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Impact of Breakthrough Innovations on Design for Manufacturing and Assembly

Design for Manufacturing and Assembly (DFM/A) is a technique well entrenched in most companies that design and build products. Originating in the late 20th Century, DFM originally focused on optimizing the design of components for rapid low-cost production, while DFA focused on optimizing designs for rapid low-cost assembly.

As the DFM/A body of knowledge matured, the focus expanded to optimizing designs for reliability and serviceability. For example, changing the oil filter on a car is a dirty job. Hot engines and tight access spaces caused many service technicians to wish the oil filter was on top of the engine and easy to reach when one pops the hood. Well, by trying to optimize serviceability, it turned out reliability was reduced. Gravity takes the heavy dirt particles to the lowest point possible and a filter on top of an engine won't catch them. And so, oil filters remained where they always were. The point is that when one tries to optimize a specific parameter, another parameter is usually degraded, and tradeoff decisions have to be made.

These days, all kinds of electronics, sensors, and software are making their way into product designs. New plastics, composites, and special alloys are replacing traditional iron and steel designs. Increasingly, there are forces to make designs more environmentally friendly to manufacture and to be recyclable when the product comes to the end of its life.

This article examines the impacts of emergent breakthrough innovation techniques on the DFM/A body of knowledge. In my April 2016 *Machine Design* column, 10 distinct breakthrough innovation techniques were described. These techniques will increasingly affect the designs of new products and their ability to be manufactured or assembled. Some techniques will have great impact; others will have low or neutral impact.

Breakthrough techniques that are software-intensive, such as Big Bang and Digical Innovation, will decrease the need for DFM/A expertise. Techniques that cause products to be "stretched" to meet the needs of consumers at both the high and low ends of the economic spectrum—such as Reverse Trickle-Up and Ambidextrous Innovation—will likely not significantly increase or decrease the need for DFM/A expertise.

Techniques that are technology-driven, such as Disruptive and Emerging Technology Innovation and Lead User Analysis, where entirely new platforms result, will necessitate DFM/A thinking from the beginning. Techniques that migrate and defeature high-end products to address the needs and economic capabilities of low-end markets, such as Bottom-Of-Pyramid Innovation, will also necessitate DFM/A thinking from the beginning. The re-thinking of design approaches, implied by techniques such as Design Thinking, will also likely result in intensive DFM/A activity.

Techniques that apply to both new products and to the redesign of existing products to minimize the environmental footprint (such as Sustainable Innovation) will likely result in the expansion and growth of the DFM/A body of knowledge. "Design For X" capabilities such as Design For Environment, Design For Recyclability, and Design For Disassembly were first postulated many years ago, but there was little demand. In fact, there was actually resistance. Manufacturers did not want to trade off their ability to efficiently turn out products for both speed and cost reasons to maximize their customers' ability to recycle a product at the end of its life. As well, societal values were not at a point where consumers would pay more for environmentally friendly products.

But, times are changing and environmental friendliness is becoming more important. Studies are now showing that businesses and consumers are increasingly willing to pay a premium for products that minimize impact on the environment.

In summary, breakthrough products that disrupt markets and change the basis of competition will affect DFM/A practices in the years ahead. Most breakthrough techniques will increase the need for DFM/A expertise in some way. Sustainable Innovation, in particular, will likely result in the growth of nascent DFM/A approaches where societal values are now becoming great enough to cause designs to be optimized for environmental impact and recyclability. md