ADDITIVE MANUFACTURING EUROPEAN CONFERENCE

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AMEC IV TAKEAWAYS

Introduction

Europe has a great range of expertise in Additive Manufacturing (AM) and the technology looks set to accelerate towards mass production in the near future. Nonetheless – with rising global competition and the risk of overregulation knocking on the door – we face a host of challenges ahead, so European legislators need to be well aware of the risks.

In the 4th edition of the Additive Manufacturing European Conference, many different experts were brought together at the European Parliament. The discussion was fruitful and we were able to identify the next steps towards industrialising AM. As the representatives of the interests of AM companies in Europe, CECIMO values the opportunity to bring to EU politicians the expert opinion of its members.

The event was co-hosted by MEPs Mady Delvaux (S&D), Dita Charanzová (ALDE) and Ivan Štefanec (EPP). The discussion was led by a number of high-level experts from the AM world, and was moderated by Frits Feenstra (Senior Project Manager at TNO) and Benjamin Denayer (Senior Business Developer AM at Sirris).

Below you can read the main takeaways from the interventions of each speaker during the 2-panel conference.

Image Caption

 

Stewart Lane, Corporate Manager at Renishaw

It will take time to translate AM into sales, as there is still a need to build business cases around the technology. We still have some way to go before industry – and society as a whole – grasp the true benefits of additive production methods. Raising awareness about the capabilities of AM dovetails with boosting educational provision in this context. As subscriptions to existing training courses tell us, engineers are the priority target for education today. Demand for AM-centric operators and technicians appears to be more of an issue in the longer-term, instead. Education should not be limited to technical experts, however. Rather, it has to permeate to the level of business leaders, as well. One conclusion is clear: the implementation of AM in Europe will require successfully mastering change management within industrial companies.

Along with education, standards will play an enabling role in the commercial uptake of AM. The standardisation community is becoming larger and larger, as new players are entering the AM market. There has also been a shift from having no available standard to relying on several industry-wide standards developed by a variety of standardisation committees. Coordination among all these different standardisation bodies will be key if we want to avoid each of them putting their own spin on a given theme.

EU research funding has also gone some way to help on immediate issues. Money should go into the development of skills, too. The example of the UK is helpful in this respect. Focusing on Tier-I suppliers to the aerospace sector, the government-backed DRAMA initiative set out investment to reduce the time and cost in the planning of AM processes, to provide a knowledge base and digital tools for AM technologies, as well as educating supply chain companies and OEMs in the end-to-end AM process. Essentially, SMEs in particular will be able to rent time on AM machines and develop applications before committing to purchasing AM systems and ancillary equipment. These kinds of comprehensive actions will be helpful in gradually pushing the technology into serial production. Overall, however, it will take time before AM becomes more cost-effective than casting. Conventional production techniques have been used for a long time in the European advanced manufacturing sector.

Roberta Sampieri, Product Development Manager at FCA EMEA
The next big frontier for AM in the automotive sector will be volume production. Since the introduction of the technology for automotive applications in the 1990s, the adoption of AM for prototypes has become a consolidated practice. New materials have allowed the use of AM for functional prototyping, beyond the aesthetical prototyping for which it was initially employed. This has drastically reduced the time-to-market, as solutions can be tested and validated in considerably less time than before. The gains achieved – thanks to AM in terms of the product development process – are noticeable, as traditionally these processes could often take a long time. Yet, for additive technologies to enter mass production in the automotive sector, several barriers need to be addressed. A key one currently being addressed is process speed. An automotive factory produces a rather high number of parts per day. Pre- and post-production aspects, such as loading a build platform and cleaning the machine for the next job, are time-consuming tasks that impact on the suitability of current AM technologies for high-volume production in the automotive industry. That is why more automation in the additive process is a key to unlocking greater opportunities for the technology in automotive serial production. Together with a decrease in the cost of AM materials and systems, another important aspect remains the repeatability of production processes, which have to meet the levels achieved in conventional manufacturing. Finally, serious attention should be put into building competences in design, in order to bring AM to mass production for automotive applications. This is why FCA is investing in a lot of resources to consolidate its internal design-for-AM competences.

If parts are to be produced additively, a different approach to designing parts is required. Designers should be driven by their creativity and tap into all the opportunities to develop the complex geometries that AM offers. The end objective is to generate, with this design-for-AM approach, added value for the final product by creating lightweight, functional structures with the same performance of conventionally-manufactured structures.

