ONSHORE SAFETY ALLIANCE (OSA)
onshoresafetyalliance.org

Root Cause Analysis (RCA) Methodology

Understanding System Root Cause

In Investigation Training

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Objectives

This following material covers some key components and principles of incident investigation. Some of the items covered will provide information regarding:

- Understanding investigation methods
- Understanding the scene of the incident
- Gathering facts through the interview process
- Developing an accurate detailed description
- Determining the root cause(s) of the incident
- Creating effective corrective action(s) to ensure sustainable change
- Implementing SMART action plan(s)

Definitions

Contributing Factor
Circumstances, events, or behaviors that help cause a result/incident

Corrective Action
Specific and effective action that addresses identified root causes and contributing factors to prevent reoccurrences

Incident Reporting System
Typically, a computer-based system for which to report incident and near miss events and capture investigation details, corrective actions, etc.

Safeguard (or Barrier)
Are the hardware and human actions designed to directly prevent or mitigate an incident or impact and include facility designs, mechanical devices, engineered systems, protective equipment, and execution of procedures. *Note: The term "barrier" is also sometimes used within the industry.*

System Root Causes
Specific underlying causes or events that (1) can reasonably be identified and (2) management can correct or influence to create sustainable change

Sustainable Change
A change that addresses a root cause, is measurable and creates a continuous solution preventing reoccurrences

SMART Action Plan
A plan that is specific, measurable, achievable, resourced, and time-bound to achieve certain results or goals

What is a Root Cause and a Root Cause Analysis (RCA)?

A root cause, simply stated, is defined as a factor that causes a resultant. It is the core issue or the highest-level cause that sets in motion the entire chain of events that ultimately leads to an event.

Root cause analysis (RCA) is defined as a collective term that describes a wide range of approaches, tools, and techniques used to uncover the causes of events. Some RCA approaches are geared more toward identifying true root causes than others, some are more general problem-solving techniques, and others simply offer support for the core activity of root cause analysis.

The easiest way to understand RCA is to think those things we often face. If our car breaks down, we typically have a mechanic diagnose the problem and provide us with a solution. If we get sick, we typically have a doctor diagnose our illness and provide us with some medication. In both cases, the mechanic and doctor are performing root cause analyses to accurately identify the underlying condition to appropriately present a solution to address and prevent the problem from reoccurring.

If the root causes of the car breakdown and health issue are not accurately identified, then issue-related symptoms are treated with ad hoc solutions that don't prevent/eliminate the problem and merely mask the problem. In these cases, the problem doesn't permanently go away. RCA looks beyond superficial cause-and-effect and can show where processes or systems failed or caused an issue in the first place.

Root cause analysis is part of a more general problem-solving process and an integral part of continuous improvement. Because of this, root cause analysis is fundamental to an organization's continuous improvement efforts.

RCA identifies system level causes (beyond human behaviors) that had an effective safeguard been in place, the event outcome would have been mitigated to an acceptable level or prevented from occurring.

Conducting Root Cause Analysis

When carrying out RCAs, it's important to note a few things that will help the analysis quality and gain trust and buy-in from stakeholders:

1) While many RCA tools can be used by a single person, the outcome is generally better when a group of people work together to find the root cause(s). Consider putting together a team of people who are most familiar with the work together with someone who is most familiar with facilitating event analysis.
2) Those ultimately responsible for removing the identified root cause(s), such as front line workers, should be prominent members of the analysis team that sets out to uncover them.
3) Conducting timely analysis is important when trying to capture accurate information from those involved in an event.
4) Formulate and ask several, good open-ended questions to help paint an accurate and complete picture of the event.
5) Be mindful and cautious about leading with questions which support your theory or biases before the analysis is complete.
6) Realize there most often are multiple root causes.
7) Focus on HOW and WHY something happened, rather than WHO was responsible. Tell the story of “how” the event happened.
8) Be mindful about bringing bias to the even causes and cautious about jumping to conclusions during the investigation.
9) Seek out enough information to inform a corrective course of action.
10) Consider how a root cause can be prevented (or replicated) in the future.
11) Focus on correcting and remedying root causes rather than just symptoms.
12) Develop a report that summarizes the learnings from the investigation. This report should contain a summary of events representing the evidence gathered during the investigation.

