

PATHWAYS FOR KNOWLEDGE: HOW COMPANIES LEARN THROUGH PEOPLE

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Abstract

Many reports state that an organization may be more successful if the company exhibits a high level of learning. Learning and storage of the knowledge gained is of great importance to this end. Where do the people within R&D, the area generating new products for a company, look for knowledge? What are the means by which the knowledge is conveyed, and between whom? This paper explores the issue of how a company learns through investigation of the pathways by which people convey information. A structured interview process elicited the avenues by which R&D personnel in top American companies find and transmit knowledge. Several interesting and provocative opinions were obtained: 1) on the average, when people look for knowledge, they consider that about 64% of the knowledge base resides outside of the company boundaries; 2) more than half of all company knowledge transmission flows verbally and informally through ad hoc channels, giving evidence that the communication means has changed greatly over the past decade. Ten years ago, most large company information was sent by explicit means (e.g., formal documents). Today, a growing amount of company information sharing is taking place via fax and, to a greater degree, email. From near zero at that time, to the present range of 25%. A number of interesting indicators of successful learning people and learning companies were described, in addition to the documented success rates and good ROI. Measures for people were the diversity of projects given and the breadth of questions asked. A measure of successful learning companies was the ability to hire good people. This study gives significant new dimensions of needs beyond the company boundaries. It also reinforces the concept of the tacit and informal nature of core competencies. A further descriptive study is anticipated to confirm these findings.

Introduction

Organizational learning has become an increasingly important concept and practice in today's business world. Ray Stata of Analog Devices has stated that "the rate at which individuals and organizations learn may be the only sustainable competitive advantage, especially in knowledge intensive industries." Further emphasizing this point, it has been said that "a firm's competitive advantage depends more than anything on its knowledge... what it knows - how much it uses what it knows - and how fast it can know something new" (Prusak 1997).

Thus, learning and knowledge management are two key aspects of judging a successful company. An important yardstick where this learning and knowledge reveal themselves, is in the

innovative products and processes a company may possess. Citing leading academics (Tushman & O'Reilly 1997): "Organizational renewal demands mastering the dynamics of innovation and organizational change."

There is no better place to look for these abilities than in the R&D areas of leading technology firms. Those in the R&D area are the ones the company depends upon for new products. They must keep up with the rapidly advancing sciences of technology, decipher the highly specialized detail, and make products which will work and meet the demands of the ever-changing landscape of modern society. "Outside sources of knowledge are often critical to the innovation process, whatever the organizational level which the innovating unit is defined" (Cohen & Levinthal 1990).

Where do the R&D people look for knowledge? What methods and means are used to obtain the knowledge necessary for new products and processes needed to maintain survival of the firm? Who requests and receives this knowledge, and who gives it out?

This paper answers the above questions by exploring the following: "How does the company learn through people, and what pathways are used to convey that new information?"

Background

An overarching area of research is *organizational learning*, as well as other management topics that have grown within it. Organizational learning may be described as: "First, learning occurs when an organization achieves what was intended; that is, there is a match between its design for action, and the actuality or outcome. Secondly, learning occurs when a mismatch

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between intentions and outcomes is identified and corrected; that is, a mismatch is turned into a match" (Argyris 1994).

Other disciplines used in this research are *individual learning* and *knowledge management*. These two disciplines have been found within organizational learning. However, recent needs in developing technologies and organizational structures have created greater interest in these areas, and they are now coming into their own.

