Solve the Real Problem Using Root Cause Analysis

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"To solve a problem or to reach a goal, you don't need to know all the answers in advance. But you must have a clear idea of the problem or the goal you want to reach."
W. Clement Stone

Root Cause Analysis (RCA) is a structured investigation that aims to identify the true cause of a problem and the actions necessary to eliminate it with a permanent fix rather than continuing to deal with the symptoms on an ongoing basis. The true root cause is difficult to determine immediately, it often takes analysis using one or more tools to separate it from the symptoms or masking factors. Root Cause Analysis determines what happened, why it happened, and how to eliminate it so it will not happen again.

RCA is a group of problem solving approaches designed to identify the true causes of problems or events. The practice of RCA is based on the premise that problems are best solved by correcting or eliminating the fundamental causes, as opposed to merely addressing short term or obvious symptoms. By directing corrective measures at root causes, the likelihood of problem recurrence is minimized. Prevention of problem recurrence by a single intervention is rarely possible. RCA is often an iterative process. RCA is a reactive method of problem detection and solving. When combined with other, pro-active improvement tools, such as Failure Mode and Effects Analysis, or Risk Analysis, quality professionals are more likely to forecast the possibility of a problem before it can occur.

RCA is not a single methodology; there are a number of different tools, processes, and philosophies of RCA published in myriads of texts. However, most of the different approaches can be classed into five, very-broadly defined "schools":[1]

- Safety-based RCA descends from the fields of accident analysis and occupational safety and health.
- Production-based RCA has its origins in the field of quality control for industrial manufacturing.
- Process-based RCA is basically follow-on to production-based RCA, but with a scope that has been expanded to include business processes.
- Failure-based RCA is rooted in the practice of failure analysis as employed in engineering and maintenance.
- Systems-based RCA has emerged as an amalgamation of the preceding schools, along with ideas taken from fields such as change management, risk management, and systems analysis.

[1] The Juran Institute. 2007. "Simplify & Energize Your Enterprise: Being World Class." Available online at: http://www.juran.com/news_details.aspx?id=69. Accessed October 21, 2009.

Underlying Assumptions of Root Cause Analysis:

1. RCA must be performed in a systematic manner with assumptions, potential causes, and conclusions backed up by data and documented evidence.
2. To be effective, the data gathering and analysis must establish all known causal relationships between the root cause(s) and the defined problem. This is done using a Cause and Effect Diagram or Fault Tree.
3. There are usually multiple potential root causes for any given problem.
4. Interaction among potential root causes must be understood and analyzed to determine how they impact each other and the problem or issue under discussion.
5. Potential solutions must be developed and analyzed to determine the extent to which they will permanently fix the problem and what the economic impact to the organization is to fix the problem.

Problem Solving Methodology:

"We can't fix problems with the same kind of thinking we used when we created them"

Albert Einstein

The Plan-Do-Check/Study-Act Cycle is a problem solving methodology that supports root cause analysis. The following general steps outline a root cause analysis approach:

PDCA/PDSA should be repeatedly implemented in spirals of increasing knowledge of the system that converge on the ultimate goal, each cycle closer than the previous.

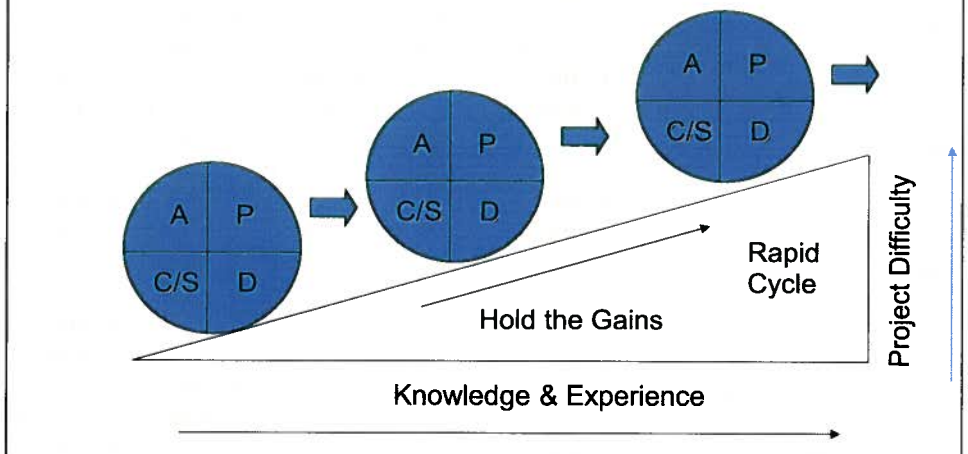

Figure 1

Plan:

- Define the problem – create a clear and discrete Aim Statement.[2]

A problem is the difference between an expected result and what actually happens. Gather relevant data (fact and opinion) about the problem to define its boundaries, how long it has existed, any special conditions that allow this problem to exist, any particular sequence of events internal or external to the organization that leads to this problem, and understand what the specific symptoms/impacts of this problem are on the organization.

