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3D ADEPT MAG

3D PRINTING

DOSSIER : 2023 YEAR IN REVIEW

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AMSG 2024

The International Catalogue of AM Solutions

Once you've decided that Additive Manufacturing/3D Printing is right for your project/business, the next step might be quite intimidating. In their quest for the right technology, be it by email or during 3D printing-dedicated events, professionals ask us for advice or technical specifications regarding different types of 3D printing technologies & post-processing solutions that raise their interest. Quite frequently, these technologies are not provided by the same manufacturer.

The International Catalogue of Additive Manufacturing Solutions comes to respond to this specific need: be the portal that will provide them with key insights into valuable AM & post-processing solutions found on the market.

More importantly, an important focus is to enable potential users to leverage the latest developments in Additive Manufacturing. Companies can now feature the strengths of their AM Machine / Material offerings.

Please note that the International Catalogue of AM Solutions is distributed in all industry events where 3D ADEPT is a media partner and to our subscribers at home/in offices

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3D PRINTERS



MATERIALS

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Hello & Welcome



« Shifting mindsets »

Mindsets have power. They can help us become more successful or they can block our way and keep us repeating the same mistakes. As we reflect on another year of change in the AM industry, I can't help but see how our mindsets are changing. For a long time, we have been focusing on demonstrating the advantages of AM across industries. Today, demonstrating it is not enough. As corporate leaders spend much of their time seeking the right strategies to grow and adapt to changing conditions, it is crucial to assess the different ways of thinking about our industry's problems.

One blatant example is seen in manufacturing itself: while technology providers are going the extra mile to improve quality, repeatability and reliability, AM users are increasingly thinking about costs and how they can benefit from the best quality/price ratio. But there is more.

Another example reveals that coming to AM is one thing, staying and growing in this market is another one – which requires addressing a fundamental question that goes straight to mindsets: **“What changes do we need to make in our assumptions to develop a strategy that will meet our goals?”**

In the last edition of this year, through various segments from business, technology, events, strategy or careers, we discover that our mindsets are shifting – for better or worse and they will continue to do so, hopefully for the benefit of vertical industries adopting AM technologies.

Season's greetings



Kety SINDZE

Managing Editor at 3D ADEPT Media

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Editorial

Significant Cost Savings on Additive Tool

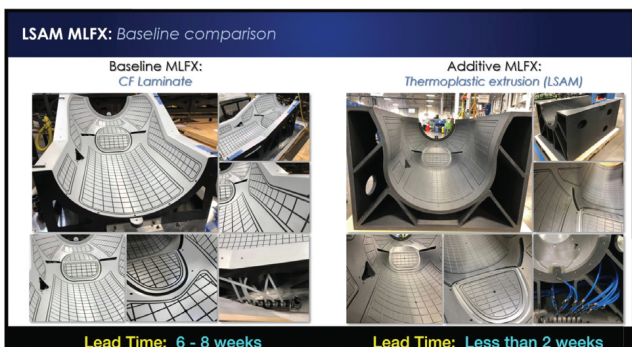
Partnership between Thermwood and General Atomics

The Details

Using a Thermwood LSAM 1020, the tool was printed from ABS (20% Carbon Fiber Filled) in 16 hours. The final part weighing 1,190 lbs was machined in 32 hours.

Cost Savings of around \$50,000 vs traditional methods

Total lead time for the part decreased from 6-8 weeks to less than 2 weeks by utilizing the powerful LSAM system.

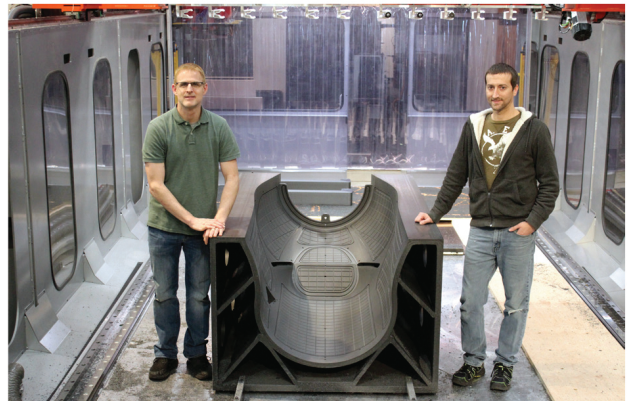


Scan QR code to view a video of the LSAM and General Atomics process.

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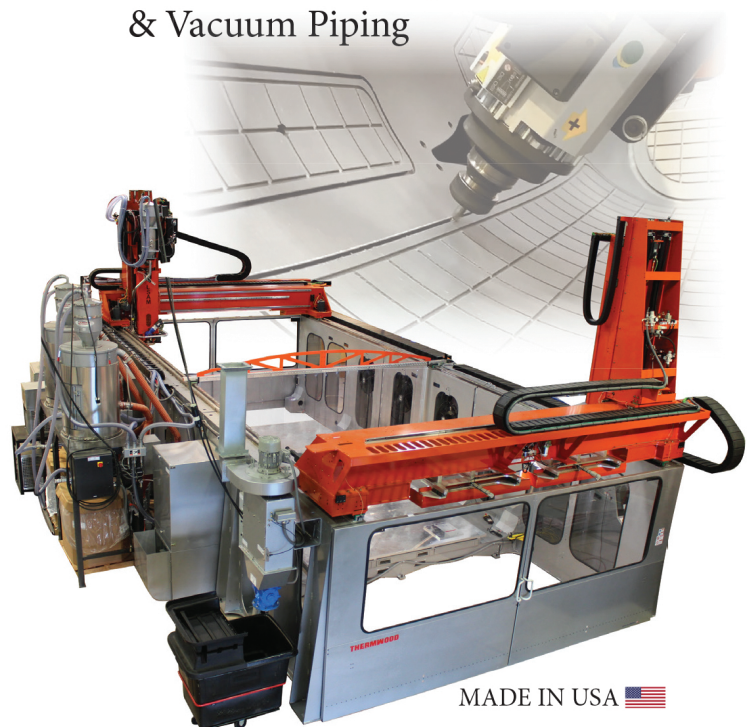
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2023 : ADDITIVE MANUFACTURING, FOR BETTER OR WORSE (PART 1)

The Additive Manufacturing market is struggling to survive.

Before starting this “2023 year in review” article, I had a look at [what I wrote last year](#): consolidation through acquisitions & funding dominated the market, materials & software called the tune in the manufacturing value chain, and QA & CT scanning were defined as potential areas of focus for this year.

Then, I made a detailed analysis of this year. And the first thing I realized is that, in many regards, 2023 was a repetition of 2022.

A financially stressful condition

Once more, it was about money. Even when they say it was not, it was about it. Consolidation has continued through strategic acquisitions. This year, we covered **over 24 acquisitions** – compared to 21 reported last year. Some of these transactional discussions entertained so much that they became a saga whose end results disappointed their audience (cf. Stratasys-3D Systems-Nano Dimension-Desktop Metal).

While shareholders' profitability becomes hard to guarantee within big corporations, one notes – through this year's acquisitions – an increasing interest from companies across vertical industries to position themselves in the AM market. Unlike an AM company that will expand its portfolio of technologies through

acquisition, companies in vertical industries invest in technologies that will help further develop their applications. The example of Align Technology and Cubicure perfectly illustrates it and I am keen to see how Align will push this Hot Lithography® process.

Buyer	Acquired
L3Harris	Aerojet Rocketdyne
Berlin.Industrial.Group	GEFERTEC
Xometry	Tridi
ADDiTEC	Xerox
Nano Dimension	Additive Flow
SLM Solutions	Adira
General Motors	TEI
RapidFlight	Local Motors' IP portfolio
BigRep	Hage3D
Nexa3D	AddiFab
Nexa3D	XYZprinting
Nexa3D	Essentium
Align Technology	Cubicure
3D Systems	Wematter
Schaeffler	Desktop Metal
GoEngineer	Rapid PSI
Cumberland Additive	Stratasys
6K Additive	Global Metal Powders
Evonis	Lima Corporate
Interfacial Consultants	M. Holland
CB-CERATIZIT	CW Toolmaker
restor3D	Conformis
Hexagon	CADS Additive GmbH
Stratasys	Covestro's AM materials business

On another note, we haven't heard of a lot of businesses that shut down their activities – apart from **3D Metalforge** and recently **Sculpteo** which discontinued its online 3D printing marketplace, but restructuring is happening in other ways. Budgets are being reallocated to cope with the slow sales of products. While AMT and 3D Systems are the few companies that publicly announced their restructuring initiative, the growing number of top talents that are “open to work” on LinkedIn indicates that more is happening behind the scenes.

In the midst of this bustle, I am glad to be the bearer of good news: a **dozen companies officially debuted** on the

market this year: **ECL**, Outokumpu, Evove, JPB Système, SAEKI, 3D BioFibR, flō, Additive Appearance, Pelagus 3D, and ArcelorMittal Powders. Most of them leverage decades of experience and expertise in other core businesses, so I hope they will make it.

Does the devil remain in the details?

At Formnext 2023, I had to look at the smallest details to see exceptional growth and I wanted to apply this approach here. The only thing is that everything was bringing me back to money. From the most established companies, we didn't see new



product launches per se – only improvements of existing processes but from SMEs and companies that do not necessarily rely on investors' money, we witnessed new technological developments: **Thermwood**, **Solukon**, **Lithoz** and **Raise3D** are a few that I would like to keep in mind here.

Apart from Lithoz which has benefitted from investors' money, the growth of the other companies has urged me to attempt to make a realistic assumption for the prospective future of this industry: **what if by generating genuine revenue and profits, the industry will further develop, in a prolonged but most certainly sure and continuous way?**

But that's not all. More than ever, investment in thoughtful go-to-market strategies (if you're a startup – but that's something we'll discuss later on) and **applications** – regardless of your size – always pays off.

Applications, the ultimate promised land

I'll keep voicing it: no matter how efficient you say your technology is, if you don't demonstrate it through tangible applications, it will only remain

good on paper.

At 3D ADEPT Media, we have understood it since the very beginning, which is why, we cover **all vertical industries** adopting AM technologies: Aerospace & Space, Defense & Nuclear, Architecture, Fashion, Art, Automotive & railway, Construction, Education, Energy, 3D Foodprinting, High-Tech, Medical & Healthcare, Oil, Gas & Maritime, Sports, R&D, and Sustainability.

As you will see below, the segments where we observed AM activities the most include Medical & Healthcare, closely followed by Aerospace & Space. By AM activities, I mean the development of applications, current collaborations to develop new applications in the upcoming months (or years) as well as specific product launches for each of these markets.

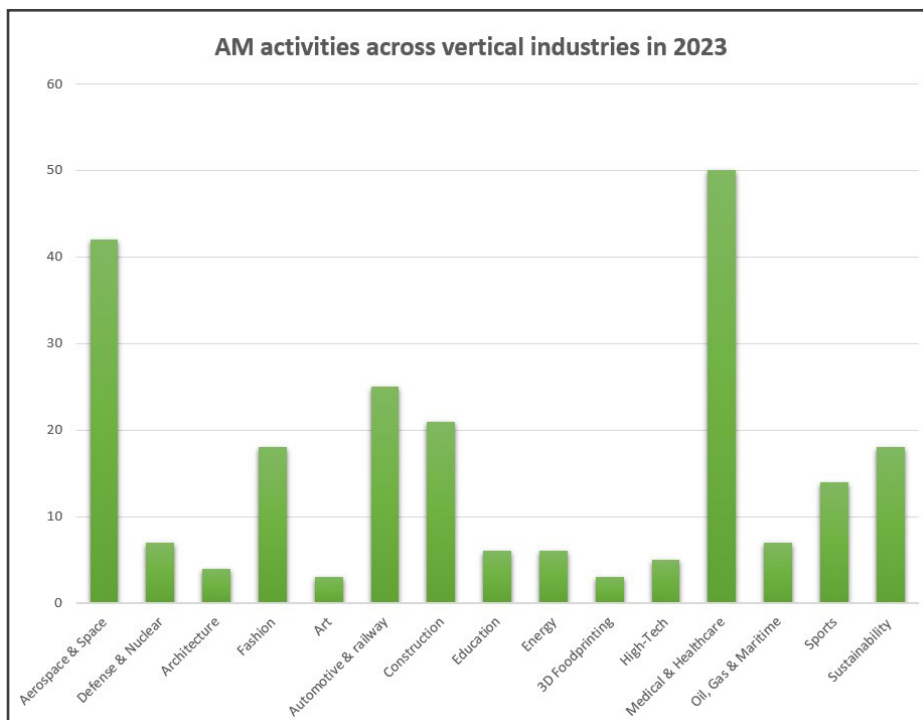


Figure shows the different AM activities per vertical industries covered by 3D ADEPT Media throughout 2023. **Graph credit: 3D ADEPT Media.**

With **over 15 applications** publicly demonstrated this year, the Medical and Healthcare industries are building a strong case for AM again; the most solid case being 3D printed cranial implants, 3D printed bite splints, 3D printed skin supplements, 3D printed tibia implants, 3D printed medical-grade cushions, 3D printed exoskeletons, 3D printed bandages, ophthalmic, 3D printed medical devices and 3D printed drugs.

I know that most of these applications **do not answer the “mass production” concern** but let us not try to have it all at the same time. Make baby steps first and if you want to grow quickly, look at applications that have already made a strong case with conventional manufacturing processes and where AM can do better. The production of aligner molds is a great example, and here again, you might learn one or two lessons from [Align Technology](#).

Furthermore, you might be tempted to only look at

those industries that invest the most in technology, but a lot is happening in heavy industries and they should be the ones that AM companies should target more next year.

