by modified work processes
• Knowledge helpers to integrate, review, categorize, contextualize, administer, manage and facilitate knowledge
5.1 State of the Company

In the societal and cultural context, Xerox views diversity as a critical business imperative and has a well-established and well-recognized tradition of valuing diversity in the workplace. On the negative side, Xerox does not have an “adaptive” culture (based on two recent culture surveys). Xeroids do not accept quick changes. This was painfully felt by Rick Thoman, ex-CEO of Xerox who found that his “My way or the Highway” style of leadership to radically and quickly change Xerox, did not fare too well. He, himself, ended up taking the highway.

He had created a “burning platform”, which was insensitive to the employees’ reaction and had a detrimental effect on him and the company. For the first time in 16 years after quarter after quarter of reporting double digit revenue earnings, Xerox reported a loss of 20 cents a share in October 2000. There are several causes for reaching this condition. One missive action commonly discussed on the Street was the one of letting go of order/billing workers in the spirit of becoming lean, without institutionalizing the tacit knowledge they had. This resulted in massive disruption in the sales/service end of the value chain causing severe cash flow problems for the company, despite having leadership products on the market and leading market share in a growing market. This clearly points to the need for increasing the explicit organizational knowledge within the company converted from individualized tacit knowledge, so that this gap in corporate knowledge does not reoccur.

Xerox must rethink traditional business assumptions. It has already learnt the lessons of not utilizing its own research the hard way. John Seely Brown (1998) talks about how Xerox PARC (Palo Alto Research Center) was created in 1970 to pursue advanced research in computer science, electronics and materials science. The Computer Systems Lab and the Information Systems Lab were instrumental in innovating some of the basics in the personal computer revolution, now twenty years old. These innovations however resulted in other companies commercializing them more quickly than Xerox did.

Among them were the “bitmap” display computer screens for easy graphic user interfaces, the local area network Ethernet (Digital Equipment and others), overlapping screen windows and icons (the mainstay of Microsoft and Apple), point-and-click editing using a “mouse”, Small talk (the first object oriented programming language), the first prototype of the laser printer in 1973 and the first prototype of the fax machine then called the telecopier.
5.2 Knowledge at Xerox

According to Nonaka and Takeuchi (1995) knowledge is about beliefs and commitments and is a function of a particular perspective or intention. It is also about action and meaning. It is context specific and relational, as they describe organizational knowledge creation using the “seci” (socialization, externalization, combination and internalization) diagram. Knowledge is converted from individual tacit to individual explicit to organizational explicit to organizational tacit.

Xerox has like other companies has striven to capture, share and use both tacit and explicit knowledge. However, it is a serious challenge for Xerox as different groups are looking at technologies, other groups are looking at markets and yet others looking at different kinds of customers. Knowledge at an organizational level takes on similar characteristics but yet unknowable, similar to several blind men describing an elephant, may call it a “hose”, a “tree”, a “snake” and so on. This emphasizes the need to move from the syntactic to a semantic and eventually to a pragmatic plane for effective knowledge sharing using Carlile’s (2001) framework.

Current trends in the workplace include increasing information and services becoming online (available via the internet/intranet/extranets); global competition; convergence of management of documents, content and knowledge; emergence of cross-functional, cross-organizational and virtual workgroups; and online B2B interaction. The tools for knowledge capture and sharing are still evolving, and even more so, for collaborative tools to allow multiple groups sharing ideas and decisions. Communities of practice allow virtual teams to share common knowledge, practices and know-how whereas individuals share the know-what. For Xerox to acquire and share knowledge, and use it to improve the company, we need to understand what constitutes knowledge and a model of how people and corporations create, use and share it. This model will continue to co-evolve with technology.

Xerox has transformed itself from selling products and services to selling solutions to business problems where corporate knowledge becomes paramount and the primary asset.

Xerox has a tagline “Keep the conversation going”. It really relates to continuous knowledge sharing within the company. It is a challenge for the globally distributed teams, which have to interact across several time zones and disciplines. However, with Xerox’s strengths in developing world class products, its research in key knowledge technologies (linguistic, text retrieval and visualization); its global reach into enterprise wide document systems and combined with reputation for quality and a solid systems integration team, it is poised to address current knowledge based work system needs.

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
The basic premise is that knowledge-sharing solutions improve the quality and efficiency of business processes as used by enterprises to carry out their business. The act of sharing puts the business processes online and amplifies and leverages knowledge resources. Eliminating the barriers in the acquisition (listening, reading, gathering), sharing (speaking, writing, distributing) and acting (developing, organizing, using) on knowledge within the company will allow Xerox to make sense of itself, finding the right expert at the right time and better understand its own activities in order to speed or improve its business processes.

The tools for knowledge capture and sharing are still evolving and even more so for collaborative tools to allow multiple groups sharing ideas and decisions.

Communities of practice allow virtual teams to share common knowledge, practices and know-how whereas individuals share know-what.

### 5.3 Research at Xerox

On the tools and process side, Xerox scientists are developing collaborative processes, practices and technologies that facilitate knowledge sharing. Examples include askOnce (all-in-one search mechanism which can search files, databases, other multimedia through internal and external sources including the intranet and extranet), DocuShare (facility to use for document sharing across the web with powerful search and metadata management capabilities), and Eureka (case based reasoning package developed to aid field service engineers in repairing Xerox equipment. The Eureka concept was developed by a core team of PARC researchers working in collaboration with members of the Xerox field service force, and was based on the observation, that a key to knowledge sharing in field service was the socialization of knowledge developed by and for service engineers while working real problems. Xerox Knowledge Pump is an aid to develop knowledge map, which can point to people, documents and databases and can also serve as an inventory mechanism of knowledge.

Research at Xerox in Knowledge Ecologies addresses three areas:

- **First**, to explore how meaningful knowledge can be extracted from large collections of documents;
- **Second**, to explore ways to capture and share implicit and typically unwritten knowledge within a community and
- **Third**, to define ways to capture knowledge that is shared in informal settings.

On the practical side, researchers are working with selected universities to develop and transition information technologies to building paper-like appliances that enhance a reader’s ability to extract, organize and reuse knowledge. They are
developing a computer-based tool as an ally that will interact with knowledge
workers using face-to-face conversational techniques fundamental to most human-
to-human interactions; and developing tools supporting the creation and sharing of
knowledge by knowledge workers in different locations in different time zones;
developing multimedia note-taking; paper user interfaces; video indexing; video
classification; video summarization; automatic camera steering; and combining
traditional statistical techniques for information retrieval with linguistic information,
along with modeling natural language syntax and semantics.

PARC’s ideas have found way into Xerox product design. For example, instead of
eliminating “trouble” in copier operations, they choose to devise ways to manage
“trouble” such as keeping the machine as transparent as possible - by making it
easy for the user to find out what is going on, and discover immediately what to do
when something goes wrong. When something does go wrong, PARC’s research
on GUIs, have helped Xerox machines have display panels, that immediately show
a picture of the machine that visually indicates where the problem is and how to
resolve it. Where it used to take 28 minutes on average to clear a paper jam, now
it takes only 20 seconds with the new design. These innovations were crucial to
Xerox’s success in mitigating Japanese competition and regaining market share
during the past decade.

According to Brown, researchers must rethink traditional business assumptions,
and tap needs that customers themselves are not yet aware of. Xerox needs to
shake its reputation of “fumbling the future” and PARC for doing brilliant research
but in isolation from the company’s business. Redefining what we mean by
technology, innovation and research itself is the result of the pioneering research
being conducted at the six Xerox research centers. Few companies understand the
importance of informal improvisation, let alone respect it as a legitimate business
activity. By challenging the background assumptions that traditionally stifle
innovation, PARC hopes to create an environment where the creativity of talented
people can flourish and “pull” new ideas into business. Research’s ultimate partner
in co-productions is the customer.

PARC had the Express project which was a product-delivery management designed
to commercialize PARC technologies more rapidly by directly involving customers in
the innovation process. Using Express, PARC was exploring ways to use PARC
developed technologies to help Syntex, a Palo Alto pharmaceutical company,
manage more than thirty thousand case reports it collects each year. Syntex and
PARC employees have spent time in each others work environment and software
developers from both have worked together to create prototypes of new software
systems.

PARC researchers are combining the best practices of pure research and applied
research by studying technology in use, what John Seely Brown calls “pioneering
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research”. Pioneering research is closely connected to the company’s most pressing business problems like the best applied research, it is also seeks to redefine these problems fundamentally in order to come up with fresh- and sometimes radical solutions like best basic research.

John Seely Brown believes that research on new work practices as just as important as research on new products. He also believes that innovation occurs in all parts of the company and at all levels and the fundamental challenge is to learn from it. He believes, that the research department must “coproduce” innovations and the research lab’s ultimate partner is the firm’s customer. Xerox’s competitive advantage will depend on co-producing information technology products with customers, by customizing technology and work practices to meet the customer’s current and future needs. He believes that in the future, Xerox’s chief product will be its customer learning. Xerox would sell expertise to help users define their needs and create products best suited to them rather than developing general products and services.

They are studying work processes as well as new technologies and products. Using the entire company as their lab, researchers are developing technologies to support “local innovation” that takes place at all levels of the company. Involving even Xerox customers, they are “coproducing” innovations in both technical and organizational domains.

Studying how people work, use technology to help them work, and how to create an innovative environment so all employees can participate in the creation process; they are using research to reinvent the corporation. Relationship between technology and work is being studied by anthropologists, sociologists, linguists, artists and psychologists working with PARC’s traditional computer scientists, physicists and engineers. Group collaborative dynamics and how information technology can support work are focus of some of the studies. Using radically new approaches to computing and its uses, Xerox PARC is hoping to maintain its competitive edge, and bringing to market fundamental break-through innovations. According to Brown (1998) big companies have the potential to be remarkably innovative, if they can capture the pervasive local innovation and learn from it. Unfortunately, such informal insights such as an individual making a work process improvisation rarely spread beyond the local workgroup.

Anthropologists, who have studied occupations, have done most important research at PARC in the past decade and work practices throughout the company, providing fundamental insights into the nature of innovation, organizational learning and good product design.

I do not know enough about JSB’s business acumen, but most of the ideas he has described are good. Some are too idealistic and not really pragmatic. JSB
mentions envisioning these laboratories, which could simulate the impact of a new product, before it is actually built by creating “evocative simulations of new systems and new products”. He talks about using a multimedia computer-animation studio like Lucas-film, which could create elaborate simulations of new products, and explore the implications of the same in customer’s work organization. JSB, may be carrying along PARC’s fascination in the 70’s with the computing environments, maybe too long. He carries the torch of something that is now long ago in the past.

5.4 Knowledge Management Tools

Xerox has a set of tools, that need to be further enhanced for collaboration by virtual teams, using Xerox key knowledge technologies in linguistics, text retrieval and visualization from its research centers. These tools need to be integrated in a cohesive working system so that they work seamlessly with each other. Combined with its popular Docushare tool, it can bring its TTM and other business processes on line, in a consistent manner across all program delivery teams within its intranet. Using its ContentGuard capabilities, it can have proper access controls in property right management and protection. The Visualization tools such as Web Forager can be used for monitoring, notification, visualization and summarizing. The knowledge Pump, can be extended across other disciplines and the knowledge shared using DocuShare. Scanning tools can be used to capture knowledge from documents and other printed media. This will give the company, an “organizational memory” which can be searched by partner tools such as knowledge brokers, Murax and Cross – Lingual IR. XTRAS could be used to summarize and linguistically transform the knowledge to have global meaning.

PARC is considering the possibility of developing advanced multimedia information systems, that would make it easier for service representatives and other employees to plug in to this collective social mind, which will allow the service representatives to pass around annotated video clips of useful stories, to sites all over the world. By commenting on each other’s experiences, the service representatives could refine and disseminate new knowledge.

