CHAPTER 2
W. EDWARDS DEMING'S THEORY OF MANAGEMENT

Sections

Chapter Objectives

- To explain W. Edwards Deming's Theory of Management
- To present and discuss Deming's 14 Points for Management
- To explain the relationship between Deming's 14 points and variation in a system
- To discuss the paradigm shift in management caused by Deming's theory of management

2.1 Introduction

The concept of quality has existed since ancient times. However, it took people like Walter Shewhart, Kaoru Ishikawa, and W. Edwards Deming to operationally define quality. Deming took the idea of quality and grew it into a practical philosophy of management, called the **System of Profound Knowledge**. He also provided a roadmap for pursuing quality in a system (organization), called the **14 Points for Management**. This chapter presents and explains how quality, the System of Profound Knowledge, and the 14 Points provide the theory and practice required for professional management.

2.2 A Brief History of Quality

Issues of quality have existed since tribal chiefs, kings, and pharaohs ruled. One of the first recorded uses of statistics was by Narmer, King of the North, in ancient Egypt around the year 3200 B.C. The Narmer Palette, shown in Figure 2.1, is a soft greenish piece of slate about 65 centimeters tall with hieroglyphics chiseled on the front and back. On the side of the Narmer Palette, shown on the left side of Figure 2.1, a falcon rests atop six papyrus plants. This symbol is a pictograph of Pharaoh Narmer capturing 6,000 enemies, where each papyrus

plant represents 1,000 enemies. On the other side of the Narmer Palette, shown on the right side of Figure 2.1, one of the figures preceding Narmer in the procession is a Vizier. A pharaoh's Vizier was charged with keeping records of the varying levels of the Nile, controlling the reservoirs and food supplies, and assessing crop production and consumption along with other necessary agricultural statistics. Narmer's Vizier is one of the first references to an individual doing statistical work.

Figure 2.1
Narmer Palette

Sources: http://www.ptahhotep.com/articles/Narmer_palette.html and http://asia.geocities.com/atennz/iunytVizer.htm

Another example of a quality issue in ancient times is found in the Code of Hammurabi, dating from as early as 2000 BC. Item 229 states "If a builder has built a house for a man, and his work is not strong, and the house falls in and kills the householder, that builder shall be slain." Phoenician inspectors eliminated any repeated violations of quality standards by chopping off the hand of the maker of the defective product. Inspectors accepted or rejected products and enforced government specifications. The emphasis was on equity of trade and complaint handling. In ancient Egypt, in approximately 1450 BC, inspectors checked stone blocks to determine if they were square with a string as the stonecutter watched. This method was also used by the Aztecs in Central America.

In 13th-century Europe, apprenticeships and guilds developed. Craftsmen were both trainers and inspectors. They knew their trades, their products, and their customers, and they built quality into their goods. They took pride in their work and in training others to do quality work. The government set and provided

standards, such as weights and measures, and, in most cases, an individual could inspect all the products and establish a single quality standard. If the world had remained small and localized, this idyllic state of quality could have thrived and endured. However, as the world became more populated, more products were needed.

During the 19th century, the modern industrial system began to emerge. In the United States, Frederick Taylor pioneered scientific management in the late 19th and early 20th centuries, removing work planning from the purview of workers and foremen and placing it in the hands of industrial engineers. The 20th century ushered in a technological era that enabled the masses to avail themselves of products previously reserved for only the wealthy. Henry Ford introduced the moving assembly line into Ford Motor Company's manufacturing environment. Assembly line production broke down complex operations that could be performed by unskilled labor. This resulted in the manufacture of highly technical products at low cost. As part of this process, an inspection operation was instituted to separate good and bad products. Quality, at this point, remained under the purview of manufacturing.

It soon became apparent that the production manager's priority was meeting manufacturing deadlines; achieving product quality was not a priority. Managers knew they would lose their jobs if they did not meet production demands, whereas they would only be reprimanded if quality was poor. Upper management eventually realized that quality was suffering as a result of this system, so a separate position of "chief inspector" was created.

Between 1920 and 1940 industrial technology changed rapidly. The Bell System and Western Electric, its manufacturing arm, led the way in quality control by instituting an Inspection Engineering Department to deal with problems created by defects in their products and lack of coordination between their departments. George Edwards and Walter Shewhart provided leadership in this area as members of this department. Western Electric management, at the time, stated that quality control exists if actions are taken to create products characteristics that are of lower unit-to-unit variability than they would have been without the application of quality control.

Edwards coined the term **quality assurance** and advocated quality as part of management's responsibility. Edwards recognized that high quality is not an accident; rather it is the result of managerial policies and practices that coordinate the efforts of all areas in an organization towards the reduction of unit-to-unit variation in output that is in line with specifications. This responsibility requires that a top level manager be in charge of coordinating the quality policies and practices of the organization.

In 1924, Walter Shewhart introduced **statistical quality control**. [Scherkenbach, 1986] This provided a method for economically controlling quality in mass production environments. In his book of lectures at the Graduate School of the U.S. Department of Agriculture, he asked the reader to write several letter A's as carefully as possible. He then suggested that the reader examine them for variations. Clearly, no matter how carefully one formed the letters, variations occurred. This was a simple yet powerful example of variation in a process. Although Shewhart's primary interest was statistical methods, he was very aware of principles of management and behavioral science.

World War II quickened the pace of quality technology development. The need to improve the quality of products being manufactured resulted in increased study of quality control technology and more sharing of information. In 1946 the American Society for Quality Control (ASQC) was formed, and George Edwards was elected its president.

In this environment, basic quality concepts expanded rapidly. Many companies implemented vendor certification programs. Quality assurance professionals developed failure analysis techniques to problem-solve, quality engineers became involved in early product design stages, and environmental performance testing of products was initiated. But as World War II ended, progress in quality control began to wane. Many companies saw it as a wartime effort and felt that it was no longer needed in the booming postwar market.

In 1950, W. Edwards Deming, a statistician who had worked at the Bell System with George Edwards and Walter Shewhart, was invited by the Union of Japanese Scientists and Engineers (JUSE) to speak to Japan's leading industrialists. They were concerned with rebuilding Japan after the war, breaking into foreign markets, and improving Japan's reputation for producing low-quality goods. Deming convinced them, despite their reservations, that by instituting his methods, Japanese quality could become the best in the world. The industrialists took Deming's teaching to heart. Over the following years, Japanese quality, productivity, and competitive position were improved and strengthened enormously. Deming was awarded the Second Order Medal of the Sacred Treasure by Emperor Hirohito for his contribution to Japan's economy. The coveted Deming Prize is awarded each year in Japan to the company that has achieved the greatest gain in quality and to an individual for developments in statistical theory. [Gitlow and Gitlow, 1987, p. 7] Prize-winning Japanese companies include Nissan, Toyota, Hitachi, and Nippon Steel. In 1989, Florida Power & Light Company became the first non-Japanese company to receive the Deming Prize.

Deming's ideas have spread in the United States and the rest of the world. His clients have included automobile companies, paper companies, railways,

telephone companies, consumer researchers, hospitals, law firms, government agencies, and university research organizations. While a professor at the New York University Graduate School of Business Administration and at Columbia University, he wrote extensively on statistics and management.

Armand V. Feigenbaum advanced the concept of quality control in all areas of business, from design to sales. [Feigenbaum, 1961] Until then, quality efforts had been primarily directed toward corrective activities, not prevention.

The Korean War sparked increased emphasis on reliability and end-product testing. However, all of the additional testing did not enable firms to meet their quality and reliability objectives, so quality awareness and quality improvement programs began to emerge in manufacturing and engineering areas. **Service Industry Quality Assurance** (SQA) also began to focus on the use of quality methods in hotels, banks, government, and other service systems. By the end of the 1960s, quality programs had spread throughout most of America's major corporations. But American industry was still enjoying the top position in world markets as Europe and Japan continued to rebuild.

Foreign competition began to threaten U.S. companies in the 1970s. The quality of Japanese products such as cars and TVs began to surpass American-made goods. Consumers began to consider the long-term life of a product in purchase decisions. Foreign competition and consumers' increased interest in quality forced American management to become more concerned with quality. The late 1970s through the present have been marked by striving for quality in all aspects of businesses and service organizations including finance, sales, personnel, maintenance, management, manufacturing and service. The focus is on the entire system, not just the manufacturing line. Reduced productivity, high costs, strikes, and high unemployment have caused management to turn to quality improvement as the means to organizational survival.

Motorola introduced **Six Sigma management** in the mid-1980s. This is a style of quality management that endeavors to improve or innovate processes to reduce the number of defects to no more than 3.4 per million to affect the bottom-line results of an organization. In 1987, the **ISO 9000** (International Organization for Standardization) Series quality standards were published and they have spread worldwide. These standards promote standardization of activities within an organization. They are standards for governing quality management systems. In 1986, ANSI (American National Standards Institute) and ASQC (American Society for Quality Control) announced the ANSI/ASQC Q90 Series of standards. The ANSI/ASQC standards are the technical equivalents of the ISO 9000 Series standards. The Malcolm Baldridge National Quality Award (MBNQA) was established in the United States in 1988 by the Malcolm Baldridge National Quality Improvement Act of 1987. The first winners of the MBNQA award

included Motorola, Globe Metallurgical, and the Nuclear Fuel Division of Westinghouse Electric.

