

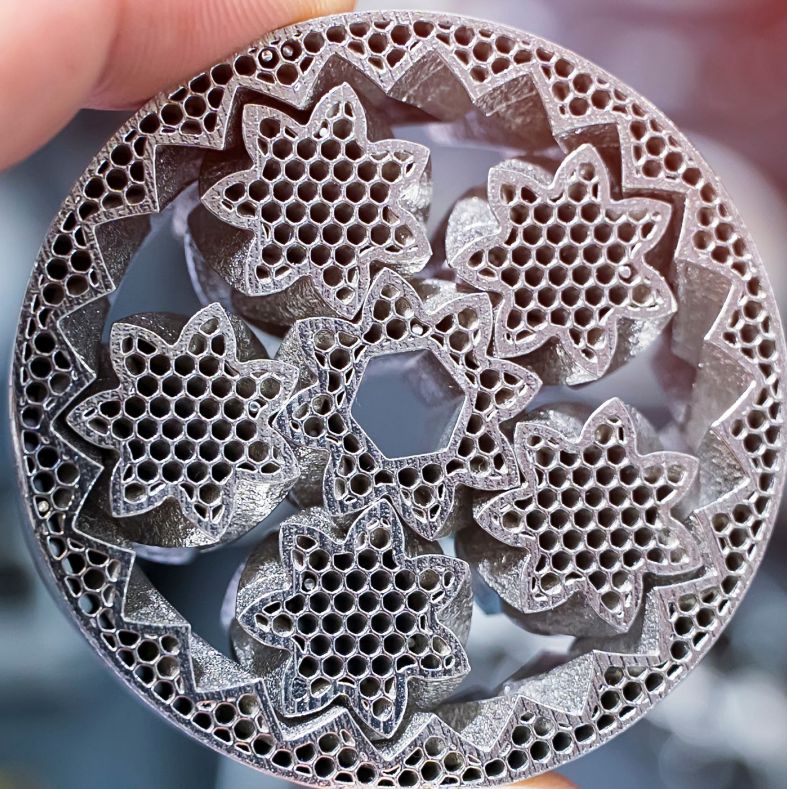
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3D ADEPT MAG



3D PRINTING

**ROUNDING OFF ANOTHER DEMANDING YEAR: WHAT THE AM
INDUSTRY SHOULD KEEP FROM 2022 TO MOVE FORWARD IN 2023**

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THE KILLJOYS, THE ELDERS AND THE KIDS OF THE "FAMILY" REUNION

Hello & Welcome

No risk, no reward.

For some people, the 'risk-reward' factor is a reminder to not pull the trigger on a critical decision without the assurance they stand to gain (reward) more than they lose (risk). It's a balancing act. For others, risk should lead to reward. They take a stand to do what they believe in, and then stick to the game plan. Both are well thought out plans. You just need to know the appropriate timing to leverage each of them.

As 2022 draws to a close, 3D Adept Media looks back over a rather demanding year: from mergers & acquisitions to bankruptcies, expected & unexpected milestones, 2022 led us through an emotional rollercoaster. When one reflects on key moments that shaped this year, one can say there were situations where weighing the 'risk-reward' factor was more pivotal than just taking the risk and expecting a reward afterwards – and vice-versa.

That being said, this emotional rollercoaster is the sign that this industry never sleeps; it's the indication that there is still so much to do, to leverage AM and its related technologies properly: whether it is for prototyping, series production or large-scale production purpose.

Furthermore, as we reflect on 2022, we can say that this emotional rollercoaster is not limited to the business part of this world, it also touches on the people who drive it. What actions should leaders take to be effective? What should talents do to find their ideal job in the AM industry? And how does one prepare for the changing investment landscape? These are just a couple of questions we aim to address in this November/December edition.

As you reflect with us in this last issue of the year, make sure to rethink a vision of yourself, of where you want to go – as a person or as a company – and who you want to be; make sure to take accountability for your failures and celebrate your wins; and most importantly, make sure to celebrate the people who are in this journey with you.

Season's greetings from the 3D
ADEPT Media Team.



Kety SINDZE
Managing Editor at 3D ADEPT Media
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Editorial

Significant Cost Savings on Additive Tool

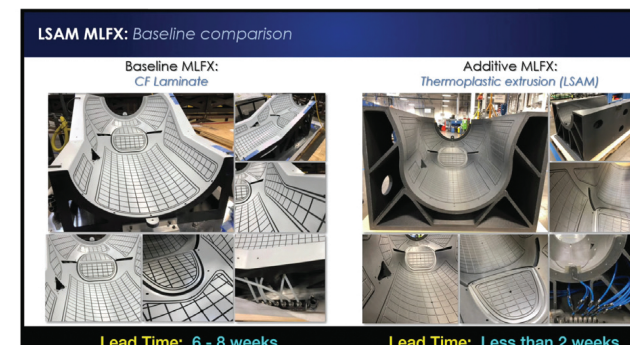
Partnership between Thermwood and General Atomics

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**

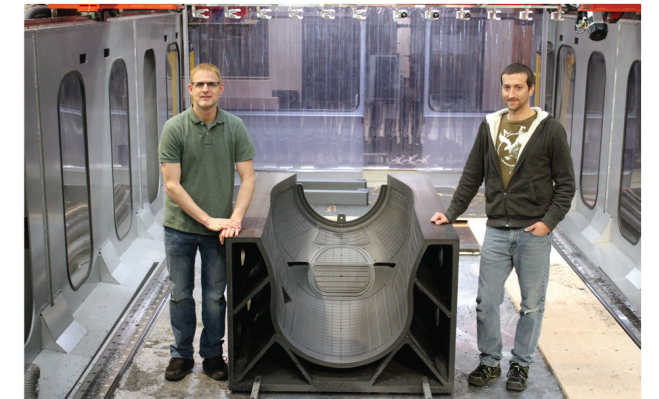
Total lead time for the part decreased from 6-8 weeks to less than 2 weeks by utilizing the powerful LSAM system.



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

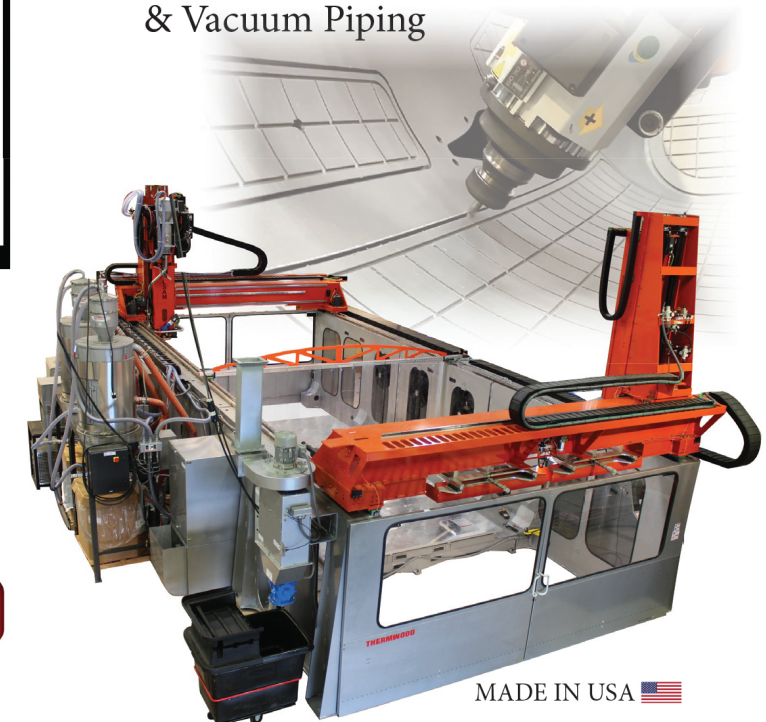
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MADE IN USA

Rounding off another demanding year: what the AM industry should keep from 2022 to move forward in 2023

From mergers & acquisitions to bankruptcies, expected & unexpected milestones, 2022 led us through an emotional rollercoaster.

As 2022 draws to a close, 3D ADEPT Media is looking back over a year difficult to characterize. To paraphrase a well-known book, we rejoiced with those who rejoiced, we felt empathy with those who were in some real uncomfortable situations, and most importantly, we analyzed, learned lessons and takeaways that hopefully, the industry will consider moving forward. Here is a wrap-up of what we will keep from business, the manufacturing value chain as well as vertical industries & standards.

1. “Fortune favors the brave”, the saying goes, but is it always enough?

With over 53 acquisitions (including SPACs) recorded throughout the year – the biggest number ever reported since AM has been recognized as a true industry, 2021 was legitimately named a year of consolidation. With over 21 acquisitions reported this year, it’s fair to say this consolidation has continued in full force in 2022. However, unlike last year where the need for more financial resources was the main driver of these mergers & acquisitions, acquisitions reported this year highlighted a more thoughtful strategy from the buyers.

Buyer	Acquired	
Stratasys	Covestro	
Nikon	SLM Solutions	
Lithoz	CerAMing	First company
Materialise	Identify3D	
Carbon	ParaMatters	First company
Nano Dimension	Admatec, Formatec & Global Inkjet Systems Ltd.	
Bico	Allegro 3D	
Hyperganic	DirectFEM	First company
3D Systems	Titan Robotics, Kumovis, dp polar	
CORE Industrial Partners	RE3DTECH	
Markforged	Digital Metal	
Quickparts	Xcentric Mold & Engineering	
Addman Group	Harbec, Castheon	
HP	Choose Packaging	
Prodways	Auditech Innovations	
Authentise	Elements Technology Platform	First company

Table shows a short overview of M&A reported this year.

For instance, while the deal isn’t actually expected to close until early next year, speculation is well underway regarding the acquisition of SLM Solutions by NIKON. The multinational technology corporation is acknowledged for its metrology services in the additive manufacturing and for the quiet development of a 3D printer that has



yet to be commercialized. However, with the acquisition of Morf3D, metal AM manufacturer of aerospace parts and SLM Solutions, Nikon’s strategy is very similar to that of GE that acquired several big and specialized names to position itself as an undeniable expert on this maturing industry. In this case, if completed, this acquisition will bring an unparalleled range of possibilities across the entire value chain of the AM industry, but also across a key vertical that is driving the growth of this technology: aerospace.

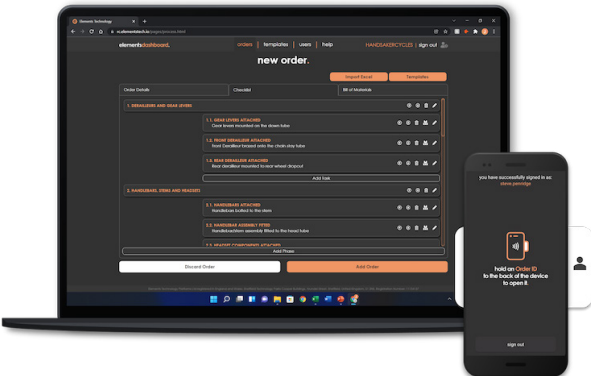


Another interesting example might be the one of HP and Choose Packaging, a Scotland-based startup that fabricates paper containers that could be a wise alternative to packaging for drinks, laundry detergent, make-up or food. At first glance, the first thought might be: what does a company that makes paper containers, have to do with 3D printing? Well, at the heart of the manufacturing process, one finds HP’s Multi Jet Fusion (MJF) technology and a plant-based barrier material that can make molded fiber containers waterproof. The combination of these solutions results in packages that are recyclable, even compostable. Although this purchase builds on top of HP’s existing molded fiber tooling service, can we not see the fact that 3D printed tools are used to quickly fabricate molds as a boost for a vertically integrated sustainable business enabled by additive manufacturing; the one of eco-friendly containers for the consumer goods industry?

The last example I would like to mention here is the one of Authentise that goes beyond AM with its acquisition of Elements Technology Platform. As of today, the software company is now gaining some market shares outside of the AM as well, by providing a unique self-serve tool for all types of manufacturing operations, to quickly create, capture and access repeatable shop floor processes. It’s the rule of not putting all your eggs in one basket. It’s that simple.

While these mergers and acquisitions have brought a breath of fresh air to the acquired companies, others have been suffocating due to the lack of air.

It’s crucial – in my opinion – to look at the companies that have filed for bankruptcy or shut down their activities. The reasons behind each disposal might be a warning that others should take into account to strive. We reported that **8 companies shut down or filed for bankruptcy this year**: Digital Alloys (3D printer manufacturer), Local Motors (automotive manufacturer of 3D printed EV), Satori (resin 3D printer manufacturer), Fast Radius (AM Service bureau), Xerox, RIZE (3D printer manufacturer), and Clara.io (online 3D modelling company).



Most of the time, financial resources are pointed out as the number one reason behind a disposal, but I truly believe another crucial aspect to thrive – and therefore generate profits – is often overlooked: a **thoughtful marketing strategy**. Please, bear with me as I do not find any kind of joy in writing these lines. I do understand that one of the most heart-breaking decisions of a founder can take is to close their business, but **tech founders need to realize that sometimes, the company that sells the most is not often the one that has the best product, but just the best marketing strategy**.

That being said, another reason that may explain the disposal of activities for some of these companies is the **current economic environment**. That was anyway the case for Fast Radius. The Chicago-based advanced digital manufacturing company states in a press communication it filed for bankruptcy due to “recent turbulence in the capital markets, which severely hampered [its] ability to set up the required capital structure.” The announcement was made last month, nine months after the company announced that it would list on the NASDAQ stock exchange, at which point a wave of layoffs started in the summer. The business



has declared that it will remain operational and serve customers in the due course despite having filed voluntary petitions for relief under Chapter 11 of the United States Bankruptcy Code in the District of Delaware.

