Real Design Matters

If you missed the recent U.S. White House initiative on the Advanced Manufacturing Partnership (AMP), you shouldn't have missed it. If you read the story carefully, you will find that it is at least as much about design as it is about manufacturing. No matter what you think about politics, this is the closest we have gotten yet to bringing design on the American national agenda. The AMP initiative is one of the several examples where design occupies Washington thinking these days. Let me explain.

I use the term "real design" to refer to products that will be manufactured and used and to systems that will be built and operated successfully without exorbitant cost and time overruns. While the national discussion on manufacturing is taking place in the context of politically and socially charged issues like jobs, the subtext is about making innovative products in innovative ways that are hard to replicate, at least for a while. This message is clear as you thumb through documents like *A National Strategic Plan for Advanced Manufacturing* by the President's National Science and Technology Council (http://www.whitehouse.gov/sites/default/files/microsites/ostp/iam_advancedmanufacturing_strategicplan_2012.pdf) or the material on the Advanced Manufacturing Partnership's website (http://manufacturing.gov/advanced_manufacturing.html).

The most recent activity in this front is the creation of the $1 billion National Network for Manufacturing Innovation (http://www.manufacturing.gov/amp/nnmi.html) that, among other things, calls for identification of products or processes to be studied at several innovation institutes to be created around the country. Again, products are clearly associated with manufacturing, a tacit recognition that the U.S. history of manufacturing success is almost exclusively tied to manufacturing of U.S.-designed products.

Another example is the recognition that design of successful systems requires more than good science-based technology and old-style systems engineering. An earlier National Academy of Science report on *Human-System Integration in the System Development Process: A New Look* made the case that good system design must account for the "human factor" at all levels of its development and operation (http://www.nap.edu/catalog.php?record_id=11893). The U.S. government interagency effort is now in full swing trying to identify basic research problems and follow-up actions for designing large complex engineered systems (e.g., http://www.cvent.com/events/nsf-and-nasa-workshop-on-large-scale-complex-engineered-systems-from-basic-research-through-product-/custom-21-10b076af68944847be4d2d07cc44aa85.aspx, and an earlier NSF workshop, a report of which can be found in a JMD article http://dx.doi.org/10.1115/1.4004465). Indeed, in October 2011, JMD devoted an entire special issue on the design of complex engineered systems and only scratched the surface of the issues involved and the fundamental research needed.

So "real design" matters, but it presents several challenges for JMD. When an author presents an innovative design, say, in a design innovation paper, can we accept it for publication if a prototype has not been tested successfully? If there is one successful test, would it be repeatedly successful? If the prototype is successful, can the object be manufactured? At what cost and reliability? You get the idea.

It gets worse when we talk about "validating" systems that could not possibly be built in a university laboratory; systems that "their first failure is their last test" (there goes the dictum of "fail early and fail often"); or systems that involve a large number of people in their development or use.

So while the JMD reviewer may argue correctly that real design requires validation with real products and real systems, the hapless author knows that this is just not going to happen. What is one to do then? I can only offer the practical answer that we have to look at this on a case-by-case basis, and the spiritual answer that we should aspire to perfection while knowing that we will never reach it. In the meantime, when you hear about manufacturing, think design.

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