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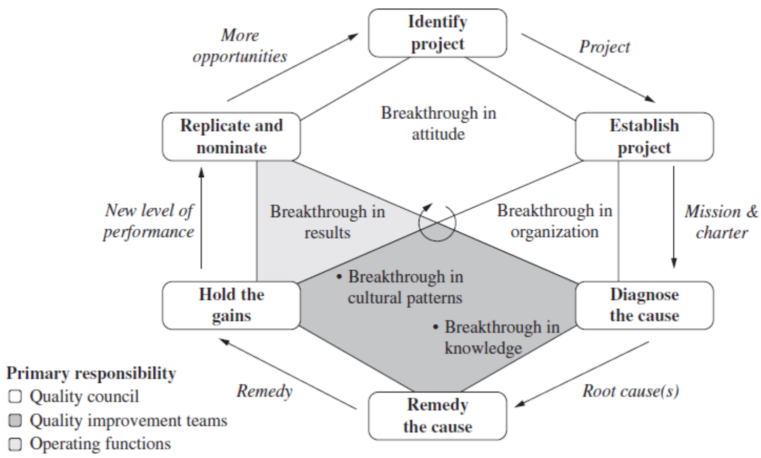
Authors: Joseph A. De Feo

16.3. Juran's RCCA

Juran's four-step process for RCCA is an outgrowth of the work of Dr. J. M. Juran in which he described the universal process for quality improvement, shown in Fig. 16.2. This universal, as Dr. Juran stated in earlier chapters is the third universal of "control—the process for preventing adverse change." To ensure that all processes are in a state of control requires three basic elements:

1. The means to know the actual performance of the process
2. The ability to compare the actual performance to the targets or quality goals
3. The means to act on the difference to maintain control

Figure 16.2 The six major steps of problem solving.



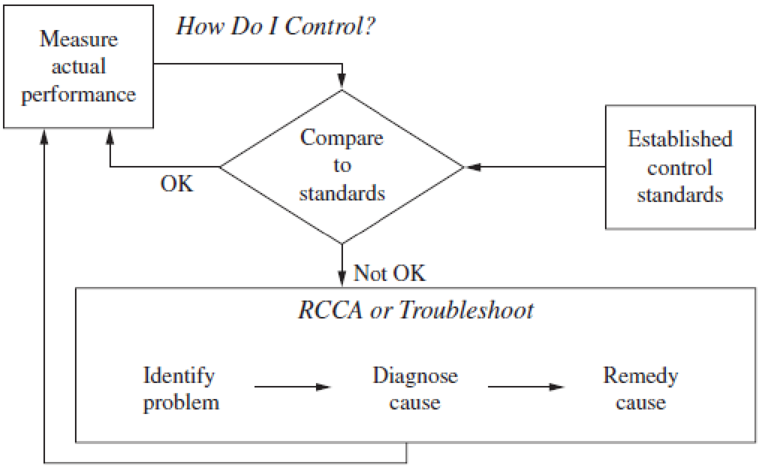
The third step requires a means and a method to determine what correct action should be taken. There have been many versions to act on the difference for centuries. Walter Shewhart coined the term PDCA (Plan, Do, Check, Act) as a means to set up the control functions. Practitioners of PDCA still need to know how to perform the action. While there are many tools to aid in root cause analysis, a simple method is needed to solve daily, sporadic, small-scope problems.

The Juran RCCA method described here is a simplification of the universal process for improvement described by Dr. Juran, and consists of four steps:

1. *Define*. Identify a change in performance.
2. *Analyze.* Diagnose the cause.
3. *Improve*. Remedy the cause.
4. *Control.* Hold the gains.

"Quality control can be defined as the maintenance or restoration of the operating status quo as measured by [meeting] the acceptable level of defects and provision of customer needs" (Monroe, 2009). The mechanism of controlling quality is depicted in Fig. 16.3. The troubleshooting portion of the control feedback loop is where RCCA is needed. When a measurement of a control subject is outside the established standard of acceptability, some means for identifying the cause is needed. Once the root cause or causes are identified, a remedy must be put in place that will eliminate them. After the cause is eliminated, the control feedback loop continues to monitor the process so the cause and problem do not recur.

Figure 16.3 The control feedback loop.