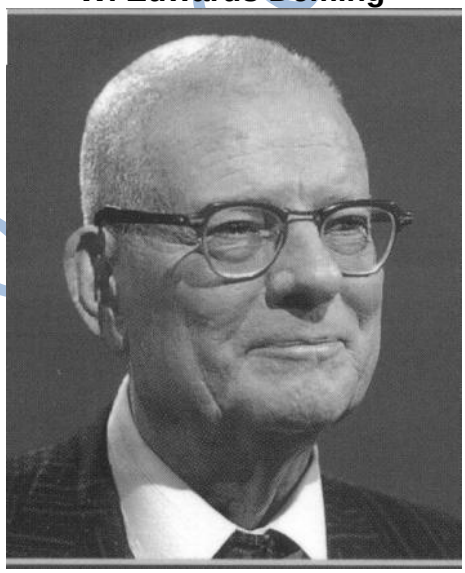
The 1990s and the beginning of the 21st century have seen an explosion in interest in quality management, especially ISO 9000 and Six Sigma management. Motorola, General Electric, Dupont, Allied Signal and other well-known organizations have done much to popularize the success of Six Sigma management.

Some of the quality leaders in the United States have been W. Edwards Deming, Joseph Juran, and Armand Feigenbaum. In this book we focus largely on the ideas of W. Edwards Deming.

2.3 W. Edwards Deming's Theory of Management

W. Edwards Deming was born in Sioux City, Iowa on October 14, 1900 and died in Washington, D.C. on October 20, 1993. He developed a theory of management that will be described in the remainder of this chapter. A photograph of Deming is shown in Figure 2.2.

Figure 2.2
W. Edwards Deming



2.3.1 Deming's System of Profound Knowledge

Deming developed a theory of management that promotes "joy in work" through the acquisition of process knowledge (learning) gained from experience and coordinated by theory. This theory is called the System of Profound Knowledge [Deming, 1993 and Deming, 1994]

The System of Profound Knowledge is appropriate for leadership in any culture. However, applying this theory in a particular culture requires a focus on issues that are unique to that culture. For example, in the Western world, managers have frequently operated using the following assumptions (often without realizing it):

- Rewards and punishments are the most effective motivators for people.
- Optimization of every area in an organization leads to optimization of the entire organization.
- Results are achieved by setting objectives.
- Quality is inversely related to quantity.
- Rational decisions can be made based on guesswork and opinion.
- Organizations can be improved by fighting fires.
- Competition is a necessary aspect of life.

Leaders who manage in the context of the above assumptions are lost in the 21st century. They have no idea of how to manage their organizations because they do not know the assumptions required for success in tomorrow's marketplace. Such leaders need a theory from which they can understand the assumptions of quality management.

2.3.2 Purpose of Deming's Theory of Management

Deming's theory of management promotes joy in work for all of the stakeholders of an organization. Deming believed that joy in work will "unleash the power of human resource contained in intrinsic motivation. Intrinsic motivation is the motivation an individual experiences from the sheer joy of an endeavor." [Deming, 1986, Deming, 1993, and Deming, 1994]

2.3.3 Paradigms of Deming's Theory of Management

Deming's theory of management is based on four paradigms, or belief systems that an individual or group uses to interpret data about conditions and circumstances. You can think of each of Deming's paradigms as a shift in assumptions for the practice of management, designed to create the environment required to promote joy in work, and hence, release the power contained in intrinsic motivation.

Paradigm 1. People are best inspired by a mix of intrinsic and extrinsic motivation, not only by extrinsic motivation. Intrinsic motivation comes from the sheer joy of performing an act. It releases human energy that can be focused into improvement and innovation of a system. It is management's responsibility to create an atmosphere that fosters intrinsic motivation. This atmosphere is a

basic element of Deming's theory of management. Extrinsic motivation comes from the desire for reward or the fear of punishment. It restricts the release of energy from intrinsic motivation by judging, policing, and destroying the individual. Management based on extrinsic motivation will "squeeze out from an individual, over his lifetime, his innate intrinsic motivation, self-esteem, dignity, and build into him fear, self-defense." [Deming, 1993 and Deming, 1994]

Paradigm 2. Manage using both a process and results orientation, not only a results orientation. Management's job is to improve and innovate the processes that create results, not just to manage results. This paradigm shift allows management to define the capabilities of processes, and consequently, to predict and plan the future of a system to achieve organizational optimization. This type of optimization requires that managers make decisions based on facts, not on guesswork and opinion. It is critical that top management change the culture of their organization from “management by guts” (called KKD in Japan) to “management by data.” It is easy to refute an argument based on guesswork or opinion, but it is difficult to refute an argument based on solid, scientific data. Managers must consider visible figures, as well as unknown and unknowable figures (for example, the cost of an unhappy customer or the benefit of a prideful employee).

Paradigm 3. Management's function is to optimize the entire system so that everyone wins, not to maximize only their component of the system. Managers must understand that individuals, organizations, and systems of organizations are interdependent. Optimization of one component may cause sub-optimization of another component. Management's job is to optimize the entire system towards its aim, or mission. This may require the managers of one or more components of a system to knowingly sub-optimize their component of the system in order to optimize the entire system.

Paradigm 4. Cooperation works better than competition. In a cooperative environment, everybody wins. Customers win products and services they can brag about. The firm wins returns for investors and secure jobs for employees. Suppliers win long-term customers for their products. The community wins an excellent corporate citizen.

In a competitive environment, most people lose. The costs resulting from competition are huge. They include the costs of rework, waste, and redundancy, as well as the costs for warranty, retesting, reinspection, customer dissatisfaction, schedule disruptions, and destruction of the individual's joy in work. Individuals and organizations cannot reap the benefits of a win-win point of view when they are forced to compete.

Is competition ever the preferred paradigm? The answer is “yes,” if and only if

the aim of the system is to win. If the aim of the system is anything other than to win, for example to improve or have fun, then competition is not the preferred paradigm. Cooperation is the preferred paradigm in all systems with non-competitive aims.

According to Deming, if leaders practice these four paradigms, they will reap enormous benefits.

2.3.4 Components of Deming's Theory of Management

Deming's theory of management consists of four components: appreciation of a system, theory of variation, theory of knowledge, and psychology. [Deming, 1993 and Deming, 1994] All four components are interdependent. This discussion presents some of the highlights of Deming's theory of management.

Appreciation of a System. A system is a collection of components that interact and have a common purpose or aim. It is the job of top management to optimize the entire system toward its aim. It is the responsibility of the managers of the components of the system to promote the aim of the entire system; this may require that they sub-optimize some components.

Theory of Variation. Variation is inherent in all processes. Recall, there are two types of variation, special and common. Special causes of variation are external to the system. It is the responsibility of local people and engineers to determine and resolve special causes of variation. Common causes of variation are due to the inherent design and structure of the system; they define the system. It is the responsibility of management to isolate and reduce common causes of variation. A system that does not exhibit special causes of variation is stable; that is, it is a predictable system of variation. Its output is predictable in the near future.

There are two types of mistakes that can be made in the management of a system. The first mistake is to treat a common cause of variation as a special cause of variation; this is by far the more frequent of the two mistakes – it is called tampering and will invariably increase the variability of a system. The second mistake is to treat a special cause of variation as a common cause of variation. Shewhart developed the control chart to provide an economic rule for minimizing the loss from both types of mistakes.

Management requires knowledge about the interactions between the components of a system and its environment. Interactions can be positive or negative; they must be managed.

Theory of Knowledge. Information, no matter how speedy or complete, is not knowledge. Knowledge is indicated by the ability to predict future events with a

quantifiable risk of being wrong and the ability to explain past events without fail. Knowledge is developed by stating a theory, using the theory to predict a future outcome, comparing the observed outcome with the predicted outcome, and supporting, revising, or even abandoning the theory.

Experience is of no value without the aid of theory. Theory allows people to understand and interpret experience. It allows people to ask questions and to learn.

All plans are based on assumptions. An assumption is the future output of a process. If the process underlying an assumption is not stable with an acceptable degree of predictability, then the assumption required for the plan cannot be relied upon with any degree of comfort. Consequently, the plan must be changed or abandoned, or the process must be improved to enhance the likelihood of the assumption being valid when called for by the plan.

Communication is possible when people share **operational definitions**. Operational definitions are statistical clarifications of the terms people use to communicate with each other. A term is operationally defined if the users of the term agree on a common definition.

Success cannot be copied from system to system. The reason for success in one system may not be present in another system. The theory underlying a success in one system can be used as a basis for learning in another system.

Psychology. Psychology helps us understand people, the interactions between people, and the interactions between people and the system of which they are part. Management must understand the difference between intrinsic motivation and extrinsic motivation. All people require different amounts of intrinsic and extrinsic motivation. It is the job of a manager to learn the proper mix of the two types of motivation for each person.

Overjustification occurs when an extrinsic motivator is used to reward a person who did something for the sheer joy of it. The result of over-justification is to throttle future desire to act.

People are different. They learn in different ways and at different speeds. A manager of people must use these differences to optimize the system of interdependent stakeholders of an organization.

2.3.5 Deming's 14 Points for Management

The System of Profound Knowledge generates an interrelated set of 14 Points for leadership in the Western world. [Deming, 1982, Gabor, 1990, and Gitlow and

Gitlow, 1987] These 14 Points provide guidelines, or a road map, for the shifts in thinking required for organizational success. They form a highly interactive system of management; no one point can be studied in isolation.

Point 1: Create constancy of purpose toward improvement of product and service with a plan to become competitive, stay in business, and provide jobs

Leaders must state their organization's values and beliefs. They must create statements of vision and mission for their organizations based on these values and beliefs. Values and beliefs are the fundamental operating principles that provide guidelines for organizational behavior and decision-making. A **vision statement** seeks to communicate the desired future state of the organization to the stakeholders. A **mission statement** serves to inform stakeholders of the current reason for the existence of the organization. The values and beliefs plus the vision and mission statements provide a frame of reference for focused, consistent behavior and decision-making by all stakeholders of an organization. This framework permits stakeholders to feel more secure because they understand where they fit into the organization.

