



MEDICAL MACHINING

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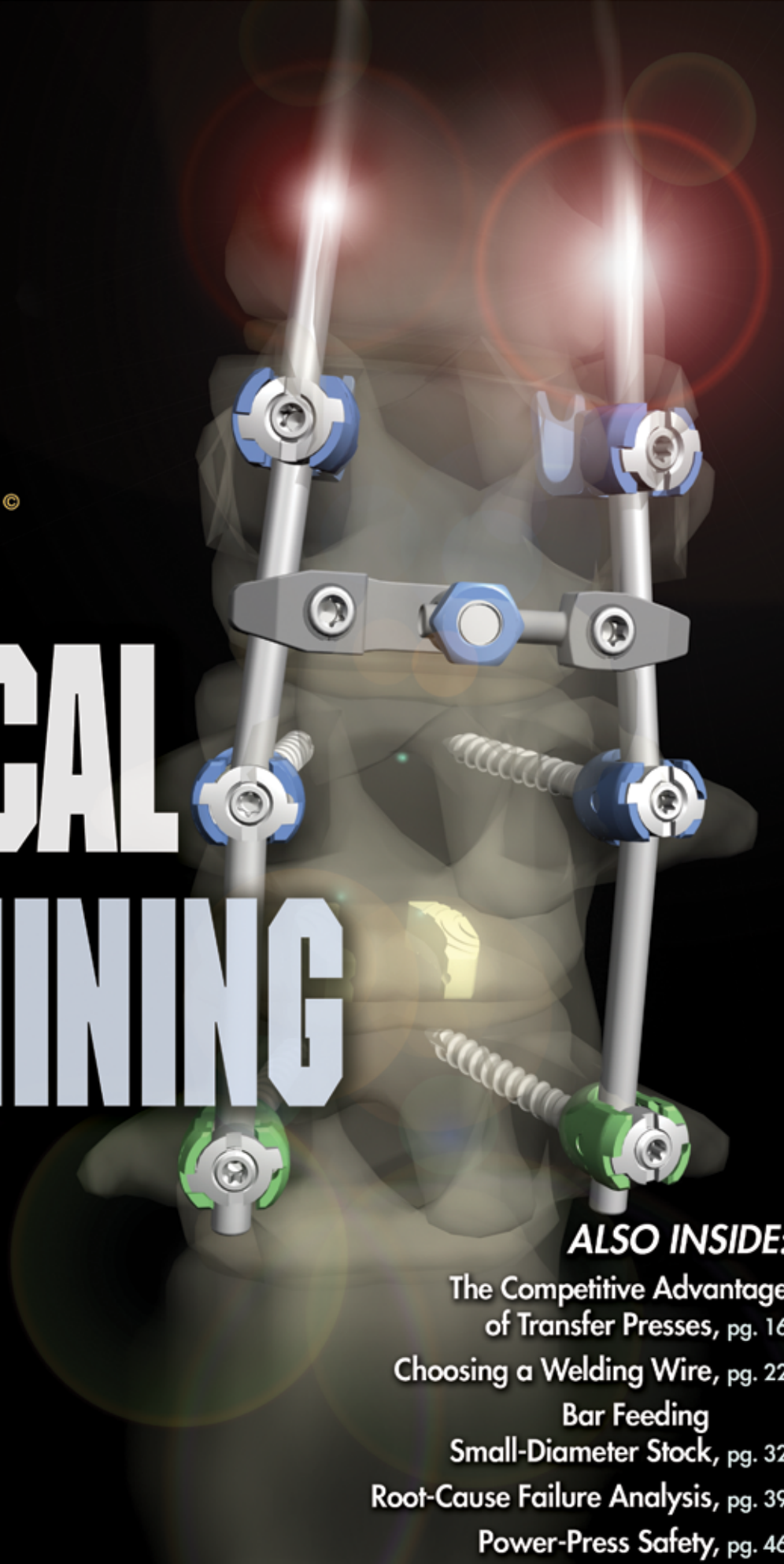
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A Foundation of Evidence

The effectiveness of root-cause-failure analysis—or any investigation—depends first on the evidence gathered.

