

WORKING PAPER

**Knowledge Management and Innovation
An Initial Exploration**

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Introduction

The underlying question which surrounds, or should surround, each business activity is to what end? Knowledge management activities are no different. Our recent research examined innovation as one end to which knowledge management can be applied. Innovation has been demonstrated to be a key value creator for organizations, in both times of cost cutting and in times of growth. As such, it stands out as one excellent objective of management activity in general, and knowledge management specifically.

This paper lays the groundwork for further discussion about the links between knowledge management and innovation, including questions of causality, knowledge differences among various types of innovation (i.e., product, process, etc.), and industry/company-level variations in how the impacts of knowledge management upon innovation are realized. These, and other further research questions, are presented at the end. Before arriving at these questions, however, we present the *why* of innovation in general, a dynamic model of the major stages in the evolution of an innovation, and then discuss how knowledge management can support value creation in this evolution process.

In order to best reflect the experiences individuals have had in managing knowledge and the impact this has had on innovation, the research team interviewed managers at 20 Fortune 500 companies, obtaining survey responses from 18 individuals, each from a different organization. Their comments and feedback are reflected throughout; company names are not used to preserve agreed-upon anonymity. A copy of the research questionnaire appears in the Appendix.

What's the Value?

Innovation is a key driver of growth. Single product innovations lead to increased revenue in the short run and, by stringing many new products together, some companies (3M and Rubbermaid, for instance) have been able to turn product innovation into a key to their corporate success. While not an easy challenge, as companies move away from the cost-cutting and down-sizing of the 1980s and early '90s, and look to grow their businesses with renewed vigor, they must learn to innovate faster and better than their global competition. Robert Reich, in his book *The New American Frontier*, says that *American comparative advantage may lie more in quick-changing, customized product and technology development, rather than the highly routinized, mature industries where relative labor cost disadvantages can no longer be overcome by capital improvements.*¹

Innovation is a key driver of efficiency as well. Through process innovations, compa-

nies have been able to drive down costs, reduce cycle time, and create tighter links to their customers and other business partners.² There is always a need for greater innovation in this area as most organizations will strive to develop their process efficiencies in new and unique ways, whether in an expansion or cost-reduction mode. Effective process innovations can provide benefits over time which far exceed their initial efficiency boosts. Paul Geroski states that innovations have a long-run effect (requiring perhaps as

An Innovation Process Model

The environment in which new ideas are created can be seen as a greenhouse or garden. Within this greenhouse, gardeners (i.e., managers) try to create conditions which will least inhibit the growth of a prize-winning (high value) flower. That is, greenhouse gardeners can change the light, moisture, food mixture, etc., in the hope of beneficial results, but cannot actually make the plants grow. Similarly, management has the ability to influence certain factors—capital resources, physical surroundings, and employee skill levels, for example—but the actual creation of new ideas is uncontrollable.

In this model, the pot in which an idea grows comprises the physical environment and social/cultural context in which knowledge work takes place. The “soil” and the “food” is composed primarily of 1) disseminated organizational knowledge, 2) personal knowledge and experience, 3) capital resources such as tools, equipment, etc., all of which feed the people. People are the seeds from which new concepts sprout, and are therefore the central ingredient of the innovation process. Whether through introspection or group interaction, the spark of an idea has to come from the mind of an individual (the appropriate mix of other ingredients thrown into the pot simply increases the likelihood of such sparks. For the purposes of this paper, the internal process by which an idea is sparked is called creativity.⁹

While the gardener can provide an ample pot, rich soil, and plentiful food, water, and sunlight, each seed must absorb these necessary nutrients in order to grow. Given all the proper inputs, plant development can be said to be limited by the seed's capacity to combine and convert these inputs into the energy needed for growth. Therefore, development hinges upon the absorptive capacity of the seed. Similarly, the absorptive capacity of the people involved determines a team's ability to apply knowledge, capital resources, etc. to a given problem. Learning is the process by which people absorb these resources.

Once an idea is brought to light, its development is equivalent to the growth of a new plant. In the greenhouse metaphor, given limited resources, only flowers which look hopeful of thriving are given additional attention, while others are either ignored or eliminated to make room for potential prize winners. Similarly, ideas can be nurtured within a company or weeded out through idea portfolio management. Attention is no guarantee of success, and likewise being ignored is no guarantee of failure, but active management can have a direct positive impact at this stage.

