

Reengineering and Knowledge Management

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Abstract. This paper investigates some of the relationships between reengineering and knowledge management, with particular emphasis on sequencing relationships between reengineering and knowledge management. This is done using four basic approaches. First the paper explores how some knowledge management computing artifacts can be reengineered. Second, the paper traces the interaction between reengineering and knowledge management in typical organizational projects, illustrating the importance of sequence, and extending the results with a real world example. Third, the impact of reengineering on ontologies and knowledge bases is briefly reviewed. Fourth, issues that differentiate reengineering knowledge management systems and typical transaction processing flows are analyzed. Finally, simultaneous reengineering and knowledge management are investigated.

1 Introduction

The purpose of this paper is to investigate some of the issues in the relationship between reengineering and knowledge management. Both reengineering and knowledge management are seen as basic processes being used to manage a particular environment in order to improve processes and create value from the processes. Much of the focus of knowledge management has been to develop knowledge management artifacts and processes around an existing set of processes, in order to support further value creation from those processes. However, reengineering is concerned with changing processes to exploit the available technology. As a result, there are inevitable interactions between reengineering and knowledge management.

Unfortunately, knowledge management and reengineering are not often used in the same settings, either simultaneously or sequentially. This paper argues that greater improvement and value creation could occur if original artifacts and processes were reengineered and then knowledge management artifacts and processes were developed, or if both were done simultaneously.

2 Reengineering

Reengineering has been defined (Hammer 1990, p. 104) as using "...the power of modern information technology to radically redesign our business processes in order to achieve dramatic improvements in their performance." There are two basic approaches to reengineering, the obliteration approach and the best practices

approach. Consistent with Hammer, the obliteration approach seeks to start from ground zero and build the right processes. The best practices approach has taken the view that a library of best practices be developed and maintained. Then firms would choose a portfolio of best practices as a way of building the reengineered organization.

Hammer elicited seven basic principles of reengineering that are useful in analyzing how reengineered systems differ from their predecessors:

- Organize around outcomes, not tasks
- Have those who use the output perform the process
- Subsume information processing work into the real work that produces the information
- Capture information once and at the source
- Put the decision point where the work is performed
- Treat geographically dispersed resources as though they were centralized
- Link parallel activities instead of integrating their results

Other authors (e.g., Davenport 1993 and Hammer and Champy 1993) have developed alternative and additional principles. However, in each case these principles suggest that reengineered systems are fundamentally different than the previous system.

Ultimately, as firms do reengineering, organizations, processes and people change. Rather than being task oriented, jobs become outcome oriented. Tasks are shifted to different persons to accommodate reengineering. Portfolios of tasks performed by particular individuals change. Reengineering leads to changes in who performs a given process with those using the output performing the process. In reengineered processes, there are fewer accountants talking to accountants. Instead, information activities are gathered while the work is being done. For example, loading dock personnel can wand bar coded goods to gather input for a centralized database. As a result, of that shift, information is gathered a single time and decisions in reengineered systems can be made where the work is performed. The dock worker gets information as to whether or not the goods were ordered, and decides how to proceed based on that information. Reengineered systems are likely to treat geographically dispersed resources as centralized, in order to generate economies of scale. Finally, rather than producing components in parallel and then assembling, the processes are linked. Too often in non-reengineered systems, parallel results did not assemble effectively. Throughout, processes are changed to exploit new technologies.

3 Reengineer Knowledge Management Computing Artifacts [1]

Recently, Brown (1999) made the case for “calm computing.” One of the primary tenets of that speech was that current systems lead to information “underload” since they limit context and periphery. Brown asked the listener to imagine trying the

“toilet tube” phenomena: put on the equivalent of toilet tube glasses and see your periphery disappear. Brown noted that experience was similar to what a computer user would experience in today’s systems. After noting the problem of information underload, Brown addressed the issue of how computing could be changed to accommodate broadening across three dimensions to generate context: center vs. periphery focus; explicit vs. the implicit; and attending vs. attuning.

