



# Lyle's Law of Possibility

One pleasant but windless spring day, my wife and I were aboard our sailboat *Gitana*, motor-ing up Eastern Bay, a branch of the Chesapeake. Dorothy was at the helm, and I had gone below for something. As I came back on deck, I noticed a wisp of vapor rising from the stern, apparently coming from the exhaust. I quickly checked the engine temperature gauge, saw that the engine was overheating, and shut everything down.

Now what? I was a reasonably capable shade tree mechanic back before cars had a dozen computers, but my experience with three-cylinder diesel engines is limited, (more limited at the beginning of that day than at the end). I will spare you the details of checking the thermostat, disassembling and reassembling the impeller housing, and flushing the heat exchanger. Finally, I did what I should have done in the first place and checked to see if the cooling water inlet was blocked. Why is it that the last thing you try is always the thing that corrects the problem? I poked a wire into the tube and wiggled it around a bit. Almost immediately there was a gush of water, carrying with it a little silver fish about the size of my finger. I reassembled the hose, and in another minute we were on our way.

Now what is the probability of just the right size little fish swimming up the cooling water inlet of a moving boat? Clearly, it is small but ... Murphy's Law strikes again.

Most people—certainly most engineers—know about Murphy's Law. It has been stated in several ways, and its origin has been disputed, but, fundamentally, it says that if anything can go wrong, it will. It is a representation of what has been called the innate perversity of inanimate objects. For many years, however—even after coming eye to eye with that little silver fish—I have felt that Murphy's Law is too pessimistic. It is the negative side of Lyle's Law of Possibility—If it can happen, it will happen. This more general law allows for the possibility that both good things and bad things can happen since "it" can be either good or bad. And, borrowing from Robert Frost, that can make all the difference.

The Law of Possibility can be broken down into two parts: Murphy's Law—If anything can go wrong, it will—and what we might call Feisel's Complement—If anything can go right, it will. Neither statement includes the words

"every time," so an engineer's job is to make sure Feisel trumps Murphy as often as possible.

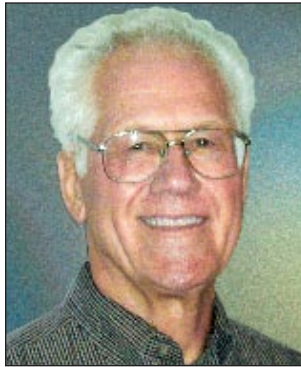
That is an interesting challenge for engineers. On the one hand, they must be almost ridiculously optimistic. Think about it. President Kennedy asked the engineering community if they could put a man on the Moon and bring him back safely to Earth. The engineers said, "Oh sure. We can do that." That was optimistic. There was no place for pessimism in the *Apollo* project. If the team (or, more accurately, teams) had not believed it could be done, it would not have been. They had to believe that the myriad complex systems would all work and that the mission could and would be accomplished. They had to believe that if it can go right, it will go right.

On the other hand, engineers must also be skeptical. They must believe that if it can go wrong it will go wrong. Realizing that, they must reduce the probability of it doing so until it is vanishingly small. This requires a very suspicious eye as well as a vivid imagination and a thorough understanding of the system and all of the external and internal factors that can affect it. It also requires discipline. In design and development, the focus is on "What will make this work?" You must also remember to ask "What can make this fail?"

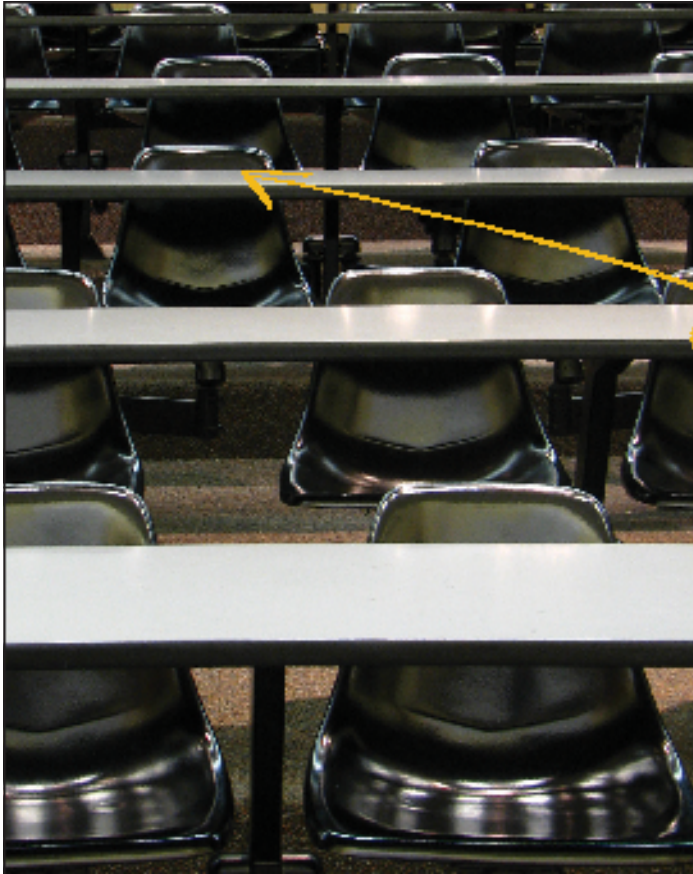
It is important to note that optimism and skepticism, as I am using them here, are not antonyms. Thus, engineers have to be skeptical optimists with an attitude of, "I know this will work, but I have to defeat all of the forces that will keep it from working" or optimistic skeptics who say, "There are lots of things that will make this fail, but I know I can defeat them and make it work."

Students need to remember the Law of Possibility, too. I remember a young woman who was struggling in an electrical engineering course (not mine) asking me, "Does anyone ever pass this course?" I assured her that yes, people have been known to pass that particular course and even go on to pass all the other courses and actually graduate from our program. Greatly reassured, she went on to pass the course and graduate. We were joking, of course, but the fact remains that she needed to believe that it was possible—even likely—that she would pass. She had to be optimistic.

On the other hand, students need to be skeptics. They need to ask what might keep them from passing a course or, in other words, what they don't know but should. That



*If anything can go right, it will.*



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is why I believe so strongly in written learning objectives, i.e., a list of what a student must be able to do to master a course. I can't learn for my students, but at least I can tell them what they need to know. Then if they know what they are expected to know and skeptical enough to question whether they know it, they are very likely to succeed.

I hope no readers will parse the Law of Possibility and try to demonstrate that it is mathematically untenable. I'm afraid they would succeed. In the end, the message of

*If  
 anything can  
 go wrong,  
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the Law is that Murphy does not rule. Yes, bad things can happen, and, if they can happen, then there is a non-zero probability that they will. So either make sure those things can't happen, or, if that's not possible, make the probability of their occurrence as small as possible. And remember that good things can happen, too, and, with sufficient effort, the right knowledge, and a little bit of luck, they will.

—Lyle D. Feisel, Ph.D., P.E.  
*Iowa Alpha '61*

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