5.5 Organizational Learning

The challenge is to transform Xerox into a learning organization. Change needs to be valued and not avoided, to survive in today’s competitive environments, where the value of knowledge transcends functional boundaries, and where innovation (knowledge creation) is deemed more valuable than control and stability (another Xerox cultural norm). Unless Xerox deals with the knowledge sharing holistically (including the cultural element) and can become an adaptive organization, all of the
wonderful technology will just collect dust. Xerox needs to “precondition” its employees to be able to share and learn from each other and crave for more knowledge. It is also a challenge for the globally distributed teams, which have to interact across several time zones and disciplines. Xerox strives to put local support to improve its ability to serve customers, such as customer call centers as well as development teams centrally in Americas, Europe, Middle East and the Far East. Knowledge acquisition, harnessing of the knowledge and sharing needs to be done globally to enhance the Xerox workforce.

The basic premise is that knowledge-sharing solutions improve the quality and efficiency of business processes as used by enterprises to carry out their business. The act of sharing puts the actual instances of business processes on line and amplifies and leverages knowledge resources. Eliminating the barriers in the acquisition (listening, reading, gathering), sharing (speaking, writing, distributing) and acting (developing, organizing, using) on knowledge within the company will allow the company to make sense of itself, finding the right expert at the right time and better understand its own activities in order to speed or improve its business processes.

5.6 Xerox Culture of Quality

Xerox has mastered the problem solving process on a company wide scale. In 1983, senior managers launched the company’s Leadership Through Quality initiative; since then, all employees have been trained in small group activities and problem solving techniques.

Today a six-step process is used for virtually all decisions:
1. Identify and select the problem statement;
2. Analyze problem;
3. Generate potential solutions;
4. Select and plan the solution;
5. Implement the solution and
6. Evaluate/Monitor the solution.

Employees are provided with tools in four areas:
- Generating ideas and collecting information (brainstorming, interviewing, surveying);
- Reaching consensus (list reduction, rating forms, weighted voting)
- Analyzing and Displaying data (cause-and-effect diagrams, force-field analysis)
- Planning actions (flow charts, Gantt charts)
Training is presented in “family groups” and tools are applied to real problems facing the group. Results of this process have been a common vocabulary and a consistent, company-wide approach to problem solving.

5.7 Diversity

At Xerox, diversity is something more than a moral imperative or a business necessity – it is seen as a business opportunity. Tom Kochan (2001) warns us that we need to shift from this “business case” rhetoric, and not rely upon just increasing diversity to expect higher business performance, but a need to systemic approach in channeling diversity into positive energies for business and individuals. Diversity goes beyond numbers and targets: it is the acceptance of people of all ages with globally diverse backgrounds whose fresh ideas, opinions, perspectives and borderless creativity enrich the lives of others. This is exactly what we should be seeking harness and channel into better and more efficient operations and reaping the benefits. The satisfaction that comes with utilizing everyone’s best potential and rewarding the diverse teams, goes far beyond better numbers on the bottom line. It enriches the corporation and makes it competitive in today’s global economy.

Cultural Diversity is the greatest challenge and an opportunity for the Xerox global workplace. Culture being an integrated system of learned behavior patterns is characteristic of a society. Productive cross-cultural relationships require each global team member to embark on a personal learning journey that initially can be even more frustrating than it is rewarding. Cultural competence is also emerging as a key management skill. The development of an explicit corporate culture will need to include values about people and be equidistant to all cultures. Unlike corporate culture, professional and functional cultures offer common ground globally. Professional culture is a lifelong choice and functional cultures are the roles, practices and habits associated with a particular work function. Work cultures mirror the social cultures in which they operate. The natural convergence between the primary culture, work culture and corporate culture is a significant challenge to national companies setting up foreign divisions or joint ventures. Globalization has yet to produce a global culture. However with more and more widely shared values such as democracy, secularism, market-oriented economics, individual freedom, and fundamental human rights, global culture is now emerging. Xerox has been developing the infrastructure and processes to embrace this global culture.
5.8 Knowledge Strategy

Customer focused and empowered employees are accountable for business results working in an environment, which enables participation, speed and teamwork based on trust, learning and recognition. All employees’ objectives are to be aligned to the Xerox business direction, with disciplined process to assess progress. They use customer-focused processes, and each one takes responsibility to communicate and act on benchmark knowledge to enable rapid change to benefit the customers and shareholders. Knowledge of Xerox business processes is easily available, used and shared actively by employees. Instead of the usual command/control hierarchical management structure, Xerox seems to have a plan to have a flat, networked, empowered and continuously learning organization, taking full advantage of its global diversity in meeting global society needs.

Strategic partnering with companies such as Microsoft, IBM and Oracle, who are strong in managing data, exchanging information and sharing knowledge, would be a must as Xerox will not be able to do it alone. Database and Networking technologies need to complement Xerox knowledge technologies. Once the business processes are on line, pertinent organizational learning can grow exponentially using the Internet model of growth.

A structured approach, such as proposed by Nancy Dixon (2000), can include the following steps:

- Establish a inter-company steering committee,
- Conduct a knowledge assessment,
- Establish a framework for knowledge transfer,
- Identify organizational goal and corresponding knowledge components,
- Identify the appropriate transfer process for each type of knowledge,
- Locate current informal systems that can be enhanced,
- Identify resources and developing integrated systems for knowledge transfer.

Societal implications of such an inter-company alliance would be vast.

Peter Senge has defined the learning organization as the organization “where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to learn together”. Xerox needs to become that learning organization.
5.9 Global Complexities

Knowledge as a primary global product – Information technology has the capacity to augment the productivity of the higher-order information worker. Given that 2/3rd of US workers are in the service business, knowledge is itself becoming one of global economy’s most important “products”. Information needs to be constantly updated, reliably filtered, and instantly accessible to keep all the teams fully informed of everything they need to know about the goals, processes, resources and activities of all the other relevant nodes in the corporate network. The electronic runway, created by the rapid technological advances in information technology including the Internet, has transformed the workplace into global cyber “workspace”; all but eliminating the 9to5 workdays, lifetime jobs, predictable hierarchical relationships, and corporate culture security blankets. Newer “knowledge” industries have started small and mostly stayed small such as the Biotech industry. Small firms provide the vast majority of all the new jobs being created today.

Challenge for Xerox is to establish effective global organization, to facilitate an appropriate level of focused communications and information gathering among distributed individuals and groups, and to improve its business processes to produce better, faster and cheaper products meeting increasing customer value.

Like Intel, Xerox experienced the same issues with videoconferencing, so now audio conferencing supplemented by intranet Docushare sites is the main vehicle for communications. Even though the verbal communication is around 20% of a communication or less, and the rest is non-verbal 80% of greeting styles, gestures, posture and so on; with proper team preparation and follow up, audio works just fine, so long there are no cross-cultural or linguistic differences. Video conferencing is used for major decision-making and decision-confirming meetings, or where strong cultural or language differences exist such as high context culture in Japan vs low context culture in US. Personal relationships and long term aspects are highly regarded in Latin America and Asia, as opposed to, immediate work and short-term goals in US and Northern Europe. The other issue dominating globally dispersed teams is that not enough is shared about differences in group, culture, goals and values. Sub-teams only focus on dependencies and receivables/deliverables from other sub-teams giving rise to “we and them” vs the desired “us” mode. Sharing group difference knowledge is crucial to understanding the needs and on what needs to be done to make teams work more efficiently. This common ground can be created in Cyberspace, where Xerox does have strengths in its own developed tools such as Docushare¹ for sharing, askOnce for searching, LiveBoard for collaboration and other linguistic tools which automatically translate and summarize electronic documents. Imagine your emails across language boundaries automatically translated before reaching their globally

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distributed destinations, so you could relax and calmly communicate in your own native language while being sure that they read your email in their own.

Xerox, with a knowledge based global and flexible workforce (family, work, community), develop and deliver document solutions and services, utilizing its global core strengths in technology, outsourcing, brand, sales, service and document knowledge with teams working seamlessly across temporal, cultural, national and economic global valleys. Xerox needs to internalize and deal with issues mentioned above.

Xerox needs to formalize the strategy of developing and maintaining globally dispersed teams by:

- Pacing the global team work with a regular communication vehicle which is consistent and omnipresent
- Continue use of cultural guides so that local expertise is fully utilized at the right opportunity
- Building relationships and trust and being generous in resource allocation for personal visits, infrastructure
- Improve group processes to allow for and utilize cultural, temporal, knowledge and skill differences
- Global project management where roles and responsibilities are clearly understood and followed
- Use Information technology to the fullest extent in terms of collaborative and intranet tools/processes
- Continue to reward culturally aware and consensus –style supervision as opposed to authoritarian style

John Seely Brown (1998), Chief Knowledge Officer and Chief Scientist of Xerox Corporation, notes that the most important invention that will come out of corporate research labs in the future will be the corporate itself. He describes the business logic behind this distinctive vision of research’s role and the way Xerox PARC (Palo Alto Research Center) has tried to realize that vision.

5.10 Xerox Current Status and Plans

Xerox has already decided on the goal of improving knowledge sharing across the corporation to develop knowledge based work systems. It has a set of tools that need to be further enhanced for collaboration by virtual teams, using Xerox key knowledge technologies in linguistics, text retrieval and visualization from its research centers. It needs to have the tools integrated in a cohesive working system so that they work seamlessly with each other.
Xerox has focused on key best practices that are being promoted with domain experts and sharing knowledge during the product development process and monitored at stage gate reviews. Among the best practices being diffused through the organization are:

- Engineering Planning
- Technology Readiness
- Failure Modes and Effects Analysis
- Critical Parameter Management
- Robust Design Methods
- Quality Reliability Sensitive Parts
- Functional Important Topic (FIT) Management
- Design Reviews
- Peer Reviews
- Drawing Release Checklist
- Problem Management Process

Stage gate reviews, is where now peers from different organizations and functions get together with the PDT and where sharing of knowledge gets the “most bang for the buck”.

Assessing against the knowledge sharing enablers compiled from the literature search and interviews with practitioners, we can note that, Xerox has succeeded in developing common goals for the corporation, its divisions and business strategy, it has developed a knowledge-oriented culture, and it has recognized the criticality of knowledge. With its diversity in its worldwide workforce, and the technical and organizational infrastructure, it has developed a knowledge supportive environment. Xerox senior management has shown visible support for knowledge acquisition, storage and dissemination along multiple fronts.

Xerox does have challenges in improving trust and morale among its employees, which can be achieved by developing visible metrics for value of knowledge, and a support structure for standardized corporate knowledge and a strong rewards and recognition program for good knowledge behaviors.

Vicki Powers (1999) describes then Xerox’s Corporate Strategy Director, Dan Holtshouse’s vision of 10 domains of knowledge management, which are:

- Sharing knowledge and best practices;
- Instilling responsibility for knowledge sharing;
- Capturing and reusing past experiences;
- Embedding knowledge in products, services and processes;
- Producing knowledge as a product;
- Driving knowledge generation for innovation;
- Mapping network of experts;

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Dan Holtshouse uses these 10 domains to evangelize knowledge management within the company. Eureka, was a grass-roots knowledge sharing endeavor, which became a permanent fixture in Xerox arsenal of corporate knowledge. With Xerox’s 25,000 person service organization, it currently saves between 5 to 10% on labor and parts costs due to Eureka, and Xerox’s ability to support worldwide knowledge sharing and availability of community-owned, and maintained knowledge environments.

Xerox has been recognized in 1999, as #1 in the overall quality of the knowledge program by Teleos, a UK market research and service firm for knowledge management. It also had significant recognition for its effectiveness of knowledge sharing.

Xerox needs to instill the love of learning in its workforce by properly constructing the reward and recognition policies, management behaviors and installation of technology and tools to facilitate virtual, global and mass learning via forums, webcasts, databases, online chats. Knowledge experts should be rewarded in sharing the knowledge, and knowledge learners should be rewarded in seeking and acquiring that knowledge.