After an idea has been sufficiently developed, it can be taken to market and implemented; this implementation step is what transforms an idea into an innovation. It is important to consider that markets need not be external to the organization. In the case of some new product ideas, and most new process concepts, the market is an internal one where value is expressed through better operations, higher efficiencies, improved quality, or increased profitability. Of course, ideas can also be implemented externally by introducing a new product or service to the world at large, where value can be measured by market penetration, number of units sold, copy cat competitor products, etc. In a similar vein, it is important to note that ideas can produce value by being wholly developed outside the organization in which they originated. For a number of reasons, including organizational capabilities, resource availability, and market positioning, it may make more sense to outsource the developmental elements of the innovation cycle. In the greenhouse metaphor, this is the equivalent of selling off seedlings to be grown or used for cross-breeding elsewhere.

Diffusion occurs when new products and services begin flowing deeper within their initial markets, or to areas different from the one(s) in which they were originally introduced. For instance, a new process for order fulfillment, established in one segment of an organization, may become used in many other segments over time, sometimes purposefully, though often randomly. Diffusion occurs in a botanical sense when plants scatter their seeds or spread their pollen, leading to the potential spreading of their genome. This process can be actively encouraged, although there is no guarantee that a diffused innovation will take hold in its new market area, just as there is no guarantee that pollen transferred from one flower to another will actually cause fertilization. However, a certain amount of diffusion can occur inadvertently without any intervention on the part of management.

The final element of this model is feedback. This is not actually a stage, but a continuous cycle by which lessons learned from experience enter back into the innovation process. This kind of feedback is represented both by the gardener who, based on his prior horticultural experience, grows heartier plants by using more effective fertilizers and creating more conducive greenhouse environments, and by the genetic evolution of the seeds and seed types over time. Organizations interested in generating, developing, implementing, and diffusing valuable new ideas need to encourage and leverage such feedback.

While perhaps stretching the metaphor to its limits, the above description paints a picture of the many sets of activities which contribute to innovation. Some of these stages can be influenced directly, and some indirectly, to promote greater results. While there are many interventions available, knowledge management represents one set of activities which can prove to be quite useful in encouraging, or at least not squelching, valuable innovations. The next section defines knowledge management activities and describes some approaches to managing knowledge to influence the various stages of innovation.

Managing Knowledge for Innovation

A Relevant Knowledge Management Typology

De Long, Davenport, and Beers¹⁰ have identified eight types of knowledge management projects which organizations have undertaken:

Capturing and Reusing Knowledge, such as utilizing old project deliverables as source material for a new project.

Sharing Lessons Learned, such as conducting a team debrief to examine what went well and not so well within a completed project.

Documenting Expertise, such as creating a database of employee qualifications.

Structuring and Mapping Knowledge, such as organizational yellow pages or typologies.

Measuring and Managing the Economic Value of Knowledge, such as attaching an economic value to patent holdings and managing those patents accordingly.

Synthesizing and Distributing External Knowledge, such as creating widely-distributed bulletins based on trade publications, news reports, etc.

Using a Technical Infrastructure for Knowledge Exchange, such as implementing email, Lotus Notes, intranets, etc.

Embedding Knowledge in Products and Services, such as smart products.

We use this typology to identify knowledge management initiatives and practices. We consider initiatives to be official programs which are explicitly put in place within an organization in order to more effectively manage knowledge. Practices are those same types of activities which individuals engage in as a natural part of the way they work. Effective initiatives are often absorbed into organizations in such a way that they become practices, enforced only by organizational norms.

Impact on Innovation

Our initial exploration of knowledge management's implications for innovation focused on the impact the above activities are seen to have on innovation and innovativeness. While all survey respondents either agreed or strongly agreed that managing knowledge well increases innovativeness, we do not pretend that there is an easy, direct path from one set of activities to effectiveness in the other.¹¹ The following ideas and implications are presented as an opening for further discussion and investigation, and as examples of practices which managers have found to have interesting effects on innovation in their organizations. Because of the sample size and methodology employed, these findings are not presented statistically, and they do not inform as to causality. However, they do indicate ways in which knowledge management initiatives and practices may contribute to innovation. Our analysis is presented in line with the various stages of the innovation process described above.