Point 2: *Adopt the new philosophy. We are in a new economic age. We can no longer live with commonly accepted levels of delays, mistakes, defective material, and defective workmanship.*

Point 2 encompasses the paradigm shifts that leaders must accept as a consequence of Deming's System of Profound Knowledge.

Point 3: *Cease dependence on mass inspection. Require, instead, statistical evidence that quality is built in to eliminate the need for inspection on a mass basis.*

There is a hierarchy of views on how to pursue predictable dependability and uniformity at low cost: (1) defect detection, (2) defect prevention, and (3) continuous improvement.

1. **Defect detection** involves dependence upon mass inspection to sort conforming material from defective material. Mass inspection does not make a clean separation of good from bad. It involves checking products with no consideration of how to make them better. Management must eliminate the need for inspection on a mass basis and build quality into the processes that generate goods and services. Mass inspection does nothing to decrease the variability of the quality characteristics of products and services. Dependence on mass inspection to achieve quality forces quality to become a separate subsystem (called Quality Assurance), whose aim is to police defects without the authority to eliminate the defects. As the Quality Assurance department

optimizes its efforts, it causes other departments to view quality as someone else's responsibility.

2. **Defect prevention** involves improving processes so that all output is predictably within specification limits; this is often referred to as **zero defects**. Defect prevention leaves employees with the impression that their job (with respect to reducing variation) is accomplished if they achieve zero defects. Unfortunately, zero defects will be eroded by a force similar to the concept of entropy in thermodynamics, or the natural tendency of a system to move toward disorder or chaos. This force makes a stable and capable process eventually stray out of specification limits. Further, when people are rewarded for zero defects, they may attempt to widen specification limits, rather than improve the process's ability to predictably create output within specification limits. Defect prevention is illustrated by the goal post view of quality, shown in Figure 1.14.

3. **Continuous improvement** is the on-going reduction of process (unit-to-unit) variation, even within specification limits. Products, services, and processes are improved in a relentless and continuous manner. It is always economical to reduce unit-to-unit variation around the nominal value, even when a process is producing output within specification limits, absent capital investment. Continuous improvement is illustrated by the Taguchi Loss Function in Figure 1.15.

kp Rule. Deming advocated a plan that minimizes the total cost of incoming materials and final product. Simply stated, the rule is an “inspect all-or-none” rule. Its logical foundation has statistical evidence of quality as its base. The rule for minimizing the total cost of incoming materials and final product is referred to as the **kp rule**, and discussed in Chapter 13. It specifies when mass inspection of all items should be performed and when only routine monitoring of a sample of items should be done. This method facilitates the collection of process or product data such that variation can be continually reduced; this means progressing from defect detection to continuous improvement.

Point 4*: End the practice of awarding business on the basis of price tag. Instead, minimize total cost. Move toward a single supplier for any one item on a long-term relationship of loyalty and trust.*

Buyers and vendors form a system. If each individual player in this system attempts to optimize his own position, the system will be sub-optimized. Optimization requires that policy makers understand the three scenarios in which purchasing can take place. Deming called these three scenarios World 1, World 2, and World 3.

World 1 is characterized by a purchasing situation in which the customer knows what she wants and can convey this information to a supplier. In this scenario, purchase price is the total cost of buying and using the product; no supplier provides better service than any other supplier. Several suppliers can precisely meet the customer's requirements and the only difference between suppliers is the price. In this world, purchasing on lowest price is the most rational decision.

In World 2, the customer knows what she wants and can convey this information to a supplier. The purchase price is not simply the total cost of buying and using the product; one supplier may provide better service than any other supplier. Several suppliers can precisely meet the customer's requirements, and all suppliers quote identical prices. In this world, purchasing based on best service is the most rational decision. World 2 frequently includes the purchasing of commodities.

In World 3, the customer thinks she knows what she wants and can convey this information to a supplier. However, she will listen to advice from the supplier and make changes based on that advice. Purchase price is not the total cost of buying and using the product; there is also a cost to use the purchased goods. Several suppliers tender their proposals (all of which are different in many ways), and all suppliers quote different prices. In this world, selecting a supplier will be difficult.

Some purchasing agents buy as if all purchases were World 1 scenarios; that is, they purchase solely on the basis of price, without adequate measures of quality and service.

In World 3, after careful and extensive research, it makes sense for customers and suppliers to enter into long-term relationships based on trust (that is, relationships without the fear caused by threat of alternative sources of supply) and statistical evidence of quality. Such long-term relationships promote continuous improvement in the predictability of uniformity and reliability of products and services, and, hence, lower costs. The ultimate extension of reducing the supply base is moving to a single supplier and purchasing agent for a given item. [Gitlow and Gitlow, 1987] Single supplier relationships should include contingencies on the part of the supplier and customer for disasters.

The concept of single supplier extends beyond the purchasing function. For example, employees should focus on improvement of existing information channels, rather than create additional information channels when the main channel does not yield the desired information. [Gitlow and Gitlow, 1987]

Point 5: *Improve constantly and forever the system of production and service to improve quality and productivity, and thus constantly decrease costs.*

Improvement of a system requires statistical and behavioral methods. Management should understand the difference between special and common causes of variation and the capability of a system. They must realize that only when a system is stable (that is, when it exhibits only common causes of variation) can management use process knowledge to predict the output of the system in the near future. This allows management to plan the future state of the system. Further, management of a system requires knowledge of the interrelationships between all functions and activities in the system; this includes the interactions between people and the system, as well as between people.

Operational Definitions. Any two people may have different ideas about what constitutes knowledge of an event. This leads to the need for people to agree on the definitions of characteristics that are important about a system. Operational definitions increase communication between people and help to optimize a system; they require statistical and process knowledge. Operational definitions are fully discussed in Chapter 4.

SDSA Cycle. The **Standardize–Do–Study–Act (SDSA) Cycle** is a technique that helps employees to standardize a process. It includes four steps:

1. **Standardize**: Employees study the process and develop best practice methods with key indicators of process performance. The best practice method is characterized by a flowchart. It is important for all employees doing a job to agree on (operationally define) a best practice method. If multiple employees perform the same job differently, there will be increased variation in output and problems will result for the customer(s) of those outputs. For example, the medical records department in a hospital receives, processes, and files patients' medical records. The director of the department decided to standardize the medical records process. First, she trained all of her personnel on how to construct a flowchart. Second, she asked each employee to create a detailed flowchart of the medical records process. Third, she reviewed all of the flowcharts with her entire staff and created a best practice flowchart. The best practice flowchart incorporated all of the strengths and eliminated all of the weaknesses of each employee's flowchart. Fourth, she identified the key objectives and indicators for the medical records department. The key objective is: file more than 80% of all medical records within 30 days of a patient's checking out of the hospital. This is a state-mandated objective. The key indicator is: % of medical records filed within 30 days of a patient checking out of the hospital.

2. **Do**: Employees conduct planned experiments using the best practice methods on a trial basis. In the case of the medical records department, the director collected baseline data on the key indicator for a period of months.

3. **Study**: Employees collect and analyze data on the key indicators to determine the effectiveness of the best practice methods. Again, in the case of the medical records department, the director studied the key indicator data and determined that the percentage of medical record filed within 30 days of a patient leaving the hospital was a predictable process with an average of 35% per month, and would rarely go above 45% per month or below 25% per month. She knew that this was woefully inadequate given her state-mandated key objective.

4. **Act**: Managers establish standardized best practice methods and formalize them through training. In the case of the medical records department, the director formalized the best practice method by training all employees in the method and putting it in the department's training manual for the training of all future employees. Finally, she prepared to move onto the **PDSA cycle** to improve the best practice method.

The Japanese developed a method to promote good housekeeping practices; it is called the **5-S movement** [Hirano, 1996 and Hirano, 1990]. "In a 5S environment there is a place for everything, and everything in its place. Time spent searching for items is essentially eliminated, and out of place or missing items are immediately obvious in a properly functioning 5S facility." [Bullington, 2003, p. 56]

The name 5-S movement is derived from five Japanese words that begin with the letter "S." The words are: *seiri* (sort), *seiton* (set in order), *seiso* (shine), *seiketsu* (standardize), and *shitsuke* (sustain). The five words are part of a very basic management system that focuses employee's attention on the following:

Seiri (Sort) – simplify a process by omitting unnecessary work-in-progress, unnecessary tools, unused machinery, defective product, and unnecessary documents and papers.

Seiton (Set in order) – label things so they are easy to identify; for example, label storage locations with tape on the floor so that one glance identifies missing or improperly stored items; keep things organized and ready for their next use by putting them in their proper place; for example, put tools and materials in their assigned places.

Seiso (Shine) – maintain a clean workplace; promote a proactive system for maintenance.

