

# Improving Enterprise Wide Knowledge Sharing Via Anchor Point Reviews

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## ABSTRACT

The premise of this paper is that in today's knowledge-based economy, competitive advantage comes from the effective use of corporate knowledge. The study explores the hypothesis that anchor points in a software development process are important for sharing corporate knowledge across functions and organizations, and that the software development process itself serves as an infrastructure for meaningful knowledge sharing.

Social interactions with peers, who act as advisors/mentors in the context of peer reviews, increase effective knowledge sharing in product development. Peer reviews that occur in the context of anchor point reviews appear to be an effective form of interaction in which knowledge is not just transferred, as is attempted through databases, but transformed.

The increasing focus during reviews on feedback by peers, rather than evaluation by managers, is conducive to developing trust among employees. Using the same members for the assessment team throughout the program helps to build upon shared meaning, giving rise to shared processes, and "lessons learned" for the next product program.

**Keywords:** Knowledge Management, Anchor Points, Product Development Process, Software Development Life Cycle, Rational Unified Process.

## 1. INTRODUCTION

Knowledge is the new economic currency and the key to market success and sustainability. Knowledge is defined as the ability to act on information. Information is the message behind data. Data are the raw material or facts. Knowledge may be construed as a company's principal asset. It can grow over time and if maximized, provides the company with a sustainable competitive advantage.

In practical terms, corporations recognizing the value of knowledge must progress focusing and improving along the knowledge spectrum: Data → Information → Knowledge → Corporate Wisdom → Competitive Advantage → Profits.

## 2. BACKGROUND

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 note that an organization cannot create knowledge by itself and new knowledge originates from the tacit knowledge of individuals [9]. Barret, et al point out that knowledge is not static but fluid and is absorbed by individuals who interpret, modify and use it for their own purposes [2]. Thus, knowledge transfer includes both the transmission and absorption through use. Dan Holtshouse of Xerox, sees knowledge management as the next logical step for organizations that have embraced quality processes, have downsized, and are developing strategies and competencies for the future [7].

Knowledge sharing enables the firm to act quickly and skillfully, the employees to connect and communicate more effectively about their work, and solve problems in real time by interacting with each other. Knowledge transfer occurs based on personal factors such as proximity, trust and reputation via informal networks.

Knowledge is closer to action than either data or information. Knowledge is information in action. Knowledge that can be expressed formally is explicit and objective. Tacit knowledge is based on personal beliefs, learning, experiences, values and viewpoints. Tacit knowledge is subjective and hard to formalize or articulate. It can take various forms such as experience, stories augmenting facts and adding meaning to them, judgment, intuition, rules of thumb, compressed expertise (allowing for rapid action through complex situations), values and beliefs. Knowledge is acquired internally and externally. Innovative knowledge creation occurs when

two different knowledge or skill-sets fuse through dynamic interaction, resolve the differences in their individual perspectives and understanding of information, deal with ambiguity, interact and build on each others' knowledge and develop shared meanings. Knowledge is more important and valuable than its Organizational knowledge, though changing at a slower pace than individual knowledge, is also dynamic and needs similar attention. A firm has to make its knowledge as complete and available as possible to get the full value of its asset base in its development of quality products and services.

Carlile maintains that "Knowledge is localized, embedded and invested in practice"[4]. These characteristics make it difficult to apply knowledge in other contexts. Several factors add to the difficulties in the use of cross-boundary knowledge: 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). For an organization to innovate across multiple departments, it must 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 only to 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 also need to 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. The semantic view recognizes these differences. The 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. To consider the consequences of the differences in syntax and semantics, we need to use the pragmatic approach.

If differences have consequences that cause dynamic dependencies, it requires that different functions need to change their own tacit knowledge to account for these dependencies. Carlile 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. This is where we need Nonaka's "community of interaction" concept [10], to achieve mutual understanding, i.e., a "shared meaning" by analyzing the consequences across each team's boundary, and transforming the local knowledge across the boundaries into something new.

### 3. EFFECTIVE KNOWLEDGE SHARING

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. Every time knowledge is shared it doubles in size and can grow in a binary fashion. Knowledge is a usable asset only if it is accessible. Information and telecommunications technology have enabled unprecedented opportunities to develop knowledge pipeline and storage entities within a company. To facilitate knowledge sharing, 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 carry out cross-training on tasks and skills. These teams often stay together from the product inception phase through post-launch phase of development, bringing together a synergy of their varied knowledge domains. Team efforts are supported by technology via electronic document sharing, discussion databases, knowledge data bases and specialized telecommunications.

