Rapid Prototyping in 'Fuzzy' Front End Achieves Faster Cycles

Engineers typically have used rapid prototyping technology to carve a week or two from the design cycle—and often near its final phases. "That's not acceptable today," claims the leading authority on accelerating the product development process, Preston G. Smith, principal, New Product Dynamics (Portland, Ore.; *preston@-NewProductDynamics.com).* Smith believes engineering managers and design engineers should update product development to include next generation rapid prototyping tools that can be used earlier in the process to significantly impact design cycle time and speed time-to-market.

In this exclusive interview with *MDE,* Smith (who co-authored with Donald G. Reinertsen, the highly acclaimed classic, *Developing Products in Half the Time: New Rules, New Tools,* John Wiley & Sons) expresses his views and observations on the new look and application areas for rapid prototyping technology.

MDE: *Traditionally, rapid prototyping has been applied during the last phases of product development to shorten the design cycle. Yet, you maintain that the technology can be leveraged to achieve even more significant time compression in product development.*

Smith: A new generation of rapid prototyping equipment—conceptual modelers—appeared a few years ago. These modelers have great potential to accelerate the front-end of development, although few users have discovered this opportunity so far.

Conceptual modelers produce models that are "quick-and-dirty" relative to mainstream rapid prototypes. However, quick-and-dirty models are quite sufficient in the early stages of design, when many design alternatives need considering and when the fragmentary information involved does not justify a refined model.

MDE: *What design phases are prime candidates for the new forms of rapid prototyping, and what might the benefits be from these applications?*

Smith: Over the past decade most companies have wrung much of the possible savings out of the later stages of the product development process. They have done this through concurrent engineering and DFX programs that typically concentrate on the later activities of the design cycle.

The opportunities now are in the more fluid early stages of development—the fuzzy front end, as it's called. Just in the past year or two, we have started to see conferences devoted to the fuzzy front end of development. However, many people are still avoiding, or denying, the front-end opportunities because these activities usually require that sales and marketing players be involved differently.

When you analyze where development time slips away in the fuzzy front end, you discover that it has a lot to do with decision-making. That is, deciding what the customer wants; deciding which alternative to pursue; and deciding when the concept is refined enough to freeze it.

Lots of quick-and-dirty models for people to handle are perfect in this situation to crystallize options and force decisions. Conceptual modelers are perfect for this. They are fast, use cheap materials, and don't require dedicated operators.

Let's look at an example. A major toy manufacturer often needs a head for a new model of a doll. The model shop makes a rapid prototype of a head and sends it to design and marketing. After a while (often too long), the head comes back with a request for a slightly larger or smaller version.

Now, when the model shop gets a request for a head, they wisely send out three—the size requested, a larger one, and a slightly smaller one. This forces a decision on size and eliminates a whole loop from the process. It may "waste" models, but it saves time.

MDE: *What rules or procedures might design engineers/engineering management follow to determine how to best utilize this new application of rapid prototyping for maximum benefit/return?*

Smith: The trick is to look at the very early stages of development as a sequence of decisions that progressively firm up the design concept. Analyze these early activities to see what decisions are needed, where the time goes, and how many loops occur to re-plow the same ground.

Then consider how physical models could help decision makers to focus on options and reach decisions more quickly. Use models liberally. If you have a dozen ideas or variants, make a dozen models and toss most of them after an initial screening.

What you are after at this stage is quantity of models, not quality. This is where conceptual modelers excel, but also where you are likely to get resistance from the rapid prototyping community. They are justly proud of the gains they have made in model quality, and they aren't very interested in regressing.

MDE: *How can engineering management justify the investment in rapid prototyping equipment? What is the advantage of in-house installation vs. the service bureau?*

Smith: Since this is all based on the notion that there is benefit in speed, you first need to quantify this benefit. If you saved a week, how does this affect your company's bottom line? In fact, Chapter 2 of our book describes how to calculate this value, which we call the cost of delay. Fortunately, conceptual modelers cost only 10% to 20% that of a traditional rapid prototyping system. This should make them pretty easy to justify, especially if your process analysis finds some big opportunities to cut time.

Your analysis also will show whether you can afford the delay inherent in using any type of offsite conceptual modeler.

The folks who take conceptual modelers most seriously locate them right where the designers sit, as they would a plotter.

At the current state-of-the-art in conceptual modelers, if you have several alternative ideas for a part, you can make hand-held models of them all in about two hours. And they will cost you about $5 to $10 in materials. No wonder some people call these systems 3D printers.

MDE: *Focusing now on the individual—what new skills, thinking, attitudes, practices must be adopted to apply the new rapid prototyping tools effectively?*

Smith: This is the most important part. Unfortunately, it goes beyond engineering, because, as suggested before, many of the decision loops involved also include marketing and sales people. All decision makers must be involved to successfully shorten the process.

Recently, I heard of what was described to me as a nightmare. A company had followed the above approach well and was indeed able to make models of design concepts quickly. However, marketing and sales used this capability to just keep tinkering with the design since concepts were so cheap and fast to realize. The end result was that this company's development cycles had actually stretched out due to faster models.

As we all learned in calculus class, a process doesn't necessarily converge automatically. It has to be carefully designed to converge. Parties outside of engineering are quite essential to this convergence.

There is another, related, point. Many design engineers have been trained in Design of Experiments or Taguchi methods, which optimize the search for the best design solution. Consequently, these tools economize on the number of models built.

As I have suggested, the cost of conceptual models has dropped greatly, while the cost of delay implicit in floundering on design commitment can be huge. DOE/Taguchi is clearly a valuable engineering tool, but it shouldn't be allowed to cloud this bigger picture. □