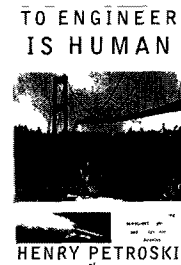


To Engineer Is Human

HENRY PETROSKI

Reviewed by Todd

Everything fails. It is just a matter of when. Parents forewarn their children that failure is common even likely, through the nursery rhymes of "Humpty Dumpty" and "Jack and Jill." Our first steps and first bike rides without the training wheels give us an idea of what failure feels like—literally. As we find our balance, scraped-up knees and bruised pride happen less frequently. Henry Petroski begins his book *To Engineer Is Human*, by revisiting these same children's tales cautioning us again, and with an engineer's eye, describing a world more reminiscent of London Bridge.



Due to their design, the pen on your desk is likely to last for months while your automobile will likely get you from point A to B for many years, their life spans governed by a balance between function, aesthetic, and economy. Engineers arbitrate those competing forces when bringing an idea into the material world. This arbitration, as Petroski describes it, is something closer to art than science. But sometimes, Petroski warns, art comes at the expense of sound engineering and construction.

The construction of the Hyatt Regency Hotel in Kansas City called for a grand atrium with two walkways suspended from the ceiling by a set of rods that ran through both structures. The single rod mechanism was replaced during early planning with two separate rods to simplify construction and utilize standard fabrication techniques. This small change left the system with barely enough strength to support the walkway, adding people proved disastrous. On July 17, 1981, the walkway collapsed, killing 114 people and injuring 200 others.

Petroski uses the Hyatt Regency story to illustrate several nuances of engineering. Many parties were simply negligent; an early ceiling collapse and comments from construction workers about instability gave engineers ample warning to reexamine the walkway plans; no changes were made. Letters to the editors of trade publications following the accident also suggested what seemed like obvious engineering alternatives.

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But that is the trick. Knowing the nature of a failure provides paths to the core problem, but this is a hindsight luxury the original engineers didn't have. And there we return back to the idea of engineering as art. The unique design and construction of these walkways left engineers working in a thought space that was dangerous, more so than they realized.

As much as the field of study seems to be based in fact and formula, engineering is better described as grounded in hypothesis, a working practice of individuals developing ideas that tentatively describe phenomena but need constant reevaluation. Engineers spend enormous amounts of time studying the mistakes made by their colleagues. Petroski points to an Egyptian pyramid in Dahshur with its sudden change to a more shallow angle midway up as an early example of a trial and error method of construction. Flying buttresses on European cathedrals indicate a similar postconstruction epiphany. Computer-aided three-dimensional drafting and finite element analysis do not protect today's engineers from failure as new designs further strain the tensions between competing factors. While unequivocally a tragedy, the Hyatt Regency walkway collapse becomes a valuable case study from which future engineers can learn.

“Engineering, like poetry, is an attempt to approach perfection.”

Petroski's expertise in failure analysis provides important lessons for those in business. Formulas for organizational success, whether self-determined or suggested, are like design, better described as hypothesis, accurate under some conditions and always open for reexamination. What engineers call a factor of safety and inventory analysts call safety stock deals with the parallel uncertainty of real world conditions on a rope or a distribution system. Businesses have their own versions of engineering's "factor of safety," whether it concerns extra boxes of inventory under the expeditor's desk or adding a few days to a customer promise for variation in the distribution center, but they'd better make sure those safety factors don't inflate and allow sloppy business practices.

Much lip service is given to accepting failure in business as a natural phase in the learning process, yet internalizing the idea seems a little more difficult. Shareholders don't show sympathy for failed products. Customers expect their product to arrive when promised and in pristine

condition. Most of the other books featured in these pages detail the workings of successful companies, while Petroski's book tells a more complicated tale of failure, one in which business practitioners can find wisdom. The most important lesson has to be appreciating failure as a learning opportunity. Failure is common. Not learning from failure forces companies to repeat the same mistakes. In engineering, that repetition can cost lives; in business, our livelihood.

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WHERE TO NEXT? « Page 61 for **more subtle forms of failure** « Page 256 for **how genius can fail** « Page 167 for **operational failure** | EVEN MORE *The Evolution of Useful Things* by Henry Petroski *The Logic of Failure* by Dietrich Dorner *Mistakes Were Made (But Not By Me)* by Carol Tavris and Elliot Aronson