Step One: Scene Preservation

Preserving the Scene

Based on the significance of the incident, the scene may need to be controlled and maintained until authorized by the appropriate company representative (Jobsite Manager, Supervisor, Manager, HSE, etc.).

Do:

Preserve:

- Incident area and the area immediately surrounding the site of the incident
- Documentation
- Alarms/Data/Electronic systems (EDR systems, rig operating system settings, etc.)

Ensure:

- All involved personnel (including 3rd party) are included in the investigation
- Photographs are taken only as directed by management
- Control of social media (texts, photographs, videos, etc.)

Do Not:

- Alter any physical evidence
- Allow pictures or videos to be taken by employees, third-party personnel, or operator representatives unless authorized by management
- Allow written witness statements without appropriate company representative approval
- Provide public statements – direct all questions to your Immediate Supervisor
- Allow equipment involved in an incident to leave location without appropriate company representative approval
- Provide any documentation to Operator Representatives, Third-Party Companies, or Governmental Agencies without appropriate company representative approval

If you're ever unsure, reach out to your support teams for help and guidance.

Step Two: Incident Summary

- Compile a brief summary of the incident for reporting into the Incident Reporting System
- Keep it simple (who, what, where, how)
- Be clear and not vague
- Remember this may be seen by the entire company
- Use proper terminology - Do not use slang
- Don't speculate or assume
- Stick to just the facts
- Do not use "IE" or "IP" for Injured Employee or Injured Person
- DO NOT USE ALL CAPS

Incident Summary Examples

Below are some examples of incident summaries that are not well written and those that are well written.

Obscure Examples

- Employee twisted ankle.
- Employee reported eye irritation.
- Employee reported pain.
- Hand touched and felt a tingle.
- Rigging up casing, elevators damaged beaver slide.
- Spill in sub.

Preferred Examples

- Employee was stepping out of the parts house at night and stepped on bolt twisting left ankle.
- Employee reported eye irritation while mixing chemicals.
- Employee reported a pain in his back while pulling slips.
- While pressure washing on a walkway that contained electrical wires, an employee made contact with a low voltage source and felt an electric shock.
- While rigging up casing, the v-door slide was damaged while hoisting casing elevators.
- While drilling ahead, the flowline packed off resulting in a conductor slip joint failure causing a spill.

Step Three: Gathering Findings

Understanding the Incident

In order to fully understand the incident, all contributing factors need to be considered, including but not limited to:

- **Date** – *Date of incident, Day of the week, Holiday, Crew Change, etc*.
- **Time** – *Time of incident, Day, Night, Dusk, Dawn, etc.*
- **Location** – *Rig Floor, Change House, Pipe Racks, etc.*
- **Operations leading up to the time of incident** – *Rigging up Casing crew, etc.*
- **Operation at the time of incident** – *Drilling, Tripping, Pressure Washing, etc.*
- **Job tasks** – *Steps required to perform the task directly associated with the incident.*
- **Consequences of incident** – *Fire, Spill, Equipment Damage, Injury/Illness, etc.*
- **Cause of injury/illness** – *Struck by, Caught between, Fall, etc.*
- **Simultaneous operations** – O*ther operations taking place at the time of the incident.*
- **People** – *Leadership, Culture, Consistent and Inconsistent behaviors*
- **Any other contributing factors** – *Vehicles, Equipment, Falling objects, Weather, etc.*

Conducting Interviews

The information obtained during an interview is used by the Investigation Team to piece together an accurate account of the events. This ensures the description of the incident is factual and accurate.

Interviews need to answer Who, What, When, Where, Why, and How the incident took place from each employee's perspective. When conducting interviews, it's important to note a few things that will add to the depth of the findings and ensure all aspects are covered for the investigation notes.

