

Plan	Define	Clarify the Problem	1. Create Team & collect Information
	Measure	Break down the Problem	2. Describe the Problem
		Set a Target	3. Define Containment Actions
	Analyse	Analyze the Root Cause	4. Analyze the Root Cause
		Develop Countermeasures	5. Define possible corrective Actions
Do	Improve	See Countermeasures	6. Implement corrective Actions
Check		Evaluate Results & Processes	7. Define Actions to avoid Recurrence

## Problem Solving Methodologies EXPLAINED BY GABRIEL DANIELS PE. LEAN SIX SIGMA MASTER BLACK BELT

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Gabriel Daniels FE | [+ Follow](#)

Junior Managing Partner at Paramonos Enterprises

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### Problem Solving Methodologies

[EXPLAINED BY GABRIEL DANIELS PE. LEAN SIX SIGMA MASTER BLACK BELT](#)

PDCA, Ford's 8D, [DMAIC](#) In this lesson we are going to look at some of the common problem-solving methodologies used in quality improvement initiatives. We will address the Plan-Do-Check-Act (PDCA) methodology in detail, and briefly introduce Ford's 8D method and the [Define-Measure-Analyze-Improve-Control \(DMAIC\) methodology](#) associated with [Six Sigma](#). Quality Engineering and Quality Management© University of Wisconsin-Madison

**What is a Problem?** A problem is a perceived gap between the existing state and the desired state, or a deviation from a norm, standard, or status quo. Example: Customer expects zero defective parts to be shipped to them. If your company has a customer reject rate equal to 0.5%, you have a problem. To begin with, let us define a problem as a perceived gap between the existing state and the desired state, or a deviation from a norm, standard, or status quo. The example shows that a problem does exist. If, on the other hand, the customer had allowed up 0.6 percent defective parts to be shipped to them, there would be no



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**PDCA Methodology** In 1950, Dr. Deming drew the following diagram on the blackboard during his first meeting with the Japanese Union of Scientists and Engineers (J.U.S.E.):

**Act Plan** The Plan-Do-Check-Act or **PDCA methodology** is not a new idea. It was developed back in the 1930's by Dr. Shewhart at Bell Labs and first introduced in Japan by Dr. Deming in 1950 as the Shewhart cycle, during his first meeting with the Japanese Union of Scientists and Engineers (J.U.S.E.). The **PDCA methodology** is often shown as a circle with four quadrants, graphically representing the continuous process of on-going improvement (or Kaizen), we can use to solve problems and implement improvement goals. Once you go through the **plan-do-check-act cycle**, you're back to the plan. **Check Do** It graphically describes a systematic approach we can use to solve problems and implement improvement goals.

### PDCA Methodology C A P D What Definition of Problem

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Analysis of ProblemPlanWhyIdentification of Causes HowPlanning co  
phase of PDCA is planning, which involves defining what the problem  
causes of that problem, why did the problem occur, and how we can in  
eliminate the problem and prevent its recurrence. The Do phase involv  
implement the solution plan that was defined in the planning stage. In t  
cycle, we then check the results of our action to make sure that there is  
what we hoped to accomplish and what we actually achieved. And, finally, we act to  
standardize the changes, often by developing procedures for adherence to those changes that  
were successful. Let us now take a detailed look at each of the four phases of Plan-Do-  
Check-Act cycle, as well as the steps involved in each  
phase.DoImplementationCheckConfirmation of ResultActStandardization

### PLAN DECIDE ON THE PROBLEM

The first step in planning to decide which problem to solve. This is an important step as it will focus the team's attention on one specific problem. The first step in planning is to decide what problem to solve. This is an important step, as it will focus the team's attention on one specific problem, often one of several possible opportunities for improvement. This focus is important since not all the organization's problems can be solved at once, given the limited time resource and other resources in any organization. In deciding what problem to concentrate on, you need to consider problems which if solved, will provide the greatest benefits for your customers, both external and internal. These may be problems that generate the most waste or problems where there is a high level of confidence that a successful solution can be implemented. "The beginning is the most important part of the work" Plato

### PLAN DEFINE THE PROBLEM

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possible. A problem well stated is a problem half solved. Once you have decided what problem to work on, the next step of the Plan phase is to define the problem as precisely as possible.

