



I am finally sitting down to write my TBD article — it isn't due until tomorrow! I have been holding off this time for a couple of specific reasons. The first is that we are currently in the middle of this year's Conference and I wanted to wait and see if something came up at the Conference worthy of comment. The second is that it is now just two days away from the 2020 U.S. election, and I wanted to see if all of that activity would turn up any "nuggets" to discuss in this column.

My comments on the Conference are pretty brief. There is a pretty good attendance; the last I heard, it was around 150 attendees. That isn't quite what we need to "break even" with the Society's annual budget, but it is close enough that we can cover the budget with savings from past years. We knew it was going to be a problem when we had to transition to a "virtual conference." It turns out there are some parts of the virtual conference that are very good; perhaps we can find a way to keep some of the "goodness" in our face-to-face conferences. One thing that is really great is the ability to record the presentations for later access. This allows the participants to both see and hear what was presented in parallel sessions. I think this is a *huge* benefit.

Of course, there is a balancing loss by not having the ability to meet and enjoy our colleagues, customers and friends face to face. I find the virtual conferences to be very short in giving me the "feeling" of being connected to the group. It is all well and good as far as conveying information goes, but it just doesn't have the personal impact of seeing and talking to people in person. The Society has made new plans to once again attempt to hold next year's conference during August in Portland, Oregon. We didn't cancel our plans or contract from this year; we just delayed it a bit. Hopefully, Portland will be virus free, and settled down from all of the recent social unrest in the streets. I am certain that, while the unrest got a lot of play on the news channels, it would have been just fine this past August if we had been there.

Other than this short note about the Conference, it seems that things are progressing nicely with some

of the activities that the ISSS has been working on over the past few years. Our initiatives appear to be getting a little more traction; perhaps we will make some strides in that direction during the coming year. Perhaps the biggest reason for improvements with furthering the goals of the Society was hiring a management company to run its day-to-day activities. This has resulted in taking some of the workload off of the shoulders of the Society's volunteers, opening up some space for them to work on more strategic and forward-looking activities. I am hopeful that this will continue into the next year and beyond.

Watching the lead-up to the U.S. presidential election has caused me to consider the important question of, "How do we recognize and judge truth and/or facts?" Clearly, this has been front and center politically during this amazing year (Not amazingly *great*, just amazingly *different* from what we have experienced in the past). The question that keeps coming into my mind is, "How do we decide what to believe?" While it is an obvious concern with all that is swirling around us these days, it is also a major concern in our field of system safety. I don't want to tread into the mine field of politics, so instead of discussing that part of our lives, I will just focus on the problems that we encounter in our profession.

The problem that we encounter is that we are always working with great uncertainty. The bulk of our activities occur before there is even a system to consider; there is only an *idea* of a system — and perhaps some bits and pieces to see and touch — but nothing that has been assembled and whose function we can observe. So we end up "imagining" what it is going to be like, and we make expert "judgments" (guesses?). Because we are just imagining a future system, we are unsure about many — perhaps most — of the details. Even if we have a finished prototype in front of us, we know very little about how the pieces were made, assembled or tested. We don't know if there are defects in the design, or defects in manufacturing. We don't really know about the details of the use environment. We don't know much about the people who will use it, or what imaginative uses it might be put through.

Not only do we not know much about it, but we don't know much about the things that we assume are correct, such as engineering handbooks and "trusted" sources of information/knowledge; we just assume that they are correct. We didn't do the experiments, we didn't generate the data, we didn't "experience" the results. We hope and trust that others did what was necessary and that their conclusions are valid. However, we don't personally *know* any of it.

On the other hand, we don't necessarily trust what we read or are told, even by the design engineers who know more than anyone else about the specifics of the design. We don't necessarily believe, or trust, their opinion that the design is great and safe. Maybe it is, or maybe there is something that they are overlooking or are accepting as "safe enough" that we will disagree with. Who knows? Maybe they are willing to accept more risk than we are, or that the customer is willing to accept.

So what do we do?

How do we proceed when we know that we don't have all of the facts, or that our opinions are just our opinions, perhaps not those shared by others that have a reason to be concerned? What do we do when we know that most of the data points that we accept as "fact" are actually based upon statistical variations, and we don't know the statistics involved? We don't have access to the data that was used to generate the statistics to create the "mean" values that we pretend are the "real" values. We don't know the loads, we don't know the environment and we don't know external conditions. We assume things like normal distributions where we know for certain that they aren't normal, but we can't afford to get the data because of time and cost constraints. Not only that, but usually knowing more wouldn't change the decisions.