Individual learning has been defined, on a basic level, as "a relatively permanent change in behavior potentiality which occurs as a result of reinforced practice" (Houston 1976). Technology advances in computers have changed the way people in the company communicate to each other and to outside sources. In many ways, individual learning is important as the decentralized (and then reengineered) company has moved toward virtualization. It has been observed (Hammer & Champy 1993) that jobs today "are more challenging and difficult. Much of the old routine work is automated or eliminated. If the old model was simple tasks for simple people, the new one is complex jobs for smart people, which raises the bar for entry into the workforce. Few simple, routine, unskilled jobs are to be found in a reengineered environment. People's roles change - from controlled to empowered." Therefore, not only is it important for each person in the firm to gather much knowledge to do their job, but each job is much more autonomous, and leverages more of the company's power. With the significance of the individual's role in corporate success, the learning difficulties are magnified - "Every company faces a learning dilemma: the smartest people find it the hardest to learn" (Argyris 1991). It is clear there is a need for research into individual learning.

Another discipline of growing importance is *knowledge management*. Knowledge management has been used in many ways, representing different ideas (such as computer storage systems and database mining), or a management technique similar to inventory control of parts. The best definition of knowledge management may come from two current researchers, both widely consulted practitioners in the field (Davenport & Prusak 1998), who said, "a fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers." There are several reasons why the need for knowledge management is great. Accepting the statements of business leaders (summarized), that knowledge is perhaps the best resource and the only sustainable competitive advantage, then we must ask these questions. How does one find what one needs to know, and then store the information? Further, how is this information retrieved when needed? To recognize information is resident within the company in case it is needed, is a form of saying the information is knowledge; to be aware of it. The knowledge is a vast pool of potentially commercializable knowledge. In a growing number of countries, with expanding organizations contributing, this knowledge is migratory in some forms, and embedded and slow to be retrieved in other forms (Badaracco 1991). The need for a company to obtain knowledge is greater in this more highly competitive world of fast changing technology and increasingly complex sciences associated.

It has been recognized that the R&D functions must work together with the corporate and business managers as partners, to focus on providing value to customers and shareholders in perpetuity; the "Third Generation R&D" (Roussel et al 1991). It is also understood that the greatest need for knowledge, varying types of knowledge, and the most difficult to obtain knowledge, is in the area of R&D as well. For these reasons, individual learning and knowledge management are more important today than perhaps ever before. A purpose of this article is to obtain answers for knowledge pathways, and align those pathways' efficient techniques.

Methodology

This research was an exploratory study, using the interview process to obtain opinions held by individuals. Ten individuals in technology-intensive firms were chosen. They were "successful" people in their environment, as measured by positions in the company and length of service with the company. In fact, the service ranged from 10 years to 44 years, with a mean of 27 years, almost exclusively with the same company or family of companies. This provided a longitudinal perspective of some key communication factors.

The interviewees were R&D "types," with science backgrounds and a lifetime of scientific inquisitiveness. There were two in different fields: one was director of marketing for a Fortune 100, and another was president of a Fortune 100.

This study was designed as an exploratory research project. The survey was accomplished as a structured, in-depth interview, each lasting about an hour. A basic list of questions to be answered was used, with ample time for response in a broad fashion, as the opinions may vary from the direct question. This openness was to allow for insight as to future directions to take in further research.

Results

There were a number of interesting results from the in-depth, structured interview process. The opinions of these interviewees can be classified in categories as described below:

- Origin of knowledge sources

- Informal knowledge

- Growth of intermediate knowledge communication

- Broad & deep knowledge

- Different method for outsiders

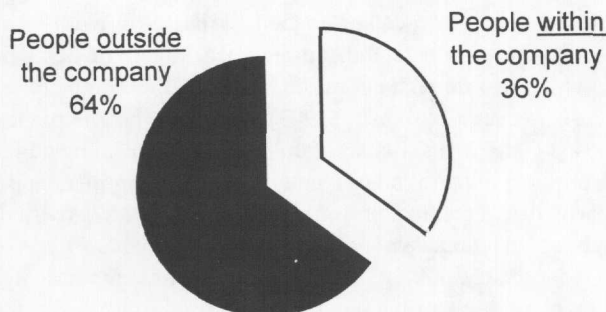
Origin of Knowledge Sources. When looking for information which can be used for their project needs, the interviewees searched for answers. The search process covered sources within the company, as well as outside the company boundaries. One way to measure the proportion of searching within the company to outside the company, is to count the people on their *knowledge tree*. The knowledge tree consists of the people with whom a person may communicate in order to learn new knowledge. This relationship can be formal and informal. If an engineer asks another person several cubicles down, if he ever encountered a certain problem, and if the other engineer responds, there has been knowledge transfer. "These everyday knowledge transfers

are part of organizational life. In a knowledge driven economy, talk is real work" (Davenport & Prusak 1998).