The four-step RCCA approach described above has several sub steps that must be undertaken to effectively diagnose and remedy the cause:

1. Define the problem
   - Identify frequency of the problem: sporadic or chronic (if the latter, apply breakthrough methods)
   - Establish responsibility to solve it, if it is not already established in a control plan
   - Prepare a problem statement
2. Analyze and diagnose the cause
   - Analyze symptoms
   - Formulate theories
   - Test theories
   - Identify root cause(s)
3. Improve and remedy the cause
   - Design and implement the remedy
4. Control to hold the gains
   - Adjust controls

Each of the steps and sub steps of Juran's RCCA approach is discussed in more detail in the following sections.

16.3.1. The Medical Analogy

The Juran RCCA approach is analogous to the approach a physician takes in treating an ill patient. First, the doctor will want to understand what is wrong: What's the problem? Without a clear understanding of the problem, it will be impossible to solve.

Next, the doctor will want to know more about the outward evidence that the problem exists: the symptoms. He might take the patient's temperature, ask what kind of discomfort the patient is experiencing, look into the patient's throat and ears, and so on.

Based on the observed symptoms, the doctor will formulate tentative diagnoses—theories about what could be causing the patient's illness. At this point the doctor is still unsure what the true cause of the illness is, so he will order tests to determine which of his tentative diagnoses is true. Perhaps blood will be drawn from the patient for analysis; perhaps the patient will be given an MRI exam or other diagnostic tests.

Once the data about the possible causes of the illness have been gathered, the doctor is ready to settle on a final diagnosis based on the facts. Now, hopefully, the true root cause of the patient's illness is known and the doctor can apply an appropriate remedy. Perhaps the patient will be given medication, prescribed physical therapy, recommended to make certain lifestyle changes—whatever the appropriate remedy is to alleviate the proven cause of the illness.

Finally, the doctor might say, "Come back and see me in two weeks." This is the activity of holding the gains intended to ensure that the patient is continuing with the prescribed regimen and the remedy is effective: the patient is getting better.

16.3.2. Elements of Effective RCCA

These are the necessary elements for effective root cause corrective action:

- *A problem*. A problem is outward evidence that something is wrong and warrants a solution, for example, a visible performance deficiency in the output of an important design, manufacturing, service, or business processes. Time and resources are needed to analyze and solve problems.
- *Data and information*. We cannot solve the problem until we have the hard facts that prove what the root cause is. Without data, we are merely guessing at the causes of the problem, and our efforts to solve it will be hampered by our lack of knowledge. More importantly, we will create doubt and greater risk will be introduced into our system.
- *Tools*. When a problem arises, there are many questions that need answers. Those answers will come from data found within our processes. At times, we are often faced with a great deal of data, but little information or facts. We can use tools to help us organize and understand the data. They are invaluable aids to effective root cause analysis.
- *Structure*. A logical and structured approach is needed to guide the RCCA process. This structure becomes the "guide or boss," not the people trying to solve the problem. At a minimum, this structure needs to use and involve multiple functions to discover root causes. This structure will allow us to "torture the data until it confesses." Data contains information. We need a means to extract it.

An almost unlimited number of tools are available to the problem-solving team, but those most often used for basic RCCA are:

- *Affinity method and brainstorming*. Brainstorming is a quality tool intended to stimulate creativity. It is useful because it helps the team consider a full range of theories about possible causes. The affinity process helps organize those theories.
- *Cause and effect diagrams*. An effective way to organize and display the various theories of potential causes of a problem.
- *Data collection*. These methods are used to gather information about a quality problem. A typical data collection form is arranged for easy use and includes clear instructions.

- *Failure mode and effects analysis (FMEA).* This is a structured methodology for identifying potential failure modes in a process or design and assessing the risk associated with the failures. It helps identify the most likely possible causes and helps design a more robust remedy.
- *Graphs and charts.* These are pictorial representations of quantitative data. They can summarize large amounts of information in a small area and communicate complex situations concisely and clearly.
- *Histograms.* These are graphic summaries of variation in a set of data. The pictorial nature of the histogram enables us to see patterns that are difficult to see in a simple table of numbers.
- *Box plots.* Like histograms, box plots provide a graphic summary of the pattern of variation in a set of data. The box plot is especially useful when working with small sets of data or when comparing many different distributions.
- *Juran's Pareto analysis.* This is a ranked comparison of factors related to a quality problem. It helps identify and focus on the vital few factors.
- *Process control plans.* These plans summarize the plan of action for a process out of control. Their purpose is to document the actions necessary to bring the process back into control and assist the process owners in holding the gains achieved by the problem solving.
- *Scatter diagram.* This is a graphic presentation of the relationship between two variables. In root cause corrective action, scatter diagrams are usually used to explore cause-effect relationships in the diagnostic journey.
- *Stratification.* It is the separation of data into categories. Its most frequent use is during the diagnostic journey to identify which categories contribute the most to the problem being solved.

