

The 5 Whys: It's a DAM problem!

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What we observe is not nature itself, but nature exposed to our method of questioning.

—Werner Heisenberg

This month, we'll focus on "what" based questions: how they reveal solutions to problems faster and better than "why" based questions.

The [5 whys](#) are a tool that has been adopted by Six Sigma and Lean, and comes from [Taiichi Ohno](#), the pioneer of the Toyota Production System. Even though this technique is highly regarded, it's a tool I rarely see used in practice, and for me, it just doesn't work as promised. What the 5 whys are supposed to do is find the root cause to any problem quickly. The example Ohno uses goes like this:

Q1: Why did the robot stop?

A1: The circuit was overloaded, causing a fuse to blow.

Q2: Why is the circuit overloaded?

A2: There was insufficient lubrication on the bearings, so they locked up.

Q3: Why was there insufficient lubrication of the bearings?

A3: The oil pump on the robot is not circulating sufficient oil.

Q4: Why is the pump not circulating sufficient oil?

A4: The pump intake is clogged with metal shavings.

Q5: Why is the intake clogged with metal shavings?

A5: Because there is no filter on the pump.

In this example, the 5 whys appear to work perfectly. Part of the reason is the person answering these questions has a perfect under-



standing of the robot. If you take a moment and think through this example you will start to see an immediate problem. For example, if you had a perfect understanding of the machine, why wouldn't there be a filter on the pump to begin with? Where did the metal shavings come from? Are the gears and other metal rubbing together inside the robot and wearing themselves out unexpectedly because of a poor design? Does this mean that in a matter of months all of these robots will require a very expensive overhaul? Are we kidding ourselves that the small filter will solve our problem when there are much more serious issues with the robots and their design to consider?

What if we have a very limited understanding of our problem? Will the 5 whys help? For example, let's say you have too much wicking in a drilled hole. Here is how the 5 whys might play out:

Q1: Why is the wicking excessive?

A1(a): Because the glass bundles have been damaged so much that there are microscopic pathways for plating chemistries to be absorbed through capillary action.

A1(b): Because there was poor impregnation of the resin system to the glass creating microscopic canals that were never filled with resin. This provides a wicking path for plating chemistries.

A1(c): Because the material was left too long in the plating tank, where chemical materials absorbed to their maximum within the material.

And so it goes with multiple answers. Are any of these answers right?

Let me put this multiple answer scenario in mathematical terms. Let's say for each why question (e.g., "why did this happen?") there are at least four possible answers. Therefore, for each of these four answers there would be the

second round of why questions (or second level) that would each generate four possible answers. This would mean there are 16 questions to ask for the third why (third level), producing 64 answers. By the time we reach the 5th level the expectation is we will unearth the true root cause.

What we wind up with instead is 256 questions and 1,024 possible answers! This type of geometric progression, discussed in [What is the DAM Problem with Scheduling?](#) (The PCB Magazine, July 2013), is why these types of problems are called NP Hard or Complex problems. The reality is, the less we know about what happened, the more the 5 whys will make finding a solution within our lifetime hopeless. It seems in order for these why questions to work, we have to start off with a pretty good understanding of our problem.

There is something even worse to consider with the 5 whys. What is the probability of being right if there is only one right answer at each level? If you are just guessing, then the probability of being right at the first level is 25%. The probability of being right at the second level is 6.3%. The probability of being right at the third level is 1.5%. The probability of being right at the fourth level is 0.4%. And for the fifth level the probability of being right is 0.097%. In order to compute the probability of being right at all five levels so that you find the one true root cause you must multiply all of these probabilities together, resulting in a 0.00000009165% chance of being right!

Some of you may object to the whole way I went about this argument, and you insist on using the 5 whys anyway. Consider the following video in which Nobel Prize winning physicist Richard Feynman is asked, "[Why do two magnets held in a particular way repel each other?](#)" He answers that a "why" question is predetermined by our existing understanding of nature and our bias of how we think things work. For example, how would you respond to

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an alien who asks, "Why can't you pass your hand through a rock?" As absurd as this question appears, it is a fact that [matter is mostly pure empty space](#), as explained quickly and efficiently in this short video.