Part of that intriguing speech was concerned with generating “Knowledge Management Computing Artifacts,” (KMCA) designed to mitigate the underload problem. KMCA would include the many efforts to develop maps of knowledge, such as Inxight, developments in personal digital assistants (PDA’s) and other computing artifacts. In particular, Brown (1999) discussed a number of KMCA, including audio icons and some “squeezy interfaces.” Since the choice of the nature of these icons and interfaces is based in process and designed using technology, they are a potential subject for reengineering.

Audio icons that make noise when objects are trashed are one such artifact. As noted by Brown, one way in which audio icons can be used is to have the noise, made based on the size of the file that is being trashed. This is analogous to other phenomena, for example, when a rock falls and hits the ground the bigger the rock, the bigger the sound. As a result, the audio icon captures some of the context in a manner that is consistent with broad reaching human experience. A big noise when the expectation is for a small noise (or conversely) creates an awareness of a potential problem.

With squeezy interfaces computing artifacts are established so that when a user interacts with an artifact the right thing happens. For example, a tilt-sensitive personal digital assistant (PDA) was developed that mimicked the movement of a Rolodex set of cards.

A physical Rolodex includes a card for each relevant person or organization. As a result, a Rolodex captures information about names, addresses, phone numbers and email addresses. A tour of organizations will find that many secretaries and some managers have rolodexes on their desks. Rolodexes can take many different forms, as can be seen in an office supply order book, each with their own look and feel.

Overtime, Rolodex’s percentage of the address listing business has decreased and will continue to decrease. Increasingly, physical rolodexes are being replaced with computer-based rolodexes. Further, with the increasing use of “hoteling” in some organizations, physical rolodexes are disappearing as manager’s desks disappear.

As a result, the Rolodex probably is not based in as broad reaching human experience as say the noise of a file being trashed. Many have probably never used a Rolodex. (The author has no intuition for a Rolodex.) Accordingly, a PDA that duplicates such a dated technology may be directing KMCA efforts in the wrong direction. Instead as with reengineering, squeezy interfaces for KMCA should focus

on experiences with broader-based human experience, or resident in more contemporary technology.

Another dated technology proposed for knowledge management is the “smart paper staple.” The notion of a smart staple derives from a staple placed in a cow’s ear to keep track of information about the cow. Smart paper staples have an http address stored in them so that addition or confirmatory information can be stored in an alternative form. However, the basic notion is that a paper copy is the primary version. An old technology is driving the KMCA.

In both the case of the Rolodex PDA and the smart paper staple, knowledge management was applied to an existing process without reengineering and the result is KMCA that is based in limited experience and/or old technology.

4 Stages of Interaction Between Reengineering and Knowledge Management

Reengineering and knowledge management inevitably interact with each other. In addition, typically they are sequentially used to make processes more valuable and efficient. Some of the relationships are summarized in figure 1.

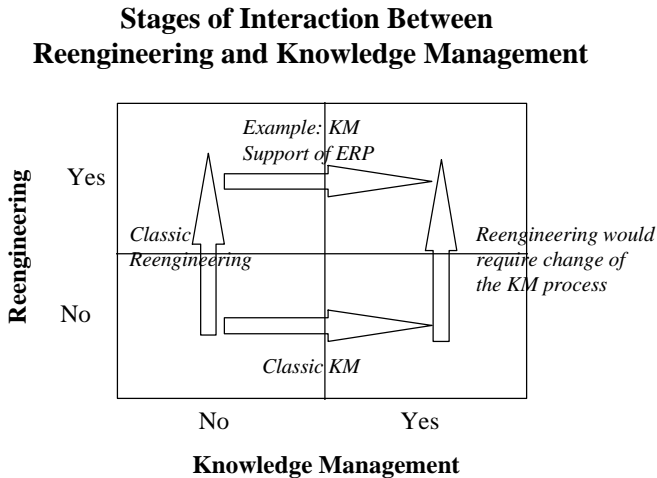


Fig. 1. The interaction of reengineering and knowledge management and their sequencing.

4.1 Classic Reengineering

In a classic reengineering process there is little attention given to knowledge management per se. The primary concern is making sure that the processes are changed to exploit technology. As part of this change, systems are likely to be changed based on the seven principles of reengineering, discussed above.

Developing systems based on those principles gets different portfolio's of tasks to different people than in the original system. In addition, those principles often reduce the number of employees. All of these changes resulting in substantially different systems.