One would think that most of the knowledge sources would occur within the company; however, the responses showed a surprising 2/3 of all knowledge comes from sources outside of the company. This reliance on outside sources has been reported elsewhere, and may be the result of downsizing, causing a lack of internal resources. This reflects the changing view of resources, such as an engineer or scientist, from strictly a "company" base to an individual "knowledge" base, and the person as a "free agent" (Rothstein 1998).

Exhibit 1. The sources of knowledge

People who supply answers for project needs



Informal Knowledge. The individuals interviewed had developed knowledge relationships with people in their organizations and, without exceptions, felt that the *informal knowledge trees* were the most important. Additionally, they felt there was a high level of *tacit knowledge* relevant in the company strategic plans and projects, and in learning and in job needs. Tacit knowledge is defined (Nonaka & Takeuchi 1995) as "something not easily visible or expressible" and has been recognized as an important element of knowledge transfer. The *paths* of communication that were inquired on in the survey included: 1) within firm, 2) people outside of the firm, 3) technical knowledge needs, and 4) company wide type of knowledge needs. Over 40% of all communication in these essential pathways was via verbal means. This implies an informal nature, and it also may imply that much of the talk may include a tacit dimension; that the ideas may not be easily communicated via written methods. This transfer by its nature goes undocumented.

This verbal communication is related to the *informal network*. The informal network also includes much *face time* with individuals who are important in the need to acquire knowledge. Face time is an important dimension in corporate life. It has been noted by others, such as (Davenport & Prusak 1998): "Personal contact and trust are intimately related. The U. S. Army recognizes face time as an essential element in building trust between groups, and it is one of the determinants of successful treatment." Face time can also be a "transfer relationship" to get knowledge where it is needed. As one respondent (a scientist in the pharmaceutical industry) stated during the interview concerning face time and knowledge trees, "One way I enjoy learning in my job is when talking to experts who come in and give

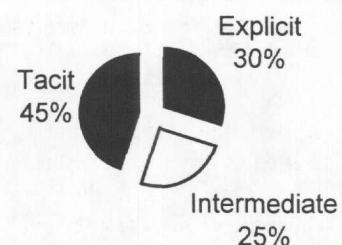
their expert opinion on scientific principles and for them to sift out and to get them to commit and to get their support of a certain claim - I think that's the most challenging and I think I learned a lot from them, and asking them what books and literature do we read to become more expert in that field. We pull experts in because we don't have the expertise when we start a new project. If we have a new project, I would tackle that by getting a group of people with expertise in the company, using a brainstorming of an ad hoc team.... As I have been here 6 years I have found I have a feel for who to contact, that I can go to OTC (over the counter), Pharmaceutical, Regulatory, Clinical, Medical, Library Resources - I have my contacts built up. Most contacts I have worked with in the trenches and I feel they are experts in their field, and I can rely on their judgment because I have witnessed what they can do for me and with me."

