

The cautious first steps of AM in oil and gas

Several industries, such as automotive or aerospace, seem to have embraced additive manufacturing. The oil and gas sector has been a laggard but has warmed up more and more to the above concept. To pave the way for AM in oil and gas, standardisation, supply chain collaboration and clear business cases are needed.

By Lucien Joppen

First of all, what is Additive Manufacturing? According to one of the global experts in this domain, Terry Wohlers, AM is the official industry standard term (ASTM F2792) for all applications of the technology. 'It is defined as the process of joining materials to make objects from 3D-model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies. Synonyms are 3D Printing, additive fabrication, additive processes, additive techniques, additive layer manufacturing, layer manufacturing, and free-form fabrication.' Many different technologies can deliver layer-upon-layer production, which all fall under the AM-umbrella.

Viable alternative

According to the Wohlers Report 2019, the global sector (products and services) will represent a combined turn over for 2020 of USD 15.8b. The company expects, based upon interviews with 177 AM-companies, that revenue forecast to climb to USD 23.9b in 2022, and USD 35.6b in 2024.

It remains to be seen how accurate these numbers are. A better indicator would be the



Onno Ponfoort: AM mature enough to deliver quality-assured parts.

acceptance level and usage of the industry. Onno Ponfoort, Practice Leader 3D-printing at Berenschot, an international management consultancy firm: "Many industry sectors, such as automotive or aerospace, have embraced AM as a viable alternative for some of their product applications. Having said this, AM is still in its infancy - in industry uptake and sectoral size in dollars - compared to conventional manufacturing."



Valeria Tirelli: "Covid-19 has put AM into the forefront, with large companies - such as Shell, Total, BP and others - using AM to produce masks, face shields, ventilators and medical components. "This will result in an increased uptake and use in all sectors, including valve manufacturers."





Valeria Tirelli, fifth from the left (red jacket). The participants of JIPs celebrate the official release of guidelines, at DNV GL office in Høvik, Norway.

Awareness

One of the major reasons why AM's 'market share' is still modest, is awareness. "Many companies have not yet investigated what AM could do for them. AM is not a panacea but an enabling technology to improve one's business. And the technology is mature enough to deliver quality-assured parts. I advise companies to analyse which bottlenecks or opportunities in production, supply and proposition development could benefit from AM."

Apart from the above factors, AM also requires supply chain collaboration, Ponfoort says. It is an ecosystem: from raw material suppliers, 3D-design software developers, post-processors, AM-machinery suppliers to end-users. "Drive and commitment are needed from all supply chain actors." With drive and commitment also comes investment. As AM is still a relatively new technology, testing is paramount. In many

cases, also destructive testing which drives up the price even more. "Therefore, NDT-development for AM-products is crucial."

Stamp of approval

Specifically for the oil and gas sector and related industries, standardisation is paramount, Ponfoort states. "Needless to say, there are critical and less-critical parts. However, each part needs to have a 'stamp of approval'. With an eye for different criticality levels, guidelines have been developed in the JIP ProGRAM on Additive Manufacturing for Oil, Gas and Maritime that was managed by DNV-GL, in which Berenschot collaborated." This particular Joint Industry Program (JIP) focused on developing procedures for specification requirements, procedure qualification and requirements regarding quality assurance, on ensuring production in a safe and repeatable manner. It was established to produce guidelines that ensure process and product quality for metal components that are manufactured either via WAAM (Wire Arc Additive Manufacturing) or L-PBF (Laser Powder Bed Fusion). Both are AM-technologies but have different benefits and limitations. WAAM is more suited to larger objects and has a relatively low resolution. L-PBF offers advantages in terms of design freedom and accuracy but has limitations regarding the size of the object.

AM-oil and gas guidelines published

On January 30th of 2020, the above JIP ProGRAM presented its document containing the AM-guidelines and an accompanying economic model for companies to assess whether it pays off for them.

"Our involvement was creating a toolbox for part selection, supply chain set-up and economic viability", says Ponfoort. "Within the JIP's, the companies have jointly developed real-life parts to ensure that the guidelines are rooted in everyday practice and not based upon abstract models. Going through the development and production steps, enabled the consortium members to assess all activities that need to be monitored and qualified to ensure a complete guideline. It also gave insights into the economic and organisational differences between traditional manufacturing and AM."

Acceleration

One of the JIP-case studies is a crank disk produced via LPBF by Aidro for Kongsberg. The original part, produced with conventional manufacturing, takes from 8 to 10 weeks while the 3D-printed part requires less than one week to be printed in Inconel 718, using an EOS M290 printer.

"This is a good example of how AM can accelerate the replacement of parts and avoid long downtimes due to relatively long lead times", says Aidro-CEO Valeria Tirelli. "During the workshop at Valve World Conference, I will co-host a presentation with Luisa Mondora (Valland) focusing on a valve-related business case. AM has possibilities for the valve sector." Tirelli also mentions that "regarding prototyping, the use of AM saves time and money because you don't need to make the prototype out of metal. There could also be design benefits, for example, the design and manufacture of cooling channels that don't require drilling. Other design benefits can be light-weighting or volume-reduction." Finally, there could be implications for more effective maintenance/repair procedures. Siemens has managed to repair turbine burner heads using AM. In other words, the possibilities are endless. The trick is to determine whether a specific AM-technology works for a particular application.

Workshop on AM

During the Valve World Conference 2020, Onno Ponfoort will moderate a workshop on AM. "I am very excited about the opportunity to inform the audience about the possibilities of AM. As I have indicated before, more awareness is needed to pave the way for this promising technology."

The presenters during the workshop are: Valeria Tirelli (Aidro) and Luisa Mondora (Valland)

Edwige Ravry (Total)

Jukka Borgman (Metso)

Carlo de Bernardi (ConocoPhillips)



The crank disk 3D printed by Aidro with EOS M290 and machined by Kongsberg.

Valve World

The global magazine for valve and
actuator users, suppliers and specifiers
Vol. 25, Issue 4, May 2020

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