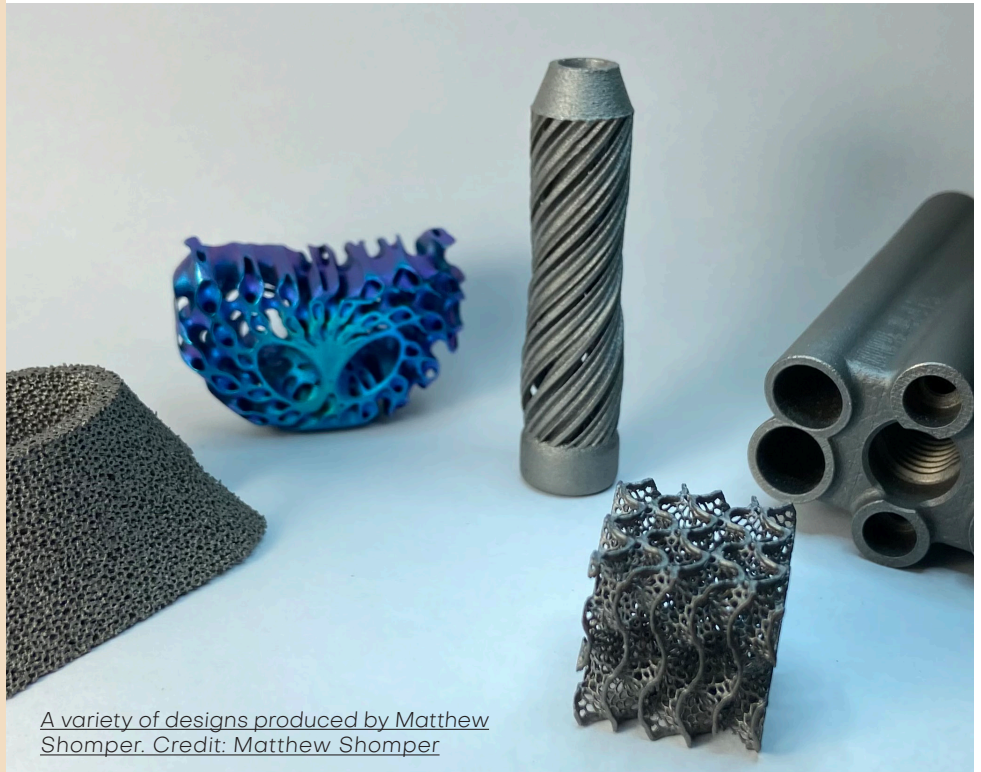
Struggling to survive is the only way to grow

It is precisely because of countless struggles and survival that life becomes stronger and more meaningful. Somehow, this also applies to the AM industry and its people.

From mergers and acquisitions to technology complexities and development, the industry continues to invest resources, time and energy to push for the full integration of AM across vertical industries. If one of the biggest drawbacks is that it remains **very expensive**, there are always a few ways to alleviate these costs (**See Business article PAGE 16**).

10 TECHNOLOGY HIGHLIGHTS OF 2023 THAT SHAPED THE ADDITIVE MANUFACTURING WORLD (PART 2)

2023 has been a very interesting year both from a business and a technology perspective. Whether it was through participation in trade shows, conversations with industry insiders and coverage that encompasses the adoption across vertical industries or companies' latest developments, there was a lot to see and learn about. In this article, we have decided to highlight 10 important technology highlights that have marked this year. Hopefully, they will provide some food for thought on how you should approach 2024.



A variety of designs produced by Matthew Shomper. Credit: Matthew Shomper

1. The DfAM language is more and more complex

It all starts with design. Design for Additive Manufacturing increasingly requires a deep understanding of the DfAM toolbox and how each of the design tools would help you get the best value for the part. In the [May/June edition of 3D ADEPT Mag](#), we shed light on some of the most used design tools but new startups are working on new advancements that increasingly bet on computational engineering models.

As [Matthew Shomper told us](#), computational design is not for the faint of heart. The tools are rather inaccessible (with large learning curves) and it usually requires a dual knowledge of designing for requirements and aesthetics at the same time. Good design sense is a must, regardless of what's being created, and computational design is not a 'shortcut' to get around solid engineering principles.

That being said, understanding how this approach works and where it can be applied will be crucial to delivering parts in very short lead times.

2. The expanding reach of ceramic 3D printing

Ceramic 3D printing is growing in a way that I did not expect to see. This specific segment has often been given minor attention compared to metal or polymer 3D printing – which is understandable when we know that metal and polymer have always been the ideal materials for conventional manufacturing processes. Since most adopters of

the technology continue to compare conventional manufacturing processes with AM, it makes sense to see less attention to ceramics. But this is changing as more and more companies are increasingly developing solutions in ceramics.

Another reason for this slow adoption is that ceramics are often considered as “exotic” materials – ideal for products in the arts sector. One example that justifies this example, but still worth noting as it is an interesting development in materials, is [Nanoe's porcelain 3D printing filament](#).

On an industrial scale, I was glad to see the use of ceramic 3D printing in vertical industries such as energy where the technology has proved to be an ideal production candidate that could bring the hydrogen economy closer to effective implementation. My thoughts go here to [companies like 3DCeram](#) which has helped to develop an intricate optimization process encompassing printable feedstock Zr8Y, 3D printing parameters, and thermal treatments.



Credit: Coherent Corp.

3. The Introduction of intriguing AM processes

There is always a startup that is working in stealth mode on some disruptive processes. In the short list of startups that turned stealth mode off this year, I would like to keep in mind **Rosotics** and **Fabric8Labs**.

The former is working on a new way to print metals called **“rapid induction printing.”** This technique would make use of the conductive property of metal to generate heat from within the feedstock. The ultimate goal at the end of the process would be the creation of hardware that is a lot more efficient and simple and less dangerous for the people who operate it. **Mantis**, the company’s first completed 3D printer prototype is a huge, unfolding contraption capable of printing 45 kg of material per hour on the power from a standard 240V outlet.

The latter is developing a technology called **Electrochemical Additive Manufacturing** short for ECAM. Fabric8Labs explains that its proprietary technology ECAM could produce pure copper components, which can be directly printed onto temperature-sensitive substrates such as PCBs, silicon, or existing metal components. Without using powder, neither wire nor lasers, the process can fabricate fully solid metal 3D printed parts. Its secret ingredient? Electroplating – a process that is often leveraged to provide a metallic coat to polymer 3D prints.

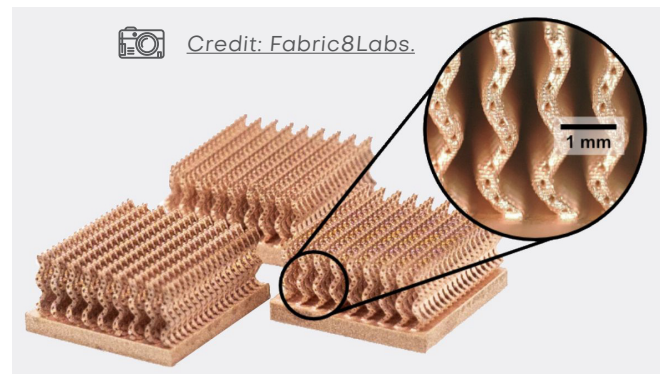
Both concepts are intriguing and have raised debates across the community. Beyond delivering on their promise, will they address the challenges of speed and mass production, existing industrial



Credit: Rosotics

3D printers have to cope with?

Another process that I would like you to keep in mind is the one of voxeljet. The company has a solid experience in sand 3D printing and knows how to deliver solutions that answer the needs of the foundry industry. Its **Cold IOB (Inorganic Binding) 3D printing** technology targets this specific industry again; it would enable molds and cores for the foundry industry to be produced from sand and an inorganic binder without the need for microwave treatment.



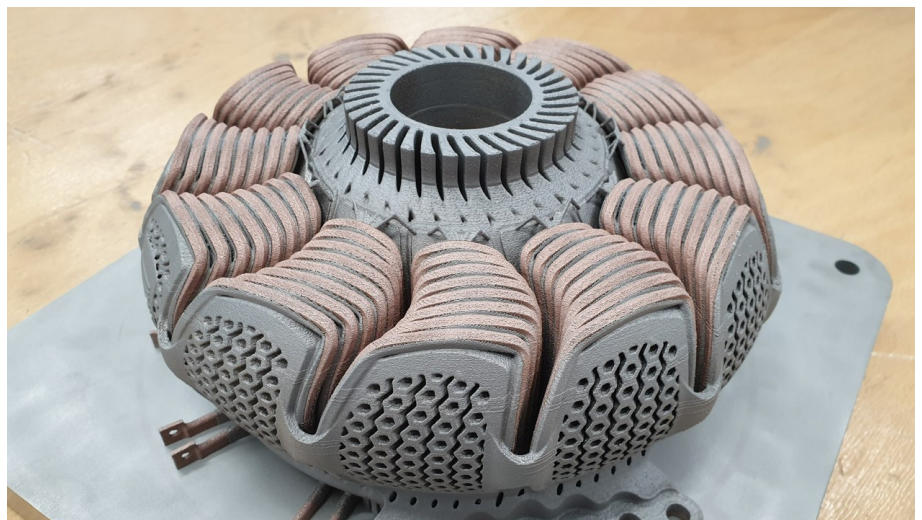
Credit: Fabric8Labs.

4. Multi-material 3D printing remains challenging but continues to gain attention

I have said it before. Multi-material 3D printing is one of the manufacturing techniques with the strongest unique selling proposition: using multiple materials at the same time to fabricate a part. Unfortunately, its adoption remains utopian for many users due to a range of limitations at the design, materials, and manufacturing levels. For instance, in FDM 3D printing, with a very complex design, the designer would have to change their materials several times to get to a definite part.

That being said, companies are still working on how to improve this approach and I am happy to see Lithoz as part of this small group. Apart from FDM, SLA, material jetting, binder jetting, DED, and powder-bed/SLS have often been mentioned as the types of AM technologies that could enable multi-material 3D printing. Lithoz is making new strides by exploring the combinations

of ceramics-ceramics, and very soon polymer-ceramics or metal-ceramics with its **new CeraFab Multi 2M30 3D printer**. I am also keen to discover new applications the Quantica’s NoviJet OPEN multi-material 3D printer will enable and **Schaeffler AG, the new parent company** of multi-material 3D printing expert Aerosint.



Multi-material 3D printed rotor. Courtesy of LEAP 71

5. AI and ChatGPT are making their way in the Additive Manufacturing industry but should we trust them yet?

If the first three industrial revolutions were defined by breakthroughs in manufacturing processes, electricity and digital technology, today, we are at the threshold of the fourth industrial revolution, where AI and ChatGPT technology are positioned as the driving forces.

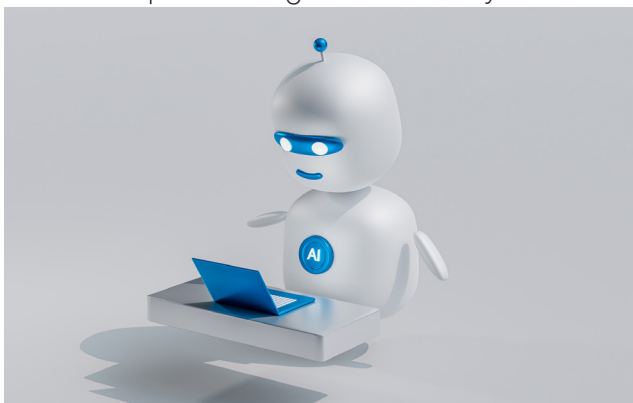
I am sure about a couple of things, AI enhances AM at multiple levels and I would like to highlight three examples here:

- Leveraging AI for analyzing operational data allows for preemptive equipment maintenance is undeniably an appropriate use. Predictive maintenance can help you reduce unplanned downtime while ensuring a smooth and more efficient manufacturing process.

- At the design level, by exploring a wide range of design variations, the technology can help produce a wide range of parts that are more efficient than those humanly conceptualized. However, [in the very first edition of 3D ADEPT Mag](#) of this year, we urged product designers to remain cautious. There are various forms of AI bias, and some of them can be detrimental. In addition to data and algorithmic bias (the latter sometimes reinforcing the former), AI is developed by humans – and humans are inherently biased. So, the challenge here goes beyond gender and race, to encompass people with disabilities. For the product designer leveraging AI-powered tools, it's about daring to think broadly about world issues.

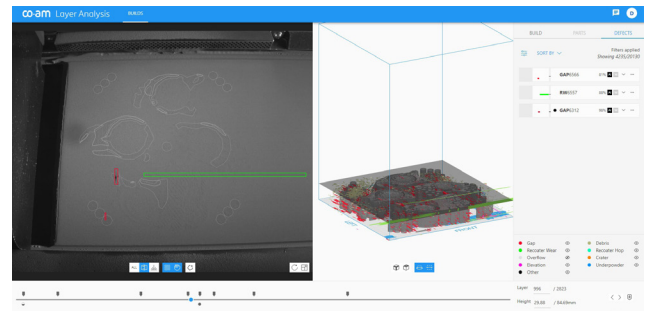
- At the manufacturing level, one applies AI, specifically machine learning, to capture a user's knowledge, and leverage it to automate repetitive tasks. This integration would make more sense to me in a conventional manufacturing sector like sheet metal which requires mass manufacturing but in AM, where there is more interest in customization and personalized products, should we already bet on it?

This year also saw the introduction 3DGPT, a [ChatGPT concept for AM](#). The concept might definitely seduce more than just investors, but I am still questioning its credibility in an AM



industry that is still trying to define itself and its concepts.