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16.4. Phase 1: Define and Identify the Problem

It has been said that a problem well defined is half solved. The clear identification and definition of problems to be addressed in the RCCA project is an early key to success. In practice, a well-constructed control plan with effective feedback loops will identify problems to be addressed by RCCA nearly in real time. For further discussion of control activities, see the section "Phase 4: Control to Hold the Gains."

16.4.1. Select the Problem

Select the problem to be addressed. Once the data and information about potential problems to address have been gathered, tools must be applied to select the most important problems to address. Data collection and Juran's Pareto analysis are most often used to identify the vital few problems to address.

Once the problem for action has been selected, the nature of the problem must be stated clearly and concisely. A good problem statement should have the following characteristics, summarized by the acronym MOMS:

- *Measureable*. The problem must be stated in terms that can be measured, either by using an existing measurement system or creating a new one. Although the problem may not have been measured to date, the problem-solving team must be able to conceptualize how it could be measured in quantifiable terms.
- *Observable*. The problem must be seen and evidenced by its symptoms. Symptoms are the outward evidence that the problem exists.
- *Manageable*. The problem statement must be narrow enough in scope that the team can solve it with a reasonable application of resources over a reasonable period of time. "Boil the ocean" projects should be avoided.
- *Specific*. The problem statement should focus on specific products, services, or information; specific parts of the organization; or specific aspects of a larger problem.

In addition to the MOMS guidelines, problem statements should never include implications of a cause, blame for the problem occurring, or suggested solutions.

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16.5. Is the Problem Sporadic or Chronic in Nature?

This is a fork in the road. If the problem involves a process that has gone out of control—for example, a fire has erupted and is burning—apply the RCCA process and tools discussed in this chapter to restore process control. If the problem is one that has been around for a while (chronic) and plaguing the operation with higher-than-tolerable COPQ, consider using the more sophisticated breakthrough improvement methods described in **Chap. 14**, Lean Techniques and the Shingo Prize and **Chap. 15**, Six Sigma Breakthrough to in-Process Effectiveness.

Tools most often used at this step are data collection and Juran's Pareto analysis.

16.5.1. Prepare a Goal Statement

Typically, the goal statement for an RCCA project is simple: eliminate the root cause or causes of the problem and restore control. In some cases, complete elimination may not be possible or practical; then the goal should be to reduce the impact of the causes so that the undesirable effects are minimized. In this case, the goal may be stated in terms of a percentage improvement, reduction in defect levels, etc.

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16.6. Phase 2: Analyze and Diagnose the Cause

16.6.1. Analyze Symptoms

Analysis of symptoms is an important step in finding the root cause of the problem because this activity enables us to understand the current situation. How often is the problem occurring? How severe is it? What types of failures contribute most to the problem being analyzed? At what point in the process is the failure most often observed? These types of questions about the current situation must be answered to help us better understand where the root cause(s) may lie.

Think of it this way: If you were asked what route to take if driving to Cleveland, what would your response be? Typically, people will respond from their own frame of reference: "Well, go to route 224 east, and then take I-77 north …" This misses an important point, however; the question didn't specify a starting point. Depending where one starts their journey to Cleveland, the route to get there will be entirely different. The point is that unless you know where you are starting from (the symptoms of the problem), it is difficult to map a route to where you want to be (achievement of the goal). This is why it is so important to do a thorough analysis of symptoms as a first step in diagnosing the cause. This analysis will be of great help when the team gets to the point of brainstorming possible causes and will result in a more thorough list of possible causes than would otherwise be achieved.

Tools that are often used at this step are data collection, process flow diagrams, Juran's Pareto analysis, and stratification.

16.6.2. Formulate Theories

A theory is simply an unproven statement of the cause of a certain condition. A student receiving a poor grade on an exam may tell his or her parents that the cause is that the teacher included material on the exam that was not discussed in class, but the parents may consider this only a theory. The parents may consider a number of other theories as well, such as the student did not read required chapters that explained the material or the student did not attend class every day. In the same way, when determining the cause of a quality problem, there must be speculation about its many possible causes. Jumping to conclusions before considering many theories and proving which one is correct could mean wasting time and resources on an inappropriate solution.