- If the problem is not defined correctly, it will never be solved permanently
- Some quality improvement tools like Pareto Charts, Run Charts, Scatter Diagrams, and Histograms may be helpful during the data gathering process.

Do:

- Develop a Cause and Effect Diagram to identify and develop all the causal relationships associated with the defined problem.
- Identify which causes if removed or changed will prevent recurrence of the problem.
- Attempt to shrink the problem down to its smallest size – define what it is and is not.
- Identify effective solutions that prevent recurrence, are within your control, meet your goals and objectives and do not cause other problems.
- Develop targets to be achieved and a timeline for their achievement.
- Define measures to track the solution's effectiveness in reducing or eliminating the stated problem or issue.
- Implement the recommendations.

Check:

- Are the solutions achieving the targets and timelines?
- Is the original problem or issue eliminated or controlled?
- If the answer to the above questions is "No" then determine why.

Act:

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[2] Reference: *Ready, AIM, Problem Solve*, L. Beitsch, MD, G. Duffy, and J. Moran; Quality Texas Newsletter October 2009, http://www.texas quality.org/ SiteImages/125/Newsletter /October 2009 Newsletter.pdf, Accessed October 25, 2009, pp. 14 -18, for more information on AIM Statement preparation.

- If the solution(s) implemented do not achieve the set targets and do not eliminate or control the original problem then analyze why and either develop a corrective action plan and timeline or re-analyze the problem starting at the Plan stage.

Potential Classification of Root Causes:

1. **Tangible Causes** – material, equipment, methods, facilities, and physical environment is inappropriate for the tasks to be accomplished, or other items failed in some way. "My car died."

2. **People Causes** – some one did something incorrectly or did not do something, poorly trained workforce, or inadequate staffing levels. Human causes can be related to physical causes. "Car died since no one maintained it properly."

3. **Economic/External Environmental Causes** – changes in our economy (recession), H1NI virus, political influences, and acts of God. Things we have very little control over but must react to because of the impact they have on our internal environment.

4. **Managerial Causes**- inappropriate organizational structure to run the organization, lack of a defined mission, poor communications, poorly trained managers, inattention to tasks, or no consequence for poor performance.

5. **Organizational Causes** - A system, process, or policy that people use to make decisions or do their work is faulty (for example, no one person was responsible for vehicle maintenance, and everyone assumed someone else had filled the brake fluid).
6. **Information Management or Technology Causes** – necessary information is not available, accurate, or complete when needed to make informed decisions. Technology platforms, equipment, and software are inadequate for current needs of the organization.

Solving a Problem with Root Cause Analysis:

Beneath every quality, process, or safety problem lays a root cause for that problem. Therefore, when trying to solve a problem, RCA considers two approaches:

1. Identify the cause (or causes) of the problem;
2. Find ways to eliminate these causes and prevent them from recurring.

This two-step approach seems quite simple, but it is often very difficult to find the real causes of a problem. Often what appears to be the cause of a problem is actually a symptom, or a secondary cause, and not the root cause.