Miguel Castillo Acero, Vice President Technology Development at Aernnova
Aernnova is a Tier-I business that develops lightweight structures for aircraft makers. AM technology is well-placed to meet the current challenges in the aerospace industry. Thanks to topology optimisation software, additive technologies are capable today of producing lightweight, performant parts that lead to a reduction in the aircraft's weight, with derived benefits in terms of decreased fuel consumption.

It should be remembered that there are stricter regulations for the approval of parts for civil aircraft applications, regardless of the technology with which they are fabricated. Thus, with safety being a key dimension in the aircraft business, each part supplied to aircraft makers must fulfil extensive and challenging specifications. AM's value in this sector has also been shown, as additively-fabricated parts have proven they can meet safety requirements. Yet, for each new significant factor introduced in the AM production process – such as purchasing a new type of material – a new evaluation of required properties is triggered. Standardising materials for AM production would thus support the aviation industry in this qualification and certification process, and encourage new businesses in the aerospace field to explore AM technology in their portfolio of solutions.

It should also be noted that the process parts need to go through to qualify also requires a considerable investment on the part of the supplier. And, sometimes, it is difficult to identity with certainty whether parts will pass the qualification hurdles or not. This is why a further increase in the adoption of AM for aerospace applications will come once the technology is mature enough to reassure suppliers that they can build further business cases around it. The benefits of implementing AM for maintenance, repair and overhaul (MRO) purposes are also significant for airlines and part manufacturers. Research has shown AM's positive effect on bringing down working capital in airline inventory operations, as well as on producing spare parts on-demand. At Aernnova, the total time-span for spare part production via AM – from the moment the powder enters the factory to where the spare part is delivered to the airline – was reduced to 1 month from an original time-span of 1 year with conventional methods and operations. This is especially the case for spares fabricated with very expensive raw materials.

Florian Feucht, Head of Additive Manufacturing Application and Sales at DMG MORI/Realizer
AM is still a niche market if compared to the machine tool market. However, AM has been attracting significant attention in the advanced manufacturing community, and it is growing – albeit because the base number of installed machines worldwide is low. In 2018, it is expected that there will be around 1500 systems sold across the world. This is a small figure compared to sales in the machine tool sector. AM's business relevance can not only be found in mass production, but also in customised products for the healthcare sector, as well as other titanium-based applications.

To industrialise AM, it is important to guarantee a level playing field with other manufacturing technologies. While selling machines to specific industries does not prove complex from a regulatory standpoint, regulatory requirements do pose challenges when it is a spare part – such as a laser or powder material – being supplied. The problem appears clear when the regulatory burden is compared to that faced by other manufacturing technologies. Especially for companies with a global footprint, this is problematic. Furthermore, limitations on the flow of data feeding back to the machine manufacturer should be removed, as they haven't proven to be justified on any specific ground. These limitations appear to have emerged from an unjustified perception of a difference between AM and other subtractive technologies. In this sense, it is important to consider having no differences on data flow aspects.

The suitability of AM processes for the development of specific dual-use items is another telling issue. Presently, it is not possible to create dual-use parts with AM that are of a sufficient quality without resorting to the use of other equipment in the post-processing stage. The alleged understanding of AM as a dual-use technology can therefore be dismissed, too. AM is an addition to existing technologies, not a replacement. The EU has the potential to improve existing processes and keep its international leadership in an increasingly competitive field. It should lead the way on powder preparation standards, for example, or on health and safety standards in the design of machines – even if this is just one part of the equation. Overall, standardisation is beneficial, particularly to customers of AM system suppliers – not AM suppliers themselves, since standards help them to start adopting the technology. EU funding should also better target SMEs, which are able to speed up the maturity of AM and bring many interesting applications to the market.

The option of shortening the typical 3-year time-frame of EU project implementation should also be carefully evaluated. There is a risk of coming up with obsolete project findings by the time the EU-funded action has been completed, or sometimes even before it begins. Shorter, more-focused projects would be more useful and suitable for the current needs in AM R&D. The future of AM will be in the set-up of a process chain, where it will be considered an established technology, alongside others such as casting. High-performance computing will be important in achieving this. There is a wealth of data that can be collected from build processes. Although it is a complex challenge, industry efforts will need to focus on capturing more data by pre-calculating deviations during the build job. Automation and digitisation will also be topics at the top of the industry's agenda in the near future. In regard to automation, the challenge revolves around removing airborne particles (sized in the range 5-45 microns) from the part without the involvement of manual labour.