By Tim Heston

The most common question people ask root-cause-failure-analysis (RCFA) expert Robert Latino may seem, on the surface, a bit basic. Latino, executive vice president of Hopewell, Va.-based Reliability Center, Inc., has spoken at length about root cause, considered the most in-depth of all evidence-based maintenance tasks. Yet most want to know—what exactly defines root-cause failure analysis?

"The process of root-cause failure analysis is a fancy term for what is, in essence, a police investigation," he says. When police enter the crime scene, they don't know what is relevant; so they rope off the area and take pictures of everything. The information produces leads, which, as implied by the term, "lead" to more relevant information.

The same thing happens for RCFA. Of all the RCFA elements, gathering evidence provides the keystone. Without it, all subsequent analyses of data falter. The process makes no presumptions—and this in itself helps limit the "blame" culture. At first, a problem may seem like operator error. Yet in an in-depth root cause, that may not be all the evidence shows. Operator training procedures may be faulty, as well as product and process design. The investigation starts out with a level playing field, digs deep and offers a solution only with all the evidence gathered.

THE FIVE PS

Latino groups evidence-gathering into what he calls the Five Ps: parts, position, people, place, paradigm.

Parts represent "anything tangible: gears, bearings, seals, lubrication." Here, the pressure to get back into production is at its greatest, and "often overrides the need to collect evidence," Latino says. "Just imagine in a crime scene if that were the mentality, and everybody cleaned up the scene before the detectives could get the data?"

Paper involves more than data printouts from quality and control systems, he says. What if operators did not follow procedures, or weren't trained properly? Or there was a vendor problem? To cover these possibilities, paper records can also include maintenance and operator procedures, OEM data, training records and purchasing records.

As for **people**, root cause should include not only the obvious participants: the observers and participants of the failure. "A real investigation is going to branch out," he says. "You may be interviewing purchasing people to find out if they've switched vendors. There may be a design failure, so engineering would be involved. "We tend to focus on the people closest to the work," he says. "That's where the 'blame' culture comes from."

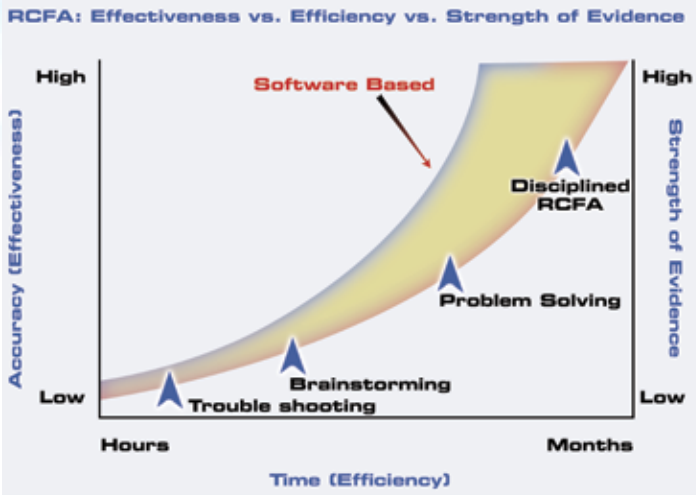
Position, Latino says, is "the most overlooked category." This evidence includes positions in space and time. Most relate to where failures occur—say, a shaft broke so many feet away from a pump. What's left out is time. When did the fault happen in the process? Does it only happen at this plant location, or do other facilities have similar failures? Those conducting root cause should interview those close to similar operations as well.

Paradigm involves common themes. "There will be common themes that you will start to hear throughout all these interviews," he says. Those themes show how people see the world, and everyone sees it a little differently. As a simple example, an operator might say the equipment was old, and that is why it failed. Meanwhile, maintenance personnel might say the failure was the operator's fault. "The task in root cause analysis is to determine, are these paradigms reality or just perception?"

THE RIGHT QUESTIONS

A manufacturer could learn a lot from the courtroom litigator. So much of root-cause involves information gathered from people, and how much information they tell you depends a lot on the way questions are phrased. Root cause can seem accusatory, particularly in negative, "blame-culture" shop floors. "You have to ask questions with so much clarity, as if you were looking through the eyes of the person you are interviewing."

