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QUALITY GURUS

The Quality Gurus—Dr. W. Edwards Deming, Dr. Joseph Juran, Philip Crosby, Armand V. Feigenbaum, Dr. H. James Harrington, Dr. Kaoru Ishikawa, Dr. Walter A. Shewhart, Shigeo Shingo, Frederick Taylor, and Dr. Genichi Taguchi—have made a significant impact on the world through their contributions to improving not only businesses, but all organizations including state and national governments, military organizations, educational institutions, healthcare organizations, and many other establishments and organizations.

DR. W. EDWARDS DEMING (1900–1993)

Dr. W. Edward Deming is best known for reminding management that most problems are systemic and that it is management's responsibility to improve the systems so that workers (management and non-management) can do their jobs more effectively. Deming argued that higher quality leads to higher productivity, which, in turn, leads to long-term competitive strength. The theory is that improvements in quality lead to lower costs and higher productivity because they result in less rework, fewer mistakes, fewer delays, and better use of time and materials. With better quality and lower prices, a firm can achieve a greater market share and thus stay in business, providing more and more jobs.

When he died in December 1993 at the age of ninety-three, Deming had taught quality and productivity improvement for more than fifty years. His Fourteen Points, System of Profound Knowledge, and teachings on statistical control and process variability are studied by people all over the world. His books

include: *Out of the Crisis* (1986), *The New Economics* (1993), and *Statistical Adjustment of Data* (1943).

In emphasizing management's responsibility, Deming noted that workers are responsible for 10 to 20 percent of the quality problems in a factory, and that the remaining 80 to 90 percent is under management's control. Workers are responsible for communicating to management the information they possess regarding the system. Deming's approach requires an organization-wide cultural transformation.

Deming's philosophy is summarized in his famous fourteen points, and it serves as a framework for quality and productivity improvement. Instead of relying on inspection at the end of the process to find flaws, Deming advocated a statistical analysis of the manufacturing process and emphasized cooperation of workers and management to achieve high-quality products.

Deming's quality methods centered on systematically tallying product defects, analyzing their causes, correcting the causes, and recording the effects of the corrections on subsequent product quality as defects were prevented. He taught that it is less costly in the long-run to get things done right the first time then fix them later.

THE RISE OF DEMING'S INFLUENCE

The son of a small-town lawyer, Deming (a teacher and consultant in statistical studies) attended the University of Wyoming, University of Colorado, and Yale University, where he earned his Ph.D. in mathematical physics. He then taught physics at several universities, worked as a mathematical physicist at the U.S. Department of Agriculture and was a statistical adviser for the U.S. Census Bureau.

From 1946 to 1993 he was a professor of statistics at New York University's graduate school of business administration, and he taught at Columbia University. Deming became interested in the use of statistical analysis to achieve better quality control in industry in the 1930s.

In 1950 Deming began teaching and consulting with Japanese industrialists through the Union of Japanese Scientists and Engineers (JUSE). In 1960, he received the Second Order Medal of the Sacred Treasure from the Emperor of Japan for improvement of quality and the Japanese economy. In 1987 he received the National Medal of Technology from U. S. President Ronald Reagan because of his impact on quality in the United States.

From 1946 to 1993, he was an international teacher and consultant in the area of quality improvement based on statistics, leadership, and customer satisfaction. The Deming Prize for quality was established in 1951 in Japan by JUSE and in 1980 in the United States by the Metropolitan Section of the American Society for Quality.

American companies ignored Deming's teachings for years. In 1980, NBC aired the program "If Japan Can, Why Can't We?," highlighting Deming's contributions in Japan and American companies began to discover Deming. His ideas were used by major U.S. corporations as they sought to compete more effectively against foreign manufacturers.

As a consultant, Deming continued to conduct Quality Management seminars until just days before his death in 1993.

DEMING'S SYSTEM OF PROFOUND KNOWLEDGE

One of Deming's essential theories is his System of Profound Knowledge, which includes appreciation for a system, knowledge about variation (statistics), theory of knowledge, and psychology (of individuals, groups, society, and change). Although the Fourteen Points are probably the most widely known of Dr. Deming's theories, he actually taught them as a part of his System of Profound Knowledge. His knowledge system consists of four interrelated parts: (1) Theory of Optimization; (2) Theory of Variation; (3) Theory of Knowledge; and (4) Theory of Psychology.

THEORY OF OPTIMIZATION. The objective of an organization is the optimization of the total system and not the optimization of the individual subsystems. The total system consists of all constituents—customers, employees, suppliers, shareholders, the community, and the environment. A company's long-term objective is to create a win-win situation for all of its constituents.

Subsystem optimization works against this objective and can lead to a suboptimal total system. According

to Deming, it is poor management, for example, to purchase materials or service at the lowest price or to minimize the cost of manufacturing if it is at the expense of the system. Inexpensive materials may be of such inferior quality that they will cause excessive costs in adjustment and repair during manufacturing and assembly.

THEORY OF VARIATION. Deming's philosophy focuses on improving the product and service uncertainty and variability in design and manufacturing processes. Deming believed that variation is a major cause of poor quality. In mechanical assemblies, for example, variations from specifications for part dimensions lead to inconsistent performance and premature wear and failure. Likewise, inconsistencies in service frustrate customers and hurt companies' reputations. Deming taught Statistical Process Control and used control charts to demonstrate variation in processes and how to determine if a process is in statistical control.

There is a variation in every process. Even with the same inputs, a production process can produce different results because it contains many sources of variation, for example the materials may not be always be exactly the same; the tools wear out over time and they are subjected to vibration heat or cold; or the operators may make mistakes. Variation due to any of these individual sources appears at random; however, their combined effect is stable and usually can be predicted statistically. These factors that are present as a natural part of a process are referred to as common (or system) causes of variation.

Common causes are due to the inherent design and structure of the system. It is management's responsibility to reduce or eliminate common causes. Special causes are external to the system, and it is the responsibility of operating personnel to eliminate such causes. Common causes of variation generally account for about 80 to 90 percent of the observed variation in a production process. The remaining 10 to 20 percent are the result of special causes of variation, often called assignable causes. Factors such as bad material from a supplier, a poorly trained operator or excessive tool wear are examples of special causes. If no operators are trained, that is system problem, not a special cause. The system has to be changed.

THEORY OF KNOWLEDGE. Deming emphasized that knowledge is not possible without theory, and experience alone does not establish a theory. Experience only describes—it cannot be tested or validated—and alone is no help for management. Theory, on the other hand, shows a cause-and-effect relationship that can be used for prediction. There is a lesson here for the widespread benchmarking practices: copying only an example of success, without understanding it in theory, may not lead to success, but could lead to disaster.

THEORY OF PSYCHOLOGY. Psychology helps to understand people, interactions between people and circumstances, interactions between leaders and employees, and any system of management. Consequently, managing people requires knowledge of psychology. Also required is knowledge of what motivates people. Job satisfaction and the motivation to excel are intrinsic. Reward and recognition are extrinsic. Management needs to create the right mix of intrinsic and extrinsic factors to motivate employees.

DEMING'S SEVEN DEADLY DISEASES

Deming believed that traditional management practices, such as the Seven Deadly Diseases listed below, significantly contributed to the American quality crisis.

1. Lack of constancy of purpose to plan and deliver products and services that will help a company survive in the long term.
2. Emphasis on short-term profits caused by short-term thinking (which is just the opposite of constancy of purpose), fear of takeovers, worry about quarterly dividends, and other types of reactive management.
3. Performance appraisals (i.e., annual reviews, merit ratings) that promote fear and stimulate unnecessary competition among employees.
4. Mobility of management (i.e., job hopping), which promotes short-term thinking.
5. Management by use of visible figures without concern about other data, such as the effect of happy and unhappy customers on sales, and the increase in overall quality and productivity that comes from quality improvement upstream.
6. Excessive medical costs, which now have been acknowledged as excessive by federal and state governments, as well as industries themselves.
7. Excessive costs of liability further increased by lawyers working on contingency fees.

DEMING'S FOURTEEN POINTS

Deming formulated the following Fourteen Points to cure (eliminate) the Seven Deadly Diseases and help organizations to survive and flourish in the long term:

1. Create constancy of purpose toward improvement of product and service. Develop a plan to be competitive and stay in business. Everyone in the organization, from top management to shop floor workers, should learn the new philosophy.

2. Adopt the new philosophy. Commonly accepted levels of delays, mistakes, defective materials, and defective workmanship are now intolerable. We must prevent mistakes.
3. Cease dependence on mass inspection. Instead, design and build in quality. The purpose of inspection is not to send the product for rework because it does not add value. Instead of leaving the problems for someone else down the production line, workers must take responsibility for their work. Quality has to be designed and built into the product; it cannot be inspected into it. Inspection should be used as an information-gathering device, not as a means of "assuring" quality or blaming workers.
4. Don't award business on price tag alone (but also on quality, value, speed and long term relationship). Minimize total cost. Many companies and organizations award contracts to the lowest bidder as long as they meet certain requirements. However, low bids do not guarantee quality; and unless the quality aspect is considered, the effective price per unit that a company pays its vendors may be understated and, in some cases, unknown. Deming urged businesses to move toward single-sourcing, to establish long-term relationships with a few suppliers (one supplier per purchased part, for example) leading to loyalty and opportunities for mutual improvement. Using multiple suppliers has been long justified for reasons such as providing protection against strikes or natural disasters or making the suppliers compete against each other on cost. However, this approach has ignored "hidden" costs such as increased travel to visit suppliers, loss of volume discounts, increased set-up charges resulting in higher unit costs, and increased inventory and administrative expenses. Also constantly changing suppliers solely on the base of price increases the variation in the material supplied to production, since each supplier's process is different.
5. Continuously improve the system of production and service. Management's job is to continuously improve the system with input from workers and management. Deming was a disciple of Walter A. Shewhart, the developer of control charts and the continuous cycle of process improvement known as the Shewhart cycle. Deming popularized the Shewhart Cycle as the Plan-Do-Check-Act (PDCA) or Plan-Do-Study-Act (PDSA) cycle; therefore, it is also often referred to as the Deming cycle.

In the planning stage, opportunities for improvement are recognized and operationally defined. In the doing stage, the theory and course of action developed in the previous stage is tested on a small scale through conducting trial runs in a laboratory or prototype setting. The results of the testing phase are analyzed in the check/study stage using statistical methods. In the action stage, a decision is made regarding the implementation of the proposed plan. If the results were positive in the pilot stage, then the plan will be implemented. Otherwise alternative plans are developed. After full scale implementation, customer and process feedback will again be obtained and the process of continuous improvement continues.

6. Institute training on the job. When training is an integral part of the system, operators are better able to prevent defects. Deming understood that employees are the fundamental asset of every company, and they must know and buy into a company's goals. Training enables employees to understand their responsibilities in meeting customers' needs.
7. Institute leadership (modern methods of supervision). The best supervisors are leaders and coaches, not dictators. Deming highlighted the key role of supervisors who serve as a vital link between managers and workers. Supervisors first have to be trained in the quality management before they can communicate management's commitment to quality improvement and serve as role models and leaders.
8. Drive out fear. Create a fear-free environment where everyone can contribute and work effectively. There is an economic loss associated with fear in an organization. Employees try to please their superiors. Also, because they feel that they might lose their jobs, they are hesitant to ask questions about their jobs, production methods, and process parameters. If a supervisor or manager gives the impression that asking such questions is a waste of time, then employees will be more concerned about pleasing their supervisors than meeting long-term goals of the organization. Therefore, creating an environment of trust is a key task of management.
9. Break down barriers between areas. People should work cooperatively with mutual trust, respect, and appreciation for the needs of others in their work. Internal and external organizational barriers impede the flow of information, prevent entities from perceiving organizational goals, and foster the pursuit of subunit goals that are not necessarily consistent with the organizational goals. Barriers between organizational levels and departments are internal barriers. External barriers are between the company and its suppliers, customers, investors, and community. Barriers can be eliminated through better communication, cross-functional teams, and changing attitudes and cultures.
10. Eliminate slogans aimed solely at the work force. Most problems are system-related and require managerial involvement to rectify or change. Slogans don't help. Deming believed that people want to do work right the first time. It is the system that 80 to 90 percent of the time prevents people from doing their work right the first time.
11. Eliminate numerical goals, work standards, and quotas. Objectives set for others can force sub-optimization or defective output in order to achieve them. Instead, learn the capabilities of processes and how to improve them. Numerical goals set arbitrarily by management, especially if they are not accompanied by feasible courses of action, have a demoralizing effect. Goals should be set in a participative style together with methods for accomplishment. Deming argued that the quota or work standard system is a short-term solution and that quotas emphasize quantity over quality. They do not provide data about the process that can be used to meet the quota, and they fail to distinguish between special and common causes when seeking improvements to the process.
12. Remove barriers that hinder workers (and hinder pride in workmanship). The direct effect of pride in workmanship is increased motivation and a greater ability for employees to see themselves as part of the same team. This pride can be diminished by several factors: (1) management may be insensitive to workers' problems; (2) they may not communicate the company's goals to all levels; and (3) they may blame employees for failing to meet company goals when the real fault lies with the management.
13. Institute a vigorous program of education and self improvement. Deming's philosophy is based on long-term, continuous process improvement that cannot be carried out without properly trained and motivated employees. This point addresses the need for ongoing and continuous education and self-improvement for the entire organization.

This educational investment serves the following objectives: (1) it leads to better motivated employees; (2) it communicates the company goals to the employees; (3) it keeps the employees up-to-date on the latest techniques and promotes teamwork; (4) training and retraining provides a mechanism to ensure adequate performance as the job responsibilities change; and (5) through increasing job loyalty, it reduces the number of people who “job-hop.”

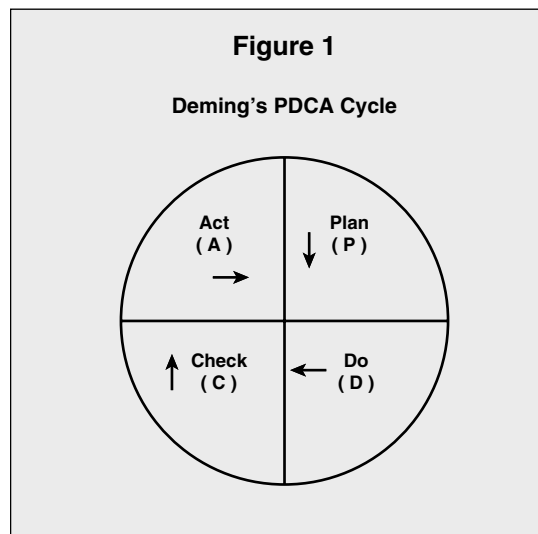
14. Take action to accomplish the transformation. Create a structure in top management that will promote the previous thirteen points. It is the top management’s responsibility to create and maintain a structure for the dissemination of the concepts outlined in the first thirteen points. Deming felt that people at all levels in the organization should learn and apply his Fourteen Points if statistical process control is to be a successful approach to process improvement and if organizations are to be transformed. However, he encouraged top management to learn them first. He believed that these points represent an all-or-nothing commitment and that they cannot be implemented selectively.

THE DEMING CYCLE

Known as the Deming Plan-Do-Check-Act (PDCA) Cycle, this concept was invented by Shewhart and popularized by Deming. This approach is a cyclic process for planning and testing improvement activities prior to full-scale implementation and/or prior to formalizing the improvement. When an improvement idea is identified, it is often wise to test it on a small scale prior to full implementation to validate its benefit. Additionally, by introducing a change on a small scale, employees have time to accept it and are more likely to support it. The Deming PDCA Cycle provides opportunities for continuous evaluation and improvement.

The steps in the Deming PDCA or PDSA Cycle as shown in Figure 1 are as follows:

1. Plan a change or test (P).
2. Do it (D). Carry out the change or test, preferably on a small scale.
3. Check it (C). Observe the effects of the change or test. Study it (S).
4. Act on what was learned (A).
5. Repeat Step 1, with new knowledge.
6. Repeat Step 2, and onward. Continuously evaluate and improve.



Deming was trained as a mathematical physicist, and he utilized mathematical concepts and tools (Statistical Process Control) to reduce variation and prevent defects. However, one of his greatest contributions might have been in recognizing the importance of organizational culture and employee attitudes in creating a successful organization. In many ways, his philosophies paralleled the development of the resource-based view of organizations that emphasized that employee knowledge and skills and organizational culture are very difficult to imitate or replicate, and they can serve as a basis of sustainable competitive advantage.

DR. JOSEPH JURAN (B. 1904)

Dr. Juran was born on December 24, 1904 in Braila, Romania. He moved to the United States in 1912 at the age of 8. Juran’s teaching and consulting career spanned more than seventy years, known as one of the foremost experts on quality in the world.

A quality professional from the beginning of his career, Juran joined the inspection branch of the Hawthorne Co. of Western Electric (a Bell manufacturing company) in 1924, after completing his B.S. in Electrical Engineering. In 1934, he became a quality manager. He worked with the U. S. government during World War II and afterward became a quality consultant. In 1952, Dr. Juran was invited to Japan. Dr. Edward Deming helped arrange the meeting that led to this invitation and his many years of work with Japanese companies.

Juran founded the Juran Center for Quality Improvement at the University of Minnesota and the Juran Institute. His third book, *Juran's Quality Control Handbook*, published in 1951, was translated into Japanese. Other books include *Juran on Planning for Quality* (1988), *Juran on Leadership for Quality*

(1989), *Juran on Quality by Design* (1992), *Quality Planning and Analysis* (1993), and *A History of Managing for Quality* (1995). *Architect of Quality* (2004) is his autobiography.

SELECTED JURAN QUALITY THEORIES

Juran’s concepts can be used to establish a traditional quality system, as well as to support Strategic Quality Management. Among other things, Juran’s philosophy includes the Quality Trilogy and the Quality Planning Roadmap.