Seiketsu (Standardize) – be a clean and neat person; assist in the development of best practice methods for your area. The first 3Ss (seiri, seiton

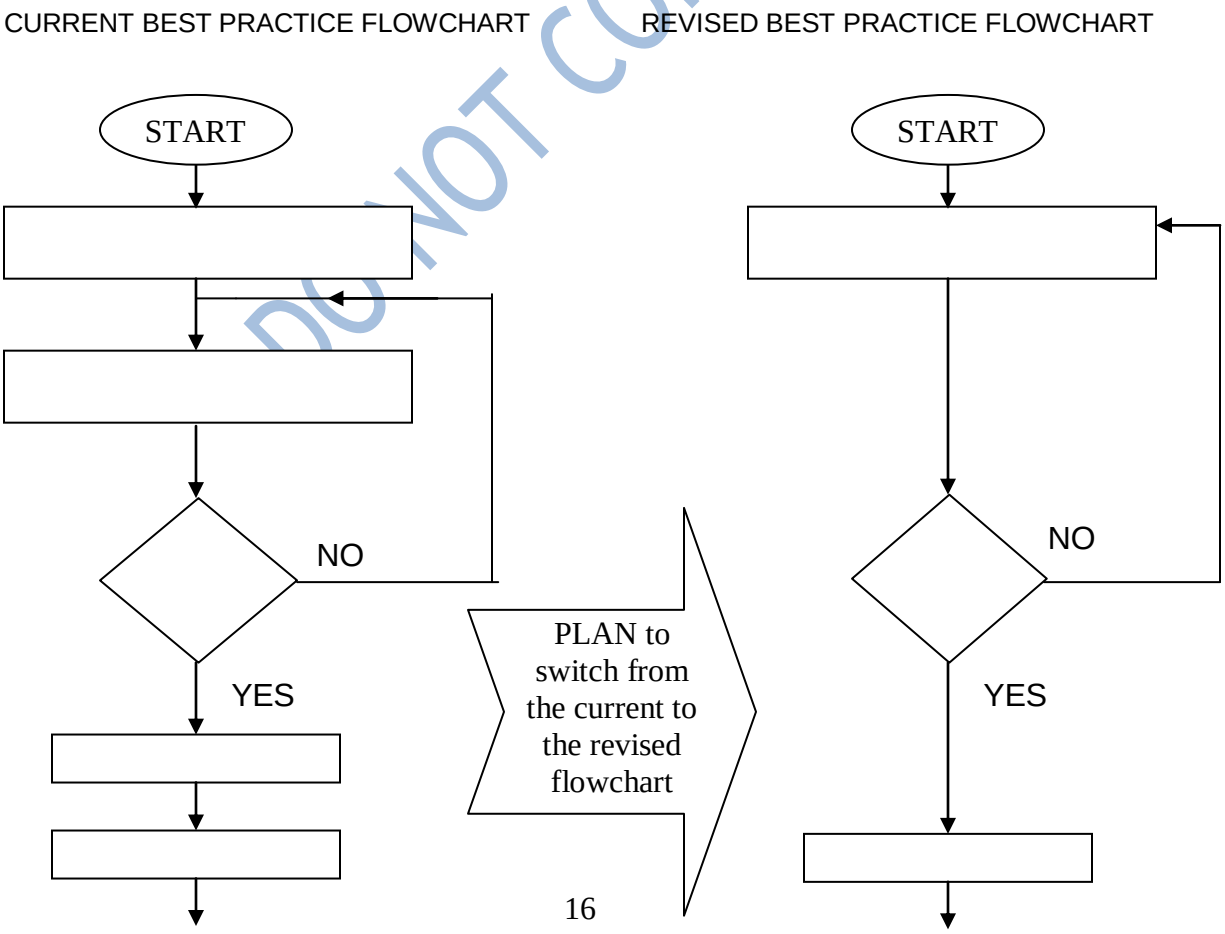
and seiso) prevent backsliding in seiketsu.

Shitsuke (Sustain) – be disciplined and adhere to best practice methods.

Some employees at Motorola Corporation added a sixth “S” to the list: *shituke* - be well-mannered.

Deming (PDSA) Cycle. The **Deming cycle** [Deming, 1982, pp. 86-89] can aid management in improving and innovating processes; that is, in helping to reduce the difference between customers' needs and process performance. The Deming cycle consists of four stages: **Plan-Do-Study-Act (PDSA)**. Often, the Deming cycle is referred to as the PDSA cycle. Initially, a plan is developed to improve or innovate the standardized best practice method developed using the SDSA cycle. The revised best practice method is characterized by a revised flowchart. Hence, a process improvement team PLANS to modify a process from operating under the existing best practice flowchart to operating under a revised and improved best practice flowchart, as shown in Figure 2.3.

Figure 2.3
PLAN Portion of the PDSA Cycle



The revised best practice method is identified using five possible methods:

- Process improvers can statistically analyze key indicator data on the components of the process under study (using the existing flowchart) to identify an effective change concept to allow for the construction of a revised and improved flowchart. This is the Plan portion of the PDSA cycle.

- Process improvers can **benchmark** their process using a flowchart against another organization's process (using the other organization's flowchart) that is considered excellent to identify an effective change concept. The other organization should be one that is known for the quality of the process under study. Benchmarking is accomplished by comparing your flowchart with another organization's flowchart to determine if anything in their flowchart makes sense in your organization. If it does, utilize the new information to improve your flowchart. This is the Plan portion of the PDSA cycle.

- Process improvers can utilize a list of 70 tried and proven ideas to identify an effective **change concept** and determining if it makes sense within the context of the process under study. This list of change concepts is discussed in Chapter 10. The change concepts are used to move from the current flowchart to a revised and improved flowchart that uses one or more of the change concepts. Again, this is the Plan portion of the PDSA cycle. Process improvers can talk with experts to identify a change concept that will promote a turn of the PDSA cycle. Frequently, experts have valuable insights into what change concepts are most appropriate for a given situation. Again, this the Plan section of the PDSA cycle.

- Process improvers can use a search engine, such as Google, to identify other people's solutions to their process problem(s). It would be unusual for an individual to have a problem that someone else has not experienced, studied, and solved. This is an excellent method for finding a change concept that promotes a turn of the PDSA cycle.

As an example of statistically analyzing key indicator data to find a change concept, in a medical records department, cycle time data was collected for the length of time from when a physician ordered a medical report until the medical records department received (in the inbox) the patient's medical report, from

each of 16 departments, such as EEG, EKG and Laboratory. Statistical analysis showed that 15 of the 16 departments' cycle times were stable and predictable processes with cycle times being measured in hours. However, the laboratory department had cycle times being measured in weeks, with an average of 6 weeks. From this analysis it was obvious that a huge proportion of medical records could not be filed within 30 days if one of the component reports took an average of 6 weeks to get to the medical records department. The director of the medical records department went to the laboratory department and was greeting by the director with the comment: "We grow cultures and they can't be rushed." The director of the medical records department asked if she could visit the laboratory department anyway. The laboratory director agreed. After poking around the lab, the medical records director noticed that each lab report required three signatures before it could be released. She asked the first signer how often he refused to sign a lab report. He replied never. She asked the second signer how often he refused to sign a lab report. The second signer had seen the director's interaction with the first signer and said: "It happens." She asked: "Does it happen every day?" He said: "No." She asked: "Every week?" He said: "No." She asked: "Every month?" He said: "No." She asked: "Every quarter?" He said: "No." She asked: "Every year?" He said: "No." The director of medical records asked the director of the laboratory department if he would eliminate the need for the two signatures since they were no screen for quality. The laboratory director agreed with a modicum of irritation. The average cycle time for the laboratory reports fell from 6 weeks to 3.75 weeks. The percentage of medical records filed on time rose from an average of 35% to an average of 60%. This was better, but still woefully inadequate for the state-mandated goal of 80% per month.

The Plan is then tested using an experiment on a small scale or trial basis (Do), the effects of the plan are studied using measurements from key indicators (Study), and appropriate corrective actions are taken (Act). These corrective actions can lead to a new or modified plan, and are formalized through training. The PDSA cycle continues forever in an uphill progression of continuous improvement.

One method for validating the effectiveness of a change concept is to conduct a series of tests alternating between the flowchart before the change concept and the flowchart after the change concept; this is a repetitive cycle between the Do and Study phases of the PDSA cycle. If failure appears and disappears every time you switch between the before and after flowcharts, then your degree of confidence grows in the effectiveness of the change concept.

Empowerment. **Empowerment** is a term commonly used by managers in today's organizational environment [Pietenpol and Gitlow, 1996]. However, empowerment has not been operationally defined and its definition varies from

application to application. Currently the prevailing definition of empowerment relies loosely on the notion of dropping decision-making down to the lowest appropriate level in an organization. Empowerment's basic premise is that if people are given the authority to make decisions, they will take pride in their work, be willing to take risks, and work harder to make things happen. While this sounds ideal, frequently employees are empowered until they make a mistake, and then the hatchet falls. Most employees know this and treat the popular definition of empowerment without too much respect. Consequently, empowerment in its current form is destructive to Quality Management.

Empowerment in a Quality Management sense has a dramatically different aim and definition. The aim of empowerment in Quality Management is to increase joy in work for all employees. Empowerment can be defined so as to translate the preceding aim into a realistic objective. Empowerment is a process that provides employees with (1) the opportunity to define and document their key systems, (2) the opportunity to learn about systems through training and development, (3) the opportunity to improve and innovate the best practice methods that make up systems, (4) the latitude to use their own judgment to make decisions within the context of best known methods, and (5) an environment of trust in which superiors will not react negatively to the latitude taken by people in decision-making within the context of a best practice method.

Empowerment starts with leadership, but requires the commitment of all employees. Leaders need to provide employees with all five of the preceding conditions. Item (5) requires that the negative results emanating from employees using their judgment within the context of a best practice method lead to improvement or innovation of best practice methods, not to judgment and punishment of employees. Employees need to accept responsibility for (1) increasing their training and knowledge of the system, (2) participating in the development, standardization, improvement, and innovation of best known methods that make up the system, and (3) increasing their latitude in decision making within the context of best known methods.