So, the verbal method of communication accounts for about 45% of all communication of knowledge. But the means of communication for knowledge transfer which is usually considered, is the written word. This same written, formal word is also, then, the way one would normally measure knowledge transfer - number of memos, etc. This importance on the written word has been in Western tradition from Frederick Taylor to Herbert Simon. This is called *explicit* by researchers, and is defined (Nonaka & Takeuchi 1995) as "something formal and systematic... can be expressed in words or numbers, and easily communicated and shared in the form of hard data, scientific formulae, codified procedures, or universal principles." This explicit knowledge transfer amounted to only about 30% of the total in this study. A new method of communication, which may call *intermediate*, has come into being. This consists of faxes and email, for the most part. These methods have the informal and tacit nature of being personal, quick to create and send, and are similar to a verbal conversation in that they are easily two-way. At the same time, though, the fax and email are able to be kept for long periods of time in storage, are permanent enough to act as a verification of what was stated, and can be broadcast to many people at once, like the formal, written document or book. This intermediate method of knowledge transfer also is essentially an informal means of communication.

Companies at present put little emphasis on tacit knowledge and enforce adherence to documentation as much as possible. In spite of this desire, there is a significant 45-70% of knowledge transfer is of tacit and verbal knowledge.

See Exhibit 2, which summarizes the forms of knowledge transfer.

Exhibit 2. Forms of communicating knowledge



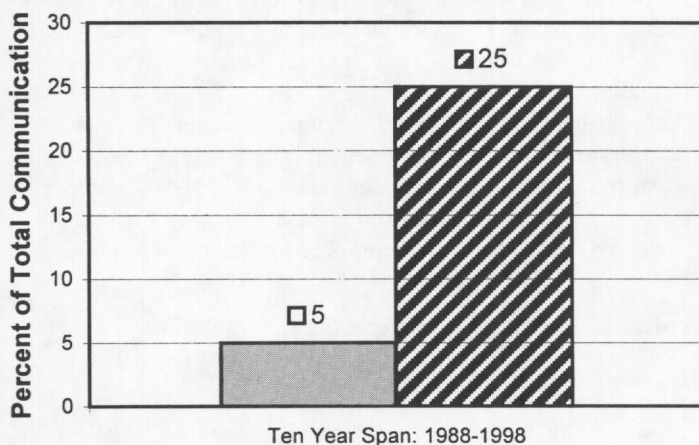
Reflecting that email and faxes can be considered informal communications, just as verbal, as much as 70% of the company's knowledge transfer is informal. This reinforces the argument that a company loses much of its abilities when it downsizes or has a rapid turnover of personnel, or that there is little transfer of knowledge, once those "in the know" have left and important information is not written down.

Another perspective is that on the leading edge of technology, there may be more of a tacit dimension to information and knowledge. It is hard for one to explain what he is just beginning to grasp. There is also a paucity of written information to substantiate what one is just developing. As one interviewee stated concerning the time period when software programming was just in the formative stages at Bell Labs: "there was a large amount of tacit knowledge around the organization. I would say you needed about 50% tacit on the leading edge areas, but later you could go with 75% book learning because you could hire a programmer off the street and they would know what to do....The programmer was experiential because it was cutting edge and no books available."

This is similar to the craftsman who has skills of his art, but would find it difficult to write it down in a procedure. One must see and do it firsthand to learn.

Growth of intermediate knowledge communication. It was ascertained from the interview process that the intermediate form of communicating, using faxes and email, is quite new. Just ten years ago this intermediate method was used very little. Today, the method is about 25% of all communication. The email method is growing rapidly each year, with new software and the internet offering increasingly easy access to information, and the virtual office taking hold. See Exhibit 3.

Exhibit 3. Increase in intermediate knowledge use



Broad & deep knowledge. A significant amount of knowledge transfer was classified as broad knowledge and deep knowledge.

Recognition has been made in the distinction of managing specialization. There are different skills and "languages" in each of our specialized functions. In a specific department, say the

R&D area of a chemistry firm, very particular and highly technical information is required for projects, for innovation, and to perform everyday activities. This is the functional, disciplinary, or *deep* knowledge. This may also include *signature* skills, the ones certain individuals are known for having in the company.

The knowledge which may be used across situations and interdepartmentally may be termed *broad* knowledge. This could be the routine knowledge of company procedures, work hours and so forth. Creatively, this could be the knowledge of where to go to get budgeting, how to line up resources for a project, or to know that a core competence exists to complement a project task and to facilitate a successful completion.