Disclaimer: This article was written before the acquisition of **Fast Radius by SyBridge Technologies in \$15.9M deal**.

Photocopier pioneer **Xerox** which has sought to revitalize its business by venturing into AM with an ambitious acquisition that led to the deployment of the Elem X metal 3D printer, has completely eliminated its AM business. The company is now solely focused on supporting current installations.

To end on a lighter note of this “Business” part, I will say that fortune may not have favored those who are shutting down their activities, but it might favor the next wave of new comers entering the market. This is good news as most of them are spin-offs from research institutes or well-established companies with a solid expertise in another manufacturing field. Being backed by a bigger company is always good music for any player trying to find its move on the dancing AM floor. Some of these new entrants include EPSON, Jeol, Grob, Krauss Maffei and AviaTOOLS.

2. The manufacturing value chain: materials and software called the tune

Manufacturing has historically been the industry to carry the most weight when it comes to leading the overall economy out of downturns. This has never been truer than during this post-Covid era. Indeed, the spotlight placed on additive manufacturing (AM) during the pandemic as a tool to overcome supply chain hardships led to an increasing transition to AM for its flexibility and on-demand production capabilities, and toward the use of AM as a source of product development. This also led to key developments across specific fields of the manufacturing value chain and specific vertical industries that have also been observed in 2022.

Materials, first area of growth

In this vein, the first area where we've observed interesting developments for the industry is **materials**. 2022 was **another year where copper shone**, be it in applications or new forms of materials available – That's something **Olaf DIEGEL** also highlighted in his retrospective for 2022 (Page 15). Companies that added the third-most-consumed industrial metal to their portfolio include **Infinite Flex**, producer of smart materials, that has developed a pure copper powder for industrial SLM 3D printing; Kupros, a US-based company that develops an **all-metal conductive copper filament**; or 3D Systems that adds **copper-nickel alloy for use with Metal 3D printing**.

Applications that have demonstrated the potential of this material when combined with AM, include for instance **induction hardeners (inductors) for gear wheels** in the automotive sector and for chain wheels on chainsaws (developed by **Schunk** and **AIM3D**); a **3D printed copper cooling plate** developed by JX Nippon Mining & Metals (**JXNMM**) and **Alloyed**, or this **radio frequency quadrupole (RFQ)**, one of the most complex parts of any accelerator complex – developed by TRUMPF for CERN-coordinated I.FAST project.

On another note, I have been pleasantly surprised to see **the development of materials that increasingly takes into account the environmental challenges and the need to fight climate change**.

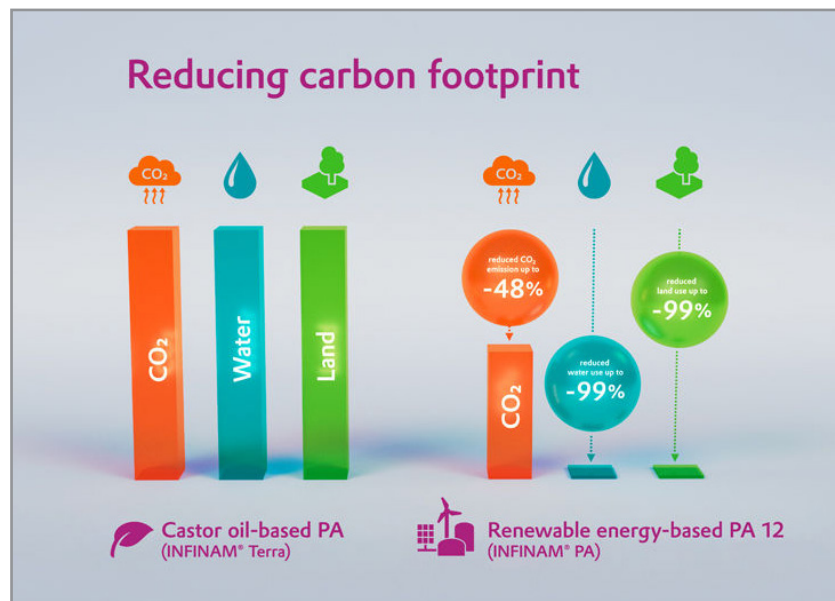
In the metals side, one company that I would like to continue watching is **IperionX** (pp 38-40), a US material producer that is fostering a new age of low-cost Titanium for Additive Manufacturing. The material producer is one of



Image via AIM3D GmbH – hardeners (inductors) for gear wheels 3D printed with copper.

the rare manufacturers that has demonstrated how its proprietary titanium metal processing technology does not involve the numerous carbon intensive melting processes seen in the Kroll process; and how they can produce titanium from either 100% scrap titanium or from conventional titanium minerals.

I wouldn't stop looking at how companies take action in the polymer side, because as I always say, the challenge is higher for them due to the nature of their activity. Kudos to **Evonik** that is finally backing words with actions in the AM industry, with



the introduction of a **new grade of PA12 powders with significantly reduced CO₂ emissions** and which plans to go **one step further next year**. **WASP** is also one to mention as it develops a **recycled fishing net material**. This does not include the number of one-time applications that have been achieved with recycled materials.

Moving forward, my hope for next year is that more and more companies realize that **sustainability should not be seen as a selling point, but truly as a core issue**, given the fact that manufacturing has long been one of the most significant contributors to environmental pollution.

Software, finally taking off – and real solutions to reduce carbon footprint

It's been a couple of years that AM users have been asking for more robust software solutions across

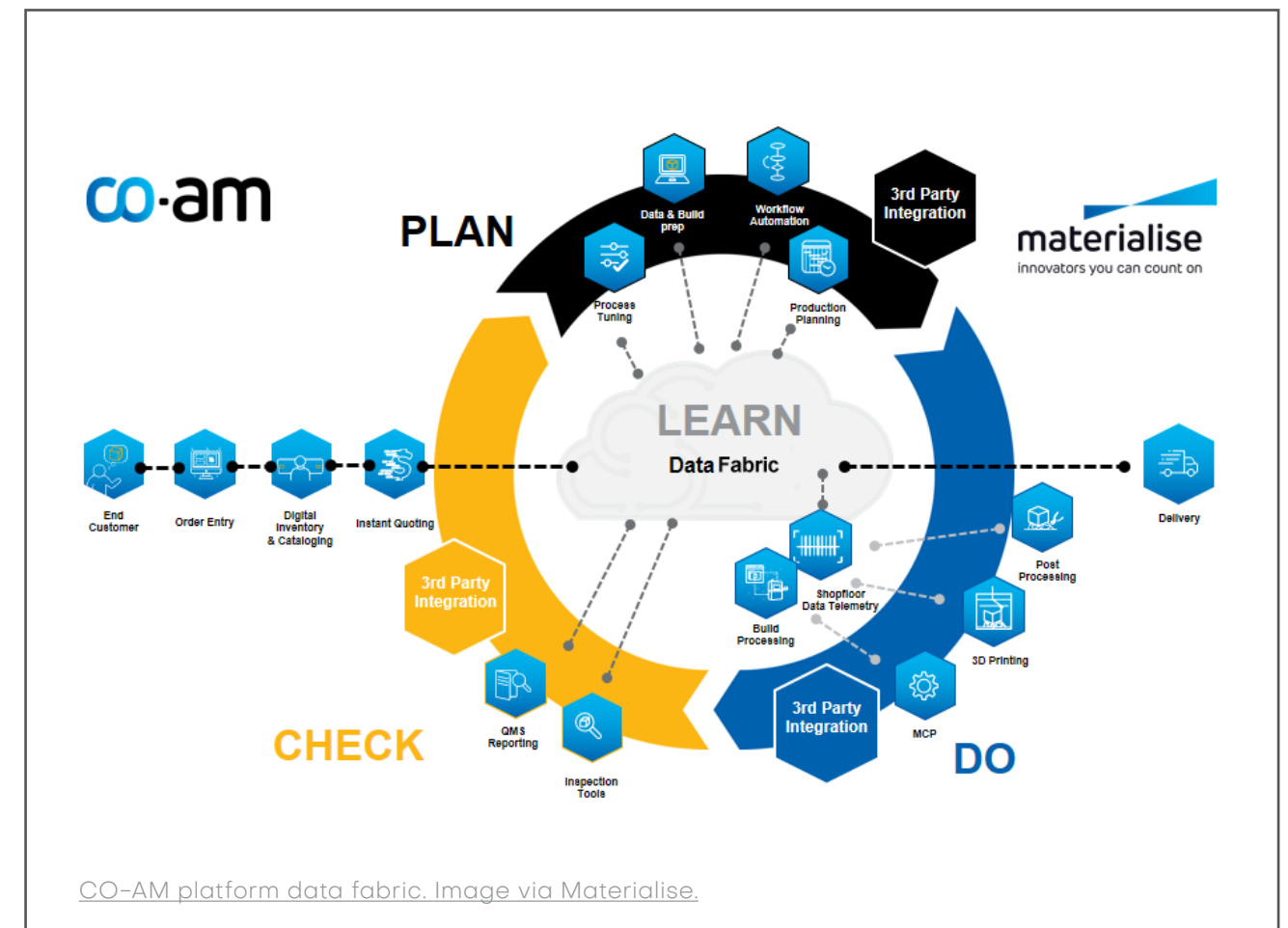
the manufacturing workflow; software solutions that can streamline workflows and integrate with existing enterprise solutions, software that can make it easier for engineers to design a part directly for additive manufacturing rather than having to design that part twice. I am not saying that what was available so far was not interesting, I am saying that they have been improved and others have been developed with a couple of magic ingredients.

AI is one of those ingredients. However, be aware that most companies use this word to make their product looks fancy, while a couple of them are actually taking advantage of it.

One company that really knows what they are doing here is **Hyperganic** that develops an AI-powered Algorithmic Engineering software. The latter uses

customisable building blocks and frameworks to create individual applications and automate repetitive tasks, which may lead to applications for mass customisation, or generating complex internal cooling channels, lattice structures, and thin-walled geometries.

Speaking of SaaS solutions that can streamline workflows and integrate with existing enterprise solutions, I like the AI driven factory operating system developed by **Oqton**. The team brings to the table some solid expertise and their platform really encompasses all the capabilities one may look in product development. I was given a tour of the cloud-based manufacturing operating system, so I have been able to understand how it automates the end-to-end workflow across & beyond the production floor.



CO-AM platform data fabric. Image via Materialise.



Another one that I can't help but mention is **Materialise** CO-AM platform – built on LINK3D's acquisition. With more and more partners that join the open access platform, Materialise truly provides seamless access to a full range of software tools for planning, optimising and monitoring every step of their 3D printing process.

At the design and simulation level exclusively, I didn't have the opportunity to approach them yet, but I have heard good things about **1000 Kelvin GmbH**, a start-up that delivers an AI-powered all-in-one solution. We will probably keep them in our radar next year.

Digital Twin (DT) is another one of those ingredients. A few companies may stand out from the crowd here, but my biggest takeaway for this year is the fact that [post-processing solutions manufacturers](#) (e.g. Solukon) have started improving their software solutions with this technology. Another key takeaway that will probably constitute a key trend for next year as well, is **CFD powered by DT**. With **Flow Science** for instance, we saw that computational fluid dynamics (CFD) solution powered by DT helps to address the need to test several designs quickly and efficiently before choosing one to build on an additive manufacturing system, or even the need to test the integration of the full design by connecting the simulation software to hardware. Speed and accuracy are also two other advantages of this type of software as they enable high-order numerics, scale-resolving simulations and hardware acceleration.

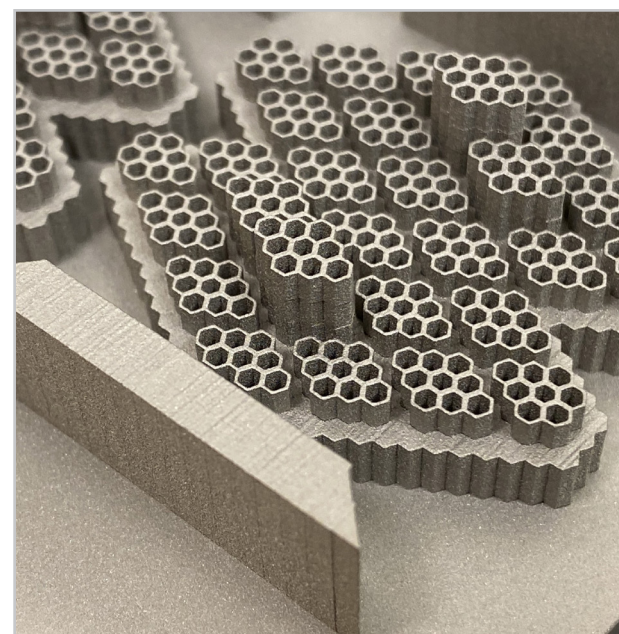
A major milestone in terms of sustainability has been achieved by software companies

that have developed **“Product Carbon Footprint Calculator” tools** for 3D printed parts. Two companies that are ahead of the curve here, are [Siemens Digital Industries Software](#) & [CASTOR](#).

That being said, software is a big world that remains very platform-dependent – whether we talk about manufacturing processes or post-processing processes.

Manufacturing processes: a need for dedicated processes

Speed has always been the number one technological challenge to address in the development of industrial 3D printers – especially for industries driven by mass serial production – followed by materials. This year, speed has remained one of the top challenges to address in the development of 3D printers but sometimes, the need to address it was driven by a bigger vision.