Individual workers must be educated to understand that increased variability in output will result if each worker follows his own best practice method. They must be educated about the need to reach consensus on one best practice method. Management should understand the differences between workers and channel these differences into the development of the best practice method in a constructive, or team-building, manner.

The best practice method will consist of generalized procedures and individualized procedures. Generalized procedures are standardized procedures that all workers must follow. The generalized procedures can be improved or innovated through team activities. Individualized procedures are procedures that

afford each worker the opportunity to utilize his individual differences. However, the outputs of individualized procedures must be standardized across individuals. The individualized procedures can be improved through individual efforts. In the beginning of a quality improvement effort, management may not have the knowledge to allow for individualized procedures.

Note that latitude to make decisions within the context of a best practice method refers to the options an employee has in resolving problems within the confines of a best practice method, not to modification of the best practice method. Differentiating between the need to change the best practice methods and latitude within the context of the best practice methods must take place at the operational level.

Teams must work to improve or innovate best practice methods. Individuals can also work to improve or innovate best practice methods; however, the efforts of individuals must be shared with and approved by the team. Empowerment can only exist in an environment of trust that supports planned experimentation concerning ideas to improve and innovate best practice methods. Ideas for improvement and innovation can come from individuals or from the team, but tests of ideas' worthiness must be conducted through planned experiments under the auspices of the team. Anything else will result in chaos because everybody will “do his own thing.”

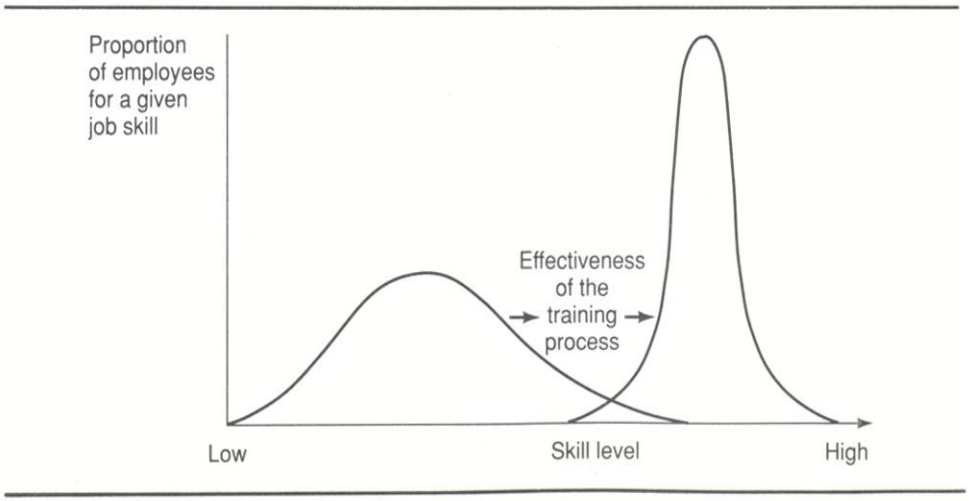
Empowerment is operationalized at two levels. First, employees are empowered to develop and document best practice methods using the SDSA cycle. Second, employees are empowered to improve or innovate best practice methods through application of the PDSA cycle.

Point 6: *Institute training on the job.*

Employees are an organization's most important asset. Organizations must make long-term commitments to employees that include the opportunity to take joy in their work. This requires training in job skills.

Training in job skills is a system. Effective training changes the distribution for a job skill, as shown in Figure 2.4. Management must understand the capability of the training process and the current distribution of job skills to improve the future distribution of job skills. Data, not guesswork or opinion, should be used to guide the training plans for employees.

Figure 2.4
Distribution of Job Skills



Training is a part of everyone's job and should include formal classwork, experiential work, and instructional materials. Training courseware must take into consideration how the trainee learns and the speed at which she learns. It should utilize statistical methods that indicate when an employee reaches a state of statistical control; that is, only common causes of variation are present in the key indicator(s) used to measure the employee's output. If an employee is not in statistical control with respect to a job characteristic, then more training of the type she is receiving will be beneficial. However if an employee is in a state of statistical control with respect to a job characteristic, then more training of that type will not be beneficial; the employee has learned all that is possible from the training program.

***Point 7**: Institute leadership. The aim of leadership should be to help people and machines and gadgets to do a better job. Leadership of management is in need of overhaul, as well as leadership of production workers.*

A leader [Deming, 1993, pp. 125-128] must see the organization as a system of interrelated components, each with an aim, but all focused collectively to support the aim of the organization. This type of focus may require sub-optimization of some system components.

According to Deming, "A leader uses plots of points and statistical calculations, with knowledge of variation, to try to understand both his performance and that of his people." [Deming, 1993, p. 127]

Leaders know when employees are experiencing problems that make their performance fall outside of the system, and leaders treat the problems as special causes of variation. These problems could be common causes to the individual (e.g., long-term alcoholism), but special causes to the system (an alcoholic works differently from his peers).

A leader must understand that experience without theory does not facilitate prediction of future events. For example, a leader cannot predict how a person will perform in a new job based solely on experience in the old job. A leader must have a theory to predict how an individual will perform in a new job.

A leader must be able to predict the future to plan the actions necessary to pursue the organization's aim. Prediction of future events requires that the leader continuously work to create stable processes with low variation to facilitate rational prediction.

Point 8*: Drive out fear so that everyone may work effectively for the company.*

There are two kinds of negative reactive behaviors: fear and anxiety. Fear is a reaction to a situation in which the person experiencing the fear can identify its source. Anxiety is a reaction to a situation in which the person experiencing the anxiety cannot identify its source. We can remove the source of fear because it is known; this is not the case with anxiety. Thus, Point 8 focuses on driving out fear.

Fear has a profound impact on those working in an organization, and consequently, on the functioning of the organization. On an individual level, fear can cause physical and physiological disorders such as a rise in blood pressure or an increase in heart rate. Behavioral changes, emotional problems, and physical ailments often result from fear and stress generated in work situations, as do drug and alcohol abuse, absenteeism, and burnout. These maladies impact heavily on any organization. An employee subjected to a climate dominated by fear experiences poor morale, poor productivity, stifling of creativity, reluctance to take risks, poor interpersonal relationships, and reduced motivation to optimize the system of interdependent stakeholders. The economic loss to an organization from fear is immeasurable, but huge.

A statistically-based system of management will not work in a fear-filled environment. This is because people in the system will view statistics as a vehicle for policing, judging, and punishing, rather than a method that provides improvement opportunities.

Fear emanates from lack of job security, possibility of physical harm, ignorance of company goals, shortcomings in hiring and training, poor supervision, lack of operational definitions, failure to meet quotas, blame for the problems of the system (fear of being below average and being punished), and faulty inspection procedures, to name a few causes. Management is responsible for changing the organization to eliminate the causes of fear. Generally, fear creates variability in the behavior of employees within an organization; fear creates common causes of variation. Managers may have unknowingly designed fear into the structure of

their organization through the construction and deployment of policies and procedures such as management by objectives and traditional performance appraisal systems, discussed later in this chapter.

Point 9: *Break down barriers between departments. People in research, design, sales, and production must work as a team to foresee problems of production and in use that may be encountered with the product or service.*

Management's job is to optimize the system of interdependent stakeholders of an organization. This may require sub-optimization of some parts of the system. An example of sub-optimization of a part, which leads to optimization of the whole, is a supermarket's "loss leader" product (a product carrying an extremely low price). The aim of a loss leader is to entice buyers into a store. Once in the store, buyers purchase other products, thereby creating a greater profit for the store. Profit from the loss leader is sub-optimized to optimize store profit. Managers must remove incentives for sub-optimization of areas if they want to optimize the organization. For example, rating departments or divisions with respect to profit alone will usually foster sub-optimization of the organization.

Barriers between the areas of an organization thwart communication and cooperation. The greater the interdependence between the components of a system, the greater is the need for communication and cooperation between them.

Point 10: *Eliminate arbitrary numerical goals, posters, and slogans for the work force that seek new levels of productivity without providing methods.*

Slogans, exhortations, and targets do not help to form a plan or method to improve or innovate a process, product, or service. They do not operationally define process variables in need of improvement or innovation. They do not motivate individuals or clarify expectations. Slogans, exhortations, and targets are meaningless without methods to achieve them.

Generally, targets are set arbitrarily by someone for someone else. If a target does not provide a method to achieve it, it is a meaningless plea. Examples of slogans, exhortations, and targets that do not help anyone do a better job are:

> Do it right the first time.
> Safety is job number 1.
> Zero Defects.
> Just Say No.

These kinds of statement do not represent action items for employees; rather, they show management's wishes for a desired result. How, for example, can an

employee "do it right the first time" without a method? People's motivation can be destroyed by slogans.

Slogans, exhortations, and targets shift responsibility for improvement and innovation of the system from management to the worker. The worker is powerless to make improvements to the system. This causes resentment, mistrust, and other negative emotions.

Point 11a: *Eliminate work standards (quotas) on the factory floor. Substitute leadership.*

Work standards, measured day work, and **piecework** are names given to a practice that can have devastating effects on quality and productivity. A work standard is a specified level of performance determined by someone other than the worker who is actually performing the task.

The effects of work standards are, in general, negative. They do not provide a road map for improvement, and they prohibit good supervision and training. In a system of work standards, workers are blamed for problems beyond their control. In some cases, work standards actually encourage workers to produce defectives to meet a production quota. This robs workers of their pride and denies them the opportunity to produce high-quality goods and thus to contribute to the stability of their employment.

