

Models for Understanding the Dynamics of Organizational Knowledge in Consulting Firms

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Abstract

Some consulting firms are implementing processes and technologies that transform individual experience into organizational knowledge, preserve it, and make it available to their employees. Advocates of knowledge management believe that these practices accelerate collective learning, improve competitiveness, and facilitate response to market changes.

This paper uses a systems approach to understand knowledge management practices in the context of one prominent consulting firm. It incorporates influences that affect the firm and its ability to sustain knowledge, including staff departures, market shifts, and technological innovation. Knowledge managers must understand the dynamics imparted by these influences to ensure the future of the firm.

1. Introduction

Consulting firms rely heavily on individual and collective skills to generate revenue. Compared to tangible assets, which firms consume and depreciate, a consultant's knowledge provides almost continuous value. Consultants acquire 'know-how' knowledge through project experience, education and training. Acquired knowledge is reused and shared with others at various engagements. Nonaka and Takeuchi [1] distinguish between two types of knowledge: explicit and tacit. Explicit knowledge refers to written or other formal knowledge, usually in the form of documents. Its salient feature is its existence outside the mind of the individual. Tacit knowledge is less formal knowledge that is harder to articulate, (e.g., the ability of a consultant to determine a company's worth). Consulting firms also rely on social networks for locating individuals who can develop and complete projects and for identifying prospective clients. This knowledge represents the 'know-who' of individual consultants and is especially important for making valuable connections with clients and peers outside the firm.

Collectively, the various types of knowledge possessed by consultants represent organizational knowledge. When a consultant's knowledge is collected and shared, it becomes part of the collective wisdom of the firm (i.e., organizational knowledge). Organizational knowledge accumulates over time. It is largely dependent on the development of personal knowledge, but may also decay from obsolescence. It may be explicit, in the form of databases or documents, or tacit, expressed by action. The current definition of organizational knowledge emphasizes both repositories.

The success of consulting firms depends on their ability to manage organizational knowledge. As a result, many consulting firms have knowledge management (KM) programs in place that have policies and procedures for developing, transferring, storing and disseminating organizational knowledge. Yet, managing organizational knowledge is a difficult task considering the variety of factors that affect it over time, including organizational structure; informal social processes; interactions among people, activities, and incentives, and market changes [2]. There is general recognition among consulting firms that these forces impart dynamic behavior to organizational knowledge that is not fully understood. The two predominant KM issues for these firms are: 1) What is the dynamic behavior of our organizational knowledge, and 2) What policies should be enacted to assure positive growth of organizational knowledge, and with it, financial success in uncertain markets.

To answer these questions, this paper presents seminal and evolving work on the development of a system dynamics model of organizational knowledge. It explicitly considers influences that stimulate and inhibit the development of organizational knowledge over time. The context for this work is IT consulting firms, where knowledge transfer is an important strategy. The paper presents a causal model of organizational knowledge based on work with a prominent IT consulting firm. The causal model is the basis for a confidential simulation model that is currently under development.

2. Knowledge Management Practices

Case studies of several consulting firms [e.g., 3, 4] describe the activities and technologies that constitute KM programs. Generally, firms use a combination of formal and informal processes and activities to capture and transfer knowledge. Formal practices include documenting the firm's best practices, developing seminars, and structuring project information into searchable formats (see Table 1). Informal activities include contributing to online discussions and providing advice over the telephone and through e-mail.

The case studies also reveal the importance of having consultants contribute unbilled time to KM activities. The collective activities of a firm's KM program and its employees as well as the external factors that affect a firm constitute a system for analyzing organizational knowledge and KM programs.

Table 1. Typical KM Activities in Consulting Firms

	From Personal Knowledge to Organizational Knowledge	From Organizational Knowledge to Personal Knowledge	From Personal Knowledge to Personal Knowledge
Formal Activities	Documenting Best Practices Delivering seminars Codifying data	Reading and using Best Practices Attending seminars Searching databases Making telephone calls Sending questions by electronic mail Reading discussion databases	Project mentoring
Informal Activities	Participating in discussion databases	Reading and using Best Practices Attending seminars Reading discussion databases	Answering telephone calls Responding to electronic mail

3. A Systems Perspective of Organizational Knowledge

A number of factors affect the organizational knowledge of consulting firms. For example, in consulting firms, personnel turnover is an important determinant of organizational knowledge. When experienced consultants leave a firm, they take their knowledge with them, especially if little of it has been captured. New hires change the mix of knowledge and skills.