Do:

- Conduct one-on-one conversations in their normal work environment
- Learn how work is normally conducted
- Make employees feel comfortable
- Be curious
- Remain unbiased
- Find facts – not fault or opinions
- Look for:
  - Consistencies
  - Inconsistencies
- Explore conflicting information
- Interview multiple sources
- Take notes
- Verify information

Do Not:

- Wait too long to interview
- Make Assumptions
- Prove your theory
- Have a pre-determined list of questions or personnel
- Gather everyone into a group, unless discussing solutions
- Focus only on the incident
- Assume everyone is being truthful

If you have any questions or concerns identified beyond the scope of the investigation notify your immediate supervisor for additional resources. *(i.e. Life Saving Actions violations, HR concerns, etc.)*

Interview Questions

1) Establish a series of events by having the individuals tell their story. It's important to have each interviewee provide their perspective of the incident, as one person's perspective isn't always the same as another's. Closed-ended questioning doesn't provide as much insight into the incident as open-ended questions do. Some examples of open-ended questions to help provide a picture of the series of events could be like:

   - *Walk me through what led up to the incident?*
   - *What were you doing before the incident took place?*
   - *And then what happened?*
   - *Is that typically what happens?*
   - *If not, what does it typically look like?*
   - *How did your day/shift/hitch start off?*
   - *How do you typically perform this job?*
   - *What is your process for…?*
   - *Tell me what this usually looks like?*
   - *Show me what you usually do?*
   - *Help me understand…?*

2) Make sure you've completely understood the interviewee and captured their responses correctly. Repeat back to the interviewee what they said to confirm their statements, such as:

   - *So let me get this right…*
   - *Let me see if I understand what you're saying…*
   - *Let me make sure I've captured this correctly…*

3) Make sure you've captured all that you need and maybe more than you think you need. End by asking the employee what else they can share that relates to the incident, such as:

Do you have any other information that we haven't already discussed that you feel is important to note or would help add understanding to what happened?

Guide the Interviews

Guide the interview with specific, open-ended questions allowing the individual to describe the incident in their own words. Let their answers prompt your next question. Continue down the path of questions based on the interviewee's responses until you can't think of any other questions to ask.

A good example to start off a conversation with an interviewee could be, "W*hat do you do when you first come on tour?"*

Do Not:

Be too broad – "What happened?"
Ask leading questions – "Do you normally perform flow checks?"
Violate confidentiality between employees – "So and so told me you did…"
Make assumptions – "You guys set your alarms, right?"
Rush to conclusions – "Let me guess…" or "I know where this is going."
Accuse – "You shut off your alarms, didn't you?"

Data Gathering

Many important findings may be found in data associated with the incident. This includes photos, journals, maintenance logs, real-time trends, procedures, and operation reports. Also important is to learn about the factors surrounding the incident such as what were the priorities that day and were there any recent shift changes. Other questions to consider:

- Is this a repeat incident?
- Is there evidence of any assurance on this process?

Writing Detailed Descriptions

When writing a detailed description, focus on important facts that help paint a picture of the event. In the description, don't focus on why something happened, only what happened. The cause(s) will come a bit later. For writing detailed descriptions, pay attention to:

1) Explain the incident and be sure to include **Who**, **What**, **When**, **Where**, and **How**

2) Do not focus on the why. The "**WHY**" will go in the root cause box.

Remember:

- *No speculation, no assumptions*
- *Just the facts*
- *Clearly state Who did What on When and Where and How they did it*

Below are a couple of detailed description examples that clearly paint a picture of the event.

1. At approximately 10:30 am, John Smith and Jane Doe were performing daily maintenance on the catwalk. After checking the trough rollers on top of the catwalk, Jane jumped off the side of the catwalk and twisted her left ankle on the matting board.

2. While making up BHA, the Driller was picking up a mud motor from the catwalk. As the mud motor was lifted, the elevators were not properly sized allowing the mud motor to fall from the elevators to the rig floor and out the v-door. No employees were injured. Damage occurred to the catwalk trough and v-door slide when the mud motor fell.

