ADDITIVE MANUFACTURING
IN THE AGE OF EXPERIENCE

Backgrounder

THE ECONOMIC GAINS WILL BE IMPRESSIVE. THE CHANGES TO THE DESIGN AND MANUFACTURING DOMAINS WILL BE EVEN MORE DRAMATIC.

The outlook for additive manufacturing is exciting. It is making rapid gains in manufacturing, albeit from a low base, and has clearly moved beyond the mere making of prototypes and short manufacturing runs. This is particularly true in the aerospace industry where weight, efficiency, and the lifespan of components are key considerations.

In one example, a manufacturer that once took six hours to make a blade-like part can now make it in six minutes with additive manufacturing. That's a dramatic gain. Another manufacturer is making 80,000 metal parts a year through similar techniques, which hardly qualifies as a niche. Consumer goods is another industry where additive manufacturing is moving into the mainstream.

The economic gains, in terms of materials that must be acquired, are dramatic. To make a titanium blade the traditional way, a manufacturer must acquire 15 times the amount of titanium than actually ends up as the part. The rest is wasted. But with additive manufacturing techniques, the ratio is closer to one-to-one. Roughly the same amount of titanium appears in the part as was purchased.

New printing machines, new types of resins, plastics and metals, and new processes are emerging virtually every month. At least seven different additive manufacturing processes have been established globally with resins, plastics, carbon fiber and metals all in use. One key differentiator is how the materials are deposited in a printing device. Lasers are finding a growing role in in this area, helping to solidify the powders containing these substances.

Initially, parts made by additive manufacturing were simply replacing parts made by traditional forging methods. An example of this early evolution is how aircraft maintenance organizations at major airports have started to use 3D printers to make specific parts for planes that need urgent repairs. They maintain libraries of 3D parts so that they know how to produce, or refurbish, each part that is actually needed. That is far easier, and more cost effective, than maintaining an inventory of parts that *might* be needed.

But the real allure is that 3D printing is going to allow entirely new types of parts and products to be designed. Designers will have blank drawing boards, so to speak, that allow them to ask, "In an ideal world, what should this part look like?"

Some of these designers are finding that organic shapes, more in keeping with Mother Nature, are sometimes better and more streamlined than the clunky industrial-style shapes that have prevailed in the past. In one study of what the next generation of a jet's fuselage should look like, researchers examined the way a swan's skeleton works as a possible model. Under normal circumstances, such an organic model would be impossible to produce, but because additive manufacturing is not limited by traditional manufacturing techniques, such a design is now possible.

Designers also will be able to design a part or a subsystem that is a single, solid object, rather than relying on many different components that must be assembled. Additive designers can dare to go where no CAD-CAM designer can imagine because the range of topologies available to the 3D designer is so much greater.

The next question manufacturers will have to decide upon is, which material is best to make a part or product? Machines have reached the level of sophistication that they can, for example, apply two layers of one material and then four layers of another material. The ability to integrate different materials within a single part or product brings completely new capabilities in the areas of strength, weight, flexibility, and more.

To enable all this, manufacturers will have to redesign the way material engineering is conducted and how designs are defined. It calls for a completely new way of thinking, free of traditional manufacturability constraints, and relies on rapid computer simulation and processing to generatively find the right design based on a set of functional requirements. This is called function-based generative design.

The linking of all manufacturing processes and mastering the data flows will truly enable 3D to blossom even faster than it has so far. There is a huge amount of data involved in enabling additive manufacturing, so learning how to master the data flows now is a step toward a greater goal.

Manufacturers also need to create "hubs" of expertise, bringing together experts in building the machines, in creating the materials and then in actual manufacturing. It is clearly an interdisciplinary effort requiring manufacturers to establish an "ecosystem" of skills. Many niche players today possess exciting technologies and expertise but they must be integrated before they become truly effective. A software platform that can support this joint activity is key.

Additive manufacturing will clearly contribute to the goal of mass customization because customers may be able to choose designs from a catalogue or online site and even specify what type of material they want used in their product. Additive manufacturing promises to be one of the most transformational forces that the industry has ever witnessed.

The simple question is, are companies technologically ready? Are their processes digitalized and platformized to best take advantage of this innovative new technology?

Americas
Dassault Systèmes
175 Wyman Street
Waltham, Massachusetts
02451-1223
USA

Europe/Middle East/Africa
Dassault Systèmes
10, rue Marcel Dassault
CS 40501
78946 Vélizy-Villacoublay Cedex
France

Asia-Pacific
Dassault Systèmes K.K.
ThinkPark Tower
2-1-1 Osaki, Shinagawa-ku,
Tokyo 141-6020
Japan