On the metal AM side, I have had good feelings for **Seurat**, a US-start-up that started with the goal of improving speed of LPBF machines and over the road, became driven by the need to solve the energy problem. To migrate away from casting processes, which produce emissions equivalent to one barrel of oil per ton of metal, the strength of Seurat's Area Printing technology in a high-powered laser. The process would split a single, powerful laser beam into up to 2.3 million separate beams and each of the 30kW laser's pixels can be programmed to either block or let light through. Each of these pixels thereafter helps to define a laser spot by welding metal powder.

Furthermore, Seurat's example highlights one key aspect that has been common to 3D printers' developments observed this year: **laser** – While lasers remain one of the most expensive part in a 3D printer – and the most effective energy source in additive manufacturing, the challenge for OEMs **has been, is likely to be, and is the exploration of new forms of laser for their machines.**

As part of a [collaboration with Blue laser developer NUBURU](#) for instance, machine manufacturer **ESSENTIUM** will leverage NUBURU's blue laser which would enable printing with 10x the build speed and the ability to print with a very high metal density without any post processes.

On another note, just as more materials (still) need to be qualified for use on AM machines, one should acknowledge **the importance of new 3D printing processes** that stand out from the crowd, and that

are developed to process exotic, and sometimes more challenging materials. One of the first examples that come to my mind right now is **“Goliath”** a large-format 3D printer developed by **Teu2tec GmbH** and that enables printing of objects from any type of granules using the [paste extrusion modelling process \(PEM\)](#). Other examples that are worth mentioning, include **silicone 3D printers** – a type of printer that I thought, was no longer of interest to the market – but [Lynxter and Spectoplast proved otherwise](#). And before I forget, FDM 3D printing is still on fire, since companies like DUPLEX debuted on the market with [multi-directional printing](#) and RAISE3D introduced a toolkit which could be the much sought-after solution to that speed problem.

Post-processing: Quality Assurance and CT Scanning are and may be the next area of focus

We have clearly passed the stage where we had to inform, educate about the fact that post-processing is the most complicated task to perform because it was not automated, resulting therefore in a price increase of the final part; and long lead times.

Whether we are talking about [powder removal, support removal, machining or any other post-processing solution](#), we are at a stage where **users want more options – fancy, useful, more sophisticated – and they want to know how they can add value to their process.** In any case, this has clearly been one of the trends observed in solutions introduced to the market this year – all solutions combined.

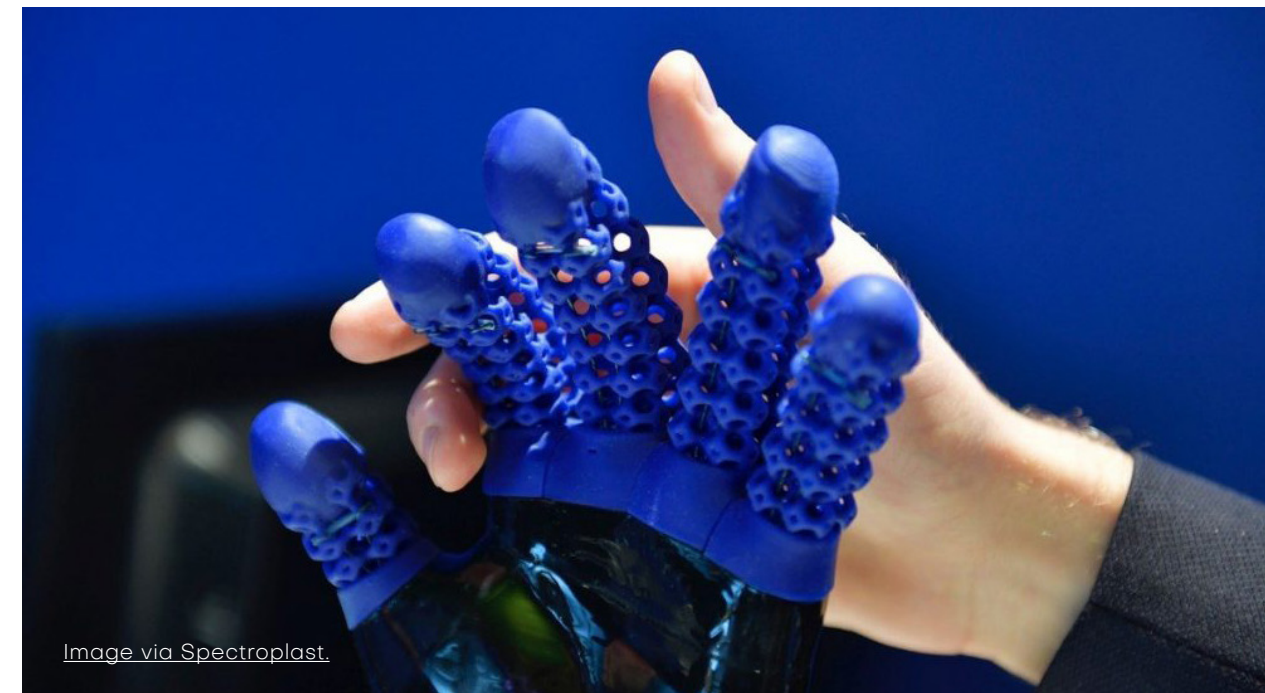


Image via Spectoplast.

Amid the wide range of solutions developed and improved for the post-processing stage, I have to say that Quality Assurance (including CT Scanning) solutions stand out from the crowd and will probably continue to do so in 2023. The companies I would certainly be tracking here, include [ZEISS](#), [Sigma Additive Solutions](#) and [Lumafield](#).

On another note, the recent Formnext revealed that – whether they are used with post-processing solutions or manufacturing processes, the upcoming months or years will probably see a lot more of **AM-dedicated developments compatible with robotic systems**.

3. Standards and vertical industries adopting AM technologies

It is no secret that the growth of industries, technologies or processes emerge and grow along with the need for standardization – which helps ensure safety, reliability, and repeatability. Whether driven by regulators, standards bodies or the industry itself, this year saw an **“emergence of an assurance culture in AM”** that will definitely help build confidence across the value chain. This has been marked by the growing number of standards-developing organizations and classification bodies as well as the development of new standards for specific industries.

A few examples have been seen with the **American Petroleum Institute (API)** – an organization that represents all segments of America’s natural gas and oil industry – releasing [two standards this year](#), namely the **API Standard 20S**, *Additively Manufactured Metallic Components for Use in the Petroleum and Natural Gas Industries*, and the **API Standard 20T**, *Additively Manufactured Polymer-Based Components for Use in the Petroleum and Natural Gas Industries*, the new standards reflect the



Image via ZEISS

industry’s incorporation of new technologies and innovations to improve operations.

Lastly, as I said before, whether we talk about technology advances at the machines level, at the software, materials or depowdering levels, enabling applications through all of these processes is the example that demonstrates they perfectly work together. It’s a virtuous circle. And amid the vertical industries adopting AM technologies, the **aerospace & space industries** remain the key verticals that have driven this market with [new complex and fascinating applications](#) and with the emergence of new companies that penetrate the market with AM as a key enabler of their operations. However, two other industries that leverage AM on their own way continue to expand: [construction 3D printing](#) and [3D bioprinting](#). While a lot of professionals remain cautious, those verticals saw a growing number of applications and developments – e.g. this [3D printed human lung scaffold](#) in 3D bioprinting and [new materials](#) in construction 3D printing – , thus opening up a myriad of possibilities people are

probably not ready to explore.

So...

Coming from a [year of recovery](#), I have to say that 2022 did not disappoint me. There was a lot to see and discover, a lot to learn and obviously a lot I didn’t mention, but that’s fine because I have come to realize that until AM gets more mature, this industry will always make you feel this way: sometimes bored, which is good as it shows there is a certain steadiness, but most of the time, hungry for more.

Opinion

Thoughts on a changing investment landscape in the AM industry.

A lot of money is being poured into AM right now, a lot more than usual and with a lot of precautions from investors, and I want to understand why and where it can lead us. The change in this investment landscape occurred two years ago, with the pandemic. It brought increased volatility in (almost all) the markets, intensified headwinds for globalization, and industry consolidation which led to a number of IPOs and several M&As. In an attempt to understand the world of stock markets that most additive manufacturing companies were entering, I questioned [this trend](#) – with the standpoint of a potential company that could be interested in going public. At the recent Formnext, I discussed with a lot of investors, and found myself in a position where I could see the world just like them.

Which world? – You may ask

Well, the one where **low market entry barriers, interest rates and profitability** may be the current main drivers behind the money they invest.

To be honest, low market entry barriers are not that new when we talk about drivers. They are like those “secrets” everyone knows, but nobody wants to say them aloud. With significant patents that have expired, one continues to witness a growing number of companies entering the market, which is weird because of the four categories – core, applications, materials and software –, the market share by software topped the growth rate.

Low interest rates are likewise buoying up the market by making capital more readily accessible – but only for those who have the means to pay. That’s the reason why big players in aerospace, medical technology or turbomachinery who opt for AM as their production technology will always find major investors ready and waiting close by. The irony is, these are not the ones that urgently need money. Those who need cash are technology providers and developers – those who need to implement a go-to-market strategy for the products that the former would potentially use and for them, the interest rates tend to increase due to a number of factors among which inflation.

As interest rates increasingly rise, investors decide to focus on profitability. That’s a word I heard a lot. After a couple of [research](#), I found out that, profitability – measured by free cash flow (FCF) margins – not revenue growth, had the higher correlation to positive stock returns in the software sector. As mentioned in the “Interview of the Month” ([Page 19](#)), this may result to a number of lay-offs witnessed throughout this year. I don’t think this will fade during the upcoming year...On the contrary. So, be prepared.

Could investors change their strategy? Maybe. Uncertain times



are not behind us. More due diligence in companies is definitely predictable, less dollars could be given, or changes in existing portfolios may occur.

Are there any specific markets that might raise interest? My guess is that, despite being affected by COVID-19 again, Asia can derive solid growth, therefore raise investors’ interest. Next in the line might be the US. You would call me a fool but I am pretty sure this economic downturn would play to the strengths of more than one company. And those companies should be best in their league; they should follow the edicts of “lean manufacturing” to increase quality and productivity and bet on local supply chains to innovate more quickly and better manage risk.

So, how could you position yourself as a start-up or a company looking for money? Yes, I know, I said I wanted to see the world just like investors but bear with me, I can’t help but support founders.

So, founders:

- Build and prove your business model is **“sustainable”** and I mean, in every sense of the word. Measurable data points and targeted milestones should be your daily mantra.

I strongly believe that this is one important weapon to have a win in.

- No entrepreneur would like to be told that, but provide investors with more protections...Maybe preferred shares? Anything that can help to reduce the risks.

- Lastly, talk. Never stop looking for the right advice from the right person.

AM Shapers



Legend: complex geometrical shape created using industrial 3D printing – Image via thyssenkrupp

Olaf Diegel and John Barnes on the little wins of the 2022 AM market, and questions AM users are asking themselves

“Any destination in the AM maturity model is the perfect place where to be.”

Taking one's first steps into AM or evolving in this industry calls for a range of methods or processes that all converge towards the same goals: acquiring new skills, implementing the right steps for a go-to-market strategy, staying informed on the current state of the market or learning new ways to grow one's business model – all of which can be achieved through industry publications/trade press, academic institutions and consultancy firms. As we look back over 2022, it makes sense to take into account the point of view of experts that are shaping the AM market from an education and/or a consultancy standpoint – and understand through them the 2022 AM market and what would be areas of interest in 2023. Once combined with the right experience and expertise, the unique understanding of experts from academic institutions and consultancy firms enables them to get to the bottom of a problem that often has its roots in the industry itself; or to share takeaways based on their close connections with the AM end user – all of which is useful to help both technology providers and adopters to move forward. In this specific case, the experts we decided to rely on are **Olaf Diegel** and **John Barnes**.

Both gentlemen have many super powers.

Diegel is probably one of those coolest professors I wish I had when I was a student. He teaches AM in its entirety and is always looking for a way to apply and explore this technology. His most famous application remains a range of 3D printed guitars with bold designs.

On the other hand, Barnes' notable experience prior to founding [TBGA](#) in 2017 is his experience as a senior manager at Lockheed Martin's Skunk Works where he helped bring metal 3D printed parts to a number of experimental military aircrafts and where he led several other programs to foster the adoption of AM technologies. Today, with a team of ADDvisors®, TBGA's goal is to get AM qualified and in service across a range of industries.

AM learning and research in 2022

AM learning is often said to become more complex, research is happening at a



Professor Olaf Diegel from The University of Auckland's Creative Design and Additive Manufacturing Lab.

break-neck pace and ever-advancing technologies are driving new teaching models. Diegel told us they have a dedicated full semester post-grad course focused on design for AM, and they offer a lot of industry 3- or

4-day hands-on DfAM courses (through ASTM and Wohlers Associates) to company engineers.

Furthermore, compared to previous years, “it seems the end of all the pandemic restrictions has created a thirst for hands-on learning”, the professor of AM explained. “I think that a lot of students have been fairly deprived of practical and applied work during the pandemic so, now that it is possible to get back into the labs and workshops, I am finding a lot of students really want to get their hands dirty with solving practical engineering problems. And, in my opinion, because design for additive manufacturing (DfAM) is not a theoretical area of knowledge, but rather one that must be practically applied to add true value to products, students are just loving it. And the same goes for companies. As they are starting to realize just how critical good design for AM is to them being able to economically implement AM, they are crying out for knowledge to do it the right way”, he said.

For Barnes, training has always been one of the major roadblocks to AM adoption. After over 2 decades in the AM industry, and five years of TBGA, he still emphasizes on it:

“I think awareness and appreciation of what AM can do is still relatively young. Whether we call it training, or skills development, we are seeing in almost all ‘mature’ countries that the qualified workforce is the missing item in manufacturing industries. If you take a step back, any time when you come with something disruptive, by nature, it's hard for people to deal with it. Plus, given the diversity of the technology available, there are

many solutions to choose from, and most people are stuck because they just don't know what AM can do. They are still not designing products that can really take advantage of AM, because it requires risks, it requires a step change process”.

