Fundamentals of Total Quality Leadership

Module 3: System of Profound Knowledge

Lesson 4: Knowledge

Instructor Information

Lesson Outline

Lesson Objectives

By the end of this lesson to the student will be able to:

EO 3-19 Explain the definition of the theory of knowledge.
EO 3-20 Explain effective planning and decision-making approaches.
EO 3-21 Explain that planning and decision-making require prediction.
EO 3-22 Describe the importance of operational definitions.
EO 3-23 Describe the Plan-Do-Check-Act (PDCA) cycle.
EO 3-24 Explain how the PDCA cycle provides a method for continual improvement.

Length of Instruction

This lesson takes approximately 1.5 hours

Methods of Instruction

Lecture and discussion

Instructor Information (continued)

Media Required

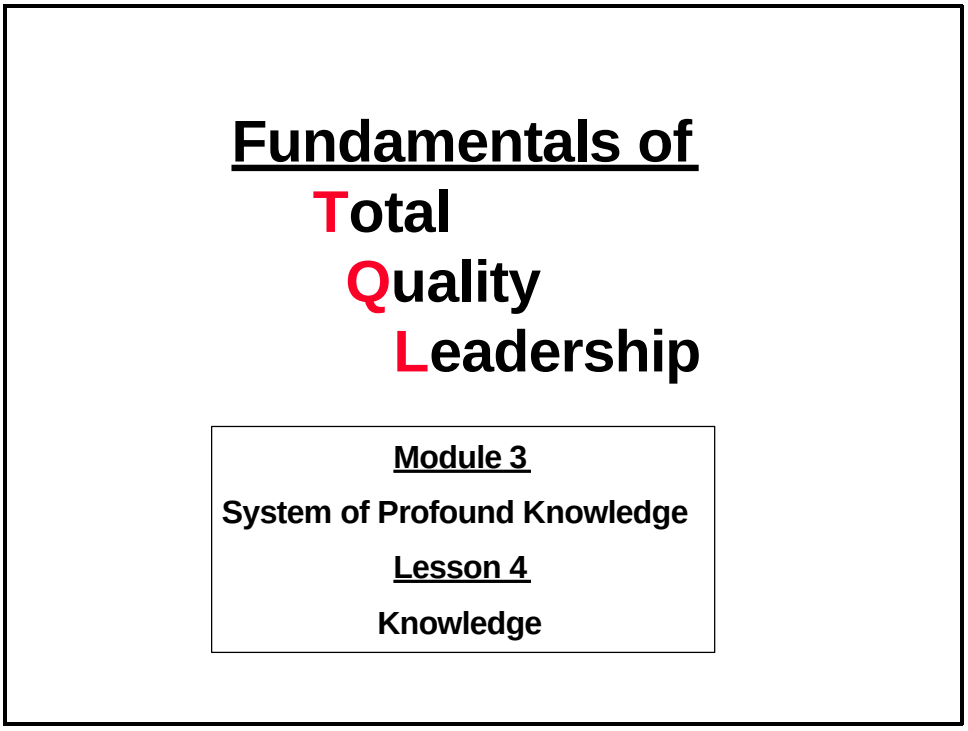
Overhead projector, screen, chartpack, and felt-tip pens

Videotapes

None

Additional Reading

Process improvement: A step-by-step approach to analyzing and improving a process. Moen, R.D., & Nolan, T.W. (1987, September). Quality Progress, 20 (9), 62-68.

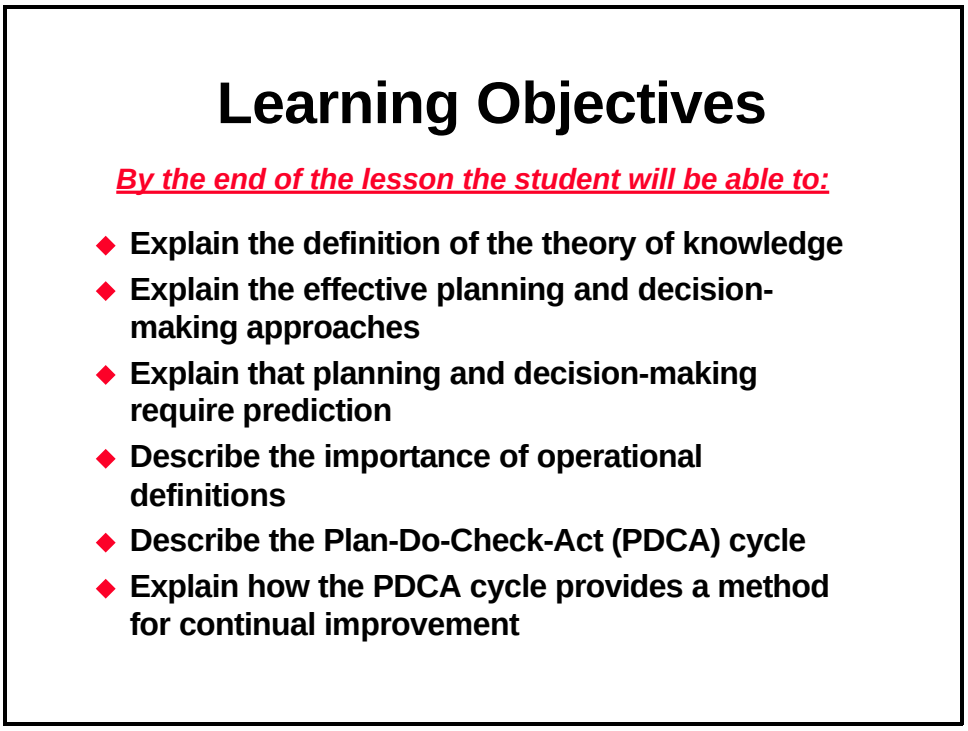


Fundamentals of Total Quality Leadership (FTQL)

Module 3: System of Profound Knowledge

Lesson 4: Knowledge

You will learn the importance of prediction and theory in quality improvement. You will learn how the scientific method is applied to process improvement, and you will see how this relates to continuous process improvement.



Learning Objectives

By the end of this lesson the student will be able to:

- **Explain the definition of the theory of knowledge**

In this lesson you will learn the concept of the theory of knowledge and discuss its importance in developing a body of knowledge. When you have a body of knowledge, you can develop theories, test the theories, and predict. You will see how knowledge comes from the state of statistical control.

- **Explain effective planning and decision-making approaches**

Described will be some typical approaches and some alternative planning and decision-making approaches characteristic of a TQL organization.

- **Explain that planning and decision-making require prediction**

Effective planning and decision-making depend on the degree to which a leader can predict future events: the better the prediction, the better the plan or decision. You will learn how prediction about the capability of our organization may be achieved using a scientific approach to management.

- **Describe the importance of operational definitions**

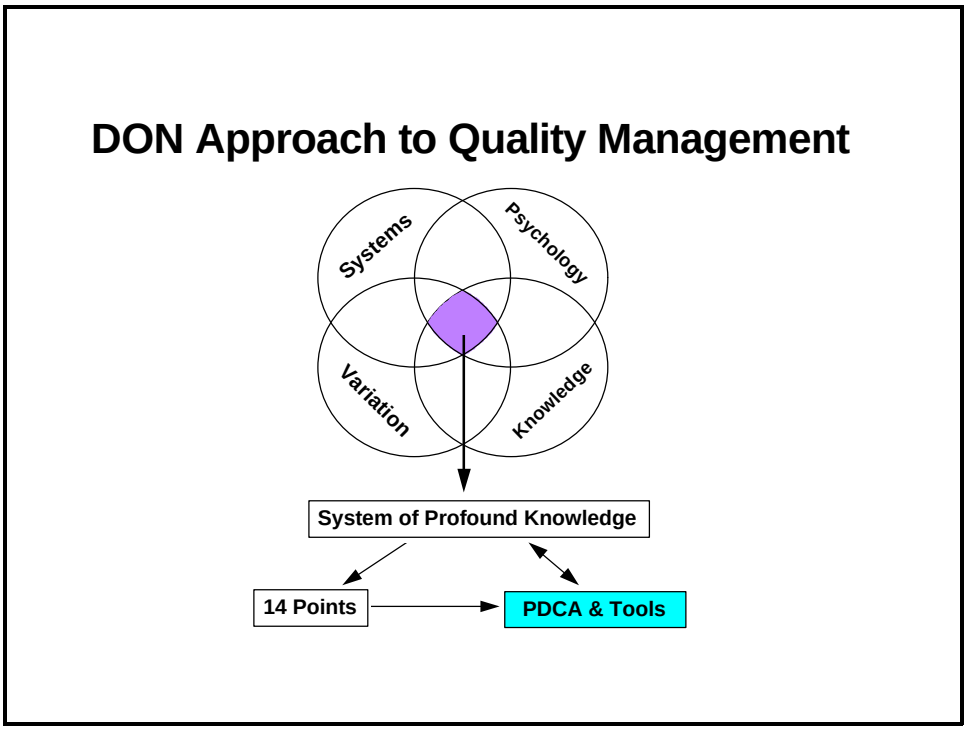
True science requires us to be specific. We will talk about "operational definitions" and how these help to create a clear understanding in defining quality characteristics for improving the organization's products and services.

- **Describe the Plan-Do-Check-Act (PDCA) cycle**

The PDCA cycle is an adaptation of the scientific method and describes a sequence of four specific and interrelated activities. Managers can apply the PDCA cycle to most aspects of the organization to gain the knowledge required to effectively predict the future of the organization and the quality of its products and services.

