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formnext magazine

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by **formnext**

If you're  
competitor-focused,  
you have to wait until there  
is a competitor doing  
something.  
Being customer-focused  
allows you to be more  
pioneering.

[ Jeff Bezos, Founder of Amazon ]

Cover: Mesago / Mathias Kutt

## EDITORIAL

AM continues to enjoy a good deal of momentum. According to the latest surveys, the demand for 3D printers in the global marketplace has risen further in spite of the pandemic. While our industry is one of the many that are feeling the effects of various supply chain issues, industrial systems with price tags over U.S.\$100,000 saw growth on the order of 40% in the first three quarters of 2021. Units starting at U.S.\$20,000 have taken somewhat of a hit due to COVID-19, but things are now looking up again. Polymer and metal printers are finding the most success, and the top systems also include several that are designed for composites.

Alongside these positive developments, the connection between the increased demand and the return of in-person events in 2021 is something we find particularly interesting. A related market analysis has confirmed that the small number of gatherings that did take place were a significant driver of demand last year. In other words, Formnext not only helped keep things moving in AM; it even energized the business further. Our annual November highlight in Frankfurt (and the Digital Days that were held immediately thereafter) gave the worldwide AM community the chance it had been longing for to meet face to face once again.

These are all good reasons to be optimistic as 2022 gets rolling. The pandemic and supply-related problems are still making their presence felt in a variety of areas, but the positive trend in the demand for AM technologies and applications looks set to continue. Whether it's with physical or digital event formats, we look forward to following these developments and making our own particular contribution to the industry.

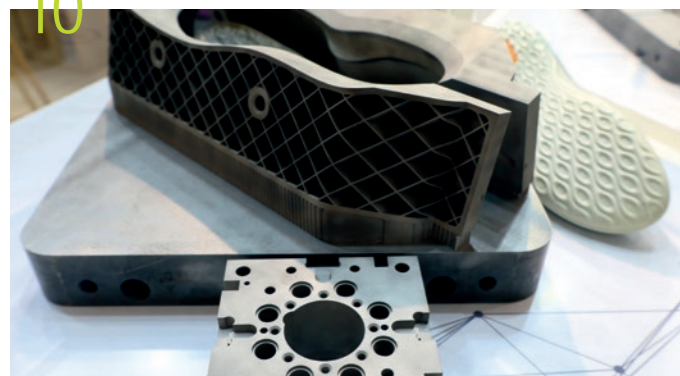


Sincerely, Sascha F. Wenzler  
Vice President Formnext



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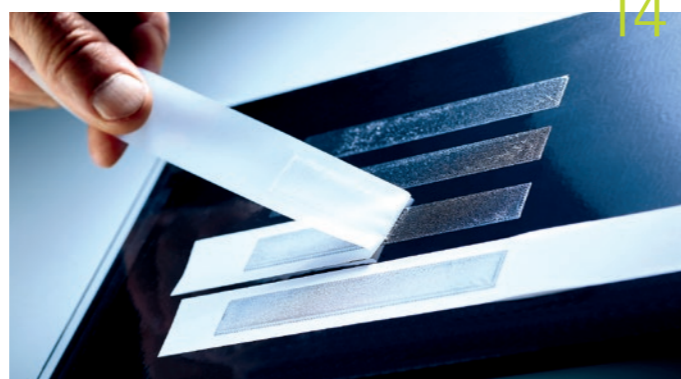
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# FORMNEXT NEWS

## A FLYING START TO THE NEW YEAR

Formnext has hit the ground running in 2022, with nearly 330 exhibitors already in February. »We've never had so many registrations this early in the year,« says a very happy Sascha F. Wenzler, Vice President of Formnext at event organizer Mesago Messe Frankfurt GmbH.

The companies that have signed up hail from 30 different countries and nearly half (49%) are based outside of Germany, which will provide for the usual international flair at the 2022

event. In addition, the amount of space they have reserved has already nearly matched the surface area exhibitors occupied at Formnext 2021. »This outstanding development shows that exhibitors continue to view Formnext as both an invaluable exhibition platform and the most important gathering of the AM industry at large. That's why we're very optimistic about our prospects for a successful 2022 edition,« Wenzler continues. »At the same time, the trend we're seeing underscores the fact that for many

companies in AM, in-person meetings are crucial to succeeding in business.«

Those who attended Formnext 2021 in Frankfurt got to experience this potential up close and personal at what turned out to be the highlight of the year for the world of additive manufacturing. Just under 18,000 visitors flocked to the Hessian finance and exhibition capital to find out more about new products, possible applications, and countless innovative developments all along the process chain. Many exhibitors raved about how knowledgeable they were and how much booth traffic they had, which frequently made it possible to close deals on the spot.