The formulation of theories follows a thought process moving from creative to empirical, divergent to convergent. Beginning with brainstorming, the team and any subject matter experts will attempt to identify as many causes as possible. Next, the team will organize these brainstormed theories into logical groups, probably using the affinity process. Finally, the group will begin to hone in on the most likely root causes by using cause and effect diagramming, FMEA, and possibly other prioritization tools.

These most likely theories of causes are the input for the next step of the diagnostic journey.

16.6.3. Prove Theories to Identify Root Cause(s)

"Before beginning to test theories, the team should be very clear on exactly which theories are being tested. A copy of the cause-effect diagram is an excellent guide for the team at this point. Diagram the theories that will be tested with a particular set of data. If the data demonstrate that a theory is not important, that theory can be crossed off as a possible cause. The cause-effect diagram also helps identify related theories that can be tested together. When the theories to be tested are stated clearly and precisely as they are understood, it is time to plan for collecting data to test them" (Juran Institute, Inc., 2008).

Assessing data that have been collected to answer questions regarding the truth or falsity of a given theory tests theories. The theory is assumed to be false unless the data indicate it to be otherwise. Once the data have been collected, appropriate analysis tools must be applied to convert the data into information. Information then becomes the answer to the question. This process is sometimes referred to as "torturing the data until it confesses."

The project team should recognize that rarely does the answer to one question constitute the end of the exploration. Testing of theories is typically an iterative process. The answer to one question leads to another question, and another, and another. Each time an answer is discovered, the team should ask again, why? Why does the analysis look the way it does? Why is the upper level (not root) cause we have proven occurring? When the "why" questions reach a level that has no more answers or goes beyond a level of cause that can be controlled, the team has arrived at the (operationally defined) root cause.

As an example, take the case of a problem the National Park Service experienced several years ago concerning the Jefferson Memorial[1]. The stone in the monument was crumbling due to frequent washing to remove bird droppings. The initial (mistaken) approach the Park Service took was to reduce by half the number of times the stone was cleaned. This saved some money and reduced the magnitude of the stone erosion, but it's easy to see how the "solution" led to other problems. People visiting the monument were dissatisfied with the unclean conditions.

So the Park Service undertook a more thorough analysis to find the root cause of the problem. They first asked, "Why are there so many bird droppings?" Of course, they considered several theories to answer the question. Perhaps the birds were attracted to food dropped by visitors. Perhaps they were attracted to the good roosting places in the structure. Perhaps there was an abundant natural food supply. Could they immediately determine which of these theories was true? Of course not, it was necessary that they visit the place where the problem was taking place (what the Japanese call the "gemba"), collect data about the possible causes, and identify the true cause of the proliferation of birds in the monument. It turned out that the third theory was true; hundreds of fat spiders were providing an ample food source for the birds. But was the investigation complete? No, it was not because the investigators had not yet reached the root cause of the problem.

The next question to be answered was, "Why are there so many spiders?" A number of theories could have been forwarded about this question too:

- The crevices in the monument provide a good place to spin webs.
- There are insects there that provide food for the spiders.
- The spiders are attracted to and hide in the shadows inside the monument.

Further data-gathering proved that the second theory was true. Inside the Jefferson Memorial were thousands of tiny midges (a small flying insect that spiders eat). The investigators were nearing the root cause of the problem, but were not there yet.

"Why are there so many midges?" they asked. Possible answers included:

- Midges were attracted to a food supply inside the monument.
- The Jefferson Memorial, like many others in Washington, D.C., is near a body of water (the Potomac River), and the midges lay their eggs in the water.
- The midges are attracted to the lights that illuminate the memorial at night.

The second theory actually did explain why so many midges were in the vicinity of the monument, but not why they were on and inside it. Investigation revealed that the midges came out at sunset each evening in a "mating frenzy" at just the time that the lights were turned on. They were attracted to the illumination of the monument and took up residence where the spiders could feast on them. Now the investigators had found the true root cause of the problem: illuminating the monument each night at dusk. They delayed the lighting by 1 hour (the remedy), the midge population was dramatically reduced, and the food chain was broken. Now the Park Service could substantially reduce the washings and, therefore, the crumbling of the stone (the original problem). This application of the remedy to the true root cause resulted in many multiples of savings compared to the original solution of just reducing the washings. The solution was also one that could be replicated to other D.C. monuments to reap additional savings (The Juran Quality Minute: Jefferson Memorial).

