

KNOWLEDGE MANAGEMENT FROM THE PERSPECTIVE OF SYSTEMS THEORY AND CYBERNETICS

Stuart A. Umpleby

Research Program in Social and Organizational Learning
The George Washington University
2033 K Street NW, Suite 230
Washington, DC 20052
umpleby@gwu.edu

December 22, 2000

Prepared for the annual meeting of the Society for the Advancement of Socio-Economics
Amsterdam, The Netherlands, June 2001

Knowledge Management from the Perspective of Systems Theory and Cybernetics

Stuart A. Umpleby
Research Program in Social and Organizational Learning
The George Washington University
Washington, DC 20052
Umpleby@gwu.edu

ABSTRACT

In the past fifty years the field of systems theory and cybernetics has developed new understandings of the nature of knowledge and several models and methods for improving the management of organizations. In terms of conceptions of knowledge the paper reviews the distinction between producer – product relationships on the one hand and cause and effect relationships on the other hand. Process improvement methods are a means of organizational learning that lead to increased knowledge both in individuals and in the organization as a whole. Stafford Beer's Viable System Model is a model of organizational structure and functioning that helps in identifying what knowledge is necessary for viability. Russell Ackoff's interactive planning process is a method of organizational redesign that emphasizes the

importance of knowing how present procedures can lead to problems in the future. Finally, constructivist theories of knowledge emphasize the role of the observer and hence the importance of multiple perspectives.

INTRODUCTION

Systems approaches to management emerged from the experiences of World War II. During the war men and materiel had to be moved around the world with great precision. The right amount of soldiers, guns, trucks, food, and tents had to be delivered to battlefields despite enemy actions. Quality of production was important. The guns, trucks and planes had to work as intended. The war presented other challenges. For example, radar-guided anti-aircraft guns were built and installed on ships in the Pacific Ocean near the end of the war. In many ways the war required people to think in more systemic and holistic ways than they had before. After the war the people who had developed the new methods of planning and optimization turned to using them to improve the performance of large manufacturing firms.

Since the 1940s many clever ideas have been added to the literature on systems thinking in management. This chapter will deal with just three of the most important ideas – process improvement methods, the viable system model of organizational structure, and interactive planning methods.

PROCESS IMPROVEMENT METHODS

Background

Probably no management ideas have had a greater impact on the relative power of nations than process improvement methods. Statistical quality control was originally developed by Walter Shewhart at the Bell Telephone Laboratories. These methods were widely used during World War II to improve the production of military equipment. However, after the war managers of major corporations began to emphasize quantity of production over quality. In the late 1940s nations that had been damaged in the war were rebuilding their cities, roads, and factories. Developing countries were also demanding more consumer goods such as refrigerators, radios, washing machines, automobiles, and telephones. Consequently American corporations could sell nearly everything they produced, regardless of quality.

However, the people in Japan were suffering. They had to export manufactured goods in order to buy food. But Japanese products had a reputation for poor quality. At this time Japan was occupied by the American army under the command of General Douglas MacArthur. MacArthur's staff decided that it would be useful to have a census to gather data on the number of people, houses, apartments, automobiles, etc. W. Edwards Deming, an American statistician and quality control expert who was then working for the U.S. Bureau of the Census, was invited to Japan to teach statistics and sampling methods to Japanese scientists and engineers. He not only taught them statistics, he also taught them quality improvement methods. In 1950 the Japanese Union of Scientists and Engineers established a prize for progress in quality improvement methods and named it after Edwards Deming – the Deming Prize. During the 1950s, 1960s, and 1970s the Japanese economy grew steadily at a high rate of growth. Japan emerged from wartime destruction to become one of the strongest economies in the world. By 1980 American manufacturers found that they could not compete with the Japanese. The

Japanese were selling products in the US more cheaply than American manufacturers could produce similar products. And the Japanese products were of higher quality.

In 1980 the NBC television network created a special report, “If Japan can, why can’t we?” The program investigated several possible reasons why Japanese businesses were able to out-perform American businesses – lower labor costs, the Japanese work ethic, less government regulation of business, and less labor-management strife. However, whenever the American reporters asked Japanese managers the reason for their success, the Japanese pointed to statistical quality control, which they had learned from Americans. This television program included an interview with Edwards Deming.