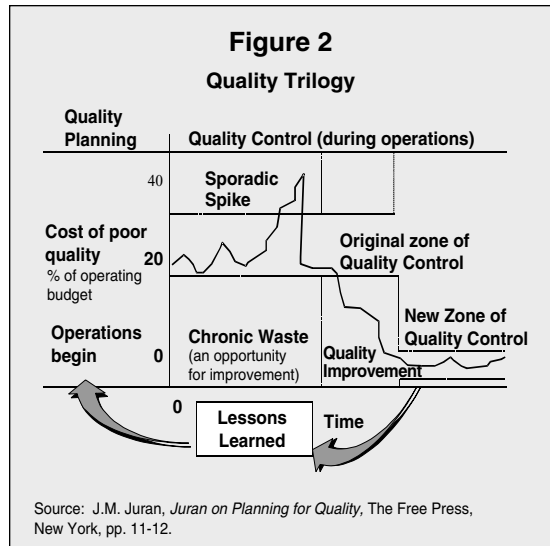
JURAN’S QUALITY TRILOGY. The Quality Trilogy emphasizes the roles of quality planning, quality control, and quality improvement. Quality planning’s purpose is to provide operators with the ability to produce goods and services that can meet customers’ needs. In the quality planning stage, an organization must determine who the customers are and what they need, develop the product or service features that meet customers’ needs, develop processes which are able to deliver those products and services, and transfer the plans to the operating forces. If quality planning is deficient, then chronic waste occurs.

Quality control is used to prevent things from getting worse. Quality control is the inspection part of the Quality Trilogy where operators compare actual performance with plans and resolve the differences. Chronic waste should be considered an opportunity for quality improvement, the third element of the Trilogy. Quality improvement encompasses improvement of fitness-for-use and error reduction, seeks a new level of performance that is superior to any previous level, and is attained by applying breakthrough thinking.

While up-front quality planning is what organizations should be doing, it is normal for organizations to focus their first quality efforts on quality control. In this aspect of the Quality Trilogy, activities include inspection to determine percent defective (or first pass yield) and deviations from quality standards. Activities can then focus on another part of the trilogy, quality improvement, and make it an integral part of daily work for individuals and teams.

Quality planning must be integrated into every aspect of the organization’s work, such as strategic plans; product, service and process designs; operations; and delivery to the customer. The Quality Trilogy is depicted below in Figure 2.

JURAN’S QUALITY PLANNING ROAD MAP. Juran’s Quality Planning Road Map can be used by individuals and teams throughout the world as a checklist for understanding customer requirements, establishing measurements based on customer needs, optimizing



product design, and developing a process that is capable of meeting customer requirements. The Quality Planning Roadmap is used for Product and Process Development and is shown in Figure 3.

Juran’s Quality Trilogy and Quality Roadmap are not enough. An infrastructure for Quality must be



developed, and teams must work on improvement projects. The infrastructure should include a quality steering team with top management leading the effort, quality should become an integral part of the strategic plan, and all people should be involved. As people identify areas with improvement potential, they should team together to improve processes and produce quality products and services.

Under the “Big Q” concept, all people and departments are responsible for quality. In the old era under the concept of “little q,” the quality department was responsible for quality. Big “Q” allows workers to regain pride in workmanship by assuming responsibility for quality.

PHILIP CROSBY (1926–2001)

Philip Bayard Crosby was born in Wheeling, West Virginia, in 1926. After Crosby graduated from high school, he joined the Navy and became a hospital corpsman. In 1946 Crosby entered the Ohio College of Podiatric Medicine in Cleveland. After graduation he returned to Wheeling and practiced podiatry with his father. He was recalled to military service during the Korean conflict, this time he served as a Marine Medical Corpsman.

In 1952 Crosby went to work for the Crosley Corp. in Richmond, Indiana, as a junior electronic test technician. He joined the American Society for Quality, where his early concepts concerning Quality began to form. In 1955, he went to work for Bendix Corp. as a reliability technician and quality engineer. He investigated defects found by the test people and inspectors.

In 1957 he became a senior quality engineer with Martin Marietta Co. in Orlando, Florida. During his eight years with Martin Marietta, Crosby developed his “Zero Defects” concepts, began writing articles for various journals, and started his speaking career.

In 1965 International Telephone and Telegraph (ITT) hired Crosby as vice president in charge of corporate quality. During his fourteen years with ITT, Crosby worked with many of the world’s largest industrial and service companies, implementing his pragmatic management philosophy, and found that it worked.

After a number of years in industry, Crosby established the Crosby Quality College in Winter Park, Florida. He is well known as an author and consultant and has written many articles and books. He is probably best known for his book *Quality is Free* (1979) and concepts such as his *Absolutes of Quality Management*, *Zero Defects*, *Quality Management Maturity Grid*, *14 Quality Improvement Steps*, *Cost of Quality*, and *Cost of Nonconformance*. Other books he

has written include *Quality Without Tears* (1984) and *Completeness* (1994).

Attention to customer requirements and preventing defects is evident in Crosby’s definitions of quality and “non-quality” as follows: “Quality is conformance to requirements; non-quality is nonconformance.”

CROSBY’S COST OF QUALITY. In his book *Quality Is Free*, Crosby makes the point that it costs money to achieve quality, but it costs more money when quality is not achieved. When an organization designs and builds an item right the first time (or provides a service without errors), quality is free. It does not cost anything above what would have already been spent. When an organization has to rework or scrap an item because of poor quality, it costs more. Crosby discusses Cost of Quality and Cost of Nonconformance or Cost of Nonquality. The intention is spend more money on preventing defects and less on inspection and rework.

CROSBY’S FOUR ABSOLUTES OF QUALITY. Crosby espoused his basic theories about quality in four Absolutes of Quality Management as follows:

1. Quality means conformance to requirements, not goodness.
2. The system for causing quality is prevention, not appraisal.
3. The performance standard must be zero defects, not “that’s close enough.”
4. The measurement of quality is the price of nonconformance, not indexes.

To support his Four Absolutes of Quality Management, Crosby developed the Quality Management Maturity Grid and Fourteen Steps of Quality Improvement. Crosby sees the Quality Management Maturity Grid as a first step in moving an organization towards quality management. After a company has located its position on the grid, it implements a quality improvement system based on Crosby’s Fourteen Steps of Quality Improvement as shown in Figure 4.

Crosby’s Absolutes of Quality Management are further delineated in his Fourteen Steps of Quality Improvement as shown below:

- Step 1. Management Commitment
- Step 2. Quality Improvement Teams
- Step 3. Quality Measurement
- Step 4. Cost of Quality Evaluation
- Step 5. Quality Awareness
- Step 6. Corrective Action

Figure 4
Crosby's Quality Management Maturity Grid

Rater	Unit				
Measurement Categories	Stage I: Uncertainty	Stage II: Awakening	Stage III Enlightenment	Stage IV: Wisdom	Stage V: Certainty
Management understanding and attitude	No comprehension of quality as a management tool. Tend to blame quality department for "quality problems."	Recognizing that quality management may be of value but not willing to provide money or time to make it all happen.	While going through quality improvement program, learn more about quality management. Becoming supportive and helpful.	Participating. Understand absolutes of quality management. Recognize their personal role in continuing emphasis.	Consider quality management an essential part of company system.
Quality organization status	Quality is hidden in manufacturing or engineering departments. Inspection probably not part of organization. Emphasis on appraisal and sorting.	A stronger quality leader is appointed but main emphasis is still on appraisal and moving the product. Still part of manufacturing or other organization.	Quality department reports to top management, all appraisal is incorporated and manager has role in management of company.	Quality manager is an officer of company; effective status reporting and preventive action. Involved with consumer affairs and special assignments.	Quality manager on board of directors. Prevention is main concern. Quality is a thought leader.
Problem handling	Problems are fought as they occur; no resolution; inadequate definition; lots of yelling and accusations.	Teams are set up to attack major problems. Long-range solutions are not solicited.	Corrective action communication established. Problems are faced openly and resolved in an orderly way.	Problems are identified early in their development. All functions are open to suggestion and improvement.	Except in the most unusual cases, problems are prevented.
Cost of quality as % of sales	Reported: unknown Actual: 20%	Reported: 3% Actual: 18%	Reported: 8% Actual: 12%	Reported: 6.5% Actual: 8%	Reported: 2.5% Actual: 2.5%
Quality improvement actions	No organized activities. No understanding of such activities.	Trying obvious "motivational" short-range efforts.	Implementation of 14-step program; thorough understanding and establishment of each step.	Continuing the 14-step program and starting Make Certain.	Quality improvement is a normal and continued activity.
Summation of company quality posture	"We don't know why we have problems with quality."	"Is it absolutely necessary to always have problems with quality?"	"Through management commitment and quality improvement we are identifying and resolving our problems."	"Defect prevention is a routine part of our operation."	"We know why we do not have problems with quality."

Source: Philip B. Crosby, *Quality Is Free*, McGraw-Hill Book Company, New York, 1979, pp. 38-39.

- Step 7. Zero-Defects Planning
- Step 8. Supervisory Training
- Step 9. Zero Defects
- Step 10. Goal Setting
- Step 11. Error Cause Removal
- Step 12. Recognition

- Step 13. Quality Councils
- Step 14. Do It All Over Again

ARMAND V. FEIGENBAUM

Feigenbaum was still a doctoral student at the Massachusetts Institute of Technology when he completed the first edition of *Total Quality Control* (1951).

An engineer at General Electric during World War II, Feigenbaum used statistical techniques to determine what was wrong with early jet airplane engines. For ten years he served as manager of worldwide manufacturing operations and quality control at GE. Feigenbaum serves as president of General Systems Company, Inc., Pittsfield, Massachusetts, an international engineering firm that designs and installs integrated operational systems for major corporations in the United States and abroad.

Feigenbaum was the founding chairman of the International Academy for Quality and is a past president of the American Society for Quality Control, which presented him its Edwards Medal and Lancaster Award for his contributions to quality and productivity. His Total Quality Control concepts have had a very positive impact on quality and productivity for many organizations throughout the industrialized world.

DR. H. JAMES HARRINGTON

An author and consultant in the area of process improvement, Harrington spent forty years with IBM. His career included serving as Senior Engineer and Project Manager of Quality Assurance for IBM, San Jose, California. He was President of Harrington, Hurd and Reicker, a well-known performance improvement consulting firm until Ernst & Young bought the organization. He is the international quality advisor for Ernst and Young and on the board of directors of various national and international companies.

Harrington served as president and chairman of the American Society for Quality and the International Academy for Quality. In addition, he has been elected as an honorary member of six quality associations outside of North America and was selected for the Singapore Hall of Fame. His books include *The Improvement Process*, *Business Process Improvement*, *Total Improvement Management*, *ISO 9000 and Beyond*, *Area Activity Analysis*, *The Creativity Toolkit*, *Statistical Analysis Simplified*, *The Quality/Profit Connection*, and *High Performance Benchmarking*.

DR. KAORU ISHIKAWA (1915–1989)

A professor of engineering at the University of Tokyo and a student of Dr. W. Edwards Deming, Ishikawa was active in the quality movement in Japan, and was a member of the Union of Japanese Scientists and Engineers. He was awarded the Deming Prize, the Nihon Keizai Press Prize, and the Industrial Standardization Prize for his writings on quality control, and the Grant Award from the American Society for Quality Control for his educational program on quality control.

Ishikawa's book, *Guide to Quality Control* (1982), is considered a classic because of its in-depth

explanations of quality tools and related statistics. The tool for which he is best known is the cause and effect diagram. Ishikawa is considered the Father of the Quality Circle Movement. Letters of praise from representatives of companies for which he was a consultant were published in his book *What Is Total Quality Control?* (1985). Those companies include IBM, Ford, Bridgestone, Komatsu Manufacturing, and Cummins Engine Co.

Ishikawa believed that quality improvement initiatives must be organization-wide in order to be successful and sustainable over the long term. He promoted the use of Quality Circles to: (1) Support improvement; (2) Respect human relations in the workplace; (3) Increase job satisfaction; and (4) More fully recognize employee capabilities and utilize their ideas. Quality Circles are effective when management understands statistical techniques and act on recommendations from members of the Quality Circles.

DR. WALTER A. SHEWHART (1891–1967)

A statistician who worked at Western Electric, Bell Laboratories, Dr. Walter A. Shewhart used statistics to explain process variability. It was Dr. W. Edward Deming who publicized the usefulness of control charts, as well as the Shewhart Cycle. However, Deming rightfully credited Shewhart with the development of theories of process control as well as the Shewhart transformation process on which the Deming PDCA (Plan-Do-Check or Study-Act) Cycle is based. Shewhart's theories were first published in his book *Economic Control of Quality of Manufactured Product* (1931).

SHIGEO SHINGO (1919–1990)

One of the world's leading experts on improving the manufacturing process, Shigeo Shingo created, with Taiichi Ohno, many of the features of just-in-time (JIT) manufacturing methods, systems, and processes, which constitute the Toyota Production System. He has written many books including *A Study of the Toyota Production System From An Industrial Engineering Viewpoint* (1989), *Revolution in Manufacturing: The SMED (Single Minute Exchange of Die) System* (1985), and *Zero Quality Control: Source Inspection and the Poka Yoke System* (1986).

Shingo's greatness seems to be based on his ability to understand exactly why products are manufactured the way they are, and then transform that understanding into a workable system for low-cost, high quality production. Established in 1988, the Shingo Prize is the premier manufacturing award in the United States, Canada, and Mexico. In partnership with the National Association of Manufacturers, Utah State University administers the Shingo Prize for

Excellence in Manufacturing, which promotes world class manufacturing and recognizes companies that excel in productivity and process improvement, quality enhancement, and customer satisfaction.

Rather than focusing on theory, Shingo focused on practical concepts that made an immediate difference. Specific concepts attributed to Shingo are:

- Poka Yoke requires stopping processes as soon as a defect occurs, identifying the source of the defect, and preventing it from happening again.
- Mistake Proofing is a component of Poka Yoke. Literally, this means making it impossible to make mistakes (i.e., preventing errors at the source).
- SMED (Single Minute Exchange of Die) is a system for quick changeovers between products. The intent is to simplify materials, machinery, processes and skills in order to dramatically reduce changeover times from hours to minutes. As a result products could be produced in small batches or even single units with minimal disruption.
- Just-in-Time (JIT) Production is about supplying customers with what they want when they want it. The aim of JIT is to minimize inventories by producing only what is required when it is required. Orders are “pulled” through the system when triggered by customer orders, not pushed through the system in order to achieve economies of scale with the production of larger batches.

FREDERICK TAYLOR (1856–1915)

An industrial (efficiency) engineer, manager, and consultant, Frederick Taylor is known as the Father of Scientific Management. In 1911, he published *The Principles of Scientific Management*. Taylor believed in task specialization and is noted for his time and motion studies. Some of his ideas are the predecessors for modern industrial engineering tools and concepts that are used in cycle time reduction.

While quality experts would agree that Taylor’s concepts increase productivity, some argue that his concepts are focused on productivity, not process improvement and as a result could cause less emphasis on quality. Dr. Joseph Juran said that Taylor’s concepts made the United States the world leader in productivity. However, the Taylor system required separation of planning work from executing the work. This separation was based on the idea that engineers should do the planning because supervisors and workers were not educated. Today, the emphasis is on transferring planning to the people doing the work.

DR. GENICHI TAGUCHI (B. 1924)

Dr. Genichi Taguchi was a Japanese engineer and statistician who defined what product specification means and how this can be translated into cost effective production. He worked in the Japanese Ministry of Public Health and Welfare, Institute of Statistical Mathematics, Ministry of Education. He also worked with the Electrical Communications Laboratory of the Nippon Telephone and Telegraph Co. to increase the productivity of the R&D activities.

In the mid 1950s Taguchi was Indian Statistical Institute visiting professor, where he met Walter Shewhart. He was a Visiting Research Associate at Princeton University in 1962, the same year he received his Ph.D. from Kyushu University. He was a Professor at Tokyo’s Aoyama Gakuin University and Director of the Japanese Academy of Quality.

Taguchi was awarded the Deming Application prize (1960), Deming awards for literature on quality (1951, 1953, and 1984), Willard F. Rockwell Medal by the International Technologies Institute (1986).

Taguchi’s contributions are in robust design in the area of product development. The Taguchi Loss Function, The Taguchi Method (Design of Experiments), and other methodologies have made major contributions in the reduction of variation and greatly improved engineering quality and productivity. By consciously considering the noise factors (environmental variation during the product’s usage, manufacturing variation, and component deterioration) and the cost of failure in the field, Taguchi methodologies help ensure customer satisfaction.

Robust Design focuses on improving the fundamental function of the product or process, thus facilitating flexible designs and concurrent engineering. Taguchi product development includes three stages: (1) system design (the non-statistical stage for engineering, marketing, customer and other knowledge); (2) parameter stage (determining how the product should perform against defined parameters; and (3) tolerance design (finding the balance between manufacturing cost and loss).

SEE ALSO: Quality and Total Quality Management

Mildred Golden Pryor

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QUALITY AND TOTAL QUALITY MANAGEMENT

Although quality and quality management does not have a formal definition, most agree that it is an integration of all functions of a business to achieve high quality of products through continuous improvement efforts of all employees. Quality revolves around the concept of meeting or exceeding customer expectation applied to the product and service. Achieving high quality is an ever changing, or continuous, process therefore quality management emphasizes the ideas of working constantly toward improved quality. It involves every aspect of the company: processes, environment and people. The whole workforce from the CEO to the line worker must be involved in a shared commitment to improving quality.

Therefore, in brief, quality and total quality management (TQM) in particular can be defined as directing (managing) the whole (total) production process to produce an excellent (quality) product or service.

It differs from other management techniques in the attitude of management toward the product and toward the worker. Older management methods focused on the volume of production and the cost of the product. Quality was controlled by using a detection method (post production inspection), problems were solved by management and management's role was defined as planning, assigning work, controlling the production. Quality management, in contrast, is focused on the customer and meeting the customer's needs. Quality is controlled by prevention, i.e., quality is built in at every stage. Teams solve problems and everyone is responsible for the quality of the product. Management's role is to delegate, coach, facilitate and mentor. The major quality management principles

are: quality, teamwork, and proactive management philosophies for process improvement.

