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NAVY SBIR TRANSITION PROGRAM

SPOTLIGHT

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MELD Manufacturing: Innovative 3D printing process offers huge advantages for defense manufacturing

Launched in 2018, MELD Manufacturing Corporation has attracted interest across the Department of Defense for its revolutionary additive manufacturing (AM) technology. Known as additive friction stir deposition, the MELD process enables users to print large metal parts of unprecedented size with forged-like properties. The capability to print these parts on demand addresses a key issue for DoD supply chains: cutting down the long lead times associated with traditional forging and casting, while also reducing dependence on foreign suppliers.

"There was definitely a time when people were uncertain about the potential of MELD technology, or any kind of 3D printing technology," says Nanci Hardwick, CEO of MELD. "Now I would say there's real excitement and enthusiasm. The delay in forgings is hindering the progress of many programs. A technology that can solve this problem generates excitement even before people get the details of how it works, how much it might cost or when we can deliver. As soon as they realize that something projected to take years could be done in weeks, they're in."

MELD offers a range of AM machines ready to be purchased for production or research use. These range from the compact L3 machine with dimensions of 10-by-8 feet to the larger 3P0, which measures 26.5-by-36 feet and features an integrated subtractive head, eliminating the need for a separate machine for subtractive processes. In addition to its products, MELD has also worked closely with DoD programs and academic researchers to test and refine its technology for specific applications.

In 2021, the U.S. DEVCOM Army Ground Vehicle Systems Center (GVSC) selected MELD to be the additive manufacturing supplier for the Jointless Hull Project, building a 3D printer capable of printing components up to 30 feet long, 20 feet wide and 12 feet high. The completed printer, installed at Rock Island Arsenal, gives the Army the capability to produce monolithic hulls, as well as other large, heavy metal components required for ground combat vehicles, more quickly and efficiently than what's possible in the current manufacturing and logistics supply chain.

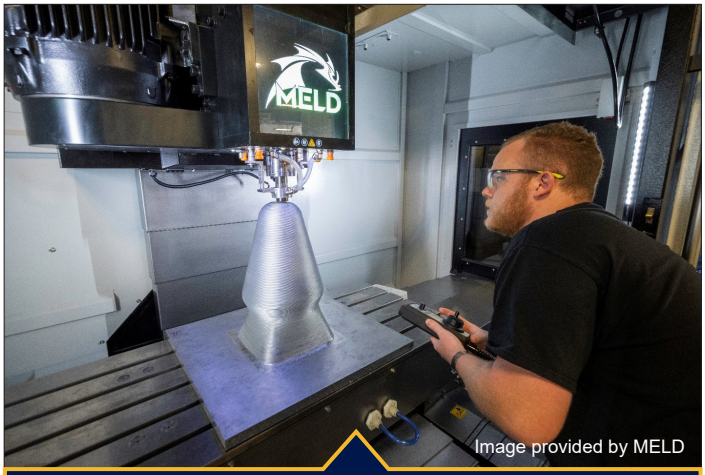
MELD CEO Nanci Hardwick inside the large build space of the MELD K2 machine.

While the Jointless Hull Project has garnered significant attention, MELD also has several completed or ongoing projects benefitting the Navy and Marine Corps. In 2021, MELD received a Phase II SBIR award from the Navy to explore applying their AM process and equipment for use in shipyards. MELD has delivered one of its L3 machines to NAVAIR as well, targeting repairs on the F/A-18 and Navy rotorcraft platforms.

In 2022, the Navy selected MELD to provide one of three different AM machines at the newly opened Additive Manufacturing Center of Excellence at the Institute for Advanced Learning and Research in Danville, Virginia. The Center is a

Naval Sea Systems Command (NAVSEA) project and is led by shipbuilder Austal USA, with a mission to accelerate and scale AM to address critical gaps within the Navy shipbuilding supply chain.

In 2024, MELD was selected by the Air Force as one of 67 companies on a potential nine-year $975 million contract supporting the Air Force Rapid Sustainment Office. At the same time, MELD is working on additional projects with the Navy, including one funded by the National Shipbuilding Research Program (NSRP) in which MELD is working with another small business, Hepburn and Sons, as a research partner. The NSRP project, supported by NAVSEA, the Naval Surface Warfare Centers, and Huntington Ingalls Shipyard, investigates whether the MELD process can be used to bond two different types of metal with sufficient strength to secure Navy aircraft on a ship's flight deck.



MELD employee Bryce Stump inspecting a cone print on the MELD L3 machine.

"The goal was to create flight deck tie downs using the MELD technology maintaining the geometry and function of current tie downs while reducing both cost and schedule," says Hardwick. "The aim is to develop a single tie down that works on both steel and aluminum ship decks by adding a collar of material that matches the deck it is being welded into. The question was, 'Can MELD technology apply aluminum to the outside edge of steel in such a way that it won't fail?' We're celebrating that in testing the fixture failed before our part did."