- **Explain how the PDCA cycle provides a method for continual improvement**

Not only does the PDCA cycle provide a method for prediction, it also provides a method of inquiry that is repeatedly applied to the continual improvement of the organization's processes, products and services.

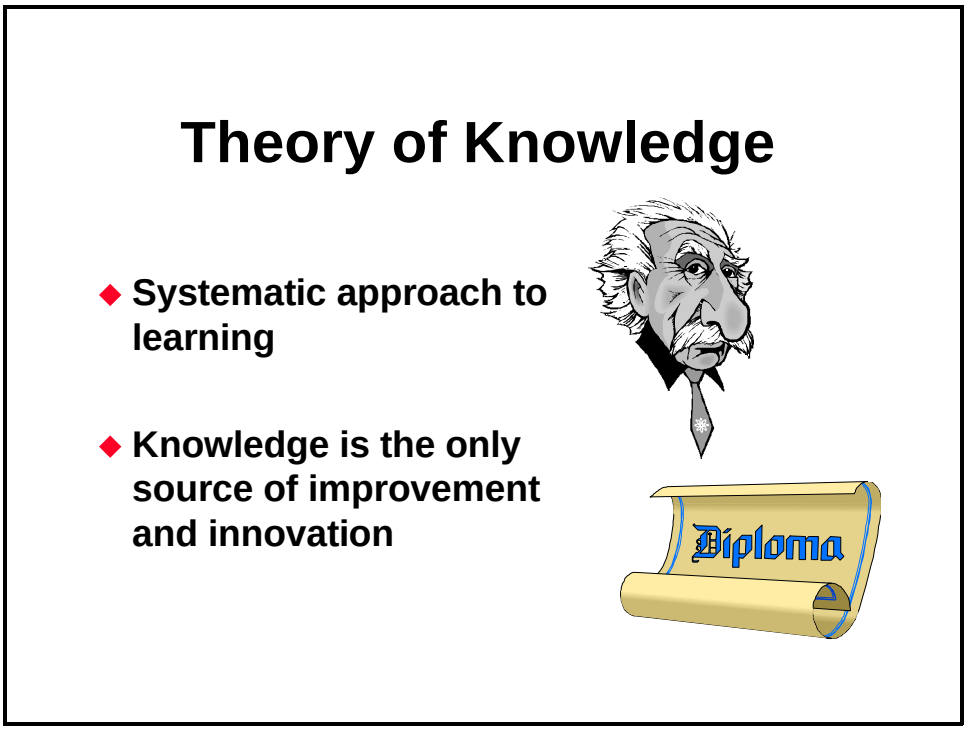


DON Approach to Quality Management

The fourth part of profound knowledge relates to the way knowledge is obtained and increased. Without understanding the theory of knowledge, managers cannot know if they are reducing variation. Further, they cannot adequately understand the complexity of the organization as a system, and they cannot help people to learn and understand. Managers need to apply scientific methods to the discipline of business if they are to plan and make decisions effectively and efficiently. A person practicing TQL needs to:

- Form theories about the work
- Make predictions based on those theories
- Carry out a change
- Collect and analyze data
- Judge the adequacy of the theories to explain the results as they relate to developing plans and making decisions

Two interrelated elements of DON's approach are symbolized by the boxes labeled "PDCA" and "Tools." PDCA stands for Plan-Do-Check-Act. The PDCA is a cycle for systematically gaining knowledge about problems and processes. The tools refer to graphic displays that are developed from data. The tools, discussed in the next module, are used throughout the PDCA cycle.



Theory of Knowledge

◆ **Systematic approach to learning**

You are all familiar with the word knowledge. It may be defined as a familiarity, awareness, or understanding of some phenomena learned by study, investigation, observation, or experience. For example, a naval aviator knows something about the field of meteorology. An effective leader knows how to help employees work together in teams.

The phrase, theory of knowledge, relates to how knowledge is **obtained**, and what is more important, how knowledge may be **increased**. The theory of knowledge describes a way of learning that is systematic instead of haphazard. The aim of this learning system is to increase our knowledge about a topic of interest.

The theory of knowledge is reflected in a method used in science -- the scientific method. The scientific method helps to advance the state of knowledge in any given field. The method requires:

- Formulating a theory
- Testing the theory
- Explaining the results or events
- Predicting future results or events based on the theory

The method also requires collecting, analyzing and interpreting data about the theory under consideration. We support, disprove or modify a theory based on information from data analysis instead of on hunches or pet theories which are usually unsubstantiated.

★ **Additional Information** :

1. The theory of knowledge is defined in the *Senior Leaders Seminar* as follows: "The supposition that knowledge increases when information from the environment supports or fails to support a prediction derived from *a priori* (valid independently of observation) knowledge or experimentation."
2. Epistemology is defined as:
   a. "The division of philosophy that investigates the nature and origin of knowledge. A theory of the nature of knowledge" (The American Heritage Dictionary, 1969).
   b. "The study or a theory of the nature and grounds of knowledge especially with reference to its limits and validity" (Webster, 1986).

◆ **Knowledge is the only source of improvement and innovation**

The responsibility for quality in any organization lies with top leadership. Producing quality products and services requires continuous process improvement and innovation in processes, products, and services based on customer-defined requirements and acceptance.

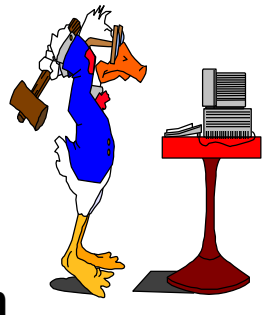
The theory of knowledge (application of the scientific method) helps management at all levels in the organization gain the knowledge required to improve the processes that produce its products and services.

The purpose of this lesson is to recognize the importance in applying the theory of knowledge to improving quality. In TQL, the theory of knowledge prescribes a systematic way of learning more about organizational processes to help foster process improvement and innovation.

For managers at any level in an organization, the theory of knowledge relates to two important managerial functions: **planning** and **decision-making** . To better understand the role of the theory of knowledge for the manager, we are first going to look at some traditional approaches (probably current for many organizations) toward planning and decision-making.

Typical Approaches to Planning and Decision-Making

- React to problems
- "Shoot from the hip"
- Form "tiger teams"
- Blame the workers
- Work around the system
- Take a short-term perspective



Typical Approaches to Planning and Decision-Making

This is a list of some typical approaches managers have used to solve problems that relate to planning and decision-making. The list isn't exhaustive, but it probably captures the most common examples.

☞ **Instructor Direction:** As you go through the list, you might want to ask the class for examples.

◆ **React to problems**

Crisis management, often called "firefighting," is a reactive form of problem-solving. Problems require immediate attention -- requirements change, unexpected events occur, and emergencies need to be handled. Fires must be put out, so we still need some quick fixes. A problem with this approach, however, is that although the problem may be solved, its root causes still exist. Consequently, it is very likely that the same problem will occur again. This recurrence is frustrating, time consuming, and costly. In reality, fixing what has happened is really the "management of failure" -- the failure to determine how to prevent the event from happening again. Crisis management is a form of reactive management -- what we need is proactive management.

- **"Shoot from the hip"**

When management makes decisions based on insufficient or inaccurate information, he or she is "shooting from the hip." The approach may be the result of firefighting where there is not enough time to collect the necessary information. Often, there is enough time to obtain more information. The manager, however, may not think more information is needed or may not know how to obtain the appropriate information. When management acts without information obtained from data, they are acting without knowledge.

- **Form "tiger teams"**

Forming tiger teams for the purpose of problem solving usually occurs because of some crisis. The members of a tiger team are usually people who are the most knowledgeable about the problem, and so tiger teams are often successful.

Unfortunately, once the problem is solved, the tiger team goes away. Seldom is what the team learned formally instituted in the organization to help ensure that the problem will not return. As with firefighting (reacting to problems), this approach focuses on solving the immediate problem instead of looking for root causes and improving the process that caused the problem in the first place.

- **Blame the workers**

One method for dealing with problems is to blame the worker. Quality "gurus," such as Juran and Deming, advocated for years that 85 to 94 percent of problems are due to the systems in which people work and not to the people themselves. The "blame the workers" approach is appealing to managers because it is much easier for them to point a finger at workers than it is for them to take actions to improve the systems for which they are responsible.

☞ **Instructor Direction** : You might want to cite the situation of Chicago's 1991 flooding of its downtown business area. The immediate response of the mayor (Mayor Daley) was his desire to find out who was responsible for the flood and to fire the culprit(s). Who was responsible for determining if the water system was a process strategically important to the smooth functioning of the city? The bottom line is that there was no process for the systematic collection and analysis of appropriate data to determine when the water pipes should be replaced.

- **Work around the system**

One of the most disastrous approaches to solving problems from a total quality perspective is to "go around the system." Unfortunately, the ability to do so can be very rewarding, particularly in the military.

People often think highly of a "Radar O'Reilly" type person (from the TV program M*A*S*H) because that person gets things done. Short-term solutions will be found, but what will be the long-term cost? What happens when this effective person leaves and is replaced by a less effective "Radar?"

The important question to ask is why do we need these kinds of people in the first place? Could it be that there is something wrong with the system, and wouldn't it be a good idea to improve the system?

- **Take a short-term perspective**

The approaches to problem solving described so far have a common theme. They all have a short-term focus. The idea is to take care of the immediate problem and move onto the next. No thought is given to improving the process associated with the problem so that the same problems won't show up in the future.

