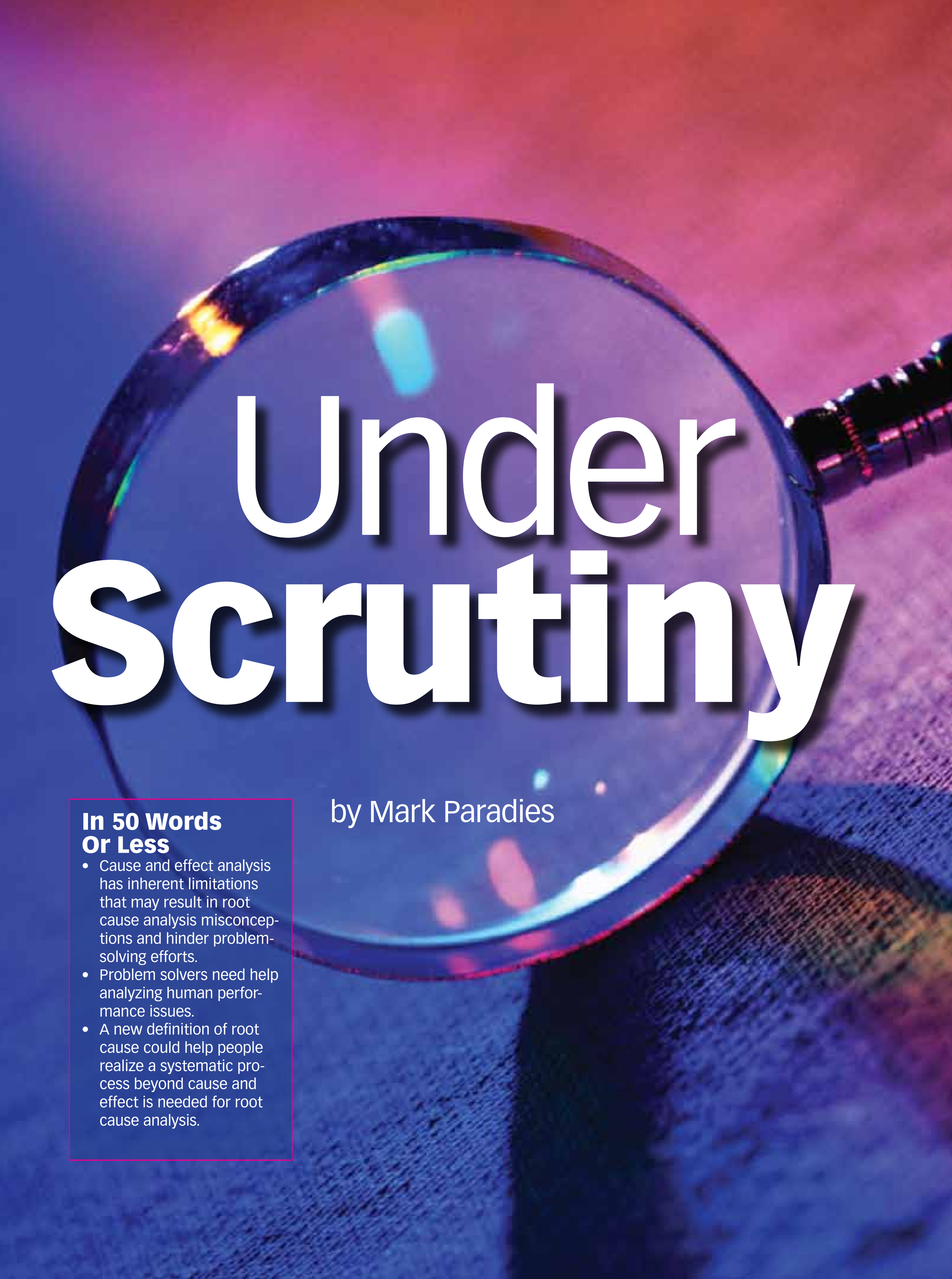

Under Scrutiny

by Mark Paradies

In 50 Words Or Less

- Cause and effect analysis has inherent limitations that may result in root cause analysis misconceptions and hinder problem-solving efforts.
- Problem solvers need help analyzing human performance issues.
- A new definition of root cause could help people realize a systematic process beyond cause and effect is needed for root cause analysis.