Work standards are negotiated values that have no relationship to the capability of a process. When work standards are set too high or too low, there are additional devastating effects. Setting work standards too high increases pressure on workers and results in the production of more defectives. Worker morale and motivation are diminished because the system encourages the production of defectives. Setting work standards too low also has negative effects. Workers who have met their quota spend the end of the day doing nothing; their morale is also destroyed.

Work standards are frequently used for budgeting, planning, and scheduling, and provide management with invalid information on which to base decisions. Planning, budgeting, and scheduling would improve greatly if they were based on **process capability studies** as determined by statistical methods. These will be discussed in Chapter 11.

Point 11b: *Eliminate management by objective. Eliminate management by numbers and numerical goals. Substitute leadership.*

The Old Way. Setting arbitrary goals and targets is a dysfunctional form of management. Numerical goals are frequently set without understanding a

system's capability. They do not include methods, and hence, do not provide a mechanism for improvement of a process. In a stable system, the proportion of the time an individual is above or below a specified quota/goal is a random lottery. This causes people below the quota to copy the actions of those above the quota even though they are both part of the same common cause system. This increases the variability of the entire system due to inappropriate copying of actions.

Deploying arbitrary goals and targets causes problems in most organizations. Managers use **management by objectives (MBO)** to systematically break down a "plan" into smaller and smaller subsections. Next, managers assign the subsections to individuals or groups who are accountable for achieving results. This is considered fair because subsection goals emerge out of a negotiation between supervisor and supervisee. For example, an employee may negotiate a 3 percent increase in output instead of a 3.5 percent increase as long as the subsection's goals yield the goals of the plan. Note that employees are not being given any new tools, resources, or methods to achieve the 3 percent increase. Consequently, they must abuse the existing system to meet the goal. This type of behavior may allow an employee to meet a goal, or to work a lot of uncompensated overtime. The result of either option creates system failure due to a lack of resources. Arbitrary numerical goals hold people accountable for the problems of the system, and consequently, steal their pride of workmanship.

The New Way. The types of relationships that managers establish between the aim (or mission) of a system, methods, and goals (or targets), can define a functional style of management. A group of components come together to form a system with an aim. The aim requires that the components organize in such a way that they create subsystems. The subsystems are complex combinations of the components. The subsystems require certain methods to accomplish the aim. Resources are allocated between the methods by setting goals or targets that may be numerical and that optimize the overall system, not the subsystems, with respect to the aim. For example, a group of individuals form a team with an aim. The individuals must combine their efforts to form subsystems. These combinations may require complex interactions between the individuals. The subsystems require methods, and the methods require resources. Resources are allocated between the methods, and ultimately, the subsystems and individuals by setting goals that optimize the team's aim. The aim, methods, and goals are all part of the same system; they cannot be broken into three separate entities. Separation of the aim, methods, and goals destroys them because they are defined by their interactions.

Variation can cause a good method to yield undesirable results. Therefore, one should not overreact (tamper) and change methods by considering negative results in the absence of theory.

Point 12: *Remove barriers that rob the hourly worker of his right to pride of workmanship. The responsibility of supervisors must be changed from stressing sheer numbers to quality. Remove barriers that rob people in management and engineering of their right to pride of workmanship. This means abolishment of the annual merit rating and of management by objective.*

People are born with the right to find joy in their work; it provides the impetus to perform better and to improve quality for the worker's self-esteem, for the company, and ultimately for the customer. People enjoy taking joy in their work, but very few are able to do so because of poor management. Management must remove the barriers that prevent employees from finding joy in their work.

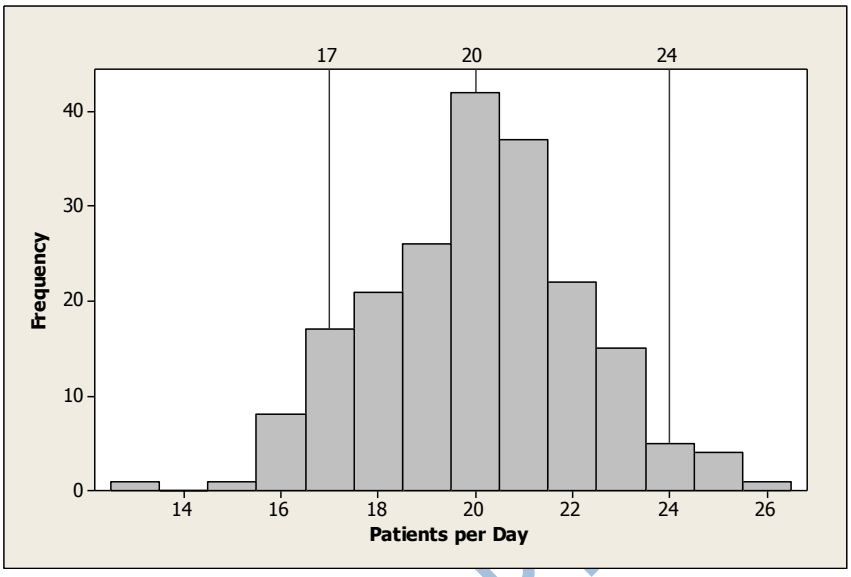
In the current system of management there are many such barriers: (1) employees not understanding their company's mission and what is expected of them with respect to the mission, (2) employees being forced to act as automatons who are not allowed to think or use their skills, (3) employees being blamed for problems of the system, (4) hastily designed products and inadequately tested prototypes, (5) inadequate supervision and training, (6) faulty equipment, materials, and methods, (7) management by objective systems that focus only on results, such as daily production reports, and (8) the traditional performance appraisal process, which will also be discussed in Chapter 17. Organizations will reap tremendous benefits when management removes barriers to joy in work.

The Case Against Management by Objectives. Traditional management creates and enforces decision making through an interrelated pair of systems; they are management by objectives (MBO) and performance appraisal. Figure 2.5 shows the results for a physician who sees patients on a daily basis. The physician attends to about 20 patients on average, with a standard deviation of 2 patients per day. This distribution of patients has been stable and predictable for some period of time.

Assume the Chief Medical Officer and the Chief Financial Officer are under extreme pressure to increase physician productivity. The question is: How will they do it? Traditional management offers three basic options.

The first option sets a stretch goal of 24 patients per day. The rationale is that a stretch goal provides a strong incentive to do better. Unfortunately, it does not indicate how to do better. In such a case, doing better usually means working more uncompensated overtime, or cutting corners to meet the goal. Given the current operational system used by the physician, from Figure 2.5 we see that he can expect to exceed 24 patients per day 2.28% of the days, based on statistical calculation.

Figure 2.5
Histogram and Patients per Day by Physician X



The second option is to set the goal at 20 patients per day; the average number. The rationale assumes that, if you try a little harder, you can always do better than the average. This option may seem logical, but it is not. Given the symmetry of the distribution of patients seen per day by the physician, as shown in Figure 2.5, you can expect 50% of the days to be above the average, and 50% of the days to be below the average.

Using the average as a goal encourages the physician to look for reasons why he is above or below average on any given day, encouraging him to replicate the above average experience, or prevent the below average experience. Unfortunately, the hospital's operational system determines the distribution of patients seen per day. Consequently, the physician's search for a special cause in a process exhibiting only common causes of variation is fruitless, and will likely result in overreaction to random noise which serves to increase the variability in the system.

The third option is to set an easy goal of 17 patients per day. The rationale is that an easy goal provides a strong incentive to do better; thereby enhancing the physician's perception of his performance. Given the operational process currently used, from Figure 2.5 we see that he can expect, based on statistical calculation, to exceed 17 patients per day about 93.32% of the days.

The options described do not achieve an improvement in physician productivity because the distribution of patients seen per day derives from the operational system (common cause of variation), and is not responsive, over time, to the efforts of the individual physician.

The Case Against Traditional Performance Appraisal Systems. Performance appraisal systems are used by managers to enforce MBO within their organization. If a worker, Dr. A, does very well with respect to a particular goal, deadline, or other mandate, then she gets a high performance score, say 5, on a 1 to 5 scale, where 1 is unacceptable, 3 is average, and 5 is excellent. If she does very poorly with respect to a particular goal, deadline, or mandate, then she gets a low performance score, say a 1. This all seems rational and fair. But it rests on the underlying assumption that an individual's performance score is due solely to her efforts. That may not be the case. Let us restate this in the form of an equation:

$$\text{Dr. A's Performance Score} = \text{Dr. A}_{\text{Individual Effort}} = 4.8$$

Actually, the individual's performance score reflects both her individual efforts and, the effect of the system in which she performs her job. The system may treat everyone equally and fairly, or not. The problem is, you don't know how much of Dr. A's 4.8 to attribute to her individual effort, and how much to attribute to the system in which she works. Again, restate this in the form of an equation:

$$\text{Dr. A's Performance Score} = \text{Dr. A}_{\text{Individual Effort}} + \text{Dr. A}_{\text{System Effect}}$$

The equation has two variables; hence there are a large number of solutions to it, for example:

$$\text{Dr. A's Performance Score} = 4.8 + 0$$
$$\text{Dr. A's Performance Score} = 0 + 4.8$$

or any values in between that sum to 4.8. Managers lose the ability to use traditional performance appraisals to score an individual's performance. They cannot separate the individual's effort from the effect of the system on the individual.

