General Principles of Root Cause Analysis (RCA)

1. The primary aim of root cause analysis is: to identify the factors that resulted in the nature, the magnitude, the location, and the timing of the harmful outcomes (consequences) of one or more past events; to determine what behaviors, actions, inactions, or conditions need to be changed; to prevent recurrence of similar harmful outcomes; and to identify lessons that may promote the achievement of better consequences. ("Success" is defined as the near-certain prevention of recurrence.)

2. To be effective, root cause analysis must be performed systematically, usually as part of an investigation, with conclusions and root causes that are identified backed up by documented evidence. A team effort is typically required.

3. There may be more than one root cause for an event or a problem, wherefore the difficult part is demonstrating the persistence and sustaining the effort required to determine them.

4. The purpose of identifying all solutions to a problem is to prevent recurrence at lowest cost in the simplest way. If there are alternatives that are equally effective, then the simplest or lowest cost approach is preferred.

5. The root causes identified will depend on the way in which the problem or event is defined. Effective problem statements and event descriptions (as failures, for example) are helpful and usually required to ensure the execution of appropriate analyses.

6. One logical way to trace down root causes is by utilizing hierarchical clustering data-mining solutions (such as graph-theory-based data mining). A root cause is defined in that context as "the conditions that enable one or more causes". Root causes can be deductively sorted out from upper groups of which the groups include a specific cause.

7. To be effective, the analysis should establish a sequence of events or timeline for understanding the relationships between contributory (causal) factors, root cause(s) and the defined problem or event to be prevented.

8. Root cause analysis can help transform a reactive culture (one that reacts to problems) into a forward-looking culture (one that solves problems before they occur or escalate). More importantly, RCA reduces the frequency of problems occurring over time within the environment where the process is used.

9. Root cause analysis as a force for change is a threat to many cultures and environments. Threats to cultures are often met with resistance. Other forms of management support may be required to achieve effectiveness and success with root cause analysis. For example, a "non-punitive" policy toward problem identifiers may be required.

General Process for RCA-based Corrective Action

1. Define the problem or describe the event to prevent in the future. Include the qualitative and quantitative attributes (properties) of the undesirable outcomes. Usually this includes specifying the natures, the magnitudes, the locations, and the timing of events. In some cases, "lowering the risks of reoccurrences" may be a reasonable target. For example, "lowering the risks" of future automobile accidents is certainly a more economically attainable goal than "preventing all" future automobile accidents.. 2. Gather data and evidence, classifying it along a timeline of events to the final failure or crisis. For every behavior, condition, action and inaction, specify in the "timeline" what should have been done when it differs from what was done.

3. In data mining Hierarchical Clustering models, use the clustering groups instead of classifying: (a) peak the groups that exhibit the specific cause; (b) find their upper-groups; (c) find group characteristics that are consistent; (d) check with experts and validate.

4. Ask "why" and identify the causes associated with each sequential step towards the defined problem or event. "Why" is taken to mean "What were the factors that directly resulted in the effect?"

5. Classify causes into two categories: causal factors that relate to an event in the sequence; and root causes that interrupted that step of the sequence chain when eliminated.

6. Identify all other harmful factors that have equal or better claim to be called "root causes." If there are multiple root causes, which is often the case, reveal those clearly for later optimum selection.

7. Identify corrective action(s) that will, with certainty, prevent recurrence of each harmful effect and related outcomes or factors. Check that each corrective action would, if pre-implemented before the event, have reduced or prevented specific harmful effects.

8. Identify solutions that, when effective and with consensus agreement of the group: prevent recurrence with reasonable certainty; are within the institution's control; meet its goals and objectives; and do not cause or introduce other new, unforeseen problems.

9. Implement the recommended root cause correction(s).

10. Ensure effectiveness by observing the implemented solutions in operation.

11. Identify other possibly useful methodologies for problem solving and problem avoidance.

12. Identify and address the other instances of each harmful outcome and harmful factor.

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