Xerox needs to adopt a learning organization model where learning and teaching is seen as a win/win proposition, discarding the traditional notions of knowledge and skills as a source of power and authority and use of skills and qualifications as positional goods. The reward and recognition system needs to be modified to adapt to the new model. Attitude towards learning need to shift from passive to immensely rewarding and active. It needs to develop flexibility in its handling of learning, partner with best knowledge providers such as MIT, UC Berkeley, and Stanford, to develop relevant learning programs and reward its workforce to share, learn and continuously improve its capabilities.

Xerox needs to invest in knowledge creation, acquisition and sharing tools to facilitate it becoming a learning organization. When investments are made, besides looking at the expected rate of return on the investment, the period of investment as well as life of investment, and the net present value of all costs and benefits, we also need to consider the risk in not making the investment of loss of opportunity as well as costs and risks of failure in the implementation. This analysis will change the investment decision to that of a business strategy because it will lead us to investigate alternate strategic options and weigh those against each other. This becomes a matter of policy rather than deciding on a budget.
As mentioned before, some organizations try to create chaos and redundancy by shifting organizational structure to react to rapidly changing business environments. This method has its own perils, as Xerox is now painfully aware due to its botched-up reorganization attempts.
Chapter 6. Xerox, an Ideal Organization?

In an effort to understand where Xerox stands in the use of best practices for knowledge sharing, a series of surveys and personal interviews were conducted with key managers at Xerox. The managers are either previous, current or potentially future product managers, who are involved, in the direction and/or influence of product development and delivery using the Xerox TTM (Time to Market) process.

Purpose of the data gathering was to assess the gaps between current state of Xerox and an ideal global organization which uses best practices in knowledge sharing, and to get a holistic feel for the scope of Xerox efforts as well as assess the depth and quality of the best practices put into practice during the TTM process.

As indicated before, the premise of this thesis is that in today’s knowledge economy, competitive advantage comes from the effective use of the corporate knowledge. How well does Xerox practice those activities? The activities, which are the individual “common sense” activities, but however, when implemented collectively, they make up a forceful enabler for effective knowledge sharing and thus providing the company its competitive advantage.

Using the background of the ideal organization for knowledge sharing developed earlier from literature research and personal interviews with knowledge experts in academia and in industry, a questionnaire containing both closed and open ended questions was developed along the themes of management, TTM (Time to Market) process, culture, infrastructure, technology and the use of the Internet.

Agreements of key managers at Xerox were sought of the 19 statements around effective knowledge practices. Presence of good knowledge sharing enablers in the areas of trust, morale, common goals, value and criticality of knowledge, diversity, adequate support structure, rewards/recognition policies and initiatives for knowledge management along multiple fronts was assessed.

There were also open-ended questions, allowing the same respondents to share their thoughts about the areas of improvement in current practices and their suggestions for removing those gaps.

Thirty-three (33) key senior managers at Xerox were contacted. Three of those were no longer with the company due to retirement, and one was on military duty (but he answered). Responses of twenty eight (28) managers, who replied before the deadline, are compiled below.

The numbers indicate their level of disagreement with the statement indicating the presence of an effective knowledge enabler. A score of 1 indicates strong agreement, 2 is agreement, 3 is no opinion or no knowledge, 4 is disagreement and 5
indicates strong disagreement. Thus, the absence of agreement, therefore, indicates a gap.

6.1 Gap Identification

| AVERAGE | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
|---------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 1       | 2.61 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 4 | 4 | 4 | 2 | 2 | 4 | 2 | 2 | 4 | 2 | 2 | 2 | 4 | 4 | 4 | 4 | 2 | 4 | 2 | 4 | 2 | 2 | 2 |
| 2       | 2.61 | 2 | 2 | 2 | 4 | 2 | 2 | 1 | 2 | 4 | 2 | 2 | 4 | 4 | 2 | 2 | 4 | 2 | 2 | 4 | 2 | 2 | 4 | 4 | 2 | 2 | 5 | 3 | 2 | 2 | 2 |
| 3       | 2.11 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 4 | 2 | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 4 | 4 | 2 | 2 | 2 | 2 | 4 | 2 | 2 | 2 | 4 |
| 4       | 3.04 | 2 | 4 | 2 | 4 | 2 | 4 | 4 | 2 | 2 | 4 | 3 | 2 | 2 | 1 | 2 | 4 | 3 | 4 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 4 | 3 | 2 | 2 | 2 |
| 5       | 2.75 | 2 | 2 | 3 | 2 | 3 | 4 | 2 | 2 | 2 | 4 | 2 | 1 | 2 | 2 | 2 | 2 | 3 | 2 | 4 | 4 | 4 | 4 | 4 | 3 | 5 | 4 | 3 | 2 | 2 | 2 |
| 6       | 2.18 | 2 | 1 | 2 | 1 | 5 | 2 | 1 | 4 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 4 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| 7       | 3.93 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 2 | 4 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 3 | 5 | 4 | 4 | 2 | 4 | 4 |
| 8       | 2.50 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 2 | 2 | 2 | 2 | 2 | 4 | 4 | 2 | 2 | 4 | 2 | 2 |
| 9       | 3.46 | 3 | 4 | 3 | 2 | 4 | 2 | 4 | 2 | 4 | 4 | 2 | 2 | 1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 2 |
| 10      | 3.64 | 5 | 3 | 4 | 2 | 4 | 5 | 4 | 4 | 4 | 1 | 4 | 4 | 4 | 4 | 4 | 3 | 2 | 4 | 4 | 4 | 4 | 2 | 4 | 4 | 4 | 3 | 4 | 4 | 4 |
| 11      | 3.04 | 4 | 2 | 2 | 4 | 2 | 2 | 4 | 2 | 4 | 3 | 2 | 3 | 1 | 4 | 3 | 4 | 2 | 4 | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 2 | 4 |
| 12      | 2.39 | 3 | 3 | 2 | 3 | 2 | 4 | 2 | 2 | 2 | 4 | 2 | 2 | 2 | 5 | 2 | 1 | 2 | 3 | 3 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| 13      | 2.46 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 2 | 2 | 2 | 2 | 4 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 4 | 3 | 4 | 2 | 3 | 2 | 2 |
| 14      | 2.71 | 2 | 2 | 3 | 2 | 2 | 1 | 4 | 2 | 5 | 2 | 2 | 2 | 2 | 2 | 4 | 1 | 3 | 3 | 2 | 2 | 2 | 4 | 4 | 2 | 5 | 2 | 3 | 4 | 4 |
| 15      | 3.35 | 5 | 2 | 3 | 3 | 4 | 3 | 2 | 2 | 3 | 2 | 4 | 3 | 4 | 4 | 4 | 3 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 2 | 4 |
| 16      | 2.89 | 2 | 2 | 2 | 4 | 3 | 2 | 4 | 2 | 2 | 4 | 4 | 4 | 1 | 4 | 2 | 4 | 2 | 4 | 2 | 4 | 2 | 4 | 2 | 4 | 2 | 4 | 3 | 2 | 4 |
| 17      | 2.68 | 4 | 2 | 2 | 3 | 2 | 4 | 3 | 2 | 2 | 2 | 2 | 4 | 3 | 1 | 2 | 2 | 2 | 4 | 3 | 2 | 4 | 2 | 2 | 1 | 4 | 3 | 4 | 4 |
| 18      | 2.54 | 3 | 2 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 2 | 4 | 2 | 2 | 2 | 2 | 4 | 4 | 3 | 2 | 2 | 4 | 3 | 4 | 2 |
| 19      | 3.21 | 2 | 2 | 4 | 2 | 3 | 4 | 2 | 2 | 2 | 2 | 4 | 3 | 2 | 2 | 4 | 4 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 1 | 4 | 3 | 4 | 4 |

Table 6.1.1: Level of agreement about existence of effective knowledge enablers

Figure 6.1.1: Histogram of assessment average of absence of knowledge enablers

The average values were then put in pareto chart and prioritized according to the level of disagreement i.e. indication of a perceived gap against the ideal practices.
6.2 Gap Prioritization

Figure 6.2.1: Pareto chart of average absence of knowledge enablers

The statements, shown below, are sorted according to the level of disagreement, ranging from the most disagreed to the most agreed. The ones in bold italics, reflect the top gaps as seen by the practicing managers of the TTM (Xerox’s enhanced PDP) process.

1. Managerial compensation methods reflect recognition for good knowledge behaviors such as sharing and collaborating.
2. The morale of employees within the company is high.
3. Xerox has free flow of information supported by knowledge infrastructure facilitating access and sharing of common knowledge.
4. There is a visible, ever-present and infectious trust among the employees towards each other.
5. Knowledge within the company is converted to organizational memory stored in repositories by modified work processes.
6. Senior management actively sponsors and supports continuous learning and sharing of corporate knowledge.
7. Xerox employees are engaged in active learning.
8. Xerox has provided the means (tools, facilitators, teams) to manage and facilitate corporate knowledge for use in the TTM process for product development.
9. The criticality of knowledge is evident throughout the TTM process in terms of how it improves the product being developed and to the Xerox business.
10. Xerox, as a company, understands what it takes to create, capture and share knowledge among the employees as demonstrated during the TTM process for product development.
11. Xerox management has described its intentions of its business strategy in clear and actionable terms providing the basis for the initial phases of TTM involving market strategy, vision and market approach.
12. Knowledge is regarded by everyone as a critical asset of the company.
13. Xerox employees have access to personal collaborative tools, communications and collaboration technologies, and infrastructure to share their knowledge with fellow employees.
14. Xerox has a knowledge oriented culture, where the employees value acquiring and sharing of knowledge, and are continuously learning and collaborating.
15. There is a desire to share knowledge with other employees to achieve critical business goals together.
16. Xerox provides commonly shared repositories for its best practices, business processes, design experiences and links to knowledge sources and experts.

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In summary, according to the survey, Xerox has enabled several good practices conducive to knowledge sharing.

### Figure 6.2.2 Product Development Process and Time-to-Market Team Structure

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
The knowledge is shared extensively between the Xerox managers as they develop new products and services. Collective knowledge of the members is brought on to bear upon the development. Diversity in Xerox’ employees allows the company to better match the products with the diverse customer requirements around the globe. Commonly shared repositories are used for its best practices, business processes, design experiences and links to knowledge sources and experts.

Xerox managers show the desire to share knowledge with other employees. Xerox does have a knowledge-oriented culture with emphasis on acquisition of knowledge. The company’s has efforts to enable such acquisition with Xerox intranets/ extranets and the Internet supported by collaborative and communications technologies.

Xerox management has succeeded in communicating its business intentions to the employees, and making clear its company wide vision and its market approach. Its development of the knowledge infrastructure shows its understanding of knowledge creation, capture and transfer enablers. Knowledge is managed and utilized during the TTM process via the various processes, resources and enablers put into place.

While generally Xerox seems to be in a good shape with respect to being a knowledge company, there are areas where greater attention is required. While generally Xerox has a philosophy of “pay for performance”, recognizing and rewarding good knowledge behavior may be a desired proactive step appropriate in today’s environment. Whether good processes yields good results or not, there is a tendency in these days to reward results and not process. This is a reactive methodology, but currently practiced in most companies. Change initiatives such as TQM (Total Quality Management) and SPI (Software Process Improvement) have yielded less than spectacular successes and below management’s expectations. The human resource departments and budget center managers, which are currently economically strapped, have understandably lobbied for rewarding only the bottom line.

Lack of morale, lack of free flow of information, and lack of trust which paves the way of employees feeling comfortable with the company, with each other and sharing knowledge with each other, to enable a win-win atmosphere is also indicated by the survey results.

It was also noticed, that Xerox processes could improve the organizational learning and make such learning visible and easy to access.