The U.S. Department of Defense's Definition of Total Quality

Total Quality (TQ) consists of continuous improvement activities involving everyone in the organization—managers and workers—in a totally integrated effort toward improving performance at every level. This improved performance is directed toward satisfying such cross-functional goals as quality, cost, schedule, missing, need, and suitability. TQ integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach focused on continued process improvement. The activities are ultimately focused on increasing customer/user satisfaction.

ORIGINS

Quality management is not derived from a single idea or person. It is a collection of ideas, and has been called by various names and acronyms: TQM, total quality management; CQU, continuous quality improvement; SQC, statistical quality control; TQC, total quality control, etc. However each of these ideas encompasses the underlying idea of productivity initiatives that increase profit by improving the product.

Though most writers trace the quality movement's origins to W. Edward Deming, Joseph M. Juran and Philip B. Crosby, the roots of quality can be traced even further back, to Frederick Taylor in the 1920s. Taylor is the "father of scientific management." As manufacturing left the single craftsman's workshop, companies needed to develop a quality control department. As manufacturing moved into big plants, between the 1920s and the 1950s, the terms and processes of *quality engineering* and *reliability engineering* developed. During this time productivity was emphasized and quality was checked at the end of the line. As industrial plants became larger, post-production checks became more difficult and statistical methods began to be used to control quality. This was called *reliability engineering* because it moved quality control toward building quality into the design and production of the product. Taylor was the pioneer of these methods. Although some writers consider Taylor's methods part of classical management in opposition to the quality management system, both Deming and Juran both used statistical methods for quality assurance at Bell Telephone laboratories.

In the decades that followed World War II, the U.S. had no trouble selling everything made. This demand had the effect in the U.S. of driving industry to increase production, which resulted in less quality control. U.S. manufacturers became complacent, thinking that they could sell any product and that the

consumer did not want or demand quality. The post World War II situation in Japan was just the opposite. The war had left the country devastated, and it needed to rebuild its means of production. In addition, Japanese manufacturers needed to counteract the shoddy reputation they had that products "made in Japan" were of low quality.

Japan began focusing on serious quality efforts. Japanese teams went abroad to visit foreign countries to learn how other countries managed quality, and they invited foreign experts to lecture in Japan on quality management. Two of these foreign experts were Americans W. Edward Deming and Joseph Juran. They each had a profound influence on Japanese quality processes, encouraging quality and design, *built in*, and zero defect programs. It took twenty years of concerted effort to revamp Japan's industrial system. The strategies used involved high-level managers as leaders, all levels and functions were trained in managing for quality, continuous progress was undertaken, quality circles were used, and the entire workforce was enlisted. By the early 1980s Japanese products, particularly automobiles and electronic products, were superior in quality to U.S. products. U.S. companies lost markets in the U.S. and in the western world to the Japanese and went in search of the *Japanese secret*. They found W. Edward Deming.

DEMING'S CONTRIBUTIONS

Deming was an American who worked in the 1930s with Walter A. Shewhart at Bell Telephone Company. Shewhart was a statistician who had the theory that product control could best be managed by statistics. He developed a statistical chart for the control of product variables. Deming developed a process, based on Shewhart's, using statistical control techniques that alerted managers of the need to intervene in the production process.

He then utilized these techniques during World War II while working on government war production. In 1947 Douglas MacArthur and the U.S. State Department sent Deming to Japan to help the war-devastated Japanese manufacturing plants. He introduced these "statistical process control" methods in a series of lectures on statistical methods to Japanese businessmen and engineers. The Japanese were an attentive audience and utilized Deming's ideas readily. They found him charming and considerate and listened to his ideas. His concept of employees working toward quality fit well into their personal ideas. His philosophy went beyond statistical quality control and encouraged building quality into the product at all stages.

Deming developed the chain reaction: as quality improves, costs go down and productivity goes up; this leads to more jobs, greater market share, and long-term survival. He stressed worker pride and satisfaction and

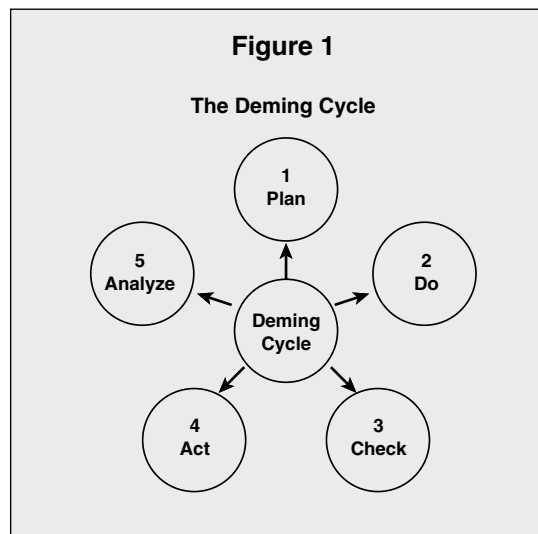
considered it management's job to improve the process, not the worker. Quality circles, a central Deming theme, are based on the importance of employees meeting regularly in groups to comprehensively discuss product quality. The GDP in Japan rose steadily from 1960s by more than 10 percent per year. By 1951 the Japanese had named their quality prize in his honor. Deming's book, *Out of the Crisis*, emphasized improving quality of the product as more important than short-term financial goals. He de-emphasized quantity, and emphasized quality. He believed that "statistical process control" was an invaluable instrument in the quest for quality. Deming developed fourteen points for management which can be summarized as:

1. Create a plan; publish the aims and purposes of the organization.
2. Learn and adopt the new philosophy of quality.
3. Understand the purpose of inspection; stop depending on inspection.
4. Stop awarding business based on price alone.
5. Improve the system constantly.
6. Institute training.
7. Teach and institute leadership.
8. Drive out fear, create trust, and create a climate for innovation.
9. Optimize the efforts of teams, groups and staff areas.
10. Eliminate exhortations, and targets for the work force; provide methods of achievement.
11. Eliminate numerical quotas for the work force.
12. Remove barriers that rob people of pride for workmanship.
13. Encourage education and self improvement for everyone.
14. Make action to accomplish the transformation, make it everyone's job.

Besides the fourteen points, Deming is known for the *Deming Cycle* and the *Seven Deadly Diseases*. The Deming Cycle is illustrated in Figure 1. It involves five steps: consumer research and planning of the product (plan), producing the product (do), checking the product (check), marketing the product (act), and analyzing how the product is received (analyze.)

The Seven Deadly Diseases can be summarized as:

1. Lack of constancy of purpose to plan products and services.



2. Emphasis on short-term profits.
3. Personal review systems for managers and management by objectives.
4. Job hopping by managers.
5. Using only visible data in decision making.
6. Excessive medial costs.
7. Excessive costs of liability driven up by lawyers that work on contingency.

JURAN'S CONTRIBUTIONS

Joseph M. Juran, like Deming, went to Japan in 1954 and assisted the Japanese in their quest to achieve quality. Like Deming, Juran emphasized planning, organizing and controlling. However he emphasized customer satisfaction more than Deming did and focused on management and technical methods rather than worker satisfaction. Juran was a prolific author, publishing over a dozen books. His most influential book *Quality Control Handbook* (later called *Juran's Quality Handbook*) was published in 1951 and became a best seller.

By 1960 Japan was using quality control circles and simple statistical techniques learned and applied by Japanese workers. Juran developed basic steps that companies must take, however he believed there was a point of diminishing return, a point at which quality goes beyond the consumer needs. For example, if the consumer trades his car in after 50,000 miles, the car need only be built to perform trouble-free for 60,000 miles. Building a better car would drive up costs without delivering the expected product. This is called the *Pareto Principle*, or the Juran 80/20 rule: 80 percent of the trouble comes from 20 percent of the problems. The rule is named for Vilfredo Pareto,

an economist, but it was Juran that applied the idea to management. It can be expressed as: “concentrate on the ‘vital few’ sources of problems; don’t be distracted by less important problems.” Juran’s trilogy involves:

1. Quality planning (determine customer needs, develop product in response to needs).
2. Quality control (assess performance, compare performance with goals, act on differences between performance and goals).
3. Quality improvement (develop infrastructure, identify areas of improvement and implement projects, establish project team, provide teams with what they need).

Juran’s ten steps to quality improvement are:

1. Build awareness of opportunities to improve.
2. Set goals.
3. Organize to reach goals.
4. Provide training.
5. Carry out projects to solve problems.
6. Report progress.
7. Give recognition.
8. Communicate results.
9. Keep score.
10. Maintain momentum by making annual improvement part of the systems and processes of the company.

The Union of Japanese Scientists and Engineers (JUSE) considered Juran’s vision of top-to-bottom quality management even more important to their quality turnaround than Deming’s insights. JUSE asked Juran if it could name its top-level award, a ‘super-Deming award’ after him, but he declined. This medal is called the Japan Quality Control Medal.

CROSBY’S CONTRIBUTIONS

Philip Crosby, author of *Quality is Free*, founded the Quality College in Winter Park, Florida. Crosby emphasized meeting customer requirements by focusing on prevention rather than correction. He claimed that poor quality costs about 20 percent of the revenue; a cost that could be avoided by using good quality practices. He pushed for zero defects. His “absolutes” are: (1) quality is defined as conformance to requirements, not *goodness*; (2) the system for achieving quality is prevention, not appraisal; (3) the performance standard is zero defects, not *that’s close enough*; and (4) the measure of quality is the price of non-conformance, not indexes.

Crosby’s method does not dwell on statistical process control and problem solving techniques that the Deming method uses. He stated that quality is free because prevention will always be lower than the costs of detection, correction and failure. Like Deming, Crosby had fourteen points:

1. Manage commitment, that is, top level management must be convinced and committed and communicated to the entire company.
2. Quality improvement team composed of department heads, oversee improvements.
3. Quality measurement are established for every activity.
4. Cost of quality is estimated to identify areas of improvement.
5. Quality awareness is raised among all employees.
6. Corrective action is taken.
7. Zero defects is planned for.
8. Supervisor training in quality implementation.
9. Zero defects day is scheduled.
10. Goal setting for individuals.
11. Error causes are removed by having employees inform management of problems.
12. Recognition is given, but it is non-financial, to those who meet quality goals.
13. Quality councils meet regularly.
14. Do it all over again (i.e., repeat steps one through thirteen).

Looking at the history of quality management, we see several stages of development. The first was *quality control*, which involved setting up product specifications and then inspect the product for leaves the plant. The second state is *quality assurance*, which involved identifying the quality characteristics and procedures for quantitatively evaluating and controlling them. The next phase is the true *total quality control*, a term actually coined by Feigenbaum in 1983. At this stage the quality became a total organization effort. It effected production, profit, human interaction and customer satisfaction. The fourth stage is *total quality management*. In TQM the customer is the center and quality is an organization-wide effort.

QUALITY PRIZES

The top three quality prizes are the Deming Prize, the Baldrige Award and the European Quality Awards. Union of Japanese Scientists and Engineers have annually awarded the Deming Prize since 1951. For three decades it was *the* quality award and is still the

Figure 2
Chronology

1931	Walter A. Shewhart of Bell Laboratories publishes <i>Economic Control of Quality of Manufactured Products</i> and introduces statistical quality control.
1950	W. Edwards Deming addressed Japanese scientists, engineers, and corporate executive on subject of quality.
1951	First Deming Prize awarded by the Union of Japanese Scientists and Engineers (JUSE).
1952	Joseph M. Juran publishes the <i>Quality Control Handbook</i> .
1970	Philip Crosby introduces the concept of zero defects.
1979	Crosby publishes <i>Quality is Free</i> .
1980	Ford Motor Company invites Deming to speak to executives.
1981	Bob Galvin, Motorola's chairman starts quality improvement, which leads to the six sigmas.
1982	Deming publishes <i>Quality, Productivity, and Competitive Position</i> .
1984	Crosby publishes <i>Quality without Tears: The Art of Hassle-Free Management</i> .
1987	Congress creates the Malcolm Baldrige National Quality Award.
1992	First European Quality Awards named, which is sponsored by the Foundation for Quality Management with support from the European Organization for Quality and the European Commission.

most prestigious award. The Deming Prize is given to a person or group of people who have advanced the practice and furthered awareness of TQC. The Deming Application Prize goes only to companies based on successes attributable to implementing TQC. The second major quality prizes was established by Congress in 1987 (Public Law 100-107) and is called the Baldrige Award. The award set a national standard for quality and companies use the criteria as a management guide. Applicants must address seven specific categories: leadership, strategic planning, customer and market focus, information and analysis, human resource focus, process management, and business results. Winners are required to share their successful strategies. U.S. Department of Commerce's National Institute of Standards and Technology administer the Malcolm Baldrige National Quality Award. The third award is the awarded by The Foundation for Quality Management with support from the European Organization for Quality and the European Commission. It is called the European Quality Award and was first awarded in 1992.

QUALITY IN THE U.S.

The U.S. was slow to see the advantages of TQM, although the American Society for Quality Control (now known as American Society for Quality) was formed in 1946. Huge markets for American-made products after World War II kept American industries producing products with little change in manufacturing methods. It wasn't until the late 1970s that U.S. manufacturing came up against foreign competition and the trade deficit, and at that time it became obvi-

ous that Japanese companies were far ahead of U.S. companies in quality.

One of the first companies in the U.S. to grasp and utilize TQM was Motorola. In 1981 Bob Galvin, Motorola's chairman, called for an across-the-board improvement of 10:1 in five years. To accomplish this they needed a breakthrough technique. This breakthrough is detailed in the Six Sigma process:

- Faith that the improvement target could be achieved.
- Total customer satisfaction.
- Powerful new tools, especially design of experiments.
- Cycle-time reduction.
- Designing for ease of manufacturing.
- Manufacturing innovations.
- True partnerships with key suppliers.
- Training for all employees.

Within five years Motorola had achieved their goal. In 1988 they were awarded the Malcolm Baldrige National Quality Award for their impressive Six Sigma process. Keki R. Bhote nurtured the Six Sigma project for eleven years at Motorola and then went on to consult with other companies.

In the early 1980s when Donald Petersen was CEO of Ford, Ford executives were investigating the secret of the Japanese success. They discovered W. Edwards Deming's holistic blend of statistics and management. Deming's ideas came to Detroit. Ford was in serious trouble because of Japanese competition.

Deming introduced the statistical methods needed to improve processes. These are the foundation of what became known as Six Sigma, a statistical measure that refers to 3.4 defects per million. Besides this scientific method of improving quality, Deming emphasized that all employees needed to work toward quality. He advocated teamwork and cross-department collaboration, close work with suppliers and employee training. Other companies that adopted the Deming quality methods were General Motors, Florida Power & Light, and Procter and Gamble.

Not all U.S. attempts at quality improvement have been successful. Frequently cited reasons for failure are poor leadership, team-mania (setting up teams before management or employee have been trained in team work), and lack of integration of quality efforts into the whole organization. Obstacles and barriers to success have been researched by Robert J. Masters. He lists eight common problems that lead to failure:

1. Lack of management commitment. Management must commit time and resources and clearly communicate the importance and goals to all personnel.
2. Inability to change the organizational culture. Change takes time and effort. In order for the culture to change, the employees need to want change and be willing to participate. This requires reasons that management must convey. The change will only occur if the employees trust the management. It cannot occur from a state of fear.
3. Improper planning. Planning must involve all parts of the organization and be communicated clearly to employees.
4. Lack of training. The most effective training comes from senior management. Informal training needs to occur on a continual basis.
5. Organizational structure problems and isolated individuals or departments. Multi-functional teams will help break down some of these barriers. Restructuring is another method.
6. Ineffective measurement and lack of data. Effective decisions require that the employees have access to the necessary data.
7. Inadequate attention to internal and external customers.
8. Inadequate empowerment, lack of teamwork. Teams require training. Their recommendations should be followed whenever possible. Individuals need to be empowered to make decisions.

IMPLEMENTING TQM

Although different authorities on total quality management emphasize different techniques and use different terminology, all share three common ideas: quality, teamwork and process improvement. Although many books have been written to guide U.S. companies through TQM, one of the major writers was Joseph Jablonski. In *Implementing TQM*, he identified three characteristics: (1) participative management; (2) continuous process improvement; and (3) utilization of teams.

Participative management is the opposite of the hierarchical management style of the early twentieth century businesses. It involves all employees in the management process and decision making by having managers set policies and make key decisions based upon the advice and ideas of subordinates. This method provides management with more information from the front line and motivates the workers as they have some control of the decisions. Continuous process improvement is one of Deming's major ideas and involves small steps toward the ultimate goal. This involves patience on the part of management. Teamwork refers to cross-functional teams of workers that share in problem solving.

Jablonski went on to list six attributes necessary for success: (1) customer focus; (2) process focus; (3) prevention versus inspection; (4) employee empowerment and compensation; (5) fact-based decision making; and (6) receptiveness to feedback.

U.S. companies have long relied upon company organization by functions. TQM emphasizes a decentralized structure to encourage leadership and creativity. The purpose of this change in structure is to change the behavior of the employees. This is a major change for most U.S. companies. However, successful companies have more functional integration and fewer layers of hierarchy.

QUALITY AND THE 1990S AND BEYOND

In the 1980s many U.S. companies implemented total quality management systems in order to be competitive in the global market place. Successes lead them to be interested in hiring managers and engineers with some TQM training. This prompted universities to start teaching quality methods. To help universities in this, the University Challenge program was developed by a group of companies that had implemented TQM successfully. Their goal was to encourage universities to commit to integrating TQM in their own operations and courses. Initially eight universities with both business and engineering schools were chosen. Milliken worked with North Carolina State University and Georgia Institute of Technology. IBM worked with Massachusetts Institute of Technology

and Rochester Institute of Technology. Motorola worked with Purdue University. Procter & Gamble Company worked with University of Wisconsin at Madison and Tuskegee University. Xerox worked with Carnegie Mellon.

Another area of transformation by TQM since 1990 is in human resources. Numerous studies have indicated that human resource practices that improve the corporate culture lead to better profits. Therefore many companies have extended TQM to the HR department. Yet another area of development of TQM in American firms is in the area of ethical philosophy and behavior of top management. Recent corporate scandals have increased interest from the public in corporate responsibility and accountability. Corporate responsibility is defined as how a company's operating practices affect its stakeholders, such as consumers, and the natural environment. This is new quality movement is being called total responsibility management. It involves responsible vision and values, leadership build on these values.