The behavior of the organizational knowledge and the effect of KM programs are best understood in a broad context that includes pertinent information on multiple factors outside the usual boundaries of KM. Based on almost 20 interviews with the knowledge managers and participants in consulting firms and relevant theory on the topic, some of these factors are:

- Nature and volume of tasks performed by the firm
- Available staff and their personal knowledge
- Corporate policies and procedures for collecting, storing and disseminating knowledge
- Time allocations devoted to OK activities
- Corporate knowledge management practices

The key factors and their interactions are portrayed in a sector model (see Figure 1). The formal activities of a typical consulting firm result in the application of consulting time to tasks. A change in task levels from market demand affects the demand for staff time. Staff allocate their time to various tasks and decrease the level of outstanding tasks, generating revenue. The number of tasks completed is dependent upon the quality and productivity of the consulting staff, both of which respond to changes in experience.

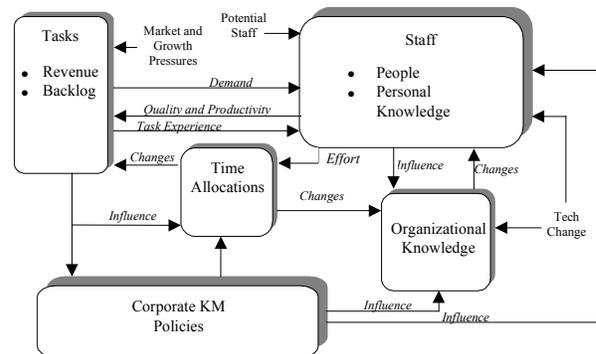


Figure 1. System Model of KM

Corporate KM programs affect this process by influencing the development and use of organizational knowledge. To develop organizational knowledge, firms re-allocate staff time towards eliciting knowledge, which in turn affects the level of tasks completed. In this way, the investment of current time results in later productivity gains. Resources directed towards better technology and knowledge organization make explicated knowledge more accessible and increase its influence on personal knowledge. Finally, policies that encourage informal sharing of knowledge and personal network development affect the transfer

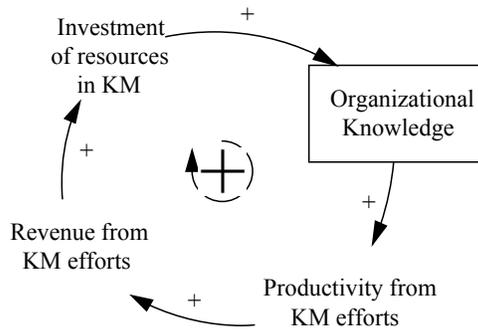


Figure 2. Reinforcing feedback loop

of knowledge between individuals, even if it is not formally part of the organizational knowledge store. The premise of these KM practices is that through influencing the actions of individuals away from individual productivity and towards the sharing of experience, the firm will be able to sustain growth, survive turnover, and indoctrinate new hires faster. An effective KM program should significantly increase productivity over its baseline state. Will KM practices fulfill this optimistic prediction over time?

4. Modeling the dynamics of organizational knowledge

To begin answering this question it is necessary to explore the structures and forces within the firm that affect organizational knowledge over time. The System Dynamics (SD) methodology uses the concept of feedback to illustrate how complex environments behave over time [5, 6]. Causal loops provide the mechanism for feedback within the system, where outcomes exert influences upon their inputs.

To illustrate the effects of feedback in KM, consider a simplified model of the effect of an investment in explicating knowledge over time (see Figure 2). An investment in KM increases the store of knowledge available to the organization, a positive link between the investment and explicated organizational knowledge. (Accumulating variables (stocks) are surrounded with boxes, while time-dependent (flow or rate) variables are not. See [5] for a full discussion of SD notation.) The increase in knowledge increases productivity, which in turn increases revenue from KM efforts. A successful KM program is likely to stimulate investments in knowledge management efforts over time. This expectation creates a closed loop. In the language of SD, this is an example of a reinforcing loop, where a positive change in one rate generates positive feedback. This figure also illustrates how system models combine hard (financial investment) and soft (expectations) variables to represent causal feedback.