Different Levels of Causes

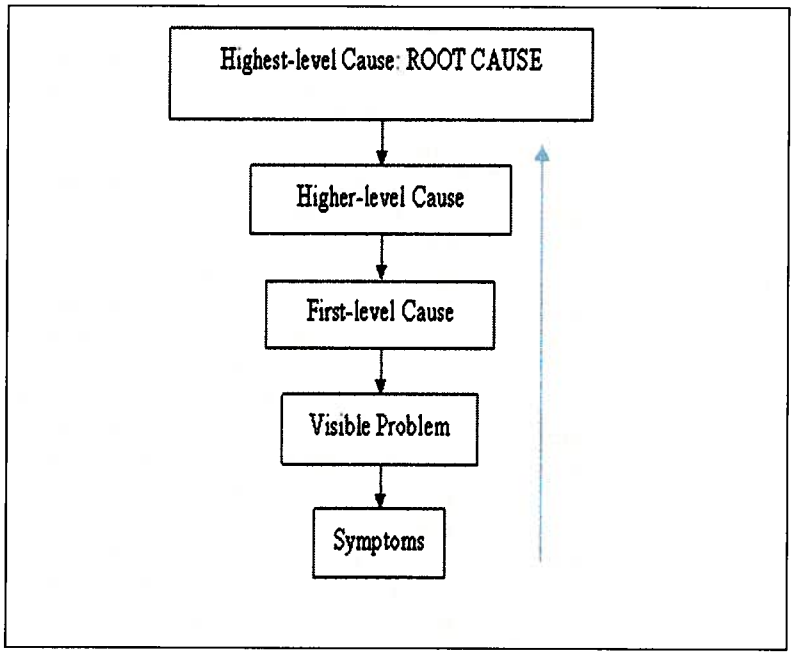
A problem is often the result of multiple causes at different levels. This means that some causes affect other causes that, in turn, create the visible problem. Causes can be classified as one of the following levels:

1. ***Symptoms:*** These are not regarded as actual causes, but rather as signs of existing problems.
2. ***Problems:*** a gap between how the process performs and how it should perform.
3. ***First level causes:*** Causes that directly lead to a problem.
4. ***Higher-level causes***: Causes that lead to the first-level causes. While they do not directly cause the problem, higher-level causes form links in the chain of cause-and-effect relationships that ultimately create a problem.
5. ***Highest-level cause:*** This is the root cause.

In addition, most problems often have compound causes, where different factors combine to cause the problem. It is rare that a problem has a single cause. However, in RCA an effort is made to isolate one major factor that is the primary cause.

The highest level cause of the problem is called the root cause. This highest level cause is the factor that sets all other causes in motion, or combines with other causes to create a problem. In other words, the root cause sets in motion the entire cause-and-effect chain causing the problem(s). Figure 2 shows the root cause as the highest level cause, and its relationship with other causes, the visible problem, and symptoms.

Figure 2: Root Cause & How it Relates with Other Factors



Example of RCA

Consider a health department that has received adverse media attention because of a series of food borne illness outbreaks from the same restaurant. The problem could be defined as "Unfavorable media attention." However, this media attention is actually a symptom, not the problem. The visible problem is poor enforcement. The first level cause might be sporadic and incomplete restaurant inspection, while higher level causes could be a lack of staff, inadequate training, and poor follow-up scheduling. These higher level causes ultimately resulted in serious food borne illness outbreaks occurring at the same restaurant. However, it is still not clear what the root cause is for this inspection and enforcement failure. The root cause can only be determined after a careful and methodical analysis.

Correctly Identifying the Root Cause

There are many times that the root cause of a problem has not been correctly identified, and the problem continues to persist because the solution will not solve the problem. In order to effectively solve a problem, it is essential to correctly identify the root cause. Often, only the symptoms or first-level causes are identified, and the solutions are either ineffective or temporarily effective. This provides some temporary solution, but will never produce a lasting solution. When the wrong root cause is identified, the solution will result in one of the following:

1. Identify and remove symptoms: If only the symptoms are identified and removed, the problem will still be present, but there will no longer be easily recognized symptoms that can be monitored.
2. Identify and remove first-level and higher-level causes: This may temporarily alleviate the problem, but the root cause will eventually find another way to manifest itself in other ways.

In RCA, the only way to discover the root cause of a problem is to follow the chain of cause and effect behind a problem all the way to the beginning of the causal sequence. This root cause is often the cause of many different problems, and it is important to find and eliminate it.

Root Cause Identification

Problems in quality, process, and safety constantly present themselves in health field processes. Using a run chart or control chart is the most effective way to monitor a process to determine if a problem has occurred. When special cause is identified by a run chart or control chart, it is clear that a problem has occurred. This needs to be identified and solved. However, the cause of problems is not always obvious.

A number of possible causes are created and analyzed in RCA. From this list of possible causes, the highest level cause, the root cause is identified. This stage is the most difficult for a problem solving team.

Determining the Root Cause

A quality improvement tool used to find root causes is a Cause and Effect Diagram[3], as shown in figure 3. The Cause and Effect Diagram organizes the various causal categories in one visual.