On another note, this integration of knowledge and ways of thinking to tackle complex challenges has been achieved somehow thanks

to face-to-face encounters. Diegel drew our attention here on a consequence of the pandemic that deeply affected the educational system and that we didn't really pay attention to last year. To him the big difference 2022 brought compared to the previous year, was getting to meet face to face with people again. “That includes students, colleagues, companies, and friends. And also, a huge difference was for students and companies to not have direct access to the machines when the lab was closed. It always seems harder to solve engineering problems, or design great products, over Zoom or Teams. And we've had over 2 years of that, so it's good to get back to the machines and build real parts, physically test ideas, and do all that fun stuff. [In general], around the world, education has, of course, been heavily impacted by the inability of people to be able to travel, which means there has been a huge drop in international students. But hopefully, that will now start to correct itself”,



John Barnes

he continues.

Barnes remains practical and focuses on the need to look at **one's maturity AM model to analyse AM processes, applications and somehow one's progression**. From our understanding, the proprietary model would aim to balance product requirements, company's awareness, data and skills needed to use AM through a five-level matrix.

“It's a way to adjusting to the chaos”, TBGA's founder points out. “At the end of the day, that part that needs to be created has requirements and skills, knowledge and data are required to estimate these requirements. The maturity model basically just says: ‘you need to do your own race; you need to figure out what's best for you and your products’. And this model is different if you are making prototypes, tooling, or end-production parts. While we recommend to start creating design prototypes and text fixtures, we also usually tell people that any destination in their maturity model is the

perfect place to be.”

On a research standpoint, research activities concerning printing and post-process advanced technologies, innovative materials and design/simulation tools are gaining momentum. In this list, topics that have been raising organizations’ interest this year, often include the improvement of the design and manufacturing workflow through advanced methods and software tools, environmental sustainability opportunities of AM, advanced post-processing technologies and/or AM infrastructure for data management and cloud-based additive manufacturing. For Diegel, one area that absolutely requires focus right now is **machinery**:

“At the moment, most AM systems are ‘dumb’. By that, I mean that AM can actually be quite difficult to get good parts out of. All sorts of things can go wrong during the print process. The machine may not spread enough material for a layer, the layer may not fuse properly to the layer below, the part may distort while it is printing and crash the build. It doesn’t matter what technology you use; sh*t happens... But, at the moment, the AM systems do not yet have the intelligence to pick up a potential fault while it is happening, and then correct it during the print process. Many systems even have high-tech vision systems or melt-pool monitoring systems, but they don’t yet use them to take intelligent corrective action. A short feed of powder, for example, is a not uncommon occurrence in metal powder bed fusion. And, from a computer vision point of view, it is relatively easy to detect. So why do none of the systems do that and, when they pick up a short-feed, they re-spread another layer of powder to correct the error? To me, it is making the machines a bit smarter and idiot-proof that still needs a fair bit of work to greatly increase the adoption of AM for larger-scale production. And making all the systems way, way, way faster! [On another note], **speed is of the essence**. At

the moment, one of the factors that makes AM so expensive for production is that it is incredibly slow compared to many other conventional manufacturing technologies. So, to vastly increase options, we need to see the AM systems greatly increase in speed. We are starting to see that, with companies, for example, adding more lasers to their systems, but I think we may need a bit more of a quantum boost in speed. So, whoever cracks that first will probably gain good competitive advantage.”

Barnes on the other hand believes that there is already certain movement that is happening on the machines side, at the productivity level. “The area professionals want to look at now is the digital space. There should be a lot of focus on cybersecurity and what it actually means; the digital workflow can be improved. A lot of companies are jumping into that space now and provide solutions that look different from what we’ve seen in the past. Some software solutions now enable to rectify and smooth that workflow. And this will get bigger moving forward”, he outlines.

Please keep in mind that these warnings are not meant to water down any single advances that have occurred on the AM market this year. As a matter of fact, Diegel recognizes that **material producers** went one step further in their development:

“Copper now seems to be a hot material in the metals area. We are also starting to see some slightly more eco-friendly polymers for powder bed fusion (SLS) like nylon 11 that is made from castor beans rather than petrochemicals. Another trend I noticed at the recent Formnext AM show, in Frankfurt, was the huge proliferation of larger-scale robot arm-based 3D printers, both for printing larger-scale polymer or metal parts”.

And all of this does not take into account the little wins at the user level.

Adoption across vertical industries – and users in general: where are we?

“Finally, after many years of research into materials, machines, technologies, etc. (which is definitely great and important), design for AM is starting to be appreciated as an area of core importance if we want to see AM much

more widely adopted, so we are starting to see that as a growing research area”, Diegel continues. According to our expert, in addition to AM users, many professionals including machine manufacturers and

machine salespeople have been overlooking this area of DfAM – while they should be the one alerting users on the importance of this concept. The road is definitely still long ahead as many companies still design for machining or

injection molding; and thereafter have a mild heart attack when they are told what it would cost to print.

“If they learned to redesign it the right way, they could potentially reduce the part cost from anywhere between 25% to well over 90%. So I see a large part of our role being in educating on how to design for AM the right way, and how to add enough value to their parts, through good design, to overcome the high costs of additive manufacturing”, the professor adds.

Another thing that was also prevalent within TBGA’s exchanges with companies this year was the **willingness for the latter to do it cheaper, better and faster with AM** – unlike previous years where the interest was just in using AM. At that time, the only question was then: “what are we going to make”? I may be wrong but to me, asking if it can be done cheaper, better and faster might imply that users are no longer at the pre-production level. They have started exploring things that influence production and are looking to challenge the status quo of the technology. It’s about finding a better way to improve the

performance of one’s product.

“The other thing we’ve noticed a lot since the pandemic is companies’ willingness to use AM to reduce risks. A lot of companies are manufacturing in distant areas and are now looking to a plan to mitigate that risk. I always tell people that if you’re a CEO of a company and you cannot address this concern, you’re going to get fired. It doesn’t mean you have to answer the question immediately, you should at least have this conversation”, Barnes continues.

While he believes these two questions will continue to fuel conversations next year, he also hopes that in terms of adoption of AM per say, the use of AM will see a lot of traction in the high-end automotive industry (EVs), and in the repair industry. This does not take into account the fact that problems around the supply chain, inflation and other energy issues will continue to prompt people to explore new solutions – and for that to happen, “we need more brains”, [irrespective of their gender and skin colour], Barnes concludes.


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UNDERSTANDING THE WAVE OF LAY-OFFS IN THE AM INDUSTRY AND WHERE THE CURRENT DEMAND FOR TALENT LIES



With the development of smart devices, 3D printing, robotics, AI, 5G, quantum computing and the Internet of Things, day-to-day work in manufacturing is continually evolving. That means the demand for physical labor is decreasing, while the need for science, technology, engineering and mathematics (STEM) professionals is seeing an uptick. However, with a 2022 that saw an increasing number of lay-offs across AM companies – especially in the US, we were keen to discover where this market is headed. In case you didn't notice that, recruitment in this industry is as passionate and driven as AM, hence the increasing number of specialized firms that pop up on the market.

For this topic, we caught up with **Kensington Additive**, a **division of Kensington Consulting Ltd**, established in 2014 that exclusively focused on the Additive Manufacturing Market.

Just like manufacturing companies, that have a long-standing expertise in a conventional manufacturing process, decide to enter the AM market to diversify their offering, Kensington debuted on the AM market about eight years ago, after successfully placing a "Global Head of AM" position for one of their long standing clients. This was the turning point that made them realize the collaborative approach and demand for talent in the industry. Since then, they are on a mission to hiring the "world's best talent". To do so, the company aims to act as "a bridge in supporting EMEA/APAC businesses grow in North America and also supporting US businesses expand across the Pond".

With the main areas of focus being Europe and the United States, "we recruit disciplines covering C-Suite, Sales & Marketing, Software, Design for AM, Field Service, Engineering, R&D, Materials including metallurgy, and production operations. An



Phillip Hodson, Co-Founder and CEO of Kensington Additive.

interesting observation is that we find a lot of our clients are now also looking for candidates outside of the AM industry as the market evolves where skills are more mature such as Quality, RA and Supply Chain", **Phillip Hodson**, Co-Founder and CEO of Kensington Additive told 3D ADEPT Media.

A 2022 labour market marked by a high number of layoffs

According to layoffs.fyi, over **964** tech companies have already laid off over **149876** employees in 2022. In the AM industry, the likes of **Desktop Metal, Fast Radius, Nexa3D, Xerox** and **Carbon** have laid off a great number of people.

For those that are publicly listed companies, needless to say that with those lay-offs, their stock responded to these changes and so does the reaction of new and potential investors they are targeting. But this is certainly a minor information for you when we look at the number of people who are currently "open to work" – as LinkedIn's statuses would notify. Guess what, if you are looking to understand the "why" of this wave of lay-offs, maybe this information is not meaningless after all. For Phillip Hodson, there is a number of different PESTEL factors (Political, Economic, Sociological, Technological, Legal and Environmental):

"Even though the market for people continues to grow, obviously company lay-offs in our industry can be caused by many **different PESTEL factors**. We have seen some companies overestimate demand for their products, some companies ran out of funding and others have struggled with the challenges of growth too soon too quickly. This has affected everyone from OEMs to resellers as we move into 2023, it is clear that economic factors will have some impact on certain companies' growth plans.

The AM industry is a market driven by a lot of start-up companies promising the next breakthrough technology or material, naturally some will work, and some won't."

Kensington may be right but might forget something. In addition to this economic uncertainty, other arguments may explain this storm in the AM labour market: **pressure from investors, maturity of the company/industry, or an ingrained stereotype that lay-offs increase profitability.**

Indeed, lay-off threats

become more real as investors push for job cuts to lessen expenses. Could we envision the idea that investors become more concerned that companies will be less profitable? On another note, for big corporations, and in an uncertain economy, there is this idea that lay-offs often equate with profitability. As for the company's maturity, it's understandable for a young tech company not to have "a lot" of customers, but when most companies laying off employees are big organizations, this makes me question the maturity of the industry. Is it not stable enough to withstand this economic crisis?

Most importantly, **how does this crisis affect candidates who are now looking for a job?**

"The learning points from this is to prepare our candidates, so they are asking, searching questions at interview around funding, attrition and the reasons for this, understanding how their hiring plans feed into their long term strategies, and what progression routes does this role have in order to understand the future a little more. Providing consultative focus with candidates is key to our reputation. In terms of start-ups, as a candidate we would advise to consider the track record of investors, the Burn Rate and whether the start-up has customer orders yet or if not, business having customers investing in the company sometimes provides a good sense of the validity of longevity. Timing is also key and whether or not there is good business user cases evident" Hodson notes.

Understanding the current demand for talent in the AM industry

Despite this tumultuous labour market, recruitment firms remain optimistic

about the skills gap which is gradually decreasing. Unlike [three years ago](#), more and more universities, as well as colleges have globally adopted AM specific courses and encourage AM topics to be taught and built into curriculums across the board.

"The ability to demonstrate the advantages of making things in a different way coupled with the relative ease of having a print lab means academia has embraced AM and provided courses and facilities to increase education of AM. This has led to an increase in graduates with AM skills for sure and this has gone some way to filling entry level gaps in skills. Despite the increase of seeing more graduates within the AM space and students being exposed to Additive Manufacturing studies, there is still a shortage of skills in the industry. However, we have supported many businesses in seeing the advantage of hiring from complimentary industries to fill this gap. Role specific dependent, sourcing skills from sectors such as specialty metals, CNC, metrology or robotics go some way in solving some companies talent challenges. AM is an ever-evolving market place and as such there will always be a skills gap given the nature of the industry", Hodson comments.

In this vein, when asked the types of profile that were most sought after, and the types of companies that have recruited the most, Kensington Additive's CEO explains:

"In 2022 we saw a diverse range of roles within the AM space. Software continues to be an in-demand requirement, as there is a high requirement for software engineers across all industries with specific exposure to the hardware side (not solely data or

front-end software) to interact with 3D printers for printer control. Although some 3D printers work on basic scripting languages such as Python, they still require experience with C++ or similar complex languages.