Skills in the broad and deep knowledge areas are very important. A person holding good broad knowledge (as the top of a "T") and good deep knowledge (as the leg of a "T") would be said to have balanced T-shaped skills. She would have desired ability to understand the technical facets of her discipline, while also understanding the ways of the company as a whole. As research by Iansiti (1993) supports, "people possessing these (T-shaped) skills are able to shape their knowledge to fit the problem at hand rather than insist that the problem appear in a particular, recognizable form. Given their wide experience in applying functional knowledge, they are capable of convergent, synergistic thinking" and companies having these type skills required "fewer than one third the engineers and completed their projects an average of 2.6 years sooner than competitors designing directly competing products in the same business" (Leonard-Barton 1995).

Knowledge transfer was split evenly between the two areas. See Exhibits 4 (source: Leonard-Barton 1995) and 5.

Exhibit 4. T-shaped skills

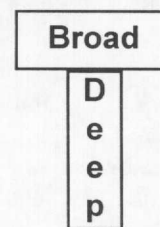
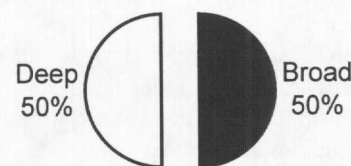
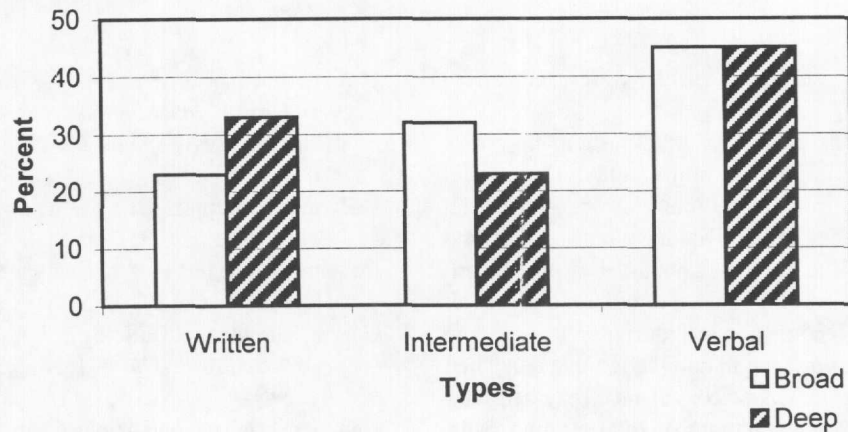


Exhibit 5. Knowledge for skills



There was a different proportion of methods of communicating deep knowledge as compared to communicating broad knowledge. More of the highly technical and specialized knowledge transfer took place via written methods whereas the broader skill knowledge was intermediate. This may reflect the need for quantifiable and accurate information when understanding new concepts and sciences, and the use of the "lab notebook"

Exhibit 6. Communication methods

style of note keeping for sequentially expanding the boundaries of knowledge. Note that verbal transfer was about the same in each case about 50% of the total.

Different method for outsiders. Another difference was noted in how communication takes place with outside sources. More of the communication is via written form than intermediate. This is probably due to the need for contracts, as well as maintaining a record in a formal way. This may be indicative of the traditional means of maintaining a barrier at the corporate wall, to keep security high and internal secrets kept within. But this also has an opposite effect. This is a larger version of the "silo" metaphor where departments become isolated and do not share information. Good knowledge links "can help one company learn specialized capabilities from another; they can help a company combine its special capabilities with those of another organization to create new embedded knowledge; and they can enable one company to help another organization build up its skills and capabilities in way that will benefit both companies later on" (Badaracco 1991).

Thus, a company may limit its leverage to use information with a partner to the profit of both participants.

See Exhibit 7 for the comparison.