One reason these short-term activities continue is that they can be very rewarding to the firefighters, the hip-shooters, and the tiger teams. Problems are usually solved in a short time, and the activity is often rewarded. This short-term perspective is the Achilles heel of management because everything appears to be well. In contrast, process improvement is usually slow and tedious, and although it clearly pays off in the long term, there is usually no immediate reward -- no sizzle.

The above management approaches primarily address problem solving, and in reality, there will always be problems that may require one or more of the above approaches. The important point to remember, however, is these approaches are inappropriate to managing an organization.

Before discussing quality approaches to planning and decision-making, note that some situations **do** require the above traditional approaches. If there is a crisis that demands immediate attention, a leader must take action (react to problems). If there is a fire, it must be put out. Sometimes there is not enough time to get sufficient data to make the best decision, but a decision is required (shoot from the hip). There will be times when a problem is so important to the immediate survival of the organization that it must get the attention of the best and brightest in the organization (tiger teams).

We must learn to look at planning and decision-making in a new way. **Our focus needs to shift from looking at problem-solving to looking at the processes that cause the problems, and to think instead in terms of process improvement** . We need to shift from a predominantly problem-solving mode to a process-improvement mode of management. Most of us, however, have had limited experience with looking at planning and decision-making from a process improvement perspective. Next we will see some examples of how a total quality approach (process improvement) differs from the traditional approaches (problem-solving) described above.

Quality Approaches to Planning and Decision-Making

- Plan for improvements
- Make data-based decisions
- Pursue continuous process improvement
- Improve processes
- Improve the organizational system
- Take a long-term perspective

Quality Approaches to Planning and Decision-Making

This is a list of quality approaches managers must understand and apply to plan and make decisions in their organizations. As you read about these, keep in mind how they differ from the typical approaches just described. We will discuss how these are more effective.

☞ **Instructor Direction:** The order of the items presented in this viewgraph maps with the order of the items on the previous viewgraph according to content area, such as crisis management vs. plan for improvements. You may want to refer back to the previous viewgraph on typical approaches to problem-solving as you discuss the total quality approach.

◆ **Plan for improvements**

One way of moving away from the firefighting mode (reacting to problems) of management is to focus more up-front attention on planning for both the short-term and the long-term. Managers often try to excuse their lack of adequate planning by saying there isn't enough time to plan because they must respond to some crisis. What managers fail to recognize is that **"fire drills" are often due to poor planning** . The time spent on firefighting will greatly exceed the time required for effective planning.

Crises cannot be ignored. They are facts of life and must be resolved. However, even while responding to a crisis, we can address problems and make decisions in a more systematic way.

- **Make data-based decisions**

Data-based decision making is the opposite of "shooting from the hip" where decisions are made with insufficient or inappropriate information. Data-based decision-making requires that we base planning and decision making on sufficient and appropriate information.

At the start of a total quality effort, obtaining the proper data will take time. However, as data gathering systems are put in place (such as control charting), pertinent information for decision-making will become more readily available. Good decisions require good information. While it is not always clear how much data is appropriate, taking action based on limited data may clearly lead to future problems.

- **Pursue continuous process improvement**

We will address this topic at length later in this lesson. It is listed here because it is the total quality alternative to the "tiger team" approach. To have continuous process improvement, we need to replace the tiger team of experts who are called in to solve a specific problem, with a cross-functional team of experts who have knowledge about the process because they own it and can work together on continual improvement of the process.

In a TQL organization, everyone's focus must be on process improvement. The key ingredient for this is knowledge of the processes, and knowledge of the methods and tools of process improvement. Every player on the improvement team will need education and training in quality methods.

- **Improve processes**

The issue here is to look at a problem as a consequence of a poorly designed process instead of looking for someone to blame. If 85 percent or more of the problems in a process result from a poorly designed process, then it makes sense to improve the process.

An added bonus from improving processes (instead of blaming workers) is that it boosts employee morale and increases the likelihood that workers will cooperate in future process improvement efforts.

☞ **Instructor Direction:** Ask the students, "Do you think blaming some worker for the Chicago flooding did anything for improving the water system process?"

◆ Improve the organizational system

The quality of the product or service of any system depends on the quality of the system. The system includes every function of the organization, such as the receipt of incoming materials, design, production of products and services, and interactions with customers. These functions affect each other. When someone goes "around" the system, it might benefit one part of the system, but it is likely to have a negative effect on another part of the system and perhaps on the effectiveness of the whole organization. Going around the system to complete a task is an example of **suboptimization** and a clear indicator that **management needs to change the system** .

When someone goes around the system, there is no opportunity for improvement. Managers must treat the organization as a system and work to optimize the system. This will eliminate the need for working around the system.

As was said earlier, the total quality approaches listed here are going to require a new way of thinking -- a new paradigm. Familiarity with the theory of knowledge can help managers avoid some problems associated with traditional management approaches. The theory can move them toward total quality practices by providing **scientific** principles for process improvement.

◆ Take a long-term perspective

The total quality management approach requires a long-term perspective. Decisions made within this context are perceived to have implications for the future as well as the immediate situation. Focusing on future needs requires well-developed plans to guide actions that will lead to improvements in the long term. Sometimes this means making an unpopular decision that has short-term negative consequences. For example, one might miss a deadline to ensure delivering a high quality product because it will pay off in the long-term by satisfying the customers.

Taking a long-term perspective is often difficult because we are usually rewarded for a quick return on investments and short-term successes. This long-term view may be more troublesome for the military side of the DON because tours of duty tend to be shorter than those for civilian employees. Also, there is the problem of overcoming the military "tradition" of making a significant contribution "on my watch." Making decisions for "my watch" may actually suboptimize the aim of the organization when a long-term focus is ignored.

Management and the Theory of Knowledge

- **Management must be able to predict the future**
- **Prediction requires knowledge**
- **Theory is required to increase knowledge**
- **Knowledge comes from applying the scientific method**

Management and the Theory of Knowledge

The goal of science is to **explain** past events, **predict** future events, and, where possible, **control** current and future events. The **process** of advancing knowledge in science is usually through a slow, continuous stream of tests and experiments, each designed to advance the state of knowledge in a particular field. Occasionally, breakthroughs or innovations produce rapid advances in knowledge, but the general process is slow, incremental growth based on experimentation **guided by theory** .

Managers at all levels should pursue goals like those of the scientist (explain, predict, and manage) to gain more **knowledge about the systems and processes** in their organizations. Managers need to learn how to increase their knowledge of the processes for which they are responsible. They do this by participating in such scientific activities as forming theories (hypotheses), and designing and conducting experiments to test the theories. They need to know how to collect, analyze, interpret, and apply data or information derived from experimentation, **guided by theory** .

◆ **Management must be able to predict the future**

The transformation from traditional management practice to TQL cannot happen without planning. **Planning requires prediction** . **Prediction can only be based on the current state of knowledge of the process under consideration** . Knowledge of the process cannot advance based on a "gut feeling" or a "hunch." It must be based on data collected to answer a specific question generated by a theory.

Any rational plan requires prediction concerning conditions, behavior, or comparison of performance. For example, how will I go home this evening? I predict that my automobile will start up and run satisfactorily, and I plan accordingly.

Effective leaders must be able to make predictions . An example is the military concept of "know your enemy." In combat, the more a leader knows about the enemy (historical strategies and tactics, logistics, weapons capabilities, size of forces, strengths and weaknesses, and so on), the better will be his or her ability to predict what the enemy will do. The more accurate the prediction, the more effective the battle planning and operational decision-making can be.

◆ **Prediction requires knowledge**

How much a manager knows about the organization, its processes, products, and services, will determine how data are interpreted and how predictions about changes are made. Managers who are unfamiliar with, or do not understand the processes for which they are responsible, cannot accurately predict the results of changes in those processes.

Many business schools today teach the idea that there is a set of managerial skills or techniques that enable a manager to manage anything effectively. This idea needs to be reexamined. We have just seen some of the problems associated with these traditional management approaches -- and **few if any of the traditional approaches enable managers to predict** . These traditional managerial skills and techniques are not suitable for an organization that practices TQL. Again, the degree or amount of process improvement a manager can expect depends, in part, on how thoroughly the manager knows the process for which he or she is **directly responsible** .

◆ **Theory is required to increase knowledge**

For knowledge to be useful -- explain, predict, and manage -- it must be organized into a **form** that lends itself to testing and experimentation. That form is theory. A theory is a **system** of assumptions, principles, and relationships that help to explain and predict the nature or behavior of a specified set of phenomena. The **theory provides a framework for replacing or integrating old knowledge with new knowledge in order to provide a greater understanding of the phenomena of interest** .

A theory does not have to be complex. It can be as simple as stating (predicting) that one method of training might be more effective than another to learn certain skills. Another example of a theory is that recruits from the Northeast part of the country are more likely to re-enlist after their first tour than recruits from the Southwest. Although theories can be complex, a “rule of thumb” in science is to strive for simplicity.

★ **Additional Information:** Here is an additional definition of "theory" for your reference: "Systematically organized knowledge applicable in a relatively wide variety of circumstances; especially, a system of assumptions, accepted principles, and rules of procedure devised to analyze, predict, or otherwise explain the nature or behavior of a specified set of phenomena" (The American Heritage Dictionary, 1973).

Theory requires precision in the definition of its terms and relationships. In the training example above, everyone concerned must agree on the meanings of terms such as "method of training," "more effective," and "certain skills." **Operational definitions** provide such precision in communication.