Following the broadcast of this program Edwards Deming and other American quality control experts were rediscovered within their own country. Large American corporations hired these experts to “save them from the Japanese.” In 1985 the Baldrige Award, named after Secretary of Commerce Malcolm Baldrige, became the American quality award for corporations. The President’s Quality Award is a similar award for quality management in U.S. government agencies. Many states in the US also have set up quality awards. There is now a European Quality Award as well.

Basic ideas

Quality improvement methods are based on the idea that an organization can be thought of as a collection of processes. Each process can be described using a flow chart. The people who work in the process constitute the quality improvement team for that process. Key features of the process are measured, for example the error rate and the cycle time. Data is collected to determine where in the process errors and delays are occurring. Then the people who work in the process try to think of ways to reduce errors and delays. New ideas are tested on a small scale and the effects on the process as a whole are measured. If the changes result in improvement, the changes are implemented on a larger scale. This process is repeated again and again – experimenting with ideas to reduce errors and delays and implementing them on a larger scale if they prove to be effective.

Quality improvement methods require training and time before they yield widely noticeable results. During this time leadership and commitment on the part of management is essential. However, the methods can be introduced by a manager at any level in an organization. As performance improves, he or she is likely to be promoted, thereby acquiring responsibility for additional processes than can be improved using these methods.

Customer satisfaction is an important part of quality improvement. Every process has customers. Customers can be inside the organization or outside the organization. Indeed, the person working in any step in a process is the customer for the person working in the previous step of the process. A very simple but highly effective method of quality improvement is the Quality Improvement Priority Matrix. First one lists the features of a product or service (e.g., styling, price, repair costs, and resale value). Customers are then asked to rate each feature on importance and performance, for example on a scale from 0 to 10. 0 importance would mean the feature is not at all important. 10 would mean the feature is very, very important. 0 performance would mean that current performance on that feature is terrible. 10 would mean that current performance on that feature is excellent. One then creates a matrix with importance on one axis and performance on the other axis. Using the average scores from customers, each feature is plotted on the matrix. It is then possible to readily see which features lie within the quadrant where importance is high and current performance is low. Improving these features

then becomes the task of process improvement teams.

The Quality Improvement Priority Matrix has many advantages. No sophisticated mathematics or statistics are required. It can be used to improve performance in manufacturing, services, government, education, and health care. Furthermore, the matrix leads to “data-driven decision-making.” Without data on which to base decisions, managers often allocate resources to friends or favored groups or to those who complain the loudest. “Data-driven decision-making” on the other hand leads to improved customer satisfaction and hence improved performance for the organization as a whole.

Every process has not only customers but also suppliers. High quality products are not possible if raw materials are of inferior quality. Hence, quality improvement requires an organization to work with suppliers to improve the quality of their products. In this way the desire of American manufacturers to adopt quality improvement methods in order to compete with Japanese manufacturers led to pressure on suppliers throughout American industry to adopt quality improvement methods. Even law firms and educational institutions have felt pressure to adopt such methods.

“Benchmarking” is an important part of quality improvement. Benchmarking refers to adopting the best practices for any particular process. One can look at similar processes within an organization or in other organizations. Indeed quality improvement awards are much more than merely ways of congratulating organizations that have done well. More importantly, the awards point to organizations that are very well managed. Organizations seeking to improve their processes can then study the methods of the award-winning companies, adopt their methods when they are applicable, and then make additional improvements on their own. Hence, benchmarking is a way of quickly making dramatic improvements by imitating the practices of the most successful organizations.

Advantages

Continuous quality improvement assumes that every person in an organization has two tasks. Each person works IN at least one process. But each person should also be working ON the process, that is, working with other team members to improve the process.

The methods used to improve processes are similar for all processes. Hence, everyone in the organization learns to speak a common language of process improvement. Frequently in organizations people in different departments use quite different technical terms. People in accounting, finance, marketing, production, and personnel departments often use quite different measures to evaluate organizational performance. The different languages of these academic specializations tend to divide people and interfere with reaching consensus on a course of action. In contrast the language of quality improvement tends to unite people and to focus attention on customer satisfaction. Consequently quality improvement methods constitute a well-developed set of tools for organizational learning. Individuals are continually learning new skills for process improvement, and the organization is continually improving its procedures.

