

## **Root-Cause-Analysis (RCA) Best Practice**

### Best Practice

If a failure event that impacts safety/regulatory, production, expensive equipment, or repetitive failures (more than once per year) of any value, or repetitive failures occur, a Root-Cause-Analysis (RCA) must be performed corrective actions implemented where economically or safely reasonable.

### Procedure

1. Failure occurs. Reference the RCA Worksheets. Continue the RCA process if:
  - 1.1. The failure is a repetitive failure;
  - 1.2. It is a safety or regulatory related failure;
  - 1.3. The failure interrupts production;
  - 1.4. Or, the failure incurs significant cost
2. Containment Action: Containment action is the first step in the process. These are actions taken immediately following awareness of the event to stop the event from occurring and preventing or minimizing impact from the failure. This is referred to as the Immediate Corrective Action.
  - 2.1. Stop the event from occurring
  - 2.2. Once the event has been stopped, determine what and how much damage has been done
  - 2.3. Contain effects of the damage
  - 2.4. Notify affected personnel and departments
3. Define the problem: Clearly define the actual problem. The steps involved in problem definition are:
  - 3.1. Forming a team
  - 3.2. Identifying the problem
  - 3.3. Gathering and verifying data
4. Forming the team: Assemble a team of stakeholders in the problem. Include personnel who know the process, have the data and experience, and the ones that will have to implement the corrective actions. This may include Maintenance, Management, Operations, Safety, Training, Vendors, etc. Without the full buy-in and support of the stakeholders, long-term solutions are unlikely. All members must be able to contribute information, technical expertise, management support, advice or facilitation. In larger issues, the team may be dynamic, with members changing as expertise is required.
  - 4.1. It is acceptable to determine the need for outside RCA assistance or facilitation, where cost effective.
5. Identifying the problem(s): In order to provide a valid corrective action, the problem must be clearly and appropriately defined. Frequently, the failure identified is not really the problem, but the symptom of the problem.
  - 5.1. What is the scope of the problem?
  - 5.2. How many problems are involved?
  - 5.3. What is affected by the problem(s)?
  - 5.4. What is the impact on the plant/facility?
  - 5.5. How often does the problem occur?

- 5.6. Once defined, the problem must be stated in simple terms. The event question must be short, simple, concise, focused on one problem and starts with ‘Why?’ It must not tell what caused the event, instruct what to do next, or explain the event.
6. Gather and verify data: When the problem is identified, it is time to begin collecting data. The data must be factual and data may have to be obtained several times during the process. Initial data gathering starts at the scene and must be obtained immediately. Take note of who was present, what is in place, when the event occurred and where the event happened. Types of data to collect include:
  - 6.1. Location: The site, building, facility, department, field, equipment or machine where the event took place.
  - 6.2. Names of Personnel: Personnel, visitors, contractors, etc.
  - 6.3. Date and time of event
  - 6.4. Specifications: What are the requirements?
  - 6.5. Operational Conditions: Start-up, shutdown, normal operations or other
  - 6.6. Environmental Conditions: Noise levels, visual distractions, lighting, temperature, humidity, weather, etc.
  - 6.7. Communications: Verbal or written, what orders or procedures were being followed?
  - 6.8. Sequence of Events: In what order did things take place?
  - 6.9. Equipment: What was being operated?
  - 6.10. Physical Evidence: Damaged equipment or parts, medical reports.
  - 6.11. Recent Changes: In personnel, equipment or procedures.
  - 6.12. Training: Classroom, OJT, none
  - 6.13. Other Events: Has there been other similar occurrences?
  - 6.14. Ensure that gathered data is correct and complete.
7. Analysis: When the problem is identified, and preliminary data has been gathered and verified, the analysis can begin. The procedure recommended by this best practice is referred to as the 5-Why process. It is named this because it normally takes 5 ‘why’ questions to get to the logical end of the cause chain. Not all cause chains will be complete in 5 whys, some will take 7 and others will reach their end in 3. The answers to the why questions form a chain of causes leading to the root cause. The answer to the first Why is the direct cause. The logical end of each chain (problems can branch out) is a root cause and the causes in between the direct cause and the root cause are contributing causes. There may be no contributing causes, but there is always a root cause – the best and logical place to stop as identified by the team. This place is where continuing to ask why adds no value to prevention or recurrence, reduction or cost savings.
  - 7.1. For example, if the event is:
    - 7.1.1. A procedure does not exist or needs revision – why doesn’t it exist (and stating that someone didn’t know is not acceptable) – What was the systematic reason for the lack of knowledge?
    - 7.1.2. Operator (or maintenance) not trained and/or qualified – Why was the operator not trained (stating that training was not conducted only restates the finding) and why is an unqualified operator performing work?
  - 7.2. There may be multiple branches and multiple root causes. Each branch will need to be analyzed and worked down to its logical end. Many of these identified causes, may not directly relate to the problem at hand, but point to issues that still need to be addressed to prevent future problems.