6. An increasing focus on real-time inspection methods



Credit: Materialise. Process Control Unit

I will call this one a trend. Last year, in my [“2022 Year in review”](#) article, I mentioned Quality Assurance as one of the areas we should focus on to deliver 3D printed parts that meet specific industry criteria. I was glad to see a few developments here and there in the industry. It's a pity that a lot of companies specializing in the field do not communicate more about their solutions and their capabilities but their lack of communication is playing to the strengths of the likes of **Materialise**, **Phase3D** and **ZEISS** that are working on solutions to improve this specific stage of the manufacturing process.

If there is something you should keep in mind here is that the new era of AM in-situ inspection goes beyond monitoring, to enable reduced part costs. As we are looking to each tool that could help reduce the overall production cost, I can only encourage AM users to sign up for this type of action.

7. The development of specific parameter marketplaces should continue

Entire libraries of material properties somehow propelled the adoption of casting for traditional processes. “In comparison, you only have a couple of boxes with AM. Trying to compete with that difference in material characterization is very difficult.” Throughout the year, this challenge has been one of the most shared limitations by AM users I have talked to (AM experts from [Honeywell Aerospace](#) are one of them). The good news is that since last year, companies like Rosswag have started developing a [process parameter marketplace](#) that aims to address this type of issue.

While it is only available for LPBF right now, it could be interesting to see the development of such marketplaces for other AM technologies.

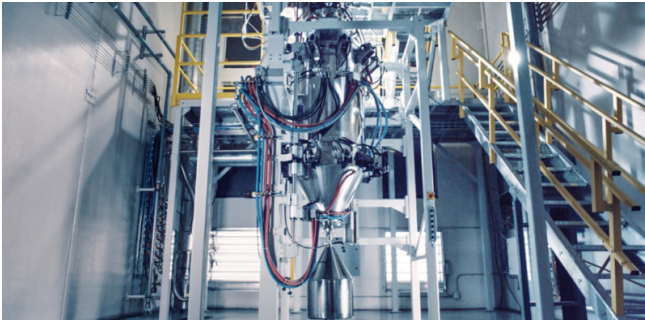
8. Development of new materials

Given the importance of materials in the manufacturing value chain, and the gap that still needs to be filled to develop materials for specific AM processes, I don't think we will ever see an end-of-year review without any new

material developments.

Apart from qualification and certification of the most-used materials for LPBF metal processes, we've noticed that [refractory metals such as tantalum debuted on the AM industry](#). With the ability to deliver implants with improved biocompatibility (reduced clotting) and stability, enhanced bone in-growth, tolerable to higher stress, tantalum's benefits should lower the rate of surgery revisions. Its use in AM is relatively new and I hope we will see more applications of this material next year.

On another note, with the growing environmental concerns, I can't help but recognize the efforts of some material producers in the field. We have closely followed [the work of Evonik this year](#) which has enabled us to discover the steps that still need to be taken in material producers' sustainability journey. Looking at material developments with this topic in mind, we witnessed the [development of bio-based materials](#) for some applications and something tells me that this type of development will continue next year.



9. Adoption is different from one continent to another

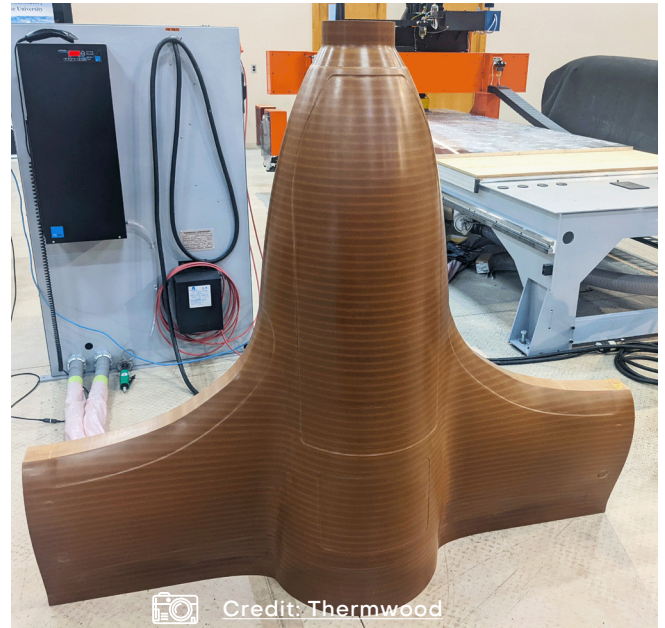
I tried to compare the different coverages we've done this year in AM trade shows we attended in the US and in Europe and I assessed the different conversations we had with industry insiders. I discovered for instance that the [new Cut Layer Additive from Thermwood](#) is gaining traction in the USA whereas industrials are not yet interested in this technology in Europe. In Europe, the main interest remains LSAM.

On another note, with most American adopters or potential users of AM, the experience with AM technology is always explained in comparison with some conventional manufacturing technologies whereas with European AM users, the focus is directly on their experience with the technology itself, and how they feel about it.

While the USA and Europe remain the largest adopters, the APAC region is transforming into the fastest-growing AM market. It will come as no surprise that China is the biggest force behind the growth of AM on the continent with machine manufacturers like BLT and Eplus3D trying to penetrate the European AM market. Interestingly, in this region, a user will come to AM after a

thorough comparison between AM processes themselves – for instance between a metal AM and a polymer 3D printing application.

Overall, European AM technology providers often compare themselves to North American AM technology providers and vice-versa. They often forget that they have a different culture, thus a fundamentally different approach with AM.



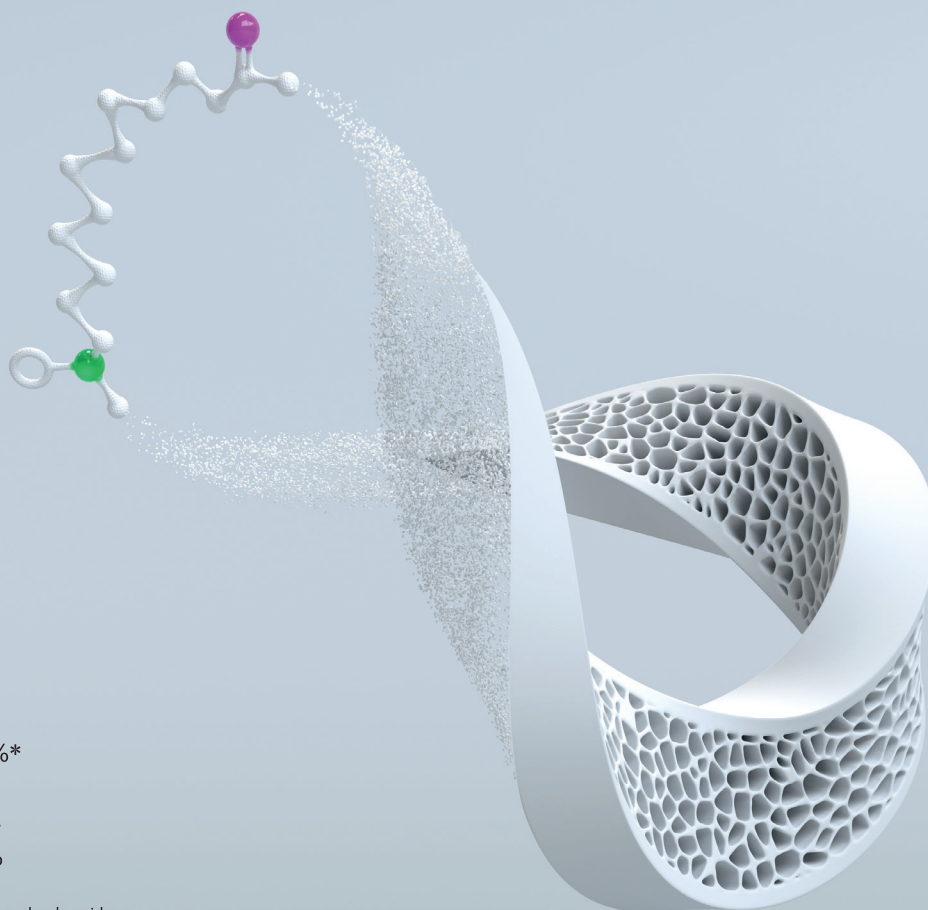
Credit: Thermwood

10. AM remains expensive

Between the demand for more customized AM machines and the demand for more customized applications, AM has a cost that does not always satisfy everyone. The cost consideration will continue to raise debate within the industry, and somehow I believe I will be fine with that as long as speed, reliability and repeatability are met.

What about you? What have been your key highlights of 2023?





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5 REASONS WHY YOU SHOULD INVEST IN TRADE MEDIA



This end of year was quite special as I have had the opportunity to talk with a few entrepreneurs and industry insiders working in startups or SMEs about what they should prioritize in their strategic growth. A common thread across these conversations was the importance of trade media in developing their company. As this period allows us to reflect on the way we work, and what we should do better, I believe it is the right time to shed light on 5 reasons why you should invest in trade media. Reflection regarding the role of trade media is of paramount importance with the growing number of newcomers that turn stealth mode off in the AM industry.

1. Trade media reaches the specific audience that can pull the trigger

A feature in trade media provides more benefits to a company that launches a new innovative 3D printer than in mass media publications for instance. Due to its targeted nature, trade media reach specific target audiences and capture even more attention of readers when they are seeking answers to their challenges or looking for specific trade information.

Reaching the right audience should be a top priority for any organization because it increases the likelihood of making your brand known and generating new inquiries. Even if they might not need the product, readers of trade media would probably know someone who does.

2. Trade media makes it easy to understand a complex product

AM technologies remain new by nature – with more and more complex products being developed every day. Be mindful of that complexity and keep in mind that there is a great chance that the decision maker and the operator do not have hands-on experience yet with the technology.

A trade media helps to unlock the mystery around such complexity and makes it easy for non-tech-savvy people to understand what you're talking about.

3. Trade media can help you stand out from the crowd

Whether you are at a trade show, or in a room

full of fellow companies providing a service similar to yours, your goal should be to stand out. This goal should remain the same when working with trade media. A press release that can be pasted in every publication is good but not enough. Be authentic and explore with trade media how you can develop and implement marketing projects that help you properly educate your audience on what matters when talking about your products, on that specific expertise that is captivating the attention of new clients, that will make a real splash on social media or even turn your customers into your ambassadors.

4. Working with trade media shows you're aware of your environment – that of long sales cycles.

This year, a few people came to me and asked: I am looking to reduce my marketing funnel. Do you think you can help with that? Well, because of the complexities surrounding technology and the high investment each technology often implies, it takes time to convince a potential buyer. For this reason, a pay-per-click (PPC) ad campaign isn't going to drive the same results in B2B marketing as it does in B2C marketing, where many people see almost immediate conversion results.

For this reason, your marketing tactics should essentially be about brand awareness. Lead generation can also be considered depending on the type of marketing campaign you explore. All of this could be explored with trade media.

5. Each effort is part of an ecosystem

Whether it is to reach a highly specific audience, gain the trust of potential buyers, explain your technical product, or gain more valuable business opportunities, trade media can provide a hundred services that can help you achieve each of these goals. Whether you choose to invest in digital or print ads, thought leadership content, case studies, webinars, social content, or even podcasts, don't try to tie results to one specific marketing tactic. In the end, each of these marketing tactics has a purpose and brings added value when well leveraged. That's why your main driver should always remain to target the right people with the right message in the right places.

LEASE? BUY? SUBSCRIBE?

THE PROS AND CONS OF DIFFERENT ACQUISITION MODELS OF INDUSTRIAL 3D PRINTING EQUIPMENT.

"I know we need an industrial 3D printer but I am not sure if we will be able to amortize the cost of such an investment in our company. Any idea where I should start looking?" an engineer new to the industry once asked me.

Once you know Additive Manufacturing is the right path for you, the next step can be quite intimidating. What's most intimidating here is the cost consideration that appears at many levels of the decision-making process.

Back then, I didn't know exactly what I could tell this engineer. After thorough reflection – and obviously, after many discussions with different machine manufacturers, I should have told him to weigh the pros and cons of each acquisition model. At that specific time, for their specific needs, **buying** was probably not the ideal option.

One of the most common assumptions we make in manufacturing is that we should buy our own AM machine. This is not a bad assumption in itself but when you start thinking about the manufacturing area, the number of operators you would need to operate the machine, the maintenance, and other related equipment (materials, post-processing, software, etc.) needed in your manufacturing value chain, that need can easily become a utopian dream – especially if your company does not have an unlimited budget at hand.

In such cases, it could be smart to explore **subscription** as well as **leasing or renting options**.

What does each option consist in?

If you've ever leased a car, then you should already know the leasing model: you pay a fixed amount per month for a specific term. At the end of the agreed period, you can either return the equipment or buy it for a lower price.

In the AM industry, companies like [NCP Leasing](#) based in the U.S., **specialize in purchasing AM equipment from manufacturers** to lease them to those who do not have the same financial flexibility as those who can purchase directly their 3D printer. NCP Leasing has



Production environment of 3DPRINTUK – Credit: 3DPRINTUK

already worked with the likes of ExOne, Renishaw, Stratasys, and 3D Systems in this regard.

That being said, it is also possible to **lease or rent a 3D printer from a distributor**. UK-based distributors Tri-Tech 3D and Additive-X (formerly GoPrint 3D) offer direct rental contracts on a wide range of 3D printers including filament, resin, (and metal 3D printing technologies – in the case of Tri-Tech 3D). Short-term rentals can even be explored for one-off projects or events.

