

Dassault Systèmes SIMULIA Analyst Briefing 2018: Digitally Accelerating Additive Manufacturing

CIMdata Commentary

Key takeaways:

- CIMdata believes Dassault Systèmes has made significant progress simulating the entire Additive Manufacturing (AM) process. Since their acquisition of ABAQUS, Inc., in 2005, the company has transformed the use of Finite Element Analysis (FEA) tools from evaluating discrete items to simulating the entire AM lifecycle.
- The briefing highlighted the significance of simulating everything from raw material to end-use production ready parts, not only prototypes.
- Dassault Systèmes is clearly focused on the Industrialization of AM.
- Companies are in transition from static-electronic to live-digitally connected processes, and companies need to eliminate silos and unite all functions into a seamless digital thread, bringing into focus not only technology challenges but organizational issues.

Digitally Connected, Science Based

Mr. Scott Berkey, SIMULIA CEO, kicked off the Briefing day by describing the rich history of the SIMULIA brand, which originated in Rhode Island in 1978 as Hibbitt, Karlsson & Sorensen, Inc. (HKS). At that time the company focused on the development of its sole product ABAQUS, for nonlinear structural mechanics. In the year 2000, HKS changed its name to ABAQUS, Inc. and in 2005, Dassault Systèmes acquired the company and created the SIMULIA brand. Since that time Dassault Systèmes has continued to expand its simulation portfolio through organic R&D and a number of acquisitions.

Dassault Systèmes set the scene for the event by highlighting challenges (see Figure 1) inhibiting manufacture of end-use production ready parts via AM. The main takeaway was that companies are in transition from static-electronic to live-digitally connected processes, and companies need to eliminate silos and unite all functions into a seamless digital thread, bringing into focus not only technology challenges but organizational issues.

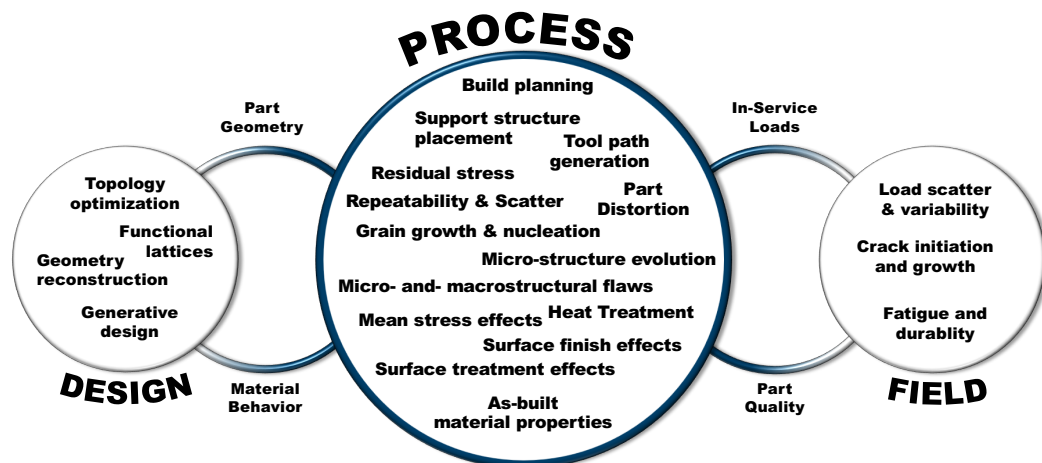


Figure 1—AM Design Through Manufacture Challenges
(Courtesy of Dassault Systèmes)

Mr. Berkey then handed the meeting over to Mr. Akshay Narasimhan Senior Technical Consultant, Additive Manufacturing & Materials, who, along with his colleagues, outlined a 5-step strategy (Figure 2) themed: Digitally Connected, Science Based:

1. **3DEXPERIENCE** Marketplace
2. In-Silico Material Engineering
3. Function-Driven Generative Design
4. Process Definition & Production Planning
5. Global Production Systems



Figure 2—Digitally Connected 5-Step Process from Atoms to Parts
(Courtesy of Dassault Systèmes)

This 5-step strategy encompasses a holistic end-to-end approach that highlights the scope of Dassault Systèmes comprehensive Additive Manufacturing (AM) solution portfolio and encompasses material, geometry, process, and the environment in which the final part performs. Starting out, the **3DEXPERIENCE** Marketplace is not only a procurement marketplace, but an entire ecosystem comprising AM manufacturing experts, AM machine builders, AM service providers (e.g. strategy, materials, manufacturing, labs, and academics).

The second step, Material Engineering, comes before design and simulates materials at microscale level in three stages as defined below. By simulating in three stages, engineers can choose the best material for the target application, such as medical or dental implants or an aerospace high temperature burner nozzle, by simulating the chosen material’s behavior at each stage. This helps make better material selection decisions. The three stages are:

1. Material Microscale (before manufacture)
2. Material Evolution (during manufacture)
3. Material Performance (after manufacture)

The third step, Function-Driven Generative Design brings engineers a new concept of designing products starting with functions not features, and then combining these with space and performance constraints under various loading conditions, to create a range of conforming results. These results together with analytics allow the engineer to choose the best solution or do further trade-off iterations before making a final design decision. The engineer may then choose topology optimization and latticing to improve part performance. CAD engineers need not worry that their jobs are being obsoleted by generative design

technology but rather they are now empowered to perform more design iterations in a shorter amount of time and make better design choices.