A theory must be applicable in a relatively wide variety of circumstances. Deming claimed, for example, that his Fourteen Points for management (Module 4) describe his **theory of management** and may be effectively applied to any organization.

A theory may change based on new information, but the source of the information must come through the application of the scientific method.

- **Knowledge comes from applying the scientific method**

To gain knowledge about an organization and about the products and services the organization provides, we need to apply the scientific method to studying processes in the organization. From that study, we will gain knowledge -- knowledge that managers can use for planning and decision-making.

You need to understand the meaning of the term “operational definition” because operational definitions are extremely important when applying the scientific method to planning and decision-making.

Operational Definition

- **Give communicable meaning to a concept by specifying how the concept is measured and applied within a particular set of circumstances**
- **Operational definitions have three elements:**
  - **Criterion**
  - **Test**
  - **Decision**

Operational Definition

> **Gives communicable meaning to a concept by specifying how the concept is measured and applied within a particular set of circumstances.**

Many industrial leaders believe that using operational definitions are the most important requirement in business today. It may also be one of the most neglected. The concept, however, is simple.

The term “Operational Definition” is simply **an agreed-upon meaning of terms and concepts that are stated so they can be measured in specific contexts** to obtain consistent results. This implies that operational definitions will be different in different contexts. For example, the operational definition of "clean" will have a different meaning in a surgical operating room than for a teenager's bedroom.

It defines how a word or phrase is used when it is applied in a specific context. This implies that words may have different meanings when used in different situations. For example, the operational definition of "ready" used in an air squadron would be very different from the one applied in a naval hospital. Operational definitions put workable meaning into our everyday terminology.

Words such as "good," "reliable," "defect," and "uniform" can have many meanings unless they are defined in specific terms that apply in particular circumstances. As an example, in the absence of an operational definition, the term "squared away" might mean one thing to an Executive Officer (XO) immediately prior to the visit of a VIP, and quite another to a young sailor involved in preparing for the visit but anxious to start a three-day weekend. However, if "squared away" were operationally defined among all of those getting the ship ready for the VIP, the term would mean the same thing to the XO and the sailor.

To communicate effectively and avoid misinterpretations, members of your team, data collectors, and both internal and external customers and suppliers must use the **same operational definitions for the same concepts** .

Misunderstandings often have their roots in failure on both sides to state in advance, in meaningful terms, precisely what is intended. Concepts must be clear. What we want measured and how we want it measured must be operationally defined. When they are not, we will still get something -- but it probably will not be what we need.

◆ **Operational definitions have three elements** :

- **Criterion:** The standard against which to evaluate the results of the test.
- **Test:** A specific procedure for measuring a characteristic.
- **Decision:** The determination as to whether the test results show that the characteristic meets the criterion.

The following example (Deming 1993, pp. 287-290) illustrates how you can establish one or more criteria, measure, and reach a decision.

What is meant when a blanket label says "50 percent wool"?

- One interpretation might be that one-half of the area of the blanket is wool and the other half is another material, such as cotton.
- Another interpretation might be that the wool is evenly dispersed throughout the entire blanket.
- Still another interpretation might be that the blanket is two-ply, with one side made of wool and the other side made of cotton.

In the absence of more information, any of these definitions could be "correct." But what do you want your blanket to be like? You and your team won't get what you want unless you develop an **Operational definition** of what is meant by the term "50 percent wool."

- **Criterion**: First, you need to set the **criterion** or standard for calling the blanket "50 percent wool." In this example, the criteria are that the wool and cotton fibers are evenly distributed throughout the blanket and the wool comprises half the total weight of the blanket. Other criteria *could* have been used, such as the number of threads of wool compared to the number of threads of cotton.

- **Test**: After you have decided on the criteria for "50 percent wool," you must set up a **test procedure** to determine whether the blanket meets the criteria.

  In this example, the decision was made to use a quantitative test in which ten 2-inch-by-2-inch squares were cut from specified areas in sample blankets. These swatches were handed over to a laboratory technician to analyze and measure the proportion of wool by weight.

- **Decision**: Now you must make a decision. When the laboratory technician has performed the test on the samples and presented you with the data, it becomes a yes-or-no decision: Did the results of the test meet the criteria?

★ Additional Information:

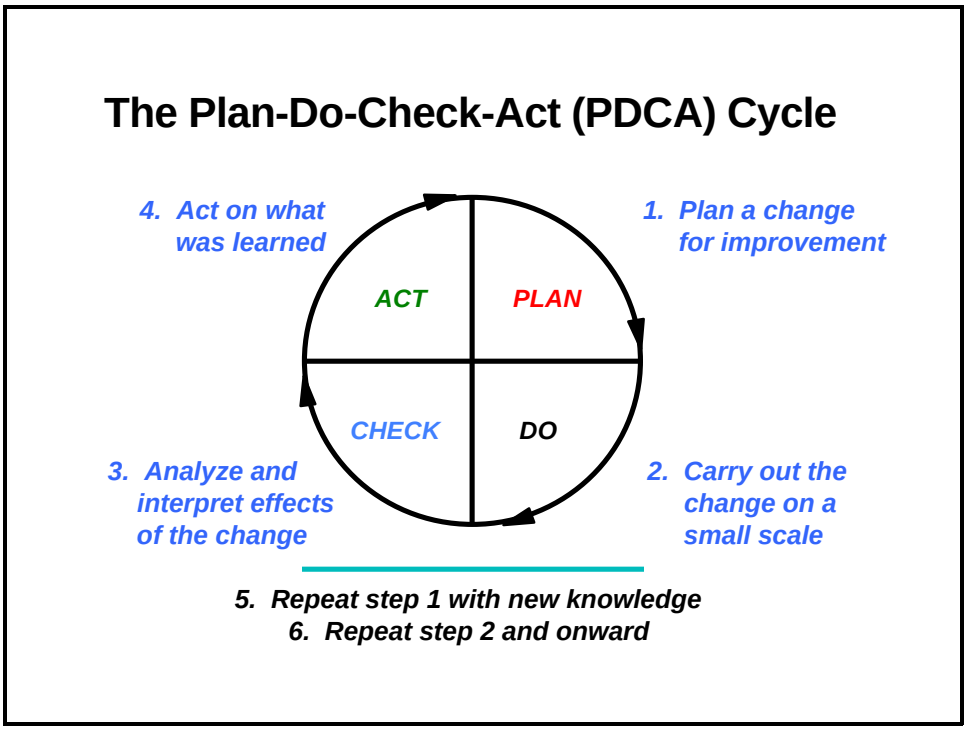
Gitlow (et al., 1989, p. 49) states:

"Operational definitions establish a language for process improvement and put communicable meaning into a process, product, service, job, or specification. . . . An operational definition consists of:

1) a criterion to be applied to an object or to a group
2) a test of the object or of the group
3) a decision as to whether the object of the group did or did not meet the criterion."

Scholtes (1988, p 2-28) states:

"An operational definition describes **what** something is and **how** it is measured."



The Plan-Do-Check-Act (PDCA) Cycle

The PDCA cycle is an application of the scientific method applied to management planning and decision-making . It represents a systematic way of increasing our knowledge of processes and of implementing change to assess whether improvements resulted.

Deming popularized the PDCA cycle. He credits Walter Shewhart, a physicist at Bell Telephone Laboratories, with developing it first. Deming referred to this model as the Shewhart cycle. The Japanese and others call it the Deming cycle. Others refer to it as the PDSA cycle, the learning cycle, the scientific method, or the process improvement cycle.

★ **Additional Information:**

1. In 1990, Deming and others **began** calling the PDCA cycle, the PDSA cycle. The "S" stands for study or synthesis. By whatever name it is called, its activities remain the same. For consistency, we will refer to the approach here as the PDCA cycle.
2. Ishikawa (1985, p. 59) claims the Japanese came up with PDCA, and they refer to it as the Control Circle.

Here is a brief overview of the cycle. To begin the cycle, we develop hypotheses to explain why specific results occurred. For example, suppose you aren't receiving messages from customers fast enough. By the time you receive a message, it is too late to serve the customer satisfactorily. We hypothesize that the messages are late because our staff does not have a standardized process for forwarding messages. So we develop a set of forwarding procedures for them. Then we test the change in procedures to see if they were effective. If, through data collection and analysis, events prove to be predictable and the outcome is satisfactory, we are on our way to improving the message forwarding process.

First, the **PDCA model** itself directs us to **identify** and **plan** the changes we want to make. Identification of a desired change requires hypotheses that need to be tested. The top leaders should ensure that these plans relate to organizational goals (based on customer requirements). To evaluate these changes, you must decide what data we need and then ask, "What data will we get? How, when, and by whom will the data be collected?" All of these questions must be operationally defined if they are to have meaning.