TQM has had a wide acceptance in the U.S., which has been growing since the 1970s. Quality management principles have had a remarkable influence on every sector of American business and are spreading to non-profit organizations and universities. It is essential that this trend continue for U.S. companies to be competitive in the global market and to meet consumer demands.

SEE ALSO: Continuous Improvement; Japanese Management; Management Awards; Participative Management; Quality Gurus; Teams and Teamwork

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QUALITY OF WORK LIFE

In today's high tech, fast-paced world, the work environment is very different than it was a generation ago. According to the Institute of Industrial Engineers, it is not uncommon for a person to change careers an average of six times in his or her lifetime. It is now rare for a person to stay with a single company his or her entire working life. Because employees are often willing to leave a company for better opportunities, companies need to find ways not only to hire qualified people, but also to retain them.

Unfortunately, many employees these days feel they are working harder, faster, and longer hours than ever before. Job-related employee stress can lead to lack of commitment to the corporation, poor productivity, and even leaving the company; all of which are of serious concern to management. Many employees bring work home with them on a regular basis, especially

now that it is so easy for them to do that. With the wide availability of cell phones, pagers, personal digital assistants (PDAs), and computers, employees find it harder to get away from the office.

One of the more stressful professions today is in the Information Technology (IT) field. Not long ago, IT professionals were extremely well respected and in demand. As technology advanced rapidly, there was a high demand for programmers and engineers. Most had their choice of high-paying jobs as technology companies competed to recruit the best of them.

This is not the case today. In June 2004, Meta Group, Inc. surveyed 650 companies and found that nearly 75 percent of the companies acknowledged morale problems among their IT staffs. This number was up from the year before, which showed that two-thirds cited poor worker morale as an issue. Perhaps this is because the U.S. technology sector experienced widespread layoffs during the third quarter of 2004. In general, when layoffs happen the remaining employees are forced to pick up the workload of those who were laid off. This leads to added responsibility and longer work hours, often without additional compensation. This in turn leads to stress, burnout, and resentment. Other causes of employee dissatisfaction include low wages, lack of challenges, insufficient resources, unrealistic expectations, pressure to produce, willfully blind management, unreasonable policies and procedures, difficulty balancing family and work, and increased health benefit costs.

As employers try to address employee turnover and job satisfaction issues, they must first determine what the issues are. Several companies have convened focus groups and conducted employee-satisfaction surveys to find out how their employees feel and to determine what they can do to make their employees happy.

There are also a number of independent organizations that conduct employee surveys to gather this information. One such organization is the Families and Work Institute (www.familiesandwork.org), a nonprofit research center “that provides data to inform decision-making on the changing workforce and workplace, changing family and changing community. Founded in 1989, FWI is known for ahead of the curve, non-partisan research into emerging work-life issues; for solutions-oriented studies addressing topics of vital importance to all sectors of society; and for fostering connections among workplaces, families, and communities.”

Every five years FWI conducts the National Study of the Changing Workforce (NSCW), a nationally representative sample of employed workers designed to collect and compile information on the work and personal/family lives of the U.S. workforce. The study is widely used by policy makers, employ-

ers, the media, and all those interested in the widespread impacts of the changing conditions of work and home life.

The 2002 NSCW showed a slight increase from 1992 in the number of companies that offer work-life supports on the job—both specific benefit entitlements and less formal policies and practices. Despite this, the survey showed a large increase in the number of employees with families who felt there was interference between their jobs and their family lives, than employees 25 years ago. The NSCW also found “the importance of supportive work-life policies and practices, such as flexible work arrangements, is clear—when they are available, employees exhibit more positive work outcomes, such as job satisfaction, commitment to employer, and retention, as well as more positive life outcomes, such as less interference between job and family life, less negative spillover from job to home, greater life satisfaction, and better mental health.”

What does this mean to the employer? As more companies start to realize that a happy employee is a productive employee, they have started to look for ways to improve the work environment. Many have implemented various work-life programs to help employees, including alternate work arrangements, on-site childcare, exercise facilities, relaxed dress codes, and more. Quality-of-work-life programs go beyond work/life programs by focusing attention less on employee needs outside of work and realizing that job stress and the quality of life at work is even more direct bearing on worker satisfaction. Open communications, mentoring programs, and fostering more amicable relationships among workers are some of the ways employers are improving the quality of work life.

ALTERNATE WORK ARRANGEMENTS

Many employers have found it beneficial to allow alternate work arrangements for their employees. This is one way to improve employee productivity and morale. There are three alternate arrangements that are widely used today.

Telecommuting is the term used to describe the work situation in which the employee works outside of the office, usually at home or at a location closer to home. In general, when one telecommutes, he or she communicates with the office via telephone and email, and may go into the office periodically to touch base with the employer and to attend meetings. Advancements in technology have made this possible for many people to telecommute. The telecommuting employee may be able to access files on the office’s network from remote locations. And with conference call, videoconferencing, and WebEx capabilities, the employee can *attend* meetings from other locations. With WebEx

technology, meeting attendees can sit at their own computers and view the meeting organizer's computer desktop via the Internet. As the meeting organizer opens applications and moves the mouse on his or her computer, the remote attendees can see those same applications and movements as if they were running them on their own computers.

Flextime is another name for flexible work hours. Although most employees with flextime do work a full eight-hour day, they can start and end the workday at a time agreeable to both the employer and the employee, rather than the traditional 8:00 a.m. to 5:00 p.m. work day. Most employers require their employees to be in the office during "core hours," such as 10:00 a.m. to 2:00 p.m. but do not mandate the start and end times.

Alternate work schedules, like flexible schedules, involve working outside of the traditional 8 to 5 workday. However, alternate schedules have a fixed start and end time, whereas flextime allows the employee to vary start and end as long as they are there during the core hours. An alternate schedule may be 6:00 a.m. to 3:00 p.m. or 11:00 a.m. to 8:00 p.m. five days a week, or it may be four 10-hour days, or any other *different* schedule.

The advantages of these alternate work arrangements to the employee include flexible work hours, shorter or no commute, and a comfortable working environment. The advantages to the employer include less need for office space, increased productivity, lower use of sick leave, and improved employee morale.

While there are many advantages to these alternatives, there are also several disadvantages that the employer must consider. These include problems maintaining adequate staffing coverage, difficulty scheduling meetings, lack of interpersonal dynamics, and concerns about safety and security (for flextime and alternate schedule employees that come in early or leave late). It is up to the employer to weigh the advantages against the disadvantages to determine if any of these alternatives will work.

To improve the quality of work life and eliminate job stress, employers can also make efforts to be more aware of the workload and job demands. Employers need to examine employee training, communication, reward systems, coworker relationships, and work environment. Employees often are able to give employers the best advice on reducing work stress.

Employees in the future will likely be looking for corporations that have a new work environment, one that encourages each employee to work toward improvement in the product or service; gives employees the responsibility and authority to make decisions, provides timely feedback, and rewards employees based upon the quality of the product and efforts.

Team effort will assume central importance, especially that of self-directed work teams. Employees will choose employers who have aims and values that match theirs and who value balance in their employees' lives. Employees want to learn and advance, so opportunities for professional growth will attract employees.

Companies will seek employees with technical skills, vision, and the ability to organize and persuade in presentation of ideas and information. Strong communication skills and the ability to learn will be high on employers' demand list for employees. There are a great number of common elements between the employee list and the employer list. To attract and retain employees, companies need to be exploiting those points of convergence and continuously work with employees to redesign the work, eliminate job stress, increase job autonomy, provide learning and training opportunities, and improve the quality of work life.

SEE ALSO: Contingent Workers; Employee Assistance Programs; Human Resource Management; Safety in the Workplace; Work-Life Balance

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RADIO FREQUENCY IDENTIFICATION

SEE: Bar Coding and Radio Frequency Identification

REACTIVE VS. PROACTIVE CHANGE

Workplace change occurs rapidly and often in many businesses. This change may take place in order to respond to a new opportunity or to avoid a threat to the company. Regardless of the reason, change can be difficult for all involved; managers and employees face new challenges with change, and managers must learn to ease the difficulty of the transition. One of the major issues associated with managing change is reactive versus proactive responses to change. This entry will discuss proactive and reactive responses to change, the major models of organizational change, and the responsibilities of change managers with special emphasis on the roles of transitional management teams and change agents.

PROACTIVE AND REACTIVE RESPONSES TO CHANGE

Proactive change involves actively attempting to make alterations to the work place and its practices. Companies that take a proactive approach to change are often trying to avoid a potential future threat or to capitalize on a potential future opportunity. Reactive change occurs when an organization makes changes in

its practices after some threat or opportunity has already occurred. As an example of the difference, assume that a hotel executive learns about the increase in the number of Americans who want to travel with their pets. The hotel executive creates a plan to reserve certain rooms in many hotel locations for travelers with pets and to advertise this new amenity, even before travelers begin asking about such accommodations. This would be a proactive response to change because it was made in anticipation of customer demand. However, a reactive approach to change would occur if hotel executives had waited to enact such a change until many hotel managers had received repeated requests from guests to accommodate their pets and were denied rooms.

MODELS OF CHANGE

There are a number of theoretical models of change. Each attempts to describe the process through which organizations successfully alter their business practices, their organizational structure, or their organizational climate. The models of change which will be discussed in this section are summarized in Exhibit 1.

LEWIN'S THREE-STEP MODEL FOR CHANGE. In the late 1940s social psychologist Kurt Lewin developed a three-step model for implementing change based on the concept of force field analysis. Force field analysis addresses the driving and resisting forces in a change situation. Driving forces must outweigh resisting forces in a situation if change is to occur. Thus, managers must be willing to advocate change strongly in order to overcome resistance from employees.

There are three steps in Lewin's model. The first step is "unfreezing," which involves dismantling those

Exhibit 1
Models of Change

Model/Approach	Summary
Lewin's three-step model	Old activities must be unfrozen, a new concept introduced, then new activities must be frozen
Bullock and Batten's planned change	Exploration, planning, action, and integration
Kotter's eight steps	Establish a sense of urgency, form a powerful guiding coalition, create a vision, communicate the vision, empower others to act on the vision, plan for and create short-term wins, consolidate improvements and produce still more change, institutionalize new approaches
Beckhard and Harris's change formula	$C = [ABD] > X$, Where C = change, A = level of dissatisfaction with the status quo, B = Desirability of the proposed change or end state, D = practicality of the change, and X = cost of changing
Nadler and Tushman's congruence model	Organization is a system that draws inputs from internal and external sources and transforms them into outputs through four components: the work itself, the people, the informal organization, and the formal organization
Bridges's managing the transition	Transition, which differs from change, consists of three phases: ending, neutral zone, and new beginning
Carnall's change management model	Change depends on level of management skills in managing transitions effectively, dealing with organizational cultures, and managing organizational politics
Senge et al.'s systematic model	Start small; grow steadily; don't plan everything; expect challenges
Stacey and Shaw's complex responsive process	Change emerges naturally from communication and conflict; and managers are a part of the whole environment

things that support or maintain the previous behavior. In an organization, these elements of the old could be the compensation system or the approach to performance management. In the second step, the organization “presents a new alternative.” This means introducing a clear and appealing option for a new pattern of behavior. The final step in this model is “freezing” which requires that changed behavior be reinforced both formally and informally in the organization. It is in this step that managers can have a great amount of influence through their use of positive reinforcement.

Lewin's model does not explicitly state the notion that simply introducing change will result in the change being adopted or being sustained over the long run. If an attempt to create change in the organization is unsuccessful, it means that there is a problem in one of the three steps in the model.

BULLOCK AND BATTEN'S PHASES OF PLANNED CHANGE. R.J. Bullock and D. Batten derived their ideas from project management and they recommend using exploration, planning, action, and integration for planned change. Exploration occurs when managers confirm the need for change and secure resources needed for it. These resources may be physical or they may be mental, such as managers' expertise. The next step, planning, occurs when key decision makers and experts create a change plan that they then review and approve. Next, action occurs with enactment of the plan. There should be opportunities for

feedback during the action phase. Finally, integration begins when all actions in the change plan have taken place. Integration occurs when the changes have been aligned with the organization and there is some degree of formalization, such as through policies and procedures in the organization.

KOTTER'S EIGHT STEPS. John P. Kotter identified eight steps every organization must follow in order to reap long-term benefits from organizational change: establish a sense of urgency; form a powerful guiding coalition; create a vision and strategy; communicate the vision; empower others to act on the vision; generate short-term wins; consolidate improvements and produce still more change; and institutionalize the new approach (i.e., make it a part of the organizational culture).

The first step, establishing a sense of urgency, involves selling the need for change to managers and employees. Kotter recommends creating a “felt-need” for change in others. The second step is for managers to create a powerful group of people who can work together to enact change. Their power will be a driving force in encourages others to adopt change. Third, the organization must have a vision that will guide the entirety of the change effort, and this vision must be communicated repeatedly (step four)—as much as ten times as often as one would expect to.

Steps five through eight occur after the sense of urgency is created, and these steps are easier to dele-

gate or decentralize. In step five, others in the organization are empowered to act on the vision. Managers should assist in this process by eliminating barriers such as old systems or structures. Step six asks managers to plan for and to create short-term wins. This means that small improvements should be recognized and celebrated publicly. In step seven, the current improvements are built upon with new projects and resources. Finally, in step eight, the new approaches should be institutionalized; that is, they should become a routine path to organizational success.

BECKHARD AND HARRIS'S CHANGE FORMULA. The change formula is a mathematical representation of the change process (see Exhibit 1). The basic notion is that, for change to occur, the costs of change (X) must be outweighed by dissatisfaction with the status quo (A), the desirability of the proposed change (B), and the practicality of the change (D). There will be resistance to change if people are not dissatisfied with the current state of the organization (A), or if the changes are not seen as an improvement (B), if the change cannot be done in a feasible way (D), or the cost is far too high (X).

This formula can also be conceptualized as $(A \times B \times D) > X$. The multiplicative nature of this formula indicates that if any variable is zero or near zero, resistance to change will not be overcome. In other words, the variables of A , B , and D do not compensate for one another, and when one is very low, the cost of change is likely to be too high.

NADLER AND TUSHMAN'S CONGRUENCE MODEL. Nadler and Tushman's model presents the dynamics of what occurs in an organization when we try to change it. The foundation of this model is that of the organization as an open system, in which organizational subsystems are influenced by the external environment. The organizational system draws inputs from internal and external sources—such as the organization's own strategy, its resources, and its environment—and transforms them into outputs, such as behavior and performance. This transformation from inputs to outputs occurs through four organizational elements: the work, the people, and the formal and informal organization. The work involves the daily activities carried out by individuals in the organization. The skills and capabilities of the people involved in the organization are critical. The formal organization is characterized by its structure, its standard procedures, and its policies. The informal organization encompasses things such as norms, values, and political behavior.

In this model, effective change occurs when all four components (work, people, formal, and informal organization) are managed, because they are all interrelated. A change in the work procedures themselves may not be effective if the people do not have the

capabilities to engage in the new practices. A change to the formal organization may not be effective if the beliefs and values of people (i.e., the informal organization) do not support it. If there is a lack of congruence among these four elements, then there is resistance to change. Furthermore, there may be control issues in which there is confusion over who regulates the new structures and processes. Finally, power problems may occur as managers and employees feel threatened that their current power may be removed by the change.

WILLIAM BRIDGES'S MANAGING THE TRANSITION. William Bridges distinguished planned change from transition. He believes that transition is more complex because it requires abandoning old practices and adopting new behaviors or ways of thinking, whereas planned change is about changing physical locations or organizational structures. Bridges believes that transition often lags behind planned change because it is more complex and more difficult to achieve. Because it is psychological, it is harder to manage.

Bridges describes three phases of transition: ending, neutral zone, and new beginning. Ending is similar to Lewin's concept of unfreezing in that you must end a current situation before you can begin something new. So, in this phase, old structures, practices, and behaviors must be stopped. Ideally, this ending can be commemorated or marked in some way. In the second phase, the neutral zone, the old practices have been stopped, but new ones have not yet been adopted. In this phase, many employees will feel disoriented and anxious; nevertheless, it may be a time in which creativity rises. Finally, new beginnings are not planned and predicted, but must evolve as organizational members psychologically adjust to transition. Managers can encourage, support, and reinforce these new beginnings. Bridges recommends that four key elements be communicated to people during a new beginning: the purpose behind the change; a picture of how the organization will be after the change; a step-by-step plan to get to that stage; and the part they can play in that outcome.

CARNALL'S CHANGE MANAGEMENT MODEL. Carnall's view of change is focused on managers and the skills they can use to manage change. Carnall describes three skills that must be present at all levels of management: (1) managing transitions effectively; (2) dealing with organizational cultures; and (3) managing organizational politics. Managing transitions involves helping employees learn as they change and supporting a culture of openness and risk-taking. Managing organizational cultures involves creating a "more adaptable culture." This is an organizational culture in which people are more open, there is greater information flow, and perhaps greater autonomy. Finally, to manage organizational politics, the manager should recognize and

understand different organizational groups and their political agendas. The manager should be able to build coalitions and control the agenda through his or her political skill.

SENGE'S SYSTEMIC MODEL. Senge and colleagues encourage managers to think like biologists when approaching organizational change. That is, to better understand how organizations react to change, one should view them as systems bound by many interrelated actions that may affect each other over a long period of time. To enact change, Senge et al recommend that managers start small, grow steadily, do not plan the whole thing, and expect challenges. Furthermore, Senge et al offer a number of issues related to the challenges of first initiating change, then sustaining that change, and finally redesigning and rethinking change.

CHANGE MANAGERS

In both proactive and reactive responses to change and in every model of change, one element remains the same: the need for change managers. There are different types of change managers and their roles encompass a variety of duties. Managers may have responsibility for change that is not ever formally dictated or outlined, or a person or group may be specifically chosen to enact or facilitate change. Described below are two formal ways in which change managers can be identified: transition management teams and change agents. Some responsibilities of change managers are then described.

