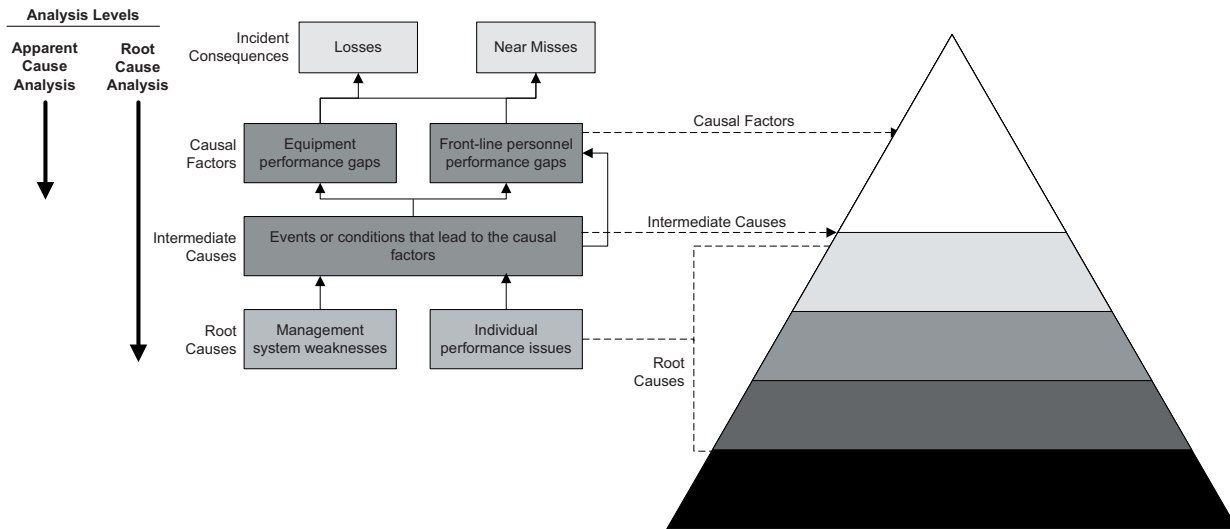


## Section 1: Basics of Root Cause Analysis



**FIGURE 1.11: Levels of Analysis**

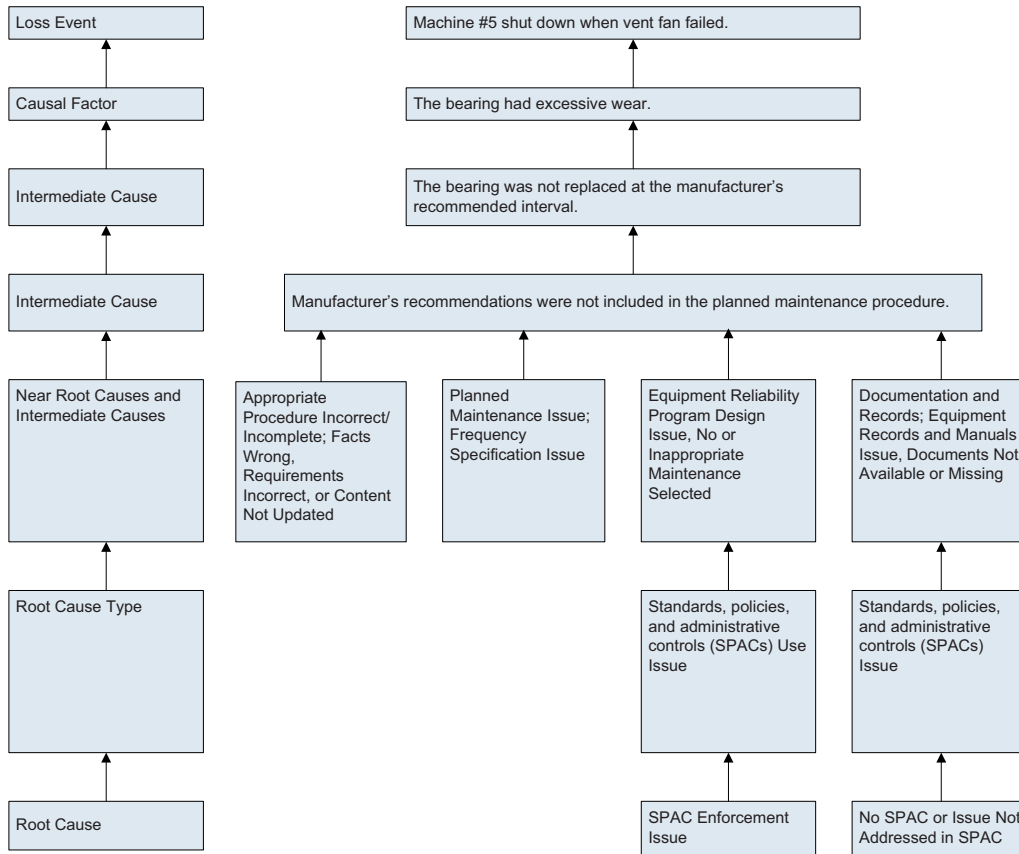
Root cause analyses (RCAs) investigate the causes of the incident all the way down to the root cause level. Apparent cause analyses (ACAs) only investigate the causes of the incident down to the causal factor level. If the goal of the analysis is simply to determine who or what caused the incident in a short amount of time, then an apparent cause analysis is all that is required. ACAs are generally only performed on incidents with small consequences. However, if the goal of the investigation is to determine the underlying causes of why the incident occurred, then a root cause analysis is the best approach. By digging deeper into the root causes (instead of simply doing an ACA) the recommendations generated from the analysis will have broader impact. RCAs are generally performed on incidents with larger consequences.