Stefanie Brickwede, Head of 3D Printing at Deutsche Bahn and Managing Director of the Network 'Mobility goes Additive'

Deutsche Bahn 's(DB)'s first use of AM dates back to 3 years ago, when the technology had been introduced to explore what it could offer. As DB is a maintainer and operator of trains, attention remains on the introduction of additively-manufactured spare parts into trains. Until today, the service bureaus network on which DB relies, which has so far proven to be more beneficial for the organisation than keeping AM production in-house, has fabricated more than 4500 AM parts – two thirds of which have already gone into trains. The main advantage of additive techniques for the generation of spare parts lies in the dramatic reduction of time needed to make them available. For spares manufactured traditionally, lead time can take up to 2 years in some cases. The huge reductions in lead time, achieved with AM, allow DB to remain confident in their ability to keep the trains on-time. Substantial cost savings are also guaranteed. For instance, switching to producing dust caps with AM has generated €15,000 in savings per year. Other benefits can be seen in the introduction of customised parts, such as Braille signposts for visually-impaired people.

It is on the back of this successful journey to the adoption of AM that DB decided to establish its ''Mobility goes Additive" network to attract players in the market and jointly address issues such as spare part production for a range of mobility-related sectors. As an example, the network is now investigating new materials for additive production, such as flame-retardant materials, in which both railway and automotive network members are interested. It is thanks to these common efforts that synergies are beginning to emerge that will address cross-sectoral challenges. One of these is the qualification of products in highly-regulated industries. Here, automotive companies are looking at DB's supplier qualification system for AM spare parts as a source of insights. And airlines are finding valuable cooperation with railway actors since the set of AM applications addressed appears to be largely similar.

Finally, it is important to guarantee IP protection – a topic of interest also for railway OEMs. The EU should support industry with supporting actions to identify a secure data format on which all actors can rely. Some actors are addressing the lack of data format standards. Yet, this is an issue requiring as many players across the AM ecosystem around the table as possible.

Valeria Tirelli, CEO at Aidro Hydraulics & 3D Printing
While the hydraulics sector is perhaps less well-known than others, hydraulic solutions are key to drive and control machinery in sectors like agriculture, food and packaging, as well as machine tools. In this industry, there has been little innovation taking place in terms of design. In some cases, some hydraulic components are still designed in the same way as 70 years ago, with no change in their intended shape and concept. This lack of innovation on design is attributable to the importance of volume in the hydraulic market, which makes aspects such working with established technologies and prioritising cost-effectiveness highly relevant.

Yet with the type of flexibility that a small business can enjoy compared to a larger company, Aidro has identified some room for manoeuvre in accelerating innovation in this sector – by adding value through AM. After having initially introduced the technology for prototyping purposes, Aidro moved towards considering AM for end-use production as a way of creating entirely new hydraulic solutions that would challenge the relatively conservative approach to technology in the hydraulic market. To this extent, the company is tapping into all the possibilities offered by design for AM and is developing new hydraulic components where multiple pieces are consolidated into just one. In addition, weight has been significantly reduced and sensors can be more easily integrated into the final machinery product with a view to boosting its efficiency. Great emphasis is being put on guaranteeing that additively-manufactured hydraulic components have the same mechanical properties as conventionally-produced ones. For that to be guaranteed, Aidro conducts a great deal of tests in-house, as well as in cooperation with universities based in Italy.

Yet, while SMEs like Aidro have few layers of hierarchy and can introduce technologies such as AM relatively quickly into production, that does not mean their adoption of AM came without challenges. For a small business, in particular, jumping into AM requires a clear strategic approach. Investing into it goes beyond machines. It entails also auxiliary equipment, such as powder handling, post-processing equipment and – importantly – skills. On the latter issue, new talents are continuously needed given the shortage of competent workforce in this field. Existing designers, too, must be open to changing their traditional approaches towards design in order to fully leverage the potential of AM, all while learning to use one of many different types of AM software that exist today. In this sense, it is important to integrate the input of designers into the development of AM design software, to ensure software coming to the market fits with the mindset of the part's designer, who is its ultimate end-user. It must also be highlighted that expectation around an exciting technology like additive, with its positive impact on society as witnessed in many healthcare applications (for instance), will elicit the interest of new people into manufacturing and thus boost the skills pipeline.

Emilio Juarez, HP Vice President & Head of 3D EMEA at Hewlett-Packard
The industrialisation journey of AM will be concluded only when the technology is considered just as one in a list of manufacturing methods to make products, rather than a novelty in the industrial world. The true potential of AM lies in its ability to customise objects, get rid of inventories, reduce carbon footprint and generate "smart parts" with embedded electronics and integrated traceability and intelligence.