### **PLAN Define the problem by identifying the following: Who What**

When (4W1H) Where How many (Use data whenever possible) Defining the problem is often done by identifying the “who,” “what,” “when,” “where,” and “how many” aspects of the problem, referred to as the 4W1H approach. Plan to ask questions such as: “Who is being affected?” “What is being affected or what are the symptoms?” “When does it appear?” “Where does it appear?” “How many products or lines are affected?” And so forth. It’s important to use data whenever possible, either numerical data or language data (such as ideas, opinions, issues based on people’s experiences)

**THREE KEY MEASURES** Throughput: The rate at which the system generates money through increased sales (not production). Inventory: The amount of money that the company has invested in purchasing things that it intends to sell. Operational Expense: The money the company spends in order to turn inventory into throughput. When selecting measures of performance, keep in mind the 3 key measurements of throughput, inventory, and operational expense. Throughput is the rate at which the manufacturing system generates money through increased sales—not through production. We’re not talking about the number of pieces produced, unless they can be turned into sales. Inventory is the amount of money that the company has invested in purchased things that it intends to sell. Operational expense represents the money the company spends in order to turn inventory into throughput.

**9 THREE KEY MEASURES** “Remember, saving time on a process that does not lower inventories or increase the throughput rate is a wasted effort.” Why focus on these 3 key measures? Well, very simply, saving time on a process that does not lower inventories or increase the throughput rate, or reduce the related operational expense, is a wasted effort.

**10 PLAN DEVELOP LIST OF POTENTIAL CAUSES** The process improvement team must now think of all the possible causes to the problem. If no one thinks of the correct one, it will be very difficult to solve the problem. Thus, generating many good ideas for potential causes is important since this greatly increases the chances of coming up with the right one. Once the problem has been defined, the next step of the process improvement team to develop a list of all the possible causes to the problem. The intention is to generate as many good ideas as potential cause as you can come up with—to make sure that you don’t miss any possibly important causes.

Use brainstorming technique used to help a group create as many ideas as possible, in as short a time as possible. A simple, non-threatening, efficient way for people to express ideas. Brainstorming is a technique often used by the team to create or generate many ideas in a short period of time. If done correctly, brainstorming provides a very simple, non-threatening and efficient way for people to express their ideas.

### **Tips for Brainstorming**





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discussion/comments during recording void forcing the member who originally offered the idea to be solely responsible for clarifying the idea never criticize ideas it quickly, minutes works well when doing brainstorming, it's important, however, that your group size not be too large. If the group is greater than 20; then break it into smaller groups, so that the group size is no larger than 8 to 12 people. First have the group do a silent brainstorm where they think of and write down as many ideas as they can. Then do a round-robin recording of the ideas. If someone doesn't have an idea to offer when it comes to their turn, they simply say "pass." When you are recording the ideas, minimize or prevent discussion or comment. After the ideas are collected and recorded, avoid forcing the person who originally offered the idea to be solely responsible for clarifying the idea. Never criticize the person, only discuss the idea in a non-threatening fashion. And, also try and do it relatively quickly. It often works well if the brainstorming exercise is no longer than 15 minutes. Remember that you are looking for fresh ideas. There will be plenty of time to expand on the ideas later.

**PLAN AGREED ON THE CAUSE(S) OF PROBLEM** Many potential causes to the problem will have been identified from the previous step. It is the team's objective to select and agree on the Root cause(s) of the problem. Eliminate guessing or hearsay; use data. Achieve team consensus as to root cause(s). Use an Interrelationship Digraph or other tools having generated many possible causes, the next step is to agree on the root cause, or causes of the problem. Once again, to eliminate guessing or hearsay, the use of data is appropriate. The intention is to achieve a team consensus as to the root cause so that everyone is convinced that this is the issue to address. Later in the course we will introduce the interrelationship digraph as an effective way to identify key issues and root causes. The cause and effect diagram, and asking why 5 times, are other simple techniques that have been often used to help identify root causes of a problem.