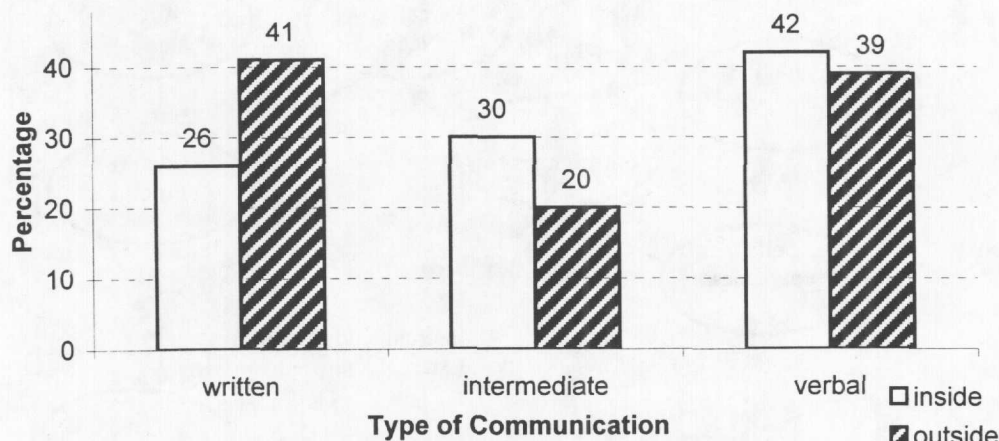
Considerations

There are several "take aways" that can be obtained from the interviews. These ideas have to be teased out of the raw information.

People working for a company help that company to gain knowledge by their own learning and teaching. Those whom we have interviewed preferred two general methods of learning and teaching. These two methods were: private and interpersonal. This is consistent with the model depicted by Nonaka and Takeuchi (1995) for tacit knowledge transferred also to tacit knowledge, and is known as socialization. One example we saw in our interviews was when the scientist needed to know how a certain conveying line operated. The only way to learn required a trip to Puerto Rico, to speak firsthand with the operator who had the "feel" for the line's operation in a sufficient way to solve the problem. He could not explain it, or document his knowledge; he needed to experience the problem, and then skillfully correct the defect.

The large degree of unrecognized, informal knowledge transfer which flows within a company, leaves a significant ambiguity to the elements of the company's success.

The uncharted methods of communication make decisions risky as to directions a company may take. The benefits and

Exhibit 7 Knowledge communication patterns

prospects of utilizing these pathways and methods remains unknown.

Lessons Learned

As this was an exploratory study, the results were used to formulate future research.

First, the pathways described by the participants were developed into a working model for future study. This model incorporates the feedback from those interviewed. The model also uses current hypotheses on knowledge management and learning from researchers like Argyris, Leonard-Barton, Davenport, Nonaka, Tushman, and Takeuchi. Actual real forms of communicating such as: telephone, email, journals, etc. are to be surveyed and ranked for importance in knowledge transfer. Then the pathways as well as the means of conveyance may be better understood. Following an understanding of the optimum pathways and the ranking of the means of communication, a "best practices" study is contemplated to set standards upon which to measure one company against other "world class" companies in the ability to learn and in the efficacy of its own knowledge management. A company may then compare its systems and know where it may improve. The model from which pathways is to be tested is shown in Exhibit 8. This model is to be tested on R&D scientists and engineers. It includes time, spec, and budget based dependent variables.

Conclusions

The research area of knowledge management and company learning through individuals is uncharted to a large degree. The potential for improvement in learning, productivity and innovation is difficult to measure, but appears great.

A reason for pursuit of research in the area of knowledge management and individual learning may be characterized as a way for the company to exercise continuous improvement. Whatever the means, the company must not be reluctant to learn new ideas, and to be open to the outside world. To learn about

learning is essential to this task. As has been stated (Garvin 1993): "Continuous improvement requires a commitment to learning."

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Exhibit 8. Basic model for company learning through individuals