Step Four: Assessing Safeguards

Safeguards prevent or mitigate unwanted outcome(s) and are most effective when they protect against human failure. Just prior to determining root causes, the team brainstorms and compiles a list of safeguards and protective systems that may be associated with the incident based upon what they have learned about the event and the data they have discovered. After brainstorming, leverage the list to identify causal factors and most importantly system root causes. The team should understand

1. what was in place and worked;
2. what was in place and did not work; and
3. what was not in place but may have worked if it had been.

This exercise reveals protective systems and safeguards that contributed to event failure as well as those that mitigated unwanted outcomes. In many cases, a safeguard is a combination of hardware and human action(s) (e.g., an operator responding to an alarm by triggering the activation of a manual emergency shutdown button per a written procedure). To assess and effectively operate these safeguard systems, one must understand and verify the performance and interdependencies of the individual components. Safeguards can be further categorized by how they are implemented, hardware versus human safeguards, and by how the safeguard is intended to address the relevant risk. It can be helpful to further assess where on the hierarchy of controls the safeguard sits and to assess whether the safeguard(s) could be more robust.

Incorporate the status of safeguards or protective systems in the sequence of events (e.g., shutdown activated, inert system turned off, level alarms not functioning). This is an excellent way to make sure that causes that contributed to the incident are not missed. This step is also helpful in getting team members to think about other possible causes or factors involved in the incident. The safeguards and protective systems In Place And Did Not Work should be referenced as a cause in the analysis. Those that were identified as In Place And Worked may also be relevant to include on the Why Tree to show what didn't happen. While the team is working on the analysis, the safeguards and protective systems list needs to be reviewed to check that all those identified have been addressed. The list of items that were Not In Place But May Have Worked may be useful when the team develops the recommendations. Safeguards and protective systems should always be assessed to be those that protect against unwanted outcomes regardless of human failure (mistake or otherwise).

Step Five: Finding Root Cause

The purpose of every investigation is to identify the Contributing Factors and Root Causes in order to determine effective Corrective Action(s) that will create Sustainable Change and prevent reoccurrences. As a reminder, here are the definitions for these terms above:

Contributing Factor
Circumstances, events, or behaviors that help cause a result/incident

Corrective Action
Specific and effective action that addresses identified root causes and contributing factors to prevent reoccurrences

Root Causes
Specific underlying behaviors or events that (1) can reasonably be identified and (2) management can correct or influence to create sustainable change

Sustainable Change
A change that is measurable and creates a continuous solution preventing reoccurrences

Root Cause vs. Contributing Factor

1) Employee's foot was struck by a lift sub when the lifting strap broke.

*Synthetic Lifting Strap Broke: Is this a **root cause** or a **contributing factor**?*

2) Water found on the gear end of the mud pump.

*Derrickhand not draining the water: Is this a **root cause** or a **contributing factor**?*

Root Cause Analysis: The Why Method

In order to understand incidents beyond contributing factors, we need to dig deeper and get to the root cause. One technique is the Why Method.

- This is a process of asking the question "*Why?*" repeatedly in order to identify the contributing factors (and eventually the Root Causes) of an incident.
- Keep asking *"Why?"* until a measurable and sustainable solution can be created preventing reoccurrences.

Root Cause Analysis: Example Scenario Using the Why Method

In the example below, use the Why Method and continue asking "*Why?"* until we're able to arrive at a root cause that: (1) involves a process – not a person; (2) can be directly acted on; and (3) has a high likelihood of significantly reducing or eliminating the stated problem.

