The Principle of Insufficient Reason

By Jon A. Schmidt, P.E., SECB

In the November 2007 issue, I discussed the difference between scientific knowledge and engineering knowledge. In this column, I would like to explore the related subject of the types of reasoning that scientists and engineers typically employ, and why this distinction is important from a philosophical perspective.

My thoughts on this subject have been shaped by a series of papers written over the last twenty-five years by Dr. Steven L. Goldman, the Andrew W. Mellon Distinguished Professor of the Humanities at Lehigh University in Bethlehem, Pennsylvania. The most recent one is, "Why We Need a Philosophy of Engineering: A Work in Progress" (*Interdisciplinary Science Reviews*, Vol. 29, No. 2, June 2004, pp. 163-176).

Dr. Goldman points out that scientific reasoning is primarily concerned with the concepts of necessity, certainty, universality, abstractness, and theory. It seeks objective knowledge of timeless truth that is based on reality, for the purpose of intellectual contemplation and understanding. By contrast, the reasoning of engineers is characterized by contingency, probability, particularity, concreteness, and practice. We rely on subjective beliefs and historical opinions that are derived from experience, with the goal of willful action and use.

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As an illustration, consider the example of a bridge. There is no single optimal span for a particular location, although a solid case can be made that the one across the Golden Gate comes pretty close. A staggering array of variables contributes to establishing the type, alignment, materials, height, etc. Tradeoffs are inevitable because of legal restrictions, budgetary constraints, and many other considerations, only some of which are explicit, and many of which are not even technical. In the end, it is the collective (and fallible) judgment of the design team that dictates the final form of the structure, rather than a rigid (and inerrant) formula.

Dr. Goldman presents the approaches of science and engineering under two headings: the Principle of Sufficient Reason (PSR) and the Principle of Insufficient Reason (PIR), respectively. Strictly speaking (per **www.wikipedia.org**), PSR states that anything that happens does so for a definite reason, while PIR – also known as the Principle of Indifference – states that if there are multiple mutually exclusive and collectively exhaustive possibilities that are indistinguishable except for their names, then each one should be assigned the same likelihood. PSR essentially assumes that there is always one "right" solution to every problem, while PIR requires an intentional choice from among several equally valid alternatives.

Dr. Goldman goes on to suggest that Western culture has long favored PSR over PIR, and that this bias has contributed to the generally high regard in which science is held (relative to engineering) to this very day. In fact, the conflict within the discipline of philosophy goes all the way back to Plato's harsh criticism of the Sophists, the ancient Greek champions of rhetoric. His perceived triumph in that exchange is reflected in the negative connotations that words like "sophistry" and "rhetorical" still carry some twenty-four centuries later.

Plato relentlessly contended that the Sophists were only interested in teaching tricks for winning arguments and were ignorant of the good, the right, and the true. He sought the ideals of pure reason and perfect justice, which the Sophists rejected as unrealistic; instead, they advocated social discourse and pragmatic action. The original function of classical rhetoric was to teach citizens in a democracy how to make and justify seemingly arbitrary decisions in a context of uncertainty – exactly the task of modern engineers, as well as free human beings throughout the ages.

Ironically, scientists would put themselves out of business if they could ever actually achieve full comprehension of the mysteries of nature. Karl Popper insisted that only propositions that are "falsifiable" – capable of being disproved – should ever be described as "scientific". Thomas Kuhn popularized the idea that science only advances significantly when one paradigm is replaced by another, usually because it fits the data better. Theories are not discovered; they are selected from a number of plausible explanations, then tested and modified as necessary, and are always subject to being revised or discarded.

In other words, while drawing contrasts between scientific and engineering reasoning has been common historically, it really sets up a false dichotomy, as Dr. Goldman observed; in the absence of complete knowledge, PIR is the only feasible option. It is precisely when there is more than one path available to follow that it is possible and desirable to exercise wisdom – *sophia* in Greek, from which the Sophists took their name. Consequently, because of our training and temperament, engineers are uniquely suited to help society wrestle with the many challenges that it faces – not just in the technological realm, but in all areas of life.▪

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