In a subscription model, on the other hand, the **equipment remains the property of the vendor**. However, you pay for more than just a 3D printer; you pay for a wide range of services that will enable you to operate your machine successfully. Apart from Carbon which has made this option a part of its business model from the beginning (with pricing starting at **\$20,000**), the subscription model is quite common in the software business (Markforged and EOS for instance provide subscription-based plans for their software platform).

Since the Covid-19 pandemic, other machine manufacturers such as HP & Desktop Metal have started integrating a subscription-based plan in the way they provide their services.

"Rent and subscription models can be an appealing way to acquire exclusive access to a 3D printer with reduced risk through low or no initial capital expenditure. Renting may be the most flexible, but of course, this comes at a higher price over the long term. Subscription models can often be extremely competitive, however many are based on a minimum threshold of throughput that may be hard to guarantee without an established market. Purchasing a machine can be a daunting prospect, however, in the long term this can offer the most flexibility to the purchaser. A salient point is that the correct acquisition model for a user will often be determined situationally depending on their circumstances and potential markets," **Tom Cornthwaite**, from [DiManEx](#), told 3D ADEPT Media. DiManEx provides a platform that converts

traditional, physical supply chains into future proof, digital supply chains.

Purchase is quite simple to understand as you invest money in a device that you own completely. What should absolutely need to be assessed here is the set of factors that could amortize the cost of the 3D printer into the projected cost per part, before you decide to order the machine.

To this, **Cornthwaite** replies: “whilst amortizing capital costs through increased part prices is common in other manufacturing methods, care needs to be taken in doing so for 3D printed parts. Amortization is straightforward if there is a high demand for very similar parts, however, this is unlikely to be the case when utilizing the flexibility afforded by 3D printing! Overall, one needs to establish a part cost model that takes into account machine costs and depreciation whilst allowing flexibility to cope with demand and potential failures that can occur more often when applying 3D printing to new applications.”

“Our foremost consideration is the quality of the part, prioritizing it over the cost of the machine. As a 3D printing bureau, our commitment is to

provide the highest standard of parts using cutting-edge AM technology, irrespective of the financial outlay. Additional factors such as material performance and repeatability are crucial, ensuring our clients can rely on consistent results time and time again,” **Nick Allen**, CEO at [3DPRINTUK](#) states. 3DPRINTUK is a 3D printing service provider that prefers to purchase all their machines. “Over the past decade, we consistently observed that investing in top-quality equipment has consistently proven to be a wise decision, yielding long-term benefits. Achieving a near injection-moulded finish with Additive Manufacturing (AM) requires not only the right printer but also substantial upfront investment in finishing equipment. Often, the combined cost of the finishing equipment is 2 to 3 times that of the 3D printer itself, a crucial factor not always immediately apparent,” Allen adds.

The table below presents a short overview of the main acquisition models and when it could be interesting to consider each of them. Needless to say that each of these items depends on the contract you have with each vendor or distributor.

	When should you consider it?	Other points to take into account
Purchase	<ul style="list-style-type: none"> - Length of use: If you intend to use the printer extensively (for example for product design and long manufacturing roadmap), buying it is likely more cost-effective over time. However, if you only need it for a specific project or prefer frequent technology upgrades, renting might be a better choice. This means you already know your business case. - You own your equipment and can do whatever you want with it: you can expand your reach, and educate yourself within a timeframe that is yours. - When time and labor costs are NOT a factor 	<ul style="list-style-type: none"> - Gradually becomes obsolete after the purchase
Lease or rent	<ul style="list-style-type: none"> - Because renting is considered an expense rather than a capital investment, the approval process in your organization may be more straightforward. - Possibility to own the machine after the rental term – depending on your contract. - Rent payments are usually tax-deductible when they are made for business purposes – so no need to carry the 3D printer as a depreciating asset on your balance sheet. 	<ul style="list-style-type: none"> - It is “another monthly fee” to add to other things you’re already paying for
Subscription-based models	<ul style="list-style-type: none"> - Shift costs from CAPEX to OPEX - Continual platform improvement: you benefit from the latest technology updates when they are available. - Flexibility: you can stop the plan when you want 	<ul style="list-style-type: none"> - You never own the machine



If you're an AM beginner whose business case is not clear yet, I would recommend following DiManEx advice:

"Working with an experienced AM partner in the first instance is a great way to de-risk the process of developing and manufacturing parts for 3D printing. By letting an experienced partner guide the process, a lot of information can be gleaned about the most suitable

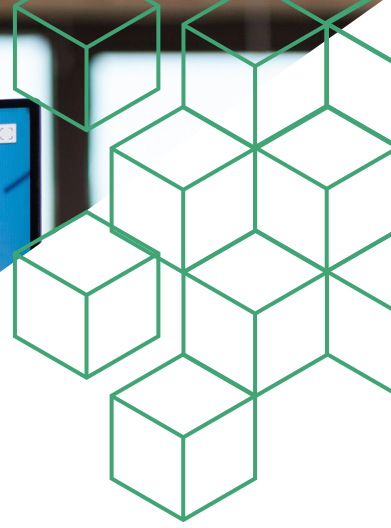
machines, materials and even design for 3D printing, without the commitment and cost of acquiring a machine in the first instance. This can give the end user an opportunity to prove and grow their demand sufficiently to then potentially consider acquisition of their own machine to improve their costs further. It also gives an opportunity for a business to adapt their systems and

processes to working with 3D printing as opposed to traditional methods. Quality systems and process flows may need alteration which can take time!"

In the end, whether you purchase, lease, rent or subscribe to a plan, you should keep in mind that there is no right or wrong answer, there is just one that works for your project or not.

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We talk additive

We'll be back in 2024

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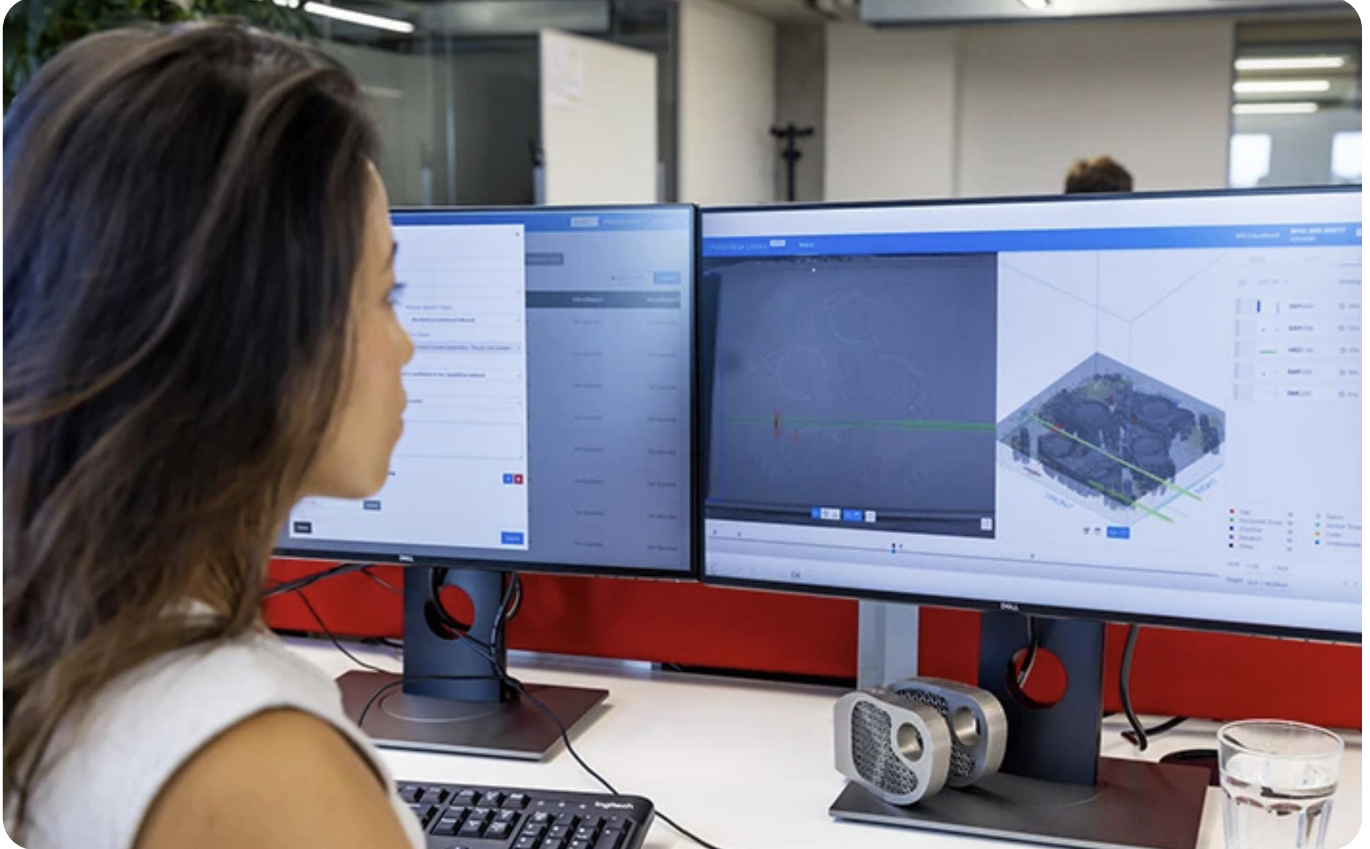
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Software

Identifying defects in metal 3D printed parts can lead to up to 70% savings in production costs. **Materialise** explains how and why.



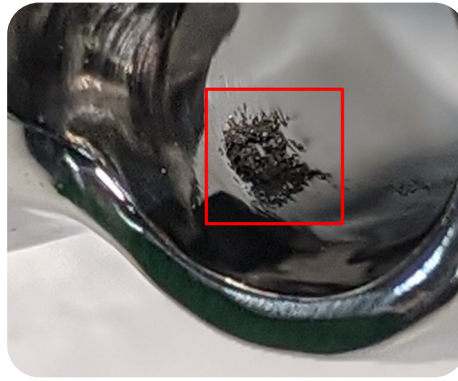
As part of the additive production of a critical medical component, a defect identified after the post-processing phase made the team lose one HIP cycle, one day of post-processing and quality inspections, not to mention time and money. Analyzing layer images could help to prevent this. The problem is that with thousands of layer images to analyze when searching for errors, it's easy to miss a critical defect that will result in the non-validation of a part. For good reason: the process is laborious and exhausting for the engineer whose eyes can get tired during the analysis, and data are subjected to different interpretations. To address these challenges, the team at **Materialise** has developed a solution that could help engineers identify critical defects in a matter of seconds: The **Materialise Quality & Process Control (QPC) Layer Analysis** software.

Despite the proven advantages of AM, one should acknowledge the fact that different processes and manufacturing conditions can lead to inconsistencies and defects in part quality. To date, defect formation remains a critical challenge for **laser powder fusion (LPBF) processes**. This challenge is tenfold when one deals with critical applications in highly regulated industries as mentioned in the healthcare example above.

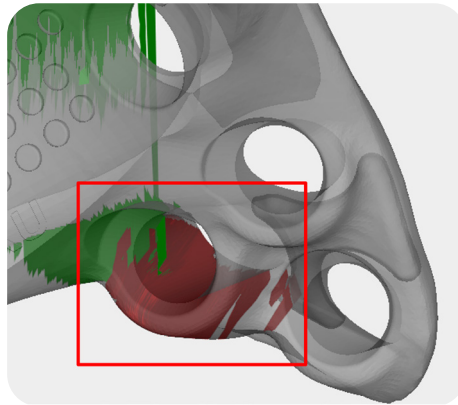
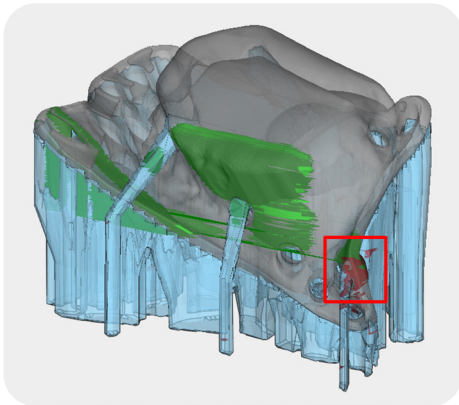
Furthermore, post-processing and quality inspection, one of three major phases of producing AM parts can account for a significant portion of **the final production cost**, especially

in the case of critical aerospace or medical parts – making production teams waste valuable time and money.

This urges engineers to understand defect identification mechanisms, influence and control methods of metal AM defects, all of which constitute the goal of this article. In the end, understanding these issues and how to address them in laser powder bed fusion-based processes is pivotal for prescribing the appropriate process parameters and selected processing techniques. More importantly, it is pivotal to deliver a part that meets the stringent requirements of its industry.



[Without Layer Analysis: defect detected after post-processing](#)



[With Layer Analysis: defect detected before post-processing](#)

Defect identification

According to **Gilles Claeys**, Market Development Manager at Materialise, there is a broad range of tools that can be used to identify defects in 3D printed parts and this can be done “by a mix of monitoring and Non-Destructive Testing (NDT), **both during the printing process and after the printing process.** During the printing, there are multiple sensors in the machine that track the process quality, from monitoring oxygen levels to advanced melt pool monitoring systems. Additionally, a visual-based defect detection approach where the 3D printer will take visual images that will be analyzed during or after printing is – when the analysis is automated – a cheap and fast method for early scrap detection. After the print job, during the quality control process, a visual inspection and NDT methods like CT scans are a couple of methods that can also be leveraged to identify

defects.”

As you may have already seen with a lot of challenges faced in the AM industry, there is no one-size-fits-all solution when it comes to tools leveraged for identifying defects. “The exact mix of monitoring and NDT technologies that are used are very much dependent on the application. The types of defects that you want to be detected in a tooling or prototype part will be different from the defects you would want to identify for a medical implant or a flying aerospace 3D printed part. So, this varies from one application to another or from one customer to another,” **Claeys** explains.

