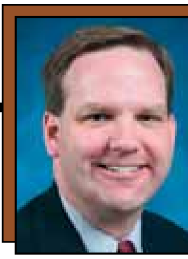
Engineering as Willing



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

In October, I had the privilege of speaking on the topic of "Philosophy and Structural Engineering" at the NCSEA 17th Annual Conference in Scottsdale, Arizona. While preparing that presentation, I compiled and reflected on all that I have been reading, thinking, and writing over the last few years regarding the relationship between the two fields. The overall thesis that emerged was this: Science is widely perceived as an especially systematic approach to *knowing*; engineering could be conceived as an especially systematic approach to *willing*.

My adaptation of Bernard Lonergan's transcendental precepts provides the backdrop for this assessment ("Engineers Are Persons, Too," January 2010). Attentive experience, intelligent understanding, and reasonable judgment lead us to adopt *beliefs* about how the world *was* in the past and *is* now; considerate deliberation and responsible decision lead us to make *choices* about how the world *will be* in the future. This framework recognizes the interactions between knowing and willing, as well as their distinctions, which become evident when comparing the scientific and engineering methods.

Scientists observe natural phenomena, propose hypotheses in an effort to explain them, and conduct careful experiments to test their theories. Although the will is implicitly involved, the *intellect* is primary, because the goal is ideal - additional "objective" knowledge. According to Billy Koen, engineers use heuristics to cause the best change in a poorly understood situation within the available resources ("The Engineering Method," March 2006). Although the intellect is implicitly involved, the *will* is primary, because the goal is pragmatic – some "subjective" outcome; knowledge serves mainly as a necessary but insufficient means to that contingent end ("Engineering Knowledge," November 2007).

Koen suggests that a heuristic is any plausible aid or direction in the solution of a problem that is in the final analysis unjustified, incapable of justification, and potentially fallible ("Heuristics and Judgment," May 2006). This formulation reflects how engineering is at odds with the dominant tradition in Western culture, which – as Steven Goldman points out – favors certainty and universality over probability and particularity; i.e., abstract *knowledge* over concrete *know-how* ("The Principle of Insufficient Reason," May 2008). While heuristics cannot be "proven" in the absolute sense, their utilization is legitimately warranted, frequently on the grounds of successful past implementation.

Each individual engineer has a unique collection of relevant heuristics at his or her disposal, along with "meta-heuristics" for selecting which heuristics are most appropriate in a given set of circumstances. When these are combined to facilitate translating a client's technical and non-technical requirements into a viable solution that adequately accounts for uncertainty and satisfies all applicable constraints, they constitute what William Addis calls a *design procedure* ("The Nature of Theory and Design," May 2009). This is analogous to a scientific hypothesis; however, seemingly identical design procedures can have diverse outcomes, and different ones can produce quite similar results.

Most design procedures include the development of mathematical models that are supposed to capture the important aspects of reality. The engineer's challenge is to ascertain what those features are and what assumptions and simplifications can safely be incorporated in order to keep everything manageable, while still yielding a meaningful assessment of likely performance. Although analysis of a model is usually straightforward, conforming to fundamental principles derived from *science*, its initial construction and subsequent adjustment require "the conscious use of skill and creative imagination" – the dictionary definition of *art* ("Philosophy and Engineering," September 2008).

The bottom line is that engineering is not deterministic; it routinely involves selecting a way forward from among multiple options when there is no one "right" answer. Consequently, the concept of engineering *rationality* is a bit of a misnomer; engineering *intentionality* is a more appropriate term. Design – in fact, all human behavior – is ultimately governed by *motives*, rather than *reasons*. Although common usage treats these two terms as virtually synonymous, the prevalence of the latter in both ordinary and philosophical discourse reflects an ancient prejudice that subordinates practice to theory and action to contemplation; i.e., willing to knowing. Since engineers exemplify willing, we should strive to resist and reverse this tendency.▪

Your Turn How do knowing and willing interact in your own practice of engineering? Do you agree that the will is primary, rather than the intellect? Is it legitimate to distinguish between rationality and intentionality? between reasons and motives? Please submit your responses and see what others have had to say by clicking on the "Your Turn" button at **www.STRUCTUREmag.org**.

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Upcoming Event

The 2010 Forum on Philosophy, Engineering & Technology (fPET-2010) will take place May 9-10 at the Colorado School of Mines in Golden, Colorado. For more information, please visit **www.philengtech.org**.