TRANSITION MANAGEMENT TEAMS. In some organizations that are experiencing change, a specific group of managers is chosen to coordinate change throughout an organization. This transition management team typically consists of eight to twelve people whose full-time responsibilities are to manage and facilitate the change process in the organization. Transition management teams are responsible not only for the structural and procedural changes that occur, but also for managing emotions and resistance to change. These teams typically report to the chief executive officer of the company on a regular basis.

Transition management teams do the day-to-day work involved in change management, and they are not simply another layer of management between top management and line employees. Furthermore, they are not the planning committee; these teams do not develop the plans for the change, they only facilitate the change that is being enacted. Neither are they responsible for determining when and where change is needed, or how it will be brought about. Instead, they manage changes that have been identified and implemented by upper management. Finally, these teams are not permanent. They exist only while the

organization is in flux, and they are dissolved once the company has successfully changed.

CHANGE AGENTS. A change agent is one person who is formally in charge of guiding a change effort. The change agent is typically a part of organizational development, which is a set of planned change interventions intended to improve a company's long-term performance and survival. A change agent may be appointed from within the ranks of current company managers, or the agent may be an outside consultant who is brought in during the period of change. Unlike the transition management team, which only facilitates a change that has been identified and planned by others, the change agent is involved in all steps of organizational change. The agent helps to clarify problems, gather relevant information, assist managers in creating a plan, evaluate the plan's effectiveness, and implement the plan. After change has been successfully enacted, the change agent either returns to his or her normal duties (if this person is from within the organization), or ends his or her work with the company (if this person is a consultant).

There are advantages and disadvantages to choosing either an organizational member or an outside consultant to be a change agent. Outside consultants can be more costly and there is a greater risk for trade secrets to be leaked. Additionally, the consultant is unlikely to have the knowledge of the organization that an employee has, nor is this person likely to be trusted by others in the organization, as they would trust one of their own organizational members. However, consultants do have a more unbiased view of the organization and its problems. They may also bring more innovative or creative ideas to the company. Finally, they may be used as a scapegoat when change is implemented. That is, the negative emotions of organizational members may be directed towards the outsider rather than at the company's management, which may make for a smoother transition during the change process.

RESPONSIBILITIES OF CHANGE MANAGERS. Change managers are responsible for garnering support for change and overcoming resistance to change. There are ten techniques that change managers can use to accomplish this:

1. Plan well. Appropriate time and effort must go into planning change before implementation begins.
2. Allow for discussion and negotiation. Employees must have some input into the changes. This two-way communication can help reduce employee concerns.
3. Allow for participation. If employees participate in changes that affect them, they are more likely to support those changes.

4. Emphasize the financial benefits. If employees can earn higher compensation through organizational change, telling them about this possibility will help to increase support for the change.
5. Avoid too much change. Employees can only handle a certain amount of change before there are negative repercussions from stress, so changes should be introduced slowly and over time.
6. Gain political support. For change to be successful, certain key employees (those with informal power in the organization) must support it.
7. Let employees see successful change. Employees will be more willing to support change if they see that it has worked successfully in other companies or other areas of their company.
8. Reduce uncertainty. Uncertainty about the change effort can cause negative emotions and actions, and any information that change managers can give to reduce uncertainty can reduce resistance to change.
9. Ask questions to involve workers. Change managers should ask workers questions that move them toward a goal or objective or that reinforce positive accomplishments.
10. Build strong working relationships. Better working relationships in general will aid in change management; trust and mutual respect are critical elements of good working relationships.

Managing change can be a reactive or a proactive process, and there are a number of different models of organizational change. Each model emphasizes different approaches to understanding and managing change. In many of these models, the role of the change manager is emphasized. The change manager may be a part of a transitional management team or may be a change agent. This person facilitates the changes to the organization and is often a critical element in the success or failure of the change.

SEE ALSO: Managing Change; Organizational Development; Trends in Organizational Change

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REINFORCEMENT THEORY

Reinforcement theory is the process of shaping behavior by controlling the consequences of the behavior. In reinforcement theory a combination of rewards and/or punishments is used to reinforce desired behavior or extinguish unwanted behavior. Any behavior that elicits a consequence is called *operant behavior*, because the individual operates on his or her environment. Reinforcement theory concentrates

on the relationship between the operant behavior and the associated consequences, and is sometimes referred to as operant conditioning.

BACKGROUND AND DEVELOPMENT OF REINFORCEMENT THEORY

Behavioral theories of learning and motivation focus on the effect that the consequences of past behavior have on future behavior. This is in contrast to classical conditioning, which focuses on responses that are triggered by stimuli in an almost automatic fashion. Reinforcement theory suggests that individuals can choose from several responses to a given stimulus, and that individuals will generally select the response that has been associated with positive outcomes in the past. E.L. Thorndike articulated this idea in 1911, in what has come to be known as the *law of effect*. The law of effect basically states that, all other things being equal, responses to stimuli that are followed by satisfaction will be strengthened, but responses that are followed by discomfort will be weakened.

B.F. Skinner was a key contributor to the development of modern ideas about reinforcement theory. Skinner argued that the internal needs and drives of individuals can be ignored because people learn to exhibit certain behaviors based on what happens to them as a result of their behavior. This school of thought has been termed the behaviorist, or radical behaviorist, school.

REINFORCEMENT, PUNISHMENT, AND EXTINCTION

The most important principle of reinforcement theory is, of course, reinforcement. Generally speaking, there are two types of reinforcement: positive and negative. Positive reinforcement results when the occurrence of a valued behavioral consequence has the effect of strengthening the probability of the behavior being repeated. The specific behavioral consequence is called a reinforcer. An example of positive reinforcement might be a salesperson that exerts extra effort to meet a sales quota (behavior) and is then rewarded with a bonus (positive reinforcer). The administration of the positive reinforcer should make it more likely that the salesperson will continue to exert the necessary effort in the future.

Negative reinforcement results when an undesirable behavioral consequence is withheld, with the effect of strengthening the probability of the behavior being repeated. Negative reinforcement is often confused with punishment, but they are not the same. Punishment attempts to decrease the probability of specific behaviors; negative reinforcement attempts to

increase desired behavior. Thus, both positive and negative reinforcement have the effect of increasing the probability that a particular behavior will be learned and repeated. An example of negative reinforcement might be a salesperson that exerts effort to increase sales in his or her sales territory (behavior), which is followed by a decision not to reassign the salesperson to an undesirable sales route (negative reinforcer). The administration of the negative reinforcer should make it more likely that the salesperson will continue to exert the necessary effort in the future.

As mentioned above, punishment attempts to decrease the probability of specific behaviors being exhibited. Punishment is the administration of an undesirable behavioral consequence in order to reduce the occurrence of the unwanted behavior. Punishment is one of the more commonly used reinforcement-theory strategies, but many learning experts suggest that it should be used only if positive and negative reinforcement cannot be used or have previously failed, because of the potentially negative side effects of punishment. An example of punishment might be demoting an employee who does not meet performance goals or suspending an employee without pay for violating work rules.

Extinction is similar to punishment in that its purpose is to reduce unwanted behavior. The process of extinction begins when a valued behavioral consequence is withheld in order to decrease the probability that a learned behavior will continue. Over time, this is likely to result in the ceasing of that behavior. Extinction may alternately serve to reduce a wanted behavior, such as when a positive reinforcer is no longer offered when a desirable behavior occurs. For example, if an employee is continually praised for the promptness in which he completes his work for several months, but receives no praise in subsequent months for such behavior, his desirable behaviors may diminish. Thus, to avoid unwanted extinction, managers may have to continue to offer positive behavioral consequences.

SCHEDULES OF REINFORCEMENT

The timing of the behavioral consequences that follow a given behavior is called the reinforcement schedule. Basically, there are two broad types of reinforcement schedules: continuous and intermittent. If a behavior is reinforced each time it occurs, it is called continuous reinforcement. Research suggests that continuous reinforcement is the fastest way to establish new behaviors or to eliminate undesired behaviors. However, this type of reinforcement is generally not practical in an organizational setting. Therefore, intermittent schedules are usually employed. Intermittent reinforcement means that each instance of a desired behavior is not reinforced. There are at least four types

of intermittent reinforcement schedules: fixed interval, fixed ratio, variable interval, and variable ratio.

Fixed interval schedules of reinforcement occur when desired behaviors are reinforced after set periods of time. The simplest example of a fixed interval schedule is a weekly paycheck. A fixed interval schedule of reinforcement does not appear to be a particularly strong way to elicit desired behavior, and behavior learned in this way may be subject to rapid extinction. The fixed ratio schedule of reinforcement applies the reinforcer after a set number of occurrences of the desired behaviors. One organizational example of this schedule is a sales commission based on number of units sold. Like the fixed interval schedule, the fixed ratio schedule may not produce consistent, long-lasting, behavioral change.

Variable interval reinforcement schedules are employed when desired behaviors are reinforced after varying periods of time. Examples of variable interval schedules would be special recognition for successful performance and promotions to higher-level positions. This reinforcement schedule appears to elicit desired behavioral change that is resistant to extinction.

Finally, the variable ratio reinforcement schedule applies the reinforcer after a number of desired behaviors have occurred, with the number changing from situation to situation. The most common example of this reinforcement schedule is the slot machine in a casino, in which a different and unknown number of desired behaviors (i.e., feeding a quarter into the machine) is required before the reward (i.e., a jackpot) is realized. Organizational examples of variable ratio schedules are bonuses or special awards that are applied after varying numbers of desired behaviors occur. Variable ratio schedules appear to produce desired behavioral change that is consistent and very resistant to extinction.

REINFORCEMENT THEORY APPLIED TO ORGANIZATIONAL SETTINGS

Probably the best-known application of the principles of reinforcement theory to organizational settings is called behavioral modification, or behavioral contingency management. Typically, a behavioral modification program consists of four steps:

1. Specifying the desired behavior as objectively as possible.
2. Measuring the current incidence of desired behavior.
3. Providing behavioral consequences that reinforce desired behavior.
4. Determining the effectiveness of the program by systematically assessing behavioral change.

Reinforcement theory is an important explanation of how people learn behavior. It is often applied to organizational settings in the context of a behavioral modification program. Although the assumptions of reinforcement theory are often criticized, its principles continue to offer important insights into individual learning and motivation.

SEE ALSO: Leadership Styles and Bases of Power; Motivation and Motivation Theory; Operant Conditioning

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Revised by Marcia Simmering

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RESEARCH METHODS AND PROCESSES

In any organization, managers at all levels need accurate and timely information for managerial decision making. Whether the decisions made are at technical, tactical, or strategic levels, good, accurate, and timely information always leads to a better decision. Gathering of information is done through a sound and scientific research process. Each year organizations spend enormous amounts of money for research and development in order to maintain their competitive edge. Accurate information obtained through research leads to enormous benefits.

APPLIED VERSUS PURE RESEARCH

Research can be defined as scientifically and methodically delving into the unknown in order to provide information for solving problems. The heart of this definition is the concept of problem solving. Both applied and pure (also known as basic) research attempt to solve problems. In applied research, the researcher attempts to solve a known problem and find answers to specific questions. In other words, the emphasis of applied research is on practical problem solving. For instance, when a paper recycling company wants to determine whether or not their recycled

papers meet the required specification as to the thickness of the paper across the roll, they might design a systematic procedure for answering this specific question. The research in such a situation represents applied research. Another example of applied research might be that of prediction. As an example, consider a trucking company that is interested in predicting the tonnage of material shipped in the next quarter. The practical problem is predicting the tonnage and determining which variables are good predictors of tonnage for the next quarter.

Applied research can help make a decision about the following, including a variety of other business and management decisions:

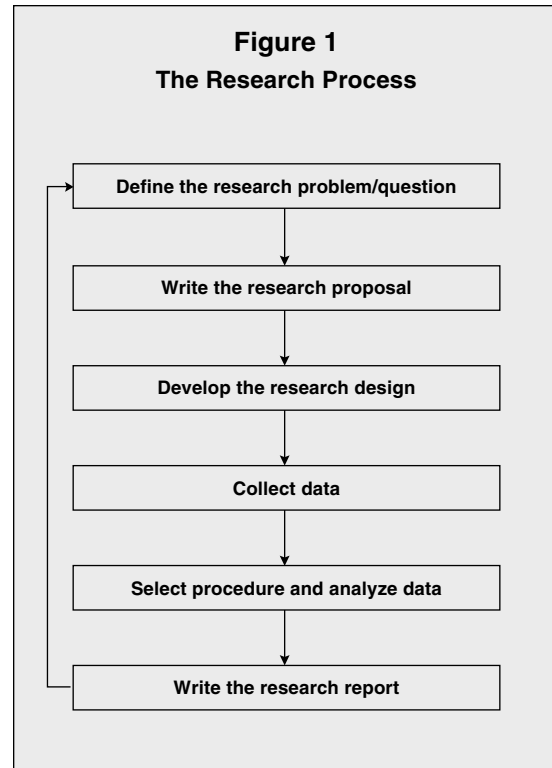
- pricing a new product
- where to locate a new retail store
- how many employees to hire
- how many products to offer
- what to pay employees

Applied research can be used to collect information about markets, competitors, and customers. For example, research can help pinpoint the optimal business location and the size of markets. It can also be used to monitor competitive actions. Customer research determines customer loyalty, customer satisfaction, and customer preferences.

On the other hand, pure, or basic, research does not necessarily try to answer specific questions or solve specific problems. Pure or basic research is done in order to expand knowledge and probe into the unknown. For example, when a researcher is interested in determining how employee demographics and tenure on the job relate to preference for flexible work schedules may represent pure research. Both pure and applied research deals with problem definition and problem solving. Most basic research is conducted by professors in academic institutions (i.e. colleges and universities), by the government, or by consulting firms. Few business organizations will engage in pure research related to business problems. However, understanding the process and methods used for both applied and basic research are important to interpreting research results.

RESEARCH PROCESS

Any research involves several chronological steps, but that does not mean each step must be completed before the next step is undertaken. Furthermore, the process of research is dynamic and the process may change as the research progresses. The steps involved in most research endeavors are shown in Figure 1.



THE RESEARCH QUESTION

Managers' needs for information are the primary source of problem definition and the research question. Managers need information to make educated decisions arising from unanticipated as well as planned changes. As such, managers must select between different alternatives and thus require information about the organization and its environment. The question to be answered or the problem to be solved must first be clearly defined. Questions to be answered could be very specific or extremely broad. The more specific the questions, the easier it will be to answer the research questions. There might be hypotheses that could be tested scientifically. Once the questions to be answered are clearly defined then the value of the research must be assessed. Clearly, if the costs of performing the research project exceed the value that the research will provide, then the project should not be continued.

THE RESEARCH PROPOSAL

Research endeavors require a proposal that explains the problem to be address and the procedure by which the questions will be answered. The researcher's proposal tells the managers what they should expect from the research. It is a contract between the managers and the researcher. For instance, if a company wants to know the degree to which its new incentive program is effective in improving employee performance, then the

consultant or employee conducting the research will create a proposal that indicates to that company how the question will be addressed and what specific information the company will have at the end of the research process. The proposal may indicate, for example, that the research will indicate the level of satisfaction of employees with the new incentive plan, the increased firm performance with the plan, and the individual increases in performance (as measured by managers) with the incentive plan. The purpose of the research proposal is to effectively guide the researchers in their development of the research design and data collection to answer the specific research questions.

RESEARCH DESIGN

Once the proposal is approved, the researcher has a foundation for development of the research design. The plan for conducting the research is the research design. There are two general forms of research design, namely non-experimental (ex-post-facto) and experimental. In a non-experimental design, the researcher does not control or alter any of the independent variables. The researcher merely studies existing situations, variables, and the interrelation among variables and reports the results of his or her findings. The two major non-experimental designs are field studies and surveys. Field studies combine literature review and possibly analysis of some case studies. For example, if one is interested in determining the effectiveness of total quality management (TQM), there will be a thorough literature search on the topic as well as a study of the firms that have applied TQM and have been successful. A literature review means that a researcher identifies previous writings and research on a topic, summarizes the current knowledge on the topic, and assesses the value of that prior research on the current problem. On the other hand, surveys deal with the formulation of a questionnaire (survey instrument) by which one can measure the magnitude of the desired variables as well as the interrelation among the variables. Non-experimental designs are primarily exploratory in nature and provide descriptive measures and can also be used for predictive purposes.

There are two broad categories of experimental designs: field and laboratory. In both field experiments and laboratory experiments, the researcher controls and may alter and introduce some variables in order to determine the effect of a given variable. Field experiments are done in a natural setting, whereas laboratory experiments are undertaken in a simulated setting. Studies on the effectiveness of different configurations of teams and their level of effectiveness can be undertaken in both field and office settings. In an office setting, a researcher might

organize workplace teams, using different criteria to establish each, then measure the success of their group interactions and their productivity on real work tasks. This would be a natural setting, except for the way in which teams were organized. Team composition could also be studied in a laboratory in which the researchers had complete control over more variables. To study team effectiveness in a laboratory setting, individuals would be placed in teams using different criteria, then asked to perform a series of tasks specially designed to measure team interactions and performance. This laboratory setting would allow the researcher more control, because the types of individuals involved could be chosen, rather than using only the employees available in a field setting; by designing tasks specific to the study, rather than using existing work tasks; and by having more ability to watch and measure team performance without hindering organizational performance.

DATA COLLECTION

Data collection is the process of gathering the specific information used to answer the research questions. There are a number of issues associated with data collection, including the use of primary or secondary data, survey design, sampling, survey administration, and increasing response rates.