Closely related to knowledge management is the concept of the learning organizations, popularized by Peter Senge [11]. A learning organization creates, acquires and transfers knowledge modifying its behavior to reflect the new knowledge and insights. Senge defines a learning organization as one in which people continually expand their capacity to create the results they 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 the use of five "component technologies": systems thinking, personal mastery, mental models, shared vision, and team learning.

Hewlett-Packard CEO Carly Fiorina, in a speech on the future of technology to the Progress and Freedom Foundation [6], implied that it is neither the strongest nor

the most intelligent, but the most adaptive companies that will survive. She challenged leaders to generate the drive among 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. Understanding others' styles 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. 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. Cusumano describes Microsoft's success in making large teams work like small ones by allowing the individuals to be creative and self-empowered [5]. At Microsoft, 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.

Over two decades ago, Argyris and Schon asserted that knowledge assets and the learning capacity of an organization are main sources of competitive advantage [1]. As we move into the 21<sup>st</sup> century's new economy, we are seeing a shift from manual and service workers to knowledge workers. Because of this shift, we need to develop a value system for good knowledge behavior. The economic value of knowledge does not lie in possessing it, but in using it. Knowledge is also perishable and needs continuous renewal.

Trust, common goals, culture, value of knowledge, diversity, support structure, environment, management support are some of the critical success factors for effective knowledge sharing. The biggest barrier to knowledge sharing is the high cost of the search for optimal knowledge. Work teams should be encouraged to have unique knowledge and be open to sharing of this knowledge. Teams who try to protect or hoard their knowledge only hurt the company's competitive advantage. 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. Knowledge sharing will not happen if there is a lack of trust. There is a need to have organizational support for face-to-face dialogs, and allocate time for personal interactions to build the trust.

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. Based on Carlile's classification, we should consider three types of differences in knowledge between individuals and groups: syntactic, semantic and newness [4]. Differences in syntax can be addressed by using the 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 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.

Examples of corporate explicit knowledge are lessons learned, decisions made, actions planned, risks mitigated, and correlating 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. Individuals learn with easy access to long-term informational sources. Organizational learning occurs as the organization identifies its errors in the past and corrects them for the future such as the application of lessons learned. 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.

Some of this sharing is done during phase 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.

## 4. ANCHOR POINTS

### Anchor Points in the Product Development Process

Figure 1 depicts the management perspective of an iterative/incremental life cycle for software product development. This life cycle model is promoted by Rational Corporation, and is called the Rational Unified Process, or RUP [8]. Inception, Elaboration, Construction, and Transition are the development phases, while LCO (Life Cycle Objectives), LCA (Life Cycle Architecture), IOC (Initial Operational Capacity), and PRR (Product Readiness Review) are Anchor Points, marking the end of the respective phases. Anchor points are a set of milestones around which we can plan, organize, monitor and control the development process. They also provide a means to reconcile technical and management perspectives. PRR marks the final review, and ultimately the launch of the product. After launch the product moves into the fifth life cycle phase, called Maintenance, until an End Of Life decision is made by senior management (This last phase is not shown on the diagram). The Anchor Point concept was originally introduced by Boehm in 1996 [3]. For up-to-date descriptions of anchor point definitions please see [8].

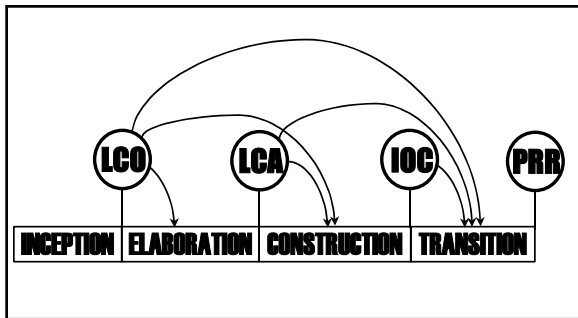


Figure 1. Anchor Points

### Anchor Point Reviews

In our practice, the development process is executed in a risk-driven fashion. All anchor points are associated with a formal review, and the main purpose of the review is to assess whether the project could progress to the next development phase with manageable risks. Figure 2. shows the logistics of Anchor Point Reviews.