4.2 Classic Knowledge Management

Classic knowledge management starts with an existing process and then builds a knowledge management system to support the process. In order to assure that knowledge is gathered, updated, distributed and used, knowledge management "bakes" it into the process, i.e., the knowledge management is embedded in the process. Perhaps the clearest example of baking knowledge management into a process is in the case of a help desk. At the help desk, representatives serve customers. Each transaction between representative and customer is captured building up a history of relationships and knowledge about the customer and the representative, in addition to the product. That knowledge base can be used to provide knowledge about customer service.

4.3 Knowledge Management Support of a Reengineered Process

Increasingly, knowledge management systems and artifacts are being set up to support reengineered processes. For example, substantial reengineering is going into the development and implementation of enterprise resource planning (ERP) systems, such as SAP. Increasingly, knowledge management systems are being developed to support use and development of those ERP systems. For example, reports from ERP databases are being developed and put on Intranets as a means of distributing information. In addition, firms are building FAQ's to help users answer questions that they may have about how to use the system and other issues.

4.4 Reengineering and Knowledge Management: Which one first?

If a knowledge management system is developed for a process it will be designed to provide information to the existing process. If the system is reengineered then, as noted above, that can change who does what tasks and needs what information. If the knowledge management system is baked into the process then if the process changes so must the knowledge management system. Accordingly, reengineering will change the requirements of the knowledge management system, requiring redesign. As a result, generally, reengineering is first, followed by knowledge management.

5 Case Study: Texas Instruments' Capital Budgeting Process

This section provides a case study of Texas Instruments' knowledge management efforts in the area of capital budgeting. In this case study, a department in Texas Instruments built a knowledge management system without reengineering the underlying process. Ultimately, this bottom-up approach, without reengineering

department level and was designed to meet the needs of a rapidly growing department, with large capital requirements. Because the department had experience at generating (successful) capital packages, they had accumulated substantial expertise in knowing what the committees wanted to see in a capital proposal.

The system had knowledge about depreciation, income taxes, and division production plans. A system user provided information about a particular capital proposal and then determined what would need to be done to make the proposal acceptable to the committee(s) responsible for evaluating capital proposals. For example, if the proposal included a request for a new welder, then the system would ask the user questions about when the welder would be needed and how many welds would be required. Based on past experience the system would determine if the welder would be approved based on the parameters gathered.

Whereas, the rest of the company averaged an 80% success rate on their capital proposals, the Microwave Manufacturing Department was able to generate a higher acceptance rate. For one set of 50 proposals, the system indicated that three proposals would not be acceptable by the capital proposals group, whereas the other forty-seven would be acceptable. The system was right on all fifty. The system apparently was so successful at generating budget proposals, that other groups, entities, divisions and departments became interested in acquiring the system for their own use.

5.2 Some Limitations in the Knowledge Management Effort

Although the system has been hailed as a success story for expert systems, there is another perspective. The Texas Instrument knowledge management effort was limited in a number of ways. First, the group that built the system was not in a position to make any changes in the existing capital budgeting process. The development group was a “process taker.” For example, even though the \$1,000 requirement was very low, there was no change in the process. Second, the group took the existing processes and developed a system that would help them best function within the context of the existing processes. The department needed capital, and the system could be used to help them develop proposals that met the requirements of the review committees. The department saw the existing processes as those that needed knowledge management support. They optimized the knowledge management system, subject to the existing processes, that the department saw as constraints. Third, the development of the knowledge management system ultimately further embraced the existing set of processes. As the system was given to other divisions, units, etc. the existing policies would be further cemented in the organization. As a result, there was no re-thinking of budgeting policy and knowledge. The organization as a whole ultimately was driven to using a system that contained the policies and other knowledge of the organization, from the viewpoint a lower level department.

6 Reengineering and Ontologies

Reengineering and ontology development also must be sequenced. Currently, much of the reengineering uses ERP systems to facilitate and enable reengineering of transaction processing systems. Implementation of those systems typically requires that an organization change its organizational design and flows of information and knowledge from a functional approach to process-oriented approach in order to accommodate the ERP software.

