Survive and Thrive:

Advances in technology driving speed, scale, and quality to improve commercial resilience and support growth in the subsea supply chain

Manufacturing

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Roundtable Synopsis

This report follows a roundtable gathering of 15 subsea energy industry leaders, organized by DEEP Manufacturing Limited, the innovative large-scale component parts manufacturer. The event was held during the Subsea Expo exhibition and conference in Aberdeen in February 2025.

The Aberdeen roundtable and subsequent report is the second in a series of global events and follow-up papers from DEEP Manufacturing on the importance of additive manufacturing (AM) in strengthening resilience in the energy industry supply chain. The first roundtable was held in Abu Dhabi and coincided with the ADIPEC exhibition and conference in November 2024.

The Aberdeen peer-driven discussion was held against a backdrop of extremely challenging and uncertain times for the subsea supply chain in the UK North Sea, where a stringent tax regime for the oil and gas industry, a lack of political clarity on the pathway for the energy transition, and rising costs in a maturing region are combining to create destabilizing conditions for the subsea service sector.

As a result, the roundtable was brought together to discuss how advances in technology such as additive manufacturing (AM), and specifically wire arc additive manufacturing (WAAM), will empower the subsea supply chain to not only stay afloat in difficult times but move forward and overcome these urgent challenges. In other words, to not only survive but also to thrive.

This paper combines research gathered by DEEP Manufacturing with insights from the Aberdeen roundtable, which was held under the Chatham House Rule. Many insights were openly shared on the challenges facing the adoption of new technology by the industry. These have been ring-fenced into three key themes which are explored below: the blockers to adoption, the critical role of the confidence factor, and the key drivers that will propel advanced technology uptake.

The paper does not aim to answer all the questions, but to further the debate on the value of AM and WAAM to the subsea industry, the current inhibitors to its widespread deployment, and the varying benefits and opportunities it can generate.

Inhibitors to new technology adoption in the subsea supply chain

A question of cost

Not surprisingly, costs, or more specifically financial risks, were identified as a major inhibitor. A typical response from the roundtable was:

"The main blocker is, who is going to fund the engineering or initial prototype of whatever new technology is involved?"

Fear of financial risk was identified as a reason for companies adhering to existing and often less efficient traditional manufacturing processes. As one attendee said:

"Technology used in our projects is typically based on tried and tested methods. There is typically no desire internally/from our customers to move away from this. These methods have been proven in the field and therefore build confidence, particularly in regard to safety."

In response, the roundtable heard examples of WAAM's advantages in designing and manufacturing components with scale, quality, and speed. These can be key drivers in reducing total project costs and safety risks.

Slow-paced standards adoption

The offshore industry operates under stringent regulatory frameworks designed to ensure safety and reliability. However, many standards were established based on conventional manufacturing processes such as forging and casting. The situation was summed up in this comment by an industry leader:

"Standards typically don't align with new technology offerings; therefore it would be unlikely something we would consider until relevant standards caught up".

The extent that certification and standards pose obstacles to AM and WAAM adoption was identified as a key issue in Aberdeen and was also raised at the Abu Dhabi roundtable – highlighting the international impact of this problem.

However, the Aberdeen roundtable heard that in the AM arena, standards are now starting to align more with emerging technologies. As an example, DEEP Manufacturing recently secured DNV approval in principle (AiP) for its use of WAAM in the production of steel for hull structures, equipment and pressure vessels for human occupancy. Deep Manufacturing is the only company in Europe with this AiP and is working towards final DNV approval. The Aberdeen roundtable recognized that acknowledgment from verification bodies, such as DNV, is essential in certifying and establishing greater recognition of the qualities of WAAM-produced components. WAAM can create a critical path toward supporting overall operational requirements and improving performance by enabling complex components to be produced quickly.

Third Party approval can prove that WAAM-produced components are materially sound. However, WAAM also has the potential to deliver significant operational advances to the subsea sector.

Production of Hemisphere's using DEEP Manufacturing Two Axis Manipulator Table.

