DASSAULT SYSTEMES

DIGITAL MANUFACTURING
IN THE AGE OF EXPERIENCE

Position Paper

THE AMOUNT OF DATA INVOLVED IN MANUFACTURING A COMPLETE EXPERIENCE IS THOUSANDS OF TIMES MORE EXTENSIVE THAN SIMPLY THE SHAPE OF THE PRODUCT.

Computer-aided design and computer-aided manufacturing (CAD-CAM) represented major advances in how manufacturers made their products when those two-dimensional technologies began to take hold in the 1960s.

But now the world's manufacturers are making the next great leap by embracing full-fledged Digital Manufacturing. Essentially, everything about designing and engineering a product and creating a manufacturing process to make it can be digitized in three-dimensions (3D) and synchronized with the actual physical assets of the production system. The payoffs for early adopters are proving enormous. Independent analyses show that production costs can be reduced by up to 15%.

There traditionally have been many lags involved in designing, architecting, engineering and manufacturing any product. Each of these functions existed in different departments or divisions within a company, often called "silos." These different silos struggled to come up with a common vision of what they were trying to achieve. They might not have been looking at the same images or been speaking the same technical language. Many iterations were necessary before they could coalesce around a common product definition, creating lags in the manufacturing process.

But if all these stakeholders are connected on a common platform in real time, they are able to move much faster. They have access to the same 3D data and use the same technical terms to describe them. They can use digital manufacturing not only to create new products, they can also model the manufacturing process virtually without any investment in physical process. They can design the tools necessary to make the product and can determine whether humans or robots are more suited to operating those tools. Far fewer physical prototypes of machines and tools must be created, eliminating another source of constant hold-ups. And manufacturers can do all this for their global operations, not just a single factory.

Information can flow in multiple directions. A product development idea, even in the early stages, can be tested out in terms of manufacturing approaches and material flows. That information is crucial to determine whether a concept can actually become "manufacturing ready."

Digital manufacturing allows manufacturers to virtually experience their entire factory production, from the design function to anticipating the global demand for a particular product. These simulation activities allow manufacturers to better address and shift processes to quickly respond to the competition or to take advantage of new market opportunities. They can perform schedule changes, introduce model change-overs and schedule maintenance operations.

The term *digital thread* refers to the use of 3D design data all the way through to 3D manufacturing process models. Expertise delivered in this layer touches on ergonomics, flow simulations, machining, process planning, manufacturing management, robotics, and more.

A corollary of the digital thread is that virtual models of products, including processes, intelligence, connectivity, functional and logical design goals, as well as geometric shapes are created before anything is manufactured. Such a comprehensive model is more sophisticated than a simple "virtual twin". Such models of complex 3D experiences become part of the digital thread. When those highly sophisticated models, encompassing massive amounts of data, are validated, a factory can start manufacturing.

The challenge for the manufacturers of the future is to extend the digital thread beyond the start of production into all the aspects of manufacturing that follow. Product and process models must integrate feedback from the shop floor, from the supply chain, from the distribution network, and even from consumers. The amount of data involved in manufacturing a complete experience is thousands of times richer than simply the shape of the product.

These insights can then be recycled back into the virtual models to test them and improve them. This is an obvious extension of the concept of continuous improvement, which Toyota Motor famously introduced as part of its lean manufacturing system. But now the concept has been embraced by manufacturers all over the world. Products can be continuously made better and so can the manufacturing processes used to make them.

Digital manufacturing techniques are increasingly essential for global companies seeking to differentiate what they make for different customers, ultimately arriving at the destination of mass customization.

As manufacturers move to more of a "pull" model, based on consumer demand for mass customization, rather than simply "pushing" product out the door, they will need the ability to visualize both their products and their manufacturing processes to make sure that all components and raw materials are available and to determine which physical location is best to use for manufacturing.

The combination of digital manufacturing with the immense influx of data behind complex product experiences can result in a huge increase in flexibility to respond to market changes or competitive challenges.

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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