One may ask, "How will I know when to stop asking 'Why?'" In other words, when have the investigators drilled down deeply enough to conclude they are at the level of the root cause?

There are two questions that will help you decide whether you have found the root cause:

1. Do the data suggest any other possible causes? After each data collection and analysis, it is usually possible to discard some theories and place more confidence in others. Theorizing is not a one-time activity, however. Each data display—the Pareto diagram, histogram, scatter diagram, or other chart—should always be examined by asking whether it suggests additional theories. If you have competing plausible theories that are consistent with the new data and cannot be discarded based on other data, then you have not arrived yet at the root cause.
2. Is the proposed root cause controllable in some way? Some causes are beyond our ability to control, like the weather. Turning up the heat or running a humidifier can control the effects of the weather, but the weather cannot be controlled directly. So no useful purpose is served by testing theories about why the weather is cold.

Tools most often used during the steps of formulating and testing theories are data collection, flow diagrams, graphs and charts, histograms, Juran's Pareto analysis, scatter diagrams, and stratification.

These steps of formulating and testing theories complete the diagnosis of the problem's root cause. Some may ask, why should I go to all that trouble just to find the root cause of the problem? Why is it important? Denise Robitaille (2009), an ASQ fellow and leading expert in root cause analysis provides useful answers in an article entitled "Four Things You Should Get from Root Cause Analysis." Emphasis on effective root cause analysis has gotten increased attention in several sectors. Registrars, for example, are requiring more substantial evidence of root cause analysis as part of responses to their requests for corrective action. All of this is good news. Except, my personal experience is that although people understand that they're required to do root cause analysis, they don't comprehend three issues:

1. What is root cause analysis?
2. How to conduct effective root cause analysis?
3. What the results of root cause analysis should yield?

Let's start by reviewing what root cause analysis is. It's an in-depth investigation into the cause of an identified problem. It asks why something happened. It should also investigate how something could have gone wrong, which will help to identify contributing factors and interim breakdowns.

There are two important things to remember at the outset. Root cause analysis is focused on cause, and the ultimate intent is to use the information to develop a corrective action plan. This perception is relevant to the next two issues people need to know.

People don't know how to do root cause analysis. They still treat it like it's a haphazard activity. Organizations fail to train individuals in good investigative techniques. They perpetuate a culture of blame: "Let's find out who screwed up." They simply don't treat root cause analysis like a controlled process.

Apart from the five whys there are many other tools that can be used. There are flowcharts, brainstorming, fish bone diagrams, Pareto charts, and design of experiment—just to name a few. Several tools should be used in concert to achieve the most productive results. For example, use brainstorming or the five whys to conjecture what could have gone wrong, then organize the results in a fish bone diagram that will direct you to the areas where you'll find the evidence you need to objectively conclude what the root cause of the problem really is. Organizations have to stop assigning people to do root cause analysis without giving them the necessary training and tools.

Finally, individuals need to understand what the expected outcome of this process is. It's great to say that we're going to conduct root cause analysis, but do people have any idea what they're supposed to do when they figure out the cause?

You should be able to get four things from root cause analysis:

1. Uncover the root cause or causes of the problem. Finding the root cause is the primary output of this process.
2. Identify weaknesses or other contributing factors, which, in and of themselves, are not necessarily nonconformance. They may be the outcome of shortsighted decisions to curtail activities so that efficiency or cost savings is perceived. You may have, for example, decided to wait until the first point of use to test components. The time-savings experienced at the receiving process could result in costly delays and scheduling snafus that dwarf any savings that had been anticipated. It wasn't a bad idea at the time, but it may have contributed to late deliveries.
3. Better understand the process surrounding the problem, as well as supporting processes. If you don't, you haven't done a thorough root cause analysis. Without that heightened comprehension of the process, you can't understand interrelations, interdependencies, or other factors that are reliant on the outcome of seemingly unrelated processes. This takes us to the final outcome.
4. Create an architecture into which you can build your corrective action plan. Corrective action isn't just one activity. It needs to be a plan, reflective of all aspects of the problem. If you've done a good root cause analysis, you'll have identified not only the root cause, but the many different factors that need to be addressed to ensure that the problem doesn't recur, that you don't inadvertently create a new problem, and that your organization experiences some benefit from the action taken.

