

Managing Additive Manufacturing Variation, Qualification and the Entire Process

In recent years additive manufacturing (AM) technologies and materials have evolved into being able to achieve industrial-grade parts production, which means AM parts are now entering the supply chain. As a result, manufacturing OEMs are figuring out how to implement that, which is bringing new thoughts, ideas, methodologies and disruptions to traditional supply chain methodologies.

In a recent discussion, AM supply chain specialists from Northrop Grumman, Equinor and Shell discussed how they are integrating and even reinventing supply chains to adopt AM into their processes. While they are not stepping away from traditional supply chains, they know that AM, if set up properly, can be a game changer simply by rethinking the possibilities that can move them away from the linear supply chain. The implementation of digital inventories and AM-focused suppliers is key to the new approach.

Brede Laerum, head of the AM Center of Excellence at Equinor, commented. *“We are looking into using a digital inventory software platform where everyone is connected. So, when everyone is connected you can deal with companies from anywhere in the world. You can order a digital part from anywhere in the world. And using additive manufacturing, of course with high quality processes, you can really recreate the physical component anywhere.”*

Inventory for the OEMs is also a concern. Laerum revealed that Equinor has more than \$3 billion in inventory, yet still needs to source more parts and that AM should be a solution to this.

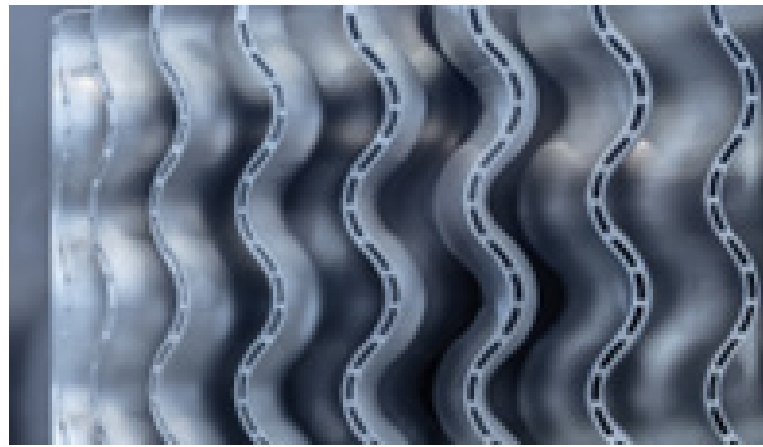
Angeline Goh, additive manufacturing technology lead for Shell agrees. *“We are looking at additive as a way to overcome some of the challenges we have in Shell with regards to a growing inventory where working capital is tied up,”* she said. *“We also face a lot of challenges from the fact that many of our assets are mature, and as a result we deal with equipment that is no longer available in the market and no longer in the scope of the OEM. And the spare parts for it are difficult to get.”*

AM is well understood for its value in on-demand production of parts and Laerum also sees that a shift to an advanced ‘just-in-time’ model would be a desired outcome for his operation.

“We would like to go more into on-demand manufacturing instead of producing them in case we need them,” he says. *“We would like to produce them just in time when the need arises. And additive manufacturing is perfectly suited for that philosophy. So digital parts can be bought and sold, and the production of the part is locally as close to the end user as possible.”*

All the OEMs are also keen to utilize AM not just for creating identical parts to those created using traditional manufacturing but to improve part performance, reduce material usage and so on.

Peter Le: *“In our industry there are a lot of traceability requirements, the quality management system, powder handling, all that good stuff,”* he says. *“But as a part of that audit, there’s also qualification builds to ensure that we execute with the supplier as well.”*



Managing Additive Manufacturing Variation, Qualification and the Entire Process, continued...

Fortunately, a new set of standards are being implemented to enable AM supplier qualification. *“We already have some international standards that we are using in the oil and gas energy industry, like the API 20S for metal parts,”* added Brede Laerum. *“We will also have a new standard called API 20T for polymer parts, and we use the DNV standard called B203, and those standards tells us how to qualify a 3D printing factory with our processes and competence and machines. But it also tells us how to qualify the physical components that are being produced so that we are absolutely sure that the quality is right and that the functionality is what we are expecting in the other end.”*

Read the entire article at: [Supply Chain: Managing Additive Manufacturing Qualification](#)

Transforming Manufacturing

In 2021, Smart Manufacturing started asking the leaders transforming manufacturing what effect the coronavirus pandemic has had on their business. The stories continue to amaze, and some of the trickle down effects of COVID-19 emerge in their answers.



More than two years into the pandemic, corporations of all sizes, startups, public-private partnerships and universities alike have continued to develop novel ideas and innovative products creating opportunities across many industries including additive manufacturing (3D printing).

Eric M. Johnson, Ph.D.

Senior Manager, Additive Manufacturing Research Lab, Eaton Corporation

Prior to getting into additive manufacturing, Johnson spent his career working on how manufacturing impacts materials and ultimately the durability of products. “Then in 2013, my employer at the time decided to buy a metal 3D printer,” he said. “As a metallurgist, I could not pass up the opportunity to work on such a cool technology. Once I started working in the field, my eyes were opened to the opportunities that additive manufacturing (AM) could bring to design, manufacturing and the supply chain.” He joined the AM community, built relationships and learned more about 3D printing. “I owe so much to the greater AM community for the awesome technology that has been developed and fantastic ideas that have inspired the adopters of additive manufacturing like me,” he said. “I believe we can change the way manufacturing is done and this is my goal for the future.”

Chinedum “Chi” Okwudire, Ph.D.

Founder and CTO, Ulendo; Associate Professor, Mechanical Engineering, University of Michigan

Okwudire and his colleagues have created new algorithms that leverage control theory, advanced modeling and sensing, and machine learning to boost the speed and precision of desktop and industrial-grade 3D printers at low cost. Manufacturers requested their FBS vibration compensation algorithm to help them speed up their 3D printers to meet the spike in demand brought about by the SARS-CoV-2 pandemic, but it wasn't ready for commercial distribution at that time. “We were really inspired by the requests,” he said. “It's great to see our solutions leave the research lab and find success in the field. We have lots more smart manufacturing solutions in development—like our SmartScan algorithm for laser-based 3D printing of metals—that we are excited to bring to the 3D printing industry and beyond.”

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