As far as types of defects are concerned, the anomaly that can alter the performance of a metal 3D printed part can be linked to something that happened during the printing process. If you’re working with a laser powder bed fusion process, there is a great chance that you

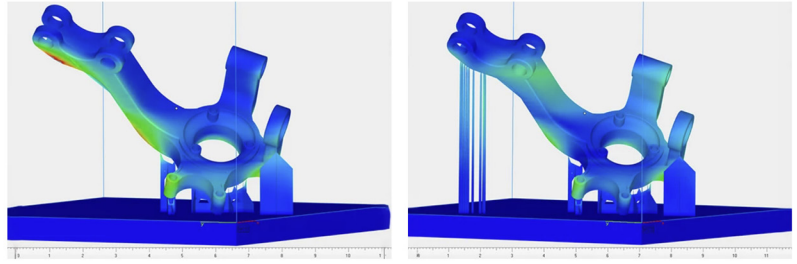
may have already dealt with geometry-related, surface integrity-related and microstructural defects. Some of these defects may be linked to keyhole collapse, gas porosity, solidification cracking, solid-state cracking, or even surface-connected porosity.

For Materialise expert, “there is a wide array of defects that can alter the performance of a metal 3D printed part like cracks, pores, inclusions,... The root cause can be something that has failed during the printing process, e.g. due to an uneven distribution of the powder bed or it could be something related to the design or supports of your part. Simulation software can help you reduce the risk upfront but, in the end, you also need to make sure that quality is delivered and that your process and quality remain stable over time.”

What influences defect formation?

Claeys' latest argument sheds light on those items that can influence defect formation during the printing process. Designing for AM and simulation are obviously important to try and get it right the first time. Even though simulation helps to reduce the amount of design iterations, many things can still happen in the printing machine that were not foreseen. A defect formation could be linked to a support coming loose during the printing, or it can simply be linked to your recoater dragging particles over the powder bed.

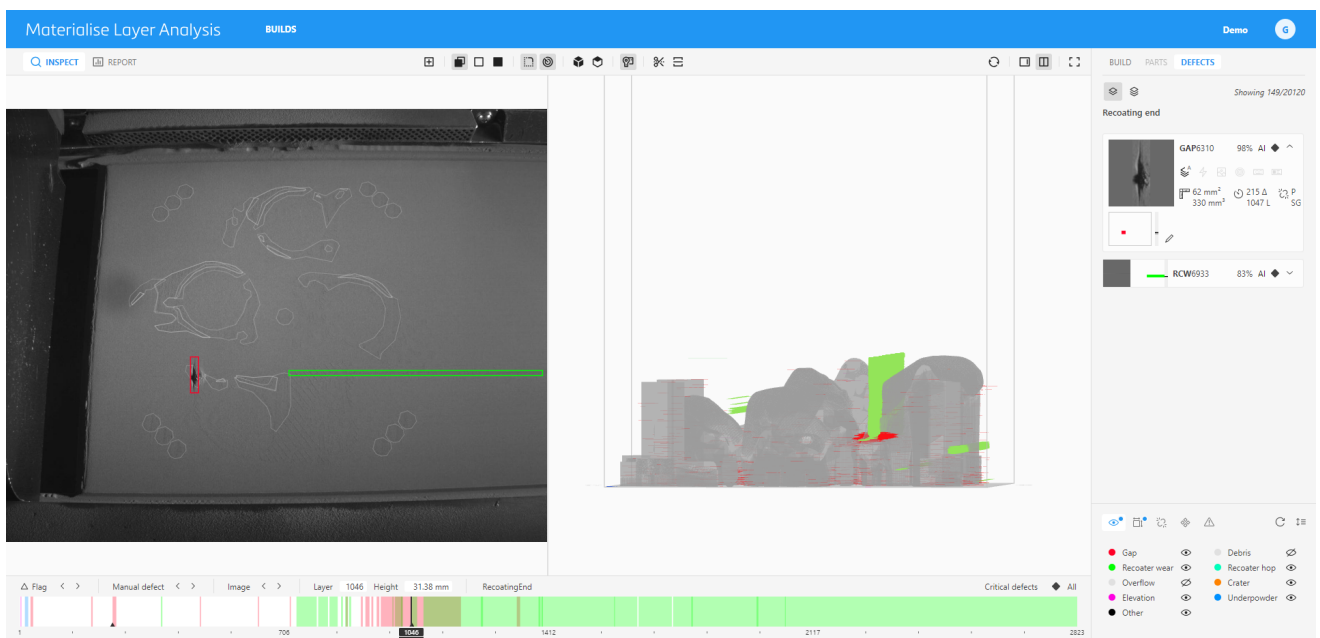
No matter what may influence defect formation, it's important to keep in mind that a defect identification mechanism aims to explain the reasons why issues directly



Credit:Materialise

happen in the printing machine. As **Claeys** points out, **“Your design, build preparation and manufacturing process can all have an impact on the quality of a part.** That’s why it’s really important to have a good tool that correlates all these data sources across your entire production chain to find out what is the root cause of what you think is occurring.”

That’s where the Materialise QPC Layer Analysis module comes in.



Screenshot Layer Analysis. Credit: Materialise

From hours to minutes: The Materialise QPC Layer Analysis software

Drawing from the demonstration **Claeys** performed, the Materialise QPC Layer Analysis software employs artificial intelligence to meticulously inspect layers captured by the cameras on 3D printers. Within a brief timeframe **(from seconds to minutes depending on the application)**, the tool comprehensively scans each layer, pinpointing errors and presenting them visually on both the individual layer and the 3D model.

The Market Development Manager explains that after this step, users receive a summary detailing defects within the build or opt for a meticulous examination of errors, color-coded

by category. This feature facilitates root cause analysis, allowing users to discern the specific impacts of each error on the overall construction. This module can also help identify errors that may go unnoticed by the human eye.

We learned with Claeys that the Materialise QPC Layer Analysis software can be used at two main stages:

“At **the R&D stage**, the Layer Analysis software will help you answer the question **“What is the root cause of these defects?”**. At this level, for AM users who are not looking to achieve series production yet, the software solution will help them perform an analysis that will help them optimize their process and make sure that they can find the right design and

process parameters for their part. of your build plate.”

The **second stage is the series production**. Once you’ve passed the R&D stage, and your product is ready to be printed in a larger volume, then the software solution could also be used to detect deviations in your printing process and to make sure that every 3D printed part meets the production standards.”

By developing the software, the team at Materialise aimed to develop an independent and agnostic solution. Speaking of how this solution stands out from the crowd, **Claeys** emphasizes on its **technology independence**:

“The system is **hardware agnostic**. It is designed in such a way that it can assess visual images from any 3D printer using its integrated visual cameras. This means that, the module is easy to get started with as there is no need to install additional hardware inside or outside the build chamber of the metal 3D printer.

Secondly, it facilitates **collaborative** work for each build. Multiple users can visualize and correlate additional data sources with one another. For example, it is possible to collect multiple data sources like other monitoring systems or CT scans and correlate all these sources together to get a complete overview of the quality

Beyond these specifications that enable a better understanding of the Materialise QPC Layer Analysis software, one thing I can’t help to stress is the ability **to make these defects measurable**. If you want to understand how and where you save costs, having clear metrics that help you to do so is for me one of the greatest advantages of any defect detection tool. And that’s something, the Materialise QPC Layer Analysis tool can help you do.

The “fail-fast” mentality

Although the critical medical component has been mentioned as a key example at the beginning of this article, it should be noted that defect detection is critical in all highly regulated industries adopting AM. I see potential interest for applications in the aerospace and space, nuclear and heavy industries which often have to build critical parts.

Last but not least, costs remain one of the reasons brought forward to explain the slow adoption of AM across industries. The Materialise QPC Layer Analysis proves to be a strong tool to address this challenge. In the end, the luckiest guys would be those who have the “fail-fast” mentality as “you can fail fast with AM, but if you’ve found your path, you can grow fast”.

This content has been produced in collaboration with [Materialise](#). If you have any questions or are interested in getting a demo, get in touch with Materialise at QPC@materialise.com.

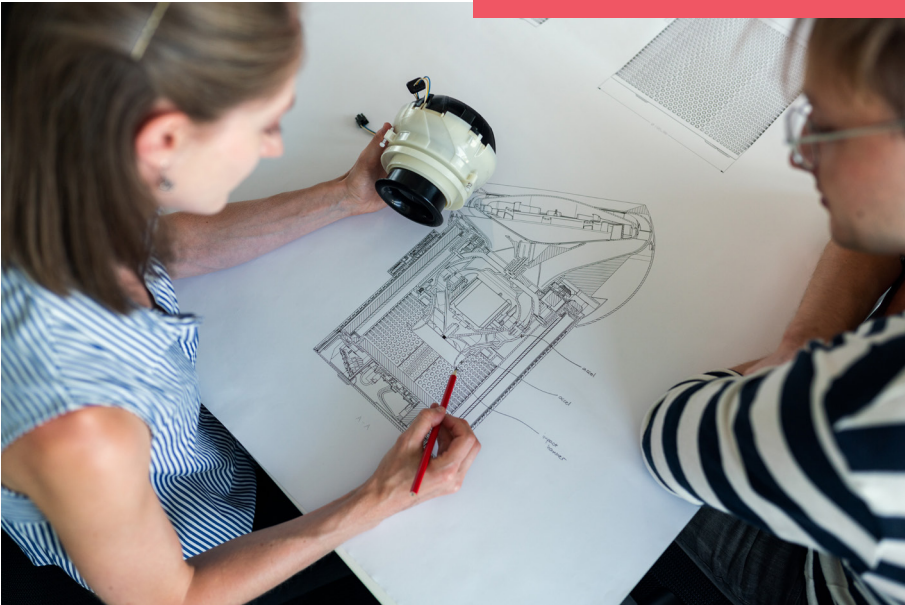
Materialise in a few words

Materialise is one of those 3D Printing/AM giants that no longer needs any introduction. With more than three decades of 3D printing experience in a range of software solutions and 3D printing services that empower sustainable 3D printing applications, the company’s open, secure, and flexible end-to-end solutions enable flexible industrial manufacturing and mass personalization in various industries — including healthcare, automotive, aerospace, eyewear, art and design, wearables, and consumer goods. Headquartered in Belgium and with branches worldwide, Materialise combines the largest group of software developers in the industry with one of the world’s largest and most complete 3D printing facilities.

Careers

LACK OF FEMALE ENGINEERS:

WHY ARE WE STILL HAVING THE CONVERSATION ?



With reports of only 18% of women in engineering roles in Germany, just under 9% in the US and around 16% in the UK, the question repeatedly being asked is whether the industry is doing enough to encourage females into the engineering profession? With an ongoing skills gap in the sector, there is still a sentiment that an increased effort needs to be made to attract women into the engineering field – and retain them. Susan Brownlow speaks to two successful female engineers within the additive manufacturing department at international technology company, Linde, to get their perspectives.

While engineering is often perceived as a more physical, science-based occupation, it is in fact, also a highly creative and innovative industry, with engineers playing a significant role in shaping our future and turning ideas into reality. Thanks to the inspired vision of engineers and their willingness to continually push the boundaries of what was once thought to be impossible – from designing high tech medical implants to devising new ways to combat the climate emergency – they make a massive contribution to enhancing our daily lives and how we might successfully thrive in decades to come.

Despite the ability to make such a positive impact – and what has seemingly been a consistent drum beat of the need to recruit more female engineers – there is an ongoing concern around the low percentage of women working within the discipline. So what's holding us back?

Half the population

It's been accepted as a general truism that women remain

under-represented in engineering, but by making the discipline more accessible to women and girls generally, not only will they have an opportunity to help shape our future, they will also reap the benefits that such a rewarding career has to offer.

Women represent half of the world's population and they face the same global challenges as men. Yet earlier this year, on the [International Day of Women and Girls in Science](#), UNESCO's Institute for Statistics could be forgiven for asking where are all the girls and women in science-based professions? While there are some outstanding female engineers, they remain the exception, not only at the highest echelons, but more generally across the industry. By overlooking and not engaging the other half of the population, we are missing out on vital developments.

Certainly, even in many mature economies, there remains some outdated but lingering cultural perceptions that can be attributed to de-incentivising potential female engineering applicants. And in emerging economies, young women face an additional and potentially greater disadvantage from lack of secondary and higher level educational resources.

Adding to this situation have been historic examples where exceptionally talented female engineers – such as **Stephanie Kwolek** who discovered the bulletproof fibre Kevlar – have been overlooked for patents and prizes in favour of their male supervisors. Yet their contributions have transformed the world and lives within it.

A perspective from today's



Elena Bernardo

female engineers

In speaking with two senior German-based female engineers involved in additive manufacturing at Linde- French-born, **Sophie Dubiez Le Goff**, Expert Powder Metallurgy, and Spanish **Elena Bernardo Quejido**, Project Manager, Metal AM (both PhD's in Materials Science) – the experience of women being a minority would appear to be ongoing. While Linde itself has a positive approach to diversity and improving the ratio of female to male engineers is a priority for managers, there remains the challenge of a relatively small talent pool from which to hire. As such both women find themselves significantly outnumbered by male colleagues and believe that their experience is not out of the ordinary.