Your root cause analysis will let you see what processes may need to be modified, what documents and forms will have to be revised, who will require training, and a myriad of other considerations that go into a typical project plan.

Without root cause analysis, effective corrective action is impossible. Without corrective action, root cause analysis is a waste of time.

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[1] Paraphrased from Juran Institute, Inc. "The Quality Minutes: The Jefferson Memorial."

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16.7. Phase 3: Improve or Remedy the Cause

Now that the project team has discovered the root cause(s) of the problem, the task is to restore control to the process. Applying appropriate remedies that will directly affect the cause and eliminate it, or at least drastically reduce its undesirable effects does this.

16.7.1. Evaluate Alternative Solutions

Like the formulate theories step, this step moves from creative to empirical, divergent to convergent thinking. Beginning with brainstorming, the team, subject matter experts, and process owners will attempt to identify as many alternatives for solutions as possible. Creativity is essential at this point, as often, solutions must be quite novel to fully address the root cause. Next, the team will evaluate these brainstormed potential solutions to determine which solution or combination of solutions will best address and eliminate the cause(s).

The team may construct flow diagrams of possible solution implementations to visualize which will act most effectively. They may also use a criteria-based selection matrix to assist their decision-making process and help them arrive at the best solutions (Fig. 16.4). The solution selection matrix can help the team optimize the ultimate solution by combining the best potential solutions from the matrix.

Figure 16.4 Solution selection matrix.

Solution Selection Matrix
Rank possible solutions 1–10. 10 = fully meets criteria

Updated: 10/12/09

		Possible solutions					
Criteria	**Weight**	**A**	**B**	**C**	**D**	**E**	**F**
Low cost	3	9	8	10	7	9	7
High effectiveness	2	8	10	9	10	9	9
Low risk	2	8	8	7	9	9	7
Low resistance	1	9	8	5	8	9	10
Minimal process disruption	2	6	7	7	6	8	7
	Total score	80	82	81	79	88	77

Tools most often used in this step are brainstorming, data collection, selection matrices, and flow diagrams.

16.7.2. Design and Implement the Remedy

Once the team selects a remedy, it designs the remedy by performing four tasks:

1. Ensure that the remedy achieves the project goals. Review project goals to verify that the remedy will achieve the desired results and that all involved are in agreement on this point. This is a final check before moving ahead.
2. Determine the required resources. Make every effort to determine, as accurately as possible; what resources are required to implement the proposed remedy. These resources include people, money, time, and materials.
3. Specify the procedures and other changes required. Before implementing the remedy, describe explicitly what procedures will be required to adopt the proposed remedy. Any changes that need to be made to existing organizational policies, procedures, systems, work patterns, reporting relationships, and other critical operations must also be described. Any surprises down the line may sabotage the remedy.
4. Assess human resource requirements. The success of any remedy depends on the people who will implement the required changes. Often, it will be necessary to train or retrain staff. Explore fully all training requirements, as well as the training resources needed.

Once these tasks have been performed, a flow diagram can be created to help specify the new procedures clearly.

As the team is designing the remedy, they should take into account the need to mistake-proof the remedy. They should consider and develop a variety of techniques to avoid, prevent, or reduce inadvertent errors that may occur even with the improved process.

The final action of this step is to implement the remedy. Depending on the complexity of the problem being addressed and the solutions to be implemented, a formal implementation plan may be needed. At a minimum, procedures, process standards, or work instructions will need to be modified to institutionalize the change.

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16.8. Phase 4: Control to Hold the Gains

This phase is the most important one in the RCCA process for ensuring that the problem does not recur or, if it does, that the recurrence is recognized and remedied quickly. If a recurrence is recognized, it should be an indication to the project team that their job is not finished—they've missed a root cause during the course of their problem solving or designed and implemented an ineffective remedy.

If the problem solving has been done methodically, as described here, and a broad range of possible causes and remedies were considered during the formulate theories and evaluate alternatives steps, the remedy should be robust and the cause and problem should not recur. The controls put in place to hold the gains will indicate whether this is so.

16.8.1. Redesign Controls

The primary activity in designing controls is the development of a control plan. Hopefully, an effective control plan for the process in question is already in place and will only require modification to add control subjects related to the problem's solution.