The behavior represented by this single loop is not a good representation of reality; knowledge investments in the real world do not continually grow over time. One balancing factor is the ability to locate and use relevant organizational knowledge. As the stock of organizational knowledge grows, the time required to locate relevant knowledge also increases, and the net effect of knowledge diminishes (see Figure 3).

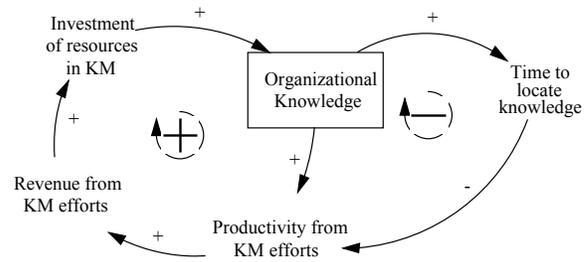


Figure 3. Sample Reinforcing and Balancing Loops

The dynamic behavior of this simple system depends upon which of these loops dominates over time. If the productivity benefits of organizational knowledge grow quickly, then the time required to locate knowledge may not be important for some time. If knowledge is hard to locate, then it will affect productivity marginally, or may cause KM efforts to fail. A more complete model would include additional structures that reflect the real behavior of the system. For example, some of the revenue gained (or anticipated) from using organizational knowledge might be allocated to collect or structure the knowledge base, increasing the productivity gains. In the

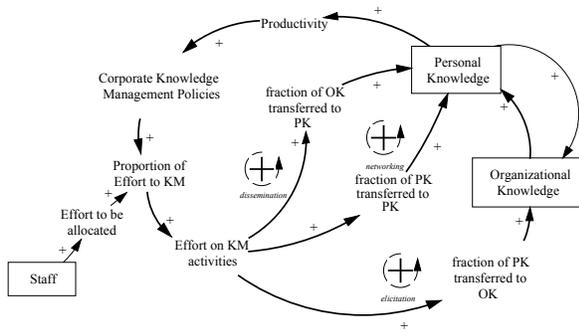


Figure 6. Effect of KM time allocations on productivity (dissemination, networking and elicitation loops)

personal knowledge (networking loop). Individuals who take time to study previously developed organizational knowledge also increase their knowledge base and their productivity (dissemination loop). These three loops are reinforcing, recognizing the positive effect that KM success use has on future investments in KM activities.

An increase in the emphasis on knowledge management necessarily decreases the relative effort on other tasks. This in turn reduces the number of tasks completed in the short term, and results in pressure to reduce the efforts spent on knowledge management (see Figure 7). This is a balancing loop, where a change in one force will create pressures that ultimately act to diminish the pressure.

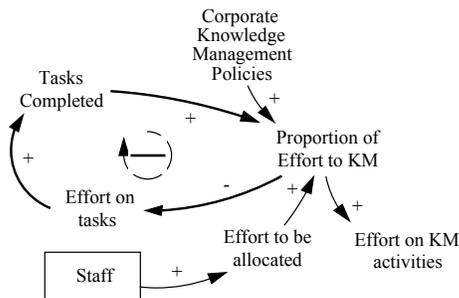


Figure 7. Effect of changes to KM efforts on task completion

The combination of these reinforcing loops (learning from experience, knowledge transfer, time allocations) and one balancing loop (time allocation) create a structure that may be used to simulate the tradeoff between task work and knowledge work. The long-term effect of KM, which results from the short-term investment of staff efforts, increases the productivity of the consulting staff.

4.3 Effects of staffing on organizational knowledge

What of the other forces that affect the firm's ability to retain and transfer knowledge over time? When the knowledge resources of the firm are largely tacit, as in the case of high-tech or consulting firms, employee turnover affects the amount of know-how and know-who available in the firm.

When individuals leave a firm, they take their personal knowledge with them, including that gained from work experience while at the firm (see Figure 8). To the extent that the firm relied upon them as a source of knowledge, organizational knowledge diminishes. Their departure also removes them from the firm's interpersonal network, eliminating the links they provided to others in the firm. The flow of staff and the knowledge associated with them are dual aspects of the same phenomenon, represented in a specialized co-flow structure.