### Conflict Resolution Conflict Can be Healthy

Team does not mean "Mutual Admiration Society" Disagree with issues and ideas, not the person. Always leave your "opponent" an out; a way of giving up her/his idea gracefully. In discussing the various causes for the purpose of achieving consensus, it's important to remember that a team is not a mutual admiration society. It is natural and healthy for people to disagree with issues or ideas presented. Again, never criticize the person offering the idea, only discuss the idea in a non-blaming and non-threatening manner. And always leave your opponent an out—a way of giving up his or her idea gracefully. It's much harder for he or she to admit their idea is weak if doing so will make them look bad in the eyes of the other group members.

**PLAN DEVELOP SOLUTION & ACTION PLAN** Given a good understanding of the problem and the Root cause(s), the team now develops a solution to the problem and a formal action plan. Use the following criteria to develop the appropriate solution: Customer satisfaction, Cost, Time. East of implementation the next steps of the planning phase is to develop the solution and action plan. Now that you have a good understanding of the problem and the root causes of the problem, the team can move forward to develop a solution to the problem as well as a formal action plan defining who's going to do what and when. In selecting the best solution, the team may look at key issues such as customers



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implementation.

**PLAN Review solutions and estimate costs vs. benefits.**

Sketch “solutions” to generate discussion & new ideas  
 Estimate time savings if the solution was implemented  
 Estimate time to achieve end result  
 Review your solution and compare the estimated costs versus the benefits. This will involve estimating the time savings if the solution was implemented, estimating ballpark costs and the likelihood of success, and estimating the time to achieve the end result. We will discuss project planning and management techniques, as well as the human side of change management later in the course.

**Define Measures to “Keep Score”**

Target  
 Now  
 Criterion  
 Time  
 Planned Result  
 The final point I want to mention in the planning stage goes back to the idea of key measures or being able to keep score of the progress you’re making as you move forward in implementing your action plan. It’s important that you identify some criteria or statistics of importance that you can use to track your success and keep score. Part of the plan is to achieve an intended result within a given period of time. That is your objective—being able to measure your progress is of critical importance. Can you tell me about any sport where they do not keep score? Imagine going to a basketball game and watching 10 people run up and down the floor without keeping score. It wouldn’t be the same. Keeping score is important in process improvement activities as well.

**DO IMPLEMENT SELECTED SOLUTION(S) EXACTLY AS PLANNED**

Provide training if necessary  
 new methods?  
 New procedures?  
 Monitor the implementation  
 The second phase of the PDCA cycle is the DO—to implement the selected solution or solutions exactly as planned. This phase may involve providing training if there are new methods, procedures, or equipment involved. It is also important that you

participate in monitoring the implementation of the DO stage to ensure that it is put in place according to the plan that was defined.

**PILOT RUN** On large projects, it is often a good idea to make a Pilot run before making any major changes. A Pilot run is a small trial run that will show how effective the solution will be, and what problems may still be unsolved. On certain large projects, it’s often a good idea to make a pilot run before making any major changes. The pilot run is one way to see how effective the solution will be and what problems may be unsolved before venturing across an organization. Very simply, a pilot run allows an opportunity for learning by doing. Learn by doing...

**CHECK MONITOR AND CONFIRM RESULTS FROM IMPLEMENTING THE SOLUTION(S) ?**  
**Planned** = Actual  
 Results ? Results  
 Monitor the process to determine the effectiveness of the changes: Have improvements been made? Are the improvements permanent or temporary? Have other problems been created?  
 The third phase of PDCA is CHECK—to monitor and confirm the results from implementing the solution. This phase





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have been made, and ascertaining how effective and lasting they are.

### **CHECK If the implemented solution does not solve the problem, then:**

Apply first aid for the reason/root cause of the underlying problem return to PLAN if checking shows that your solution did not solve the problem, then it may be necessary to apply first aid. You may have made the problem worse. If so, then to go back to the planning stage to look for the real reason your planned solution was not successful and determine what needs to be done to make it successful.

### **Use Data to Check Target Now Criterion Time Planned Result**

Once again, having data to objectively check the effectiveness of your solution is an important part of this process.