Quality improvement methods themselves continue to evolve. From time to time the criteria for quality awards are reviewed and adjustments are made in light of recent research and experience. Furthermore, quality improvement methods tend to be culture-specific. For example, the Deming Prize in Japan is very different from the Baldrige Award in the US. The Deming Prize focuses almost solely on the use of statistical quality control. The Baldrige Award includes training, leadership, planning, and business results. Every society deals with some

issues implicitly through culture and with other issues explicitly through education. Hence, the criteria for quality awards need to be designed to suit the local society.

In the United States the Baldrige Award has become the accepted model of management. Just as one can rate a hotel as a one star to a five star hotel, managers can use the Baldrige Award criteria as a way of rating, and improving, the management of their firms. The adoption of quality improvement methods in the US since the early 1980s has restored the international competitiveness of US firms.

ORGANIZATIONAL STRUCTURE

Background

Quality improvement methods say nothing about how an organization should be structured. Hierarchical organizations, network organizations, and matrix organizations are just a few possibilities for structuring a firm or agency. The viable system model, devised by British cybernetician Stafford Beer, is another model of how one can think about an organization's structure. This model is not as widely known as the others, but may receive increasing attention in the future as information-oriented businesses become an increasingly large part of modern economies.

Basic ideas

Beer suggests that the structure of the human nervous system is a suitable model for organizational structure in general, assuming that we want the organization to be viable over time. Beer notes that the human nervous system is the result of hundreds of millions of years of evolution and is the best information-processing apparatus we know.

The viable system model identifies five structures or functions. System one consists of the units that do the basic work of the organization, for example manufacturing products or delivering services. System two consists of units that handle coordination and scheduling among the system ones. System two activities include allocating space and equipment and defining rules and procedures. System three is the middle management function, except that the primary activity is to make a "resource bargain" with the system ones. That is, system three makes resources available in exchange for a commitment by the system ones to meet certain objectives that are agreed upon. System four is responsible for long-range planning and the design of new products and services. Whereas system three is responsible for activities "inside and now," system four is responsible for activities "outside and then." System five manages the interaction between systems three and four. That is, system five decides when a new product or service that has been developed by system four will be put into production by systems three, two and one.

The viable system model is recursive, meaning that it operates at all levels of an organization. For example, consider General Motors. Within this large corporation the primary divisions or product lines are Chevrolet, Pontiac, Buick, and Cadillac. At the corporate level each division would be considered a system one. System two would coordinate activities and policies among the divisions. System three would allocate resources among the divisions. System four would consider starting or stopping various product lines, such as the Oldsmobile division. System five would make the final decision.

Looking at the Chevrolet division, the system ones might be different manufacturing facilities. System two would coordinate interaction among the manufacturing plants. System

three would allocate funds for the modernization of the different plants. System four would consider whether new manufacturing facilities or models are needed. System five would decide when to phase in new models or manufacturing methods.

The levels of recursion go down as far as the individual who must both carry out assigned tasks (systems one, two, and three) and consider whether he or she wants to change jobs or obtain more schooling (systems four and five).

Advantages

Because the viable system model is repeated at each level of the organization, people can easily imagine how other levels of the organization operate. The structures and functions at another level are similar to the structures and functions at the level they are familiar with. In this way the viable system model, like quality improvement methods, aids communication and understanding within an organization.

The viable system model is a useful guide for knowledge management. The model explains what structures, information, and procedures are needed at each level of an organization. By providing a single model of activities at all levels of the organization, the viable system model increases awareness, and hence knowledge, among employees of how the organization functions and what information is needed by each part of the organization.

INTERACTIVE PLANNING

Background

A criticism of continuous improvement methods is that they permit only incremental improvements within an organization. Sometimes a more radical restructuring or reengineering of an organization is needed or is made possible by new information technology. For such cases the interactive planning method developed by Russell Ackoff and his colleagues provides a useful guide.

Interactive planning is based on an understanding of the changes that have occurred in management thinking in the past hundred years. Ackoff suggests that three models have dominated management thought. The machine model viewed the organization as a machine. Human beings were usually unskilled workers and were treated as replaceable parts. Health programs and favorable working conditions were not thought to be necessary because there was always a large supply of new workers to replace those who became sick or injured.