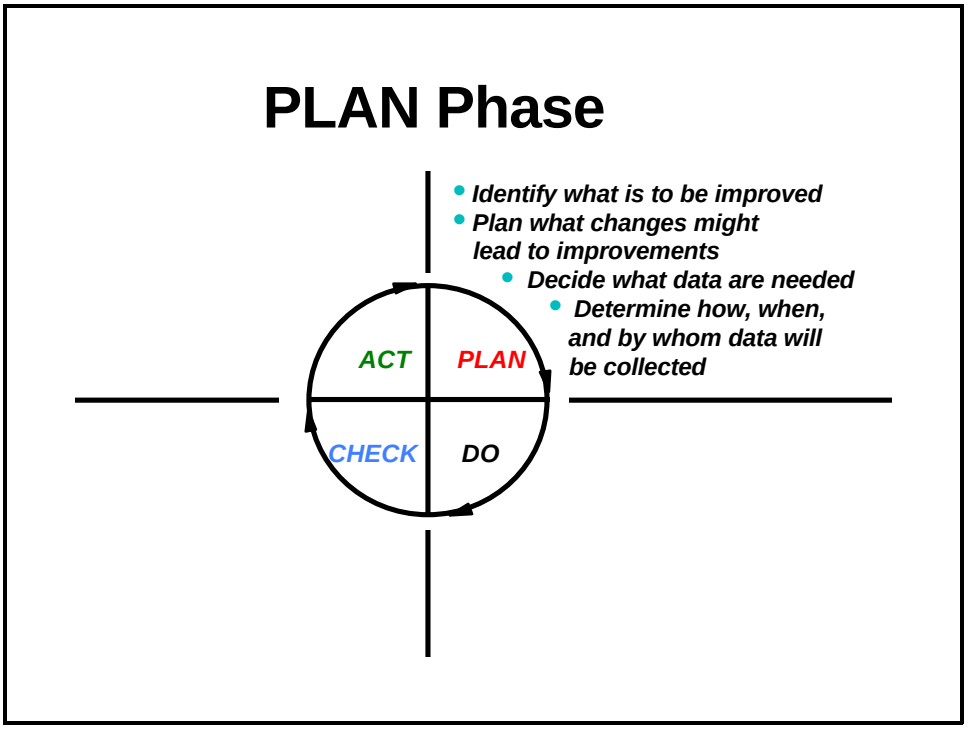
Second, we **do** by making the **changes** that will help us answer the questions we posed in the hypotheses. Since we are testing the effects of changes, it is best to implement the changes on a small scale, as a pilot test.

Third, we **check** by **observing** the effects of the changes or test. What happened as a result of the changes? We summarize the data.

Finally, you **act** on what you **learned**. We compare the data collected with our predictions and modify our hypotheses accordingly. In this way, we evaluate the consequences of our actions.

As the word "cycle" suggests, our efforts do not end here. After implementing and monitoring the effects of changes to the process, we continue to pursue continual improvement by repeating the steps. We continue to monitor our processes and strive to make further improvements.

We will now look at each phase of the PDCA cycle in more detail and identify what management needs to know and do.



PLAN Phase

- **Identify what is to be improved**

The Plan phase of the PDCA cycle begins with identifying which processes need to be improved. To do this, the major processes that relate to the organization's mission and customer requirements need to be prioritized by top management. Identifying significant processes is a role of the Executive Steering Committee (ESC).

As we discussed in Module 1 (DON Quality Approach), the customer defines quality. Therefore, processes selected for improvement should address customer concerns. For organizations, the Plan phase includes identifying customers and the products and services they require.

Each process identified and selected for improvement should be one that has a significant impact on the organization. Often organizations get caught up in improving processes that only marginally affect the final product or service, such as how office furniture is distributed, or the length of time it takes to get a travel reimbursement. These processes should be improved, but leaders should be more concerned initially about how the external customer will ultimately benefit. External customers are what keep us in business, not the arrangement of office furniture.

◆ Plan what changes might lead to improvements

How do we know which proposed changes will improve a process? This part of the planning process is analogous to what the scientific community does when it generates hypotheses. Hypotheses are tentative assumptions about the relationships between events. If we make a change (such as increasing technical training), will this lead to an improvement (such as fewer technical errors)?

As an example, we might be experiencing problems in meeting our schedule for a product or service. Suppose customers are unhappy, we are getting a bad reputation, our people are working overtime and so on. We need to find out why we are not meeting the schedule. We could develop a list of hypotheses that describe possible causes. For example, equipment may be breaking down; we may have an insufficiently trained work force; our production process may be producing bad parts; communication between the planning department and the production department may be inappropriate; and so on. To the extent that the issues are cross-functional, a Quality Management Board (QMB) may be chartered.

How do you decide which hypothesis to test? To narrow the decision, you have to know and understand your processes. Again, there is planning, as well as measurement tools, to help determine where to begin.

☞ **Instructor Direction:** You may wish to tell the class that models for selecting processes strategically important to the organization are presented in both the *Systems Approach to Process Improvement* course and the *Methods for Managing Quality* course. Some specific planning and measurement tools will be introduced in the next lesson of this course.

◆ Decide what data are needed

Management needs to identify what information or data should be obtained that will show whether improvements have occurred. Data need to accurately reflect what is occurring in the production process.

This part of the Plan phase takes time and hard work to accomplish because it requires knowledge of the process. This activity may even result in revisions to hypotheses as more information is gathered.

◆ **Determine how, when, and by whom data will be collected**

A data collection plan must be developed. The plan should include how the data will be gathered, how often data will be collected, and who will gather and record the data.

There are a variety of techniques to address the question of **how** to collect data. A common method is to conduct **interviews**. Typical polling techniques consist of asking the "average person" what his or her opinion is on a topic.

When we gather information on how specific processes operate, we are also collecting data (language data). "Chief Jones, tell me how I can get a part from supply. What do I need to do?" Chief Jones then describes the process. Chief Jones may even identify where bottlenecks appear to exist. Collecting this type of information can be done through face-to-face interviews or by survey.

Another "how to" for data collection is to record **process measures** as the product or service is being produced (number data). If, for example, we want to figure out why the thickness of a machined bolt varies from part to part, we could measure the thickness right before and right after it has been machined. These measurements should be recorded. For an administrative task, the length of time it takes a document to be processed could be recorded.

A third typical "how to" method is to use information that already exists (historical data). Sources of historical data may be log books, computer files, reports, or other media. A word of caution, however, you must know **how** the historical data were collected before considering them for use. Also, the temporal ordering of the data collection may be required if the data are to be useful.

Most of us have access to reams of data, but the problem is that these data may not be too informative, or may not readily depict the information we need. You may have situations where we are data-rich but information-poor. In any case, we need to identify our questions **first** and then see if we have the appropriate data to provide the answers.

The next major concern is **when** to collect the data. If we could collect all possible pieces of data and put them together in some meaningful way, we would not have a problem. But, it is not feasible to collect all possible relevant data in most situations.

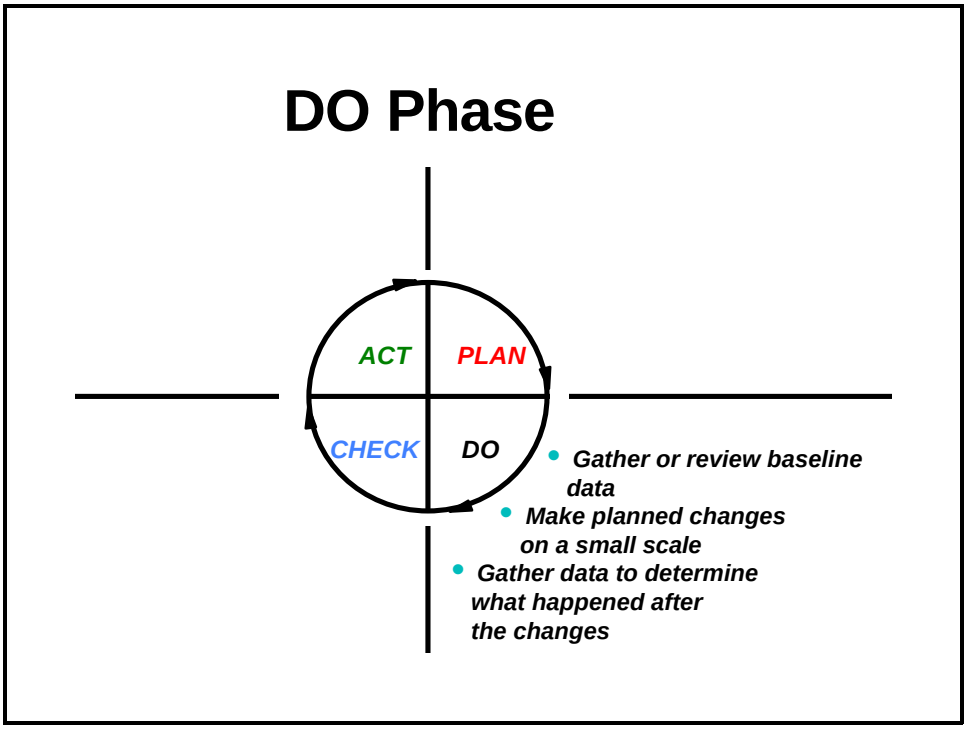
One solution is to select a **sample** of data that will give us an estimate of process performance. This requires knowledge of the process. For example, if you know that a product or service flows through a particular stage every 20 minutes, every 2 hours, or every 2 days, you have an **indicator** of how often to collect data.

A final consideration is **who** collects the data? One way is to allow the employee working in that part of the process to record the results. This process can be simplified tremendously if an employee has a check sheet or tally sheet so that all he or she has to do is write down a number or put a tally mark in a box on the form.

A potential problem with collecting data in this way is that some employers do not trust their employees to be truthful. Similarly, some employees believe their employers will use this information in a punitive way. Participation and cooperation are difficult to establish if traditional management approaches continue. Ultimately, the goal is to operate in a climate of mutual trust. This will not occur unless there is a belief that the data are accurate and that the data will be used to improve processes - not to blame people.