The first step in building an effective control plan is selecting appropriate control subjects. Control subjects are those features of the product or process that will be measured to determine whether the process is remaining in control. Each control subject's performance is monitored using the feedback loop described in Fig. 16.3. A control plan matrix is used to keep track of the function of the feedback loop and to plan for action if the process or product does not meet standards. An important purpose of the process control matrix is to alert the process operator when the process is out of control and what to do to get it back under control.

In this matrix (Fig. 16.5), the horizontal rows describe the control elements for each subject. The vertical column headings indicate each element of the control activity:

- *Control subject*. Those features of the product or process that will be measured to determine whether the process is remaining in control.
- *Subject goal or standard*. The acceptable limits of performance for the product or process. Often, these are control limits on an SPC chart and are the primary basis for determining if the process is stable or out of control.
- *Unit of measure*. How will the measurement be stated? Inches? Millimeters? Percent defective?
- *Sensor*. What device, person, or combination of the two will be used to obtain the measurement?
- *Frequency of measurement*. How often will the control subject be measured (e.g., hourly, daily, weekly, etc.)?
- *Sample size*. How many measurements will be taken at the stated frequency?
- *Where are measurements recorded* (logbook, chart, database, etc.)?
- *Measured by whom*. Who is responsible for applying the sensor to the control subject and obtaining and recording the measurements?
- *Criteria for taking action*. This generally includes whatever process performance is outside the subject goal or standard. This variation is usually due to special causes and would prompt the troubleshooting part of the feedback loop.
- *What actions to take*. Knowing the cause of the out-of-control condition helps the assigned person take the appropriate action to bring the process back into conformance with the subject goal.
- *Who decides*. Who will make the call on the action to be taken?
- *Who acts*. Specific action(s) to be taken by the actor on the control subject to bring the process back into conformance with the subject goal.
- *Where action recorded*. Identifies where the actions taken to resolve the issue will be recorded. This recording is useful for analysis of similar problems in the future.

***Figure 16.5** Control plan matrix.*

Process control plan for:						Date:		Revision level:		Approved by:		
Control subject	Subject goal (standard)	Unit of measure	Sensor	Frequency of measurement	Sample size	Where measurement recorded	Measured by whom	Criteria for taking action	What actions to take	Who decides	Who acts	Where action recorded

16.8.2. Implement Controls

Once a suitable control plan has been designed, implementation is a matter of training process owners and operators in its use. If SPC is a part of the plan, specific training on the proper use, interpretation of, and appropriate response to control charts must be included. The process owners also become the owners of the control plan, so their involvement in its implementation is essential.

16.8.3. Audit Controls

For a short time after the controls are in place, the project team, in conjunction with the process owners and operators, should monitor their effectiveness. This will provide the opportunity to recognize any ineffective elements of the plan and modify accordingly.

By following the above four-phase approach to RCCA, project teams should consistently identify the root cause(s) and apply appropriate remedies in a relatively short time. During the time that it takes to identify and alleviate the causes, an interim action may be needed to ensure that defective products, services, or information do not reach the customer. These actions are sometimes referred to as containment. They should be designed to be effective and temporary until the root cause of the problem can be determined and alleviated.

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16.9. Plan-Do-Study-Act

Plan-do-study-act (PDSA) is another problem-solving approach many use to find and address root causes of problems. The method was originally proposed by Dr. Walter Shewhart (as PDCA, plan-do-check-act) in his book *Economic Control of Quality of Manufactured Product* (1931) and later espoused by W. Edwards Deming. Deming referred to the method as the Shewhart cycle, but many, particularly after Deming achieved fame, refer to it as the Deming cycle.

The method differs from the root cause analysis method described previously in that it is primarily a guide for identifying root causes through experimentation. This implies that the analysis of symptoms and theorizing of causes are done before the cycle actually starts, and then iterative experiments are performed to drill down to the root causes of the problem being addressed.

The PDSA method is particularly popular in health care organizations, probably due to its promotion by the Institute for Healthcare Improvement (IHI) as a method for finding causes and stimulating improvement.

The work done prior to the actual PDSA cycle starts by "setting aims," which is analogous to the establishment of the goal in the Juran RCCA process. The piece of stating the problem to be solved, however, seems to be absent, so one might wonder how the activity of the team becomes focused. Then the team gathers knowledge about the process they are attempting to improve upon so they can come up with good ideas for changes to the process.