New approach to root cause analysis can help **clear up misconceptions**

FOR MANY YEARS, quality improvement practitioners have been taught to find root causes of problems by using a set of tools based on the theory of cause and effect. These tools include the five whys and fishbone diagrams. Many users of these techniques, however, find that some problems, especially those caused by human error, keep happening.

Because of the failure of these techniques to stop problems, some problem solvers might start wondering:

- Am I using the tools correctly?
- Is there a misconception in using cause and effect to find the root causes of problems that produces unacceptable results?
- Is there another technique to help me go beyond basic cause and effect analysis and get better results when investigating quality issues?

If you use cause and effect to find root causes, you might want to rethink your beliefs on this concept and look at what some consider to be misconceptions in applying commonly taught root cause analysis techniques.

"Only tool" misconception

Many quality professionals believe cause and effect (the infinite chain-of-causation philosophical model[1]) is the only (or perhaps preferred) method to find root causes, maybe because cause and effect is taught in most Six Sigma courses.

Many quality professionals don't realize, however, that cause and effect analysis has major shortcomings that could lead them astray. Perhaps their confidence in cause and effect is based on the fact that cause and effect has been around for so long. After all, Socrates first demonstrated the concept to the Western world prior to 399 B.C. through his Socratic method.

Similar to many philosophical concepts, it may surprise you that cause and effect is not a rule or law. It's a model—with benefits and limitations debated by philosophers since Socrates. For example, David Hume, author of *An Enquiry Concerning Human Understanding*, questions the very basis for our human understanding of cause and effect: "When we … consider the operation of causes, we are never able, in a single instance, to discover any power or necessary connection; any quality, which binds the effect to the cause, and renders the one an infallible consequence of the other."[2]

Rehashing philosophical arguments of a bygone era is not my purpose. Rather, as an engineer, I prefer to search for practical answers to everyday problems faced by people trying to improve performance, and to focus on the practical limitations of cause and effect.

Confirmation bias

Philosophical arguments may not convince current users of cause and effect to look beyond their current tools. An understanding of the scientific limitations of the approach, however, may convince people to explore other concepts.

For example, one practical limitation for people applying cause and effect is confirmation bias, a problem-solving heuristic that simplifies the analysis of contradictory information collected on a complex problem.

Researchers who have examined confirmation bias say people tend to jump to conclusions before all the data are gathered and analyzed. From the point that people see or hypothesize a familiar pattern (answer), they tend to look for information to confirm their conclusions (the bias).

People may subconsciously disregard evidence that counters their conclusion. This concept was first explored to explain the biases observed in scientific research. Extensive research shows this is a common human error made by all types of problem solvers, not just experienced scientific researchers or inexperienced problem solvers.[3-5]

Why are cause and effect analysis and the five whys susceptible to the trap of confirmation bias? Because the unguided, deductive reasoning inherent in cause and effect analysis requires problem solvers to use their understanding of the problem to develop a chain of causation. Problem solvers tend to collect evidence about problems they understand. Therefore, the evidence they search for confirms their existing bias. They disregard, or perhaps don't even see, evidence that doesn't fit their mental model (that is, a model based on their experience).