Process oriented ontologies are likely to be substantially different than functionally oriented ontologies. Some differences in information flows are summarized in figure 3, which illustrates the basic differences in functional and process flows in SAP's R/3 ERP system.

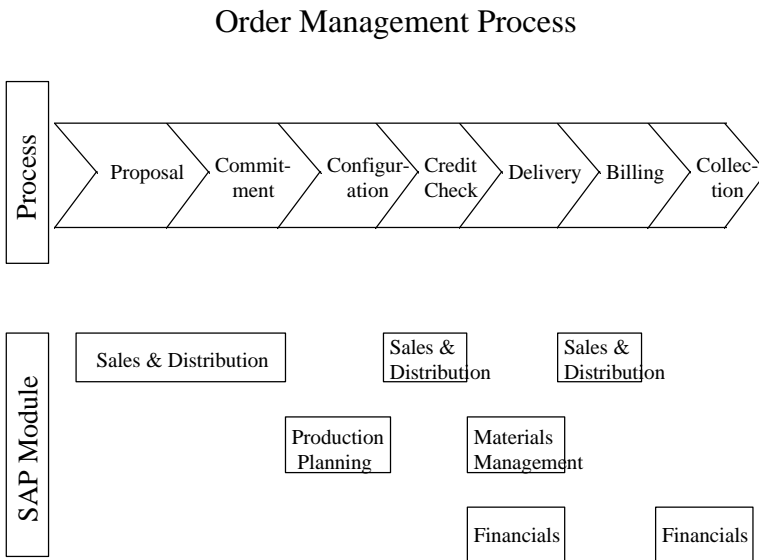


Fig. 3. Sample Mapping of a Reengineered System to a Process, based on SAP's R/3 enterprise resource planning system.

Process-based technologies are not just used in transaction-based systems. Process-based ontologies are also used in knowledge management systems. For example, a number of consulting firms have developed process-oriented ontologies that they use internally to organize best practice databases. A sample model of such an ontology is included as figure 4. A functional based ontology would be substantially different, focusing on stove-piped functional needs rather than cross functional value creation.

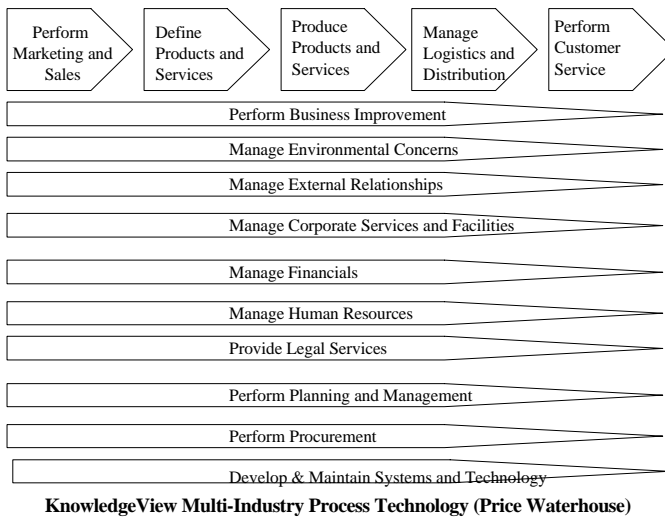


Fig. 4. One firm’s model of their ontology for their best practices knowledge base.

7 Reengineering and Knowledge Bases

Reengineering also influences the type and content of knowledge bases developed or required for knowledge management.

7.1 Knowledge Base Types

The types of knowledge bases will differ between reengineered process organizations and functional organizations. For example as seen in figure 3, a process oriented organization’s “Order Management Process” requires tight “linkages” between Sales & Distribution, Production Planning, Materials Management and Financials. However, in a classic functional organization, there are only limited linkages between the functional areas.

7.2 Knowledge Base Content Differences

A “lessons learned” knowledge base could have substantially different content in a reengineered process oriented organization, as opposed to a functionally oriented organization. In the process organization, linkages with other functions could force development of different lessons learned.

The same lesson ultimately could appear in either knowledge base, but different people could be interested in it. For example, as seen in figure 3, all of those interested in the efficiency of the Order Management process, would be concerned with the financial aspect of collection. However, in a functionally oriented organization, only the financial department would be interested.