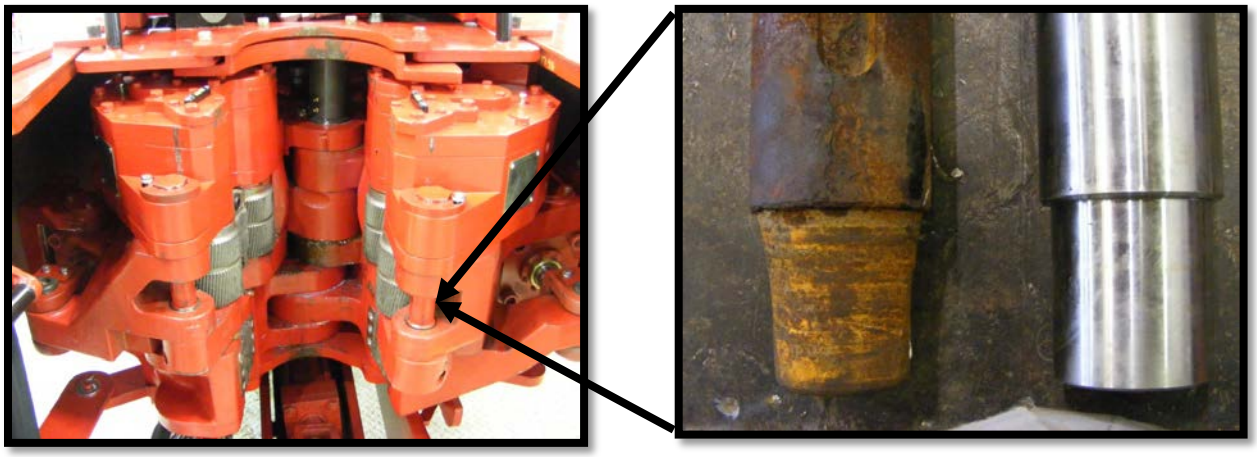
During the exercise, if you find that human error is identified as a cause, continue to explore why the error occurred (e.g. training not effective, onboarding not standardized, hiring process not covering experience, etc.).

Example:

A few months after a new Iron Roughneck was installed, the spin wrench roller shafts were damaged beyond repair resulting in a transmission replacement.

Upon inspection, it was determined that the lower spin wrench assemblies had not been properly greased. This caused the roller shaft bearing to damage the spin wrench roller shafts. The Motorhand had been tasked with daily maintenance.

Some of the questions you could begin with could be: *"Why didn't the critical grease fitting get greased?" or "Why did the Motorhand not add grease to the critical grease fitting?"* The answers to these will lead you down a path of additional questions where you can ask more *"Why?"* questions.



When you feel like you've arrived at root cause, you can check your logic by using the "therefore" test. You can do this by saying "*therefore*" to the statement above you're root cause and so on until you get to the original event statement.

Using the example above, here's some sample questions that could've arrive from the investigation:

"Why did the Motorhand not add grease to the critical grease fitting?"

Finding: Motorhand did not know there was a grease fitting there on the ST-80.

"Why did the Motorhand not know there was a grease fitting there on the ST-80?

Finding: Motorhand had not been using the ST-80 maintenance guide.

"Why did the Motorhand not use ST-80 maintenance guide?

Finding: The ST-80 maintenance guide was lost several hitches back and had not been replaced.

"Why did the maintenance guide for ST-80 not get replaced?

Finding: It was forgotten about.

"Why was it forgotten about?

Root Cause: There's no procedure in place to ensure that all the maintenance guides are available on the rig.

To perform the "therefore" test, you would then begin with the root cause and say "*therefore*" to the statement above you're root cause and to each other finding until you get to the original event statement. In the example above the "therefore" test would look like this:

1) There's no procedure in place to ensure that all the maintenance guides are available on the rig.

Therefore…

2) When a maintenance guide gets lost it can be forgotten to get replaced.

Therefore…

3) Maintenance (in this case) is completely dependent on a person's retained knowledge.

Therefore…

4) Personnel conducting maintenance can miss maintenance points on equipment, leading to failures.

Another thing to consider when identifying the root cause of an incident is to determine the presence of and/or utilization of processes (or lack thereof).

Sustainable tools like organizational processes, preventive maintenance procedures, or safe work practices are examples of systems, that when properly utilized, help reduce risk and mitigate hazards.

