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Abstract: The author provides a brief overview of the two approaches for production and quality improvement: total quality management and continuous process reengineering. He identified the basic differences and similarities in the two approaches. He also presents ideas about which of these approaches has the most to offer a company interested in maintaining or expanding its share of the market.

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Introduction

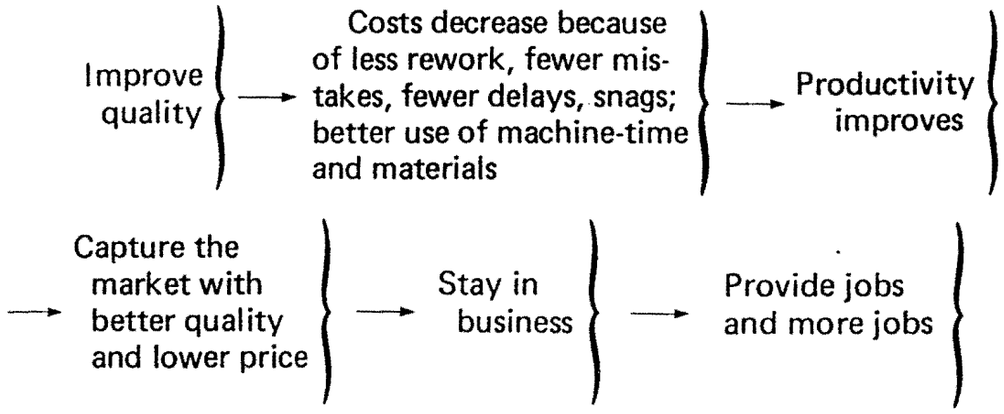
A fundamental principle of Total Quality Management (TQM) is the idea that product quality is achieved through continuous process improvement. In order to produce a product or service which consistently meets customer expectations, variations in the product must be controlled and reduced as much as possible. This reduction in variation is achieved through continuous improvements to the production process. Within the last several years, a number of authors have suggested that significant improvements in output and quality will only be achieved through process reengineering, and that small continuous improvements will not allow American industry to maintain its dominant role as a world economic power. My purpose in this paper is to provide a brief overview of the two approaches to improved production and quality. I will identify the basic differences and similarities in the two approaches. Finally, I will offer some ideas about which of these two approaches has the most to offer the company which is interested in maintaining or expanding its share of the market.

Total Quality Management and Continuous Process Improvement

Total Quality Management is a philosophy of management which had its beginnings in the mid 1920's and 1930's. It started with a group of employees at Bell Systems and Western Electric who were concerned with problems resulting from the number of defects in their products. One of these employees, Walter Shewhart, began to investigate the use of statistics as a way of measuring the current quality

of the products that were being produced. At the same time, George Edwards was working to increase management awareness of the need for quality controls. The work which these and other individuals started has grown to become a management philosophy which is being adopted by many large organizations throughout the world. In 1986, the White House issued an Executive Order which makes TQM the management philosophy of the Federal Government.

The primary focus of TQM is on quality improvement. Deming [4] describes the chain reaction which occurs when quality is improved. The process begins:



Quality is improved through continuous improvement of the production process. These improvements are achieved by minimizing the variation in the process. The techniques for identifying and minimizing variation is called Statistical Process Control.

It is important to recognize that output quality may vary for a large number of reasons. TQM divides these reasons into two categories. The first category includes those sources of variation which are inherent in the production process. These causes of variation are generally referred to as **common causes** of variation. The second category is those sources of variation which are not caused by parts of the constant system. This category was originally called **assignable causes** by Shewhart; Deming later called this type of variation **special causes.** Tom Pyzdek indicates:

> "Statistical process control (SPC) is defined as the use of statistical methods to identify the existence of special causes of variation in a process.
>
> The basic rule of Statistical Process Control is:
>
> VARIATION FROM COMMON CAUSE SYSTEMS SHOULD BE LEFT TO CHANCE, BUT SPECIAL CAUSES OF VARIATION SHOULD BE IDENTIFIED AND ELIMINATED." [9, p.40]

Reengineering or Process Innovation

In 1990, two articles appeared at about the same time. One of the articles was jointly authored by Thomas Davenport and James E. Short [3]. It was entitled, "The New Industrial Engineering: Information Technology and Business Process Redesign" and was published in the Summer issue of the Sloan Management Review. The second article, written by Michael Hammer [6] appeared in the July-August issue of the Harvard Business Review. His article was called, "Reengineering Work; Don't Automate, Obliterate." Both of these articles contained

the same theme, major changes in the quantity or quality of output can only be achieved through process innovation.