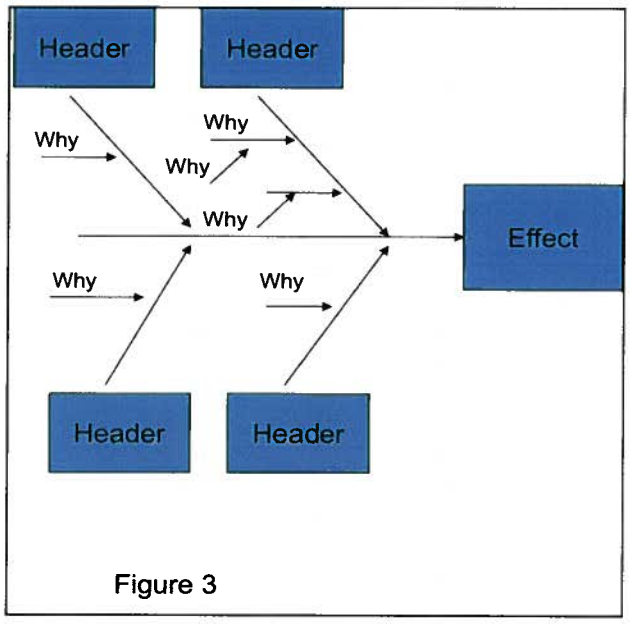


Figure 3: Cause and Effect Diagram

After various causes are determined by a Cause-And-Effect Diagram, the next step is to understand the relationship between causes. This involves tracing a precursor to a cause back to the original cause (root cause).

One technique to make sure all causes and sub-cause have been identified is the five whys technique. The five whys technique selects a cause close to the problem and asks why. The answer to the question is another cause that chronologically or logically comes before the cause that is being examined. This process is repeated up to a total of five times. The main purpose is to constantly ask "Why?" when a cause has been identified. By repetitively asking why, investigators are lead toward the root cause. The key concept of the five whys technique is to keep posing the question "Why?" for each cause identified. This relentless approach keeps probing the relationship between causes and helps not settle on anything less than the root cause. There comes a point in the chain of causes where no further causes can possibly be found. This last cause is the root cause. This is the point at which you should stop asking why.

When a team completes a Cause and Effect Diagram it often focuses on the obvious low hanging fruit where quick fixes can be made to the symptom they are studying. Seldom

[3] The Public Health Quality Improvement Handbook, Ron Bialek Grace Duffy, and John W. Moran, ASQ Quality Press, ©, pp 164 – 165 for more information on Cause and Effect Diagrams.

have we found that the low hanging fruit, if solved, has more than a short-term or minimal impact on the symptom. Things feel better quickly when the low hanging fruit is fixed but soon after the symptom returns and a new team is formed to investigate and the cycle begins again.

Remove the low hanging fruit from the Cause and Effect Diagram and fix these issues separately from the Root Cause Analysis. Low hanging fruit is usually not the root cause or the real problem would have been resolved already. Once the low hanging fruit has been removed, prioritize each of the branches of the cause and effect into the top 2 to 3 potential root causes. This prioritization can be done after data is collected on each of the potential root causes. The team members will have to subdivide the root causes on which to collect data. Pareto charts, control charts, run charts, scatter diagrams, check sheets, and histograms are all key data collection tools that could be used by the team.

Once the data is collected, the impact of each root cause can be analyzed in a matrix as shown in figure 4 to determine the overall impact on the symptom.

Root Cause Analysis Rating Form

	Impact on the Problem					
Potential Root Cause	Improved Quality	Reduced Costs	Improved Customer Satisfaction	Others	Total Score	Ranking

Impact Scoring Scale: Low = 1, Medium = 3, High = 5

Figure 4: Root Cause Analysis Rating Form

The matrix allows the team to assess each potential root cause over a number of potential impact dimensions and develop a score. The score can help rank the potential root causes with the most impact on the symptom if solved.

Causal Relationships:

Problems often have compound causes as mentioned earlier in this paper. Different factors combine to cause the problem. It is rare that a problem has a single cause. However, in RCA an effort is made to isolate one major factor that is the primary cause. One check that a team can make after they have determined the top few root causes is to determine how the causes relate to each other. The team can use an Interrelationship Diagraph[4] to determine if there are interconnections between the potential root causes. Determining these interconnections can show patterns that may change the team's decision on which root cause(s) to pursue for the ultimate solution.