☞ **Additional Information:** You might want to talk about the concept of "historical amnesty" whereby managers accept that data might have been manipulated in the past (working around the system) so that the workers could complete tasks or meet quotas. In order to improve the process, you must know what the process is doing. The data must be truthful. The manager must communicate to his workers his desire for truthful data, stating he now understands why the system forced the workers to be "creative" in their numbers. The manager must communicate that the data are to improve the process, not to blame people.

The Plan phase is the key to everything that follows in the PDCA cycle. A poorly conceived plan can lead to inappropriate and inefficient use of resources. If done properly, it probably will be the most time-consuming phase. The planning process systematically identifies the strategy that will test the accuracy of the hypotheses for improving quality.



DO Phase

The Do phase consists of making some changes, initially on a small scale. The effects of these changes are measured over time (as specified in the data collection plan) so they can be compared with measures taken before the changes (baseline data). A Process Action Team is often chartered to collect the measurement data.

- **Gather or review baseline data**

Before we know how much we are going to improve, we must determine where we are. Information on how the process is currently performing serves as our **baseline**. Baseline information can be obtained either through historical data or through a new collection effort.

If credible information exists, it can be used as the baseline. In a situation where the information may not be credible, alternative measures must be developed and allowed to operate for a time to establish baseline rates of performance.

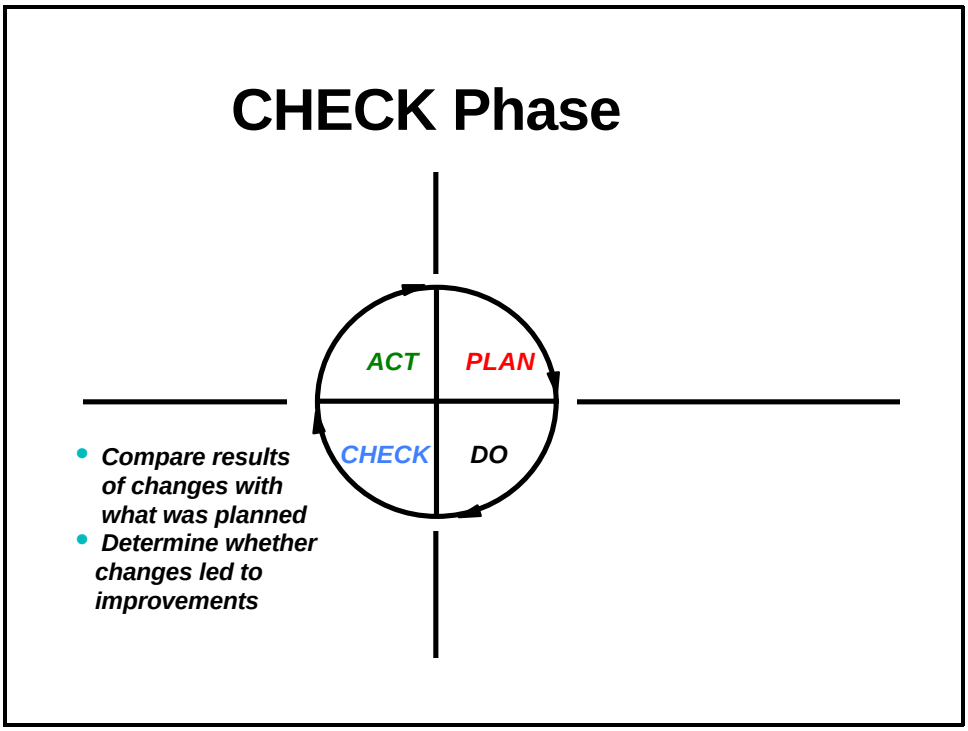
Determining **what** to measure is defined by the customer's quality characteristics you are trying to assess. Figuring out **how** to measure the quality characteristics is often very difficult. It's also very hard for managers, once they start seeing variation in the data, to leave the process alone until sufficient data are collected and analyzed. They will immediately want to make adjustments based on the variation they observe (taking action on common causes as if they are special causes). They may want to act on short-term data instead of letting the process first run a while to obtain sufficient data to understand what is occurring in the process. Again, operational definitions play a major role here, for defining the quality characteristics as well as the measurement aspects.

- **Make planned changes on a small scale**

After baseline information has been collected, the changes (tests of our hypotheses) can be made. Tests of our hypotheses are performed during this stage of the PDCA cycle. A word of caution however -- changes should be tried on a small scale first. A pilot test will allow us to estimate the potential effect of the changes before committing the entire organization to them.

- **Gather data to determine what happened after the changes**

After we make some changes, we must determine whether the changes resulted in improvements or not. To identify what happened, we need to continue to collect data. Traditionally, managers stop collecting data after making test changes. They **assume** that the changes were successful, or they **feel** that they will be effective. Unless you **continue to monitor the process and collect data** , you won't be able to determine the effects of the change. We may be creating bigger problems, but we won't know about them unless we continue to monitor process performance.



CHECK Phase

During the Check (analysis) phase, we compare the "baseline data" to the "study data" to test the hypotheses formed during the Plan phase. The manager's task is to put **meaning** into the data.

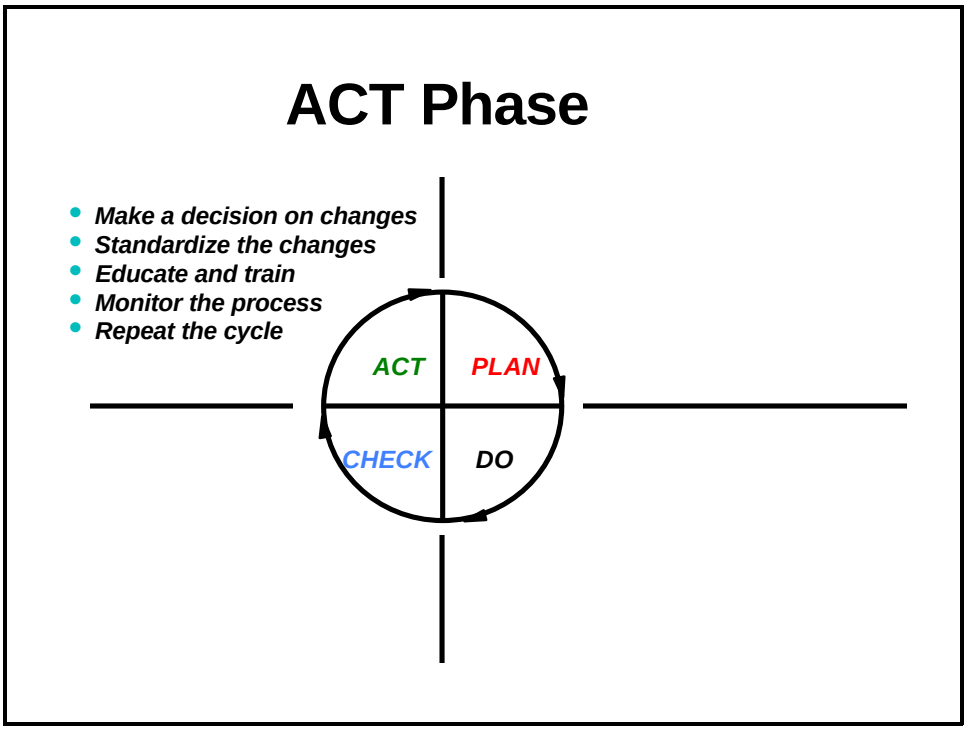
- **Compare results of changes with what was planned**

After the data have been summarized, managers must analyze, synthesize, and interpret the findings. What was learned about the process? Were the hypotheses developed during the Plan Phase supported? Did improvements result? Are viable or realistic solutions evident from the information? If so, can they be generalized to the larger organization? If the hypotheses were not supported, what went wrong? Were they incorrect from the beginning? Were the wrong data collected?

- **Determine whether changes led to improvements**

Management's task is to assess whether the data support or negate the hypotheses. Did the changes result in improvements without suboptimizing another part of the process? If so, were they cost effective? If not, was it because management measured the wrong things, used inappropriate data, or asked the wrong questions? Managers must assess what was learned. To do this, they must understand what the data say.

Whether the outcome is supportive of the hypotheses or not, the important question is, "What can be learned from the data?" This analytic perspective is vital from a total quality perspective. The success of a leader, a manager or a management team, will depend on the extent to which they apply the knowledge they have acquired as a result of the information obtained. The Check Phase provides the structure for assessing the data and acting accordingly. Whether it is to expand the changes to a larger or different segment of the organization, or to revise the hypotheses, the **data** serve as the criteria on which later decisions are made.



ACT Phase

The purpose for collecting data is to be able to make decisions and take action (Ishikawa, 1968). Whatever the decision is, it must be based on credible data.

◆ **Make a decision on changes**

At this stage in the PDCA cycle, a manager has one of two possible decisions to make: (1) to implement the tested changes on a broader scale, or (2) to revise the original hypotheses and do more testing (repeat the PDCA cycle). Things to consider in these decisions are, do the changes improve the process, what are the expected effects the proposed changes will have on the work force, and what are the potential costs compared to the anticipated benefits?

◆ **Standardize the changes**

Let's assume our changes were successful; that is, improvements resulted. A **formal** change in process procedures must be made. A formal change or implementation means that new procedures are documented in written form (standardization). These changes may also require a written formal instruction. Further, the changes may require revising training manuals or some other documents.

- **Educate and train**

Employees need to know how the work process has changed. This means retraining the employees who are affected by the change. They will undoubtedly need help in maintaining the changes, especially if they have been working the "old" way for a while.