8 Reengineering Knowledge Management Systems vs. Reengineering Transaction-Based Systems

This section provides a brief discussion of how reengineering a knowledge management system is different than reengineering a transaction processing system. AI-based systems built to reengineer transaction processing systems (either explicitly or implicitly) have concentrated on quantitative metrics that relate to measuring flows of information. Generally, those metrics are related to the principles of reengineering. For example, such systems might measure the

- number of hand-offs of a particular document (task vs. outcome orientation),
- extent to which output is used by those generating the information (have those who use the output perform the process),
- extent to which information capture is embedded in work (subsume information processing into the real work),
- information capture efficiency (capture information once and at the source),
- the amount of parallelism in a network flow representation of a process (link parallel activities rather than integrating their results),
- extent to which a process is manual or automated,
- extent to which flows are reviewed (e.g., internal audit function of checking documents).

Heuristics easily can be developed to take an existing graph representation of information flow and reengineer it to optimize across these metrics. In some cases authors have used these same metrics to begin to try to reengineer knowledge management systems.

Unfortunately, such a reengineering of knowledge management systems would likely be the wrong path to pursue. Knowledge management is not generally concerned with transaction information flows. Instead, reengineering of a knowledge management system needs to consider the principles on which a knowledge management system is based. One such approach to capture some of the principles of knowledge management was initiated in O'Leary (1998) (others have also pursued these principles). O'Leary (1998) argued that the principle functions of a knowledge management system are to facilitate (the five C's)

- conversion of data and text into knowledge,
- conversion of individual and group's knowledge into accessible knowledge,
- connection of people and knowledge to other people and other knowledge,
- communication of information between users,
- collaboration between different groups, and
- creation new knowledge that would be useful to the organization.

Some quantitative measures that relate to these functions include

- percentage of data analyzed using knowledge discovery approaches,
- percentage of text analyzed using knowledge discovery approaches,
- number of links connecting knowledge
- nature of network connecting knowledge (e.g., single level tree)
- percentage of groups or individuals actually collaborating,
- percentage of time spent collaborating

Unfortunately, these measures don't really capture how useful the system was or the quality of the interactions. Although reengineering of transaction-based systems can pursue quantitative measures, reengineering of knowledge management systems also seems to require more qualitative data, as captured in the following (and other) questions.

- Does the knowledge management system accomplish these functions?
- To what extent does the system make converted or created information available?
- Do all who need the system have access to the system?
- How can the system be modified to accomplish these functions?

9 Simultaneous Reengineering and Knowledge Management

Generally, this paper has portrayed a sequence of reengineering and then knowledge management of a process. However, from an alternative point of view, knowledge management is a technology that needs to be exploited as part of the reengineering process, suggesting simultaneity between reengineering and knowledge management.

To-date there has been limited research and real world implementation designed to address simultaneous development of a reengineered system and its supporting knowledge management system. Much of the technology designed to enable either reengineering or knowledge management is not designed to facilitate generation of the other.

10 Summary

This paper has argued that knowledge management and reengineering are tightly bound together, and generally, reengineering should proceed prior to knowledge management, or simultaneously.

When considered in the context of reengineering, some knowledge management computing artifacts that have been proposed and developed put the knowledge management first. Although some KMCA are based in broad human experience, others replicate out-dated environments that could be reengineered.

In order to provide high quality processes, generally reengineering is pursued prior to knowledge management. If not, there can be a number of problems.

- Knowledge management further cements existing processes. As a result, if processes are not efficient or need to be improved, those inefficiencies will be further entrenched. Accordingly, it is critical to reengineer before the knowledge management systems are built.
- Knowledge management needs to be pursued carefully. Without reengineering, knowledge built into systems may come from the perspective of knowledge and policy takers. The system may be built to “optimize” across the department’s view, rather than the overall organization. Ultimately, this can lead to a very different system than that developed with the overall organization in mind.
- Ontologies developed for functional organizations are not generally applicable to process-based organizations. As a result, if firms are planning to move toward a more process-based approach, then it can be important to reengineer and then develop the ontology.
- The knowledge bases that come from first reengineering and then developing a knowledge management system would differ substantially from those that would result without first reengineering.

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