The Interrelationship Diagraph is a way to determine interrelationships between root causes by doing a paired comparison process. Each root cause is compared to all the other root causes. This is done by starting with a pair of root causes and asking the following questions and recording the results on the matrix shown in figure 5.

1. Any relationship between the two causes?
    a. Yes – proceed to step 2
    b. No – pick another pair of causes for comparison
2. Which way is the cause direction?
    a. Does the first item cause the second item to happen? Y/N
    b. Does the second item cause the first to happen? Y/N
3. Draw the arrows in the right direction on the matrix
4. How strong is the strength of the relationship?

    - 1 – weak 5 – medium 10 – strong

[4] The Public Health Quality Improvement Handbook, Ron Bialek Grace Duffy, and John W. Moran, ASQ Quality Press, ©, pp 199 - 201for more information on the Interrelationship Digraph.

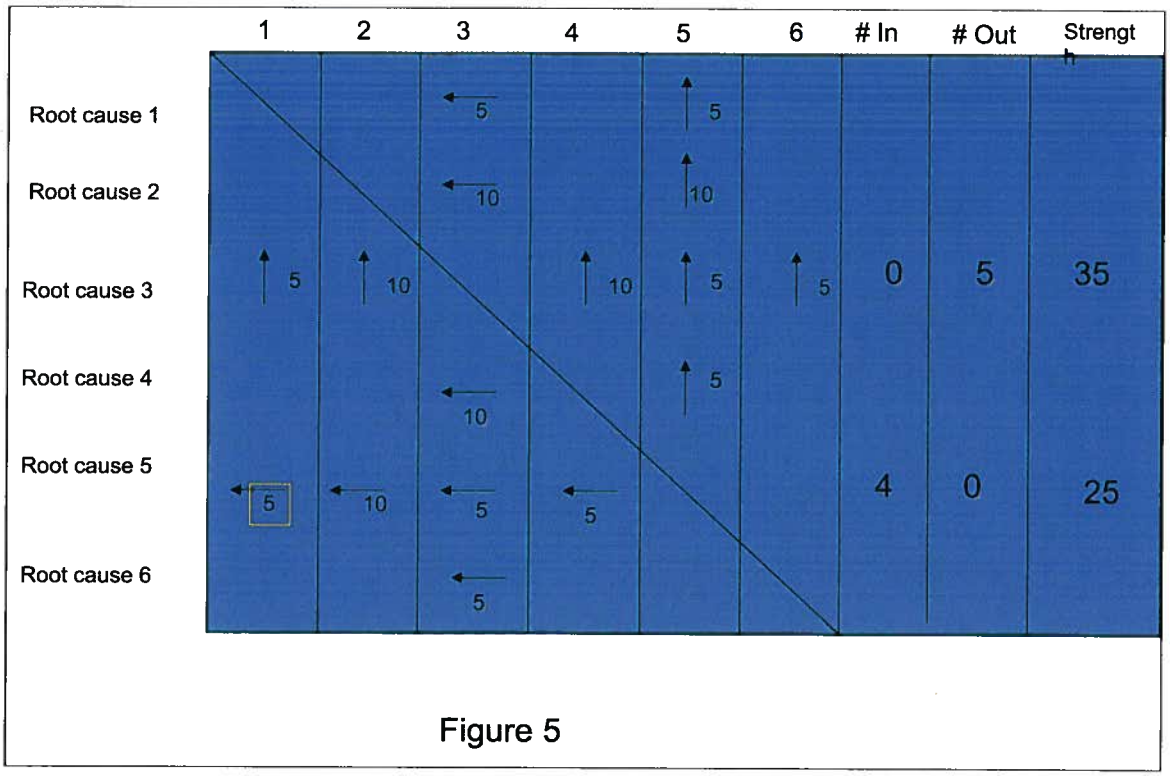


Figure 5: Interrelationship Digraph matrix

Those with the most connections and highest strength will usually be the most important factors on which to focus. This step will provide the team with a check on the potential impact and spillover effects of focusing on a particular root cause to address for solution. Sometimes this step alters the team's perspective on the most important root cause.

Solution Development:

One quality improvement tool to use to develop solutions to selected root causes is a Solution and Effect Diagram[5] as shown in figure 6.