Step Six: Sustainable Change

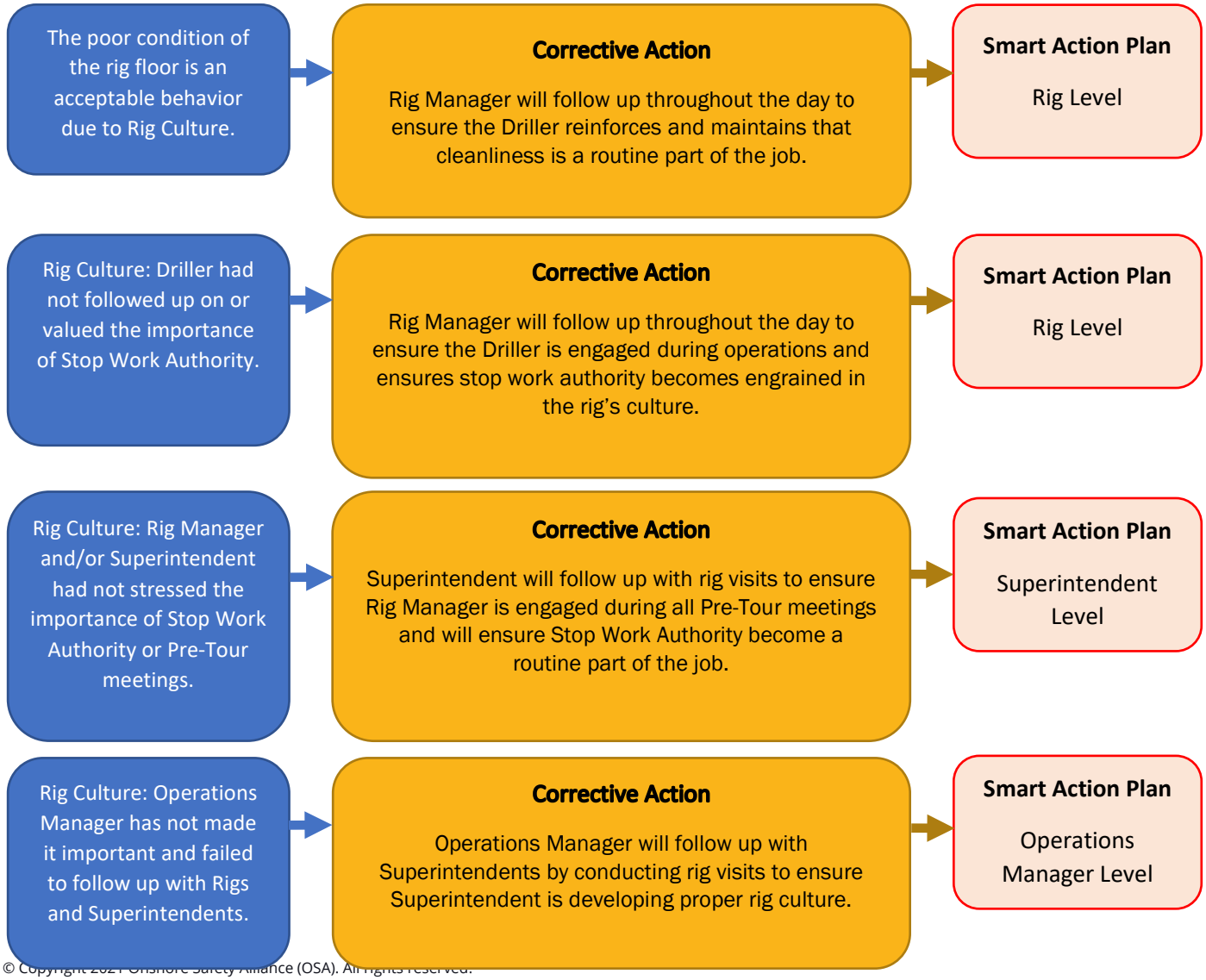
Corrective Actions

Once root cause(s) have been identified, the next step is to devise sustainable change to prevent the incident from reoccurring. The most critical part of creating sustainable change is in the corrective actions process.