Figure 1.12 shows the levels of analysis for a machine shutdown incident. The loss event is that Machine #5 shut down when the vent fan failed. The vent fan failed because the outboard fan bearing failed. The bearing failed because it had excessive wear (it wore out). The bearing was worn out because it was not replaced at the manufacturer's recommended interval (every 2 years). The bearing was not replaced per the manufacturer's recommendations because the planned maintenance procedure stated that the bearing should be replaced every 4 years instead of every 2 years. The incorrect maintenance interval was listed in the procedure (Appropriate Procedure Incorrect/Incomplete; Facts Wrong, Requirements Incorrect, or Content Not Updated). The procedure had the wrong maintenance interval listed because the wrong planned maintenance frequency was determined during the maintenance analysis (Planned Maintenance Issue; Frequency Specification Issue). The wrong maintenance interval was determined during the maintenance analysis because the equipment reliability program specified the inappropriate maintenance (Equipment Reliability Program Design Issue; No or Inappropriate Maintenance Selected). That was because during the equipment reliability program analysis, the Reliability Engineers did not have the original equipment manufacturer's (OEM) manuals available (Documentation and Records; Equipment Records and Manuals Issue; Documents Not Available or Missing).

The equipment reliability analysis program did not specify the correct maintenance because the policy that requires the Reliability Engineers to use the OEM manuals was not enforced (SPAC Enforcement Issue).

The documents were not available to the Reliability Engineers because there was no policy that required the Procurement Group to share OEM manuals with the Reliability Group (No SPAC or Issue Not Addressed in SPAC).

## Section 1: Basics of Root Cause Analysis



**FIGURE 1.12: Connection between Causal Factors and Root Causes**

So, to address all the causes of this incident would require the following:

- Replace the bearing that failed
- Modify the planned maintenance procedure to require replacement every 2 years
- Look for other fan bearings that may need to be replaced because they have not been replaced in accordance with the manufacturer's recommendations
- Look for other bearings that may need to be replaced because they have not been replaced in accordance with the manufacturer's recommendations
- Enforce the requirement that OEM manuals be used during reliability analyses
- Develop and implement a process to share OEM manuals with the Reliability Group

This analysis shows how digging deeper into the causes of an incident can reveal underlying causes that are fundamental to the functioning of the organization. In this case, the analysis of a bearing failure revealed that the Reliability Group did not have all the information they needed in order to perform their work. Solving this issue should not only prevent this bearing from failing, but should also prevent many other failures from occurring.

### 1.11 Definitions

Before we launch into the specifics for each step in the investigation process, we need to cover some definitions that we will use throughout the rest of the handbook. There is much debate in the RCA field as to the definitions that should be used. Different RCA methodologies use a wide variety of terms for the