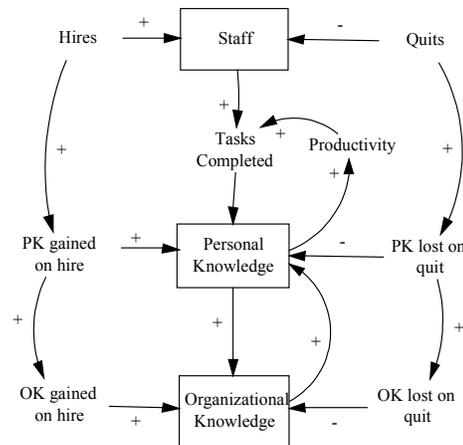


Figure 8. Hiring, Quits, and Organizational Knowledge (Staffing/Knowledge co-flow)

While the departure of skilled staff is a loss of knowledge in any industry, it is a very important concern of managers in information systems consulting. In this industry, the typical quit rate is estimated to range between 10% and 20% per year. This may be due to the relative ease of transfer between firms, the high competitive demand for skills, the relative stress of the consulting workplace, or other reasons.

Firms attempt to compensate for departing staff by hiring replacements. Some of these new employees will have work experience, and will immediately contribute to the firm. Others will be inexperienced, recent graduates, who have some general skills but

require training and experience to reach proficiency. In many firms, most entrants are of this latter type. They learn particular techniques, valuable problem-solving techniques and culture from experienced staff.

The dynamics of staff clearly affect the collection and retention of knowledge. First, the departure of experienced staff reduces tacit knowledge resources faster than that provided by new inexperienced staff, putting downward pressure on organizational knowledge. Second, the departing staff will have higher individual productivity than the newly hired staff, which exerts pressure to divert more effort to knowledge management activities to counter.

These events and their effects make it extremely difficult to predict the outcome of staff changes on the organization's knowledge capital. If the effect of staff departures on knowledge is greater than the firm's ability to build knowledge, then the firm will suffer the effects of dropping productivity and output over time. If knowledge management programs are successful, they will mitigate this effect by balancing demand for knowledge with the supply provided from KM activities.

4.4 Demand for services and growth in the firm

Growth in the firm's market is a final consideration in the dynamics of knowledge. Task backlog, the volume of work pending completion, is a critical planning measure for consulting organizations. These firms often have a mixture of short-term and long-term engagements. When engagements complete, staff are idled, and become either an overhead expense, or at

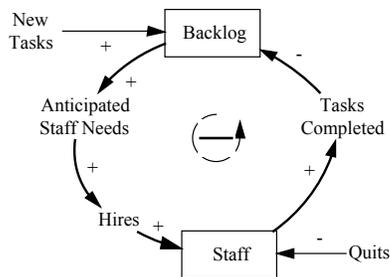


Figure 9. Task Backlog and Staffing (Backlog loop)

worst, disposable. A certain amount of backlog is desirable to ensure continuous work. Large backlogs stimulate hiring, which increases available staff, reducing the backlog (see Figure 9). There are delays in recognizing backlog and hiring additional staff,

particularly for entry-level positions that rely upon June graduations, which are not depicted here.

Backlog in turn is also dependent upon the ability of the firm to develop new projects and complete current ones (see Figure 10). New projects are necessary to meet revenue targets, which are a function of market and financial conditions. Market demand for services, treated here as an exogenous factor, affects the firm's ability to achieve its growth potential. In addition, changes in the quality of the firm's work affect its ability to locate new projects.

