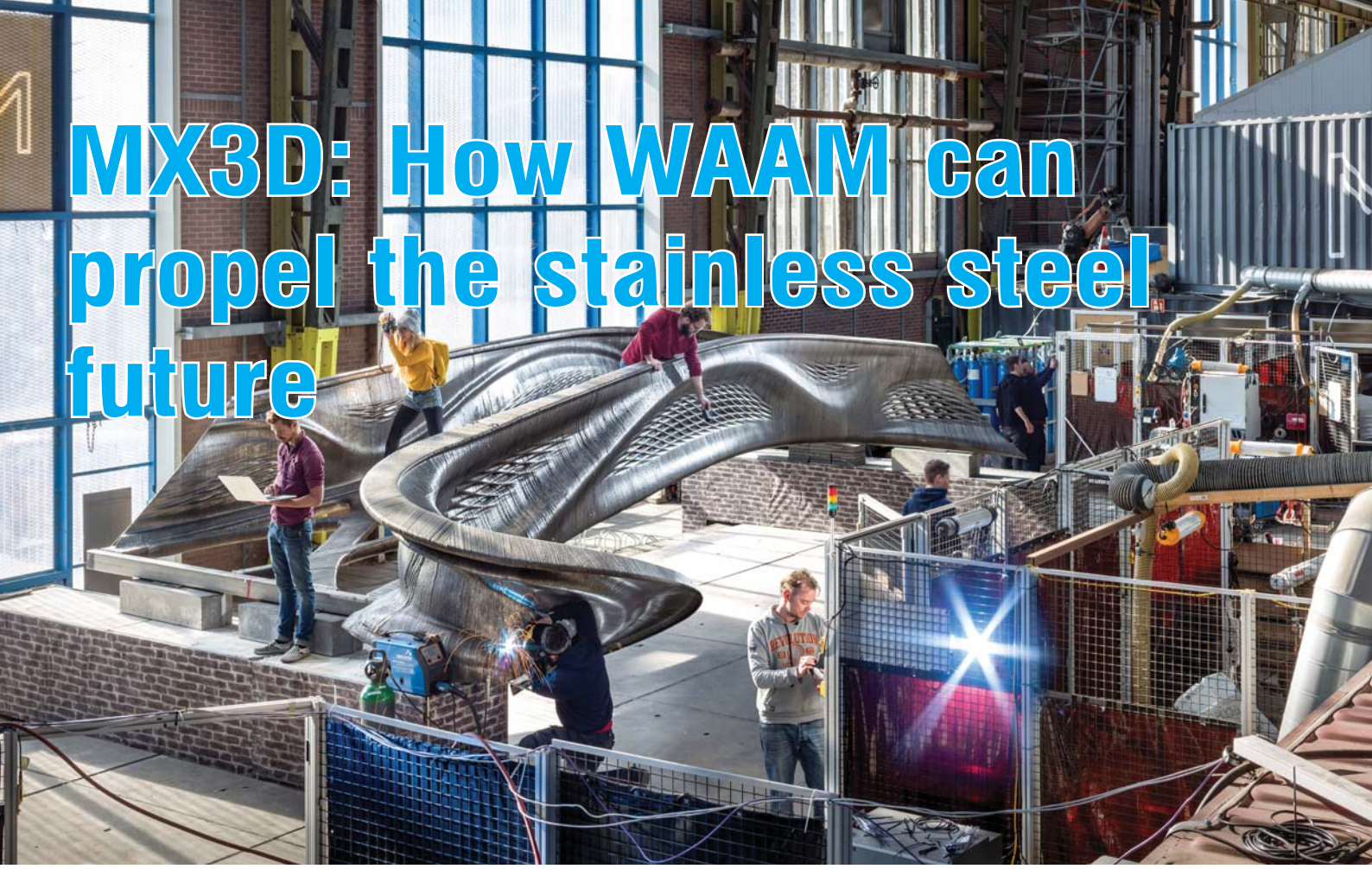
MX3D: How WAAM can propel the stainless steel future



MX3D's stainless steel 3D-printed bridge. (Image source: MX3D)

MX3D is a research-led company making waves in the design of additive manufacturing systems. We spoke with CEO Gijs van der Velden and Lead Engineer Thomas van Glabeke to discuss the MX3D story, some of the company's most exciting recent developments in wire arc additive manufacturing (WAAM), and what it can mean for the stainless steel industry.