Senior management’s active sponsorship and support for learning and knowledge sharing also needs to be more visible to get Xerox employees engaged in active learning. There is evidence that even though the very top management at Xerox has embraced the value of knowledge and are strong proponents of knowledge sharing, the middle management still needs to be educated on the competitive advantage of effective use of corporate knowledge. They seem to be over consumed with the
immediate short-term issues. They need to learn more about long-term strategic value of knowledge sharing.

6.3 Gap Removal Implementation Methodology

Xerox managers were quite candid in their recommendations to improve certain areas so that collective knowledge is captured and used more effectively. But before, we go into specifics, let us look at the big picture with respect to knowledge sharing, the enablers, and the overall framework we want to use to improve upon, what appears to be a very healthy knowledge oriented culture at Xerox.

As Carlile (2001) has stated, “knowledge is localized, embedded and invested in a particular practice and across practices with different problem-solving requirements”. In our case, we are focusing on product development knowledge, which is embedded in the Xerox TTM process across different functions and different organizations.

Carlile (2001) further concludes that “knowledge is not so much transferred as transformed”. This is across boundaries such as cross-functional and cross-organization boundaries. Making the knowledge more transferable, we need to transform it into the center of focus at a current phase.

Consider the seven different phases of the Xerox TTM process, as noted by fellow SDMer, Thomas Courtney (2001, pp. 16-17):
- 3.0 Market and Product Strategy and Vision
- 3.1 Define Market Attack Plan and Technology
- 3.2 Define Product and Deliver Technology
- 3.3 Design Product
- 3.4 Demonstrate Product
- 3.5 Deliver Product
- 3.6 Delight Customers

Collective knowledge needs to transform as we enter a phase using the process of assessment reviews. As Carlile (2001) states, knowledge is made more concrete, negotiable and transformable to those involved in the particular phase with boundary objects and various knowledge representation technologies. An example might be the use of “Lessons Learnt” repository as a boundary object to transform knowledge of those involved.

TTM, being the knowledge representation technology, provides a common syntax for the different members of the PDT (Product Delivery Team) and TAT (Technical Advisory Team) to transfer their knowledge. The tools such as Lessons Learnt repository, eCPM, ePIM, eCAD, and eCAE allow the organization to translate the knowledge into common semantics between cross-functional and cross-organizational
team members. Knowledge can then be transformed between functions and organizations to achieve a common understanding of the issues at the current phase.

The assessment reviews during stage (phase) gate transfers are now done by peers as opposed to previous management oriented reviews. Both the assessor and the assesseee benefit during the review process as they share knowledge and educate each other. This is a considerable improvement over the previous “inquisition” like stage gate reviews of the past. There is more open and frank discussion during the review based on mutual trust and respect. This a far cry from previous practices, which used to be to say as little as possible and answer the assessment questions with minimal information, mimicking behavior in some IRS audit reviews.

Another improvement in the TTM process at Xerox has also helped in the quality of knowledge sharing during stage gates. There is now a desire to form an assessment team, which carries through the entire program using the same TAT (Technical Advisory Team) members as possible. Previously, the TAT chairperson used to scramble to put together whoever was available due to the dynamic nature of the program schedules. Currently, the program schedules are planned far in advance, and are relatively stable, and it has become possible to give advance notice to the same TAT members about the schedule of the next stage gate transfer. This has resulted in a continuing dialog between the PDT (Product Delivery Team) members and the TAT membership, who can now truly act as advisors/mentors as opposed to the previous role of acting periodic inspectors.

Using Carlile's (2001) 3T (Transfer, Translate, Transform) framework, I am currently working with a product delivery team and a fellow assessor of a current program being launched, in attempting to create new knowledge in critical parameter management in the software domain. As Carlile has suggested, transformation of knowledge from one domain into another is not straightforward as both my colleague and I are finding out.

Currently, the CEC (Corporate Engineering Center) is encouraging the use of best practices through assignment of knowledge experts to assessment teams. In our case, there is one gentleman who is thoroughly familiar with the use of critical parameter management practice. He thoroughly understands the process of managing critical parameters at both sub-system and system level. His tacit knowledge, however, is in Mechanical Engineering acquired through education and over 20 years of practical experience at Xerox. He is thoroughly familiar with design parameters which should be monitored, tuned and controlled as control parameters as applied to mechanical aspects in the design of Xerox devices, such as the mechanical system itself, media and motion path, marker path and the control and image paths. He is just as anxious as me, in applying his knowledge to the domain of software, so that the company better addresses this very important and cost dominant area.
His role in the assessment team is both as a coach as well as an assessor for the engineering aspects of the product. He is coaching the team in proper definition of critical parameters at both the top level as well as individual subsystem levels. He has coached them in distinguishing between a critical parameter versus a design parameter, which could be observed and measured as input, or output parameters of a system/sub-system with appropriate constraints. Defining a parameter as a system parameter, which spanned across multiple subsystems is also part of the activity.

I have similar knowledge in Software Engineering, again acquired through education and over 34 years of practical experience (including the last 24 managing at Xerox), including complete management of hardware and software design and development of embedded controllers in Xerox devices, both network printers and multi-function (copy, fax, scan, print) devices. I am thoroughly familiar with tradeoffs between computing resources, such as, CPU speeds, memory utilization and performance against cost. I have not been involved in any critical parameter management in software. I am attempting to create new knowledge in software using my own engineering background and what I have learnt in the academic environments. The new knowledge will be the application of critical parameter management in software once we have successfully transformed my fellow assessor’s knowledge from mechanical engineering to its counterparts in software. The knowledge is new because it is not practiced in Xerox, and I was unable to find examples in industry (other than one example in the oil industry which was not immediately applicable, and again would need help from a domain expert). As a reference, we have Phadke (1989), who did an orthogonal array experiment, where he tuned and improved the response of the UNIX operating system by 60% by simultaneously studying 3 hardware and 6 software critical parameters in a lab experiment.

In the software domain, the inability to associate particular failures with exact hardware or software malfunctions makes the situation more complex. Preference to use risk-based approach in software as opposed to using the failure based analysis approach in hardware is also a barrier, however, this should be eliminated as we learn from a more mature industry. This methodology also needs to be extended to multiple parameters and critical management be done of those parameters in a holistic and systemic sense.

As Carlile (2001) has pointed out, knowledge is hard to transfer across functional boundaries. In this case, knowledge of critical parameter management in mechanical engineering was attempted to be transformed to the domain of software. It was difficult. eTTM gave us a common syntax for conversation and transfer of knowledge, eCPM (Critical Parameter Management tool) gave us a common semantic base for translation of the knowledge, but making the same knowledge more concrete, negotiable and transformable was not easy. As Carlile advises us, we are trying to use a practice-based view of knowledge in technology transfer and
organizational learning, which can be difficult, namely, in the area of critical parameter management.

PDT members were mindful of the facts, first, that this (CPM in software) has not been demonstrated as a leadership capability; second, they were not aware of this being recommended from a lessons learned session; and third, that the previous program did go through the investigation cycle with the same coach and did not identify CPs for software.

As the saying goes, “Invent the future, do not redesign the past”. Just because it has not been done before, this is not enough reason not to attempt it. PDT did agree that it was an observation / opportunity that should be listened to, and taken seriously, and hence investigated for its benefit to the program. Carlile (2001) does note that boundaries of different types of specialized knowledge are also “dynamic because the ‘collective’ knowledge to produce products rests on inputs and dependencies that necessarily change through the process”. Here the differences are more than just semantic: one set of knowledge is localized and embedded in the field of mechanical engineering. We are attempting to specify, propose and negotiate the differences in the domain of software, so that the current knowledge in transformed, and we can create new knowledge i.e. CPM in software.

As part of knowledge gathering, we attempted to contact a software engineering expert in our centralized CEC (Corporate Engineering Center) to see what parameters could be candidates for application of this knowledge. Though no one has attempted using CPM method in software, typical critical resources which are measured, tracked and accounted for are physical entities such as memory, NVM (non volatile memory – used to keep engineering default data), disk space, disk bandwidth, CPU (Central Processing Unit) bandwidth, communications bandwidth and bus bandwidth. Control factors typically include bus, disk, and memory bandwidths to achieve system level performance.

The issue that had been raised in the assessment of software during the 3.1 stage gate (proposing a product), was that CPs were not identified / measured. Parameters were being measured and tracked, but crucial parameters had not been identified or selected to develop latitude performance in the acceptable operating window. There was no evidence of failure modes. The 3.1 stage gate is supposed to validate technology readiness, which is the common goal of CP development.

The assessor, who is the knowledge expert in CPM for Mechanical Engineering, explained that difficulties arise when outputs of a system or subsystem are identified as CPs (Critical Parameters). The eCPM tool allows the identification of IOC (Inputs, Outputs and Constraints), as well as tagging certain parameters as critical parameters and system critical parameters (if they span multiple sub-systems). The PDT does this, when they have engineering responsibility of the subsystem. If the subsystem is
to be treated as a black box in the extended enterprise model, then CPs are no longer tracked by the PDT and the focus is reduced to monitoring I/O.

Following has been accomplished so far:
- We have found that it is possible to use the Xerox TTM as the boundary framework in which knowledge could be transferred from one domain into another as the process gives us the common syntax.
- We also have found that it is possible to use tools like the eCPM to translate knowledge from one domain into another using the tool to give us a common semantic base.
- We also agree that it will be possible to transform knowledge of critical parameter management from mechanical engineering domain into software engineering domain using common syntax and semantics.
- Tuning parameters such as memory, NVM, disk space, disk bandwidth, CPU bandwidth, communications bandwidth, bus bandwidth is common
- There is currently no Xerox best practice identified for the technology aspect of SW Readiness.
- Our attempts at creating new knowledge i.e. critical parameter management process within software are continuing, as we found out that it was beyond the scope of the current product delivery team, and we will be working with other CEC members next year to establish such knowledge.
- This can serve as a role model example of the process for future programs.

Work is still in progress, however tempered by the fact, that the PDT does not have sole control over the software embedded in the product. The product is based on a division wide platform, which includes software from multiple parties including the core competencies within the division, the PDT, partner companies, external suppliers of sub-system software and outside consultants. It would be difficult for the PDT to establish critical parameters, which it cannot always measure and control. So, work is continuing at a sub-system level in identification of critical parameters, their failure modes, their latitudes and trade-offs that need to be balanced for optimum performance. We are attempting to “create a shared meaning”.

In cases where a new SW (Software) technology is used, the program must perform sufficient modeling, prototyping, or other analysis during the concept phase to ensure that the technology will operate as required.

Once established, it will be a breakthrough process and serve as a role model for other engineering knowledge transformation in areas such as systems architecture (platform versus product variant knowledge), computer aided design and engineering, the constraint-based scheduling model and so on.
6.4 Proposal High Level Architecture

Through the interviews and surveys, it has been established that encouraging person to person collaboration, storage and organization of explicit knowledge documents, and sharing where the knowledge is, were the three most activities performed by the Xerox managers for knowledge sharing. In contrast, facilitation and support of communities of practice as well as improving business process by applying knowledge to services and work flows was not done as often as desired.