For instance, Latino explains, say an observer to a machine crash is asked, What did you see? That's all he will tell you—what he saw, not necessarily what he felt, heard or even smelled. He will tell you, for instance, that he saw the shaft break, yet he won't tell you that he felt a vibration at his feet all day. Now consider another phrasing: What did you sense? "That takes on a whole new meaning," Latino says.



As depicted here, disciplined root-cause failure analysis takes the greatest amount of evidence, when compared to other maintenance tools. Software can speed the process in some instances, yet it doesn't change the strength of evidence required.

That said, if people tend to blame others indiscriminately, root cause failure analysis can't happen, he says. In such a negative environment, people, feeling accused, will not give all the information they know about the problem. "The key to root-cause analysis is not finding out who made the bad decision. It's finding out *why* they thought it was the right decision at the time they made it. That, in turn, uncovers the systemic issues that are indicative of the systems of the organization."

In root cause, people aren't to blame; systems and processes are. By and large, people don't intentionally crash a machine or, for that matter, cause any error. But even if they did, the system could still be a major contributor. Consider an operator who leaves a machine unattended until it crashes. Under root-cause, the blame does not lie with the employee. Even though the employee may have a history of apathy and laziness, investigators should not presume anything before seeing all the evidence—all the Ps, from parts to paper (including personnel records) to paradigm. If the evidence points to the operator, it doesn't end there. He may be a cause, but he isn't the root cause. Any number of system failures may have led to the employee error, including faulty (or lack of) training, work load, part flow, job scheduling, hiring practices, supervisory structure, employee evaluations and compensation practices, just to name a few.

"Hindsight-bias is a big no-no for investigators," Latino explains. They shouldn't judge, but try to understand the circumstances employees were under at the time of the error. "You need to understand the pressure they were under and their entire situation to understand why they made the decision they did," he says.

Another big misconception, he says, is focusing on the incident and not the consequences. The opposite should happen, since without the consequences, of course, RCFA wouldn't serve much purpose.

"There's a distance in time between the incident and the consequence," Latino says. Consider a turbine-blade failure, with 72 hours of downtime as the consequence. A cracked blade might be one of

the reasons the turbine failed, but what about the time between "when you were able to isolate the failure and the consequence? The way we responded could have impacted the magnitude of the consequence. In this case, there are events that made the consequence worse. Had you only focused on the equipment side of it, you would not have picked that up."

MAKING THE CHANGES

With the evidence gathered and analysis made, "many organizations then drop the ball," Latino explains. "Investigators are often charged with the responsibility of recommending changes to management, then carrying them out." Yet Latino feels this actually takes away from their investigative work. Implementing root cause could be called more of an exact science than dealing with company bureaucracy. "They should be kept in the loop, but they should not be charged the responsibility of tracking and following [the implementation] up if you want them in an investigative capacity."

THE HUMAN ELEMENT

Technology such as software can help matters, but no software offers a panacea that totally automates the process. "All the [computerized maintenance management systems] out there that I know of are designed to detect physical failure," Latino says. "When you uncover the latent-level systemic issues in a root-cause analysis, [computerized systems] don't work as well."

Consider a problem caused by cheap parts that didn't work as they should. True root cause would lead down the human as well as the mechanical path. The parts may have created the error, but what caused those parts to be purchased in the first place? Perhaps the purchasing department receives greater bonuses the more money they save on part purchases, without considering quality. Software would not help in gathering that kind of evidence. Typically, CMMS systems are not designed to accommodate the handling of latent-level root causes.

WHAT MAKES RCFA DIFFERENT

Root-cause-failure-analysis shouldn't be over-applied. It's expensive. Detailed evidence gathering takes time and requires a certain amount of downtime on the floor. So before launching root cause, ensure it is applied correctly.

According to Latino, manufacturers should abide by the 80-20 rule: 20 percent of problems cause 80 percent of losses. For this, set up a spreadsheet detailing problems and the total annual losses associated with each. Rank those problems from largest to smallest annual loss.

Of all those, only 20 percent of those problems (or fewer) should be even considered for root-cause—simply because of the time and money it requires. This, Latino says, does not mean root cause should be avoided, only reserved for the problems that cause most of the company's losses.