You see, only if you have a really solid understanding of the theory of quantum mechanics and electrical forces can you have any hope of explaining your answer. Does not knowing why we can't pass our hand through a rock cause any problems for us? Would knowing why help us? Perhaps understanding why isn't as important as we think. And the reality, for even the simplest things such as being able to pick up a rock that is 99.99% empty space and throw it and watch it fall, we don't understand why. What is amazing is that if you ask why this is so, 99% of people will not admit that they don't know why? Why is that?

There is a psychological side to asking why. For example, you come home from work and your significant other isn't happy.

Fresh from your Six Sigma or Lean training you decide to try the 5 whys in order to discover the true root cause to your partner's unhappiness so you can fix it: "Honey, why are you so annoyed?" There are several possible answers you would likely receive back such as: "Why are you such a pompous jerk?" The problem with a why question is it puts us on psychological defense, because we feel instinctively attacked or cornered. We either attack back or subvert the line of inquiry so that it comes to a halt. And when we feel attacked, our brain is no longer thinking. Our fight-or-flight emotions kick into overdrive.

Where Do We Go From Why? What!

What is the alternative to the 5 whys? "What-based" questions that have no hint of prejudicial judgment or bias. For example, when a police officer arrives at an accident scene, he asks, "What happened?" Then he

gets his pen out and start listening and writing. What does that activity of taking notes do? It causes us to talk more, because we feel significant and important. We are receiving attention. We aren't being judged. And we feel safe. Could you imagine what would happen if the police officer went up to a driver involved and asked, "Why did you smash into that other car?" Or ask a witness, "Why did this crash happen?" instead of, "What did you see?"

In my column, [The Reliability Mindset](#) (*The PCB Magazine*, June 2012), I suggest these four questions when something goes wrong, such as scrap material, a machine breaks down, a loss of a customer, or somebody didn't show up for work.

- 1) What happened?
- 2) Did we know this was going to happen?
- 3) When will it happen again?
- 4) What are we going to do about it?

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Because of the 5 whys, I get a lot of resistance from smart people who think they need to understand why an event happened in order to prevent it from happening in the future. And they are typically insulted about the need to ask what happened, because this implies they didn't understand something. They will say to me, "I know what happened and what the problem is." And yet when I ask five different people what happened, I get five different answers. What does this mean? There is a poor understanding of what happened. How is this fixed? With a very careful investigation by a team.

When a plane crashes, do people ask the 5 whys on the spot and get an answer within minutes? No. They get a team of experts and they spend months carefully answering in minute detail "what happened?" What is their next question? You guessed it, "Did we know this was going to happen?" And they proceed

through the four questions above. Why? Because they live in a fault-intolerant industry. They have to be continuously improving. The same event can't ever happen again. In order to achieve this they must change what they do and how they think, because what they were doing and thinking before wasn't good enough. Can you imagine what would happen in your board shop if you started this line of inquiry for any problem you face in a spirit of not having the same problem repeat itself again and again?

Is there any value to the 5 whys? I don't know, what do you think? What has been your experience? What are your ideas about how you could make the 5 whys better? For me, I find that with a little thinking, I can take any why question and turn it into a "what" question. And the new "what" question replaces three or four "why" questions. For example, the [mind tools web site](#) considers the problem of people who aren't using a new software system. Instead of asking, "Why aren't you using the new software?" and getting the answer, "because

we don't like it," you can ask, "What are the reasons for not using the new software?" and the answers will form a list. Then you can ask, "What are your ideas about fixing the most annoying problems you are faced with?" (By the way, I find when people participate in the solution, all of the problems suddenly go away. Why is that?)

The next time your spouse is upset, start with, "What happened?" instead of "Why are you upset?" Make a note of the difference in the conversation. **PCB**



Gray McQuarrie is president of Grayrock & Associates, a team of experts dedicated to building collaborative team environments that make companies maximally effective. To read past columns, or to contact McQuarrie, [click here](#).

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Mike is presenting a linear drive drilling system that started from scratch to redefine drilling in the industry. The drives are all three axes and the cage, or "wing" as they call it, is made of super strong aircraft-type metals to minimize weight. All in all, a very exciting product!



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