The Creation of a New Idea

According to one executive in a consumer products organization, innovation is 90% learning and knowledge driven; the whole innovation process is a series of learning cycles. Innovation is also about breaking away from traditional mental frameworks that inhibit new thinking. In 1985, Peter Drucker noted that the path towards innovation is primarily found through asking the right thought-provoking questions about the issues at hand. However, these questions usually lie outside of standard mental models, making them difficult to uncover.¹² Knowledge management activities, such as sharing lessons learned, which broaden understanding of relevant issues, can help push thinking beyond the everyday in a way that spurs innovative creativity.

We posit that new ideas are generated through the creation or recombination of knowledge. Discovery of new ideas relies on knowing enough about the subject being studied to focus one's inquiry, without being overly constrained by this knowledge (i.e., trapped in the dreaded *box* of conventional thought). Stanford University organizational behavior specialist Bob Sutton calls this difficult balance wisdom ("acting with knowledge while doubting what you know," or "knowing that you don't know."¹³ Sometimes too little knowledge, and an understanding of that lack, is just what is needed for innovation. As one interviewee from a research group put it, sometimes "knowledge doesn't lead to innovation, lack of knowledge leads to innovation."

Given the above, it would seem that it would benefit an organization to know what it knows (and what it doesn't) through structuring and mapping knowledge and through documenting internal expertise, two categories of knowledge management activities. In fact, the majority of those surveyed felt their organizations almost never performed these activities, (12 of 18 and 13 of 18, respectively). Documenting expertise was said to only sometimes contribute to innovation (eight of 18), while structuring and mapping knowledge almost never did (10 of 18). When questioned, many respondents cited as reasons for failure either voluntary databases that never reached critical mass or only half-hearted attempts to initiate these two knowledge practices. A number of organizations surveyed felt that fostering innovation through knowledge identification is unneeded if old-fashioned co-location is practiced. Since knowledge recombination is the essence of idea creation, and interpersonal interaction is a key component in recombining knowledge, many companies address the innovation question by creating research labs. The model for such units tends to be fairly simple: bring together smart people, give them good equipment and sufficient resources, and then leave them alone to create. Commercialization or implementation is often left as an after-the-fact issue. More forward-thinking companies, however, are beginning to realize that the traditional research lab approach can be better leveraged via knowledge management techniques, especially when the company's intellectual capital is broadly spread.

Xerox PARC, for example, follows the "research lab" approach, yet augments it with selected knowledge management practices. PARC gives its people extra interaction opportunities, including weekly forums with outside speakers on a very wide variety of subjects. PARC representatives are quick to point out that the majority of their work

gets done by people interacting over time—not just in brainstorming sessions. For this reason, activities such as establishing a knowledge sharing technical infrastructure, synthesizing and distributing external knowledge, designing physical environments which enable serendipity, and rewarding people for sharing their ideas are all important.

Regardless of how many knowledge management practices are used effectively, organizations need a creativity-promoting culture to truly jump-start the idea generation which undergirds innovation. In general, two cultural perspectives that inhibit creativity were reflected by respondents. One was risk aversion, where a persistent fear of failure leads to a stifling level of caution. For instance, one respondent noted that his organization should do more in regard to knowledge management and innovation, but trying new practices or products is difficult because it is very easy to get fired for failing. In fact, he felt his company should be more “fast failing,” meaning it should pursue a number of new projects and kill them quickly when they start to stumble, instead of spending time and money trying to keep doomed projects alive, just because they are some of the chosen few. Although the firm’s caution leads to a high success rate, the respondent felt that this fact indicated a lack of appropriate risk taking, as the business as a whole appears to innovate at a very slow pace.