Corrective actions are a tool used to set expectations following an incident. Once corrective actions (expectations) are set, supervisors follow-up (accountability) and provide feedback on results.

Depending on the severity of the incident, corrective actions can have multiple levels of responsibility – from the newest Floorhand to Senior Level Management.

Using an example (below) for an incident resulting from a dirty rig floor and Stop Work Authority not being utilized, you can see the different types of corrective actions throughout the organization to ensure that the proper expectations are (1) set, (2) followed-up on, and (3) provided feedback around.



Once the root causes are identified corrective actions are used to create sustainable change that will prevent a reoccurrence of the incident.

Corrective actions:

- Directly address the root causes identified during the investigation
- Must be specific - Identify who, will do what, by when
- Are a sustainable solution to fix the problem long term

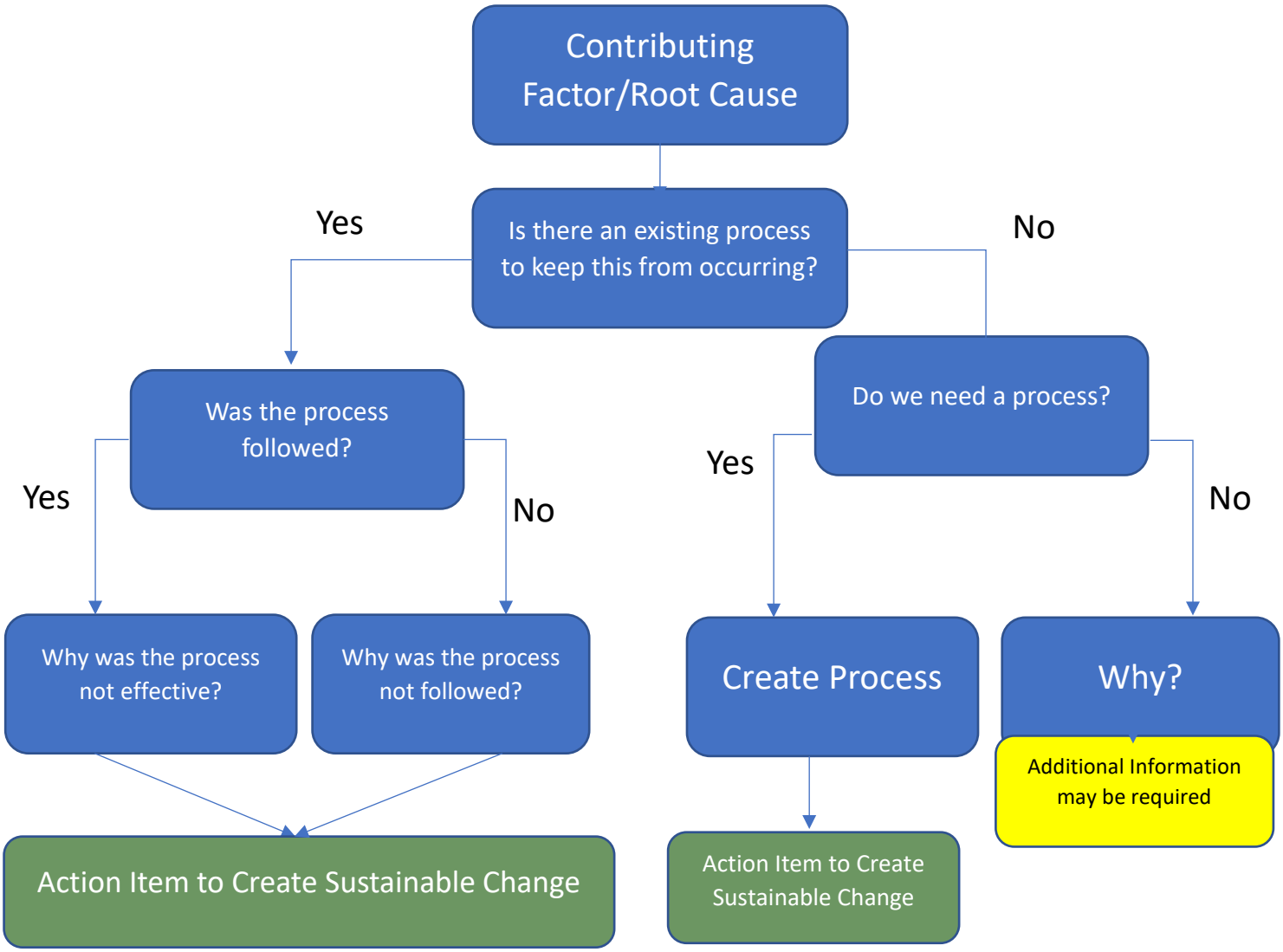
General statements such as, "*Improve adherence to written policies and procedures*," have failed to identify the specific root and therefore cannot create sustainable change.