Unlike traditional fusion-based processes, which involve melting metal in order to print with it, MELD's proprietary AM process works with metals in a solid state, bringing them to the point of malleability without actually melting them. This gives the MELD process several key advantages for DoD manufacturing.

"Some alloys just can't be melted and resolidified well. Since we don't melt, we can print things that are otherwise considered unprintable," says Hardwick. An example is aluminum 7075, an alloy widely used in the aerospace industry. "It's not possible to print that with a process that melts the metal." MELD holds advantages even for metals that can be printed through other processes, such as the widely used aluminum alloy 6061. Because it uses standard off-the-shelf metal rods, the MELD process eliminates the need for special powders or alloys. Metal powders used in traditional AM processes are associated with a number of safety hazards. The fine swirling powders can combust, causing fire to break out in the facility. They can also be toxic if inhaled. MELD's printers are safer to work around, and the process can be completed in the open air, making it easier to print and cure extremely large parts.

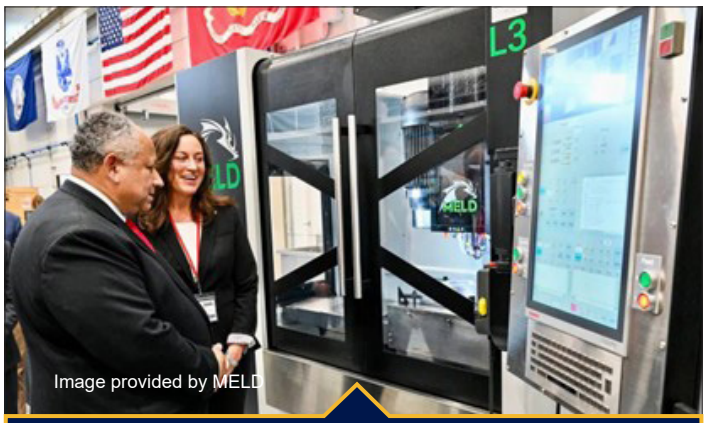
The MELD process was developed and patented by the Aeroprobe Corporation. After more than a decade of research and development, Aeroprobe commercialized the technology by launching MELD as a separate company. Hardwick has been MELD's CEO from the start.

"While our initial focus was more commercially driven, we've been working closely with the DoD throughout our development," says Hardwick. "Our largest area of activity, by far, is in aerospace. The materials we can print are

especially of interest to both aviation and space industries, which have consistently generated the highest demand since the start."

Following the passage of the CHIPS and Science Act in 2022, MELD has seen interest from a new market—the semiconductor industry. The bipartisan congressional act will provide $52.7 billion for American semiconductor research, development, manufacturing, and workforce development.

"Recently, as concerns grew about America's reliance on China for most electronics, there's been a tremendous push to figure out how to grow domestic manufacturing capability for semiconductors," says Hardwick. "The companies that make the equipment for chip production need big metal for their equipment itself, often measured in meters. When you get that large, you have very few choices for 3D printing. Add to that the materials that the parts are made from and that's where we become attractive to certain industries. For the semiconductor equipment industry, aluminum 6061, one of the most common types of aluminum, can't be printed traditionally, but it can be printed with MELD's process."



Former Secretary of Navy Carlos Del Toro speaking with MELD CEO Nanci Hardwick in front of the MELD L3 machine at the IALR Center for Manufacturing Advancement.

As CEO of a relatively new company that has already worked with a wide range of DoD organizations and primes, Hardwick has learned several things specific to the defense industry. The Navy STP program, which MELD participated in during its Phase II SBIR contract with NAVSEA, was a valuable resource.

For instance, Hardwick emphasizes the importance of understanding, as a small business, where the insertion points for your technology fall within the targeted program. "I don't think you can stand on the outside and figure that out. Finding a way to create a relationship with the right person or people on the customer side is critical. That's where I think the Navy STP program can help.

"Practically, I would advise getting expertise. When you receive a purchase order with 46 pages of terms and conditions, I know some small businesses don't read those pages. As a technology company, you really need to understand what it is that you are agreeing to. Navy STP is great about bringing awareness to issues like that and having experts to make connections with, whether those are IP attorneys or government contract experts," she says.

"There are extra requirements a business must satisfy to do business with the government, such as accounting or tracking the physical goods purchased. You need to understand the rules and then verify you're following them. You need to evaluate the risks appropriately to make a good transaction with primes. It's definitely different than the kind of business we normally conduct. Having folks who can help rather than learning the hard way is what's great about the Navy STP program."

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