[5] The Public Health Quality Improvement Handbook, Ron Bialek Grace Duffy, and John W. Moran, ASQ Quality Press, ©, pp 185 - 188 for more information on Solution and Effect Diagrams...

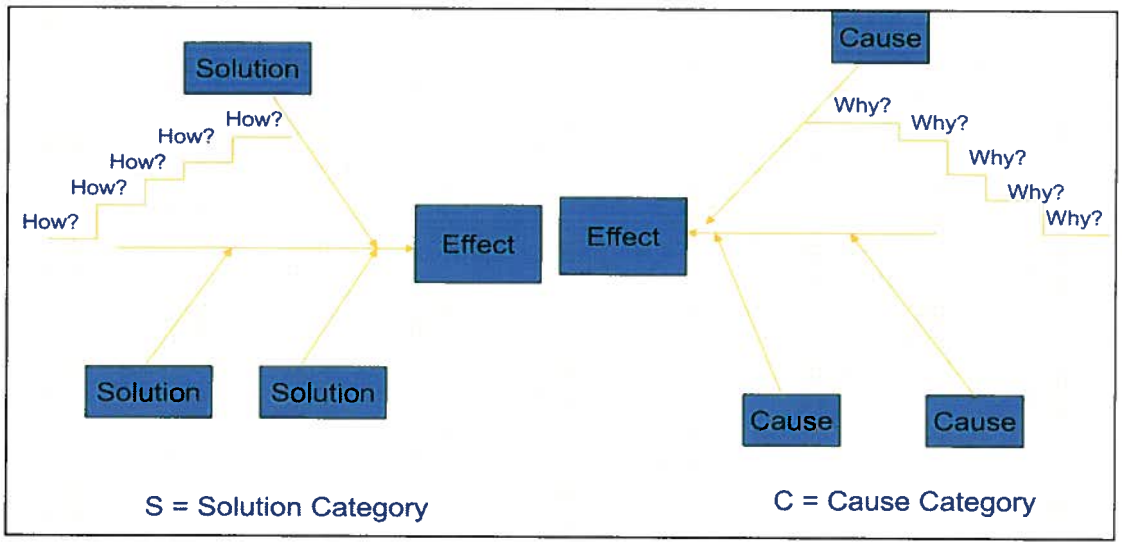


Figure 6: Solution and Effect Diagram

The Solution and Effect Diagram is similar to the Cause and Effect Diagram except that it identifies changes and recommendations. The effect is now made into a positive statement to help guide the team to solution. The root cause selected is now the effect and we develop solution branches and ask "How" instead of "Why" to develop potential solutions. These solutions are then prioritized into those with the most impact on achieving a permanent fix. The implementation plan is then developed and tracked during the Check and Act steps of the improvement cycle.

Root Cause Cost Removal Impact:

Once the root cause has been identified and a solution(s) has been developed, the next step is for the team to determine the costs and benefits to make a permanent fix. Figure 7 is a matrix to compare the various potential solutions to determine which ones may have the best cost-benefit ratios.

Root Cause Analysis Solution Impact Analysis

Potential Solutions	Corrective Action Type	Verification Method	Cost To Fix	Benefit Of Fix	Cost Benefit Ratio	Selected? Y/N

Corrective Action Type: Immediate but Interim – **II**, Short-term Temporary - **ST**, Permanent – Short Term – **PST**, and Permanent – Long Term - **PLT**

Figure 7

Figure 7: Root Cause Analysis Solution Impact Analysis

The team must decide whether the removal of the cause will cost more than the cost of continuing to deal with the symptom. If the cost of the removal is more than the cost of continuing to fix the symptom, the team and management must consider other intangible factors such as employee satisfaction, morale, stress levels, and customer satisfaction in making their decision on whether or not to fix the symptom or continue to deal with it.

This question does not have a generalized answer. Each situation must be considered on an individual basis since there are many tangible and intangible factors that influence the final decision.

Summary:

The goal of Root Cause Analysis is to find out what happened, why it happened, and what to do to prevent it from happening again. This seems simple on the surface but requires a robust problem solving investigation model such as P-D-C/S-A to ensure a rigorous analysis is conducted. The true root causes must be treated in a manner that eliminates their impact on the problem being investigated.

RCA can be done as part of a daily management (individual QI) program where individual workers analyze recurring work, people, or customer dissatisfaction problems within the organization. If causes can be fixed at the daily work level before they become organization-wide problems, the cost is less and the impact to the organization is minimized.

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