Adopting AM for industrial production implies doing something not done before and overcoming several hurdles: securing skills, validating apps, certification, acquisition of necessary equipment. The EU should support the sector, particularly by focusing on two measures. First, contributing to a better integration of AM into university courses. Designers completing their academic studies today have a traditional mindset towards design, having learned guidelines that profoundly limit their ability to improve product functional performance. As additive production methods allow for the creation of complex geometries, students should be taught more widely about the capabilities of this technology. This is a fundamental aspect to returning jobs back to Europe – one of the advantages often illustrated by AM. The second measure is about supporting the uptake of AM among SMEs, which have a less hierarchical structure than large companies, and can therefore jump more quickly into the market than their larger counterparts. Yet, it remains challenging for them to purchase new AM equipment considering their limited resources. The EU should therefore support the earmarking of fiscal incentives – whether that means tax breaks, vouchers or other initiatives – for small organisations. This will guarantee a more rapid uptake of additive production by industry.

The issue of guaranteeing repeatability in the AM process should also be addressed. By making possible a continuous monitoring of the production cycle, the development of close-loop process control modules is seen as crucial for enabling consistency and repeatability during the entire manufacturing process. This is a why a great deal of effort is being put into the area of production process software development. Perfect control of the production processes is the ultimate objective. As an enabler of quality, consistency, and reproducibility across AM systems, robust process monitoring will make redundant the need for testing every part that has been fabricated, which is the case today. These software tools will therefore speed up the path towards qualification in highly-regulated industries.

Thomas Maal, Associate Professor 3D Imaging & 3D Printing and Director of Radboudumc 3D Lab
The Radboudumc 3D Lab is a university medical centre, whose goal is to help patients using new technologies such as AM and 3D imaging. Additive technologies in the medical sector have progressed a great deal since first being introduced more than two decades ago, and many applications have been found. Virtual surgery planning and AM anatomical models improve presenting the outcome of different options for patients, depending for example on whether to undergo surgery or not. This contributes to taking better care of their wishes. In addition to that, the technology has progressed dramatically in terms of oral, maxillofacial and orthopaedic surgery solutions for patients. To this extent, the growth of AM in the latter area has become emblematic.

The Radboudumc 3D Lab originally started off with just one application. It has now developed 100 solutions in the current year alone. Improving the quality of life of patients emerges as a prominent benefit of this technology. However, also saving costs should not be underestimated – as is the case in head and neck oncologic surgery and reconstruction, which involve very long operations. Thanks to AM surgical guides, the laboratory managed to cut 2-3 hours from surgical interventions that normally last about 12 hours, with consequent benefits not only for the patient but also in terms of the total cost. Dental prosthetics are another example of the cost-effectiveness of AM applications in healthcare. In this case, the laboratory demonstrated how additively-manufactured dental restorations led to a 60% saving in terms of medical costs. Speedier patient recovery time is another area where medical AM can bring clear benefits.

It is important that medical centres and hospitals collaborate, for instance, on adopting AM for maxillofacial surgery and other fields. Examples such as these are helping to increase the uptake of AM in the medical context. In terms of the next technological developments, AI and automation are going to attract the focus of the AM medical community. Another area of interest for this sector will be the introduction of sensors fitted to a given patient-specific prosthesis. This application may recover the sense of touch in amputees, for example.

Filip Geerts, Director General at CECIMO

AM should be seen as part of the broader production technology framework. It is directly interconnected with machine tools, not least through the growth of additive-subtractive solutions in a single setup – or so-called hybrid manufacturing. While today's AM market figures are still relatively small, the technology will be a game-changer in the future and will help to meet broad societal challenges. A reduction in the transportation of goods is just one of the many examples in this sense. For AM's commercial uptake to take place in Europe, change management is truly needed in companies, as well as investing in the skills needed for design and production. The European AM community needs to tackle several technical and educational barriers to foster the deployment of additive technologies in its factories. Among these, the lack of certified competences emerges prominently. CECIMO is collaborating with partners in this regard, to add clarity to the classification of skills and competences needed in an array of different AM jobs in Europe. A comprehensive accreditation of skills will facilitate the development of a workforce dedicated to additive techniques. Another obstacle remains the lack of robust in-situ real-time process monitoring modules in AM. Today, almost everything is done after the process. But what we are really missing is the ability to monitor the process during the build job (production), when the part is made in the build chamber. There is a lot of attention being paid to this aspect today by machine manufacturers and sensor companies, as end-users of AM systems are keen to use this technology in real production. So different players are looking at the creation of monitoring instruments that can give many additional insights into the process by capturing a lot of real-time production data.