By Ellie Pritchard, Stainless Steel World. Images courtesy of MX3D

"Initially, we were just curious about how we could print 3D metal forms in a way we hadn't experienced before," Gijs begins. It was the company's open approach to sharing their experiments and successes in social media that grasped the attention of manufacturer Arcelor Mittal and software company Autodesk. "They challenged us to do something beyond our wildest dreams," says Gijs. This challenge led to MX3D's highest-profile project to date – the 3D-printed 12-metre-long stainless steel bridge. "When we first started, nobody believed that it would be useful or interesting for industrial purposes. But the bridge was a runway to develop not only the technology, but also the market – it was a symbol of what could be achieved."

More than moonshot projects

Since then, the company has grown to become a go-to in terms of exploring the new frontier of additive manufacturing, especially in stainless steel. Earlier this year, the company recently raised EUR 2.25 million in funds to develop the M1, a complete robotic metal AM system, including a welding robot, software and control system to 3D print metal parts. "The grain of the company is exploration. The bridge was a really wild, moonshot project", says Gijs, fondly. But he asserts that MX3D has capabilities far beyond this. "We've really set the level of achievement high for this industry. We showcase how useful this technology will be in the very near future." The company's goal is to embed such technology into high impact industries like Oil & Gas, Maritime and Tooling.

What is WAAM?

MX3D's latest venture sees wire arc additive manufacturing taking the lead in parts and repair. It is the process of melting metal wire using an electric arc as the heat source – essentially, welding. One big advantage of this is that it is something that the metal-working industry is already familiar with. Users simply need either the M1 fully-integrated system or they need to apply MX3D's software and control system, MetalXL, which turns existing

Thomas van Glabeke (left) and Gijs van der Velden are hoping to bring their technology to the offshore industry.

welding robots into an industrial metal AM system.
Gijs explains that this idea was borne from wanting to democratise the world of additive manufacturing. "We want to make sure that there is no mysticism around what we do; we are essentially using a welding robot to 3D-print."
The M1 was released in March and provides a full system for anyone without a robot to 3D print. Examples of the system's application include the near-net shape; instead of milling away a large block of excess material, with the M1 the user simply 3D prints the desired shape and mills away only the last 2 millimetres to get the end part.

Perfect for platforms

More specifically, however, WAAM-technology has huge potential in the oil and gas sector. We raised the question of offshore platforms, where lack of space means spare parts and tools cannot be kept on-site, and the remote locations often cause long lead times when repairs or replacements are needed.
MX3D's lead engineer, Thomas van Glabeke, explains that WAAM is the ideal solution: "This is a very lean and flexible system compared to other production methods. For example, with CNC milling you start with a big metal billet and then reduce it to the size you need, so you need a warehouse full of huge metal plates. With our printer, however, you're printing from metal wire so the feedstock is very small and you only print what you need."
Further advantages are that the system allows printing in any direction and orientation, its speed and its robust design.
"The high deposition rate means that this is one of the fastest, if not the fastest, metal printing systems", says Thomas. WAAM allows the user to print large parts in a short amount of time, roughly 5kg per hour. Gijs reinforces this: "If you print relatively slow, you can still have your part within 3-4 days".
"It blows powder-bed printing and other alternatives out of the water," says Thomas. "It's also industrial, so no need for a sterile environment or a suit and breathing mask, unlike with powder-bed printers."

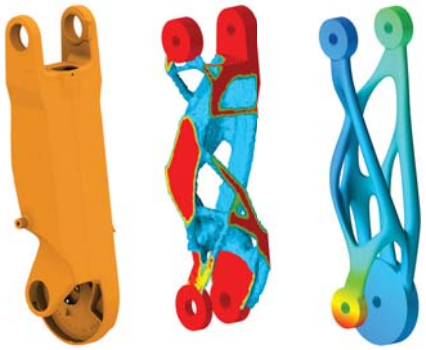
The M1 system, a fully integrated solution for WAAM printing

Hybrid manufacturing

WAAM also makes hybrid manufacturing possible. In particular, Gijs and Thomas discuss repair and extension of existing stock parts.
Thomas explains: "When parts break down, you don't want to necessarily replace the part, but with the M1 system you can invent a new patchwork piece that fixes it. So, if a huge part has a crack somewhere, you can grind it down and fill it up or print a new geometry on top".
Another exciting aspect is the range of material that can be used. "We have the weld wire manufacturers making wire specifically for WAAM and they are promising even better results," says Thomas. "And next to that, clients can choose their own alloys; the advantage of the WAAM process is that you can mix alloys as well, so you can have soft material on the inside and hard material on the outside. We are able to create multi-material objects which is quite unique. The combination of those alloys opens a new dimension in design and product characteristics." This is not the case with other processes such as CNC and certainly opens up opportunities for all users.