PRIMARY DATA AND SECONDARY DATA. Data can be primary or secondary, and whether one or both are used, and which is used, depends largely on the research question and the availability of these data sources. Secondary data refer to data gathered by others or from other studies. Secondary data is generally less costly and less time consuming than gathering primary data, typically is accumulated before primary data is gathered, and may even help determine the course by which primary data is pursued. An example of secondary data is if a company uses data from the U.S. Census or data collected for another organizational activity (e.g., performance information for individuals from the company's annual performance appraisal). While secondary data can be used for background information about specific research, it may also answer some specific research questions. However, because secondary data was collected for another purpose, it may not adequately address the new research question. In today's world of rapidly growing information technologies, secondary data are available from numerous sources. A researcher should explore the existing data before starting the research process, since there are datasets for many different types of information currently available. There are abundant data available in literature, company records, government publications, trade associations, and through the Internet.

Primary data is that which is collected by the researcher to address the current research question. Types of primary data include subject demographics, lifestyle characteristics, attitudes, knowledge, intentions, motivations, and behavior. Demographic data includes statistics regarding populations, such as age, sex, income, level of education, and so forth. Lifestyle characteristics describe a respondent's activities, interests, and opinions. Attitudes refer to views and opinions about things, events, or ideas. Knowledge is the degree to which respondents are aware of these things, events, or ideas. Intentions generally refer to a respondent's planned future behavior. Motivations describe the reasons behind a respondent's behavior. Behavior is related to what respondents do.

Primary data can be collected in the field or the laboratory through communication and observation. Communication generally requires the direct questioning of respondents via a paper-and-pencil survey (i.e., questionnaire) or telephone survey. Observation involves the direct recording of respondent behavior. Surveys are probably the most common design in business research. For instance, if one is interested in determining the success of TQM, a survey can be designed that encompasses questions regarding elements of success, strengths, weaknesses, and other questions dealing with TQM. Then the survey can be sent to companies that have been successful in implementing TQM. The survey results could shed light on many aspects of TQM.

SURVEY DESIGN. Survey design is of major importance, because if a survey is poorly designed, it will not provide the researchers with the data that addresses the research question. Survey questions, called items, must be properly chosen in order to elicit appropriate respondent answers. The steps involved include determining the information that will be sought, the type of questionnaire, the method of administration, the content of individual questions, the form of response to each question, the wording of each question, the sequence of questions, the physical characteristics of the questionnaire, and, finally, pre-testing the questionnaire.

Some items for certain areas of interest already exist. For instance, there are existing surveys that measure employees' satisfaction with pay and benefits. If survey items do not already exist in the published literature, the researchers must create their own items, based on their review of the existing literature and their own expertise. Often, a focus group of experts can also help to create items. For example, if a company wants to assess its employees' attitudes towards an intended change in work rules, the researcher may lead a focus group of several experienced company managers to capture all of the relevant ideas that need to be addressed by the survey. Before

the survey instrument is sent out, it must be tested for reliability and validity. Reliability refers to how consistently the instrument measures, and validity refers to whether the instrument is measuring.

One concern when designing a survey is how to word the items. One of the most popular ways to measure attitudes on a survey is by using the Likert scale. This method presents a series of statements to respondents for which they are asked to indicate the degree to which they agree with the statements. An example of a statement might be "The sales people are helpful." Respondents are asked to indicate the degree to which they agree with the statements by checking either SA (strongly agree), A (agree), N (neither agree nor disagree), D (disagree), or SD (strongly disagree). Respondents' answers would then be scored where SA = 5, A = 4, N = 3, D = 2, and SD = 1. A total score would be computed by average or summing scores on related items.

SAMPLING. When administering a questionnaire there are two options as to who should complete the survey. Option one is to give the questionnaire to everyone in the targeted population. This is called a census. However, a census is usually not practical or cost effective. For instance, you may not be able to survey every one of your customers from last year to determine levels of customer satisfaction with your products. Consequently, in order to save time and money, only a sample or subset of the target population receives the questionnaire.

When selecting individuals for a sample, either a probability approach or a nonprobability approach can be used. Probability samples are those where each element of the population has a known probability of being selected. A random sample, for example, is the case where each element has the same probability of being selected. There are some specific types of nonprobability samples: convenience samples, judgment samples, and quota samples. Convenience samples are chosen at the convenience of the researcher. For example, a researcher might distribute a survey to all customers who enter one retail store in a one-week period to determine their level of customer satisfaction with the company's products. This sample is rather easy to select, but it may not represent the full range of customers who have used that product. In a judgment sample, individuals are selected by the researcher because they are believed to represent the population under study. Quota samples attempt to make the sample representative of the population under study where quotas are set for specific groups of people, which are generally selected on the basis of demographic characteristics.

The chief advantage of a probability sample over a nonprobability sample is the ability to assess the reliability and the amount of sampling error in the results.

For example, if the goal were to estimate the annual household income for a given county, probability sampling would allow an accuracy assessment of the estimate. This could not be accomplished with a nonprobability sample.

SURVEY ADMINISTRATION. After the survey has been designed and its reliability and validity assessed, the company must decide the administration method that it will use. Each administration method has its own advantages and disadvantages in terms of cost, information control, sampling control, and administrative control. Information control refers to the possible variation in responses to questions. Sampling control is the ability to select cooperative respondents. Administrative control refers to factors affecting the efficiency of the survey, including timing, quality control, and standardization.

Personal interviews are generally the most expensive means of data collection. In a company, this would mean having researchers meet with employees one-on-one to ask them the survey questions and record their responses. One of the main advantages of the personal interview is the ability to ask any type of question, including an open-ended question, and to adapt to the respondent's answers. However, in addition to being expensive and time consuming, this method is not anonymous, and therefore respondents may be reluctant to answer questions that they feel are sensitive or invasive.

The mail questionnaire is usually the least expensive method of data collection. Besides cost savings, another advantage of the mail questionnaire is its wide distribution potential. However, mail questionnaires cannot control the speed of responses, and the researcher cannot explain ambiguous questions. Mail questionnaires are probably best utilized when asking personal or sensitive questions, particularly if the survey can be made anonymous. Questionnaires can be circulated using various methods, such as post, electronic mail, and fax.

The telephone interview is associated with relatively low cost and higher response rates, and is one of the fastest methods of data collection. While there are methods to address the problem, unlisted numbers make it more difficult to obtain representative samples. Establishing rapport is also more difficult in telephone interviewing than in the personal interview.

One survey administration method that is growing in popularity is the Internet survey, in which respondents answer items on a survey that is located on a web site. Newer, specialized software products are making it easier to conduct online surveys, even for those people with little to no computer programming skills. Studies indicate that Internet research can result in faster responses, lower costs, higher response rates, and better flexibility. Additionally, this method aids in data administration, since survey responses can

be directly inserted into a data spreadsheet by the web survey software.

INCREASING RESPONSE RATES. One of the main concerns of survey research is the response rate, or the number of people who are asked to complete a survey who actually do. Nonresponse error is a source of bias because of the failure to get answers from some of the sample. "Not-at-homes" plague the telephone survey and uncooperative respondents affect telephone, mail, Internet, and personal interview surveys. While research results are mixed regarding effective means for increasing response rates, the following represent some ideas for increasing response rates:

- give respondents advance notice of the survey
- guarantee confidentiality or anonymity
- provide monetary incentives
- provide a postage-paid return envelope for mail surveys
- personalize outgoing envelopes

DATA ANALYSIS

Research provides data, and it is the task of the researcher to transform the collected data into useful information for management. The first step in data analysis is preparing the data by editing it for several factors, including:

- completeness—checking for any omissions
- legibility—making sure that handwriting is understandable so that answers will be coded correctly
- comprehensibility—making sure the answer is understandable
- consistency—checking for consistent answers from the respondent
- uniformity—checking to see that responses are recorded in the same manner

Once the data is edited it is ready for coding, which is determining how survey responses will be transformed into numerical data. The first step in coding is the development of a codebook. The codebook formalizes the coding process by listing answers and their accompanying codes. After the data is coded and entered into a data spreadsheet, statistical analyses can be performed to create useful information for the researchers. If there are hypotheses to be tested, the researcher is in a position to use the gathered data to test the hypotheses. Data analysis could be as simple as reporting descriptive statistics such as averages, measures of variability, and percentages, or if needed, advance statistical techniques could be applied.

RESEARCH REPORT

The research report can be as simple as a short report of a few pages giving the overall findings of the research, or it can be a long report with numerous parts. The degree of formality required by management dictates the type of report to prepare. Figure 2 presents the order of inclusion of the various parts of a long formal report.

Figure 2
Parts of a Complete Research Report

Research report parts	
I.	Prefatory section
	A. Title fly
	B. Title page
	C. Letter of authorization
	D. Letter of transmittal
	E. Table of contents
	F. Synopsis or executive summary
II.	Introduction to the research
	A. Background comments
	B. Statement of the problem (research question)
	C. Objectives of the research
III.	Methodology
	A. Research design
	B. Instrument used and data collection
	C. Data analysis and statistical procedures used
	D. Limitations of the study
IV.	Findings
V.	Summary, conclusions and recommendations
VI.	Appendices
VII.	Bibliography

PREFATORY SECTION. In this part of the report, first a title fly needs to be prepared. The title fly only includes the title of the report. The title should be carefully worded so it tells the reader exactly what the report is about. Following the title fly is the title page. The title page should include the title of the report, the name and the title of the recipient of the report, and the name and the title of the individual who prepared the report and the date. The letter that authorized the undertaking of the research project, followed by a letter of transmittal indicating the completion of the research report are the next items included in the report. Include a table of contents followed by an executive summary. The executive summary, summarizing the report's major findings, should be brief and to the point. This summary should briefly explain the conclusions.

INTRODUCTION TO THE RESEARCH. This section of the report provides a clear background and statement of the research question and provides information about the objectives of the research. Included in this section would be a literature review about previous

studies with the same or similar problem. If there are hypotheses to be tested, population parameters to be estimated, theories to be considered, they will be incorporated into this section of the report

RESEARCH METHOD. This section will provide a detailed explanation of research design and will provide answers to many questions. What type of design was used? What instruments were used for the collection of data? Were there any subjects involved in the study? What did the subjects do? How was the sample selected? What kind of statistical or non-statistical techniques were used for data analysis? Finally, in this section of the report the limitations encountered in the study should be presented.

FINDINGS. This section is probably one of the most important parts of the research report. Provided in this section would be the results of the data analyses and explanation of all the findings. At this point, all the raw data have been analyzed and converted to meaningful information for management's use. This is the section where the original research question is answered.

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS. A concise yet precise summary of major findings will be included in this section, followed by any recommendations that the researcher considers important and meaningful.

APPENDICES AND BIBLIOGRAPHY. Statistical tests, large tables of information, copies of measurement instruments, and supporting documents should be included in the appendices. Finally, the report should end by providing a bibliography of all sources of information.

SEE ALSO: Hypothesis Testing; Statistics

Mo Ahmadi

Revised by Marcia J. Simmering

FURTHER READING:

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RESUMES AND COVER LETTER TRENDS

Employment is the goal of applying for a position. The applicant has specific tools that should be used to achieve this desired goal. The standard tools in the application process include the cover letter and the resume, as well as, in some cases, a completed application form. To use these tools effectively the applicant must know their purpose, their structure and how to transmit them to the employer with the best possible chance of employment.

THE COVER LETTER

Writing the cover letter is a difficult task. It is like an introduction to who you are, what you are seeking, and why you are applying for the position. The cover letter should create an initial impression and communicate skills and abilities—the added value that the applicant will bring to the job. It should be persuasive, showing why you are the right candidate, highlighting key work experience and education from the resume, thus encouraging the employer to read the resume. In general, the cover letter has three or four paragraphs, but it is not stylised to the extent that all cover letters have the same format. The beginning paragraph identifies the position you are seeking and gives a general statement connecting the position with your experience and background. The second paragraph is open to your development of related skills, experiences, education, and personal traits that demonstrate why you are the best candidate for the opening. The third paragraph may continue this area, but it also may illustrate your advantages for the position with special traits, other experiences, or training that strengthen the match between the position listed and you as the most suitable candidate. The information and the style of conveying yourself on paper should lead to a favorable opinion of you as an applicant and a desire to review your resume. The closing paragraph offers information for contact, availability, and desire for further interaction.

The format and content of the cover letter will vary widely depending on the corporate culture. For example, a cover letter to a law firm will be conservative in nature while a letter to an advertising firm will be more creative or unusual. The applicant's name,

address, and phone number should be at the top of each page. The cover letter should be addressed to a particular person in the company, or the salutation should be eliminated. Generally it should be brief, direct, preferably one page in length and have ample white space. If there is a strong interest in the job, then follow up with a hard copy of the cover letter and resume. Finally, the candidate should be sure to proof read the letter several times to eliminate grammar and spelling errors. Employers frequently eliminate a candidate due to a careless error in spelling or typing format. The envelope is important because it should be addressed directly to the person listed in the job announcement. If these initial pieces are in good form, the applicant can proceed to develop the resume and transmit these elements of the application process to the prospective employer. In some cases there may be an application form that must carefully be completed and included with the application. Even the most appropriate letter, resume, and completed application do not insure an interview or employment. However, follow up with the prospective employer may benefit the applicant.

INTRODUCTION TO RESUME CONCEPTS

In the professional application process, a resume serves to introduce and identify the applicants who apply for openings within an organization. Changes in the resume have occurred over time and the advent of electronic communication has brought new approaches to the process. Delineating the resume structure and function as well as the method of submission is important to today's job seeker. Clearly, there are elements, which are the same and new options open to the applicant such as presenting an online resume to a potential employer.

A resume is typically a one to three page summary of a person's skills, accomplishments, experiences, and education designed to help a person obtain a job. The resume may include a list of references and other data. It is the primary tool of the job search and may take several drafts to prepare effectively.

Before the resume is written, applicant should first identify skills and abilities as well as special needs relating to the work environment, salary, geographic location, and people environment. This will help the person develop a career objective and the types and locations of companies to which the person will apply. It will be helpful to list at least several skills that have been developed in the education, work, and internships, volunteer or extracurricular areas. These skills should be emphasized and any other relevant work talents should be included as well. A list of three great accomplishments and the personal qualities that helped reach the goals should be noted.

Individuals with a varied work history and people in some professions may require extended resumes. For example, college/university teaching, research and service requirements for faculty promotion and tenure means that faculty members applying for a position will submit resumes listing extensive publications and service involvement that may result in resumes in excess of five pages.

RESUME TYPE AND CONSTRUCTION

Resumes can be divided into two types: chronological and functional or skills resumes. The reverse chronological resume organizes the candidate's work and education experience with the most recent listed first. The reverse chronological resume is mostly preferred by employers and recruiters and is by far the most frequently used resume format. It is especially useful for individuals who have demonstrated continuous progress in their work history and are seeking a position of increased responsibilities.

The functional resume emphasizes transferable skills acquired through formal education and in non-related work experiences that would be applicable to the professional position being applied for. The employment history is generally minimized. This type of resume is suitable for the recent graduate with little relevant work experience, individuals with unexplained gaps of employment and others who have been job-hopping. With this type of resume, the applicant exhibits the relevant transferable skills and knowledge that he or she would bring to the position. Another approach is to combine a functional resume with a brief reverse chronological work history.

The information regarding the required skills and qualifications of occupations of interest is an extremely important step. This will help to decide if and how these requirements relate to one's own skills and needs. As the resume is organized, the applicant should keep in mind the specific needs of the employer. The candidate should consider what the employer seeks in a candidate and make it easy for the employer to pick out those skills by selecting appropriate categories—using underlining, boldfacing, or capitalizing, and presenting relevant experience and skill areas higher on the page. It will help to remember that you are selling yourself. Create a good first impression by highlighting skills and abilities appropriate to the position. The candidate should also use active language and articulate marketable skills acquired through one's experience or education.

The candidate should feel free to develop his or her own categories to highlight relevant special experiences and skills. For individuals with relatively little relevant work experience, it is frequently useful to separate professional experiences from other work

experiences (e.g., part-time jobs, non-career work) by creating separate categories for these content areas. In this way, more attention can be given to relevant skills by putting them in categories closer to the top of the resume so they are read first. Several categories can be used as guidelines to assist in organizing a resume. In constructing a rough draft, the candidate should not be concerned with length. Categories can be omitted or added in later revisions. There is no absolutely correct way to organize a resume.

The resume should be consistent throughout. It should follow a standard pattern of spacing, formatting, and overall presentation. The candidate should normally present information in reverse chronological order within categories, listing education and work experiences starting with the most recent first. Grammar and spelling should be checked carefully (including looking for things that automatic spell-checking would miss) because misspellings and poorly constructed sentences communicate negative impressions about a candidate. Social security numbers, marital status, race, or date of birth can be excluded from the resume. The candidate should also ensure that the resume is neat and visually appealing. In general, unusual fonts and excess graphics on the resume are not considered professional. The candidate should choose high-quality paper in white, off-white, or other conservative colors and have the final version printed at high resolution (basic laser printer or better).

RESUME FORMAT

The candidate's name, address, telephone number and email are typically listed first in the resume. Candidates should present themselves with the name they use in their personal and business life; nicknames should be avoided. If the candidate has a campus address that does not apply during vacations or after graduation, the candidate should present both a current and a permanent address. Candidates should use their permanent home address, a post office box, or someone who will know where to contact them at all times. Also, phone numbers should always include area codes. If the candidate has an e-mail address, he or she might want to include that as well.

The objective is one of the most important parts of a resume and should not be overlooked. It informs potential employers that you are moving in a certain direction, relates your work preference, and serves as a focal point from which to review and analyse the resume. It should be brief, clearly stated, and consistent with the accomplishments and demonstrated skills as documented on the resume. If the candidate is considering more than one professional goal, the person should consider developing more than one resume, each presenting a different objective. The profile is an alternative to an objective statement. It gives the candidates

the opportunity to present their strengths at the very beginning of the resume.

In writing the major areas of the resume, it is important to emphasize one's abilities and accomplishments more than past duties. The candidate may also want to indicate how well he or she has performed. This will help infuse personal qualities such as character and personality into the resume. The education category is particularly important if the candidate has not had a great deal of work experience. The highest level of education attained should be listed first. Candidates should include their degrees (A.S., B.S., B.A., etc.), major institutions attended, dates of graduation, minors or concentrations, and any special workshops, seminars, related coursework, or special projects. A G.P.A. of higher than a 3.0 (either overall or in major) should also be noted here.