Top leadership will need to decide whether the changes are appropriate for other parts of the organization. A leader might ask the question, "Do we want to do some additional testing in these other areas before an across-the-board implementation? How similar are these other areas of the organization to the one where the changes were tested?"

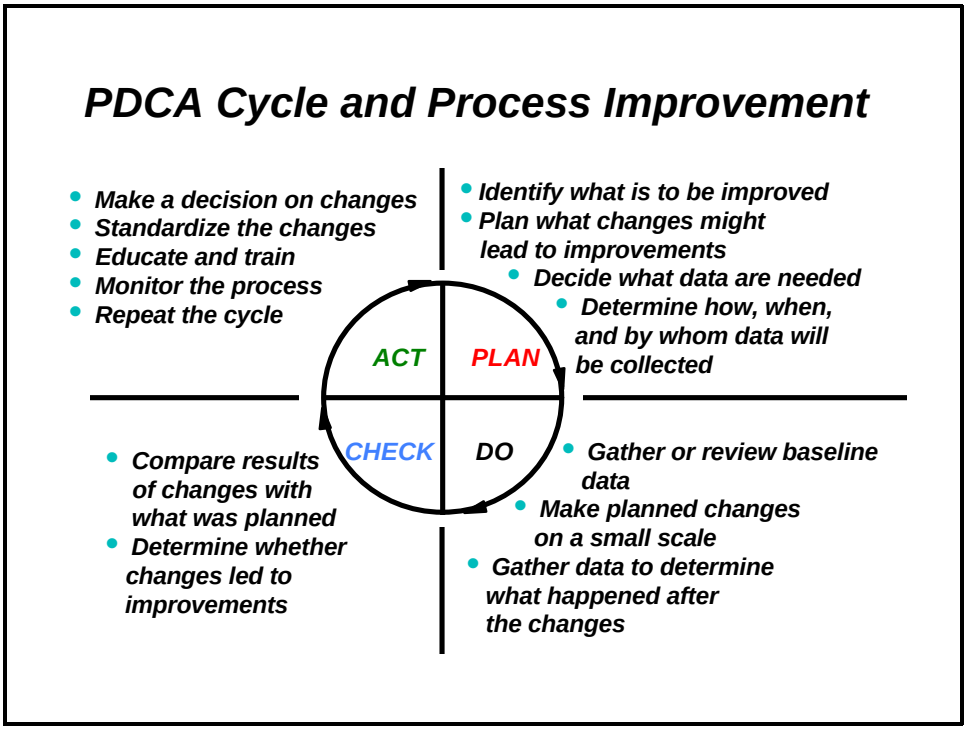
- **Monitor the process**

Unless you continue to pay attention to the formal changes in the process through some type of monitoring system, employees may revert to the earlier way of doing the work. Monitoring means continuing to collect data on the process. Further, if something starts to go wrong with the new way of operating, it may be difficult to detect unless the improved process is continually monitored. The responsibility for such monitoring rests with the process owners -- the relevant QMB. The Process Action Team (PAT) or a worker in the process might collect the process data.

- **Repeat the PDCA cycle**

☞ **Instructor Directions:** Refer to Viewgraph 9 (The Plan-Do-Check-Act Cycle), and draw the students' attention to steps 5 and 6 at the bottom of the viewgraph.

As the symbol of the circle suggests, the PDCA cycle never ends. With the new knowledge or information obtained from one turn of the cycle, we begin another turn, and continually repeat the process in a never-ending pursuit of improvement.



PDCA Cycle and Process Improvement

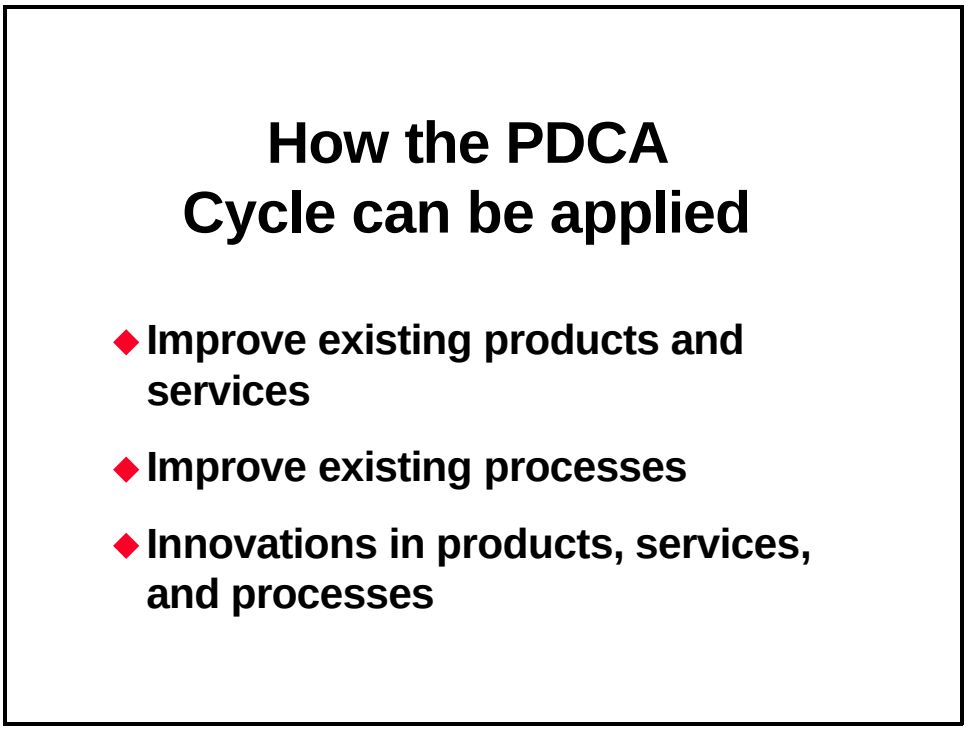
☺ **Discussion Questions:**

1. **How does the PDCA approach differ from traditional approaches to achieving quality?**

   In traditional approaches, a manager might go directly to the Act phase (no planning), or from the Plan to the Act phase, bypassing the Do (testing) and Check (evaluation) phases.

2. **What is the tradeoff between these orientations? Why not continue to use the traditional approach?**

   The traditional approach usually results in a temporary fix, at best. Problems will usually recur. More important, solutions are not considered in the context of their effect on the entire system or in terms of their immediate and long-term effects.



How the PDCA Cycle can be applied

Traditionally, we try to make improvements only when something goes wrong, or is incorrect, or is unacceptable. The **total quality perspective** is that of **continuous process improvement** . Even if our product or service is acceptable to our customers, we still try to make it better and at a lower cost. We cannot afford to rest on past successes. The quality achieved in the component parts being produced by the offshore plant (Continuous Improvement, The Batavia Incident) was a result of the continuous application of the PDCA cycle.

- **Improve existing products and services**

Using the PDCA cycle, you now have a way to assess the quality of the products and services provided. Organizations are responsible for providing customers with continually improving products and services. Diligently following the PDCA cycle with the aim of satisfying customers, will ensure that we continue to evaluate processes and improve outputs to keep pace with customer requirements.

Walton (1986) says that even a financially successful organization, one that is being run very smoothly and efficiently, can go out of business if it does not adapt and meet changing customer needs. Walton writes:

> "It is a mistake to suppose that efficient production of product and service can with certainty keep an organization solvent and ahead of competition. It is possible and in fact fairly easy for an organization to go downhill and out of business making the wrong product or offering the wrong type of service . . ." (Walton, 1986).

- **Improve existing processes**

McConnell (1988) states, "Only the process used matters. It is the process and how it is managed that is of key importance . . ." Processes must be improved to obtain and maintain improved results at a price the customer is willing to pay.

The key to long-term improvement of products and services is improvement of the existing processes. Unfortunately, we have been taught to be more results oriented with our focus on end products instead of process oriented with our focus on process improvement. The PDCA cycle allows you to assess and improve our processes, and thus, to improve our results.

- **Innovations in products, services, and processes**

Management has two sets of problems -- those of today and those of tomorrow. Problems of today concern the immediate needs of the company, such as how to maintain quality, outputs, profits, and how to solve problems as they arise. Historically, we have been very good at these activities. Our focus has been short-term. Our national motto could be, "Get the money and run!" We see this in the focus on quarterly dividends, often to the detriment of an organization's future performance. This behavior will not lead to innovation because innovation requires planning for **future** success. Planning requires a long-term commitment of funds.

This brings up the second set of problems facing management -- problems of tomorrow. How can you predict future needs? Not only does the PDCA cycle allow us to continue to improve our processes and products, it also provides us with the opportunity to develop new ones through innovation. As discussed, the PDCA cycle is a mechanism for acquiring knowledge about our processes, our products or services, and our customers' needs and wants. **Innovation comes through such knowledge** .

Customers do not always know what future products or services they will need. Innovation is based on using process and product knowledge to figure out future needs and requirements.

> A consumer can seldom say today what new product or new service would be desirable and useful to him three years from now, or a decade from now. New [products, services, and processes] are generated, not by asking the consumer, but by knowledge, imagination, innovation, risk, and trial & error . . . (Deming, 1986).

Such process knowledge promotes the development of products and services never anticipated. Did customers express the need for home movie cameras, or videotape cameras, or small, hand-held video cameras? Probably not!