From our discussions on why they feel there is a deficit in female engineers, Elena and Sophie recently provided some insight. Both women believe there continues to be a lack of role models from which girls and young women can identify. In recounting their formative years at school, they note it was mainly men that taught science or mathematics based subjects, and they suggest that disengagement of young female students begins at that early stage. Elena sums up their possible detachment: “If you don't have anyone that reflects you and to that you can compare yourself to, you think this is something that's not made for you.” And, in later years, as female students start to funnel down into selecting specific topics to focus on, it seems the hesitation and even aversion to enrolling in science courses doesn't get much better.

Rather than her male science-led teachers, Elena credits her parents as being significantly

influential. Elena's father was a physicist and her mother a teacher. She recounts, “I had the perfect upbringing for a potential role in a scientific profession and therefore didn't need external encouragement.”

Women and the world missing out

Both Elena and Sophie are emphatic that not only many women miss out on a fulfilling career, but society as a whole is missing out on half of the world's talent and capacity to innovate. They also emphasise that this is becoming an increasingly important issue to resolve in the light of climate change. In helping to combat global warming, we need as diverse a population of engineers as possible, and within the engineering community, they stress there is concern over the lack of technical profiles. One reason for this, they suggest, is that half of the potential talent isn't being part of the solution.

Commercially speaking, businesses are missing out too. Both women support the idea that female employees can bring a range of beneficial soft skills into the work environment. “While these skills are not unique to women, they are more often exemplified by women”, commented **Christine Kandziora**, a senior engineer herself and Executive Director R&D, Linde. “When a leader knows her team, facilitates clear and honest communication and fosters a trusting, collaborative culture, workers can



Sophie Dubiez-Le Goff

problem-solve together and think creatively”.

From a personal viewpoint, Elena and Sophie are agreed that there are multiple benefits to choosing an engineering career. Not least is the economic independence, giving women and their families the autonomy and self-determination that can be hard to achieve in less monetarily rewarding circumstances. And then there is the personal sense of achievement in seeing your innovations come to life. *“You can not only make your dreams come true”, commented Elena, “but you can play a real part in the future of society – and why wouldn’t we? After all, we live here too.”*

Both women concur that one of the most satisfying parts of their engineering roles is an endless opportunity to learn and grow professionally – whether it be through research, discovering a new application or via the introduction to a new member of your network. *“The job itself is very diverse and every day is different. The variation is largely linked to technology as it evolves so fast”* says Sophie.

Sophie and Elena also agree that for those more far-sighted employers such as Linde, flexibility in the workplace, including working part-time or flexi-time or working from home, can be a significant factor in women’s success, enabling them to balance career and family.

Employers and positive action

When discussing her early professional journey, Sophie believes that the female-positive approach shown by her first employer (an international company of over 50,000 employees which actively encouraged candidates from under-represented groups) gave her an invaluable opportunity. She notes however, that both the CEO was a woman who had the vision to change what they saw as the prevailing white, middle aged male contingent “in the canteen”. And while she admits to finding being the only young female engineer within her group challenging at beginning – and suffering from what is often referred to as “imposter syndrome” – she soon found her confidence and the respect of her male colleagues. Elena also makes the point that even employers who take a positive approach to diversity can still be constrained by the lack of female candidates and cites that for a typical engineering position, out of a hundred applicants, only a few might be women.

What now

Attracting and supporting more women

in engineering benefits everyone by increasing the potential to develop inclusive, innovative solutions for the complex problems the world is facing. With that in mind, organisations (both in the public and private sectors), policy makers and educational institutions need to increase their efforts to attract female engineers. Several governments are now looking at providing funds to support women eager to progress their careers and/or return to engineer training following a career gap. The key aims of such funds are to move away from the idea that engineering is a man’s field and that women can provide a large and hitherto underutilised talent pool.

Additive manufacturing is a new and fast paced technology making the creation of previously impossible products, possible. From lab-based research to real-world applications Sophie and Elena relish the daily challenge and opportunities that being at the forefront of innovation can provide. And enabled by an employer with the foresight and ambition to recruit more female engineers, they are paving a path forward – not only for other women, but for us all.



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Events

Key takeaways from partner events in 2023 and a glimpse into 2024

If you're working in the AM industry, you probably already know that attending an industry event is a unique opportunity for your business to thrive. With so many AM events being held across the world, it might be hard to make up your mind on the ones one should attend. More importantly, each event is different and comes with a unique set of advantages and limitations (depending on your goals). That's why, to help you prepare for next year, we have asked 6 of our partner events to share the highlights of their 2023 event and what will make their event worthy to be attended in 2024.



3DA: How would you summarize the highlights of the 2023 edition of your event?

Formnext 2023 was a highlight of the AM community worldwide, making it the hub of the fAMily. We are very pleased that we reached 2019 pre-corona levels in terms of exhibitor numbers, with 859 companies, around 60% of them being international. Given the economic slowdown and the tense geopolitical situation, this is a top development and underlines that AM has arrived and become relevant in industrial manufacturing. In a nutshell: more new machines, more companies, more industrial production and more series manufacturing.

3DA: Can you tease one exciting new feature or aspect that attendees can look forward to in the 2024 edition?

The printers alone are no longer the focus; it's about upstream and downstream processes and manufacturing solutions that customers want and ask for. Decentralized production, shortening of supply chains, and the combination of conventional and additive processes are playing an increasingly important role. That's what Formnext will have on display, all in the growing context of sustainability. And having Australia as the partner country in 2024 we'll have a big spotlight on the AM ecosystem in Downunder.



Sascha F. Wenzler,
Vice President of Formnext

3DA: What advice would you give to future participants (visitors and/or exhibitors)?

To visitors, I would say, make enough time and make the best out of your stay at Formnext. It's 4 huge halls covering more than 50,000 sqm with 860 companies. We have three content stages in the halls, seminars for beginners, special areas, a TV program, a career day, a famous party for networking, and much more to discover. Nor does the trade show stop after four days. With the Formnext Hub, we will give the AM community a year-round presence with the AM Directory and other events online.

To exhibitors, I would recommend this: be prepared to show your products and expertise

around the whole AM process at your stand to more than 30,000 visitors from around the globe. All business professionals in AM meet during Formnext and more and more new user industries are interested in the use of AM. Use our re-booking and early bird discounts and look for your entry in the year over AM Directory. Meet our media partners, sponsors and the press. Enter the technology stage during the event and send your message via our channels like the Formnext Newsletter or Formnext.TV. The family welcomes you for [Formnext](#) in Frankfurt.

Formnext 2024 will be held from November 19 to 22 in Frankfurt.



Shanon VanDeren,
President of AMUG

Shanon VanDeren, President of AMUG

3DA: How would you summarize the highlights of the 2023 edition of your event?

The response to the 2023 AMUG Conference was overwhelmingly positive, with many highlights over the five-day agenda. One of the standout moments was the engaging and interactive keynote delivered by Nicholas Jacobson (CU Anschutz Medical Campus) and Rob Ducey (LAIKA Studios), which emphasized the benefits of collaboration. This collaboration was sparked at a previous AMUG conference, and attendees were thrilled to hear the outcomes. Participants also enjoyed the circuit of hands-on workshops where they could easily move in and out of workshops as they desired. Other highlights included perennial favorites such as the Innovators Showcase, Technical Competition, and off-site events.

3DA: Can you tease one exciting new feature or aspect that attendees can look forward to in the 2024 edition?

Over the past 36 years, the program for AMUG Conferences has been carefully crafted and refined. In 2024, the agenda will remain largely unchanged and will include the conference's staple features, such as keynote speeches by Jason Lopes (Gentle Giant Studios) and Olaf

Diegel (University of Auckland, New Zealand) and the Innovators Showcase, which will feature Greg Morris (Zeda, Inc.).

AMUG has acted on attendee feedback requesting even more technical content and will be taking the AMUG Conference 'Back to the USER.' That theme will carry over to the Thursday family dinner, where all are invited to dress in 1980s-style garb to celebrate the founding year and original principles of AMUG in a Back to the Future way.

Also in response to attendee requests, the AMUG 2024 program will have an extra day for the AMUGexpo. The AMUGexpo will now run from Sunday night through Tuesday night, and the biggest evening event, the Special Event and Dinner, has been moved to Wednesday (March 13) evening.

3DA: What advice would you give to future participants (visitors and/or exhibitors)?

To fully benefit from the AMUG Conference, both attendees and exhibitors need to adopt a different mindset than what is typically expected at conferences and trade shows. The AMUG Conference is designed to foster conversations, information exchange, and collaboration, so attendees should plan to actively participate in discussions from breakfast through dinner.

It is recommended that attendees clear their workloads before the conference to fully engage in the experience rather than spending part of the day in a hotel room. For exhibitors, it is suggested that they take on the role of a resource, similar to that of an application engineer, to provide valuable insights, coaching,

problem-solving, and tips for effective use. By being an active part of the community and engaging in conversations, exhibitors and attendees can make the most of their experience at AMUG 2024.

AMUG will be held from March 10 to 14, 2024 in Chicago.



Nick Liberato-Randall, Director of Marketing, MILAM

3DA: How would you summarize the highlights of the 2023 edition of your event?

MILAM 2023 brought together an incredibly diverse group of additive manufacturing innovators looking to make their mark in the defense and aerospace sectors. Three individuals and organizations received awards for their outstanding achievements in 3D printing, and the event delegation heard from more than 40 unique and insightful speakers from across the defense community, academia, and industry leaders.

3DA: Can you tease one exciting new feature or aspect that attendees can look forward to in the 2024 edition?

MILAM 2024 features an international panel discussion convening delegations from across the globe to discuss "Driving the Global Adoption & Integration of 3D Printing Technologies." Additionally, in partnership with America Makes, we will be recognizing a group or individual with our inaugural "Education and Workforce

Development Award." Finally, we will be hosting more than a dozen 3D printing and defense community leaders for in-depth interviews.

3DA: What advice would you give to future participants (visitors and/or exhibitors)?

[To visitors:] Meet as many people as possible! With 80 exhibitors representing just about every aspect of 3D printing from design through the finishing process and logistics, you'll be sure to make great connections and learn about new opportunities to get involved with emerging sectors just beginning to adopt AM.

[To exhibitors:] Bring your technology! Attendees, especially military/government end-users, love to get hands-on experience. Because we make sure to schedule dedicated exhibit hall time, there are opportunities for exhibitors to leave the booth and listen in on speaking presentations and panel discussions.

MILAM will be held on January 16 and 17 in Florida.

Stuttgart, Germany 2024

MedtecLIVE



Christopher Boss, Executive Director MedtecLIVE at NürnbergMesse

3DA: How would you summarize the highlights of the 2023 edition of your event?

The MedtecLIVE 2023 event featured notable moments and new developments in additive manufacturing for medical technology. Exhibitors presented a range of technologies that contribute to the ongoing evolution of the industry. The event encouraged meaningful discussions and garnered feedback from attendees. Significant attention was given to the progress in additive manufacturing, which promotes collaboration across various industries. These developments highlight the importance of MedtecLIVE as a prominent European fair in the development and manufacture of medical technology.

3DA: Can you tease one exciting new feature or aspect that attendees can look forward to in the 2024 edition?

For the MedtecLIVE 2024 edition in Stuttgart, participants can expect a focus on evolving themes, especially in additive manufacturing. The exhibition aims to offer a forum where recent innovations and advancements in this field will be presented. The continued development of topics such as automation, digitalization, and the circular economy is expected to reaffirm

MedtecLIVE 2024 as a significant event for the future of medical technology.

3DA: What advice would you give to future participants (visitors and/or exhibitors)?

To Visitors: Plan ahead to optimize your experience at MedtecLIVE 2024. Identify essential events, explore various exhibitors, and seize numerous networking opportunities.

To Exhibitors: Beyond just a stand, MedtecLIVE offers a comprehensive digital experience. Throughout the year, the website of MedtecLIVE highlights your solutions and aligns them with the interests of visitors, connecting your products with relevant audiences. Maximize your engagement and visibility at the event. Use presentations and workshops as opportunities to showcase your innovations. Participate in networking events to build valuable relationships. Utilize the digital MedtecLIVE experience to maintain year-round visibility and engage with potential customers who show interest in your products. MedtecLIVE represents an opportunity for sustained growth and collaboration within the medical technology sector.

MedtecLIVE 2024 will be held from June 18 to 20, 2024 in Stuttgart.



**ADDITIVE
MANUFACTURING
STRATEGIES
NEW YORK**



Michael Molitch-Hou, Editor-in-Chief of 3DPrint.com on AMS

3DA: How would you summarize the highlights of the 2023 edition of your event?

AMS 2023 was a kismet gathering of industry executives, investors and thought leaders. Bringing together such experts into a contained environment led to myriad priceless interactions and connections forged, and laid groundwork for investments and M&A. The international touchpoint that New York City offers enhanced this thrust.

3DA: Can you tease one exciting new feature or aspect that attendees can look forward to in the 2024 edition?

We are very excited about the increased “finance/investment” programming that will feature at AMS 2024. Each year this aspect is given more attention in the AMS program. Highlights include a live and expanded version of the popular podcast “Printing Money”, a CEO roundtable including Cantor Fitzgerald, Stratasys, Desktop Metal and Velo3D, and a special seminar from The Barnes Global Advisers, “The Economics of Additive”.

3DA: What advice would you give to future participants (visitors and/or exhibitors)?

To visitors, check out the speakers and sponsoring companies. Once your registration is confirmed, you may write to us at ams@3dprint.com with your wishlist and we will arrange pre-event matchmaking so you can set up valuable meetings in advance. Also, be sure to stick around for the final day. We have included some extremely valuable programming to ensure a full house throughout the conference.

To exhibitors, just bring your networking hat, don't bring your super large printer! AMS does not offer classic exhibitor “booths”, but rather “dedicated networking areas”. We encourage sponsors to reserve out a “home base” so attendees always know where to find and meet with them, but not to deck out their spaces with normal booth paraphernalia. The conference is about forging business connections, not about displaying huge machinery.