The other cultural hurdle mentioned was a bias in favor of newness, oftentimes at the expense of ideas based on existing know-how. In some cultures where innovation and creativity is valued, it is often seen as ignoble to build upon other people’s ideas or to reuse previous work. This norm creates a start with a blank slate ethos which encourages individuals to spend considerable effort at reinvention before they can adequately tackle the problem at hand. Encouraging this further, most rewards given for innovation tend to be for individual accomplishment (such as annual awards for the person with the most patents approved) and not for team efforts. One particular R&D unit, although it has a physical environment which allows for serendipitous knowledge exchange, doesn’t see such exchange happening much. As the respondent put it, “people tend to cooperate in a formal way, rather than collaborate in a fluid, informal way.” Knowledge reuse needs to not only be encouraged culturally, but also procedurally. Ten organizations indicated that they had an initiative underway to regularly and formally capture and reuse knowledge. The value of this activity for innovation was seen as quite substantial, as eight respondents said that capturing and reusing knowledge had a significant or very significant impact on innovation in their organization: with nine saying that it occasionally had an impact. One firm provided a best practice in a knowledge reuse process: it keeps all its old plans for new product designs, whether or not they were actually implemented, and as a part of its new product development process looks at the last several sets of plans for ideas which might be of use in current designs, even if they were previously rejected.

Idea Portfolio Management

Most organizations generate more ideas than they can handle. Idea portfolio management is the process through which these ideas are elicited, identified, and funded for development. Whether considered explicitly, or on an ad hoc basis, the first step is to

make ideas available to others for review and discussion. Even when arrived at through a group or team process, ideas and the knowledge underlying them exist in people's heads and must therefore be actively communicated to others. Nonaka and Takeuchi describe this process in terms of tacit to explicit, individual to group knowledge transfer (see Figure 2).¹⁴

Figure 2 EMBED Word.Picture.6

Knowledge Spiral

Such activities are usually carried out informally, although knowledge management activities can accelerate the process. Knowledge elicitation and codification techniques are often institutionalized in processes, such as the US Army's After Action Reviews and Lessons Learned exercises.¹⁵ Through whatever route new ideas are collected, there will inevitably be more than can, or should, be developed.

There are many approaches to the next step of portfolio management, one which usually begins the weeding process in earnest: funding. In some companies, like 3M, people are allowed to spend 15% of their time exploring their ideas independently, occasionally proposing new product concepts to a management committee which has the ability to approve the idea for formal development, but no ability to shut down the further informal development of the idea if they do not approve. In one financial firm, there is a specific committee which looks at new product ideas in terms of the total risk exposure of their product portfolio. They set broad tolerance standards and boundaries and then entertain proposals for new offerings which fall within those guidelines, providing feedback and guidance.

One of the most difficult parts of managing the idea portfolio is killing off the ideas which are failing. One company has attacked this problem through bi-monthly meetings of the management committee where work underway, new projects, and past ideas are discussed openly and in detail. Due to the frequent nature of these meetings, it becomes difficult to hide mistakes or let failing projects snowball for any length of time. Problems are addressed as they come up and projects which are in trouble are identified and rectified before they cause too much damage.

Companies occasionally address such portfolio questions by attempting to measure and manage the economic value of knowledge, using metrics indicative of knowledge utilization, such as the ratio of patents held to the number of uses of those patents in new products and services. However, the question of what to measure is very difficult, and serves a significant roadblock to utilizing this knowledge management technique. Fifteen of 18 respondents said their organizations "almost never" or "sometimes" examined the economic value of their knowledge. The reason? Thirteen said this activity "almost never" or at most, "sometimes" had an impact on innovation, and if it did, the level of impact it had was in one or "slight." If it is true that "you cannot control what you cannot measure," intellectual capital optimization approaches to portfolio management will remain difficult until better measurement techniques are discovered.

Product/Process Development

Once ideas have been identified and either explicitly selected or worked on privately, they need to be developed into an actual product or process if they are to have value. Thirteen of the companies surveyed have a process in place to develop new product or service ideas, and an equivalent number of the companies have process development processes. Many organizations find that customer involvement in the development process produces better results and increases customer buy-in to the products, and, in some industries, to the processes.

Some organizations, especially laboratories and R&D groups, have an explicit development tracking process in the form of lab notebooks. This not only helps when it comes time to apply for patents, but is an excellent knowledge codification mechanism, allowing replication of, and learning from, past experience. Unfortunately, however, activities equivalent to leveraging lab notebooks are not widespread. Only seven of the companies questioned irregularly or often captured ideas which were not implemented immediately, while just five said that captured ideas are often or irregularly developed at some point in the future.

