Innovation and Success Fueled Additive Manufacturing in 2020

Elementum 3D helped early AM adopters overcome materials challenges

2020 was a big year for additive manufacturing (AM), with several key innovations and successes across a range of industries.

Any time a technology or industry pushes boundaries, there's risk, but having the AM community closely connected, creates an ecosystem that helps mitigate risk.

In 2020, AM saw greater interest from aerospace, space, automotive, and defense manufacturers to engage with AM companies that complement their respective technologies and objectives.

Elementum 3D's patented technology and materials development expertise support the AM ecosystem in overcoming one of its biggest challenges: materials selection. "Elementum 3D's purpose for existing has always been advancing materials and processes so others have the freedom to innovate without material restrictions," said Dr. Jacob Nuechterlein, Elementum 3D president and founder.

With a range of materials to meet specific needs and overcome specific challenges, in 2020 Elementum 3D's products, along with support from many others, fueled successes in each of these industries:

AEROSPACE has used AM technology to reach key milestones in application development.

Orbital Microsystems' (OMS) CubeSat uses the first 3D-printed antenna for space use, made from Elementum 3D's A6061-RAM2, which is highly ductile, fast-printing, and cost-effective.

Ball Aerospace's, stratOAWL™ wind measurement instrument uses A6061-RAM2 for the primary outer structure. That also acts as the principle heat sink and features a number of innovations that help measure stratospheric winds in two directions from more than 8.6 miles (14 km) away.

SPACE transport relies increasingly on AM and novel printable materials to efficiently optimize safe, reliable space travel.

Masten Space Systems' Broadsword 25k rocket engine uses a novel dual-expander cycle made primarily via AM, enabling complex design geometries, reducing part count, and compressing manufacturing times. The high thermal conductivity of Elementum 3D's A1000-RAM10 is ideal for extreme conditions.

"Much of the direct metal production for our engine production is carried out through Elementum 3D, an additive manufacturing research and development company that specializes in the creation of advanced metals, composites, and ceramics," said Matthew Kuhns, Masten Space Systems chief engineer

"We work together to mature the patent-pending PermiAM process together under a NASA SBIR contract," Kuhns continued. "This allows us to build complex porous geometries in situ with fully dense material, enabling improved cooling and reduced manufacturing costs."

With Masten, we've moved to Phase III of a NASA SBIR project. Phase 1 developed PermiAM technology for design simplification and cost savings, combining regions of controlled permeability with fully dense structures within the same component.

Additional development work was done on A1000-RAM10, GRCop-42, and Inconel 625 materials through a NASA Phase II SBIR program. Phase III will develop a large-format AM process for GRCop-42 focused on print quality and speed, property characterization, and delivering rocket engine components.

NASA named us a partner to develop technologies to return to the moon and explore beyond. The project will advance high-performance aluminum alloys for large-scale AM. Research will use A6061-RAM2 and A1000-RAM10 with blown-powder directed energy deposition (DED) to increase performance and reduce costs for complex rocket components and launch structures.

AUTOMOTIVE engineers are working to improve part strength, weight, and durability, especially for high-performance applications. For Formula 1 AM enables rapid iteration, high precision, and complex designs. Materials like A2024-RAM2 and A6061-RAM2 help Formula 1 cars perform better, operate safer, and reduce maintenance needs.

DEFENSE and national security innovations using AM range from supply chain management improvements to making better, longer-lasting, lower-cost parts. Two 2020 Air Force events named Elementum 3D as a top innovator.

The AFWERX "Base of the Future" challenge connects members from industry, academia, and government to find ways to modernize, support, and sustain aircraft new and old. The program recognized the potential for Elementum 3D's RAM technology to help maintain and improve legacy warplanes.

We also participated in the USAF Advanced Manufacturing Olympics event, which finds and tests 3D printed components for demanding conditions. The USAF must address several issues to implement AM to sustainment projects. Participants are asked to find solutions to real-world problems.

Nathan Parker, deputy program executive officer for the Rapid Sustainment Office (RSO), explained: "The Technical Challenges were designed to spark innovation, collaboration, and evolution in AM and push boundaries." Elementum 3D, in response, identified and demonstrated the ability to print high-performance aluminum alloys capable of supporting the USAF's AM sustainment initiatives.

The USAF is working to use AM aluminums for rapid on-demand production of high-strength parts. Reducing component weights and raw material requirements yield improved buy-to-fly ratios. AM and other forms of advanced manufacturing will help reduce sustainment costs (which are 70 percent of the USAF budget).

Conclusion

"Elementum 3D was fortunate in 2020 to work with industry-leading organizations committed to investing in and capitalizing on metal additive manufacturing's potential," said Dr. Nuechterlein. "Business relationships begin and are sustained through trust. Trust is also essential for adoption of new innovations."

We look forward to continuing these relationships and finding more. Ultimately, Elementum 3D pushes boundaries of metal powder capabilities and performance to do things not previously possible, so others can achieve innovation within their own fields of expertise.