For the rest, other tools are available. Troubleshooting, brainstorming and problem solving all look at the interaction of cause and effect. Problem solving, says Latino, is analogous to a fish-bone diagram or "Five Whys," where investigators ask no fewer than five questions to ensure they reach the original cause. All of these take less time and money, principally because they don't require as much evidence. However, this means the methods are also prone to be less accurate.

MAINTENANCE

THE ROOT-CAUSE POPULARITY CYCLE

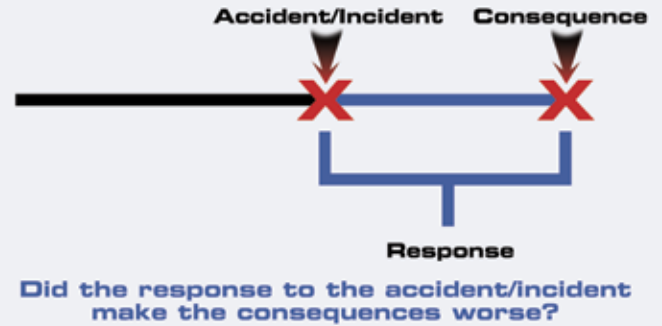
"When you have a downturn in the economy, root cause is a luxury most companies don't spend money on," Latino says. "Yet if there is ever a time you ought to be doing root cause, it's during a downturn, because you don't need those costly failures to keep recurring." Like lean, Six Sigma and similar measures, root cause can add to the bottom line without increasing revenue.

"Because of globalization, companies now focus more on margins than ever," Latino concludes. "When you're in a sold-out situation, then the key to profitability is through your revenues, so root cause is vital to reliability, because any hour you lose, you're not going to get back. In a downturn, the only way to affect margin is on the other side of the coin; you have to deal with cost."

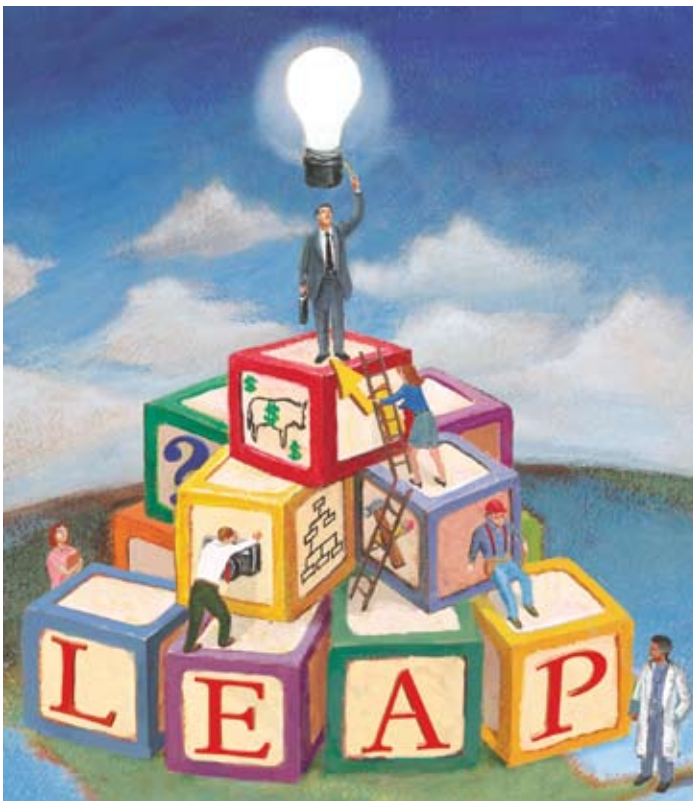
And along with other tools, root-cause analysis, he says, can be used to reduce those costs. 

Editor's Note: Robert Latino, executive vice president for Reliability Center Inc., Hopewell, Va., has facilitated root-cause and failure-mode-and-effects-analysis for 20 years, and has conducted numerous workshops on the subject. For more information, visit www.reliability.com.

Failure Time Line



Root cause should focus on how to reduce or eliminate the consequences, not just on the incident. For that, the time between the incident and the consequence should not be ignored.



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