Comparing two workers:

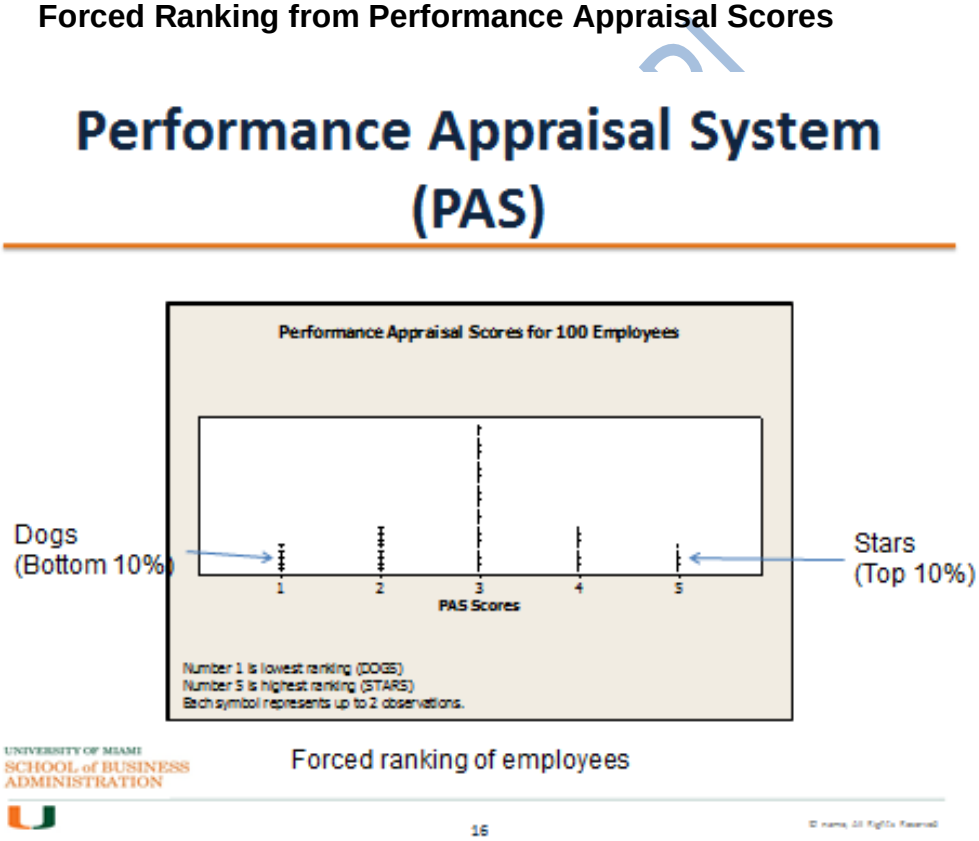
$$\text{Dr. A's Performance Score} = \text{Dr. A}_{\text{Individual Effort}} + \text{Dr. A}_{\text{System Effect}}$$
$$\text{Dr. B's Performance Score} = \text{Dr. B}_{\text{Individual Effort}} + \text{Dr. B}_{\text{System Effect}}$$

Traditional managers assume that both Dr. A and Dr. B are equally affected by the system in which they work. The assumption is not likely to be the reality.

Managers cannot make this distinction given the information contained in traditional performance appraisal systems.

The Case Against Forced Ranking. Traditional performance appraisal systems are frequently used to force the ranking of employees. Figure 2.6 shows the distribution of performance appraisal scores for 100 employees, in this case physicians, in a hospital. They all see the same patient mix. Figure 2.6 shows the top 10%, the middle 80%, and the bottom 10%. In economically challenging times, management may decide to terminate the bottom 10% of employees. This seems rational, but it causes several types of potentially serious collateral damage.

Figure 2.6
Forced Ranking from Performance Appraisal Scores



First, performance appraisal scores used in the forced ranking distribution are flawed because they do not take into account the effect of the operational system on the individual employee. So decisions based on those scores will be flawed as well.

Second, when you fire the bottom 10 percent of employees, you automatically have a new bottom 10 percent. The new bottom 10% are different from the top

90% likely due only to common causes of variation, so your average performance for the group is not improving. You cannot fire your way out of having a bottom 10 percent of employees! Further, a typical result of firing the bottom 10% of employees is that many remaining employees obsess about whether they will be in the next round of firings. Consequently, morale is adversely impacted, and performance suffers.

Third, there is a reduction of organizational cohesion and inclination to cooperate, Warring factions, with each attempting to protect its eroding turf, surface, at the expense of the organization.

In short, traditional management, using management by objectives coupled with performance appraisal and forced ranking of employees, does not achieve solutions to escalating organizational costs. The why is clear: they do not deal with the operational system of the organization. And, the operational system is the source of the common causes of variation that produce escalating costs.

Point 13*: Encourage education and self-improvement for everyone.*

Education and self-improvement are important vehicles for continuously improving employees, both professionally and personally. Leaders are obligated to educate and improve themselves and their people to optimize the system of interdependent stakeholders. Education for leaders may have to come from outside the system.

Remember, training (Point 6) is to improve job skills, while education (Point 13) is to improve the individual, regardless of his job. So, if one of the authors takes a course in Advanced Statistical Theory, it is an exercise in training for job skills. However, if one of us takes a course in floral arrangement or cooking, it is an educational endeavor.

Point 14: *Take action to accomplish the transformation.*

The transformation of an organization from its current paradigm of management to the System of Profound Knowledge cannot occur without the expenditure of energy by its stakeholders. Top management will expend this energy due to a variety of causes: for example, if they are confronted with a crisis or if they have a vision or aim that they want to pursue. Other stakeholders will expend this energy if stimulated by top management. The transformation cannot take place without a critical mass of stakeholders. The critical mass must include some policy makers.

Individuals have different reasons for wanting to, or not wanting to, accomplish the transformation. Individuals will have different interpretations of what is

involved in the transformation. To be able to plan, control, and improve the transformation, a leader must know: (1) each person's reasons for wanting (or not wanting) the transformation and (2) how each of those different reasons interact with each other and with the aim of the transformation. A model to promote Point 14 is presented in Chapters 14 through 19.

2.4 Deming's 14 Points and the Reduction of Variation

In this section, each of the 14 points is repeated with a brief discussion of how it is related to the reduction of variation in a process.

Point 1: Create constancy of purpose toward improvement of product and service with a plan to become competitive, stay in business, and provide jobs.

Establishing of a mission statement is synonymous with setting a process's nominal or target level. Getting all employees (management, salaried, and hourly), members of the board of directors, and shareholders to behave in accordance to the common interpretation of a mission statement is a problem of reducing variation. [Scherkenbach, 1986, pp. 133-134]

Point 2: Adopt the new philosophy. We are in a new economic age. We can no longer live with commonly accepted levels of delays, mistakes, defective material, and defective workmanship.

All people in an organization should embrace the System of Profound Knowledge as the focus of all action. As everyone uniformly embraces the system of profound knowledge, variation in how people view the organization -- and in how they interpret their job responsibilities -- will decrease.

Point 3: Cease dependence on mass inspection. Require, instead, statistical evidence that quality is built in to eliminate the need for inspection on a mass basis.

Dependence on mass inspection does nothing to decrease variation. Moreover, inspection does not create a uniform product within specification limits -- rather, product is bunched around specification limits, or, at best, product is distributed within specification limits with large variance and tails truncated at the specification limits. Instead, eliminate defectives and defects, using attribute statistical control charts (see chapter ?) and eliminate unit-to-unit variation within specification limits using measurement statistical control charts (see chapter ?), absent capital investment.

Point 4: End the practice of awarding business on the basis of price tag. Instead,

minimize total cost. Move toward a single supplier for any one item on a long-term relationship of loyalty and trust.

Multiple supplier processes, each of which has small variations, combine to create a process with large variation. This means an increase in the variability of inputs to the organization, which is counter to the reduction of variation. Consequently, reducing the supply base from many suppliers to one supplier is a rational action. This idea applies to both external and internal suppliers.

Point 5: Improve constantly and forever the system of production and service to improve quality and productivity, and thus constantly decrease costs.

The Taguchi Loss Function explains the need for the continuous reduction of variation in a system, as discussed in Chapter 1. Management must realize that when a system is stable, or exhibits only common causes of variation, it is able to predict the system's future condition. This allows management to plan the future state of the system and use the PDSA cycle to decrease the difference, or variation, between customer needs and process performance. The PDSA cycle is a procedure for improving process by reducing variation.

Point 6: Institute training on the job.

Statistical methods should be used to determine when training is complete. In chaos, more training of the same type is effective. In stability, more training of the same type is not effective; management may have to find the trainee a new job for which he is trainable.

Point 7: Institute leadership. The aim of leadership should be to help people and machines and gadgets to do a better job. Leadership of management is in need of overhaul, as well as leadership of production workers.

A leader must understand that variation in a system can come from the individual, the system, or the interaction between the system and the individual. A leader must not rank the people who perform within the limits of a system's capability.

Point 8: Drive out fear, so that everyone may work effectively for the company.

Managers who do not understand variation rank individuals within a system; that is, they hold individuals accountable for system problems. This causes fear, which stifles the desire to change and improve a process. Fear creates variability between an individual's or team's actions and the actions required to surpass customer needs and wants.

Point 9: Break down barriers between departments. People in research, design, sales, and production must work as a team to foresee problems of production and in use that may be encountered with the product or service.

Barriers between departments result in multiple interpretations of a given message. This increases variability in the actions taken with respect to a given message.

Point 10: Eliminate arbitrary numerical goals, posters, and slogans for the work force that seek new levels of productivity without providing methods.

Slogans and posters try to shift the responsibility for common causes of variation to the worker. This is sure to increase fear and variability in employee's behavior.

Point 11a: Eliminate work standards (quotas) on the factory floor. Substitute leadership.
Point 11b: Eliminate management by objective. Eliminate management by numbers and numerical goals. Substitute leadership.