AMS will be held from February 6 to 8, 2024 in New York.



**THE
Advanced Materials
SHOW**



Lana Mercer on the Advanced Materials Show

3DA: How would you summarize the highlights of the 2023 edition of your event?

The Advanced Materials Show co-located with The Advanced Ceramics Show was held in June 2023 at The NEC, UK was visited by over 3,500 visitors. The combined event showcased the latest in high performance materials on display for applications including aerospace, automotive, electronics, construction and industrial assets. The two-track conference was very well attended with speaking companies including Rolls Royce, WMG, Lucideon, British Ceramic Federation, Department for Business & Trade and many more.

3DA: Can you tease one exciting new feature or aspect that attendees can look forward to in the 2024 edition?

We will be partnering with The Graphene Council to provide a dedicated Graphene program of sessions, presentations and networking events. Designed to help graphene companies and end users to understand this material and how it can be applied to enhance the performance of a range of products.

3DA: What advice would you give to future participants (visitors and/or exhibitors)?

The advice for future visitors would be ensure they plan their days out as The Advanced Materials Show and The Advanced Ceramics Show is also

co-located with Battery Cells & Systems Expo and Vehicle Electrification Expo. Between these four connected industries there is a lot to see and the four track main conference will not want to be missed.

As an exhibitor at The Advanced Materials Show and The Advanced Ceramics Show, there are plenty of opportunities for you to share the latest news, press releases etc and the show will share this news on the website, social channels and in the newsletters which is distributed to a vast database.

[The Advanced Materials Show](#), co-located with The Advanced Ceramics Show is back for 2024 on the 15th & 16th May at The NEC, Birmingham, UK.

Editor's notes: How do you choose which AM event you should attend ?

3D ADEPT Media is a media partner of more than 20 industry events across the world. As a global digital and print media that specializes in AM, we give value to trade shows and conferences that aim to help industrials and AM enthusiasts make the most of their AM journey. We also understand that it can be difficult to attend each industry event across the world. So, how do you make up your mind? Whether you're an AM user or a technology provider, it comes down to a single sentence: Define your priorities.

AM users:

- If you're new to the AM industry, make your baby steps in a local show where you will see what's happening near you. There are plenty of opportunities to learn on local shows.
- Also, if you feel that you will have a barrier language, then learn the latest insights into AM events that are held in your country, or your language – if there are virtual events.
- If you're an advanced user, looking for a new machine, or a new material, or if you're looking to discover what's new in the global AM industry, then choose an industry event where you will have the opportunity to have a big overview of the market.
- Understand the differences between large industry events and conferences. While conference sessions are often included in industry events, it is not always the case for conferences. Conferences allow you to learn more about specific

topics and to meet people from specific vertical industries adopting the technology. Therefore, you can learn from other companies in your industry.

AM technology providers:

- Historically, the primary purpose of manufacturing trade shows has been to source suppliers. So, if that's your primary objective, consider attending a large industry event to assess the variety of options in the market.
- If you're looking for distributors or if you're looking to expand in a new country, a local industry event will be a great way to meet them.
- If you're constrained by budget (or not), you can also decide to attend events in vertical industries where your technology can deliver great potential. For example, not all healthcare professionals will attend large shows like Rapid+TCT or Formnext, but there is a great chance to find a bunch of them in MedTech shows.
- When it comes to educating people about your technology, you will find potential users who prefer a hands-on approach on an exhibition floor but you could also find other users who prefer to listen to a case study or a panel during a conference.

Whatever the case, one thing is certain, if you work with a trade media like 3D ADEPT Media, there is a great chance that you benefit from maximum exposure whether you take part in a specific event or not.

Newcomers

12 3D printing ventures that turned stealth mode off in 2023

Every year a range of new companies venture into the Additive Manufacturing industry. In the list of this year's newcomers, one notices that the growing trend around companies that focus on AM-dedicated applications continues. While services target the entire value additive manufacturing chain (from software to post-processing), it is interesting to see how companies provide solutions in new vertical industries that could adopt AM on a broader scale.

Here are 12 newcomers that turned stealth mode off this year. They uphold the global outlook in the AM industry.

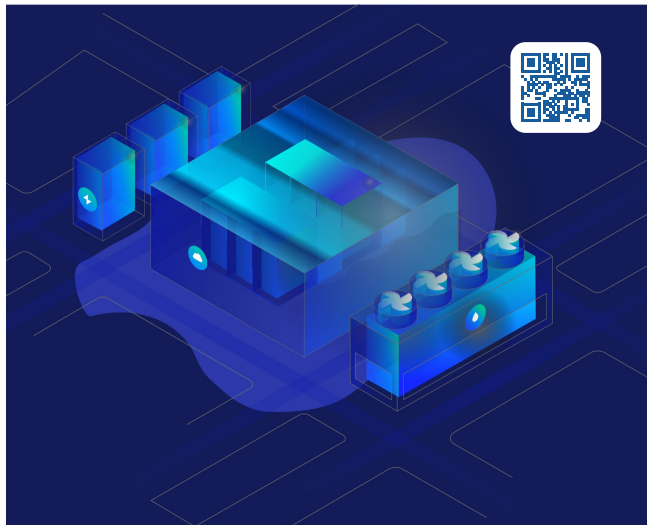
1 - ECL

At the beginning of 2023, in January a new company EdgeCloudLink ([ECL](#)) was started by former Microsoft data center employee **Yuval Bachar** to make data centers zero emission with the help of 3D printed hydrogen power grid.

The California-based company raised \$7m in funding from Hyperwise and Molex with its modular net zero proposal of making Data center-as-a service through which they planned to build 1MW units of hydrogen-powered off-grid data centers.

The company built the first zero-emission data center in Mountain View, California using a locally powered hydrogen source and a construction 3D printer. The data center was built with the help of a proprietary liquid cooling design and didn't require any diesel generators.

ECL made the design available in the second quarter of 2023, offering services to create zero-emission data centers within 6 months at half the price of building data centers in the conventional way (half of \$12-15 million per MW). The data centers built in this process are



equipped with hydrogen fuel cell tanks and connected to the local grids for added reliability which can be operated by the customers all by themselves or can be run jointly with ECL.

The company also provided ECL construction 3D printer services which can be used by customers for making data centers or other 3D construction buildings.

2 - Outokumpu

In April this year, the Finnish stainless steel manufacturer [Outokumpu](#) entered the metal AM industry with metal powder solutions. The company introduced a range of stainless steel powders which were manufactured at their new atomization plant in Krefeld, Germany.

The stainless steel powders introduced by Outokumpu can be used in various 3D printing processes like Metal Injection Moulding (MIM), Binder Jetting (BJ). Beyond powder manufacturing, the company seeks to create a viable AM ecosystem to support its customers in producing customizable 3D printed parts.

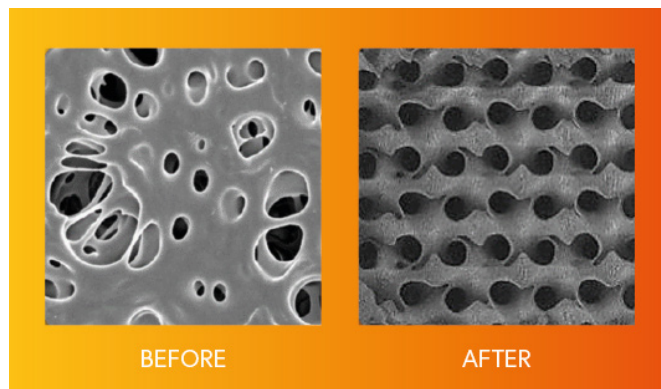


3 - Evove

Another company trying to solve net zero problems is the UK-based startup [Evove](#). The company operates in the field of filtration technology; it is on a mission to reduce the cost and environmental impact of the filtration and separation of fluids in a variety of sectors. By filtering the unfilterable, the team leverages nanotechnology and additive manufacturing processes to deliver advanced membrane technology that could reduce the impact of water filtration.

Water filtration systems affect the environment through production, testing and transport. These issues are present in any product that's manufactured and shipped to customers. Manufacturing of water purification systems requires a lot of material and water from a wide variety of different sources. Depending on the specific types of materials that are used, the degree of the impact on the environment varies, one learns from a source.

On another note, industrial process water is not (that) easy to recycle; not to mention that there is often waste in wastewater, and cleaning up heavy industry wastewater lakes is not that simple.



Membrane – before and after renovation. Credit: Evove

Evove has taken note of all these challenges and now ambitions to address them by targeting the lithium, green hydrogen, desalination, food and beverage, and water and wastewater industries.

More specifically, the company's technology harnesses graphene oxide-based coatings and a variety of 3D printed enhancements to boost the performance of conventional membranes. Separonics® are Evove's precision-engineered membranes, providing transformational productivity gains in selectivity and flux, operational efficiency, energy consumption and equipment lifetime.

4 - JPB Système

The French KeyProd production monitoring solution provider [JPB Système](#) ventured into the AM industry this year to offer metal binder jetting services for making complex 3D printed parts, especially those used in the aerospace industry.

Through the acquisition of a stake in France-based 3D printer manufacturer start-up, Addimetal, JPB Système will be involved in the development of Addimetal's innovative open hardware platform, technology and associated process to ensure both existing and future application needs are met.



5 - SAEKI

The Swiss robotics company [Saeki](#) started by **Andrea Perissinotto**, **Oliver Harley** and **Matthias Leschok** started its journey to automate factories this year by building a production unit that will support manufacturing in both the construction and other industrial sectors.

Their solution combines 3D printing, and milling, with large industrial robots that can print formwork up to many meters in length.

The Swiss company offers Robotics as a service for end-to-end automation for 3D printing, machining and inspecting of functional parts to fully automate factories.



6 - 3D BioFibR

[3D BioFibR](#), a company that specializes in biomaterials for tissue engineering, is the latest to penetrate the 3D bioprinting market. The company focuses on collagen products that can serve 3D cell culture and tissue engineering applications, especially the cellular scaffolds segment. Using its fully automated and proprietary dry spinning process, 3D BioFibR could produce “high quality, diameter-controlled collagen fibers at commercial scale.”

The machine can process **μCollaFibR™**, a proprietary bio-ink additive for use in 3D bioprinting of tissue and organ models in a laboratory setting.

The company says CollaFibR™ helps to make



more durable 3D printed tissues as they can assemble multiple types of cells layer-by-layer. This helped them to produce a more natural collagen fiber matrix with cellular movements and biochemical properties of the naturally occurring fiber.

7 - flō optics

The Israel-based company [flō optics](#) has recently made it possible for 3D printing to find applications in the ophthalmic industry through its advanced lens coatings solutions.

At the heart of the manufacturing process, one finds an inkjet-based 3D printing technology that applies unique, multi-material, multi-layer coatings to lenses. This proprietary deposition technology is built on a rich expertise in digital printing.

Coatings range in function and vary according to customer needs. And these specific needs often come from the ophthalmic labs that fulfill the opticians' requests. flō's platform will serve this audience by providing manufacturing hubs that could generate thousands of customized lenses daily.



8. Additive Appearance

Years of research into simulation software for 3D printing by a spin-off company from Charles University in Prague led to a software simulation solution that could enhance the sharpness and quality of 3D printed parts.

[Additive Appearance's](#) software is focused on the visual appearance of the resulting 3D prints and will not only achieve high color accuracy but also the best texture sharpness, which has been very

difficult to achieve with existing technologies. The team is building the software with components from artificial intelligence to form a multi-step virtual optimization that is running before the printing. By using this software in combination with PolyJet 3D printers, the resulting physical prototypes will provide designers with a unique opportunity to communicate their vision to clients on prototypes as believable as the intended final product.



9 - Pelagus 3D

This is one of the developments in the AM industry that caught my eye as it is likely to have an impact on the maritime industry. Industrial companies thyssenkrupp and Wilhelmsen joined forces to launch [Pelagus 3D](#), which will manufacture 3D printed maritime spare parts using 3D printing technology.

The aim here is to democratize and streamline access to 3D printed maritime parts and OEMs. The Singapore-based Pelagus 3D is offering a range of fleet optimization and vessel optimization through its OEMs and the AM platform also delivers 3D printed maritime spare parts on-demand, reducing vessel downtime and costs.



Caption for the picture of ribbon cutting ceremony (f.l.t.r.):

1. Kenlip Ong, Chief Executive Officer, Pelagus 3D; 3. Dr. Sebastian Smerat, Head of Customer Innovation of thyssenkrupp Materials Services and Member of the Board of Directors, Pelagus 3D; 4. Dr. Cetin Nazikkal, CEO Asia Pacific Africa and Chief Transformation Officer of thyssenkrupp and Member of the Board of Directors, Pelagus 3D; 6. H.E. Dr. Norbert Riedel, Ambassador, German Embassy Singapore; 7. Alvin Tan, Minister of State, Ministry of Trade and Industry; 11. Kjell Andre Engen, Chief Executive Officer & President, Wilhelmsen Ships Service and Member of the Board of Directors, Pelagus 3D; 12. Nakul Malhotra, Vice President, Emerging Opportunities Portfolio, Wilhelmsen Maritime Services and Member of the Board of Directors, Pelagus 3D; 13. Hakon Ellekjaer, Chief Commercial Officer, Pelagus 3D. Credit: thyssenkrupp

10 - ArcelorMittal Powders

Over a decade of experience in the steel industry led Indian steel giant [ArcelorMittal](#) to steel powder manufacturing for the AM industry. The Belgian subsidiary has been working behind the scenes on a pilot application in the steel industry with Guaranteed, a 3D printing service provider where it's also a shareholder.