WAAM advances supply chain resilience

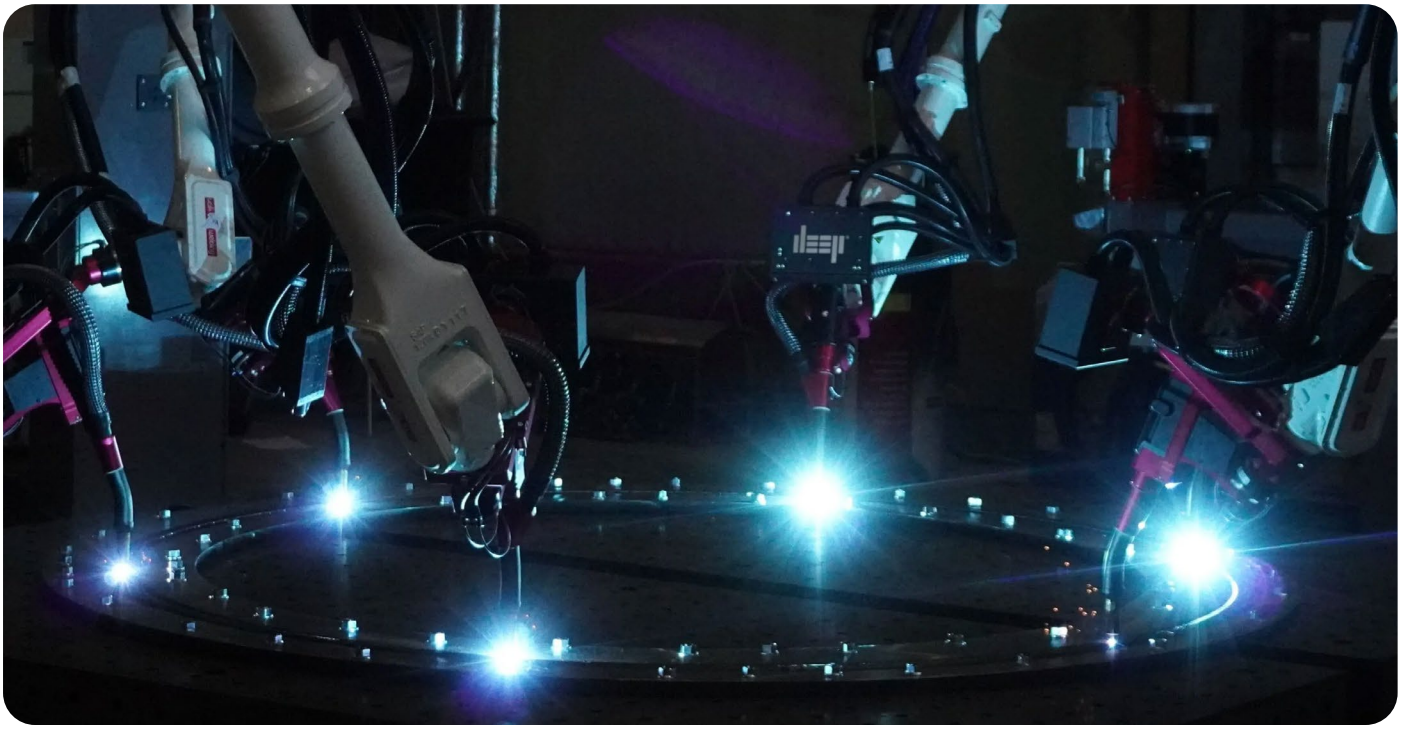
The unique capabilities of WAAM create several benefits for subsea supply chain companies. At the Aberdeen event, the speed of production and complexity of design for low-volume, large-scale components were identified as key differentiators over traditional manufacturing techniques. Both advantages generate greater efficiencies.

WAAM can support resource sustainability by allowing for a reduction in material waste. Unlike traditional manufacturing methods, which require extensive machining and produce substantial waste, WAAM builds parts layer by layer, using only the necessary material, therefore reducing the buy-to-fly ratio. This efficiency can result in significant cost savings and environmental benefits for large-scale components – a key discussion point at the Aberdeen and the Abu Dhabi roundtables.

WAAM's ability to offer improved design complexity and efficiencies for large-scale components can lead to the production of intricate geometries that would be difficult to achieve with traditional manufacturing methods. An example of this is the externals of chamber, where the piping and gas cylinders could be integrated. Traditional methods would require these to all be separate components. This level of flexibility, which includes the ability to adjust wall thickness, enables engineers to design optimized parts that enhance the performance and durability of subsea components.