Activities in the TTM, which could benefit by more collective knowledge, are:
- Sharing of lessons learnt
- Sharing the history of previous programs
- Up front marketing strategy and market attack plan development
- Upfront planning process including strategy and vision development
- Offsite TTM leadership program for training, team building, networking and knowledge sharing
- Competitive benchmarking
- Critical technology and design information
- Software architecture
- Component reuse
- Schedule and resource estimation process
- Validation of concepts with customers
- Business case development
- Engagement of downstream value chain partners

It was also recognized that there is considerable effort needed in word-smithing documents, which contain either the process or the outputs of the PDP, by different PDTs. Having common formats and syntax will alleviate significant amounts of such wasted efforts. Having corporate common repositories, which are standardized, and intranet based (currently different PDTs have their own which adds to the variance in format and content) of certain key corporate knowledge, which would be beneficial, using the eTTM knowledge infrastructure and syntax, such as:

- Project Management Website
  - Chronological log of program activity
  - TTM proposals, concepts, business cases
  - PDT minutes
  - Assessments made; decisions made; risks mitigated
  - Critical data
  - Lessons learnt; analysis; conclusions
  - Phase gate experiences and issues; including a reflective step at each activity
- Yellow Pages listing potential assessors and their areas of expertise
- Internal benchmarking

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
Best Practices
Communities of Practice
Break through concepts
Software architectures, interfaces, re-usable components

These websites, also need to be supported by the existing eTTM websites which provides the framework, such as:

- eTTM process library
- Sample documents / templates to achieve common format and syntax
- Engineering tools such as:
  - eCAD (Computer Aided Design)
  - eCAE (Computer Aided Engineering)
  - eCPM (Critical Parameter Management)
  - ePIM (Part Information Management)
- Competitive Intelligence
- Competitive product reviews
- Xerox product reviews
- Competition and partner websites
- CEC website
- Website pointing to other organization program websites

Enforcement of applying lessons learnt, were highlighted by several managers in the survey, as a needed activity, preferably during the early stages of the PDP such as at 3.0 and 3.1 i.e. the definition of the market and product strategy, the vision and the market attack plan and definition of technology to be used. If lessons are not reviewed and not applied, then they are really are not “learned”. The lessons learnt also should find the way into updating of the eTTM process activities via updated processes and checklists as time goes on, to keep the eTTM refreshed and ever-green, but first, validated with a PDT before making it an official corporate process.

Having a wider cross-functional participation at the earlier phase gates will result in greater collective knowledge sharing and would be better for the product or service being developed.

Having the right membership in the TAT team where the best people with the right experience are used would result in an effective multidisciplinary team.

There was a suggestion made that the TAT chairman should be co-located with the PDT to provide consistent leadership and advice, with the ability to call on the best subject matter experts. The TAT should be ongoing activity rather than just becoming a policing activity. Xerox has, in fact, shifted to this approach and TATs are now considerably more effective.
To address the issue of recognizing and rewarding knowledge sharing, it was iterated only results are rewarded and not the behavior. This is a reactive approach, followed by many companies. Rewarding re-use of ideas, sharing of knowledge would boost both the employee morale and trust towards one another, two enablers found in short supply at Xerox by the survey. We need to convince the managers that collaboration and knowledge sharing gives them an edge in becoming successful. We need to reward those who take risks, make new mistakes. Collaboration is a competency and needs to be embedded in the Xerox workforce via a learning intervention, which also should include creating and sustaining common goals.

Management compensation should reward re-use and avoid rewarding of duplication of effort.

To facilitate cross-organization knowledge sharing, it was suggested an extended use of staff to staff meetings, specialized workshops such as functional workshops like marketing, engineering, product managers…. towards common goal of an acceptable customer experience. Tools such as Barry Boehm’s Win-Win tool, which is a collaborative tool in developing group consensus by bringing together the stakeholders with a common vision, where the participants are encouraged to freely discuss their points of view and discouraged from having hidden agendas.

Xerox is well on its way to have a good product development process. Continued training of subject matter experts in TTM processes, TAT assessments, and standardized tools will continue to improve its competitiveness.
Chapter 7. Summary and Conclusions

After studying current literature in this area, interviewing with knowledge experts in both academia and industry, in addition to introspecting within Xerox, I agree that for long-term success, we must embed knowledge management and sharing into the firm’s business processes. A firm can achieve competitive advantage in today’s knowledge economy by the effective use of its corporate knowledge.

Knowledge sharing does enable the firm to act quickly and skillfully, the employees to connect and communicate more effectively about their work, and working together to solve problems in real time by interacting with each other, and over time mediated by documents. As employees of the firm are able to connect to one another, they begin communicating leading to conversation and ultimately collaboration. It is this collaboration among its employees that gives the company its competitive advantage.

Though any single company has not discovered the mantra for ideal knowledge management and sharing; several good practices, which were consistently enablers of perceived success, were identified. The effective enablers towards knowledge sharing were a synergistic gathering of “common sense” attributes such as morale, trust, common goals, value and criticality of knowledge, diversity, and structure, rewards/recognition, support and knowledge initiatives along multiple fronts.

Comparing and contrasting current practices for knowledge sharing in Xerox with an idealized model of best practices for knowledge sharing, I found that Xerox has had considerable success in promoting a knowledge oriented culture and does have an effective product development process. However, there is a need identified for corporate wide, accessible, standardized, and consistent knowledge repositories. Examples of desired repositories include lessons learnt, estimation processes, and platform development. Need was also identified for making the sharable repositories have a consistent format, and a standardized way of representing knowledge from cross functional and cross organizational team efforts, in order to reduce current waste in efforts at constant word-smithing of documents for such consistency.

Stage gates in a product development process are important for sharing corporate knowledge across functions and organizations, and the product development process itself serves as an infrastructure and framework for knowledge sharing. The surveyed Xerox Product Managers, who confirmed their ubiquitous practice by the PDTs, also recognized stage gate reviews positively. A major factor in the positive perception of phase-gates was the shift in the selection process of the assessor for the stage gate reviews, i.e. from a ‘management’ evaluatory team to a ‘peer’ mentoring team. This shift in context has resulted in more open and frank discussions during reviews based on mutual trust, and the behavior has shifted being at an inquisition/audit (similar to...
an IRS audit) to an exchange where trust is developed, knowledge is shared and team members educate each other.

To augment this successful practice based on mutual respect and trust, TAT membership now has continuity from one review to the next. This is in contrast to the previous practice of new TAT teams at each stage gate depending on availability. This continuity has resulted in a continuing dialog between teams and their peers, and has enabled the peers to act as advisors/mentors as opposed to the previous role of acting as outside inspectors. While trust is reported as being lacking across the firm, the fact that trust exists in the peer reviews is a noticeable exception.

A hypothesis induced from these findings is that social interactions with peers who act as advisors/mentors in the context of peer reviews, enables effective knowledge sharing in product development; in part because it relies on mutual trust and respect, and in part because knowledge can be transformed through an ongoing dialog that is open and frank. Peer reviews at stage gates appear to be a highly effective form of interaction among communities of practice, where knowledge is not just transferred as is attempted through databases, but transformed through an ongoing dialog through social interaction.

An example of such knowledge sharing occurred during the time of this study. Using the knowledge acquired through practical experience and education, and taking a holistic view of the product development process as the boundary framework for knowledge transfer, I used the eCPM (Engineering Critical Parameter Management Tool), to translate knowledge from a domain expert in mechanical engineering to a common semantic base, for transformation into the domain of software engineering.

The knowledge of CPM was localized and embedded in the domain of mechanical engineering, and transforming this knowledge to be appropriate for software engineering was found to be non-trivial. eCPM has provided a common syntax for conversation and transfer of knowledge, and I am working with the expert to create a version of eCPM, that would provide a similar common syntax for conversation and transfer of knowledge in software engineering. My research indicates optimism with regard to eCPM being useful for software engineering, and we have identified some specific transformations that are required such as extending CPM to handle multiple parameters in software engineering and to be done in a more holistic and systemic sense. This is now an ongoing dialog, which continues and will be focus of discussion and embellishment during our next stage gate review for the program.

In summary, Xerox has substantially increased the effectiveness in its corporate knowledge sharing, by increasing focus on reviews by peers rather than evaluation by managers, during stage gate assessments, thus giving it more of a mentoring attribute, conducive to sharing and development of trust among its employees. Using the same members for the TAT throughout the program helps the creation of and
building upon shared meanings, giving rise to shared processes, which remain evergreen through the program duration and as a “lesson learnt” for the next product program. The stability of dedicated teams just enhances the trust building, understanding building and shared method-building efforts.
Chapter 8. Next Steps and Future Work

On Monday, November 19, 2001, Anne Mulcahy, CEO, Xerox said that 2002 will be Xerox’s “biggest year in a decade in terms of new offerings and platforms we will begin to market”.

In a speech to a gathering of the investment community, she said that the offerings would be focused in three areas:

- **Production**: Xerox has the potential to dramatically expand the market opportunity with its current strong array of systems and solutions, led by the Xerox DocuColor iGen3.
- **Office**: Although this market has been flat, Xerox has competitive advantages in areas that are growing. Examples of the growth areas are color, multi-function devices and value-added solutions and services.
- **Services**: This is a market that is growing at 31%/year. It includes knowledge, content and document management.

Xerox has the ability to also enable its customers create a knowledge advantage. Its powerful network-ready office solutions can enable a broad range of high-performance functions for its customers. The Xerox Document Centre creates an essential network portal and output management system, which can act as a two-way document server that integrates seamlessly into the customer’s IT infrastructure.

Xerox has long ago, recognized the value of knowledge and its criticality to its competitiveness in the marketplace.

On Wednesday, November 14, Xerox had a press release titled: Xerox Salutes Prolific Inventor. Santokh Badesha got his 100th patent. The press release noted that the US Patent office has granted more than 6 million patents, but only a small fraction of inventors have received 100 or more. Xerox Corporation’s Santokh Badesha has joined that exclusive group in October 2001 with U. S. Patent 6,297,302, called the “Stabilized Fluorosilicone Materials”. The press release went on to say to quote Herve Gallaire, president, Xerox Innovation Group, as ```Xerox's substantial investment in research and technology continues to pay off in original products that lead the industry”.

Santokh Badesha credits Xerox with creating an environment where inventors can flourish and where the expertise of multidisciplinary teams helps spark ideas.

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
I agree. Xerox eTTM does give us a cross-boundary infrastructure for transferring knowledge, where multidisciplinary teams share a common language/syntax of representing each other’s knowledge in terms of activities for the different stages of the product development process.

The tools such as eCAE, eCAD, eCPM, ePIM gives us an ability to develop a common semantic base where knowledge workers can develop a “shared” meaning, i.e. the knowledge is translated to have a “shared common meaning”.

Knowledge can now be transformed across functional and organizational boundaries where knowledge experts in different areas can transfer and translate their knowledge and transform it to create new knowledge in their common quest to develop better products and services.

Further work needs to be made in applying more of these tools, especially in the areas of lessons learnt, platform development and examples in common repositories of transformation of knowledge between domains.

Xerox has recognized that knowledge is the new economic currency. Knowledge is the key to market success and sustainability. Being a pioneer in the study of knowledge and one who specializes in documents, where documents are information structured for human comprehension. The emphasis is to embed know-how in work practices and experiences.

Recommendations for next steps are that eTTM could be used to better facilitate knowledge sharing during stage gate reviews, where knowledge gets transformed during social interactions, rather than putting more emphasis on just sharing documents, where knowledge just gets transferred and sometimes lost in translation between knowledge boundaries. To catalyze such interactions and knowledge sharing, the corporation should also promote standardized and consistent methods of representing sharable knowledge. Only through successful role-model examples, will the company achieve momentum in capitalizing on its knowledge assets.

It would be useful, to additionally explore how interactions between TAT reviewers and teams may be already taking place outside the context of the stage-gate reviews, and how such ongoing interactions may be better supported.

Xerox’ goal is to help its customers leverage their knowledge to achieve a sustainable competitive advantage in their marketplace. With their success, Xerox success will come. With the advent of the internet and large populations of the world connected, office productivity will be needed which can be satisfied via intelligent digital machines that manage sets of documents on the network. Xerox
is well positioned in the knowledge-based economy. Paul Allaire, former Xerox CEO, saw knowledge sharing as information’s highest goal.

Below is the Xerox logo for knowledge sharing:

![Knowledge Sharing Logo](image-url)
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*Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process*


SURVEY QUESTIONNAIRE

Please mark your responses as:
SA: Strongly Agree; A: Agree; N: No Opinion or No Knowledge; D: Disagree; SD: Strongly Disagree

COMPANY AND SENIOR MANAGEMENT

[ ] Xerox, as a company, understands what it takes to create, capture and share knowledge among the employees as demonstrated during the TTM process for product development.

