# Good Designers Do X

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**Abstract.** "Engineering is design under constraint" is an elegantly simple definition of engineering from Bill Wulf (past president of U.S. National Academy of Engineering.) Design is how engineers get their knowledge out into the world. It is also through design that engineers have an opportunity to enact transdisciplinarity - integrating ideas across disciplinary boundaries at multiple points along a design journey. So, what then do good designers do?

If we think in terms of process, we can wonder: How do designers spend their time scoping out a problem, developing alternative solutions, evaluating and communicating about their designs?  Are there typical patterns of engagement in design activities and/or patterns that differ depending on level of design expertise? Are there places in the design process that enable broad thinking? How can we take the insights from the answers to these questions to inform design teaching and learning?

Questions such as these guided my early-mid career research on engineering design processes. I collected data from a large number of individuals with a wide range of expertise (from beginning undergraduates through expert professionals in industry) who solved multiple design problems. Analysis of these data provides empirical evidence that as individuals gain expertise as designers they engage in different patterns of design behavior. For example, as designers move towards more expert design behavior, they 1) engage in thorough problem scoping at the start of the process to understand the problem being solved, 2) gather information throughout the design process covering a broad set of topics, and 3) fluidly transition and iterate throughout the design process.

We can complement such empirical work with answers to the "What do good designers do" question with another approach: Crowdsourcing answers by asking a lot of experienced designers. This approach is something I have been exploring in my more recent scholarship by collecting answers to the question: "When you talk to someone and say "Good designers do 'X'", what are the top things you list?" The current set of responses comes from colleagues in the broader engineering design education and design research communities.

In this talk I will describe both of these streams of workL 1) research findings on design expertise, and 2) crowd sourced responses about what good designers do. In addition, I will showcase how these results have been used to support learning experiences and how students have responded to these experiences. Of note, students engaging with the empirical results and the crowdsourced list do indeed understand that "good" engineering design involves looking past themselves and their engineering knowledge and skill sets to a broader set of ideas and disciplines, embracing the ideas behind transdisciplinary engineering.

**Cynthia J. Atman** is the founding director of the Center for Engineering Learning & Teaching (CELT), a professor in Human Centered Design & Engineering, and the inaugural holder of the Mitchell T. & Lella Blanche Bowie Endowed Chair at the University of Washington. She was director of the Center for the Advancement of Engineering Education (CAEE), a national engineering education research center that was funded by the National Science Foundation. Her research focuses on design expertise, engineering design learning, considering context in engineering design, and the use of reflection to support learning.  She is a fellow of the American Association for the Advancement of Science (AAAS) and the American Society for Engineering Education (ASEE). Dr. Atman holds a Ph.D. in Engineering and Public Policy from Carnegie Mellon University.