The technology also allows for the rapid production of prototype large-scale components, and the testing and refinement of designs before committing to full-scale production. This reduces production risks and the time-to-market for new solutions.

The speed at which WAAM large-scale components can arrive at the market is significantly faster than for components made using traditional methods. DEEP Manufacturing shared examples of having manufacturing components in just 22 hours plus two days for post-processing, compared to a traditional lead time of one month.



Achieveing production scale, utilising DEEP Manufacturing's Multi Robot Arm Configuration, producing parts upto six metres in diameter.

Overcoming the confidence factor

"The race to be second" is a well-used phrase in subsea to describe the industry's reluctance to adopt new technology, and its slow uptake.

One roundtable attendee summed up the problem:

"Typically, subsea is a conservative market. The rush to be second has been a standard mantra. Often the rush is to be third, fourth or fifth."

The event heard it can take 38 years for a new technology to be adopted in the highly risk-averse oil and gas industry. However, gaining the confidence to overcome the wariness of the new can create a competitive advantage for subsea supply chain companies.

Advancing industry acceptance

For the AM industry, a way of achieving greater industry confidence is to produce at a larger scale to encourage widespread adoption. The Aberdeen event heard that more subsea supply chain companies using WAAM-produced large-scale components will help generate more examples of successful deployment and a broader industry awareness, leading to the absorption of WAAM products and processes into standard subsea practices.

Consistent material quality

A major benefit in favour of WAAM large-scale components is the manufacturer's ability to ensure consistency in feedstock material quality, testing, and inspection pathways through the adoption of advanced automation. For example, in pipeline manufacture, the AM process avoids inclusions, hard spots, and other material issues that might not come to light until the pipe-laying stage.

A pipeline expert at the roundtable said:

"There are lots and lots of issues we are dealing with on a day-to-day basis that you wouldn't have (with WAAM) because you could prove that you had control of the manufacturing process and carry out 100% of inspection during this process."

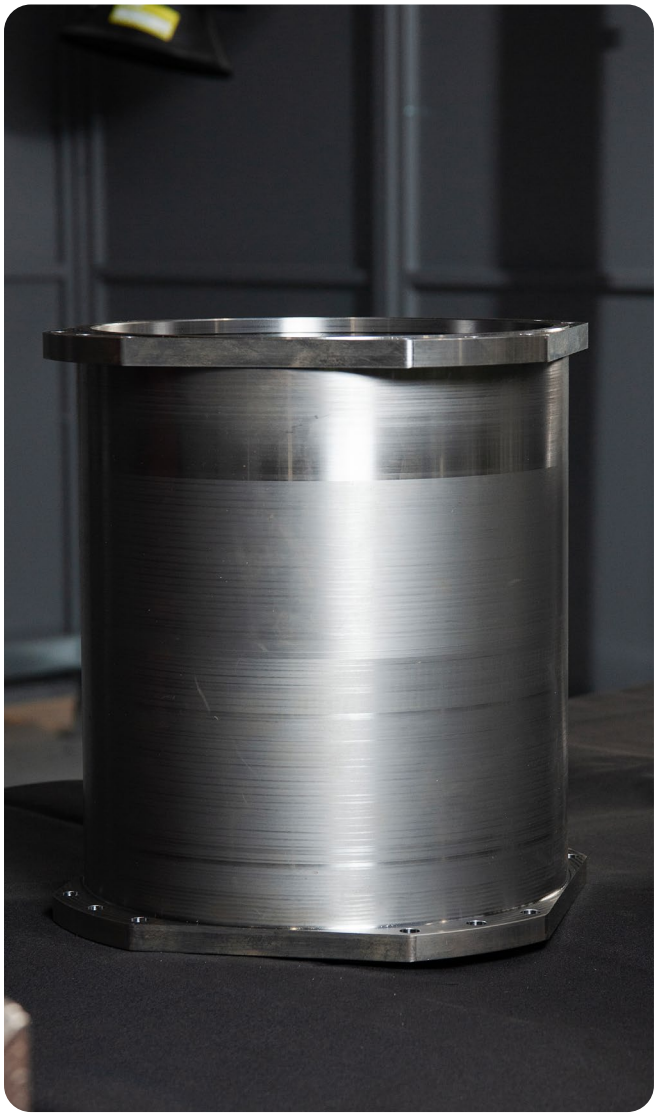


Illustration of a machined Wire Arc Additively Manufactured part as a complete component.