[ ] Xerox management has described its intentions of its business strategy in clear and actionable terms providing the basis for the initial phases of TTM involving market strategy, vision and market approach.

[ ] The TTM process utilizes the collective knowledge of the PDT, TAT and TTMDT team to develop a successful product.

[ ] Senior management actively sponsors and supports continuous learning and sharing of corporate knowledge.

[ ] The criticality of knowledge is evident throughout the TTM process in terms of how it improves the product being developed and to the Xerox business.

[ ] Knowledge is shared extensively between TAT, PDT and TTMDT members through personal interaction, sharing of experiences and application of best practices through all the phase gates.

[ ] Managerial compensation methods reflect recognition for good knowledge behaviors such as sharing and collaborating.

XEROX PEOPLE AND CULTURE

[ ] Xerox has a knowledge oriented culture, where the employees value acquiring and sharing of knowledge, and are continuously learning and collaborating.

[ ] Xerox has free flow of information supported by knowledge infrastructure facilitating access and sharing of common knowledge.

[ ] The morale of employees within the company is high.

[ ] Xerox employees are engaged in active learning.

[ ] Diversity in Xerox employees matches the company’s marketplace and its customers.

[ ] There is a desire to share knowledge with other employees to achieve critical business goals together.

[ ] Knowledge is regarded by everyone as a critical asset of the company.

[ ] There is a visible, ever-present and infectious trust among the employees towards each other.

XEROX INFRASTRUCTURE

[ ] Xerox has provided the means (tools, facilitators, teams) to manage and facilitate corporate knowledge for use in the TTM process for product development.

[ ] Xerox employees have access to personal collaborative tools, communications and collaboration technologies, and infrastructure to share their knowledge with fellow employees.
Please answer the following questions, as fully as possible. Thank you.

What TTM activities could benefit by more collective knowledge during the TTM process?

What would you recommend to improve knowledge capture and sharing during TTM?

What knowledge repositories do you frequently access to gain further your knowledge?

How can Xerox improve the TAT process to increase knowledge sharing at phase gates?

How can we improve recognizing / rewarding of collaboration and knowledge sharing?

How can we further improve cross-functional (planning, finance, engineering, marketing, manufacturing, service...) knowledge sharing during the PDT meetings?

How can we further improve cross-organizational (DSG, GSG, OSG, DMO, XSERV, OPB, XRT...) knowledge sharing during the TAT assessments?

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
What knowledge management activities did your organization use during TTM?
( ) Storing and organizing of explicit knowledge documents
( ) Information retrieval with improved search results and data mining
( ) Facilitation and support of communities of practice
( ) Encouraging person-to-person collaboration
( ) Sharing where the knowledge is and seeking it
( ) Education and training development
( ) Improved business process by applying knowledge to services and workflows
( ) Encouraging Knowledge Sharing
A. What is Knowledge?
1. Emphasize Tacit Knowledge
2. Perishable and needs continuous renewal
3. Boundaries
   3.1 Difference (Syntax)
      3.1.1 Crossed by transferring (same language)
   3.2 Dependence (Semantics)
      3.2.1 Crossed by translating (Same meaning)
   3.3 Newness (organizational work effects)
      3.3.1 Crossed by transforming (Same or overlapping space)
4. Focus on Explicit Knowledge
5. Relevance more important than Completeness
   5.1 Business needs
6. Categorized
7. Corporate Wisdom
8. Value
9. Metrics

Knowledge Characteristics
1. Differences
2. Dependence
3. Novelty
4. Dynamically changing
5. Semantic Infrastructure
6. Common Query: Language
7. Data Model
8. Common Semantics
   8.1 Symbols
      8.1.1 Slogans
   8.1.2 Metaphors
   8.1.3 Analogies
   8.2 Common Syntax

Explicit Knowledge
1. Methods
2. Business Patterns
3. Design Experiences
4. Processes

Knowledge Creation
1. Different Knowledges Interact
   1.1 Team Members
2. Different Skill Sets Fuse
   2.1 Cross Departmental
3. Chemical Reaction
4. Cross functional knowledge exchange
5. New Explicit Knowledge
   5.1 Spread and Internalization
      5.1.1 Common Cognitive Ground
      • Consultation & Communication

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
Massachusetts Institute of Technology

- Ambiguity through Redundancy

6. Variability in Work Performance
7. Resolution of Differences
8. Innovation
   8.1 Continuously incremental
   8.2 Ambiguity
   8.3 Social Interaction
      8.3.1 Different Ideas
      8.3.2 Different Methods of Analysis
      8.3.3 Different Viewpoints
9. Continuous

Knowledge Initiative
1. Management Sponsorship
   1.1 Technical Expertise
   1.2 Commitment
   1.3 Leadership
2. Identify Knowledge
3. Best practices network
   3.1 Develop a roadmap
   3.2 Determine topics
   3.3 Identify best practices
   3.4 Evaluate best practices
   3.5 Communicate best practices
4. Implement Knowledge Transfer
   4.1 Community members
      4.1.1 Managers
      4.1.2 Experts
   4.2 Distillation of implementation experience
      4.2.1 Experts
5. Represent Knowledge
6. Linking knowledge model to training programs
7. Develop specific organizational and human resource structure to facilitate knowledge transfer
8. Develop a community
   8.1 Technical leadership
   8.2 Learning
   8.3 Implementing best practices
9. Structure Contents
10. Moderate Best Practices
11. Organize Workshops
12. Coordinate Participants
13. Identify Experts

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
B. How can knowledge be shared?

Knowledge Sharing Enablers

1. Trust
   1.1 Pervasive
   1.2 Visible to all of the organization
   1.3 Propagated to the top

2. Common Goals
   2.1 Build Corporate Coherence
      2.1.1 Senior Management
         • Set
         • Promote
         • Monitor
   2.2 Clarity of Objectives and Language
   2.3 Common Syntax
      2.3.1 Common Training
      2.3.2 Common Processes
         • Education
         • Allocate time for learning
         • Discussion
         • Teamwork
         • Job Rotation

3. Strategic

4. Morale
   4.1 Difficult to maintain in large organizations
   4.2 Absolutely Necessary
      4.2.1 Tacit Knowledge Sharing
         • Comes from the Heart
         • Cannot be mandated

5. Supportive Environment

6. Knowledge Sharing Process

7. Reward & Recognition

8. Structure

9. Knowledge Culture

10. Diversity

11. Value of Knowledge
   11.1 Visible links to economic values
      11.1.1 Special Metrics
      11.1.2 Direct Correlation to business' bottom line
   11.2 Benefits of Knowledge
   11.3 Criticality of Knowledge
      11.3.2 Survival of Company

Effective Knowledge Sharing

1. Explicit Knowledge

2. Tools

3. Knowledge

4. Environment

5. Acquisition of Knowledge
   5.1 External Knowledge
   5.2 Consultants

   Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
Successful Knowledge Sharing Projects

1. Multiple Facets
   1.1 Expert networks
   1.2 Internal Document Repositories
   1.3 Lessons Learnt Databases
   1.4 High Level of Knowledge Management Processes
   1.5 Use of evaluation and compensation systems to change behavior

2. Improving Overall Knowledge Environment
3. Many championing the project
4. World Wide Video Conferencing System for Knowledge Sharing
5. Value of Knowledge
6. Employees contribute knowledge into repositories without encouragement

7. Knowledge Sharing
   7.1 Human Interaction
   7.2 Technical Interaction

8. Never struggling for resources
9. Ambitious enough to transform the organization

Knowledge Sharing Process

1. Work with external vendors of technologies and services
2. Develop different human resource management approaches
3. Develop nontrivial motivational aids like special rewards and recognition program
4. Organizational learning
   4.1 Develop Corporate Process for orientation
   4.2 Understand finer points
5. Link to economic or industry value via benefit calculations
6. Clarify vision and language
7. Do not approach it as a culture change
8. Enable Collaboration
   8.1 Knowledge Sharing
   8.2 Relationship Management
   8.3 Extended communities
      8.3.1 employees
      8.3.2 customers
9. Anayze financially
10. Manage knowledge asset portfolios

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11. Negotiate with holders of desired intellectual capital
   11.1 Internal
   11.2 External

12. Calculate Knowledge valuations

13. Channels for Knowledge Sharing
   13.1 Human
      13.1.1 Identify
      13.1.2 Develop
      13.1.3 Monitor
   13.2 Automatic
      13.2.1 Identify
      13.2.2 Develop
      13.2.3 Monitor
   13.3 Allocate Time and Space

14. Create a structure to hold knowledge

15. Persuade employees to contribute knowledge
   15.1 Knowledge Management
      15.1.1 Every employee’s job

16. Determine technology to store knowledge

Knowledge Infrastructure

1. Knowledge Processes
   1.1 Creation
   1.2 Transfer
   1.3 Harvesting
   1.4 Integral part of business Processes

2. Knowledge Measurements
   2.1 Knowledge Metrics

3. Knowledge Strategies
   3.1 Mapping
   3.2 Codification
   3.3 Coordination
   3.4 Determine Critical Knowledge
      3.4.1 Business Strategies

3.5 Economic Value of Knowledge
   3.5.1 Using it not just having it

3.6 Accumulating and Classifying Knowledge
   3.6.1 Turn Product Development Management Art into Science

4. Knowledge Support
   4.1 Knowledge Architects
   4.2 Librarians
   4.3 Project Repositories
   4.4 Document Repositories
   4.5 Communities of Practices

5. Knowledge Tools
   Structure
   1. Structure
   2. Small amounts of Process Orientation
   3. Process Infrastructure
   4. Content Infrastructure

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
4.1 Best Practices Landscape
5. Existing Structure
   5.1 Knowledge Sharing
6. Formal structure to store explicit knowledge
7. Discussion type database to store personal comments and tacit knowledge
8. Meta-knowledge management strategy
9. Technology Infrastructure
10. Identify existing knowledge in various forms
11. Knowledge Evaluation
    11.1 Usefulness
    11.2 Consistency
    11.3 Correctness
12. Business Goals served by corporate knowledge
13. Organizational Infrastructure
C. Strategic Aspects

The Company

1. Long Term Success
   1.1 Most adaptive
   1.2 Not Strongest
   1.3 Not most intelligent

2. Competitive Advantage
   2.1 Roadmaps with KM Objectives
   2.2 Rate of organizational Learning
      2.2.1 Knowledge Based

3. Competence & Innovation
   3.1 Community of Practice

4. Drivers for
   4.1 Relationship Management
      4.1.1 Scope
   4.2 Innovation
      4.2.1 Speed
   4.3 Infra-structure
      4.3.1 Scale

5. Information Based Organization
   5.1 Information Sensitive
      5.1.1 Internet Dependent
      5.1.2 Knowledge Management
         • Heavy Investment
   5.2 Less command and control
      5.2.1 less vertical departments
   5.3 Team of knowledge specialists

6. Motivation
   6.1 Creative Abrasion
      6.1.1 Intentions of the Company
      6.1.2 Company’s Customer Needs
   6.2 Rewards and Recognition
      6.2.1 Incentive Programs
      6.2.2 Change Focus
         • Critical Areas of need

7. Balance
   7.1 Knowledge Management Strategy
   7.2 Company’s Business Strategy

8. Management Style
   8.1 Focus on Knowledge Management
   8.2 Align KM with corporate objectives
   8.3 Simple and easy
   8.4 Light on administration