8. Impact: Review the original problem statement and ensure that it is correct with the additional information that is known at this stage in the process.
9. Solution: These are the solutions to the root cause, of which some may have been addressed as part of the containment action (step 2).
  - 9.1. Preventive Corrective Action: These are the actions taken to prevent recurrence. They focus on breaking the cause chain completely by fixing the contributing cause and the root cause.
  - 9.2. Preventive Action: Is a series of actions that positively change or modify system performance. It focuses on the systemic change and places in the process where the potential for failure exists. Preventive Action does not focus on individual mistakes or personnel shortcomings. In determining solutions, consider the following:
    - 9.2.1. Feasibility: The solutions need to be feasible within the plant/facility's resources and schedule;
    - 9.2.2. Effectiveness: The solutions need to have a reasonable probability of effectively solving the problem;
    - 9.2.3. Budget: Solution costs must be within the budget of the plant/facility and also appropriate for the extent of the problem;
    - 9.2.4. Employee Involvement: The departments and personnel affected by the problem need to be involved in creating the solution(s);
    - 9.2.5. Focus on Systems: The solution(s) should be focused on systemic issues. Operators do make mistakes, but that is not usually the root cause of the problem.
    - 9.2.6. Contingency Planning: All solutions are developed with a certain expectation of success. Critical elements of the solution should have contingency plans available to prevent failure of the entire solution.
  - 9.3. Guidelines for solution development:
    - 9.3.1. There may not be an absolute correct solution.
    - 9.3.2. Do not rush to a solution and be willing to think about alternatives over a reasonable period of time.
    - 9.3.3. Always be willing to challenge the root cause as a symptom of a larger problem.
    - 9.3.4. Never accept an assumption as fact without significant data.
    - 9.3.5. Does the corrective action reduce the risk of the event recurring to a reasonable level? Are there any adverse effects for the application of the corrective action?
  - 9.4. If a corrective action is deemed unacceptable, note the reasons for rejecting the action.
  - 9.5. Set responsibility for accomplishment and defined timelines.
10. Assessment: The assessment portion of the RCA includes both follow up and assessment of the corrective actions, if any.
  - 10.1. Schedule Follow-Up date.
  - 10.2. Follow-Up: Corrective actions must be assigned to someone who is responsible to assure that the actions are implemented as stated. When verifying implementation, it is important to take things literally. Was everything accomplished as you stated in the report? Were the tasks accomplished per the established timeline?
  - 10.3. Assessment: Once the action has been implemented, the actions must be assessed to determine if they are effective. In order to determine effectiveness, the criteria must be defined by which effectiveness is measured and what is acceptable. Assessing the effectiveness of actions taken will be a significant step in reducing non-sustaining corrective action.

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11. Complete RCA: Close the RCA if it is determined effective, or return to the cause chain to review corrective actions taken and if the root cause requires more definition.
12. Record and Archive findings.

**5-Why Analysis Worksheet**

Supervisor: \_\_\_\_\_ Date of Event: \_\_\_\_\_

Equipment: \_\_\_\_\_ Time of Event: \_\_\_\_\_

Type(s) of Event(s): *(Note: You may perform 5-Why on each of the following issues)*

- Maintenance     Training     Supplies     Meeting  
 Material Flow     Part Availability     Leadership     Equipment Failure

Priority Ranking:

- One-Time Issue     Repetitive Failure     Safety/Regulatory  
 Operations     Equipment Cost    Other: \_\_\_\_\_

Containment:

Containment Action: \_\_\_\_\_

Downtime (in minutes): \_\_\_\_\_ x Per Minute Cost: \$ \_\_\_\_\_ = Loss: \$ \_\_\_\_\_

Team Members (name, affiliation, phone, email):

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Investigation (add paper as appropriate):

Problem Definition (State as Simply as Possible)

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5-Why Analysis: *(Add sheets as necessary for each fault chain event – Type of Event)*

Why? \_\_\_\_\_

Answer: \_\_\_\_\_

Why? \_\_\_\_\_

Answer: \_\_\_\_\_

Why? \_\_\_\_\_

Answer: \_\_\_\_\_

Why? \_\_\_\_\_

Answer: \_\_\_\_\_

Why? \_\_\_\_\_

Answer: \_\_\_\_\_

Root Causes:

\_\_\_\_\_  
\_\_\_\_\_

Counter Measure (Preventive Actions):

\_\_\_\_\_  
\_\_\_\_\_

Responsibility: \_\_\_\_\_ Deadline: \_\_\_\_\_

Verification:

\_\_\_\_ No recurrence in \_\_\_\_ months      Signed: \_\_\_\_\_

\_\_\_\_ Close-Out RCA    \_\_\_\_ Continue RCA    \_\_\_\_ No Further Action (File) RCA Hours: \_\_\_\_\_

# RCA Best Practice

## RCA Flow Chart