The second model of a corporation was an organism. In this case management was thought of as the brain and workers as the hands and feet. In the organism model workers were more important to the viability of the firm. They could acquire skills and contribute more fully to the productivity of the firm. But workers were not considered to be autonomous entities, just as the liver or kidney does not have an independent existence outside the body.

The third model of a corporation is a social system. In this case workers are completely autonomous. They are highly skilled workers selling their services where they can get the best return. They demand favorable working conditions, flexible hours, educational opportunities and some influence over strategy, products, and production methods. When an organization is regarded as a social system, the task of management is to keep very independent-minded, highly

skilled people working together toward common goals.

Basic ideas

To accomplish this task Ackoff recommends a participatory, interactive planning process consisting of five steps. The first step is called “formulating the mess.” The colloquial term “mess” is used to designate a collection of interrelated problems. That is, there is not a single problem but many problems that influence each other. The task of the planning exercise is to define this set of interrelated problems and to define a “reference scenario.” The reference scenario can be thought of as “the future that is contained within the present.” Think of the corporation as a bus traveling down a highway. If it continues going in the direction it is now going, what cliff will it drop off? The task of the reference scenario and of formulating the mess, is to identify this “cliff.” It might be a shortage of skilled workers, insufficient financial capital or competition from other corporations or countries.

Once the critical issue for the future has been identified, the second task of the planning exercise is “ends planning,” redesigning the corporation and its product line so that the corporation does not “drop off the cliff.” In this part of the planning process creativity is highly valued. The task is to think in quite new ways -- to imagine new products and services and new ways to get them to customers.

When the new, idealized design has been completed, the group turns its attention to “means planning,” to figure out how to get from here to there. Following means planning, “resource planning” is concerned with assembling the needed resources – money, people, office space, equipment, etc. The last step is “implementation and control,” making sure that the plans that have been made are successfully carried out, on schedule and within budget.

Advantages

Interactive planning is particularly effective with business corporations in a competitive economy because it is not simply a procedure for formulating plans. At least as important, this is a method for overcoming complacency, inertia, and psychological “resistance to change.” Large successful organizations tend to be resistant to change. People often think that if they have been successful so far, there is no need to change. That is why the reference scenario is so important. The reference scenario convinces people that change is necessary for the organization to survive. Once people have been convinced of that, they are ready to change old habits and create a new organization.

The effect of interactive planning, particularly when it is practiced by many firms in many industries, is to create a very dynamic, highly creative, but very unstable economic environment. New products and services come onto the market at a dizzying pace. Forecasting by extrapolating trends becomes much less effective. Companies cannot adapt to competitors fast enough. The only solution is to continually redesign one’s own products and services by imagining features that do not yet exist.

QUESTIONS

1. What country taught the United States that it needed to improve the quality of its manufactured products?
2. Is the viable system model based upon an analogy to a living organism or the nervous

system of a human being?

3. In interactive planning what is the most important part of “formulating the mess”?
4. Which of the methods discussed above includes a strategy for overcoming resistance to change?
5. Which of the methods might serve as a guide to the practice of “knowledge management”?
6. Which of the methods discussed above provides a procedure for “organizational learning”?

REFERENCES

There are many books on continuous improvement methods. The average technical bookstore in the US will contain not just a shelf of books on the subject but a whole bookcase. Several companies offer software packages for tabulating, graphing, and displaying data. Some companies sell training materials, and many training programs are available. A search of the world wide web will quickly lead to many resources. A good introductory book is Mary Walton's *The Deming Management Method*, A Perigee Book, 1986. A more recent book by a leading current practitioner is Brian Joiner's *Fourth Generation Management*, McGraw-Hill, 1994.

Stafford Beer's viable system model was first described in his book *Brain of the Firm*, John Wiley, 1972. A further description of the model is in *The Heart of Enterprise*, John Wiley, 1979.

Russell Ackoff's interactive planning method was first presented in his book *Creating the Corporate Future: Plan or be Planned for*. John Wiley, 1981. A further explanation of how to do interactive planning is available in Russell Ackoff, E.V. Finnel and J. Gharajedaghi, *A Guide to Controlling your Corporation's Future*. John Wiley, 1984.

[back to recent papers page](#)