Many young applicants may have limited paid work experience, but have been involved in volunteer work, internships, practicums, or student-teaching work experiences. The important point to the employer is what the candidate's skills are and what the candidate can do on the job. This type of candidate may want to use a skills or functional format. The candidate should include the title of the position, the name of the organization, location of work, and dates. The work responsibilities should be described with an emphasis on achievements using action words to communicate the candidate's skills. The most important and related responsibilities should be listed first. Candidates should identify the most relevant work experiences and link them to the current position. They should be brief with the irrelevant experiences or not list the information. It is sometimes useful to divide the work experience into two categories, relevant experience and other experience.

The additional information category is useful for displaying information that doesn't fit into any other category. Although personal interests, computer knowledge, and activities can be separate categories, especially if they are very strong, they can be listed here as well. Language proficiency, or any other relevant information can be placed here. A personal interest category can sometimes be used to evaluate candidate's suitability to a geographic area or to understand their personality type. Social or civic activities, health and fitness or sports activities, or hobbies that indicate how the candidate spends leisure time could be included. If using computers is a necessary skill for the job, the candidate's knowledge should be emphasized. Activities, honors, and leadership are also important categories to include. If the activities involve work responsibility, note it in some detail. The employer is interested in the skills the candidate has developed whether through volunteer or paid experiences. Recognition and demonstration of leadership roles are valuable and should be accentuated.

REFERENCES

The candidate should ask individuals if they would be willing to be listed as references, prior to mentioning their names to prospective employers. Names of individuals are not usually listed on the resume unless there is space available at the end, but a typed list of three references should be prepared to provide at the interview. This list should include name, employer, title, address, and business email and phone numbers. *References furnished upon request* may also be stated at the bottom of the resume.

THE RESUME IN THE ELECTRONIC ERA

In the last several years transmittal of the resume and cover letter has changed substantially due to the increased use of the Internet. (Some companies still prefer regular mail to e-mail.) Due to ease of use in a 24/7 environment, rapid response time, and low expense, recruiters and job seekers are increasingly using this mode of transmittal. In the past, the cover letter and resume were mailed to the prospective employer, but more and more mega and niche job boards as well as corporate websites are being used. With few exceptions, the email cover letter and resume will remain very similar to the cover letter and resume that was mailed through the post office.

In the online environment the applicant can incorporate the cover letter as an attachment or as part of the e-mail. The salutation, body and closing of the cover letter should be formatted in the same manner as if it were being sent through the mail. Excessive formatting and the use of HTML should be avoided if the cover letter is part of the e-mail. This could result in line breaks, tabs and other formatting changes. Instead, it is wiser to use plain text or rich text format (rtf) to avoid these issues. The applicant should indicate the name and the position being applied for in the email subject line. Today the point of the resume has become more about getting the interview rather than providing a job history. Since Human Resource (HR) Departments may be reviewing hundreds of resumes for a given position, the traditional objective statement at the beginning of a resume is being replaced by an attention getting headline relating the applicant to the position to entice the HR personnel to continue reading the application.

Today a large majority of all resumes and cover letters are transmitted via the Internet utilizing several formats with various capabilities. It is now described as an E-resume, electronic resume or online resume. Due to the intended needs as well as relative advantages and disadvantages, there are a number of formats used to transmit the documents, including plain text, rich text file, Microsoft Word, image scanned PDF files, web sites, and Macromedia Flash. The list

of options for transmitting a resume will change with the introduction of new technologies/methodologies such as web logs or *blogs*.

The plain text file incorporated into an e-mail message is the simplest method of electronically submitting a resume. (However, formatting capabilities are not available unless rich text formatting is used.) The email recipient can then easily migrate plain text or rich text into Microsoft Word or Word Perfect. Attaching a Word file is widely used for transmitting a resume since the applicant can email the actual formatted resume with the ability to select a wide range of formatting capabilities. However, some organizations are hesitant to open the attached document because of a possible virus. Adobe Acrobat provides a software program to scan the document into a PDF format so that the document will remain unchanged. The employer can then view the document using a free Adobe program.

Web portfolios provide the most flexibility of all the options. It can combine the print and hyperlinks as well as stills, sound, and animation through the use of Macromedia Flash. In other words, it can be equivalent to a small website that can display graphs, charts, project activities, and work samples to showcase the applicant's capabilities. Artists, teachers, architects, and other professionals requiring a multimedia format can use it. Macromedia Flash is rapidly becoming the accepted standard for integrating various mediums in a small file size that leads to a high speed of transfer. However, the software requires a tech savvy user to create the multimedia hyper-linked portfolio or Flash application and requires some skill to access it. The latest Internet innovation has been the use of weblogs or web diaries that, to date, have seen limited use in the application process. The weblog provides the employer with information about the applicants' work experiences, business ideas, thoughts, and testimonials. Recently, sales and marketing personnel have been successfully incorporated web blogs into their resumes.

POSTING RESUMES TO AN ONLINE DATABANK

The applicant has a number of options when looking for a position. The resume can be submitted to the company website doing the hiring or posted on massive job boards such as Monster (<http://www.monster.com>) or Workopolis (<http://www.workopolis.com>). Due to identity theft on some job banks, individual job seekers submit resumes directly to individual corporate websites. There are a few safety guidelines that should be adhered to when posting your resume to searchable databases: omit personal information such as your social security number; never pay a fee up front for use of a resume bank;

never agree to a pre-screening background check online; and be wary of companies located outside the United States. In addition the applicant should use standard fonts such as *Times New Roman*, *Helvetica*, or *Arial*; avoid elaborate stylising and graphics; always maintain a professional e-mail address; and do not password protect your attached resume document.

Online resumes and job applications are exploding on the Internet. In 2002, there were 36 million resumes transmitted online. This online traffic results from applicants to individual corporate websites; to the three mega job board online portals such as Monster, HotJobs (<http://hotjobs.yahoo.com>) and CareerBuilder (<http://www.careerbuilder.com/>) and niche job boards such as association and college alumni sites; to federal government positions via the U. S. Office of Personnel Management's USA Jobs website (which posted 600,000 new online resumes and logged more than 66 million visits in the 9 months prior to June 2004) which can also post applicants of future jobs; to the 40,000 employment-related sites such as CA Source (<http://www.casource.com>) for chartered accountants. Gerry Crispin, co-author of *CareerXRoads*, estimates that in 15 percent of new hires are coming from the fast growing niche boards. In addition to identifying key websites for certain job openings, valuable information can be gleaned from e-networking through profession-related discussion boards, listservs, and instant messaging, as well as researching companies online.

Online resume banks will either be form-based or allow the applicant to paste the resume into a plain-text field. When the applicant enters the resume in either of these formats, it is critical that the applicant use words from the job posting as well as variations of the term in the resume. For example, if the applicant is a personnel officer, then personnel and human resources should both be used. If the applicant is an administrator, then use director, administrator or supervisor also. Because of the large number of applications, employers are now using applicant-tracking systems (ATS) to screen applications for identifying the top applicants for a job. Therefore, it can be important for the applicant to use key words from the job description and his or her qualifications to ensure that the applicant tracking system retrieves the application.

In the highly competitive environment of the workplace, the resume and the cover letter are the first steps to gaining an interview and ultimately the position. Being aware of effective cover letters and resume construction is highly important to all job seekers. Knowing the impact of the electronic medium is essential because it shows that an applicant is knowledgeable of the web and its impact on job advertising and applications. Evaluators of applications are seeking the most qualified and capable person for their organization. A well-developed resume and cover letter

shows a savvy candidate with the potential to contribute to the organization of interest.

SEE ALSO: Employee Recruitment Planning; Employee Screening and Selection; Human Resource Management

Bill Prince and Nancy Ryan Prince

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REVERSE SUPPLY CHAIN LOGISTICS

Consumer awareness, enhanced by legally imposed green law constraints, have led to the need for safe return of products from the field as well as more environmentally friendly products. As a result, logistics planning must now consider both forward and return flows of products, parts, subassemblies, scrap and containers. It seems that an entirely new spectrum of goods has emerged at what was once considered the end of the supply chain. These goods include:

- Products that have failed, but can be repaired or reused.
- Products that are obsolete but still have value.
- Unsold products from retailers.

- Recalled products.
- Parts repaired in the field that still have value.
- Items that have secondary usage, i.e. items that have another usage after they have exhausted their original use.
- Waste that must be accounted for and disposed of or used for energy production.
- Containers that must be returned to their origin or some sort of consolidation facility.

In their *Harvard Business Review* article, Guide and Wassenhove describe a reverse supply chain as "the series of activities required to retrieve a used product from a customer and either dispose of it or reuse it."

Donald F. Blumberg describes reverse logistics as the "coordination and control, physical pickup and delivery of the material, parts, and products from the field to processing and recycling or disposition, and subsequent returns back to the field where appropriate." This may include the services related to receiving the returns from the field, and the processes required to diagnose, evaluate, repair, and/or dispose of the returned units, products, parts, subassemblies, and material, either back to the direct/forward supply chain or into secondary markets or full disposal.

As a point of contrast, Blumberg describes forward logistics as "the overall management and coordination and control of the full direct service logistics pipeline, including the flow of the original material, parts and the final products to the central warehouse and distribution system, as well as the initial physical flow down to regional and local supply points to the end user or purchaser."

A number of forces seem to be influencing this increase in need for reverse logistics activities. These include:

- The previously mentioned *green* forces such as legislation and consumer awareness and concern. Frequently, due to legislation, the original manufacturer is now responsible for final disposal of the product. The increasing value of return products increases the need for safe return from the field.
- Increased number of customer goods returned for credit as a result of increased demand for customer service and satisfaction. Large retail chains usually have an agreement with suppliers allowing them to return goods. While originally intended to cover failed products, it has expanded to cover perfect goods that simply have not sold. From the consumer perspective, the buyer may

return a good simply because they have decided not to keep it.

- Shortened product life cycles. As products become obsolete more quickly the possibility of and potential for returns increases.
- The drive to reduce costs. Firms are striving to reuse potentially good items through reuse, recycling or secondary usage. For example, Ford Motor Company has a program for recycling plastic bumpers into tail light housings.
- Increase in e-commerce sales. The massive increase of sales made via the Internet is conducive to increased returns as consumers buy merchandise “*sight unseen*” only to be disillusioned or dissatisfied with their purchase.
- Increased demand for repairs, re-manufacturing, upgrades, or re-calibration.
- Potentially valuable products that are no longer viewed as such by the current user. Consumers may purchase a new TV or washer/dryer even though the one they own still has a useful life.
- Increased use of returnable or reusable containers.
- Warranty returns. For many items with warranties, the good is first returned and then its disposition determined.
- Rental returns. The proliferation of rental businesses ensures the return of used but still valuable furniture and appliances.
- Product recalls. Products may be recalled by the manufacturer due to potential failure in the field or safety concerns.

Guide and Van Wassenhove list five key components to the reverse supply chain:

1. Product Acquisition. The used product must be retrieved.
2. Reverse Logistics. Once collected, used products are transported to some sort of facility for inspection, sorting, and disposition.
3. Inspection and Disposition. The returned products are tested, sorted, and graded. Diagnostic tests may be performed to determine a disposal action that recovers the most value from the returned product. If a product is new it may be returned to the forward supply chain. Others may be eligible for some form or reconditioning while others may be sold for scrap or recycling.
4. Reconditioning. Some products may be reconditioned or completely remanufactured.

Most people have seen products labeled *factory reconditioned* which implies it is used but like new and may have a warranty. Some products may have parts that can be extracted for reuse or as spare parts. Others go for salvage or recycling.

5. Distribution and sales. Reconditioned or remanufactured products may be sold in secondary markets where customers are unwilling to purchase a new product. In other instances the firm may need to create a new market if demand is not currently present. Of course, there are distribution needs in getting the product to the secondary market.

Blumberg lists a number of important characteristics that need to be managed coordinated, and controlled if the reverse supply chain is to be economically viable:

- Uncertain flow of materials—firms often do not know when a return item will arrive nor are they certain of its condition. The item may be *like new* or may require substantial repair or even disposal. Field service engineers often try a new part in a field failure, assuming the old part is bad. Subsequently, the old part is returned. When it turns out that the new part did not fix the problem, the old part is still returned as *bad*, thus creating a flow of mixed good and bad parts. Typically, 30 to 35 percent of high tech returns are perfectly good.
- Customer diversity—the return flow can be quite diverse and dependent upon the specific customer or end user. This may require considerable knowledge of specific customers and their use of the product.
- Time—from a cost or service perspective it may be desirable to return/repair/process an item as quickly as possible so that it may be quickly disposed of or reused.
- Value improvement—the firm will of course want to maximize the value of its return goods by transforming them into the state that will provide the most revenue or least cost.
- Flexibility—where demands fluctuate, the facility, transportation or other services may need to be flexible to support the firm’s goals for the returned material.
- Multiparty coordination—since reverse logistics almost always involves multiple parties, an efficient and rapid real-time communication system or network is needed.

CLOSED LOOP SUPPLY CHAIN

Increasingly, it is found that the original supplier is in the best position to control the return process. The basic reverse supply chain logistics model operates independently of the forward supply chain that delivered the original product. When a firm controls the full process of forward and backward shipment the result is called a closed loop supply chain.

The closed loop supply chain generally involves a manufacturer, although sometimes it is the buyer, taking responsibility directly for the reverse logistics process. The products, parts, etc. are returned and recovered directly by the original manufacturer or through indirect (dealer) channels representing the original manufacturer's own field service force. The primary difference in this and the reverse supply chain is that in this model the entire direct and reverse flow can be and usually is controlled by the original manufacturer.

Within a closed loop system involving a consumer market the primary interaction is between the retailer and the original manufacturer. Returns can be failed products or simply those purchased and returned. In this model there are two reverse linkages, consumer to retailer and retailer to original manufacturer.

Closed loop systems allow firms to track the product and its failure and repair experience, thereby revealing how to cost-effectively service and support field service. Also, the close control and rapid recovery provided by a closed loop system allows minimum inventory for field support. Blumberg states that inventory value is maximized through:

- Rapid returns to the manufacturer for reuse.
- Ability to liquate products, parts, and sub-assemblies with value to secondary markets.
- Controlled recycling or disposition within environmental and other legal requirements.
- Ability to efficiently process returns back into the original direct supply chain.

Reducing inventory often produces significant additional efficiencies and results to the firm including:

- Simplifying processes of retail and wholesale return, reducing labor cost.
- Reducing undesirable shrinkage and damage from returns.
- Improving the database and visibility of products throughout their life cycle.
- Reducing disposition cycle times, thereby, increasing cash flow.

Blumberg also states that the strategic value of closed loop reverse logistics management operations will have a very positive effect in terms of:

- Reducing cost of returns.
- Increasing the value of the salvage merchandise.
- Capturing vital information and reliability, maintainability, and dependability of products supported.
- Reducing transportation and warehousing expenses and time including the partial or full elimination of small package shipments.
- Automating and fully controlling the total returns process.

General experience dictates that the introduction of closed loop supply chain management can result in the bottom line direct savings of 1 to 3 percent or more of total revenues, particularly for organizations in a mature or stagnating market.

RESPONSIVE VS. EFFICIENT

By strategic design, forward supply chains generally strive to be either efficient, that is, designed to deliver the product at a low cost, or responsive, meaning designed for speed of response. Obviously, there is a trade-off between the two structures; the quest for low-cost (efficiency) would tend involve foregoing actions that would increase responsiveness, while striving for increased responsiveness almost always involves an increase in cost (or a decrease in efficiency).

Blackburn, Guide, Souza and Van Wassenhove suggest that reverse supply chains follow a similar structure even though most currently strive to be efficient. They propose that reverse supply chains may be structured as efficient or responsive depending upon the type of product returned. Their research indicates that for reverse supply chains, the most influential product characteristic is marginal value of time (MVT). They also propose that efficient reverse supply chains can achieve processing economies by delaying testing, sorting, and grading until the products have been collected at a central location. This works well for products that have a low marginal value of time. However, for items with a high marginal value of time, for example, PCs, a responsive reverse supply chain is appropriate. Early diagnosis, for example by field testing, can maximize asset recovery value by accelerating returns to their ultimate disposition, a process they call *preponement* (as opposed to the postponement tactic prevalent in forward supply chains). Also, by diverting new and scrap products from the main flow, flow time for items requiring additional work, repair and reconditioning, is reduced. Therefore if efficiency is the objective, then the reverse supply chain should be designed to centralize the evaluation activity. If responsiveness is the goal, a decentralized

evaluation activity would be appropriate in order to minimize time delays in processing returns.

The total value of returned products in the U.S. alone is estimated at \$100 billion per year. With this kind of volume the importance of the reverse supply chain can only go up.

SEE ALSO: Inventory Management; Inventory Types; Logistics and Transportation; Production Planning and Scheduling; Purchasing and Procurement; Quality and Total Quality Management; Supply Chain Management

R. Anthony Inman

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RIGHTSIZING

SEE: Downsizing and Rightsizing

RISK MANAGEMENT

Risk management is a systematic process of identifying and assessing company risks and taking actions to protect a company against them. Some risk managers define risk as the possibility that a future occurrence may cause harm or losses, while noting that risk also may provide possible opportunities. By taking risks, companies sometimes can achieve considerable gains. However, companies need risk management to analyze possible risks in order to balance potential gains against potential losses and avoid expensive mistakes. Risk management is best used as a preventive measure rather than as a reactive measure. Companies benefit most from considering their risks when they are performing well and when markets are growing in order to sustain growth and profitability.

The task of the risk manager is to predict, and enact measures to control or prevent, losses within a company. The risk-management process involves identifying exposures to potential losses, measuring these exposures, and deciding how to protect the company from harm given the nature of the risks and the company's goals and resources. While companies face a host of different risks, some are more important than others. Risk managers determine their importance and ability to be affected while identifying and measuring exposures. For example, the risk of flooding in Arizona would have low priority relative to other risks a company located there might face. Risk managers consider different methods for controlling or preventing risks and then select the best method given the company's goals and resources. After the method is selected and implemented, the method must be monitored to ensure that it produces the intended results.