The Process Definition & Production Planning step provides the essential process planning to simulate the entire AM lifecycle end to end, right from within the 3DEXPERIENCE platform. This includes all process steps; materials; technologies such as powder bed, direct energy deposition, and polymer extrusion; and specific machine capabilities such as slicing, hatching, and build tray nesting. This means customers can simulate actual machine specific capabilities by accessing a specific virtual machine and its controller codes. Build tray nesting assists engineers to simulate a collection of different parts in the build tray including thermal interactions, effects of cooling such as warpage, residual stresses, service life, and fatigue life including cracking. A Reverse Shape optimizer helps incorporate the effects of distortion back into the original design so that the final AM production part conforms to quality standards.

Finally, step five is the Global Production System. Global production is not a new concept, but AM brings the possibility to disrupt the traditional global production model by allowing on demand relationships between OEM and manufacturer to be created. Manufacturing can occur close to, or at, the location where the final product will go into service. This eliminates traditional costs of machine set-up, logistics, inventory, and potentially reduces time from part demand to in-service part commissioning. On demand global manufacturing is now practical with AM, but digital security is essential.

To further support the industrialization of AM and make end-use production ready parts, Dassault Systèmes showed SIMULIA process reuse which automates proven processes to help make the same or similar parts efficiently next time.

Connecting the Digital Thread

Since AM is driven digitally, comprising geometry, material recipe, and process, it is possible to create a full digital thread. With the 3DEXPERIENCE platform, Dassault Systèmes enables their customers to create a closed-loop digital thread, that includes essential tasks such as versioning, revisioning control, data vaulting, security, state changes, and change management, which provides needed corporate governance.

As shown in Figure 3, Dassault Systèmes has cleverly augmented corporate governance with peer-to-peer (P2P) collaboration, to give the flexibility of P2P in the context of governance and control. This maintains corporate governance yet supports how people prefer to work. Within a simple personal dashboard, symbols such as “6W Tags” helps inform Who, When, What, Where, Why, and How decisions were made. Combining the rigor of corporate governance with the flexibility of P2P social media-like tools, helps overcome some traditional barriers between departments within organizations.

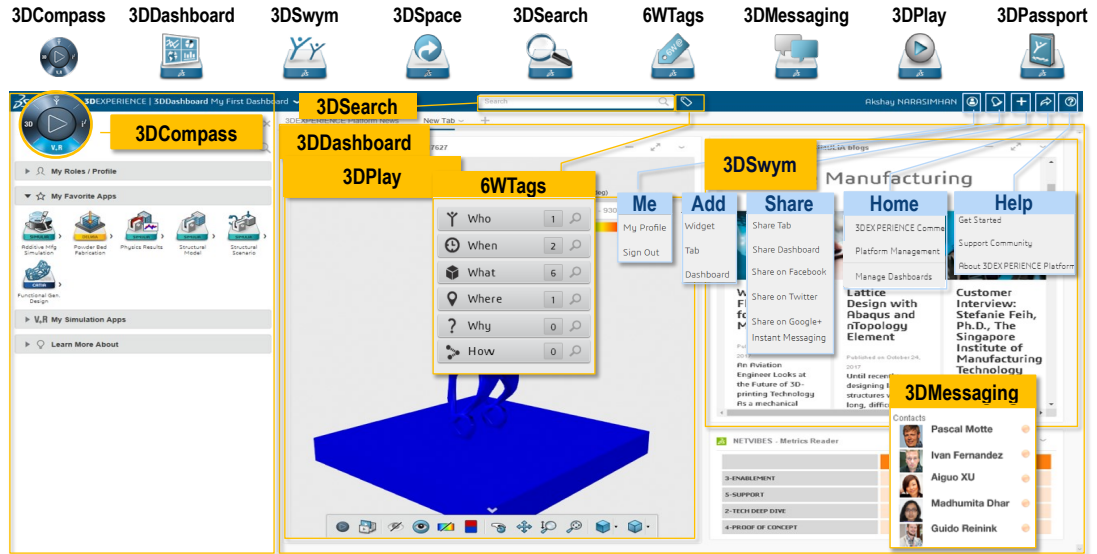


Figure 3—AM Digital Thread, Peer-to-Peer Collaborative, Governed, and Data Driven.
(Courtesy of Dassault Systèmes)

Concluding Remarks

Dassault Systèmes has demonstrated significant progress toward achieving an ideal world; from powder to working parts. Commencing from material microscale analysis to understand material behavior before, during, and after printing, all the way through to in-service part behavior, the **3DEXPERIENCE** platform with its brand application and roles, provides a comprehensive robust platform to simulate any process, any material, for any machine.

Dassault Systèmes has carefully understood the needs of both the corporation and the individuals who make products. Corporations need governance, people need freedom to think, create, and explore. Usually these two paradigms don't fit together, but Dassault Systèmes combines the rigor of corporate governance with the flexibility of Peer to Peer collaboration, to give the best of both worlds.

The SIMULIA brand applications are more than a tool suite for discrete simulation tasks, when combined with the **3DEXPERIENCE** platform and other Dassault Systèmes brand applications, they enable a transformation of how we go about designing and making everything we use. Industrialization of AM is here.

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