Hammer uses the term "reengineering" to describe process innovation. He defines reengineering as:

> "Reengineering strives to break away from the old rules about how we organize and conduct business. It involves recognizing and rejecting some of them and then finding imaginative new ways to accomplish work. From our redesigned processes, new rules will emerge that fit the times. Only then can we hope to achieve quantum leaps in performance" [6, p.104]

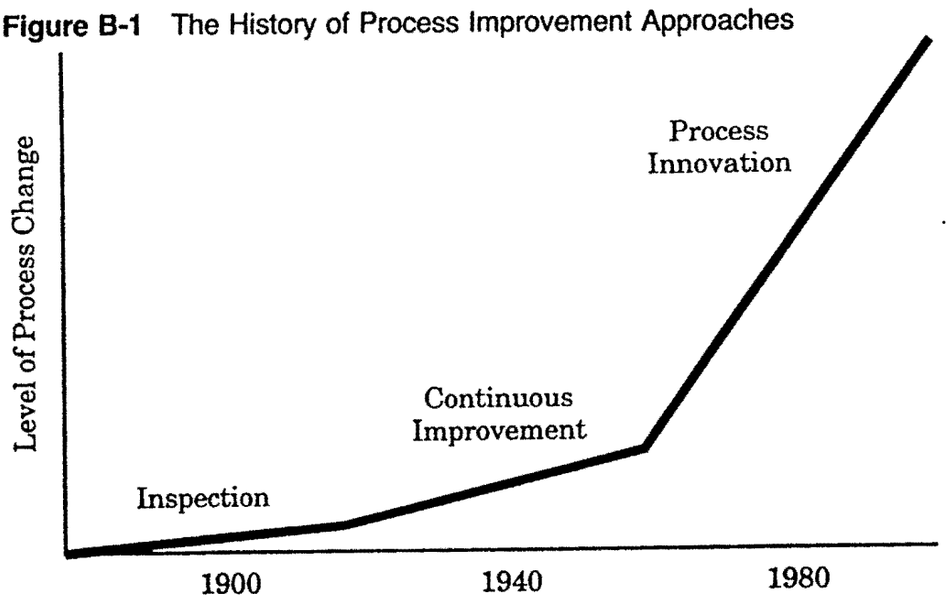
This same theme is developed by Davenport in his 1993 book "Process Innovation." He indicates:

> "Achievements of order-of-magnitude levels of improvement in these processes means redesigning them from beginning to end, employing whatever innovative technologies and organizational resources are available." [2, p.1]

Both of the original articles on reengineering focused on the use of information technology (IT) as the method for implementing process change. Hammer is particularly critical of the use of information technology which leaves the existing processes intact and uses computers to do the same work faster. He suggests "..speeding up those processes cannot address their fundamental performance deficiencies." He continues with a phrase which is being widely quoted in data processing publications, "It is time to stop paving the cow paths. Instead of embedding outdated processes in silicon and software, we should obliterate them and start over."

approach to business improvement was the quality control or TQM approach of Shewhart and Deming. Here the focus is on continuous improvement and minimizing variation in existing processes. Davenport goes on to suggest that process innovation is the next advancement in the tools available to improve quality and productivity. He includes the following graph:

Figure 1. [2, p.320]



Hammer makes the point even stronger in his new book. He indicates that reengineering is not the same as "quality improvement, total quality management (TQM), or any other manifestation of the contemporary quality movement." He goes on to indicate:

> "..the two programs also differ fundamentally. Quality programs work within the framework of a company's existing processes and seek to

> enhance them by means of what the Japanese call *kaizen*, or continuous incremental improvement. The aim is to seek steady incremental improvement to process performance. Reengineering, as we have seen, seeks breakthroughs, not by enhancing existing processes, but by discarding them and replacing them with entirely new ones. Reengineering involves, as well, a different approach to change management from that needed by quality programs." [7, p.49]

The concept of process is central to total quality management and to reengineering. In the next section, I want to examine how each of these approaches to quality improvement and productivity deals with the concept of process.

Process

In both TQM and reengineering the focus is on the production process and ways of improving the process. In order to understand what is meant by process, it is necessary to begin with the more general concept of a system. Richard Daft [1] defines a system as "..a set of interacting elements that acquires inputs from the environment, transforms them, and discharges outputs to the external environment." The transformation of inputs into one or more outputs is the production process.