Many ideas are screened out during development, as their implementation prospects become more apparent. For many companies which encourage individual experimentation, this stage is the most crucial test of fitness. One company which encourages innovation throughout its ranks said that new products were actually implemented only five percent of the time because the majority of the product ideas which circulated around the organization were killed off at the informal level during the development stage. They felt that this kept their failure rate down while still allowing people the freedom to experiment at will.

Development need not take place within the organization which came up with the idea. Sometimes the greatest value of an idea for an organization is gained through licensing or selling it to a firm which is better able to pursue implementation. Some companies, such as product design firms, are set up to do this, while others choose their development approaches on a case-by-case basis. While the majority of questionnaire respondents developed ideas internally (five 100% of the time, and six at least 50% of the time), some did outsource development or collaborate with development partners (three developed 50% internally and 50% externally, while one developed between 50% and 100% externally). In making such development decisions, a key question is, where should the knowledge reside? Some companies hold real value in their own development capabilities, while others become more distracted than enhanced by trying to build their own ideas.

Interestingly, the knowledge needs of a particular business may in fact be a disincentive to certain types of innovations. For commodity/raw materials industries in particular, where buyers are wary of getting locked into a single supplier, any product innovation has to mesh so closely with customer needs and industry standards that product differentiation is almost never worth the cost. As one respondent noted, in such a situation, product innovation doesn't count for nearly as much as efficiency, perhaps through process innovation. Free flow of information through the industry, in order to

create the needed customer-driven standards, makes big payoffs for individual product innovators unlikely. Yet one need only look to the rise of the mini-mills in the steel industry to see that for process innovators, there are also great gains to be had.

Innovation development strategies, for that reason, must take into account and balance both product and process advances, as appropriate.

Implementation: Making an Explicit Impact

Implementation occurs when a product idea is brought to the market or when a new process is put in place in an organization. The impact of an idea usually first becomes visible at this point, either through sales figures or through process measures such as efficiency, quality, or productivity. It is at this point that ideas can create value, and can actually be considered innovations.

Knowledge management plays at least two important roles during the implementation stage. The first comes through the pre-work and preparation which has been done to determine the fit of the idea with existing elements of the organization. Where the new product or process is not tightly coupled with the needs of its users, commercialization and implementation has little chance of success. In-depth knowledge of the users, obtained through market research, customer relationship management, and other techniques, which is captured, disseminated, and built into the product/process from the beginning is often a prime deciding factor of success or failure.

The second way active knowledge management techniques can provide support during implementation is in how the knowledge about the product/process is disseminated along with the product/process rollout itself. Silicon Graphics, Inc., the \$2.9 billion developer of high performance computers, has developed an integrated intranet/audio/video system, termed iWebucator, which, in its first use, allowed the introduction of a new product to some 2,000 of their sales reps and resellers, worldwide, in two days for only \$200,000. In the past, such a program would have cost some \$3 million, and required flying people in for days of training. SGI used this combination of delivery mechanisms to train people cost-effectively and nearly simultaneously, ensuring that the knowledge about this new product actually accompanied its introduction.

Diffusion: Scope of Impact¹⁶

Implementation indicates that a particular idea was developed and introduced to a market. Diffusion is a measure of the scope of impact of the implemented idea, and translates into the total value realized from the innovation. By way of understanding an idea's diffusion, and thus the impact of an innovation, seven of the companies surveyed indicated that they have a process in place to determine the value of new ideas, and eight felt that they are able to determine the value of an innovation fairly accurately after its implementation. These activities go hand-in-hand with companies' efforts to measure and manage the economic value of knowledge and can be interesting sources of feedback into development decision-making processes.