This year, companies can take advantage of an early-bird discount (amounting to more than 17%) until 31 March. Meanwhile, the Digital Days media library is still available online. Formnext's AM Directory also offers the most comprehensive listing of solutions for additive manufacturing.



+ FURTHER INFORMATION:  
» [formnext.com](https://formnext.com)

## FORMNEXT GOES STATESIDE

Formnext has also become a successful international brand, attending exhibitions and hosting its own events around the globe. An important step in this context is the planned launch of Formnext USA 2025.

An important step in the event's globalization will be the launch of Formnext USA 2025. To make this a reality, Mesago Messe Frankfurt and Messe Frankfurt North America recently agreed a strategic partnership with AMT (the Association for Manufacturing Technology) and Gardner Business Media. Formnext USA is scheduled to take place for the first time from 8–10 April 2025 at the McCormick Place Exhibition Center, Chicago, Ill. In prepara-

tion for this, Formnext will, over the next few years, start to expand its presence in the United States with various formats and in the context of this cooperation. An initial step in this direction will be the AM4U Area organized by Formnext at IMTS 2022 in Chicago from 12–17 September 2022. Then, in 2023, Formnext will be in attendance at the Additive Manufacturing Conference in Austin, Texas. From 2024, Formnext Forum Austin will launch as a standalone conference with an accompanying exhibition in partnership with Gardner Business Media and AMT. IMTS 2024 will then once again feature the AM4U Area organized by Formnext. These milestones in the

United States will, in 2025, culminate in the premiere of Formnext USA in Chicago.

This year, there are three international Formnext brand events on the cards: the Rosmould (7–9 June 2022, Moscow, Russia), Formnext + PM South China (14–16 September 2022, Shenzhen, China), and Formnext Forum Tokyo (27–28 September 2022, Tokyo, Japan). Companies in these key markets from across the additive manufacturing and modern industrial production process chain will thus have an opportunity to showcase their innovations and discuss possible applications and developments with participants and visitors.

Photo: Mesago / Mathias Kurt

## NEWS

### »A MINDSET THAT'S NEVER BEEN SEEN BEFORE«

At EOS, sustainability is a topic that's right at the top of the agenda. Among other things, making sustainable manufacturing part of its mission statement has resulted in the subject being »factored into our thinking in all our internal departments,« as Björn Hanappel, head of sustainability at EOS, explained at the company's booth at Formnext 2021 (pictured at right). »We've seen a huge increase in motivation to engage in this effort at our company.«

At last year's event, EOS demonstrated how sustainability can be achieved with innovations like the two new Polyamide 11 materials PA 802 MF CN and PA 820 CF CN, which its subsidiary Advanced Laser Materials (ALM) had brought

to market as certified, carbon-neutral polymers. EOS also presented a systematic life cycle analysis (LCA) it had conducted on 3D-printed glasses frames along with one of its customers, You Mawo, and Fraunhofer EMI, which indicated a 58% reduction in carbon emissions compared to conventional eyewear manufacturing scenarios.

»We're creating a mindset that's never been seen before,« Hanappel declares. He adds that the company's focus is bearing fruit in business terms, as well: Other eyewear manufacturers have expressed an interest in reducing their carbon footprint in production, and major corporations have been aware of the importance of sustainability for some time now.



### LAUNCHED AND SELLING

The number of international product launches a trade show features is a key indicator of its significance – and there were plenty of them at Formnext 2021. One of last year's most important debuts took place at the booth of the U.S. company Markforged. »We had the first public introduction of our new beast of a printer, the FX20 – our biggest, fastest, and

smartest machine ever. The crowds were enthusiastic, we were able to print some awesome parts right on the show floor, and we booked a bunch of orders, which is a testament to the deal-making that happens at Formnext,« raved Michael Papish, vice president of marketing at Markforged. »Our team came away energized and excited for 2022. What a kickoff it was! The

show brought out the big thinkers in additive manufacturing and was extremely well run.« The technical features of the FX20 were presented at regular intervals by Tom Muscolo (photo left), director of product management. Meanwhile, managing director Shai Terem (photo below) took advantage of the opportunity to present some of the 3D-printed parts.



Photos: Thomas Masuch

## NEWS

### »SUPER SIMPLE« CLOUD-BASED SLS PRODUCTION



Wematter, which is riding the wave of digital cloud-based production, used the most recent Formnext event as an opportunity to unveil its Gravity 2022 SLS printer. The Swedish start-up drew a good deal of attention last year, and it wasn't due to its hardware alone. It offers an entire sophisticated ecosystem that includes software and material and is »super simple to use,« as founder and CEO Robert Kniola puts it: »All you have to do is press a button!«

The company, which Kniola founded while still a student, experienced rapid growth thanks to a number of investments. Wematter now employs around 30 people. It has been shipping out its printers since 2019, and according to Kniola, some 100 machines (which are available based on a leasing model) are now out there in the market. The budding firm has also taken the topic of sustainability into account, of course: It

offers its 3D printers at much lower rates for educational purposes, and schools and universities can use powders that would no longer meet production standards if they were to be recycled.