### **ACT This phase involve steps:**

to take action to standardize the process change to make sure that the problem stays corrected, and to record your findings so that the data is available if similar problems occur in the future. The last phase of PDCA is ACT. The problem-solving effort doesn't end after you've found, implemented and checked the solution. The last steps are to standardize the new process and/or procedures to make sure that the problem stays corrected and to record your findings so that the data are available if similar problems should occur requiring similar solutions in the future.

### **ACT REFLECTION AND ACKNOWLEDGEMENT Reflect on:**

What was the problem? What alternatives were considered? What solution was implemented? What results were obtained? How could this solution be improved? What was learned? Provide feedback "report" to gain acknowledgment and recognition. Another part of the ACT phase is reflection and acknowledgment. Reflection involves reviewing what the problem was, what the team went through as a process to come up with a solution, and how successful it was—it's a very important step to take in terms of a learning organization. Some companies call this process the post-mortem or lessons learned review since it's done essentially at the end of the project. Acknowledgment involves providing the feedback report to gain recognition for the team members who contributed their energies and talents to bring about an improvement in the organization. Giving credit where credit is due.

Advantages of PDCA Defines a systematic, simple, yet effective way to solve problems and achieve process improvement. Focuses on defining and solving the root cause(s) of a problem, instead of attempting to correct symptoms. Prevents devising unnecessarily costly solutions. Develops a standardized procedure for the improved process. The advantages of the PDCA approach we have addressed here are numerous. It provides a systematic, simple and effective way to solve problems and achieve process improvement. It's easily understood. And it focuses on defining and solving the root causes of problems—not simply attempting to correct symptoms. Also in looking at cost and benefit issues, it helps prevent devising unnecessarily costly solutions or those that will not be accepted by the customer and the



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phase of ACT.

### Problems in Implementing PDCA

Effective application of PDCA in many U.S. companies has been limited by several major factors: The planning and evaluation functions have been separated from the doers. Planning has often been relegated to the “seat of the pants” approach. There is the common perception “that doers are recognized and rewarded while planners just plan.” Unfortunately, the effective application of PDCA in many US companies has been limited by several factors. Since the days of Frederick Taylor, the planning and evaluation functions in organizations have often been separated from the Doers. Planning has been relegated to the seat of the pants approach in many cases. It’s not been viewed as being where the action is. There is a common perception, that doers are recognized and rewarded, while planners just plan.

### Problems in Implementing PDCA

There has been a lack of available tools that make the job of planning simple and timely. Many people feel that they don’t have time to plan or follow such a structured approach as the PDCA cycle. The PDCA cycle calls for accountability and measurement--two elements that many people try to avoid. There has also been a lack of available tools to make the job of planning simple, timely and effective. Later in the course, we will introduce the Seven New Management and Planning Tools, which are intended to provide every engineer or engineering manager with the tools needed to make planning a more effective and satisfying process. Many people feel they don’t have the time to plan or to follow such a structured approach as the PDCA cycle. Also, the PDCA cycle calls for accountability and measurement; two elements that many people try to avoid.

### Ford’s 8-D Problem Solving Methodology

1. Establish the team
2. Describe the Problem
3. Develop Interim Containment Action
4. Define and Verify Root Cause
5. Choose and Verify Permanent Corrective Action(s) [PCA]
6. Implement and Validate PCA
7. Prevent recurrence
8. Recognize Team and Individual Contributions

PDCA is only one of several problem solving methodologies. Ford’s 8-D methodology is another based on the 8 steps shown here. Although all the methodologies have some common themes and activities, the 8-D approach formally calls for the establishment of a team in step 1, and recognizing team and individual contributions in step 8, something that typically happens in PDCA, but is not specially called out. Likewise, the development of an interim containment action in step 3 is particularly specific to the 8-D approach. It’s useful to recognize that the 8-D approach is particularly appropriate when dealing with product or part problems, where containment is often an important step. By contrast, PDCA is particularly appropriate when dealing with process or system problems or improvement. What other differences do you see?

### Six Sigma Problem Solving Methodology



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Measure, Analyze, Improve, Control, Standardize, and Integrate. It is associated with Six Sigma. Since individual teams typically only do steps 2 through 6, it has become widely known as the DMAIC approach or methodology. We will discuss this six sigma approach in greater detail in one of our classes. This is the end of the lesson on problem solving methodologies. Thank you.

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