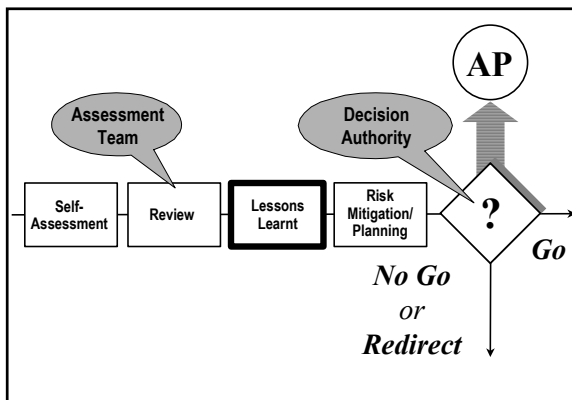


Figure 2. Anchor Point Review Details

In the first step the project team executes a self-assessment, and presents the results to an external assessment team. As a result of the review, a Lessons Learned document is created, outlining critical experiences and project risks discussed during the review. Please note that the risks are not limited to the execution of the upcoming phase, but could impact the success of further phases down the line. This risk perspective is depicted by the arrows initiated from the anchor points and pointing to future life cycle phases on Figure 1. The project team has to respond to all the assessment concerns by documenting a risk mitigation plan and presenting it to the Decision Authority, a selected senior management body. If the state of the project and the risk mitigation plans satisfy the viability and feasibility criteria set for the anchor point, then the project team is allowed to move to the next phase (“Go” decision). Otherwise they have to keep working on the pending issues (“No Go” decision). In extreme cases, particularly in the first two anchor points, the program might be redirected and ultimately terminated.

### Lessons Learned at Anchor Point Reviews

As Carlile 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 software development knowledge, which is embedded in the product development process across different functions and different organizations. Carlile further concludes, “Knowledge is not so much transferred as transformed.” This is true across both cross-functional and cross-organization boundaries. Collective knowledge needs to transform as we enter a phase using the process of assessment reviews. 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 Learned” repository as a boundary object to transform knowledge of those involved.

To further the permeation of corporate knowledge, it seems that anchor point reviews in software development process are important for sharing knowledge and the software development process itself can serve as an infrastructure for knowledge sharing. As cross-functional and cross-organizational team members get together for a commonly aligned purpose, there is more open and frank discussion during the review once mutual trust and respect is established. Both the reviewer and the reviewed benefit during the review process as they share knowledge and educate each other. As the assessment progresses and even after the phase review gate, the collective knowledge of the assessment and development team members is leveraged. The use of experienced peers as anchor point assessors as opposed to using senior managers help the transfer of cross organizational knowledge.