If a work standard is between a system's upper capability and lower capability, there's a possibility that the standard can be met, but meeting the standard this way is simply a random lottery. If a work standard is above the system's capability, then there's little chance that the standard will be met unless management changes the system. Rather than focusing on the standard as a means to productivity, management should focus on stabilizing and improving the process to increase productivity by empowering employees to do their work and improve their work using the PDSA cycle.

Point 12: Remove barriers that rob the hourly worker of his right to pride of workmanship.

Performance Appraisal Systems can increase variability in employee performance, resulting from actions such as rewarding everyone who is above average and penalizing everyone who is below average. In such a situation, below-average employees try to emulate above-average employees. However, as the employees who are above average and those who are below average are part of the same system (only common variation is present), the below-average ones are adjusting their behavior based on common variation.

Point 13: Encourage education and self-improvement for everyone.

The education and training of employees will lower variability in processes, products, and jobs, continuing the never-ending cycle of improvement. [Scherkenbach, 1986, p. 126]

Point 14: Take action to accomplish the transformation.

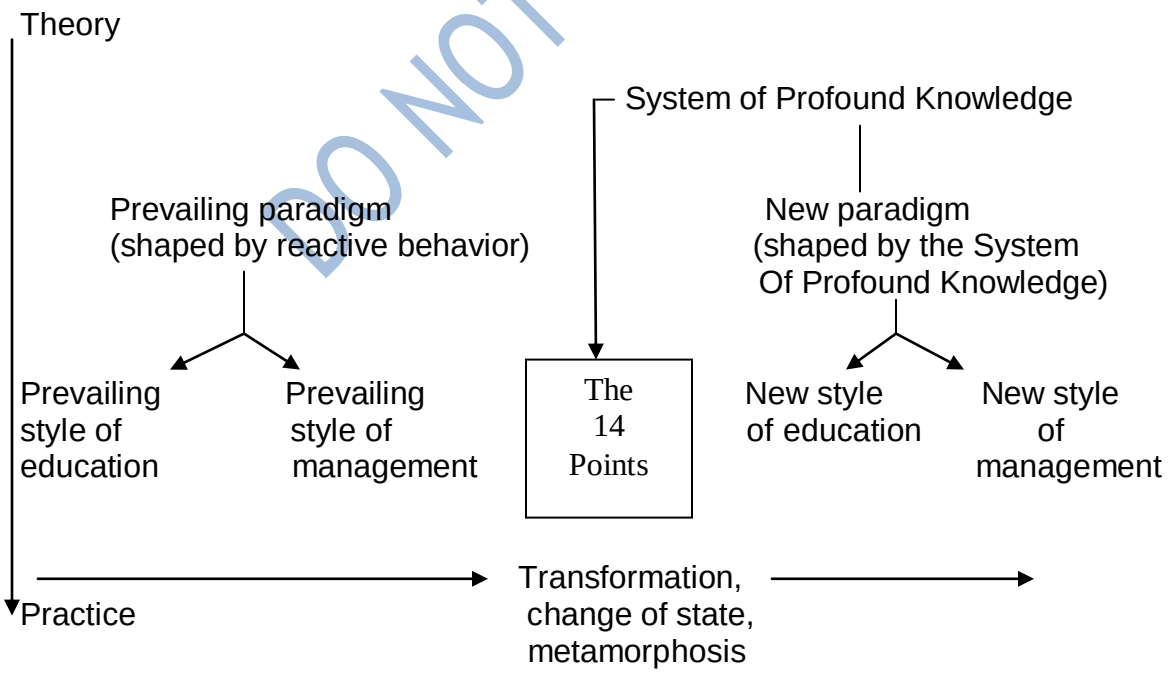
The current paradigm of Western management is shaped by reactive forces. Therefore, it has an explosive and high degree of variation in its application. The transformation must emanate out of a new paradigm shaped by the system of profound knowledge, not reactive forces. This new paradigm will have a stable, reducible degree of variation in its application.

2.5 Transformation or Paradigm Shift

2.5.1 Transformation of Management

The issues involved in understanding the transformation of people and organizations from management's prevailing style to the System of Profound Knowledge is presented in Figure 2.7, which displays: (1) the prevailing paradigm of leadership and the business and education systems it creates, (2) the System of Profound Knowledge and the business and education systems it creates, and (3) the 14 Points' role in the transformation process from the prevailing style of management to the System of Profound Knowledge.

Figure 2.7
Issues Involved in Transformation



2.5.2 The Prevailing Paradigm of Leadership

According to Deming, "The prevailing style of management was not born with evil intent. It grew up little by little by reactive behavior, unsuited to any world, and especially unsuited to the new kind of world of dependence and interdependence that we are in now." [Deming, 1994] The prevailing paradigm of management, shown on the left side of Figure 2.7, is not based on any holistic or comprehensive theory; it is just the cumulative result of assorted theories and experiences.

2.5.3 The New Paradigm of Leadership

The System of Profound Knowledge allows leadership to change and to develop a new basis for understanding the interrelationships between themselves and their environment. The environment includes people, systems, and organizations. It is based on a holistic and comprehensive theory of management.

2.5.4 Transformation

It is not easy to move from the prevailing style of leadership to the new style of leadership. The 14 Points provide a framework that helps explain the relationship between the prevailing style and the System of Profound Knowledge. They provide a window for managers operating under the prevailing techniques to compare and contrast their business practices with business practices in the System of Profound Knowledge. The real work of transformation comes from understanding the System of Profound Knowledge. According to Deming, "Transformation of American style of management is not a job of reconstruction, nor is it revision. It requires a whole new structure, from foundation upward." [Deming, 1994]

Managers in one organization should not use the experiences of managers in another organization to focus their transformation efforts. This is because organizations are unique, having their own idiosyncrasies and nuances. Conditions that led to the experiences of managers in one organization may not exist for managers of the other organization. However, this is not to say that managers' experiences in one organization cannot stimulate development of theories for improvement and innovation on the part of another organization's managers.

2.6 Quality in Service, Government and Education

The U.S. Census shows that the overwhelming majority of Americans works in service, government or educational organizations, or performs service functions in manufacturing organizations. Thus, improvement in our standard of living is highly dependent on better quality and productivity in these sectors of the

economy.

A denominator common to all organizations is that mistakes and defects are costly. The further a mistake goes without correction, the greater the cost to correct it. A defect that reaches the consumer or recipient may be costliest of all. [Deming, 1982] The principles and methods for process improvement are the same in all organizations. The System of Profound Knowledge and 14 Points apply equally to all sectors of the economy.

2.7 Summary

W. Edwards Deming developed a theory of management, called the System of Profound Knowledge, which promotes joy in work through the acquisition of process knowledge gained from experience coordinated by theory.

Deming's theory of management is based on four paradigms, which create the environment required to promote joy in work. They are: (1) People are best inspired by a mix of intrinsic and extrinsic motivation, not only by extrinsic motivation; (2) Manage using both a process and results orientation, not only a results orientation; (3) Management's function is to optimize the entire system so that everyone wins, not to maximize only one component of the system; and (4) Cooperation works better than competition.

Deming's theory of management comprises four components: appreciation of a system, theory of variation, theory of knowledge, and psychology. All four components are interdependent and will not stand alone. Fortunately, it is not necessary to be expert in any of the components to understand and apply the System of Profound Knowledge.

The System of Profound Knowledge generates an interrelated set of 14 Points for leadership in the Western world. These 14 Points provide a road map for the shifts in thinking required for organizational success. They form a highly interactive system of management; no one point should be studied in isolation.

The System of Profound Knowledge allows leadership to change and to develop a new basis for understanding the interrelationships between themselves and their environment. The environment includes people, systems, and organizations. It is based on a holistic and comprehensive theory of management.

The U.S. Census Bureau shows that the overwhelming majority of U.S. citizens is employed in service, government or educational organizations, or performs service functions in manufacturing organizations. Hence, improvement in our standard of living is highly dependent on better quality and productivity in these sectors of the economy.

EXERCISES

2.1 Explain the purpose of Deming's theory of management, called the System of Profound Knowledge.

2.2 List the four assumptions of the System of Profound Knowledge and provide an example for each assumption.

2.3 Briefly discuss the role of systems theory with respect to the System of Profound Knowledge. Be sure to include the following and provide a business or personal example demonstrating your understanding of each topic:

a. Definition of a system.
b. Responsibility for establishing the aim of a system.
c. Significance of optimizing the entire system, not just your component of the system.

2.4 Briefly discuss the role of the theory of variation (statistical theory) with respect to the System of Profound Knowledge. Be sure to include the following and provide a business or personal example demonstrating your understanding of each topic:

a. Define the two types of variation in a system (special variation and common variation). Who is responsible for each type of variation?
b. Define stability in a system.
c. Under what conditions is a system predictable into the near future?

2.5 Briefly discuss the role of the theory of knowledge with respect to the System of Profound Knowledge. Be sure to include the following and provide a business or personal example demonstrating your understanding of each topic:

a. Discuss the relationship between theory and learning.
b. Comment on planning, assumptions and process improvement.
c. Discuss operational definitions.
d. Discuss the dangers of learning from experience.
e. Discuss the dangers of copying other people's or organization's successful process improvements.

2.6 Briefly discuss the role of psychology with respect to the System of Profound Knowledge. Be sure to include the following and provide a business or personal example demonstrating your understanding of each topic:

a. Discuss extrinsic motivation, intrinsic motivation, and overjustification.
b. Discuss the managerial significance of the idea that people are different from each other. What does this imply about training and education?

2.7 Briefly describe the 14 Points for Management.

2.8 Describe the PDSA cycle and discuss its role in continuous improvement.

2.9 Define empowerment in the quality management sense.

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