9. Provide a Portal
   9.1 Knowledge
   9.2 Practices
   9.3 Company ideas
   9.4 Extend to customers

10. Multiple Fronts
   10.1 Key business partners

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
10.1.1 Interfaces
10.2 reward and recognition
  10.2.1 Knowledge practices
  10.2.2 Metrics and Methods
    • Value of knowledge
  10.2.3 Value System measuring Knowledge Management behaviors
10.3 Alignment with Business Strategies
10.4 Products
  10.4.1 Solutions
    • Knowledge Embedded
10.5 E-Business Model
  10.5.1 Knowledge Management as Backbone
  10.5.2 Trust over Price Rules
10.6 Customer Focus
  10.6.1 Management
    • Teams
    • Cross-Functional
    • Task-Focused
    • Leadership
    • Training
    • Development
    • Clear & Simple Objectives
    • Individual Accountability
    • Vision
  10.6.2 Business Relationships
    • Identify
    • Attract
    • Develop
10.7 Decentralized Organization
  10.7.1 Centralized Knowledge
11. Totally Process Oriented
  11.1 Market & Society Driven
12. Team Based
  12.1 Light on Resources
  12.2 Heavy on Knowledge
    12.2.1 Knowledge management fused with business strategy
13. Valuable Corporate Assets
  13.1 Employees
    13.1.1 Conceive new products and services
  13.2 Knowledge
    13.2.1 Meta-Knowledge (Relevance and Applicability)
  13.3 Organizational Capital
    13.3.1 Grows with use
    13.3.2 Endures Change
14. Goals aligned with business needs
  14.1 Ever changing business environment
    14.1.1 Better practices
    14.1.2 Continuously improved processes
  14.2 Measures to compare performance against the goals
15. Convert individual knowledge to explicit corporate knowledge

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process

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15.1 Focus Thinking
15.2 Encourage Dialogue
  15.2.1 Talk Rooms
  - No Agenda
  - No presentation
  - No fixed format
  - No organized discussion
15.3 Diffuse knowledge throughout the organization

Strategic
1. Multiple Fronts
   1.1 Company wide coordinated approach
2. Multiple Backers
3. Long Term Motivational Aids
   3.1 Salaries
   3.2 Promotions
4. Customer always as the central focus
5. Mandatory Yellow Pages
   5.1 Locate Experts
      5.1.1 Background
      5.1.2 Interests
      5.1.3 Expertise
   5.2 Interview Network
      5.2.1 Employees willing to meet with colleagues
6. Chief Knowledge Officer
   6.1 Advocates Knowledge Sharing and Learning
   6.2 Includes Knowledge strategy in business strategy
   6.3 Develops firm’s knowledge infrastructure
   6.4 Manages relationships with external knowledge sources
      6.4.1 Research Centers
      6.4.2 Universities
   6.5 Measures and manages value of knowledge
      6.5.1 Only Relevant Knowledge
      6.5.2 Recognize Knowledge as asset
   6.6 Develops and manages company’s knowledge strategy
      6.6.1 Do not camouflage it
7. Senior Management
   7.1 Promoting importance of knowledge
   7.2 Support resources available
   7.3 Make knowledge intentions clear
   7.4 Visible Support and Recognition of Knowledge Management
   7.5 Engage Patrons and Sponsors of Knowledge Sharing

Reward & Recognition
1. Rewards & Recognition for those who share and those who learn
2. Incentives for Knowledge Sharing
   2.1 Like Frequent Flyer programs
3. Reward Knowledge based on quality not on source
4. Personal interaction events (team building)
5. Knowledge Fairs

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
6. ShareFairs
   6.1 Recognition of reuse
7. Apprenticeships
8. Lessons Learnt conferences
9. Story telling
10. Mentorships
D. Culture and the Environment

Culture
1. Organization Skills
   1.1 Creating Knowledge
   1.2 Acquiring Knowledge
   1.3 Transferring Knowledge
   1.4 Modifying own Behavior
      1.4.1 Learning new knowledge and insights
2. Environment Conducive to Learning
   2.1 Stimulate Chaos
      2.1.1 Open up boundaries
   2.2 Nurture
      2.2.1 New & expansive patterns of thinking
   2.3 Set Free
      2.3.1 Collective Aspirations
   2.4 Learn Together
      2.4.1 Continuous Learning
3. Component Technologies
   3.1 Systems Thinking
   3.2 Personal Mastery
   3.3 Mental Models
   3.4 Shared Vision
   3.5 Team Learning
4. Innovation
   4.1 Communications
      4.1.1 Understanding different styles of thinking
   4.2 Collaboration
      4.2.1 Understanding different styles of acting
5. Behaviors
   5.1 Sharing
   5.2 Allow & Leverage
      5.2.1 Different Approaches
      5.2.2 Different Viewpoints
   5.3 Quality of Interaction
      5.3.1 Management
         • Humility
         • Openness
   5.4 Trust
      5.4.1 Foster Tolerance
   5.5 Encourage
      5.5.1 Shared Interests
      5.5.2 Common Values
      5.5.3 Going after Mutual Goals
      5.5.4 Knowledge sharing
      5.5.5 Researchers to pursue own interests for a certain percent of their time
      5.5.6 Knowledge re-use
   5.6 Emphasize
      5.6.1 Do the right thing
      5.6.2 Renew Existing Knowledge
      5.6.3 Create new knowledge

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
5.6.4 Embody knowledge in products & Services
5.7 Learning as a goal
5.7.1 New Structures
6. Good Teamwork
6.1 Clear & Limited by Unified Product Vision
6.2 Limited Personnel
6.3 Limited Time
6.4 Modularized Product Architecture
   6.4.1 Features
   6.4.2 Functions
   6.4.3 Subsystems
   6.4.4 Objects
6.5 Subprojects
   6.5.1 Clusters
   6.5.2 Milestones
   6.5.3 Feature Teams
6.6 Small Multifunction Teams
   6.6.1 High Autonomy
   6.6.2 High Responsibilities
6.7 Force
   6.7.1 Coordination
   6.7.2 Synchronization
6.8 Good Communications
   6.8.1 Across Teams
   6.8.2 Within Teams
6.9 Ability to Switch
   6.9.1 Product Focus
   6.9.2 Process Focus

Knowledge Culture
1. Desire for Knowledge
   1.1 Coaching
2. Acceptance
   2.1 Errors made in quest of creativity
   2.2 Not knowing everything
3. Work to improve reducing resentment of company
4. Management Supported Free Flow of Information
   4.1 Internally
   4.2 Externally
5. Encourage Risk taking
6. Knowledge Oriented
   6.1 Positive Attitudes
   6.2 Facilitates Intellectual Curiosity
   6.3 Enjoyment of Discussion of Knowledge
   6.4 Pleasure in helping others
7. Less Hierarchy
8. Ubiquitous Knowledge
9. Removes "not invented here" syndromes

Environment

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
1. Organized Knowledge
   1.1 Focused
   1.2 Centralized
   1.3 Easily Accessed
   1.4 Easily Shared

2. Distributed Knowledge
   2.1 Different Locations
   2.2 Different Work Cycles
   2.3 Different Cultures

3. Continuously Assimilate Feature Innovations
   3.1 Periodically Stabilize Overall Project
      3.1.1 Small Teams development

4. New Processes
   4.1 Systematic Problem Solving
   4.2 Using Experiments
   4.3 Learning from Past Experiences
   4.4 Learning from Others
   4.5 Transferring Knowledge quickly and efficiently throughout the organization

5. Open Communications Channels for Information Sharing and Support
   5.1 Video
   5.2 Audio
   5.3 Net Conferencing
   5.4 Occasional Face-to-Face

6. Corporate Infrastructure
   6.1 Information Technology
      6.1.1 Access
      • Books
      • Repositories
      • Discussion Groups
   6.2 KM initiatives
   6.3 Core Competencies
   6.4 KM Incentive Systems

7. Meeting Grounds
   7.1 Subject Matter Experts

8. Informal Networks
   8.1 Proximity
   8.2 Trust
   8.3 Reputation

9. Tools
   9.1 Measure Learning
   9.2 Validate Learning
   9.3 Distributed Knowledge Management

Supportive Environment
1. Knowledge Facilitators
2. Optimal Knowledge
   2.1 Low Cost of Search
      2.1.1 Electronic Smart Agents
      • Search and Find
      • Best and most relevant documents

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
3. Knowledge Disseminators
   3.1 Selected users based on desire
      3.1.1 Content
4. Experts
5. Company wide Internet access
6. Knowledge Oriented Technologies
   6.1 Technical
   6.2 Organizational

Diversity
1. Diversity in employees
   1.1 New Hires open to learning
   1.2 New Hires with capacity to learn
2. Globally Dispersed Teams
3. Diversity in products and solutions
4. Diverse Marketplace
5. Different Experiences
6. Different Perspectives
7. Different Knowledge

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
E. The Human Aspect

The Employees

1. Applying the knowledge
   1.1 Cognitive Skills (Know-What)
      1.1.1 Education & Learning
   1.2 Advanced Skills (Know-How)
      1.2.1 Practice of Knowledge
   1.3 Systems Understanding (Know-Why)
      1.3.1 Depth in Systems Knowledge
   1.4 Self Motivated Creativity (Care-Why)
      1.4.1 Will
      1.4.2 Motivation
      1.4.3 Adaptability for Success

2. Communities of Practice (CoP)
   2.1 Self Organized
   2.2 Grass Roots
   2.3 Common Work Practices
   2.4 Common Interests
   2.5 Common Goals
   2.6 Common Body of Knowledge
   2.7 Single Identity
      2.7.1 Shared Values
      2.7.2 Common Problems

3. Selection of Employees
   3.1 Eager to learn
   3.2 Capable of learning

4. Well Focused Teams
   4.1 Common Intention
   4.2 Overlap
   4.3 Increased Contact
   4.4 Informal Information Sharing
   4.5 Joint Training
      4.5.1 Brainstorming
      4.5.2 Problem Solving
      4.5.3 Evaluating Experiments
      4.5.4 Other Core Learning Skills
   4.6 Continuous update from external sources
   4.7 Networks
      4.7.1 Knowledge Experts

5. New Knowledge behaviors
   5.1 Self Organized
   5.2 Informal Groups
   5.3 Self-Directed
   5.4 Identify with
      5.4.1 Enterprise
         * Different Business Perspectives
      5.4.2 Enterprise’s mission

6. Mutual Trust
   6.1 Share Emotions and Feelings
      6.1.1 Different Backgrounds

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
6.1.2 Different Perspectives
6.1.3 Different Intentions

Teamwork
1. Joint Training
   1.1 Brainstorming
   1.2 Problem Solving
   1.3 Evaluating Experiments
   1.4 Other Core Learning Skills
2. Globally Dispersed Teams
3. Continuous update from external sources
4. Networks
   4.1 Knowledge Experts
5. Informal Information Sharing
6. Increased Contact
7. Overlap
8. Common Intention

Virtual Teams
1. Draw Satisfaction in being part of
2. Risk Taking Attributes
3. Trusting Relationships
4. Shared Purpose
   a. Customer Requirements Focus

Collective Sense-Making
1. Collaborative Software
2. Analysis Software
3. Database Technologies
4. Subject Matter Experts
5. Common Goals
6. Critical Knowledge Bases
7. Team share experiences and mind-sets
   7.1 Highest form of learning
      7.1.1 Introspection of outcomes
      7.1.2 Acknowledgement of mistakes

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
F. Implementation Aspects

Knowledge Bases

1. Repositories
   1.1 Yellow Maps
   1.2 Knowledge Maps
   1.3 Hyperlinked documents
   1.4 White Papers
   1.5 Sales Presentations
   1.6 Technical Specifications
   1.7 Links to Knowledge Sources outside the firm
   1.8 Best Practices
   1.9 Customer Knowledge
   1.10 Competitive Intelligence
   1.11 Product Knowledge
   1.12 Financial Knowledge
   1.13 Successful project presentations
   1.14 Successful project descriptions
   1.15 Relevant Business plans

2. Skill databases
   2.1 Structure
      2.1.1 Knowledge Competency Types
      2.1.2 Knowledge Competency Levels
   2.2 Knowledge required for a particular job
   2.3 Performance rating of employees
      2.3.1 Levels
         - Implicit Level
         - Explicit Level
         - Basic - Entry level Foundation Knowledge
         - Working - Local or Unique Knowledge of a particular skill
         - Leadership - Global knowledge of a function
         - Expert - Universal knowledge of overall business, products and drivers of industry