Can't go beyond current knowledge

Another misconception related to the reasoning behind the confirmation bias problem is that problem solvers using cause and effect seldom go beyond their current knowledge. This problem was demonstrated in a QP article, "Flip the Switch," which included an example of the Jefferson Monument dirtied by birds.[6] Park service rangers asked "why" five times (or more) to form this chain of causation:

- Why does the memorial deteriorate faster? Because it gets washed more frequently.
- Why is it washed more frequently? Because it receives more bird droppings.
- Why are there more bird droppings? Because more birds are attracted to the monument.
- Why are more birds attracted to the monument? Because there are more fat spiders in and around the monument.
- Why are there more spiders in and around the monument? Because there are more tiny insects flying in and around the monument during evening hours.
- Why are there more insects? Because the monument's illumination attracts more insects.

But this causal chain assumes the rangers know washing the monument is the causal chain to investigate. The rangers seem to come up with the idea that reducing the washing frequency could occur if the lights were turned on one hour later (thus, attracting less bugs).

You might ask, "Where did they get this idea?"

The first answer is already jumping to conclusions. You could assume that someone involved with solving this problem had the idea that bugs, birds and washing

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caused this problem. The problem solver then built a causal chain to validate the answer.

Could other ideas be developed if the rangers had started looking at the sequence of events of the monument's deterioration? Could they discover other important factors? For example:

- Selection of materials for the monument.
- Selection and installation of lighting. Was it always lit?
- Selection or purchasing of cleaning materials.
- Application of cleaners and cleaning methods.
- Changes in bird habitats and feeding or roosting patterns.

This isn't an exhaustive list, but it presents a few possibilities to demonstrate what could be missed without fully understanding the sequence of events before drawing conclusions. Missing potential alternatives can waste efforts when fixing phantom problems or pushing problems from one area to another.

But how can you argue with success? The rangers' solution of turning on the lighting one hour later in the evening reduced monument deterioration by 90%. But remember that correlation does not prove causation.

Do we know the lighting change was the only change? Did the measurement of the problem cause the monument cleaners to be more careful and do less damage? Did a weather change (dry or cold spell, or global warming) contribute to a temporary shift in insect breeding and density? Are measurements of deterioration accurate? Did the change in lighting simply shift the bird-dropping problem to another monument where the bugs and birds now congregate?

This example shows it can sometimes be difficult for people to analyze problems beyond their current knowledge because they try to make the problem fit inside their understanding of the issue. Therefore, when using cause and effect, you must know the cause of an effect, and you must have knowledge of all possible causes to be able to reach an accurate conclusion.

The human factor

This may be OK in a narrow field being analyzed by one of the world's leading experts. But most quality problems are not caused by wildlife interacting with monuments. Most quality problems aren't within a narrow area of expertise. Most people on the factory floor aren't the world's leading experts in human performance, equipment reliability, or bug and bird habits.

Human performance issues (human errors) cause most quality problems. But most problem solvers have no formal training in human engineering or ergonomics (the science of human error and human performance).

In nonscientific polls of those who attended my root cause courses, few (less than 4%) said they had training in human factors, but almost everyone said investigations they perform look into causes related to mistakes made by people (operators, mechanics, engineers, doctors, nurses and managers, for example).

How can someone without training in the science of human error use a misguided process (cause and effect) to find the root causes of human performance problems when they don't know what causes human error? W. Edwards Deming said: "Lack of knowledge … that is the problem. You should not ask questions without knowledge. If you do not know how to ask the right question, you discover nothing."[7]

One common misconception is that anyone can use cause and effect to analyze any problem. Because of the limitation of cause and effect, however, you can only use it to analyze problems that are already understood.

Single-cause misconception

Another common misconception in analyses performed by people trained in cause and effect is the error of identifying a single cause. This was demonstrated in the two cause-and-effect examples presented in "Flip the Switch."[8]

Although neither example is a typical quality related problem, they were presented as successful examples of the technique and provide interesting insight into the limitations of cause and effect.

Both examples focused on a single chain of causation. This is common when people apply the five whys method. They ask why five times around a single cause and then correct the cause at the root of their five whys chain.