The key triggers for change

For any business, stakeholders have a critical role to play in encouraging change. At the Aberdeen round table, the important influence of end users or end customers was highlighted as the most popular trigger point for a company to consider the adoption of new technology. Customer demand will drive change.

As one delegate said:

"The oil and gas industry is slow at new technology adoption through the normal routes. However, there is a fast track and that happens when you have a motivated customer. I've seen this time and time again. When they have a problem that needs solving, and you're providing a solution that they don't already have, a motivated customer will support you with standards and quality control."

Continuing the debate about the power of stakeholders in driving change, the delegate said:

"I've been waiting 20 years for subsea forged components such as flanges and pipelines to be additively manufactured in a proper way. If you can turn those kinds of equipment around in days or weeks rather than months it will create a massive order list. That will automatically drive adoption and speed up standards because there'll be such a demand for them."

Ease of manufacture and maintenance

From a practical perspective, the simplicity and ease of testing and maintenance are critical issues for subsea components. Reducing these challenges was identified as another key trigger point for new technology adoption.

The roundtable heard that important maintenance considerations and access to difficult areas can be overlooked in the designing of equipment. WAAM has the potential to overcome these challenges through things like consolidating the number of parts required because of its advanced design capabilities.

Empowering the subsea supply chain to survive and thrive

The recognition of the advantages of AM generally and WAAM specifically in the subsea sector is at a critical stage. The industry is gripped by uncertainty due to economic and geopolitical pressures. As a result, there is a widespread acceptance that the industry must move forward from its traditional operational models. For the subsea supply chain, the focus on increasing efficiencies and reducing project costs is greater than ever before.

The adoption of new technologies like WAAM provides companies with a pathway to greater efficiencies and a reduction in total project costs. DEEP Manufacturing's pioneering use of WAAM, coupled with DNV certification, demonstrates the technology's viability, reliability, and advantages to the subsea industry. Put simply, in such challenging economic times, WAAM presents a differentiated opportunity that subsea supply chain companies cannot afford to miss.

Because of this, and as more stakeholders recognize WAMM's potential, its adoption will accelerate, supporting a more resilient and innovative subsea supply chain that can not only survive but also thrive.

About Deep Manufacturing

DEEP Manufacturing exists to accelerate the production of low-volume, large-scale metal component parts. Initially, this was for the manufacture of component parts for underwater pressure vessels for parent company, DEEP. Now, the business has the capability and capacity to offer its services to other commercial customers where low-volume large-scale metal parts are required at speed, such as those in the offshore, maritime, and energy industries.

With 20 Wire Arc Additive Manufacturing (WAAM) systems at its Advanced Manufacturing Centre of Excellence in Avonmouth in the UK, DEEP Manufacturing operates one of the largest concentrations of WAAM systems in Europe and globally. Each individual robotic system can produce metallic parts up to three meters in diameter. Through extensive research, development, and investment, DEEP Manufacturing has the capability to synchronize the operation of a configuration of six multi-arm systems, which can support the production of parts with volumes up to 6.1 meters in diameter, 3.2 meters in height.

DEEP Manufacturing's journey into Wire Arc Additive Manufacturing (WAAM) began as a response to the limitations of traditional manufacturing methods in producing large-scale subsea components. The company recognized the inefficiencies of forging and casting in delivering pressure vessels and other critical offshore equipment, particularly costs, lead times, and material waste.

To address these challenges, DEEP Manufacturing invested heavily in research and development, assembling a dedicated team of engineers and metallurgists to refine the WAAM process. Unlike traditional subtractive manufacturing, which removes material from a solid block, WAAM builds components layer by layer using an electric arc to melt wire feedstock. This process enables the production of highly complex geometries with enhanced material properties while significantly reducing waste.

The company's WAAM technology has undergone extensive testing and verification, culminating in its recent DNV Approval in Principle (AiP) for the manufacturing of steel pressure vessels for human occupancy. This certification represents a significant milestone, ensuring that WAAM-produced components meet stringent industry standards for safety, quality, and durability.

By pioneering WAAM, DEEP Manufacturing is supporting the subsea supply chain sector to survive and thrive, reducing vulnerabilities, and offering a rapid and scalable solution for high-performance, quality offshore assets.

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Scale. Quality. Speed