THE EVOLUTION OF RISK MANAGEMENT

The field of risk management emerged in the mid-1970s, evolving from the older field of insurance management. The term *risk management* was adopted because the new field has a much wider focus than simply insurance management. Risk management includes activities and responsibilities outside of the general insurance domain, although insurance is an important part of it and insurance agents often serve as risk managers. Insurance management focused on protecting companies from natural disasters and basic kinds of exposures, such as fire, theft, and employee injuries, whereas risk management focuses on these kinds of risks as well as other kinds of costly losses, including those stemming from product liability, employment practices, environmental degradation, accounting compliance, offshore outsourcing, currency fluctuations, and electronic commerce. In the 1980s and 1990s, risk management grew into vital part of company planning and strategy and risk management became integrated with more and more company functions as the field evolved. As the role of risk management has increased to encompass large-scale, organization-wide programs, the field has become known as enterprise risk management.

TYPES OF RISK MANAGERS AND TYPES OF RISK

Company managers have three general options when it comes to choosing a risk manager:

1. Insurance agents who provide risk assessment services and insurance advice and solutions to their clients;

2. Salaried employees who manage risk for their company (often chief financial officers or treasurers); and
3. Independent consultants who provide risk-management services for a fee.

Because risk management has become a significant part of insurance brokering, many insurance agents work for fees instead of for commissions. To choose the best type of risk manager for their companies, managers should consider the company's goals, size, and resources.

Managers also should be aware of the types of risks they face. Common types of risks include automobile accidents, employee injuries, fire, flood, and tornadoes, although more complicated types such as liability and environmental degradation also exist. Furthermore, companies face a number of risks that stem primarily from the nature of doing business. In *Beyond Value at Risk*, Kevin Dowd sums up these different types of risks companies face by placing them in five general categories:

1. Business risks, or those associated with an organization's particular market or industry;
2. Market risks, or those associated with changes in market conditions, such as fluctuations in prices, interest rates, and exchange rates;
3. Credit risks, or those associated with the potential for not receiving payments owed by debtors;
4. Operational risks, or those associated with internal system failures because of mechanical problems (e.g., machines malfunctioning) or human errors (e.g., poor allocation of resources); and
5. Legal risks, or those associated with the possibility of other parties not meeting their contractual obligations.

In addition, environmental risks constitute a significant and growing area of risk management, since reports indicate the number and intensity of natural disasters are increasing. For example, the periodical *Risk Management* reported that there were about five times as many natural disasters in the 1990s as in the 1960s. The year 2004 was one of the worst in history, with three major hurricanes hitting the state of Florida and a tsunami causing death and devastation in the Pacific Rim. Some observers blame the rising number of natural disasters on global warming, which they believe will cause greater floods, droughts, and storms in the future.

Furthermore, any given risk can lead to a variety of losses in different areas. For example, if a fire occurs, a company could lose its physical property

such as buildings, equipment, and materials. In this situation, a company also could lose revenues, in that it could no longer produce goods or provide services. Furthermore, a company could lose human resources in such a disaster. Even if employees are not killed or injured, a company would still suffer losses because employers must cover benefits employees draw when they miss work.

ASSESSING RISKS ASSOCIATED WITH DOING BUSINESS

One way managers can assess the risks of doing business is by using the risk calculator developed by Robert Simons, a professor at the Harvard Business School. Although the risk calculator is not a precise tool, it does indicate areas where risks and potential losses exist, such as the rate of expansion and the level of internal competition. Using the risk calculator, managers can determine if their company has a safe or dangerous amount of risk. The risk calculator measures three kinds of internal pressures: risk stemming from growth, corporate culture, and information management. Rapid growth, for example, could be a risk and lead to losses, because if a company grows too quickly, it may not have enough time to train new employees adequately. Hence, unchecked growth could lead to lost sales and diminished quality.

Managers can assess the increased risk associated with growth by determining if sales goals are set by top management without input from employees. If a company sets sales goals in this manner, then it has a high level of risk in that the goals may be too difficult for employees to meet. In cases where employees feel extreme pressure in trying to achieve goals, they may take unnecessary risks. Similarly, companies that rely heavily on performance-based pay also tend to have higher levels of risk.

To assess risk arising from corporate culture, managers should determine what percentage of sales comes from new products or services developed by risk-taking employees. If the percentage is high, then the amount of risk is also high, because such a company depends significantly on new products and the related risks. In addition, a corporate culture that allows or encourages employees to work independently to develop new products increases company risk, as does a high rate of new product or service failures.

Finally, managers can determine business risks resulting from information management by determining if they and their subordinates spend a lot of time gathering information that should already be available. Another way of assessing these risks is by managers considering whether they look at performance data frequently and whether they notice if reports are missing or late.

RISK MANAGEMENT METHODS

Risk managers rely on a variety of methods to help companies avoid and mitigate risks in an effort to position them for gains. The four primary methods include exposure or risk avoidance, loss prevention, loss reduction, and risk financing. A simple method of risk management is exposure avoidance, which refers to avoiding products, services, or business activities with the potential for losses, such as manufacturing cigarettes. Loss prevention attempts to root out the potential for losses by implementing such things as employee training and safety programs designed to eradicate risks. Loss reduction seeks to minimize the effects of risks through response systems that neutralize the effects of a disaster or mishap.

The final option risk managers have is to finance risks, paying for them either by retaining or transferring their costs. Companies work with risk managers insofar as possible to avoid risk retention. However, if no other method is available to manage a particular risk, a company must be prepared to cover the losses—that is, to retain the losses. The deductible of an insurance policy is an example of a retained loss. Companies also may retain losses by creating special funds to cover any losses.

Risk transferring takes place when a company shares its risk with another party, such as an insurance provider, by getting insurance policies that cover various kinds of risk that can be insured. In fact, insurance constitutes the leading method of risk management. Insurance policies usually cover (a) property risks such as fire and natural disasters, (b) liability risks such as employer's liability and workers' compensation, and (c) transportation risks covering air, land, and sea travel as well as transported goods and transportation liability. Managers of large corporations may decide to manage their risks by acquiring an insurance company to cover part or all of their risks, as many have done. Such insurance companies are called captive insurers.

Risk managers also distinguish between preloss and postloss risk financing. Preloss risk financing includes financing obtained in preparation for potential losses, such as insurance policies. With insurance policies, companies pay premiums before incurring losses. On the other hand, postloss financing refers to obtaining funds after losses are incurred (i.e., when companies obtain financing in response to losses). Obtaining a loan and issuing stocks are methods of postloss financing.

During the implementation phase, company managers work with risk managers to determine the company goals and the best methods for risk management. Generally, companies implement a combination of methods to control and prevent risks effectively, since these methods are not mutually exclusive, but comple-

mentary. After risk management methods have been implemented, risk managers must examine the risk management program to ensure that it continues to be adequate and effective.

EMERGING AREAS OF RISK MANAGEMENT

In the 1990s, new areas of risk management began to emerge that provide managers with more options to protect their companies against new kinds of exposures. According to the Risk and Insurance Management Society (RIMS), the main trade organization for the risk management profession, among the emerging areas for risk management were operations management, environmental risks, and ethics.

As forecast by RIMS, risk managers of corporations started focusing more on verifying their companies' compliance with federal environmental regulations in the 1990s. According to *Risk Management*, risk managers began to assess environmental risk such as those arising from pollution, waste management, and environmental liability to help make their companies more profitable and competitive. Furthermore, tighter environmental regulations also goaded businesses to have risk managers check their compliance with environmental policies to prevent possible penalties for noncompliance.

Companies also have the option of obtaining new kinds of insurance policies to control risks, which managers and risk managers can take into consideration when determining the best methods for covering potential risks. These nontraditional insurance policies provide coverage of financial risks associated with corporate profits and currency fluctuation. Hence, these policies in effect guarantee a minimum level of profits, even when a company experiences unforeseen losses from circumstances it cannot control (e.g., natural disasters or economic downturns). Moreover, these nontraditional policies ensure profits for companies doing business in international markets, and hence they help prevent losses from fluctuations in a currency's value.

Risk managers can also help alleviate losses resulting from mergers. Stemming from the wave of mergers in the 1990s, risk managers became a more integral part of company merger and acquisition teams. Both parties in these transactions rely on risk management services to determine and control or prevent risks. On the buying side, risk managers examine a selling company's expenditures, loss history, insurance policies, and other areas that indicate a company's potential risks. Risk managers also suggest methods for preventing or controlling the risks they find.

Finally, risk managers have been called upon to help businesses manage the risks associated with increased reliance on the Internet. The importance of

online business activities in maintaining relationships with customers and suppliers, communicating with employees, and advertising products and services has offered companies many advantages, but also exposed them to new security risks and liability issues. Business managers need to be aware of the various risks involved in electronic communication and commerce and include Internet security among their risk management activities.

ENTERPRISE RISK MANAGEMENT

As the field of risk management expanded to include managing financial, environmental, and technological risks, the role of risk managers grew to encompass an organization-wide approach known as enterprise risk management (ERM). This approach seeks to implement risk awareness and prevention programs throughout a company, thus creating a corporate culture able to handle the risks associated with a rapidly changing business environment. Practitioners of ERM incorporate risk management into the basic goals and values of the company and support those values with action. They conduct risk analyses, devise specific strategies to reduce risk, develop monitoring systems to warn about potential risks, and perform regular reviews of the program.

In the United States, the Sarbanes-Oxley Act of 2002 provided the impetus for a number of large firms to implement enterprise risk management. Passed in the wake of scandals involving accounting compliance and corporate governance, the act required public companies to enact a host of new financial controls. In addition, it placed new, personal responsibility on boards of directors to certify that they are aware of current and future risks and have effective programs in place to mitigate them. "Fueled by new exchange rules, regulatory initiatives around the globe, and a bevy of reports that link good corporate governance with effective risk management, attention is turning to ERM," Lawrence Richter Quinn noted in *Financial Executive*. "[Some executives believe that it] will save companies from any number of current and future ills while providing significant competitive advantages along the way."

In late 2004 the London-based Treadway Commission's Committee of Sponsoring Organizations (COSO) issued *Enterprise Risk Management-Integrated Framework*, which provided a set of "best practice" standards for companies to use in implementing ERM programs. The COSO framework expanded on the work companies were required to do under Sarbanes-Oxley and provided guidelines for creating an organization-wide focus on risk management. According to *Financial Executive*, between one-third and one-half of Fortune 500 companies had

launched or were considering launching ERM initiatives by the end of 2004.

SEE ALSO: Business Continuity Planning; Strategic Planning Tools; Succession Planning

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ROBOTICS

Today's manufacturers in numerous industries are gaining rapid increases in productivity by taking advantage of automation technologies. One of these automation technologies, robotics, is a key factor leading the way in the twenty-first century. Firmly established as a critical manufacturing technology, robotics is gaining acceptance by the workforce, garnering praise for its reliability, and being utilized more extensively in medium and small companies.

As manufacturing assembly has grown increasingly complex, the need for new and expanded capabilities, particularly in automated assembly systems, has become evident. As components get smaller, as in micro-manufacturing, it is required that greater precision, more flexibility and higher throughput are achieved. Manual assembly no longer suffices for a

great many of manufacturing's current requirements. Functions formerly performed by humans, especially difficult, dangerous, monotonous, or tedious tasks, are now often assumed by robots or other mechanical devices that can be operated by humans or computers. Robots can take the place of humans in extreme settings or life threatening situations involving nuclear contaminants, corrosive chemicals, or poisonous fumes.

While the automotive industry is the largest market for robot manufacturers, other industries are increasing their use of robotics. According to reports from the Robotics Industries Association, industries such as semiconductors and electronics, metals, plastics and rubber, food and consumer goods, life sciences and pharmaceuticals, and aerospace are all finding ways that their services can be enhanced and improved through robotics.

Some of these manufacturers are also improving the quality of their products by using robots with powerful machine-vision inspection equipment or by linking their robots to statistical process control systems. Robot fixtures can move quickly and fluidly without sacrificing accuracy. Servo-driven positioners can be programmed to handle more than one model on the same line, something especially important to lean organizations. This programmability also allows its users to set up the systems again and again for different applications. In most cases, converting robots from one application to another can be completed with minimal downtime, requiring only programming changes. Benefits include reduced capital expenses (you don't have to buy new fixtures for new applications), floor space requirements, lead-time, component expenses, and training investment.

A BRIEF HISTORY OF ROBOTICS

Despite the fact that robotics technology was developed in the United States, Japan became the first nation to actually embrace robotics; many observers view this as a significant factor in Japan's emergence as a global manufacturing power. Today Japan is not only one of the major users of manufacturing robotics but it is also the dominant manufacturer of industrial robots.

In the early 1980s, 70 percent of robot orders were for use in the automotive industry. During this time, robot manufacturers simultaneously improved their reliability and performance and sought to lessen their dependence on the automotive industry by focusing on specific niche markets. By concentrating on applications other than spot welding, painting, and dispensing, the robotics industry was able to develop products that could successfully handle not only assembly, but also material handling and material removal. Spot welding, which for a long time was the major application of robotics, eventually was eclipsed by materials handling. This was a clear indication that

the robotics industry was indeed becoming less dependent on the automotive industry, since materials handling is used in a wide and varied range of industries. Additionally, non-manufacturing applications started to become viable in such areas as security, health care, environmental cleanup, and space and undersea exploration.

Advances in robot control technology, simulation, and offline programming made robots easier to program, maintain, and use. Simulation use allowed for the discovery of potential problems before the robots were actually installed.

CURRENT USE OF INDUSTRIAL ROBOTS

Though less dependent on the automotive industry than in the past, the robotics industry still finds its widest application in that market. However, driven by the need for increased manufacturing efficiency, the automakers and automotive-related industries are moving away from hard automation in favor of flexible automation. Analysts predict greater use of robots for assembly, paint systems, final trim, and parts transfer in the automotive industry. Realistic robot simulation is making an impact by integrating vehicle design and engineering into manufacturing.

One reason for increased practicality of robots is the availability to control machinery and systems through personal or laptop computers. According to Waurzyniak, some advances in computer-guided systems are robots with force sensing capabilities and 3-D and 2-D vision-guidance capabilities. NASA is using sophisticated computer-guided robot controllers for its Space Shuttle Endeavor and the Mars landing craft. Each of these systems utilize computer control of some sort, ranging from simple machine-specific tracking, to shop-wide data collection across a variety of machinery and instruments, to galactic monitoring and control in a unique, outer space environment.

The Robotic Industries Association reports that an estimated 144,000 industrial robots are in use in the United States in 2004, up from 82,000 in 1998. In 2004, North American manufacturers purchased 14,838 robots, valued at nearly \$1 billion, a 20 percent increase from 2003 and the industry's second best unit total ever. There has been a 152 percent increase in new robots ordered and a 78 percent increase in revenue in 2004 as well.

The key factors driving this growth in robotics are mass customization of electronic goods (specifically communications equipment), the miniaturization of electronic goods and their internal components, and the re-standardization of the semiconductor industry. The food and beverage industry is also in the midst of an equipment-spending boom in an effort to improve operating efficiencies. Robot installations for

such tasks as packaging, palletizing, and filling are expected to see continued growth. In addition, increases are anticipated in the aerospace, appliance, and non-manufacturing markets.

THE FUTURE OF ROBOTICS

To some, the future of robotics has never looked brighter. Production of bipedal robots that mimic human movement are being created around the globe. Honda Motor Company's ASIMO (Advanced Step in Innovative Mobility) robot is considered the world's most advanced humanoid robot. It can climb stairs, kick, walk, talk, dance and even communicate and interact via its voice and facial recognition systems. Honda plans to one day market the robot as an assisted-living companion for the disabled or elderly.

Other robots that simulate human movement have been created at Cornell University, Massachusetts Institute of Technology (MIT), and Holland's Delft University of Technology. In a March 2005 article in *Machine Design*, the creators of the three robots describe the mechanics utilized in their designs and detail how their robots use less energy than ASIMO, although they do not have the range of capabilities of the ASIMO robot. These variations in mobility indicate promise and potential in a variety of robotic applications for the future.

Chip Walter's article, "You, robot", discusses renowned robotics researcher, Hans Moravec, Carnegie Mellon University scientist and cofounder of the university's Robotics Institute. Moravec is known for his longstanding prediction that super-robots that can perceive, intuit, adapt, think, and even simulate feelings, much like humans, will be practicable before the year 2050. His confidence in his predictions led him to open his own robotics firm in 2003, the Seegrid Corporation, to assist him in fulfilling his claims. His path toward that vision is to start simply—to create mobile carts with software and vision systems that can be 'taught' to follow paths and navigate independently. Moravec believes that machines will evolve in small steps, eventually reaching the levels of human intelligence and movement. His bedrock belief, on which he bases his technology, is ". . . if robots are going to succeed, the world cannot be adapted to them; they have to adapt to the world, just like the rest of us."

Stuart Brown reports that navigation technologies such as the global positioning system (GPS) are allowing industrial robots to move around in the world. GPS in conjunction with inertial navigation systems (INS) and the booming field of silicon microelectromechanical systems (MEMS) are impacting robotics from simple automated lawn mowers to complex airplane control systems. Robotics are reaching the micro-level with the exploration of robotic water

'insects' equipped with biomechanical sensors that could be used as environmental monitors. The current prototype weighs less than a gram and draws power from ultra-thin electrical wires. An affordable and time-saving alternative to locating gas leaks has been developed in a pipe-inspecting robot crawler; equipped with multiple joints and video cameras, it easily navigates sharp turns and narrow pipes while projecting images of pipe integrity to a monitor. Plans for the future include a sensor that will detect corrosion and cracks in the pipes that do not appear in the video images.

Robots have come of age. While they were initially used for fairly simple tasks such as welding and spray-painting automobiles, these machines have increased tremendously in ability over the last decade, reaching further and broader than simple auto applications. Robotics will remain vital in the decades to come due to expanding scientific fields and increasing demand for more affordable and sophisticated methods of accomplishing common tasks.

SEE ALSO: Lean Manufacturing and Just-in-Time Production; Quality and Total Quality Management; Simulation

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