Market impact (i.e., revenue, proliferation, popularity) is often measured by firms as indicators of diffusion, but many times the primary implementation territory is internal, especially when dealing with new process ideas. Diffusion then takes the form of internal knowledge transfer about how well new processes are working and how they

can be utilized in other parts of the organization. Of the 18 organizations which responded to the survey, 10 "agreed" or "strongly agreed" that business practices which are successful in one part of the organization are often adopted by other parts of the organization. This speaks directly to the knowledge management activities surrounding the sharing of "lessons learned." Eleven of the companies surveyed said they "often" or "regularly" shared lessons, while 14 felt that lesson sharing had a "significant" or "very significant" impact on the respective organizations' ability to innovate. Ten firms cited that they had lesson sharing initiatives underway.

Diffusion happens both formally and informally. Companies indicated that they shared knowledge through technical forums, conferences, meetings, seminars, and training programs. One company found that management committee meetings allowed knowledge exchange at the high level, but were only really effective when held often, every 60 days or so. In that way, the meetings bred familiarity and trust among the participants, which decreased defensiveness and increased sharing. Interestingly, most respondents appear to have organizational cultures which contribute to sharing, with all but one indicating that they "agree" or "strongly agree" with the statement, "I feel more valued if I share what I know with others in my organization than if I keep it to myself." Companies also used upper management to guide the coordination and distribution of internal innovations, but actual adoption by other parts of the firm was never guaranteed. One high tech company simply has senior management publicly highlight the ideas they would like to see spread around, but does nothing to mandate them.

Feedback: The Key to Learning

Feedback on processes and products is often collected, and just as often ignored. A key element of knowledge management is learning through the ongoing integration of experience into the existing base of knowledge. One company interviewed has its cross-functional project team spend several days at the end of each project debriefing (looking for new insights and adding to its own and, when recorded, to the organization's knowledge). In addition, this company spends a tremendous amount of time and effort in obtaining customer feedback throughout the product development. This feedback then becomes food for thought for the later innovation attempts. While these sorts of activities are well known to be helpful, it is rare that companies actually allow time for them. Most firms find that if feedback is to be truly incorporated, feedback loops must be explicitly prescribed. Otherwise, feedback happens only at the individual level, with little shared learning organizationally. Over half of the respondents indicated that "People here learn on their own" "regularly," but only three answered that "People here learn in groups" "regularly."

Summary

Knowledge management activities are adding value to organizations by enhancing innovation and innovativeness. While the results are far from linear, survey respondents indicated numerous ways in which knowledge could be, or at least should be, leveraged to add value to the creation, development, and implementation of new product and process ideas. The organic nature of innovation means that it may be influenced, and maybe even directed to some extent, but it does not lend itself to control.

Measuring and managing the economic value of knowledge, for instance, contributes little to the creation of new ideas, but it does allow more accurate feedback about the impact new ideas have on their respective markets, internal or external. Management's role appears to be to carefully combine activities which enable and encourage ideas to be generated and grow, support their diffusion, and harvest the value for the organization. Knowledge management is one set of approaches to doing this which seems to meet with some success.

We have explored here for the first time the impacts of knowledge management on innovation, but our investigation has only scratched the surface. Further research still needs to be done on the specifics of the innovation/knowledge management interaction, especially around factors of causality, differences among various types of innovation and their knowledge needs, and industry- and company-level variations in implementation and diffusion patterns. In addition, the *isay* versus *idoi* gap needs further investigation, since answering interview and survey questions presents one set of perspectives, but knowledge work and innovation can be very subjective activities, many of which are purely tacit. Direct observation is certainly necessary. The difficulties in researching these two quite amorphous areas are many, but we believe in the value and usefulness of understanding critical impact points. While there may never be an explicit knowledge-to-innovation translation mechanism, we will continue to explore how to support growth and innovation efforts through more effective knowledge management.

Endnotes

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- 9 For further reading on creativity, see the work of Teresa Amabile (e.g., *Creativity in Context: Update to the Social Psychology of Creativity*), Edward de Bono (e.g., *Lateral*

Thinking: Creativity Step-by-Step), Roger von Oech (e.g., A Whack on the Side of the Head: How You Can Be More Creative), and others.

10 De Long, Davenport, Beers, "What is a Knowledge Management Project?" Ernst & Young LLP Center for Business Innovation, Research Note CBI311, 1996.

11 See survey in Appendix for answer categories and ranges.

12 Drucker, Peter, "The Discipline of Innovation," Harvard Business Review, May, 1985.

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