> … [T]he more complete the appropriate knowledge, the better the improvements will be when the knowledge is applied to making changes. Any approach to improvement, therefore, must be based on building and applying knowledge. This view leads to a set of fundamental questions, the answers to which form the basis of improvement:
>
> - What are we trying to accomplish?
> - How will we know that a change is an improvement?
> - What changes can we make that will result in improvement? (Langley et al., 1996)

In contrast to Juran's RCCA, the PDSA approach seeks to identify changes that might improve the process or outcomes of it, then implements those changes to see if they are effective in producing an improvement. The PDSA cycle is the method applied to this trial of changes. In a manner of thinking, PDSA seeks to confirm or refute ideas of problem causes by trial and error of solutions.

"These questions [above] provide a framework for a 'trial and learning' approach. The word 'trial' suggests that a change is going to be tested. The term 'learning' implies that criteria have been identified that will be used to study and learn from the trial" (Langley et al., 1996).

The PDSA approach follows these phases and steps:

1. Plan
    - Define the change to be tested
    - Design the experiment to test the change
2. Do

- Carry out the experimental plan
- Collect data about the effectiveness of the change

3. Study

- Analyze the data from the experiment
- Summarize what was learned

4. Act

- Determine what permanent changes are to be implemented
- Determine what additional changes need to be tested

Clearly, this approach has some advantages:

- It can yield results quickly if the experimenters are good at selecting solutions that will yield true improvement.
- It follows an experimental approach, which can yield a great deal of useful knowledge.
- It is widely accepted, particularly within health care and other organizations that typically rely on experimentation to determine beneficial changes (e.g., development of medications).

One might also note some disadvantages:

- Results can be slow to come if the experimenters are not good at selecting solutions that will yield true improvement.
- Changes that do not succeed may not yield a lot of useful information.
- Experimentation, unless it is done in a laboratory setting, can be disruptive to the process and can be resource-intensive.
- Experimentation can be costly in many cases.

Based on these pros and cons, the project team should choose the methodology that best fits their work style and organization's needs.

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16.10. Just Do Its

As the name implies, "just do it" (JDIs) do not really include an analysis of the root cause of the problem because that root cause is usually readily apparent in what is sometimes referred to as a "blinding flash of the obvious." So analyzing the root cause in this case is done entirely by observation.

A number of years ago, consultants transitioned from the old way of teaching using overhead projectors to the new computerized method: constructing the materials to be taught in a presentation graphics program and projecting them using a liquid crystal display (LCD) projector. As the transition from the old way to the new way progressed, fewer and fewer meeting rooms had overhead projectors available, and more and more had LCD projectors. A problem arose for some training providers: If the trainer arrived at the training room prepared to show slides on an overhead projector and none were available, the training had to be either postponed or done in a less-than-desirable fashion, reading from and referring to printed materials only. What was the obvious cause of this problem? The consulting organization had not provided the consultant with the proper tools (either a laptop or some digital media that could be used on the training room PC) to do the job in the new environment. The JDI in this case, of course, was to provide the trainer with the needed tools.

Another situation where the JDI approach may be appropriate is when the need for a solution is urgent and delaying can have serious repercussions.

Such an example of an urgent need for a solution occurred in London in 1854. There had been a terrible outbreak of cholera, which ultimately claimed more than 500 lives in a period of ten days. Dr. John Snow came to the rescue. After analyzing the pattern of occurrence of the deaths using a concentration diagram, Snow recognized that most of the deaths were grouped around the Broad Street pump. Even though he did not recognize the root cause was bacteria in the water, Snow went directly to a solution and had the handle removed from the pump. Within days the cholera outbreak was over (The Juran Quality Minute: London Cholera Epidemic)[1].

To implement JDIs without a thorough analysis and discovery of the root cause of the problem, three factors must be present:

1. The need for change must be urgent. Don't use the JDI approach just because it is quick and easy.
2. The change must carry a low cost of failure. What if you're wrong? The price to pay for making the change must be low, preferably zero. Dr. Snow had little if anything to lose by removing the pump handle. The worst that would happen is people would have to travel farther to get their water.
3. The change must have a significant potential reward. The decision here is, "Well, what if I'm right? Things will be a lot better if the change is effective."

JDIs used at the appropriate times and in the right situations can be a beneficial and effective method of attaining some quick wins.

[1] Paraphrased from Juran Institute, Inc. "The Quality Minutes: London Cholera Epidemic."