Now, the company is building an inert gas atomizer in Aviles, Spain to manufacture steel powders for the AM industry which will be available for use in processes like laser powder bed fusion (LPBF), binder jetting (BJ) and direct energy deposition (DED) from January 2024. The company will have an annual capacity of 1,000 tonnes which can supply steel powders in batch sizes of 3 tonnes to the AM industry.



11. Forivory

As we near the end of 2023, we came across a new 3D printer manufacturer from South Korea Forivory which has enhanced 3D printing with its FT400 3D printer. The new company Forivory has been launched by the South Korean 3D printing brand Jelect.

According to the R&D team of Forivory which built the FT400 3D printer based on the 'high performance, high efficiency, stability' characteristics, Forivory's XTC (X-axis gantry toolchanger) technology solves the problem of slow output speed due to large and heavy head. This would place it ahead of other multi-nozzle 3D printers in the market. The company is offering its new 3D printer (globally from April next year) which comes equipped with Maker Station software to monitor the process.



12 - Metafold

[Metafold](#), a newcomer in Design for Additive Manufacturing, develops an "ultra-precise, lightning-speed geometry computation engine for outputting accurate designs for 3D printing complex parts". Metafold explains that its cloud-based SaaS platform is accessible on any device, making it fast and easy for design and engineering teams to produce optimized parts with the Metafold web application or leverage the Metafold Engine API to build their own custom tools and integrations. Through this advanced geometry support, Metafold enables manufacturers to use less raw material and produce lighter, more efficient parts that use less energy, both of which contribute to helping customers achieve their sustainability goals.



FORMNEXT 2023

“THE DEVIL IS IN THE DETAILS”



I would have loved to start this article like many people on social media, by saying that formnext was wonderful from the beginning to the end of my participation but I can't. If I want to be honest with myself – and obviously to you, formnext was strange to me on the first day of the show. Strange, because despite an intense preparation upfront, I had this feeling of “déjà vu” when I entered Hall 12, where I had my very first meeting of the day. I was left with that sentiment until the middle of the afternoon, when I realized, I just needed to pay more attention.

Before I tell you what I should have paid more attention to, let me share a few interesting numbers. This year, [Mesago](#) hosted:

- 859 exhibitors (59% of which were international) in an exhibition space of 54,000 m²
- 32,851 visitors (specialists and managers – 50% international). A number that represents [a further increase of 11.1%](#) on the numbers already recorded for the previous year.

This impressive track record shows that Mesago is fully back on track – when compared to the post-pandemic period, and continuously goes the extra mile to provide AM users and exhibitors the most diverse and comprehensive experience.

That experience is where I should have started assessing. A quick look at the multifaceted conference program highlights for the first time three stages: **Application, Industry, and Technology**. Designed for AM users, industry insiders with cross-disciplinary expertise, and AM solutions providers, each of these stages featured a number of experts with a wealth of expertise

in the industry.

These stages clearly highlight the fact that the AM industry is much more than technology solutions themselves. It's a wide range of related topics that also contribute to the advancement of the industry as a whole.

Take the example of the Industry Stage only, companies from the partner region Nordic, including Equinor, Lego Group, Danfoss A/S, and Grundfos Holding A/S, discussed their use of Additive Manufacturing to conserve resources. Other key topics, such as supply chain resilience and cybersecurity – amongst others Viaccess-Orca and Daimler Truck AG – Daimler Buses GmbH, as well as emerging technologies such as bioprinting and 3D Printing of medicine were at the heart of the debates. Furthermore, experts from NewCap Partners, HZG Fund Management, Freigeist Capital GmbH, and AM Ventures Management GmbH discussed investment and financing options for startups of the industry.



Image Industry Stage. Panel Emerging Technologies. Credit: 3D ADEPT Media. Legend: Participants include from left to right: Frank Jablonski (moderator), Kety Sindze (Managing Editor, 3D ADEPT Media), Terry Wohlers (Head of Advisory Services and Market Intelligence, ASTM), Dr. Anna Worsley (Director of Innovation at FabRx) & Dr. Ing. Tobias Lam (Head Of Technology at Cellbricks)

The uniqueness of this year's edition was hidden in details you would not have seen at first glance.

Business

The Nordic region was maybe the partner country of this 2023 edition of formnext but Mesago hosted AM companies from all regions (Europe, Australia, Canada, USA, China). Europe left apart, there was a prominence of Chinese companies and visitors – accompanied by an interpreter who facilitated their tour of the show.

With China being reported as the second-largest market for Additive Manufacturing worldwide, communication on the global business landscape usually highlights the efforts of American and European companies that would like to penetrate this market. The presence of companies like **BLT**, **Elegoo**, **Scantech**, **Shanghai Digital Manufacturing Co., Ltd.**, **Shanghai Hangrui Advanced Materials Technology Co., Ltd.**,

CBD-Tech, **eMake3D Technology Co., Ltd.**, and many more is a reminder that there is also a need for these companies to internationalize their operations, and this requires to navigate cross-cultural communication and to adapt localization strategies.

On another note, [the wave of mergers and acquisitions](#) that reached its peak last year has been subtler and more strategic this year. From a business perspective, this means **fewer investments on the exhibition floors** as these companies usually join their marketing forces and handle them under one roof. BigRep is an interesting example to mention here as it has seized the formnext opportunity to announce the acquisition of [HAGE3D](#), an advanced engineering company with 40 years of experience in large-format, special-purpose machine building. Showcased in a very cool way on the show – through a “collabosphere”, the acquisition means that all Hage3D solutions will now be discovered through BigRep's booths on exhibition floors across the world.



Credit: BigRep

Another one that we will probably no longer see on its own at formnext is [Essentium](#). Absent from this 2023 edition, we are likely to see the company's solutions under the umbrella of its soon-to-be parent company: **Nexa3D**. The announcement was made right before formnext began and puts Nexa3D in a strong position in the industry as it now integrates a diverse range of solutions in its portfolio; a portfolio that has been strengthened this year with the [acquisition of Addifab](#), [XYZprinting](#), and a [collaboration with Headmade Materials to enter the metal 3D printing segment](#).

Newcomers

This has become my favorite exercise on the showfloor: discovering who is new in the market and what value they bring. Interestingly, this year, I met **newcomers to the show and newcomers to the industry**.

One often assumes that because formnext is one of the most important events in the AM industry, one should meet all the companies that provide services in this industry. Yet, despite the good reputation of the event, there are still companies that choose not to exhibit at the event – for reasons of their own.

In the exhaustive list of companies I met, my favorite one was [Deloro Wear Solutions GmbH](#). New to the show and new in the AM market, the company brings to the AM industry five decades of experience in welding solutions, and metallic wear- and corrosion protection solutions. They bring to the market a range of **anti-aging metal powders**.

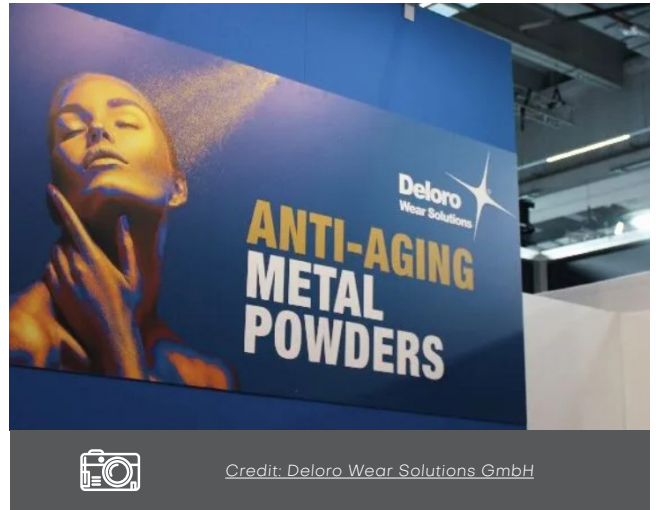
*“Some are like water, some are like the heat
Some are a melody and some are the beat
Sooner or later, they all will be gone
Why don't they stay young?”*

Remember these words from **Alphaville's** famous single [Forever Young](#)? If the German synth-pop band couldn't find the answer to the question asked in the single that made their success, Deloro seems to have found the secret for long-lasting and reliable 3D printed parts. At formnext, they introduced their Cobalt- and Nickel-based powder for 3D printing, their printed protection, and their powder feeder for Additive Manufacturing.

I like their concept, the team is experienced so I am sure you will hear more about them in the



3D printed parts showcased at formnext on Deloro's booth. Image credit: Deloro



Credit: Deloro Wear Solutions GmbH

upcoming months.

Another company that caught my attention on this show is [Fronius](#). New to the show but not in the AM world, the company's solutions have already convinced WAAM machine manufacturers like MX3D. The company builds on its strong welding expertise to improve the WAAM process. If you are well familiar with the welding process, you probably know that it needs to be as cold as possible to deliver strong layers. This means that it needs to be sufficiently low energy such that when a new layer is applied, the existing layers do not melt again. Fronius offers a wide range of solutions to address this solution and one of their highlights on the show was the **CWC-S Cobot welding cell** that guides the welding torch to the appropriate positions.

Fronius presence at formnext reminded me of the prominent presence of robotics companies last year on the show. I thought we would have witnessed more applications in this regard throughout 2023 but in the end, there were not a lot. I still believe it's only a matter of time before we witness the true potential of robotics in AM.

Directly coming from New Zealand is, [Foundry Lab](#), another company that caught my attention with another super cool marketing approach: **“Mom was wrong, you should put metal in the microwave; it won't go bang!”**.



Credit: 3D ADEPT Media

First and foremost, moms are always right – how dare they? Well, the company is bridging the gap between casting and 3D printing with their **Foundry Lab printer**, a system that can produce reusable **diecast equivalent molds** within hours in only 4 steps: print – set – load and cast.

At the heart of their 3D printing process lies binder jetting, but what makes the system stand out in this market is the microwave furnace which allows a casting to be produced within a lead time of less than one day. Whether in automotive, industrial hardware or consumer electronics, Foundry Lab is challenging a field of activity that has long been associated with labor-intensive manual techniques and molds.

The current market: technology & applications

This year at formnext, I was asked one question – several times: **“Are there any new technologies that captured your attention (yet)?”** Although this is not truly an open question, I found myself providing a somewhat detailed answer.

To those who asked me this question on the first day of the event, before the afternoon, my answer was quite short: “not really. Most of these technologies are “*déjà vu*” to me”. Then, the more I looked, the more details drew my attention. It was no longer a matter of new products, but of **improved configurations**. For most machine manufacturers – be it 3D printers and post-processing machines, the question they ultimately tried to answer was: **How can I make this existing product better?**

We saw that with [TRUMPF](#) which unveiled an upgraded version of its [TruPrint 2000](#) industrial 3D printer; we saw that with Solukon which announced several key updates for its automated depowdering machines. Between the [upgraded Digital-Factory-Tool](#) and the collaboration with [Rivelin that focuses on automation](#), the most important update for this machine manufacturer was probably the automated depowdering machine SFM-AT350-E that integrates for the first time a **piezoelectric excitation**.

In **ceramic 3D printing**, there were a number of interesting upgrades as well: one in multi-material

3D printing and another one at the software level.

As you may know, [multi-material 3D printing](#) is one of the manufacturing techniques with the strongest unique selling proposition: using multiple materials at the same time to fabricate a part. So far, we had identified **6 different types of AM technologies** that can use this technique: FFF (with single nozzle or multi-nozzle), SLA, material jetting, binder jetting, DED, and powder-bed/SLS.

Today, Lithoz LCM technology can now be added to this list as the [new CeraFab Multi 2M30 3D printer](#) can process multiple materials at the same time.

On another note, software is one of the least highlighted topics in ceramic 3D printing, yet remains one of the most important areas for improvement. I liked that 3DCeram made it its key highlight at formnext and I got to see the interface of their [CPS 2.0 which stands for Ceramaker Printing Software](#). The 2 in 1 software solution can be installed on the designer’s computer or upgraded in 3DCeram’s existing C1000 FLEXMATIC 3D printers.

With the C-PRINT option – ideal for industrials who run a 3D printing farm (at least 6 3D printers), the software solution can be used for the preparation of 3D printed parts, and provides the possibility to duplicate the parts at the manufacturing level.

Furthermore, as speed and details don’t always work hand in hand, the C-PERFORM option can help those users who are looking to produce different parts to tailor the production requirements to a given application.

Another one that I can’t help to mention here is [Evolve Additive Solutions](#). Even though, they can’t produce in high volumes yet, one should recognize the good quality of their polymer 3D printed parts. They are expanding their portfolio with [new materials](#). Let’s hope that their recent distribution agreement with Alphacam will probably further shed light on the applications their STEP process can enable.

Last but not least, if you’re still doubting of the advancement of the market, keep in mind this [milestone moment from Conflux Technology and AMCM GmbH](#), that highlights

the ability to produce a 3D printed vital part for a metal 3D printer. This **Conflux Cartridge heat exchanger** is one of those applications we live for, as it propels AM from a dream technology to a solution that delivers on its promise.

I could talk again for hours, but I would stop here as I believe this overview of the event has demonstrated real advancements lie in the details that only advanced users can appreciate for their actual value.



In this picture, Martin Bullemer, Managing Director of AMCM GmbH (on the left), alongside Conflux Technology CEO, Michael Fuller proudly showcasing the heat exchanger crafted by Conflux. Image Credit: Conflux Technology & AMCM GmbH

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The International Catalogue of Additive Manufacturing Solutions comes to respond to this specific need: be the portal that will provide them with key insights into valuable AM & post-processing solutions found on the market.

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