Here are some other examples of statements that are not sustainable:

Not Sustainable:

- **Re-writing a JRA**
- **Reviewing a policy with all employees**
- **Reviewing incident with all crew members**
- **Ensure crew follows procedure**
- **Crew error – further training required**
- **Employees promise not to do it again (sign paper)**

Creating Effective Corrective Actions



S.M.A.R.T. Action Plan

S: Specific **M: Measurable** **A: Achievable** **R: Resourced**
T: Timebound

Once root cause(s) and corrective actions are understood, S.M.A.R.T. Action Plans are then used to address those root causes and create change in one or more of the following categories:

Behavior: Positive cultural change through direct, purposeful, and repeated interaction with employees.

Note: This cannot be accomplished through infrequent spot checking of behaviors.

Process: Modification or addition of a policy or procedure to address a specific concern or issue.

Engineering: Modifications to equipment, structures, or components to address design concerns.

S.M.A.R.T. Action Plans are:

Specific	Identifying who, does what, by when
Measurable	Quantifiable results ensuring that actions can be tracked and monitored to completion
Achievable	Reasonably attainable actions
Resourced	Anything that provides assistance in the completion of the action plan. (Support Groups, documentation, processes, etc.)
Timebound	Expected completion date to appropriately and promptly complete the action plan

S.M.A.R.T. Action Plan Examples

Below are some examples of S.M.A.R.T. Action Plans for given scenarios:

Behavior: The Superintendent will attend four Pre-Tours per week to ensure fit for duty evaluations are being completed by the Rig Manager throughout the month of August.

Process: The Rig Manager will submit a policy improvement request to include the part number for the correct style derrick belts in the Comprehensive Rig Inspection and fall protection policy by April 4th, 2021.

Engineering: The Rig Manager will submit a Management of Change request to relocate the support clamps in the substructure by April 19th, 2021.

Sustainable Change

When implementing S.M.A.R.T. Action Plans to create sustainable change, consider those policies, processes, or procedures that the organization currently has in place, as these can be a good starting point for S.M.A.R.T. Action Plan points of emphasis.

Wen implementing sustainable change, consider the following:

- Utilize existing processes
- Did this fix the problem, or is it still occurring?
- Did our solution create other problems locally or elsewhere in the company?
- Are the Action Items being implemented? What are the results?
- Don't reinvent the wheel
- Don't forget to follow-Up

In the end, the purpose of every investigation is to identify the Contributing Factors and Root Causes in order to determine effective Corrective Action(s) that will create Sustainable Change and prevent reoccurrences.

Activity – Investigation

Utilizing the information you've learned, perform a root cause analysis using the Why Method for the example scenario below. As part of the investigation team, interview the crew and help to determine the root cause.

Scenario: While working BHA, an Employee tripped over a crossover sub left on the rig floor, injuring his right knee.

As a group:

- Break into groups and investigate the scenario
- Facilitators will play the role of each crew member
- You will have 5 minutes to interview each crew member
- Each investigation team member is only allowed 1 question until all team members have participated
- Use good, open-ended questioning
- Utilize the why method to determine the root cause
- Identify corrective action(s)
- Write a S.M.A.R.T. action plan
- Present your findings, root cause(s), and corrective actions to the larger group

Root Cause Tree