We have seen an increase in the need for Application Engineers as businesses see this being pivotal in increasing adoption and proving more user cases. Furthermore, Field Service Engineers are also in high demand as the number of machines installed increases and customer success becomes key. We saw a diverse range regarding the type of companies that hire the most AM specific disciplines from startups, materials companies, OEMs, Software providers, service

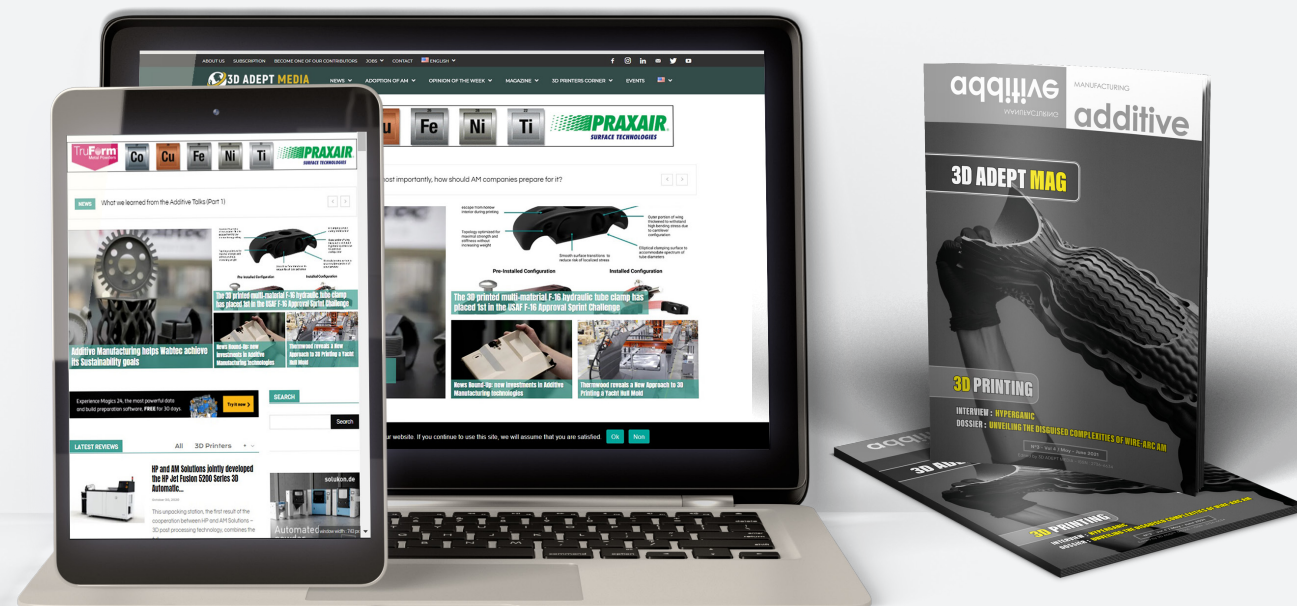
bureaus and more. The regions we saw the highest demand from continue to be **USA, Germany, France and Netherlands.**"

From our conversations at Formnext, we learned that companies are increasingly looking to find people that can enhance their supply chains, operations and QC activities. Moving forward, Kensington foresees a year that will be marked by a **high demand from vertical industries** (Medical, Aerospace, Space, Housing, Industrial etc.) adopting AM technologies.

"Some companies will have hiring freezes, however investor-backed companies that have strong application business cases, strong customer demand, good timing and the right people in place will continue to hit

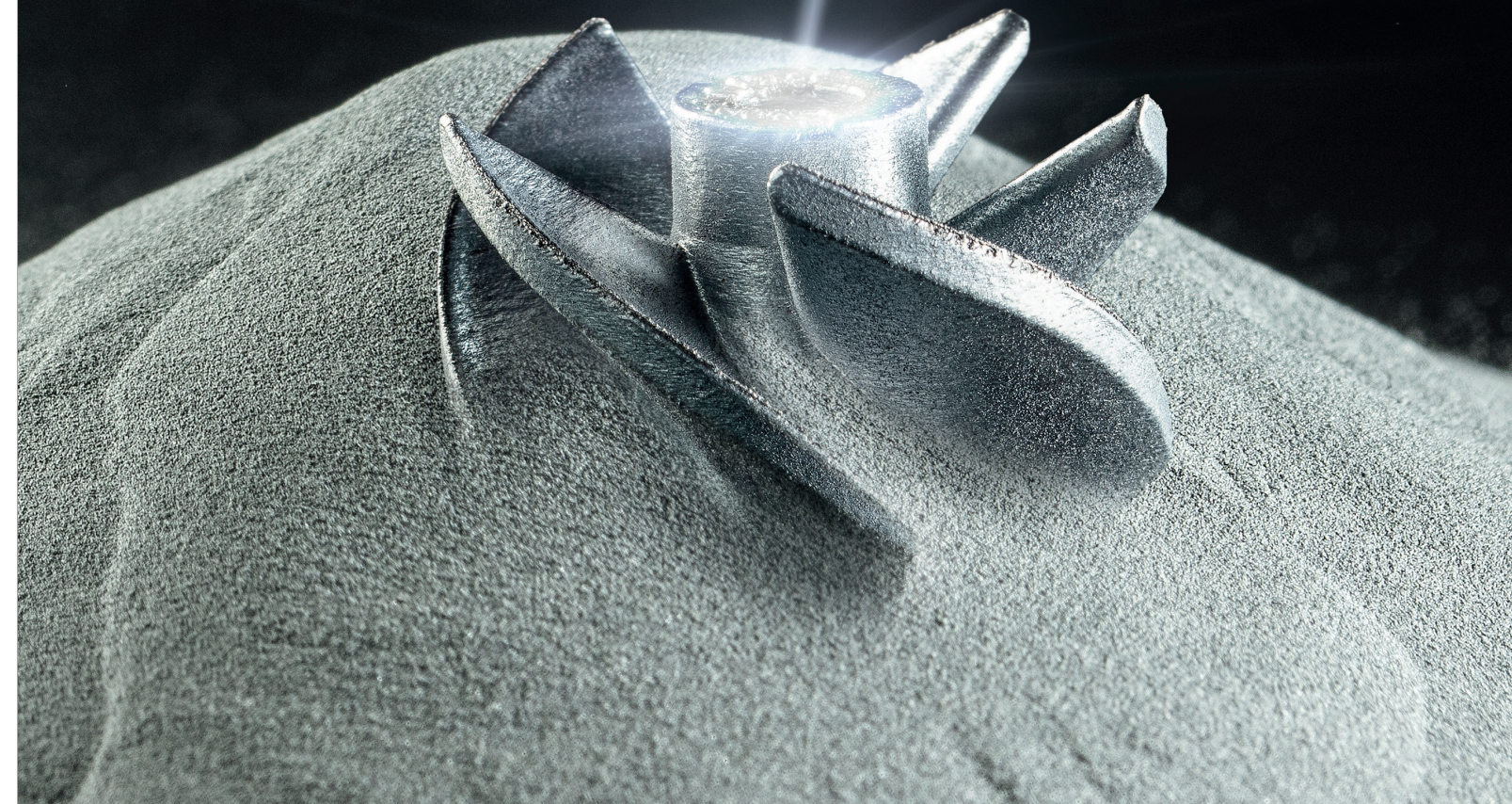
key milestones of growth in 2023. Clearly, there are some employers that are going to be holding back on hiring next year for the first one or two quarters – they seem to be larger mature organizations that operate in specific verticals. Despite this, we also know many others that have strong hiring plans and we have no doubt [they] will achieve their growth plans in 2023", Hodson concludes.

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4 trends that hold the key to breaking down the barriers associated with AM adoption

It has become a sort of tradition for Materialise to pinpoint relevant trends that will shape the AM industry of each new calendar year. For 2023, the AM company points out 4 topics that hold the key to breaking down the barriers still associated with adopting AM. Here they are:

1. Distributed manufacturing, done smart

Traditionally, manufacturing has always centered on a single location — usually a factory overseas.

This system worked well... until it didn't.

In the last few years, we've seen the Corona crisis cripple factories and disrupt supply chains. We've seen the rise of geo-political tensions and increased environmental concerns. All of this has made manufacturing companies rethink this centralized production model.

With smart, digital technologies like 3D printing, manufacturers can make the shift to operating through multiple smaller-scale production sites that sit closer to their customers.

However, many of distributed manufacturing's recent success stories have come from quick thinking in the face of a short-term need, like turning to existing, local 3D printing lines to produce

emergency medical supplies during the Corona crisis. 3D printing was used reactively — a temporary replacement.

These solutions did, however, spark new conversations about the future of manufacturing. We can see that many companies are ready to adopt a more strategic approach. They will need to carefully consider which applications provide the most value in terms of supply chain efficiency or environmental sustainability.

This requires a change in mindset: a shift away from short-term solutions and towards using 3DP for the sustainable production of certified end-use parts.

CNH, an agricultural machinery company, is a good example of this. During the pandemic, CNH relied on 3D printing to produce a vital part that they couldn't source due to Covid-related shipping restrictions. Now, the company is taking a more strategic look at how 3D printing can help manage its supply chains more cost-efficiently.

The potential is real. Even in the highly regulated and certified medical industry, hospitals are increasingly turning to 3D printing to produce medical models and personalized implants at the point of care, closer

to the patient: the medical equivalent of a decentralized industrial production model.

In the end, smart Distributed Manufacturing, enabled by 3D printing and when done strategically, can be a successful strategy in its own right, rather than an ad hoc response to problems with global supply chains.

2. The cost of 3D printing must come down

The story of 3D printing is a story of added value. 3D printing enables design optimizations that provide performance, weight saving, time, and supply chain benefits that are impossible to achieve with traditional manufacturing methods.

In many cases, these benefits create cost advantages that impact the overall end-to-end manufacturing cost, from design to delivery. In fact, a recent survey shows that «the ability to reduce the overall manufacturing cost» is cited as the most important benefit of 3D printing.

But that doesn't necessarily mean that the 3D printing process itself is cost-efficient. And increasing material and energy prices have only driven up costs even more.

Several factors determine the cost of 3D printing parts, including the materials required, production time per

part, and the type of printer. There are two important ways to reduce this:

1. The first is by working more efficiently to increase production capacity. Software plays a major role in this, by making it possible to optimize the build. We can also tune the printing process to make it more efficient and repeatable.

2. The second is using tools that improve quality. Quality comes at a cost. Looking at certified manufacturing in the medical or aeronautics industry, for example, we see that up to 70% of the production cost is in quality control.

3D printing continues to transform the factory floor as companies increasingly turn to the technology for large-scale production. But to accelerate this adoption, our industry will have to make extra efforts to reduce the cost of 3D printing.

3. From Process Automation to Workflow Automation

3D printing is a digital manufacturing technology, but it still requires a considerable amount of human intervention. And these skilled workers are increasingly hard to find. In fact, a recent survey by Materialise indicated that recruiting a workforce with the necessary expertise is the top challenge for companies that are already using or considering 3D printing.

At the same time, scaling up industrial 3D printing production into the thousands or millions requires a repeatable and consistent printing process.

These two challenges increase the need for

automation.

In recent years, software has allowed us to automate various stages of the 3D printing process: from preparing and fixing files to generating support structures, optimizing the stacking of objects into a build, or even post-processing. But these are all individual processes.

In 3D printing, these different processes follow one another, coming together to create a complete digital manufacturing process. The promise of large-scale, industrial 3D printing requires us to automate each process but also the flow between them. This is what we call workflow automation.

We see the same requirement in the medical industry, where workflow automation is needed to address the dramatic increase of customized 3D-printed solutions.

The good news is that the ability to meet this need is growing, thanks to the creation of software platforms that allow manufacturers to define their own unique 3D printing process. Several companies, including Materialise, now offer these solutions to customers, allowing them to automate not just the individual 3D printing processes but the entire 3D printing workflow, from order intake to delivery and everything in between.

4. Data security and data integrity become top of mind

We already talked about the important trend of distributed manufacturing. Systemic shocks, including the Corona-crisis, supply chain issues, geo-political tensions, and growing

sustainability concerns, have revealed vulnerabilities in the traditional, centralized production model. Smart, digital production technologies, like 3D printing, enable a shift towards multiple smaller-scale manufacturing sites closer to customers. A clear sign that the factory of the future will not be a single, central location.

This new digital, distributed production environment revolves around one key asset — data. And that data needs to be secured, preventing a rogue supplier from stealing a design and printing it on his own 3D printer. Of course, data security is important in any form of manufacturing, whether traditional or smart. In both cases, companies share their unique designs with contractors and suppliers, and they want to know that their design data remains secure.

But with 3D printing, there's more to it than that. Manufacturers that plan to scale up the production of a 3D printed part into the thousands or millions need to optimize and fine-tune their unique printing process to make it efficient, reliable, and repeatable across multiple production sites. A smart production process ensures that all 3D-printed components have the same quality, no matter where they are produced. Creating such a process is complex and time-consuming, but it allows companies to leap ahead of the competition. That's why, in addition to data security, data integrity is becoming top of mind for companies that embrace digital manufacturing.

Additive Manufacturing Events : ideas & tips for exhibitors and visitors

While most of us were getting back to the new normal brought upon by 2021 – returning to some of the activities we love (going back to physical events, albeit with new protocols and risk calculations) –, it should be noted that other parts of the world didn't have this luxury. Indeed, USA and Europe have held most, if not all of their industry events this year, whereas Asia is still coping with all the restrictions of the pandemic, and that includes the cancellation of many events in the region. That being said, whether you are based in Europe or in the USA, there are tips that are universal to everyone attending a 3D printing/AM event. To better prepare for next year's industry events you are likely to take part in – be it as an exhibitor or a visitor, we would like to share below some of our best practices to make the most of your time & money on the ground.

To be honest, we have been (and sometimes are) on both sides of the coin: the exhibitor and the visitor. Over time, we have been able to create our own guide to making the most of each event, and surviving the biggest of them. Needless to remind that we do not have the full expertise of an event's organizer, but do they not say that wisdom can only come through experience?



Location & booth features

If you're a company that often exhibits or is interested in exhibiting on a show, you will probably recognize yourself in the following lines.

It's easy to get caught in the number of square meters that you will occupy, but do not forget to highlight your location booth number on the booth itself – in addition to other on-site and/or digital marketing tracking. For international shows like Formnext, where the organization and marking inside and outside the halls are thoroughly thought, this may not be a problem. But during conferences and events of a smaller scale, these are things that companies often forget to highlight

and it's easy not to find you.

Also, be aware of your future neighbour or co-exhibit alongside a potential partner. This is something that we found very useful at Formnext. Some companies were exhibiting alongside their (potential) partners, and as a visitor, it was just interesting to see how companies can benefit from each other's capabilities or expertise.

Booth features: identity and message.