Why is this single causal-chain focus a problem? Major accidents or quality issues are seldom the result of a single causal chain. Trevor Kletz, an expert in accidents in the chemical industry and author of many books on process safety, wrote in *Lessons From Disaster*: "Every accident has many causes. Bill Doyle, one of the pioneers of loss prevention, used to say that for every complex problem there was at least one simple, plausible, wrong solution."[9]

Just like accidents, major quality problems are usually the result of a sequence of events containing multiple causal factors. Each causal factor has one or more root causes that, when corrected, will improve performance and eliminate future quality problems.

The single causal chain misconception leads to missed opportunities to improve performance by eliminating multiple root causes that may not be present in the causal chain picked by the five whys problem solver.

Some may argue the five whys technique isn't intended to be used to solve complex issues, but only simple ones. For this concept to work, a problem solver must know when a problem has a single causal chain (simple problem) and when a problem is more complex (multiple causal chains).

Unfortunately, in reviewing thousands of problem analyses, many simple problems (for example, injuries, human errors, equipment failures and management missteps) are either:

- Part of a much more complex sequence of events.
- Seen as a simple problem because they are not thoroughly investigated. After further analysis, the problems turn out to be more complex.

Thus, the five whys examples presented in "Flip the Switch" demonstrate the misconception that major problems (cholera epidemics and monument deterioration) may be caused by a single root cause, even though the article states before the examples that "There could be multiple root causes."[10]

More misconceptions

More misconceptions or problems are not the only practical limitations inherent in the cause and effect approach to root cause analysis. Other practical limitations include:

- Improper use of deductive reasoning.[11]
- Lack of practical training.[12]
- Difficulty in trending results.
- Tunnel vision.[13]
- Fuzzy haze (when the brain automatically fills in missing information when it perceives something, sometimes leading to misperceptions).[14-15]
- Results not repeatable (varied based on the analysts).[16]

Redefine and change your approach

A common definition of root cause that springs from the cause-and-effect tradition of root cause analysis is that a root cause is "an initiating cause of a causal chain which leads to an outcome or effect of interest."[17] This definition, the theory of cause and effect and the practice of "ask why five times" all lead to the problems outlined earlier.

With so many people trained in this method, is there hope? What can you do to move beyond cause and effect? Perhaps it's time to challenge some common beliefs, accept a new definition for root cause and adopt a new, systematic method for root cause analysis.

New definition: Let's begin with a completely new definition of root cause not based on the cause and effect philosophy: A root cause is the absence of a best practice and the failure to apply knowledge that would have prevented the problem.[18]

Once you accept that root cause analysis is the search for the missing best practices and knowledge that will prevent a problem, it is easier to see how a root cause analysis system should help guide a problem solver to the missing knowledge. Root cause analysis can be a structured, repeatable process that helps the problem solvers go beyond their current knowledge and find the real, fixable causes of the human errors and equipment failures that lead to most quality issues.

New method: For a root cause analysis process to help problem solvers go beyond their current knowledge, it must be much more robust than simply asking why five times (or more) or looking for an infinite chain of causation. It must:

1. Use evidence of the failure (problem) to completely understand what happened before trying to decide why it happened.
2. Identify multiple opportunities to stop the problem (multiple causal factors).
3. Have built-in expert systems that can be used intuitively by problem solvers to find the root causes of each of the causal factors.

4. Help problem solvers look beyond the immediate causes to find correctable systemic issues (generic causes).
5. Help problem solvers find effective actions to prevent the problem's recurrence when all the root and generic causes have been identified.

Anything less than the thorough understanding of the causes and corrective actions based on an advanced analysis of the problem's root causes is simply a misconception. To avoid being accused of bias, there are alternative root cause analysis techniques that can be used to find a system that avoids the drawbacks mentioned, and meets their needs and the criteria my research and experience has shown as necessary to produce reliable root cause analysis results.

Getting beyond the pitfalls common with cause and effect analysis is critical for those interested in systematic elimination of quality issues. **QP**

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