

# A Good Bet

By Mike  
Rainone



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I have been thinking about epistemology lately as it applies to engineering. Now, I don’t sit down and decide ‘I am going to think about epistemology’ like I’m Immanuel Kant thinking about phenomenology, — I do have two businesses that run me now. Rather, this question has evolved from years of trying to understand why engineers don’t trust what they know.

Many of you may react with indignation at this question. “Of course I trust what I know, I know everything,” you might say. Bear with me and I will suggest some evidence to the contrary.

**Example # 1: The “design with precision, and then double it” phenomenon. It’s common to build in irrational fudge factors in design.**

**Example # 2: Rejecting conclusions that are based on probabilities. Engineers like hard numbers, and tight conclusions. Anything based on less than 100 percent certainty is anathema.**

It took years for Ed Deming’s Total Quality Management (TQM) methods to be accepted in the U.S. after he completely remade Japanese production style — and U.S. production during WWII. His work is largely based on the fuzzy world of probabilities: TQM’s success is based on rigorous OC and the use of statistical analytical techniques, along with a lot of very smart management techniques.

But we don’t like statistics and probability, we like to say things like “the beam will support X load, or the heat exchanger will dissipate Y watts.” We don’t like to say, “The

heat sink has a 95 percent probability of dissipating Y watts. Under certain conditions there is a likelihood that the heat sink will do its job, but we don’t like the fuzziness of probabilities.

This speaks volumes about our comfort with the concept of “knowing” something. Engineers know many things; they just don’t seem to trust that knowledge very much. We have all sorts of empirically derived formulae, proven by years of practice and implementation, but right after we finish a design using these formulae, we double them, just to be sure.

Maybe it’s because we don’t think of ourselves as scientists. We are not really trained and immersed in the scientific method. We don’t often see ourselves digging into the fundamentals of our universe, or the why’s and how’s of what makes up the truths of our existence. This is ironic, because, as engineers, we have built our profession on the backs of great scientists and engineers who were always theorizing, experimenting, confirming results and providing the scientifically derived knowledge upon which we depend for our work.

As engineers we use science everyday. An engineering design is a chain of hypotheses, each piece with a probability of failure that we are chaining together to form a solution with a probability of success. Those hypotheses are tested by the design.

The CYA distrust of science leads to waste, at all quarters, and makes us irrationally comfortable. It also shows itself in the strangest of places.

An acquaintance of mine who works for a large defense contractor recently called to rail about his product assurance department. His job is to help align suppliers so that this employer can comply with a very specific performance requirement. They must ramp

up production from one part a month, to one per day. Obviously, we are not talking about a gear or a transmission; it is a large, complex machine with thousands of complex critical parts. Ramping up will not be easy.

Quality Assurance is important and the QA folks are responsible for seeing that suppliers are complying with the specs.

The problem is that the QA folk not only want suppliers to test each part when the part comes to the receiving dock, they also insist on testing each part themselves.

It makes one wonder whether QA understands its own principles of the science of statistical probabilities.

Needless to say, the friend who manages the supply chain to make sure all of the parts arrive at the proper point on the assembly line on time, is not happy with this time-consuming make-work project.

To add insult to injury, the Ph.D. who runs the department keeps telling him that if he had a Ph.D., he would understand why they need to test everything as it comes through the door.

Every time you work on an engineering design, you’re running an experiment. You may think that your mathematical models are rock solid, but the truth is they are all bets. Good bets, maybe, but a gamble nonetheless.

So, get comfortable with probability theory. Perhaps if you knew how good those bets were, you wouldn’t add such a fudge factor to your designs.

Mike Rainone, the co-founder of PCDworks, a technology development firm specializing in breakthrough product innovation. You can contact him via [mrain1@pcdworks.com](mailto:mrain1@pcdworks.com) or by visiting [www.pcdworks.com](http://www.pcdworks.com). 