Whether you have a big budget or a small one, your booth should tell who you are without you saying a word; it will tell if you're a cool person to hang out with or somebody that will require to spend a lot of time with to truly appreciate your qualities; it will tell people who you are and

what you do. It's your company's soul. No matter what your budget is, **please always prioritize quality over quantity.**

Furthermore, your booth should highlight the message you would like all visitors to keep in mind – whether they stop by your booth to get to know you or they just notice you while walking through an aisle. The questions your design & marketing teams should try to answer while constructing the booth are: **what message do you want to convey? What's the key highlight people should keep from our presence on X or Y show?**

I know it might be difficult for big companies providing a wide range of services, but keep in mind that if the unique message you want to convey can be easily caught through your booth design or what you showcase, then the visitor would be easily interested in discovering the rest of your services – and that's a win for you.

Food? Water? Chairs? – These vital items for which people will always be grateful.

My granny used to tell us that “the way to a man's heart is through his stomach”. I have always believed that this was only true for women who were looking for a husband (although today [...] Anyway, this is definitely true for any person visiting you on a big show. Between the long walks across the aisles, the long talks and sometimes the cold – when a show is taking place during winter, believe me, every visitor is eternally grateful when they are proposed a glass of water, a cup of tea or sometimes a sandwich.

Add a chair to that – given the aching feet one often gets after these long walks through the aisles and booths –, and your booth will literally become heaven on earth.

Some companies often installed walled gardens wherein partners and employees are entertained while others are kept out. Please, do not do that as this is the easiest way to make people feel marginalized. An interesting idea might be to invite visitors to drink a cup of coffee while discussing their needs and how you can serve them.

Engagement

Prior to the show? During the show? After the show? – All are great and welcome!

Prior to the show: announce what you will be showcasing with all relevant details – so that both the journalist and the potential prospect will be interested in seeing your



Legend: there were over 800 companies exhibiting at Formnext 2022, but I give kudos to XERION for showing through its booth that they can now deliver on-site manufacturing services on remote locations – With just a car where a 3D printer and other devices were installed. This booth conveyed a message without the company having to say a word. After some digging, we even realized that the machine manufacturer provides a range of other solutions that could also be interesting for the industry.

innovation in real life. Crucial tip that is often given second place or no place at all by SMEs is the trade press. Trade press must be one of your best weapons prior, during and after the show. A visitor who does not have any time to stop by your booth will definitely stay informed through the trade press to see what they are missing. A visitor who wants to make their time easy on the exhibition floor will plan their visit by having a look at some of the solutions that could be found on the show. And where will he find them? On industry trade press portals or magazines. So, invest in and maintain your relationships with the most-relevant trade press of the industry.

During the show: well the past couple of years have shown that social media are the best way to create engagement – (and live interviews



if you have the opportunity to be selected by one of the trade press conducting this type of onsite activities.) During this Formnext for instance, in the midst of all my meetings, I took some time to play at TRUMPF's booth. They had installed a 3D printed tower, and people could take a couple of pictures that they could re-share on social media, and win something. Well, I didn't win anything, but I have a great picture next to a beautiful 3D printed part. Also at Formnext, I stumbled upon an exhibitor that was gifting 3D printed stools built during the show, if they played their game – that is indeed a great way to show the capabilities of your machines in real time.

After the show? Well companies often send a lot of thank-notes by emailing, but I don't think they are effective unless there is a call to action at the end that will act as a short reminder of what they saw at your booth or an invite to chat with one of your employees. Here again, I can't help but mention the importance of the trade press that might give a shout out to your products and services. One of the best ways for people to catch up with everything that happened during the show.

If you're a visitor planning to attend a show, then the lines below are written with you in mind.

Arrive a day early or on the first day of the event.

If you already know you are attending a big show, arrive a day early to acclimatize with your environment and what you will be dealing to/with during your stay. It's always frustrating when you have to assess everything (transport,



*Image via adidas
– Baskets with 3D
printed sole*

drive, interesting places to eat, or whatever) when the show has started. Usually, you don't have a lot of time to think about those minor topics, but by arriving a day early, you can also better prepare yourself and your pocket will thank you for avoiding all unnecessary and unexpected costs.

If you are attending a small show however, you can arrive on the first day of the event but early in the morning. Small shows often last two or three days, so my advice is to bet everything on the first day(s) of the event.

Comfy shoes – everywhere you go.

If that wasn't clear enough, one walks a lot on big shows, so no matter what type of shoes you have, you may end up with aching feet by the end of the day. However, if your shoes are comfy enough, with a soft sole, damages may be limited.

Plan your visit but leave room for spontaneous discovery.

As a visitor, you should already know what you're looking for prior to attending a show – especially big shows. With up to 1 000 companies that often exhibit

on international shows, you may waste a lot of time, if you do not plan your visit.

Stay informed on the trade press to know what kind of companies will be exhibiting, read about their products, and maybe take a couple of meetings with those who already raise your interest.

But, but, but,... do not book all your agenda. Otherwise, you will find yourself going from one meeting to another, and you won't find any time to discover other booths. Maybe the solution you're looking for, will be at a booth that you didn't see online. So, leave room for wandering.

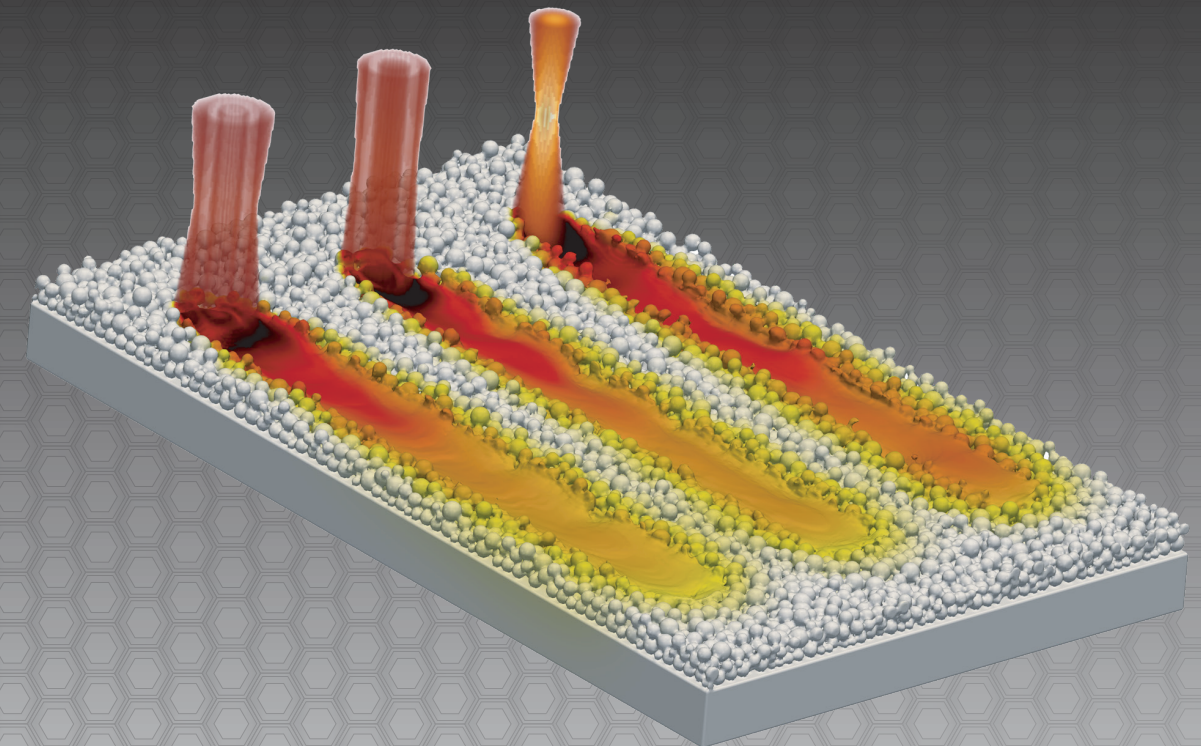
Lastly, enjoy yourself!

Did I need to add that? Definitely, yes! Because attending a local show often means travelling to a new region. So, find some time to discover some local peculiarities.

Now, when attending a big show, you may not have that time, but you may have some for networking events and getting to know people of this industry. This is a niche market, and somehow, everyone tends to know everyone – and that's an opportunity you might have during networking events.

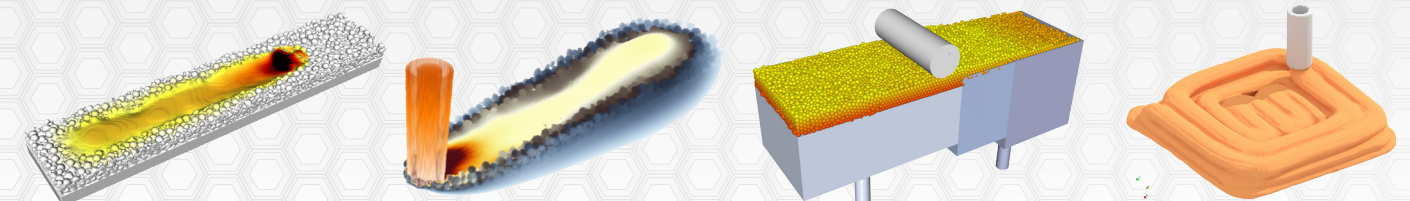
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Startup Area

10 3D Printing Start-ups you would probably want to keep on your radar

Ideas are easy. Implementation is hard. In the manufacturing and technology industry, ideas are popping up every day. However, most of the founders choose to remain in stealth mode until they have a MVP (Minimum Viable Product) to introduce to the market – with good reason, given the risks that are often involved. Interestingly, this year, ten startups stood out from the crowd and introduced their products and services to the “glocal” (portmanteau that combines the words “global” and “local”) AM industry. Here they are.

Q.big 3D GmbH

Founded in 2019, the Germany-based startup develops large scale 3D printers based on a process called **VFGF (Variable Fused Granular Fabrication)**. I saw them for the first time at [AM Forum Berlin](#). Their technology processes polymer (plastic) granulates into one single extruder. Variable because high-resolution printing is only used where the finest contours and good surface qualities are required. Everywhere else, the material throughput is much higher, the [company says](#). Their flagship product is named **Queen 1**. I don't know what inspired this name, but I like it. It's easy to remember, and it implies something majestic – which is the feeling that big things should arouse. I now hope that their product is able to deliver on that feeling.



The XXXL 3D printer QUEEN 1 – Image via Q.big 3D GmbH

The team seems to be open to have commercial relationships with all companies across the world, but its deeds show that their main area of focus is the DACH region, as communication is mainly done in German.

The Industry Sweden AB

This is one of the companies we met on the last edition of Formnext. (As we said in the “EVENT” segment, always leave room for wandering). They have actually been on the market for a while. You may have known them as [BLB Industries](#) – developing 3D printers for doors; they went on quiet mode and we lost track of their activity, then rebranded as “Industry” last year with the goal of adopting a new strategy. To be honest, it's hard to say if one should still consider the company as a new start-up in the industry – given the fact that they now operate with a different name and category of products. Anyway, what you should keep in mind is that The Industry Sweden AB currently develops FGF systems (fused granule fabrication), which use thermoplastic granules rather than filament to print 3D plastic parts.



such as wood, hemp and flax.

The company says their rebranding is the start of a new scalable business model that will focus on developing strong brand recognition, with new products and strategies to fight plastic pollution.

Disclaimer: A number of big corporations also decided to create their AM division this year, they have purposely been excluded from this article to highlight SMEs and founders who are building their company from scratch.

With a build area of 1500x1200x1200 mm, the FGF system is ideal for the use of recycled plastics, as the number of processing steps is reduced in converting raw material into feedstock when compared to filaments. It will also be capable of printing rubbers and certain biofibers fillers

Additive Assurance

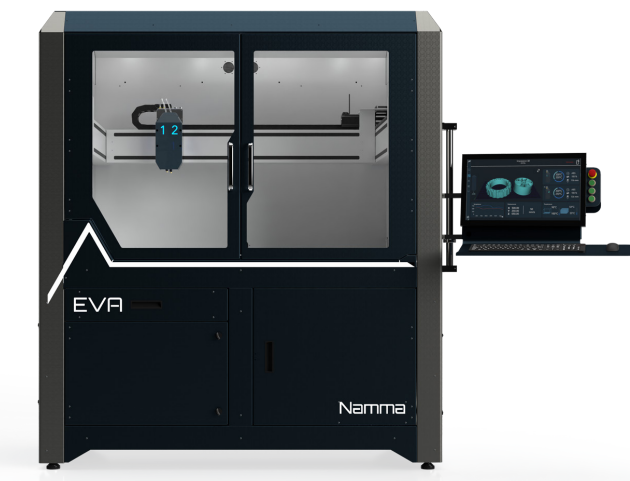
I have good feelings about these guys. The team is experienced and interesting. **Marten Jurg** and Associate Professor **Andrey Molotnikov**, the founding team behind the Australia-based company spun out of Monash University in 2019; they have developed an in-process quality assurance solution for laser powder bed fusion (LPBF). Named **AMIRIS**, it enables manufacturers to ensure the structural integrity of components as they are being made and correct any anomalies when they occur.

They said they already work with a couple of customers in the aerospace and advanced manufacturing industries to enable the use of 3D-printed parts in serial production. And they end up their year on a successful note by securing a **\$4.1 million funding round** to push forward their research and development activities and hire international business development teams.



Namma

Namma is another startup that we failed to mention last year in our [list of 3D Printing startups created in a post-COVID-19 era](#). Based in France, the engineers behind Namma believe in the best of both additive manufacturing and subtractive manufacturing worlds. Their flagship product is **EVA**, a hybrid 3D printer that combines 3D printing, CNC machining and laser engraving on one platform. Their machine integrates two separate heads that can function simultaneously – one can be a printing head, and the other, a milling or laser printhead; or you can have two unique printheads working at the same time. EVA comes with **N-Center, its own software suite** to enable its users to optimize their production at every step of the manufacturing process.