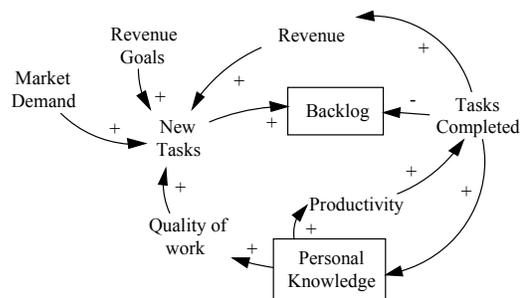


Figure 10. Market demand, task completion and task backlog

Adding corporate growth to a model of knowledge management provides a new perspective on KM strategy. Changes in demand puts pressure on the firm to grow its capacity, which in the case of consulting services, is staff and knowledge. Hiring staff too slowly limits the growth of the firm; hiring staff too quickly diminishes productivity. In the worst case, rapid growth creates a "boom and bust" scenario (see Figure 11). In response to demand, a hypothetical firm increases its staff with inexperienced employees. These employees are not as productive as those who leave, and are less effective in reducing backlog. Accumulating slippage in product delivery and quality may ultimately create a downswing in demand. Alternatively, to retain its market footing, firms may choose to control growth until capacity is available to meet demand. This is a delicate balance, as IT consulting firms are expected to be in the forefront of electronic commerce and dot.com revolution.

5. Next Steps

The causal loops presented above provide a picture of how the state of knowledge affects the organization, and how the organization affects the state of its knowledge (see Table 2). The structures either reinforce or balance the feedback in the system. The interrelationships between staff, experience, workload,

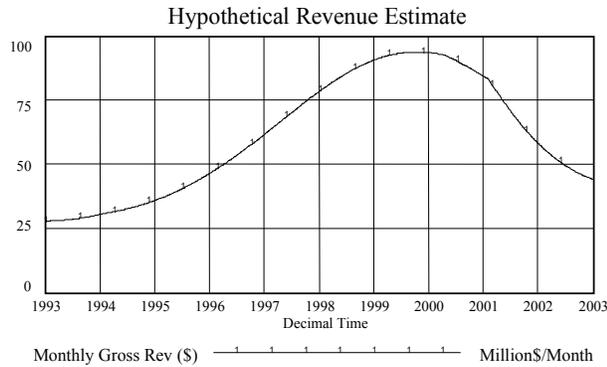


Figure 11. "Boom and Bust" from inadequate knowledge transfer

and the effect on organizational knowledge are of themselves interesting and important. From a management standpoint, however, they tell only part of the story. They identify how knowledge accumulates and dissipates, but they do not tell how quickly this occurs, and what management options exist to guide its development.

The interplay between these balancing and reinforcing loops establishes the range of outcomes of this KM system. This interplay does not become apparent until the model moves from this static state to a dynamic one, where various forces are in simultaneous motion. For example, a corporate policy allocating release time to disseminate knowledge increases personal knowledge of others, but takes away from billable hours. The tradeoff depends upon the combined effects of these loops, and the others in the system. Since the effect of disseminated knowledge is dependent upon the tenure of consultants, the effect is not permanent. Thus, the effects of knowledge management policies must be examined over time, and in context of the firm.

The next step in this analysis, then, is the development of a dynamic model that addresses the management questions surrounding knowledge management. Our current work focuses upon a simulation model to predict the interactions of the various factors in the model. Data collection is underway to fine tune the structure of the model and parameterize its variables. Unlike other attempts at evaluating the effects of knowledge management, this model does not attempt to place a dollar value on organizational knowledge. It considers instead the anticipated changes in the available knowledge in the firm, and its effect on the firm's behavior over time. With a simulation model in hand, managers will be able to predict the effect of projected growth on the

Table 2. Dynamic Structures in Knowledge Management

Structure	Description	Role
Learning from experience	Task completion leads to additional accumulated personal knowledge that affects productivity, and further increases tasks completed.	Reinforcing (+)
Knowledge Transfer	Personal knowledge may be transferred to organizational knowledge, and organizational knowledge may be transferred to personal knowledge. These effects are mitigated by limits on the effectiveness of the transfer, as well as obsolescence of knowledge	Reinforcing (+)
Dissemination, Networking and Elicitation	Efforts allocated to knowledge management increase the fraction of time spent on transferring organization knowledge to personal knowledge, personal knowledge to personal knowledge, and personal knowledge to organizational knowledge.	Reinforcing (+)
Task Completion	Increased efforts on knowledge management decrease efforts on tasks, which decreases tasks completed, which decrease efforts on knowledge management.	Balancing (-)
Backlog	Increasing backlog increases staff needs, which increases hiring, which increases tasks completed, which decreases backlog, if quits remains constant.	Balancing (-)
Staffing / Knowledge Co-flow	Changes in staffing are associated with changes in personal knowledge.	N/A

need for knowledge management efforts over time, and anticipate the outcomes of their KM policies.

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