The process will be a number of steps or work activities which are ordered in time and space and which operate together to produce the desired output. For the proponents of TQM, the continuous process improvement cycle reaches far beyond the process itself. On the input side, it extends the system boundary to include suppliers of the raw materials or inputs to the production process. On the output

side, it extends the system boundary to include the end consumer as the final judge of product quality. In this way, both the provider of inputs and the consumer of the product are included in the attempts at continuous process improvement. This TQM approach also redefines process to reach across the functional boundaries of the organization. Continuous improvement teams will often include members from marketing, research and development, and design. While it appears that TQM has extended the system boundaries, continuous process improvement concentrates on the steps or activities of the production process. The goal is to remove as much of the variation in output quality as possible.

Reengineering also deals with the organization of the steps or work activities. Where continuous process improvement looks for slow continuous improvements in quality through small changes in work processes, reengineering attempts to find large changes in quantity or quality through process innovation. The goal of process reengineering is to reorganize or eliminate steps in the production process to make the process more efficient. This leads to substantial increases in quality or quantity in short periods of time. Where TQM accepts the ordering of work activities and attempts to improve quality by reducing variation at every step, reengineering is directed at re-ordering or eliminating as many of the steps as possible. It attempts to achieve improvements in quality and quantity of output by replacing work activities with more efficient processes or changing the time and spacial relation of existing activities.

In order to achieve these breakthrough increases in productivity, both Hammer and Davenport describe reengineering as a process in which the system boundaries must be expanded or extended to include the customer and supplier. It also extends the system boundaries to include the processes used to produce the inputs to the process under study and the processes which deliver the outputs to the next stage of production or to the final customer. Several of the examples of significant increases in productivity which the authors describe are achieved by combining two or more production processes and eliminating many of the duplicated steps. Often this requires shifting responsibility for parts of the production process; often this requires relocating whole processes from one functional area to another or from one physical location to another. From a system perspective, reengineering requires that the perspective of the innovator be shifted to allow the process being studied for improvement to becomes a sub-process of a larger process.

Key Differences and Similarities

Several of the key differences and similarities between the TQM and reengineering approach to quality and productivity have already been discussed. One of the key differences is the **focus** of the two approaches. Throughout the paper, I have used the terms quality and productivity almost interchangeably. In the TQM model, the primary focus is on improved quality through reduced variation. The Deming chain reaction indicates that these quality improvements will decrease costs because of less rework, fewer mistakes, fewer delays, etc. Increased productivity is a result of

producing more usable products because of the improved quality. Quality is the primary focus of the continuous quality improvement process, increased productivity is a secondary result.

In the reengineering approach, the focus is on process redesign. The result of this redesign will be increased productivity, increased quality and decreased cost. Where TQM focused on small incremental changes, reengineering is looking for significant one-time increases. In his HBR article, Hammer [6, p.112] indicates "We must have the boldness to imagine taking 78 days out of an 80-day turnaround time, cutting 75% of overhead, and eliminating 80% of errors." He suggests, "These are not unrealistic goals. If managers have the vision, reengineering will provide a way." Both Hammer and Davenport provide a number of examples of firms which have increased productivity 60% to 80% through the use of process reengineering.

A second difference between TQM and process reengineering has to do with the **level and frequency** of change. In TQM, the changes are small and the process is controlled. If the Deming Cycle of plan, do, check and act (PDCA) is followed, data will be collected and each change will be evaluated before the next change is undertaken. Quality is the result of a series of incremental changes taken over a reasonable period of time. A reasonable time is long enough to be sure that the process being improved is stable and in control before the next change takes place. In reengineering, the change is drastic and is done once. Hammer indicates

"Reengineering cannot be planned meticulously and accomplished in small and cautious steps. It's an all-or-nothing proposition with an uncertain result." [6, p.105]

The two approaches differ in how they work with the **existing process**. In TQM, the existing process is studied using statistical process control. It is important to understand the existing process and to be sure that it is in control. This requires that all causes of variation that lie outside the system have been removed or eliminated. Continuous process improvement then works to minimize the variations in quality which result from common causes which are inherent in the production process [5]. Reengineering is directed at completely redesigning or replacing the existing process. Hammer indicates that it is alright to study the existing process but the innovator needs to be careful not to become locked in. Too much knowledge of the existing process can become a kind of trap which makes it difficult for the innovator to picture new ways of doing business.

A key ingredient for process reengineering is the use of information technology as the **enabling technology**. The use of information technology was the primary focus of the initial papers by both Hammer and Davenport. Hammer's book [7], which appeared some three years after his paper still maintains the concept of information technology being the "*essential enabler.*" The techniques he describes for accomplishing the reengineering process are essentially the same techniques

that have been used for computer systems analysis for many years. The paradigm shift which he proposes is to focus on the reorganization of work activities rather than attempting to improve the efficiency of what already exists.