A question of alloys

For the stainless steel community, alloys are a hot topic, and we were keen to establish how WAAM can stand up in this arena. MX3D's extensive experience of printing in multiple different alloys and materials means they have developed a strong database of what works best.



MX3D's Robot Arm project created a replacement part by reverse engineering, optimising, printing, finishing and finally assembling and using the robot. The project demonstrated the rapid and automated production of large-scale customized replacement parts.

"In general, pretty much all alloys that we've had in the workshop have given very good printing results", says Thomas. "We've had very good results with the standard produced alloys, so we are matching the expected material parameters or even overshooting them due to the automation and characteristics of the WAAM process – some parts turn out to be even better."
With a very small group of specific alloys, extra attention is needed but the WAAM alternatives may prompt new ways of using that material, such as the hybrid opportunities mentioned previously. "You don't necessarily need to build the full object out of a very hard material, but maybe only the outer shell –by doing that you already make the production process a lot easier", Thomas suggests. Certain alloys are more sensitive to heat or shrinkage and extra care is needed, and aluminium and bronzes are slightly more complex.
But stainless steel and duplex prove to be excellent for printing with WAAM. From the very first print, stainless steel grade 308 has given very good results and the team has only improved on this over time. "This is going to be the first material that we can offer as a certified material," Gijs affirms.

Certification

Certification is a tricky process in additive manufacturing. Complications arise when trying to prove that each individual printed part is up to standard,

The completed Robot Arm project, ready for installation

without printing countless number of replica parts for testing purposes. MX3D acknowledges that this is a long and challenging road for the whole additive manufacturing sector.

"This technology is still relatively new so there is not yet a formal certification guideline or ISO rule", Gijs explains. "At the moment, we work to all Lloyds and TWI standards – their guidelines are made more specific every year. We also work to all welding guidelines which have been around for many years."

Working closely with TWI and regulatory bodies means that MX3D are optimistic for the near future. "We can already offer simple parts, but I think with the M1 certified and with some certified parameters set, the system could deliver certified parts by the end of the year," says Gijs.

Their work for the oil and gas industry, including the WAAM Clamp, means that the company is already well on its way with tough certification processes. Thomas says confidently "We are already working towards the hardest one! We know what it will take in other sectors as well."

Why use it now?

As the certification process is still underway, some may ask: Why use this technology now? Why not wait? To this, Thomas van Glabeke says "A lot of companies are already getting a taste of the technology because they expect to adopt WAAM in the future for their production facilities, and because they want to stay ahead of the competition. They are making and testing parts in preparation for when things are finally certified".

Ready for the next opportunity

The MX3D process is propelled by research. Although their LinkedIn sports impressive feats of engineering and 'new age' possibilities, the real work is carried out through customer collaboration and making use of their 25-strong team of welding and materials experts.

With aspirations to turn their skills to the oil and gas sector, MX3D is now hoping to work with offshore platforms. "The technology is ready, and we bring our in-depth knowledge and experience to every project", says Gijs. "We are really ready to seize an opportunity and try the M1 system on a platform".

ENERGY METALS INC.
Specialty Stainless & Nickel Alloy

MultiAlloy + J&J Alloys

Joining forces to bring you the most inventory in the world.

304/304H • 316/316H • 317/317L • 310S/310H
321/321H • 347/347H • 410 • 904L • 254 SMO®
DUPLEX 2205 • SUPER DUPLEX 2507 • ALLOY 20
ALLOY 200/201 • ALLOY 400 • ALLOY 600 • ALLOY 625
ALLOY 800/H/HT • ALLOY 825 • ALLOY C276

WITH 4 LOCATIONS IN THE U.S. AND 3 INTERNATIONAL OFFICES, ENERGY METALS IS QUOTING AROUND THE CLOCK TO SERVE YOU.

U.K.
Gary Downie +44 7717 783092
garyd@emetalsinc.com

SINGAPORE
Colin Low +65 9455 5729
colinl@emetalsinc.com

SINGAPORE
Clifton Cheong +65 9768 5285
cliftonc@emetalsinc.com

U.A.E.
Marx Francis +971 50 482 4776
marxf@emetalsinc.com