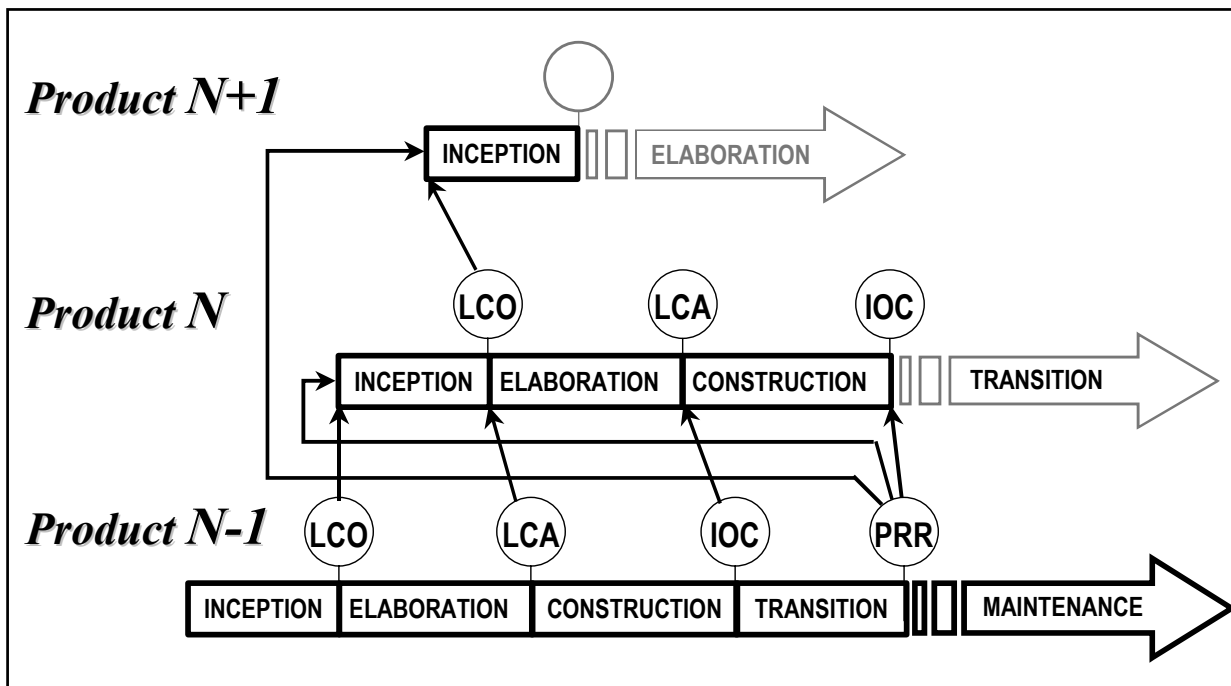


Figure 3. Use of Lessons Learned from Anchor Point Reviews

### Sharing Knowledge During and Between Anchor Point Reviews

Knowledge that should be shared across disciplines includes engineering planning, technology readiness, failure modes and effect analysis, robust design methods, quality and reliability of system modules, critical parameter management, functional important parameter management, design reviews, peer reviews, and problem management process. The knowledge should be shared in a uniform, standardized approach and promoted by subject matter experts from various domains. This knowledge can be shared during the software development process, and monitored at anchor point reviews. The firm needs to create the environment for creating new knowledge and innovations. Commonly shared repositories are used to share best practices, business processes, design experiences and links to knowledge sources and experts.

Figure 3 shows a typical snapshot of a company's software-intensive product development pipeline. Every product is represented with its simplified life cycle phases, assuming the earlier discussed RUP process. *Product N* is currently under development, in its last phase before launch, *Product N-1* is already in the maintenance phase for some time, and *Product N+1* is in the initial, inception phase. Use of anchor point review information is two-fold. The straightforward use is to consider during the planning for example *Product N*'s elaboration phase the lessons learned from *Product N-1*'s equivalent anchor point review (LCA – at the closure of *Product N-1*'s elaboration phase). The more complex use also involves the use of the final Lessons Learned

document (created during the preparations for the PRR) during the definition of the new *Product N+1*.

In addition to sharing Lessons Learned, knowledge shared during anchor point reviews may include the history of previous programs, planning processes including strategy, marketing strategy, competitive benchmarking, critical technology and design information, software architecture, software component reuse, schedule and resource estimation process, validation of concepts with customers, business case development, and engagement of downstream value chain partners.

Project management archives should contain the chronological log of program activity, proposals, concepts, business cases, software team meeting minutes, assessments made; decisions made; risks mitigated; critical data and lessons learned analysis; conclusions, relevant phase gate experiences and issues; including a reflective step at each activity, yellow pages listing potential assessors and their areas of expertise, internal benchmarking, best practices, appropriate communities of practice, breakthrough concepts, software architectures, interfaces, and re-usable components.

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

## 5. CONCLUSIONS

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, helps the employees to connect and communicate better, allows them working together to solve problems more effectively in real time by interacting with each other, and over time mediated by documents.

Besides promoting knowledge-oriented culture and having an effective product development process, there is a need for corporate-wide, accessible, standardized, and consistent knowledge repositories. Examples of desired repositories include lessons learned, estimation processes, and platform development. There is also a need 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 wordsmithing of documents for such consistency.

In summary, a firm can substantially increase the effectiveness in its corporate knowledge sharing, by increasing focus on reviews by peers rather than evaluation by managers, during assessments at anchor point transition, thus giving it more of a mentoring attribute, conducive to sharing and development of trust among its employees. Using the same members for the assessment team 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 learned" for the next product program. The stability of dedicated teams just enhances the trust building, understanding building and shared method-building efforts.

## 6. FUTURE WORK

Knowledge can 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 tools, especially in the areas of lessons learned, platform development and in common repositories for transformation of knowledge between domains.

Recommendations for next steps are that software development process 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, the corporation should also promote standardized and consistent methods of representing sharable knowledge. Only through successful role-model examples, will the firms achieve momentum in capitalizing on their knowledge assets. We are proposing the establishment of a knowledge boundary framework and common syntax for transferring knowledge. In the next step knowledge has to be translated into a common semantic base to create a shared meaning, and ultimately also determine the approach to converting knowledge between disciplines.

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