3. Personalized Knowledge Portals
   3.1 Specific desired headlines
   3.2 Special Interests
   3.3 Communities of Practice of interest
   3.4 Complex Search Engine for documents

4. Online Training databases
   4.1 Different Knowledge Competencies

5. Organizational Knowledge
   5.1 Access to FAQs
      5.1.1 Stock Answers
      5.1.2 Response from Experts
   5.2 Example Documents
   5.3 Templates
   5.4 Meeting Minutes
   5.5 Physical Asset databases
   5.6 Guidelines for specific functions
   5.7 Lessons Learnt
   5.8 Major Initiatives
      5.8.1 Relevant Documents

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
Knowledge Transfer
1. Critical Spiral
   1.1 Articulation
      1.1.1 Converting Individual Tacit Knowledge to Organizational Explicit Knowledge
   1.2 Internalization
      1.2.1 Using Corporate Explicit Knowledge to enhance individual Tacit knowledge
2. Balance during transfer of knowledge
   2.1 Scope
   2.2 Speed
3. Inter-Organization
   3.1 Entire Company
      3.1.1 Division
         • Project
         • Innovation
         • Spirals
         • Socialization (Tacit to Tacit)
         • Articulation (Tacit to Explicit)
         • Analogies
         • Metaphors
         • Combination (Explicit to Explicit)
         • Internalization (Explicit to Tacit)
4. Explicit Knowledge about Management
   4.1 Lessons Learnt
   4.2 Decision Making
   4.3 Action Planning
5. Effective Knowledge Sharing
   5.1 Clear Intentions
   5.2 Members have autonomy
   5.3 Motivation
      5.3.1 Creative Chaos
   5.4 Tacit Knowledge sharing
      5.4.1 Redundancy as enabler
      5.4.2 Proximity of contact
   5.5 Requisite Variety
      5.5.1 Diversity of employees
         • Matching the diversity in business environments
6. Exchange
   6.1 Tacit

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
6.2 Explicit
7. Knowledge Sharing
  7.1 Sharing doubles it size
  7.2 Mutual Trust
    7.2.1 Face to Face Meetings
    • Raise Important Issues
    • Learning History
    • Introspection
  7.3 Rewards & Recognition of Transfer and Application of Experience
    7.3.1 Employee Evaluation
    7.3.2 Employee Promotion
  7.4 Senior Management Support
  7.5 Availability of Resources
    7.5.1 Technology
8. Physical time together
  8.1 Transferring team
  8.2 Receiving team
9. Why do it
  9.1 Reciprocity
  9.2 Altruism
  9.3 Reputation
10. Re-use
11. Steps in process
  11.1 Gathering
  11.2 Organizing
  11.3 Restating
  11.4 Disseminating

Organizational Learning
1. Organization identifies and corrects error
  1.1 Organizational Learning
    1.1.1 Individuals
    • Long Term Informational Sources
    • Individual Workspace
    1.1.2 Knowledge Acquisition
    1.1.3 Information Distribution
    1.1.4 Information Interpretation
    1.1.5 Organizational Memory
    • Adequate Social Environment
    • Tools & Infrastructure
    • Information Technology
2. Meaning
  2.1 Pull Process
    2.1.1 Individuals in Active Intellectual Role
3. Four Modes of Learning
  3.1 Implementation
    3.1.1 Design
    • Assessment
    • Observation
  3.2 Act

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
3.2.1 Study
  • Do
  • Plan

3.3 Intervention
  3.3.1 Judgment
  • Reaction
  • Observation

3.4 Generalization
  3.4.1 Production
  • Intervention
  • Discovery

4. Measurable improvement in results
  4.1 Cognitive
  4.2 Behavioral
    4.2.1 Internalize new insights
  4.3 Performance Improvements

5. Capture

6. Diffused
  6.1 Disseminated at low marginal costs
    6.1.1 New Knowledge

7. Product Development Process
  7.1 Stage Gates
    7.1.1 Knowledge Capture
    7.1.2 Knowledge Sharing
  7.2 Work Activities
  7.3 Products and Services
    7.3.1 Embody it

8. Tacit Individual Knowledge drawn out and codified

9. Knowledge as Corporate Asset
  9.1 Accessibility
    9.1.1 Lowest Cost
  9.2 Increased Community Knowledge
    9.2.1 Individual Tacit Knowledge Sharing

10. Longer term renewal of knowledge
   10.1 Archived Memory
   10.2 Current Active Memory

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
G. Tools and Support

Knowledge Tools
1. Replication Capabilities
   1.1 Remote Use
2. File and Document Sharing Capabilities
3. Database Engines
4. Skill Databases
5. Yellow Pages
6. Search Engines
7. Virtual Team Tools
   7.1 Tools like Lotus Notes
   7.2 Collaboration Tools
      7.2.1 Workflow Software
      7.2.2 Email
   7.3 Web Browser / Intranets
      7.3.1 Publishing information
      7.3.2 Multiple computer platforms
      7.3.3 Multimedia databases
      7.3.4 Links to Company knowledge
         • External knowledge sources
8. Knowledge Monitors
   8.1 Portals
9. Knowledge Forums
   9.1 Bulletin Boards
   9.2 Discussion Groups
10. Knowledge Maps
    10.1 Meta Data
       10.1.1 Creator / Time stamp
       10.1.2 Modifier / Time stamp
       10.1.3 Accessor / Time stamp
       10.1.4 When Sharing would be useful
       10.1.5 Context of usefulness

Tools
1. Gathers Information
   1.1 Internal Sources
   1.2 External Sources
2. Disseminate Knowledge
3. Analyze meaning of information
4. Present relationships between facts
5. Meta-Knowledge to preserve the context
6. Group Memory
   6.1 Stores Information
   6.2 Communicates Information
7. Deliver Knowledge in form easy for analysis
8. Manage Shared Repository

Knowledge Facilitators
1. Discourage Disciplinary Loyalty
   1.1 Engineering
      
      Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
1.2 Manufacturing
2. Knowledge Intensive Gatherings
   2.1 Free Time
      2.1.1 Personal Interaction
      2.1.2 Knowledge Sharing
   2.2 Face to Face Dialogs
   2.3 Knowledge Fairs
   2.4 Teamwork Days
   2.5 Talk Rooms
   2.6 Special Conferences
      2.6.1 Web-cast
      2.6.2 Globally Distributed Teams
3. Enable Full Access to Knowledge
4. Hotline support
   4.1 Direct Service Delivery
5. Communication Facilities
   5.1 World Wide Knowledge Sharing
6. Relationship Builders
   6.1 Face-to-Face meetings
   6.2 Virtual Meetings
7. Telecommunication Facilities
   7.1 Audio Conferencing
   7.2 Video Conferencing
      7.2.1 Tacit Knowledge Pipeline
8. PCs
   8.1 Collaboration tools
      8.1.1 Globally Dispersed Teams
   8.2 Presentation tools
9. Knowledge Integrators
   9.1 Specialized Content
10. Knowledge Base Administrators
   10.1 Day to Day Administrative work
   10.2 Technical Work
   10.3 Managing Databases
11 Knowledge Managers
   11.1 Manage Knowledge
12 Redundant Knowledge
13 Open to Knowledge Sharing

Experts
1. Internal Experts
   1.1 Online access to Clients
   1.2 Share
      1.2.1 Experiences
      1.2.2 Product Knowledge
      1.2.3 Service Knowledge
   1.3 Coaching
2. External Experts
3. Knowledge Reviewers
   3.1 Review Documents for Sharing

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
3.1.1 Uniqueness
3.1.2 Applicability
3.1.3 Quality
3.1.4 Summarize Documents in Abstracts
3.1.5 Establish context for documents
3.1.6 Categorization
   • Type of Knowledge
   • Format of Knowledge

Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
H. The role of the Internet

Company Wide Internet Access

1. Extranets
   1.1 No more localness
   1.2 Relationships
      1.2.1 Partners
      1.2.2 Suppliers
      1.2.3 Customers
      1.2.4 Knowledge Sources
      1.2.5 Universities
      1.2.6 Other research centers
   1.3 Knowledge Sharing
      1.3.1 External Sources
      1.3.2 Internal Experts
   1.4 Consultation Board
      1.4.1 Questions Posted
      1.4.2 Answers Posted
   1.5 Project Status
   1.6 Test Results
   1.7 Links to outside organizational sites
      1.7.1 Knowledge Sources

2. Intranets
   2.1 Disseminate Knowledge
      2.1.1 Low Cost of deployment
      2.1.2 Multiply existing knowledge
   2.2 Exchange Knowledge
      2.2.1 Lotus Notes
         • Sharing of experience based knowledge
         • Knowledge Marketplace
         • Sharing of best practices
         • Recap their knowledge
         • Decision making leading to their actions
         • Logic Trail leading to major decisions
      2.2.2 Knowledge Bases
      2.2.3 Recruiting Network
      2.2.4 Good Search Engines
   2.3 Access to entire company’s knowledge
   2.4 Competitive Advantage
      2.4.1 Global Networking
      2.4.2 Local Relevance

Role of the Internet

1. Acquire (GIVE)
   1.1 Gather
   1.2 Inquire
   1.3 Verify
   1.4 Encode

2. Organize (PARC)
   2.1 Profile
   2.2 Associate

   Role of Stage Gates in Effective Knowledge Sharing During the Product Development Process
2.3 Rank
2.4 Classify

3. Distribute (AID)
   3.1 Awareness
   3.2 Identification
   3.3 Delivery

4. Intranet
   4.1 Bulletin Boards
   4.2 Email
   4.3 Shared Documents
   4.4 Shared Workspaces

4.5 Meta-Data of Knowledge
   4.5.1 Creator / Modifier / Accessor
   4.5.2 Creation Date / Modification Date / Access Date
   4.5.3 Relevant Knowledge Links

5. Web
   5.1 Global Source of Documents
   5.2 Medium for Managing Knowledge
   5.3 World Wide Access and Manipulation of Information
   5.4 Social Awareness
      5.4.1 Event Summaries Distribution
   5.5 Evolving Knowledge Space
      5.5.1 Communication Channels
      5.5.2 Knowledge Archives
      5.5.3 Open & Flexible Structures

6. Tools
   6.1 Directories
   6.2 Spiders
   6.3 Other Search Mechanisms
   6.4 OCR tools and Hand Held Scanners
   6.5 Multi-Lingual Thesari
   6.6 Data Mining Tools
   6.7 Text Analysis Tools
   6.8 Automatic Summarizing Tools
   6.9 Value Indexing Tools
      6.9.1 Qualify Knowledge Sources
   6.10 Semantic Retrieval Tools
   6.11 Object Oriented Tools
   6.12 Hyper-Media Tools
   6.13 Automatic Translation Tools
   6.14 Groupware
      6.14.1 Software to Analyze and Update Knowledge
      6.14.2 Software to Extend and Monitor Large Document Collections
      6.14.3 Notifications of Events
         - Synchronous
         - Asynchronous
      6.14.4 Communication & Interaction between Users

7. Infrastructure
   7.1 Communications
      7.1.1 Computer Networks
      7.1.2 Electronic Delivery of Training

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7.2 Technology
   7.2.1 Concept Maps
   7.2.2 Formal Attributes for Concepts
   7.2.2 Formal Relations between Concepts
   7.2.3 Idea Maps
   7.2.4 Knowledge Maps
   7.2.5 Machine Translations

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Enable Collaboration

Negotiate with holders of desired intellectual capital

Persuade employees to contribute knowledge

Knowledge Infrastructure

Knowledge Processes

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Knowledge Transfer

Appendix

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Critical Spiral

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Balance during transfer of knowledge

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Inter-Organization

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Steps in process

Organizational Learning

Organization identifies and corrects error

Four Modes of Learning

Measurable improvement in results

Diffused

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Product Development Process

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Meaning

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Knowledge as Corporate Asset

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Replication Capabilities

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