Davenport [2] also retains the notion of IT being an essential tool in process innovation. He has expanded the innovation process and now includes organizational enablers, cultural enablers, structural enablers and a host of management techniques and processes for creating an environment in which innovation can take place.

For total quality management, statistical process control is the enabling technology for quality improvement. Statistical process control is the use of statistical techniques to identify the sources of variation in production processes. Control charts are constructed by drawing samples from the output of the production process. Data from these samples is compared to determine the variation which exists in the output of the process. These charts have common form. The mean of the sample means forms the centerline for the chart. Upper and lower control limits are computed from the sample data or are determined externally based on the required standards of the process. These charts can be used to determine the variation which exists between samples and to monitor the progress of process improvements.

The major area of similarity of continuous process improvement and reengineering is the requirement for a specific **corporate culture** if these techniques are to be effective. SPC operates within a total quality program which requires a number of cultural elements to exist if it is to be successful. One of these cultural elements is the commitment and participation of top management. This management support is critical if resources are going to be available. Management support and commitment are also essential in order to create an environment in which the changes necessary to support continuous process improvement can take place. Without management support, a total quality program has little or no chance of success.

A second cultural element which must exist if TQM is to be successful is the use of teams for problem solving. These teams will involve individuals from all levels of the organization working together. The team allows the pooling of skills and creates a synergy which allows the effectiveness of the team to be greater than the sum of the individual efforts of its members. It is important that these teams adopt a consensus decision rule rather than a workgroup approach. This will insure that no decision is reached until it has at least the tacit approval of every member of the group. It is also important that suppliers and customers be involved in the problem solving process. This often requires that they participate on project teams and assume some ownership for the improvement process. While the implementation of a TQM culture is a top down process, the identification and

implementation of the necessary changes is a bottom up process.

Another cultural element which characterizes TQM is the use of the scientific approach and statistical methods for problem analysis and decision making. This creates an environment where decisions are based on a factual understanding of the production process. It also allows you to monitor the effects of on quality of changes to the production process. In addition to statistical process control, there are a number of other tools for analyzing the process, identifying potential problem areas and developing suggestions for improvement areas. These tools include the use of: 1) Pareto Charts to rank different kinds of quality defects; 2) histograms to determine the frequency of various types of defects; 3) scatter diagrams to compare two variables and; 4) flow charts to develop an understanding of process characteristics.

Davenport [2] describes the corporate culture required for a successful process innovation program. It is the responsibility of management to develop a vision of the strategic direction of the corporation. This vision must be linked to the way that work is done in the organization. This will allow process innovation to provide improvements in the production process that are consistent with the strategic direction of the business. Management support for process innovation will be a result of the degree to which the proposed process improvement supports the strategic direction of the business.

to identify only the most important process based on the business vision and the process objectives.

3) **Understand and Measure Existing Processes** - There are two primary reasons for this step. First, problems must be understood so that they are not repeated. Second, accurate measurement can serve as a baseline for future improvements.

4) **Identify IT Levers** - Awareness of the capabilities of information technology should influence the process design. For instance, information technology can transfer information rapidly and easily across large distances. This makes processing independent of geography. Davenport [2, p.51] identifies eight additional IT levers.

5) **Design and Build a Prototype of the Process** - Using a prototype allows the design team to begin to design and build the process while the other steps are being done. By not waiting until the other steps have been completed, prototyping usually achieves results faster than the traditional systems development life cycle methods.

Conclusion

On May 26, 1993, I attended The 1993 Information Systems Symposium, Emerging Issues in Information Technology. One of the speakers at the conference was William Ek who heads the West Coast Business Processes Transformation Practice for Price Waterhouse. The subject of his talk was "Reengineering the Business:

Profiting through Performance Improvement." He suggested that business process reengineering and continuous process improvement will co-exist in most business firms, and reengineering was what you do when you completely replace a process and continuous improvement was what you did in between.

There are two questions which I think need to be resolved. First, is William Ek right, can continuous process improvement and reengineering co-exist in the same organization? Second, is process innovation or reengineering the logical successor to TQM's continuous process improvement as Davenport suggests?

My impression is that neither the TQM advocates or the reengineers would agree with Mr. Ek. The notion of radical redesign or replacement of business processes runs counter to the controlled continuous improvement which is a critical element of a quality management process. At the same time, Davenport and Hammer believe that continuous process improvement will not produce the improvements in productivity and quality which are required if the U.S. is to retain a dominant position in the world economy.

I think the two approaches to quality and productivity improvement will not coexist because they each require a fundamentally different corporate culture to be effective. Continuous process improvement works in an environment where empowered work teams can exist. It requires a management style that empowers