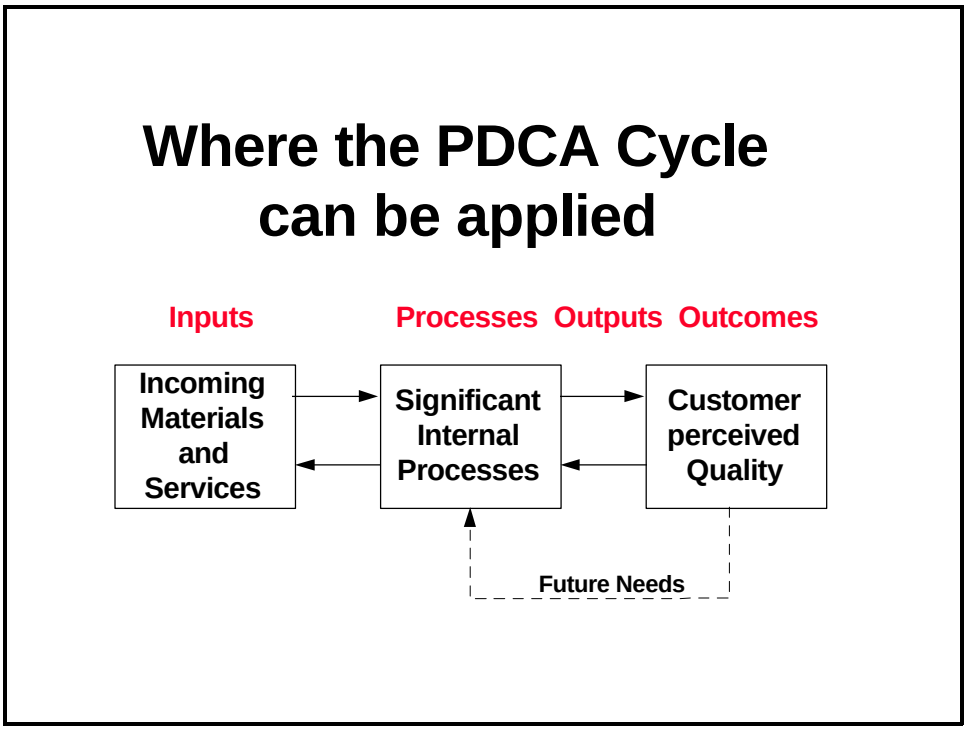
Customers may have said they want to see moving pictures in their homes, or a better way to preserve motion picture film, or they did not like lugging around a heavy video camera with battery pack. But, beyond wishful thinking, customers did not rise as a group to demand that companies develop these products. Who would have thought, even 10 years ago, that home computers would be available at such reasonable prices and become an "essential" to many households?

☺ **Discussion Questions:**

1. **What new equipment have you purchased in the past decade that was not readily available to the public before 1980? Did you envision in the early 1980s that you would own and use such equipment?**

2. **Can you think of any similar situation in the DON?**

We have been talking about the concept of **continuous process improvement** throughout this course. Sometimes it is difficult for people to understand why it is so important to break out of the "If it ain't broke, don't fix it" way of thinking. One reason is reflected in the motto of those who are convinced that continual improvement is essential to improve productivity and maintain a competitive position -- "If it isn't perfect, improve it."



Where the PDCA Cycle can be applied

Remember this diagram? It was introduced in Module 1 (DON Quality Approach) to provide a graphic definition of TQL. It portrays the systems nature of TQL and describes three essential components of TQL:

- The relationship of the organization with its suppliers (Incoming Materials and Services)
- The identification and improvement of internal processes based on customer requirements (Significant Internal Processes)
- The relationship of the organization with its customers (Customer-perceived Quality)

As stated earlier in this lesson, the purpose of the PDCA cycle is to provide a method for continual improvement. This diagram shows that an organization has four measurement points where continual improvement needs to be pursued: inputs, processes, outputs, and outcomes. The PDCA cycle can, and should, be applied at **all** these measurement points to improve the quality of materials and services received, to improve internal processes, to improve process output, and to satisfy the customer's perception of quality.

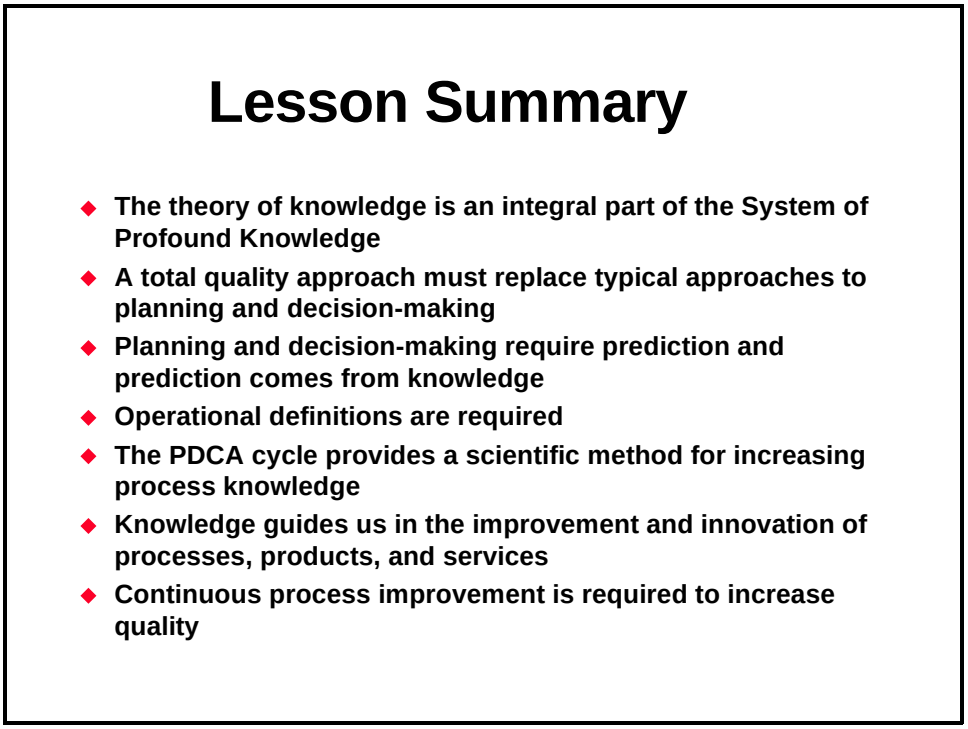
Typically, you only measure **outputs**. How many widgets did we produce without defects? How long did the customer wait for service? This information is important, but there are other measurement points that are also important from a total quality perspective.

You need to know what your customers think of what you provide them (**outcome** measures). You need to have knowledge about the quality of the materials you receive (**input** measures). And you need to know how your processes are performing (**process measures**). In each of these situations, you can effectively apply the PDCA cycle to improve your knowledge of that particular component of the process. Applying the PDCA cycle in this manner gives management the ability to predict results at each measurement point. The ability to predict improves management's ability to plan and make decisions.

★ **Additional Information:** You have an option to discuss the differences between problem-solving and process improvement. Use the chart pack to facilitate the discussion by drawing two columns. Label the left column, **Problem-Solving** and the right column, **Process Improvement.** Begin by asking the students to provide characteristics of problem-solving. Commonly heard problem-solving responses are listed below. Once the students have finished responding, ask them to provide the opposite to each given problem-solving characteristic. Commonly heard responses are listed below under Process Improvement. These lists serve only as examples of some possible combinations. Many other combinations are possible.

Some possible combinations are:

Problem Solving	**Process Improvement**
Temporary fix	Long-term solution
May increase variation	Reduces variation
Reactive	Proactive
Micro-managed	Team managed
Solve it for now	Continual improvement
Crisis management	Process management
Focus on special causes	Focus on common causes
Immediate cost is less	Costs reduced in long run
Not data driven	Data driven, Process oriented
Short-term results	Process improvement
Manager dictates	Workers' ideas encouraged
Necessary for survival	Directed at stability and capability
Product oriented	Process oriented
Wrong fix	Right fix
Process probably not defined	Process identified
Local focus	Process oriented focus
Plan/Act or Act/Act, etc.	Plan-Do-Check-Act cycle
Suboptimization	Optimization
Little picture	Big picture



Lesson Summary

- **The theory of knowledge is an integral part of the System of Profound Knowledge**

The theory of knowledge is an integral part of the System of Profound Knowledge and helps us to understand how to obtain and maintain the knowledge required to practice continual improvement. It provides a systematic instead of haphazard way of learning more about processes and how to improve them.

- **A total quality approach must replace typical approaches to planning and decision-making**

The disadvantages of traditional approaches to planning and decision-making were reviewed and compared to the advantages of adopting a total quality approach.

- **Planning and decision-making require prediction and prediction comes from knowledge**

TQL requires leaders, managers, supervisors -- all those involved in pursuing total quality -- to adopt a scientific approach in their pursuit of gaining knowledge. This knowledge helps to form theories or hypotheses to predict the effect of decisions on organizational performance.

- **Operational definitions are required**

Operational definitions must be used to provide communicable meaning -- to whatever is being addressed. Operational definitions require describing what something is and how it is measured (Scholtes, 1988).

- **The PDCA cycle provides a scientific method for increasing process knowledge**

The PDCA cycle, an adaptation of the scientific method, provides a specific methodology for gaining knowledge.

- **Knowledge guides us in the improvement and innovation of processes, products, and services**

Knowledge allows you to continually improve the organization's processes that produce our customers' products and services. Knowledge also provides a method to innovate for the future -- to design and test new processes and to develop new products and services your customers are not yet aware they will desire.

- **Continuous process improvement is required to increase quality**

The quest for quality is a never-ending task for all leaders and managers. It requires a relentless pursuit of continual improvement in products, services, and processes.