When looking at the qualification and certification requirements in the aerospace and medical sectors, in-situ process monitoring will help to provide quality assurance and a better track production in the future. Automation is a third significant barrier against the industrialisation of AM. Opposite to the belief of many, AM is not a "plug-and-play" technology. Several tasks throughout the process cycle are done manually by technicians and operators. The industry should evolve towards a future of more automated additive processes with Industry 4.0-proof connected machines.

Interventions from the Members of the European Parliament and EU Institutions

Ivan Štefanec, MEP (EPP, Slovakia) praised additive techniques in industrial production, thanks to their ability to improve the productivity of companies and expand the set of services and products they offer. Considering predictions of an AM market worth $250 billion USD by 2025, additive technologies are set to bring new radical changes to industry, just as the internet did in the past. With the right EU legislative framework for innovation and substantial investment from EU research programmes like Horizon 2020, AM can be a tool to bring production and high-skilled jobs back to Europe, and allow for the customisation of a myriad of products. Furthermore, in combination with artificial intelligence, AM can be a powerful source of innovation for European industry. Attention should be paid to guaranteeing solid standards in aspects like IP protection and raw materials, and on making sure the technology is accessible not only by a few large business groups, but also by innovative manufacturing SMEs all over Europe. AM has a great potential added value, especially in combination with AI, which is another technology EU decision-makers are committed to bringing to European industry.

Mady Delvaux-Stehres, MEP (S&D, Luxembourg) emphasised that there is a vast range of sectors in which AM can make a useful business case. Beyond bringing jobs back to Europe and introducing personalisation in manufacturing, AM has clear benefits in curbing CO_2 emissions by reducing transportation needs and reducing the consumption of resources in production. IP protection, product liability and patent frameworks are highly relevant to AM from an EU regulatory perspective. To this extent, while being aware of the value of adopting a cautious approach to legislation, the European Parliament has voiced its opinions to the European Commission and looks forward to cooperating on these aspects. A look at how similar issues are tackled in 2D printing may be beneficial for AM. Technical, market-driven solutions to cope with issues such as IP protection should not, however, be neglected.

Dita Charanzová, MEP (ALDE, Czech Republic)** remarked AM will be the future of industry. For the technology, EU-wide standards will be essential to foster the transition to additive from subtractive manufacturing, the EU should try to uphold them at the international level too. The EU patent system should enable innovation, together with strong IP protection and cybersecurity, at which they EU policy-makers should look carefully. For the latter topic, the EU's Regulation for the creation of a transitional cybersecurity scheme managed by ENISA and national ICT agencies all over Europe will be instrumental.

Signe Ratso, Deputy Director-General for Research Programmes at DG RTD, European Commission
AM is deservedly seen as a key disruptive technology of the future. It holds a great potential for the mass customisation of products, leads to the democratisation of production and offers new business models based on the consumer becoming an active part of the design process. SMEs are set to gain from the uptake of AM. The manufacturing workforce is also set to benefit from the adoption of additive techniques, since a higher number of high-skilled jobs in the medium-term will make up for any potential reduction of low-skilled jobs in the short-term. That is also why the EU has launched the so-called Blueprint for Sectorial Skills in order to support AM skill development in EU countries. Presently, Europe is a leader in AM solutions internationally but competitors have proven to be ahead in other disruptive innovations. It is important therefore to bundle the EU's R&D resources, so that Europe has an edge over other regions. EU member states made commitments to bring the EU's overall spending on research to 3% of GDP. To support technologies such as AM, national governments should prioritise efforts to reach this target.

There is also a need to boost private sector investment in Europe, since the region's share has decreased over time to less than 1/5 globally, as a result of growing investment in China. Aiming to make up the lost ground, the European Investment Fund is earmarking additional resources to leverage private investment on technology. Certainly, in the toolbox of funding programmes to support AM, Horizon Europe should not be forgotten. It will be the largest ever multi-year research programme approved by the EU, with €100 billion of funding every year (if Member States support the ambitious budget plans foreseen by the European Commission). Finally, the EU's involvement in the industrialisation of AM should not be limited to funding. Legislation has an important role in fostering its uptake. There have been cases in the past where technology has been regulated in a very prescriptive way. It would be better to refrain from this approach and let the technology reach the market properly before considering regulation. Overall, it is difficult to predict which direction all of this will progress. But certainly, sound standards in highly-regulated industries, such as the healthcare sector, should continue to be guaranteed.

To conclude, here are the main takeaways in brief:

1. Automation is key in scaling up AM in volume sectors like automotive. The EU needs to provide support in these instances.

2. Review of EU funding provisions might be needed: shorter, more focused projects that are better suited to the current fast-evolving AM context.

3. The B2B sector in Europe is already subject to the right degree of regulation.