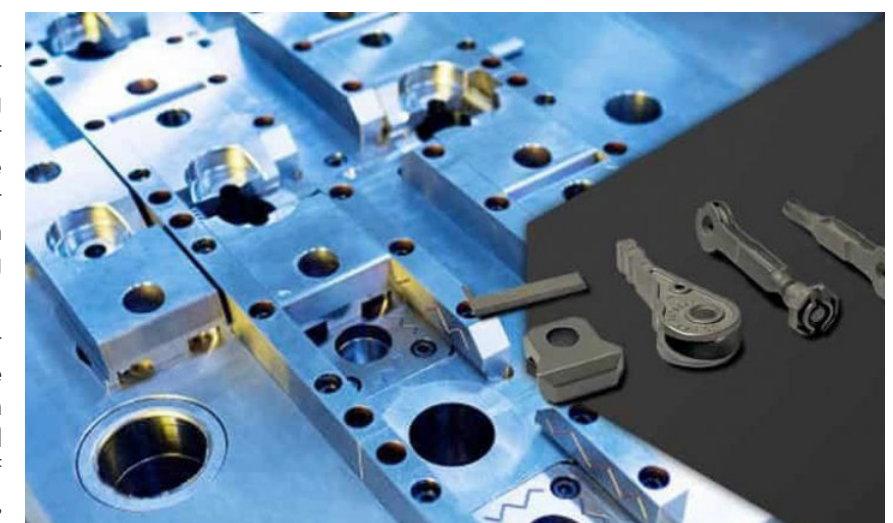
EVA by Namma

TriTech Titanium Parts

Manufacturers that have 3D binder jet printing, metal injection molding and investment casting in their production environment have understood the power of their complementarity. For me, they can only be up to something interesting and worthwhile following.

[TriTech Titanium Parts](#), a newcomer on the market combines these technologies in its production environment. Launched on April 5, 2022, the company is a spin-off of its President's former company, **AmeriTi Manufacturing**. The latter was sold to [Kymera International](#), also on April 5, 2022.

Organized in response to market needs, TriTech produces net shape titanium parts using the most appropriate technology for the part and the customer. TriTech's unique array of three production technologies includes 3D binder jet printing, metal injection molding and investment casting. The 3D printing is the latest addition, and the binder jet process is a unique cutting-edge manufacturing process for producing complex titanium parts.



Filaret

Did you know that cigarette butts are one of the most common types of marine litter in the Baltic Sea? In addition to plastic, most of the waste found in the Baltic Sea and in coastal areas is cigarette butts and cigarette filters, which are toxic and non-biodegradable. A single cigarette butt can pollute up to 1,000 litres of water, and toxins released from the filter into the water can persist for up to 10 years, becoming lethal to aquatic life.

That's the reason why **Ines-Issa Villido** and **Kristina Jacqueline Leon**, the badass ladies behind [Filaret](#) – based in Estonia – embarked on a noble mission: making recycled waste materials a norm in the 3D printing industry by collecting and upcycling cigarette butt waste into a sustainable, compostable and nature friendly 3D printing filament. To do so, they installed special litter bins on the beaches of the Põhja-Tallinn district to prevent cigarette butts from ending up in the sea. For now, no information has been given on the transformation of these cigarette butts into filament. Furthermore, we do not know if the filament could be used for prototyping or production purpose. Hopefully, this information will be shared at the end of this pilot project by Filaret or one of its partners (the Port of Tallinn and the Tallinn Airport).



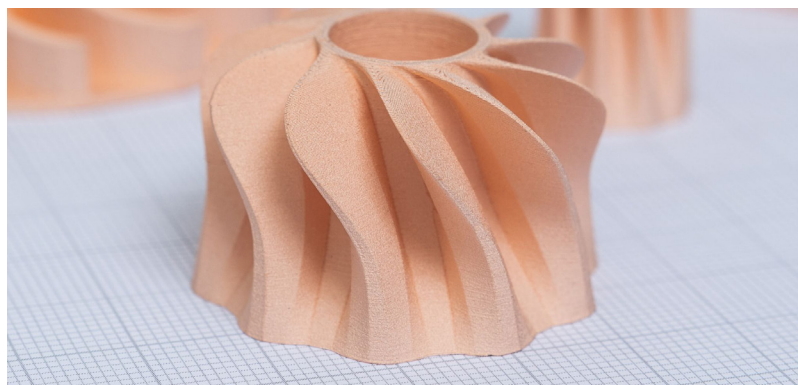
Kristina Jacqueline Leon (left), founder and CEO of Filaret, and Ines-Issa Villido, co-founder and CEO.

AM Extrusion GmbH

Based in Radebeul, Germany, the idea of AM Extrusion became reality in early 2021 when Felix Alber, Aljoscha Roch and Sven Halank joined forces to develop a range of metal and ceramic filaments for 3D printing.

*“Material availability is a high threshold for the industrial use of the otherwise so advantageous fused deposition modelling. With our unique **AM-Xcomp** binder system, we are able to lower this threshold and to process almost any available metal or ceramic powder into sinterable materials for 3D printing. Our patent pending **AM-X** thermoplastic filaments feature unprecedented powder enrichment rates, excellent printing properties and easy applicability at nearly room temperature. Warping issues in the workpieces, high occupational safety standards, the disposal of excess toxic material, and other disadvantages of conventional AM processes are now a thing of the past”,* the company says.

With production capacities that range from 500 g to several 100 kg, their portfolio of filaments currently includes light or hard metal, copper, stainless steel or ceramics; it can be customized if there are special



requirements for a filament to meet.

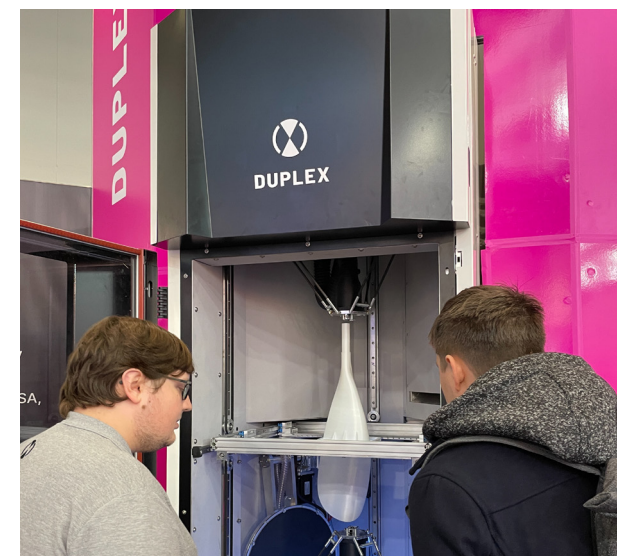
AM Extrusion invented a tool for printing copper easily. No airborne powder, no high safety requirements for the employees, and no personal protection equipment. Their special copper filament is fed in a print head of a 3D printer. The printer melts the filament and extrudes the material onto a building platform. “For 3D printing of pure copper parts, we invented the **AM-X Cu 99,97% filament** that contains a polymer filled with a high-purity copper powder at high volume fraction. The uniqueness of our material is that the polymer can be fully removed after printing and the copper powder can be sintered easily in a furnace. That enables a 100 % material consumption for getting copper parts. We avoid any material waste and have a resource-saving manufacturing process. The material is used additively, exactly where it is needed”, they explain.

Fractal Additive

Founded this year by **Olivia Krueger**, this US-based [start-up](#) provides two main services: Contract Design Engineering Services and Fractal Infill. My curiosity is aroused for this latter one: a solution that creates adaptive structures that are optimized for each part that goes through the slicer. Material savings increase as part scale increases, without the compromise of overall part strength. Why do I find it interesting? Because it's hard to innovate in the material extrusion field (FDM 3D printing) and I am very keen to discover where Krueger can go with this solution...Hopefully, very far away.

DUPLEX

Just when you think that there is not a lot to expect from FFF 3D printing anymore, a company comes to prove you wrong. A very intriguing manufacturing trend in this segment comes from a new entrant: [DUPLEX](#). The pink brand introduces MAP™ (multi-dimensional additive production), a technology that enables multi-directional printing. Not only does this speed up the fabrication process, but this two-directional process also reduces or eliminates the use of support materials, and makes it easy to print organic geometries. Amid the wide range of FDM 3D printer manufacturers that are present on the market, I think DUPLEX is the one that could make a big impact.



Sinterjet

Based in Turkey, [Sinterjet](#) has been operating for a couple of years on the market but made their premiere this year at Formnext. The company wants to position itself on the market of affordable metal 3D printers. Priced at €65,000 (US\$68,000), their flagship product is the **Sinterjet M60**, an industrial metal 3D printer with a build volume of 160 x 60 x 60 mm that uses Binder Jetting 3D printing technology, a process where a liquid binder solution is selectively deposited on powder layers until a complete object is created.

As you may guess, no support materials are required here, as the surrounding loose powder provides support for overhangs. With a resolution of 1200 x 1200 dpi, the machine can build at a rate of 50 cc per hour. This is quite fast for this type of volume, right? The machine is compatible with an in-house developed software solution which would be easy to use according to Sinterjet.





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Formnext 2022: the killjoys, the elders and the kids of the “fAMily” reunion

We just got back from Frankfurt, a European and German city best known for its production of high-quality sausages (frankfurters), but at this time of the year, for AM enthusiasts and specialists, the city becomes the global capital of industrial 3D printing. For many I talked to, it's a bit like Christmas – the grey climate and the timing may have their part to play in this analogy, but I would rather say it's a **fAMily** reunion.

(In case you are new to this industry, note that “fAMily” is a portmanteau coined by [Mesago](#), the organizers of [Formnext](#), that combines the words “family” and “Additive Manufacturing”.)

I don't know about you, but from where I am coming from, family reunions are sacred; so is the importance I attach to this fAMily reunion. And as in all families, one finds the elders whose wisdom and experience often pave the road toward success – for those who listen to them; there are always some uncles and aunts who will remain killjoys no matter how optimistic you are and there are babies and kids we rarely listen to, because they are just expected to follow the rules; yet the saying goes that out of the mouths of kids come words of truth and wisdom. So, yes, in all families we find these **three groups of people** and Formnext is surely no exception to that.

1- The killjoys

I usually never listen to killjoys – most of the time, they complain and they do nothing to address the situation they complain about. But the pandemic, and now the current political and economic situation countries have to handle make it impossible not to pay attention. These issues are actually the killjoys of this annual gathering as they continuously affect businesses.

For instance, this year, amid the **802 exhibitors present** on the **51,148 square meters** of booked exhibition space, there were no Russian companies. Well, you know why. We did see some Ukrainian companies though.

Also, it's crazy how our brains are wired to scout for the bad stuff, focus on the threat or give weight to (and remember) negative experiences or interactions more than positive ones. As you know, I am not a psychologist, but I know these people refer to this as negativity bias. And that's something that was present in some informal conversations I found myself plugged in:

- Curiosity was aroused at the sight of some companies' large booths and onsite marketing actions, when we know that they recently laid off a great number of employees.

- Conversations were about mergers and acquisitions, inflation and geopolitics, and how they all affect businesses – and the “glocal” AM world. (“Glocal” is a portmanteau I like to use to explain the fact that this industry is first and foremost global and local.)

So, what can AM really do about it? The short answer is that AM remains a technology of choice for decentralizing manufacturing processes and production, and a key enabler in making supply chains more resilient, facilitating resource and energy efficient production. How does this translate throughout the manufacturing value chain? That's the one-million-dollar question, those who remember this event is about business, were trying to answer.

2- The elders

Aging is still considered as a sign of experience and wisdom and that's something I am always eager to discover when I approach a company or an executive for the first time. Remember, a company might be new to the industry, but its founders' experience or the company's long-standing expertise in another industry may justify its presence on the AM market.

In this specific case, some of the elders that raised our interest at Formnext, highlighted **some technology advances** that we believe, represent a new direction or step forward compared to what was available last year. Anyway, this step forward or new direction was exactly what we were looking for, when we approached them.

New approaches in materials innovation

I was probably influenced by the **September/October edition of 3D ADEPT Mag** ([distributed at Formnext and available here](#)) that was dedicated to climate change actions within the AM industry, hence my keen interest in discovering more solutions and actions undertaken by material producers to drive sustainability.

A specific focus was placed on polymer material producers as the nature of their activity makes them an easy target to vanquish. Specialty chemicals company Evonik that has remained silent on this topic during the past years, has launched a new grade of PA12 powders with significantly reduced CO2 emissions. This is the first tangible and publicly announced step [Evonik](#) is taking to back words with action. With a holistic approach based on four cornerstones – carbon footprint, saving fossil resources, reusability rate and recycling –, the specialty chemicals company will be taking more actions next year to achieve its sustainability goals.

Speaking of this environmental issue, 3D printer manufacturer [WASP](#) showcased an example that is worth mentioning: **recycled fishing net material** that can now be used for 3D printing. To make it compatible with its 3D printers, the machine manufacturer improved the pneumatic



adhesion systems to the printing surface and its systems for filtering printing fumes and anti-wrapping extruders to limit the shrinkage of these plastic materials.



We also observed an increasing development of exotic materials that aim to meet the need of specific requests from manufacturers. ABS, PLA and high temperature materials like PEEK will always be the way to go for those who regularly use FFF 3D printing, but exotic 3D printing materials are here to push the boundaries of the technology – whether we talk about FFF or other AM technologies. It is now possible to envision more radiofrequency applications with FFF 3D printing thanks to [Nanoe's dielectric filaments](#) for instance or impact protection applications such as padding, gloves, and helmets with new damping elastomers from [Carbon](#).