One of the first things that I do in this situation is to attempt to determine reasonableness. I try to become as "smart" (informed) about the topics at hand as I can so I can form some "opinion" based upon what I hope is valid. Personally, I attempt to maintain a broad knowledge in "science," in "engineering," in psychology and human factors, and in the technology embedded in the "system under study." That gives me a starting point so I can wonder if the outcome is "reasonable." That sometimes gives me a solid feeling that it is, or is not, reasonable. In other cases, when I don't have that kind of

a solid opinion, I dig deeper to find better or additional information.

Sometimes, I take a different approach; sometimes, I look at the range of imagined potential outcomes to decide whether they include anything "important." Perhaps they don't and, therefore, I don't really concern myself about knowing all of the nitty-gritty details. Sometimes, I find that the potential outcomes are *really* bad, and it is worth spending the time and money to find ways to avoid those outcomes, even though I am not sure that the undesired outcome will "really" happen. If it looks

like it *could* happen — and if it did happen would be really bad — I decide that, rather than spending a lot of effort to learn more about the bad outcome to determine if it is "acceptable," it is better to instead just do things to prevent it from occurring.

I promised to stay out of politics, but perhaps global warming is a good example at this point (which I don't consider to be a political question; I consider it an existential question). In any case, at the moment, the vast bulk of scientific opinion leans toward the idea that it is real; it is caused in large part (perhaps entirely) by man's actions, that the impacts are

potentially catastrophic and it is upon us — not somewhere out in the future. Do we know this to be "true" in some absolute sense? Probably not. That undesirable future seems likely when I compare what I think I know about science with what I think the experts are using to make this judgment, but I personally have no way to verify any of it. In fact, *nobody* can or will be able to personally verify it until after it has happened.

So, what if it is true that the temperature of the Earth is increasing as projected? Is it a serious problem? It sure seems to be. Not only is it serious, but it appears to be *so* serious that the cost would be far greater than anything we could possibly spend to prevent it.

What is on the other side of the question? What if it isn't true? What if there really is no problem and it is just a bunch of science geeks being "Chicken Little" (Henny Penny) and saying that "the sky is falling"? What if we spend a lot of resources fixing a problem that doesn't actually exist? Does that effort also have the potential to cause a problem of similar magnitude? That would really put us on the horns of a dilemma, knowing that a wrong choice in either direction could prove fatal. However, in this case that doesn't seem to

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be the case. In fact, it appears that if we do things to reduce the amount of greenhouse gases we put into the air, there will be a *lot* of benefits to many other parts of the system. So, even if we are wrong about the specific outcome, the solutions result in improvements that are worth the investment.

This kind of double-edged situation is common in system safety. It is often the case that improvements to fix an imagined potential problem result in improvements in quality, reliability, usability, salability and as well as the “look and feel” of something. When that is the case, we are lucky because even though our original question was full of uncertainty, the solutions are not sensitive to our certainty.

In situations where we might not be quite so lucky, we still have to reach a decision about acceptability. How do we do that? It seems to me that, at that point, we turn to something like “consilience” as an approach to inching closer to “the correct” solution. While the meaning of this term is a little hazy, what I mean is something along the lines that all of the “stakeholders” and “thought leaders” in the various fields involved concur that a solution works for them. Thus, the system engineer, the human factors, professional, the mechanical engineer, the regulators, the management, the user community and others all agree

upon a single solution. When that happens, perhaps the solution is getting close to the “correct” solution. If any of these evaluators find that it does not work for them, then it doesn’t work at all.

The takeaway with this is that *communication is vital*. The stakeholders need to be identified, informed and provided the necessary resources to understand and evaluate the issues from their point of view, and there needs to be a process whereby they can communicate and collaborate.

I am aware that I haven’t fully addressed this problem; in fact, I have barely scratched the surface. The bottom line is that whenever we are attempting to sort out facts from fiction, truth from falsehoods or “fully” understand how something works, we are forced into identifying and using trusted (or unknown) sources. It is one of those facts of life; things are far too complex for anyone to hold all of the information on any given topic. While I can’t offer a foolproof way to accomplish this, I *can* offer the suggestion that we be aware that we are never really sure of what we think we know — and therefore should maintain a healthy skepticism about the validity of our own answers and be willing to consider the implications of “what if I am wrong?” Of course, the same holds true of other people’s “facts.” ●