On the metal AM side, I

discovered that aluminum materials have a potential large enough to constitute the core business of certain AM companies. Due to their peculiar attributes, these materials were quite challenging to process at the very beginning when AM was still a nascent technology. Addressing this challenge required to develop high-performance aluminum alloys that could only be processed by AM.

Companies like [VALIMET](#) and [Eckart AG](#) bring tons of experience in the field and have decided to focus their business on aluminum materials for AM. If you have probably already heard about [Eckart](#), VALIMET may be new music to your ears if you're a regular reader of 3D ADEPT

Media. The German owned, US-based manufacturer of spherical atomized metal powders focuses on aluminum and aluminum alloys. After atomization via inert gas for spherical morphology, its aluminum powders are sized to eliminate fines and enhance flowability. The particle size distributions (that range from -53 to $+15\mu$) are tailored to maximize density, improve mechanical properties and optimize printing performance while meeting stringent OEM specifications.

Interestingly, at Formnext, ECKART made us realize that the fact that small powder particles are spherical in shape is not always the key item that enables aluminum alloys to stand out from the crowd.

A20XTM for instance, the lightweight aluminum-based powder derived from the aerospace-approved (MMPDS) **A205 alloy** that ECKART develops and commercialises, delivers superior mechanical properties. Its unique chemical composition contains ceramic TiB2 particles which modify the solidification mechanism, resulting in fully equiaxed and fine-grained microstructures. Even at 200 °C, its yield strength is still above 300 MPa. This is attributable to two factors: ceramic TiB2 particles stabilizing the microstructure, and the choice of the alloying additions Cu, Mg, and Ag, the concentrations of which have been optimized to result in the formation of



a high number density of thermally stable nanoprecipitates. A20X has proven to exhibit fatigue properties comparable to wrought, high-strength aluminum alloys, making it the best-performing aluminum alloy for additive manufacturing, the company explains.

Software solutions that talk to 3D printers but not only.

Manufacturing trends are often the very first items highlighted in our media coverage but this time, there was something about new software solutions that outpaced what we saw at the manufacturing level.

I like the fact that **software companies start taking actions towards sustainability**. Apart from the fact that the "DfAM" principle enables to design lightweight parts, it has always been difficult for software companies to truly justify their role in this journey.

A worth mentioning action is now seen with [Siemens Digital Industries Software](#) that introduces a "Product Carbon Footprint Calculator"–developed in collaboration with ClimateTech company [sustamize GmbH](#). The new **Teamcenter® Carbon Footprint Calculator software**, part of the Teamcenter product cost management solution from the Siemens Xcelerator platform, enables organizations to measure, simulate, reduce and track their product carbon footprint early in the development phase. This will empower different departments to measure, optimize and manage carbon footprints at each level of the product value chain.

If AI has too often been mentioned, the people

behind AI-powered software solutions are still struggling to demonstrate its true potential in the manufacturing value chain. One company that is building a path to follow here is UK-based [Ai Build](#). Their focus on the show was maybe their software for robotic arms, but I can't help but talk about their automated toolpath generation solution that enables to monitor, control, measure and optimize the entire AM value chain. Plus, the cloud-based platform has already repurposed over 10 tons of recycled materials to date, reducing greenhouse gas emissions by approximately 70%.

Moreover, unlike others who bring years of experience around the table, software company Cognitive Design Systems is not really what I will call an "elder" in this industry (the company was founded last year). It is rather a kid that may

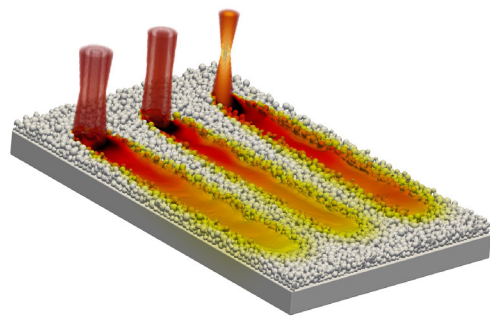
have the truth that engineers may need when it comes to the orientation of, nesting of, and support structure generation for parts. Its software solution relies on artificial intelligence (AI) to preform 3D modeling and numerical simulation to perform print preparation. Also, the fact that, the company no longer acts as the supplier of other software solutions, and solely focuses on their software services, may be the sign that something interesting is happening on their side.

Apart from AI, one notes that as the value of the digital thread is sung from all corners of the industry, the digital twin (DT) technology is gaining momentum. The technology has positioned itself as one of the advanced concepts that could help manufacturers earn credibility and viability in the new digital manufacturing realm.



Software company [Flow Science](#) told us how the concept when combined with computational fluid dynamics (CFD) solutions, help to understand or optimize different aspects of AM processes.

In a Laser Powder Bed Fusion (LPBF) process for instance, where powder is spread onto a build plate and a laser beam then melts and fuses the powder, the engineer can perform CFD simulations of the melt pool to obtain an input for modelling the laser beam's interaction with the powder bed and melt pool formation that will follow. However, it should be noted that to do so, he should



perform a discrete element method (DEM) simulation upfront to simulate the powder spreading process in detail. Such simulation method accounts for particle dynamics, particle collisions and geometry effects.

What's even more interesting is the fact that for the first time, it is now possible to make the digital twin of a part usable in post-processing. [Solukon](#), a company founded in 2013, whose founders bring over two decades of experience in this industry, is writing another page of their story with the [SPR-Pathfinder@Software](#).

New manufacturing trends

Surprisingly, extrusion-based machines – with large-scale possibilities were quite predominant on the exhibition floor. American [Thermwood](#) showcased a couple of 3D printed parts produced with its LSAM technology but the company is no longer one of the only machine manufacturers present on the market of large 3D printed parts.

Italian machine manufacturer [Breton](#) is coming into full force with GENESI, an industrial 3D printer with an enormous build volume of 2000 x 3200 x 8400 mm.

Large-scale AM possibilities come along the growing development of gantry systems and robot arm systems. [BLOOM Robotics](#), a company that delivers serial additive robotics systems for mass customization is one of the companies I would like to keep in mind here. The company's solutions are designed for AM, welding, milling and

gluing with polymers. With AM, their unique selling proposition lies in their ability to eliminate the cost of creating various molds for every product through an automated process that enables mass-production. The company's solutions are compatible with robotic systems from various different brands including STAUBLI, KUKA, ABB, FANUC, Panasonic, and OTC to name a few. This means that, during the upcoming months or years, we will probably see a lot more of AM-dedicated developments from these robot makers.

On the metal AM side, we continue to observe the rise of **Wire-Arc Additive Manufacturing (WAAM)/DED**. Also, in this field, large-format, multi-laser metal AM is on fire. Until now, Nexa3D was one of the rare manufacturers to provide SLS systems with four lasers. As a matter of fact, that was one of their main selling points. Today, other manufacturers have pushed their technology so well that they can now market powder-bed fusion systems with four lasers. [Farsoon is one of them](#).

Another manufacturing trend that represents a step forward in the use of AM technologies is the development of new ceramic 3D printing technologies that does not only open up a new range of applications

in the industry but that also facilitate their integration into the traditional manufacturing value chain. One of these technologies is the [Laser-Induced Slipcasting \(LIS\) technology](#) developed by Lithoz. One thing we learned from the company is that dark ceramics are a key enabler in the range of new applications that the manufacturing process allows.

On another note, just when you think that there are not a lot to expect from FFF 3D printing anymore, a company comes to prove you wrong. A very intriguing manufacturing trend in this segment comes from a new entrant (that I will mention below in the group of "kids" of this industry): [DUPLEX](#). The pink brand introduces MAP™ (multi-dimensional additive production) a technology that enables multi-directional printing. Not only does this speed up the fabrication process, but this two-directional process also reduces or eliminates the use of support materials, and makes it easy to print organic geometries. Amid the wide range of FDM 3D printer manufacturers that are present on the market, I think DUPLEX is the one that could make a big impact.

Lastly, [on-site manufacturing or in-situ additive manufacturing](#) remains a topic of interest for many professionals that are looking

to manufacture locally or in remote areas. While the concept is easy to understand, we have to acknowledge the ingenuity for some companies to demonstrate it directly on the exhibition floor. With a 3D printer installed in a car, machine manufacturer [XERION](#), a company known for the [Fusion Factory](#), demonstrated in a practical way the ability to manufacture locally.

3- The kids

The kids of this "fAMily" reunion are actually new entrants to this market. They are not necessarily start-ups, sometimes, there are larger companies that decided to penetrate the market. I have to say that given the number of companies that filed for bankruptcy this year, I was pleasantly surprised to see a new range of companies try their luck on this market. In addition to DUPLEX mentioned above, the companies

that I would like to follow moving forward include:

- [Partbox](#), a 3D part streaming platform, ambitions to provide the fastest possible availability of parts through 3D printing on demand (in situ additive manufacturing). The company behind this platform is [Schubert Additive Solutions GmbH](#), the AM division of large logistics company Schubert Group. There are a couple of things that I like about this concept: first you don't need to have any 3D printing knowledge; the company works with a partner who already has an online shop with ready to print 3D models; the FDM 3D printers developed by Partbox are not to sell; the platform works under a leasing mode where the user buys a number of printing hours for a one-year period. At the end of the leasing period, it's up to him to decide whether or not he should add more hours.

1.000 Printing hours	2.500 Printing hours	5.000 Printing hours
M-Package Valid 12 Months	L-Package Valid 12 Months	XL-Package Valid 12 Months
6.990 €	9.990 €	14.950 €
6.99 € / hour	3.99 € / hour	2,99 € / hour



- [KraussMaffei](#), a leading manufacturer of machines and systems for producing and processing plastics and rubber, is another OEM that debuted at Formnext with its [powerPrint and precisionPrint machines](#). According to KraussMaffei's **Magdalena Schwangler**, one of the project managers who worked on the launch of these machines, their development aimed to address their customers' existing injection moulding challenges at the manufacturing level. 2023 will be dedicated to an intensive test phase with beta customers, after which the industrial 3D printers will be available on the market.

· [Additive Assurance](#) provides solutions for quality assurance of components made with additive manufacturing. The start-up decided to specialize in metal powder bed fusion techniques (SLM, DLMS, SLS etc.). It owns a patent pending in-situ analysis method that allows for the rapid detection of faults and variation in the AM process, enabling the user to take control of their AM builds.

· **Additure, Grob** and **Jeol**, three companies that you probably already discovered through our articles debuted at Formnext. They respectively provide [metal 3D printing services](#) for the former, and develop a [liquid metal printing technology](#) and an [Electron Beam Powder Bed Fusion \(PBF-EB\)](#) metal additive manufacturing

machine (for the others).

To conclude...

With over 800 exhibitors, a [wide range of sub-events](#), and a growing number of informal events and parties, summarizing Formnext often comes down to the holistic experience of each visitor. With a number of visitors totalling 29,581, the industry event's number of visitors has grown by 65.6% [compared to the 2021 edition](#) that hosted 17 859 visitors and is gradually returning to the statistics of 2019.

"We are proud of the fact that Formnext has returned to its impressive pre-Covid level," says **Sascha F. Wenzler**, Vice President Formnext at event organizer Mesago Messe Frankfurt GmbH. "We have once again demonstrated

the importance of Formnext as the world's premiere AM platform and the vital role of face-to-face interactions at Formnext for the further development of this highly innovative sector."

While other announcements and insights will be covered individually and published on this online platform, it's fair to say that the AM industry continues to grow, with more realistic expectations of where it wants to go.

2023 EVENTS

STAY UP-TO-DATE WITH THE LATEST ADDITIVE MANUFACTURING INDUSTRY EVENTS, CONFERENCES, EXHIBITIONS AND SEMINARS.

GERMANY	USA	UK
AM MEDICAL DAYS DATES TBC	7TH ANNUAL MILITARY ADDITIVE MANUFACTURING SUMMIT 1-2 FEBRUARY, 2023	AM FOR AEROSPACE & SPACE 21-23 FEBRUARY, 2023
EBAM CONFERENCE 22-24 MARCH, 2023	ADDITIVE MANUFACTURING STRATEGIES 2023, 7-9 FEBRUARY, 2023	TCT 3SIXTY 7-8 JUNE, 2023
HANNOVER MESSE 17-21 APRIL, 2023	AMUG CONFERENCE MARCH 19 - 23, 2023, HILTON CHICAGO	THE ADVANCED MATERIALS SHOW 28-29 JUNE, 2023
RAPID.TECH 3D 9-11 MAY, 2023	RAPID + TCT 2-4 MAY, 2023	VEHICLE ELECTRIFICATION EXPO 28-29 JUNE, 2023
	SPAIN	THE NETHERLANDS
AM FORUM BERLIN 4-5 JULY, 2023	ADDIT3D 6-8 JUNE, 2023	3D DELTA WEEK 27-31 MARCH, 2023
EMO HANNOVER 18-23 SEPTEMBER, 2023	METAL MADRID 15-16 NOVEMBER, 2023	
AMTC, DATES TBC	PORTUGAL	FRANCE
FORMNEXT 2023 7-10 NOVEMBER 2023	EURO PM2023 1- 4 OCTOBER, 2023	GLOBAL INDUSTRIE 7-10 MARCH, 2023
MEDTECLIVE 2023 23-25 MAY, 2023	AM SUMMIT 2023 COPENHAGEN	PARIS AIR SHOW 19-25 JUNE, 2023
MORE EVENTS WILL BE ADDED LATER !		

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