### THE STUFF OF LEGEND



Photos: Thomas Masuch (3), Mesago/Mathias Kurtt (1)

The name Wayland Additive has given to its flagship AM system – Calibur3, which it showed off for the first time at Formnext 2021 – brings to mind the mythology surrounding the figure of King Arthur. The British folk hero is said to have drawn Excalibur's steel blade from a stone with ease, which gave him his rightful claim to the throne. While only time will tell whether Calibur3 and its new EBM technology can write a similarly successful story, Wayland Additive did at least put an auspicious first chapter to paper at last year's event. »After preparing our solution for two years, we thought Formnext was the right place to launch it,« says Pete Hansford, the company's director of business development. »We had a constant stream of visitors at our booth who came with a real purpose and application in mind.«



**Cover picture**  
To demonstrate the capabilities and build area of its AconityMIDI+ unit, Aconity3D GmbH (Aachen, Germany) created this component of pure copper for Formnext 2021. Measuring 250 mm by 250 mm, it has wall thicknesses of less than 350 µm is over 99.5% tight.

## TRENDS

# New materials, processes, and applications boosting business

At Formnext 2021, exhibitors from across the world gave the entire AM industry some real momentum by presenting key innovations and unveiling new products. We asked a few leading AM experts and representatives from prominent companies in the space about the important trends and developments they saw at last year's event.

### MORE QUALITY, COMPLEXITY, AND SPEED



Some strong developments were evident in component quality and new applications. Quality assurance in construction – and throughout the entire manufacturing process, really – has become very important. Further progress has been made in component geometry, as well. Newly developed parameters are making it possible to realize more complex geometries and overhangs without elaborate support structures. In the high-precision world of 3D metal printing (using powder-bed-based laser sintering systems), we're witnessing a constant increase in throughput per machine. High build rates that

don't compromise on a high level of quality remain one of the core requirements of Formnext attendees. By optimizing our software and illumination strategy, we've succeeded in achieving just that with our RenAM 500 series. Many of the visitors we've met at Formnext haven't been looking for an isolated process you'd use in a lab; they now need a comprehensive solution that integrates seamlessly into both shop floor and parallel digital factory scenarios.

Rainer Lotz  
President EMEA, Renishaw

### SOLIDARITY!

At Formnext 2021, the biggest trend was a simple one: togetherness. After 2020 kept the world apart, we will never again take for granted the simple power of being together. Further, we saw the importance of coming together on vital collaborative efforts. Sustainability, partnerships, and a shared vision will be what push the AM indus-

try forward to make the world a better place. We are proud at Nexa3D to be on a mission to digitize supply chain sustainably, supported by our team, partners, and customers around the world.



Avi Reichental  
Co-Founder, Chairman, and CEO, Nexa3D

Photos: Renishaw, Nexa3D

Photos: Arburg, AM Ventures, Wohlers Associates

## TRENDS

### PROCESSING OF SOPHISTICATED MATERIALS



When it comes to freedom of design, weight and material reduction, individuality, and high efficiency, AM has become an essential part of innovative applications in fields like medical technology and lightweight construction. The key trends at Formnext 2021 had to do with turning sophisticated materials like PEEK into custom medical implants, and with solutions for tracking and documenting components like

these. For manufacturers like us, it's important to have the ability to cover not just high-quality mechanical technology, but the entire process chain in AM.

Lukas Pawelczyk  
Head of Sales (Freeformer), Arburg

### FINALLY – SERIAL APPLICATIONS FROM SYSTEM PROVIDERS

Formnext 2021 was a fantastic event in a lot of different respects. In particular, the established system providers finally did more than just present their machines – they showed what users can do with AM technology, namely make products in series. The electric motors, heat exchangers, lightweight and energy-related components, and other applications they unveiled also affirmed that additive manufacturing is a key technology in the fight against climate change. I thought it

was also great to see that it's still possible to get together in person, which is something people long for and still an important catalyst for business. All across the industry, we saw an increase in incoming orders that lasted from Formnext until the end of the year. That was surely thanks in part to the personal contacts made possible by the marketplace of AM.

Arno G. Held  
Managing Partner, AM Ventures Management GmbH



### FOCUS ON POST-PROCESSING AND FINISHING

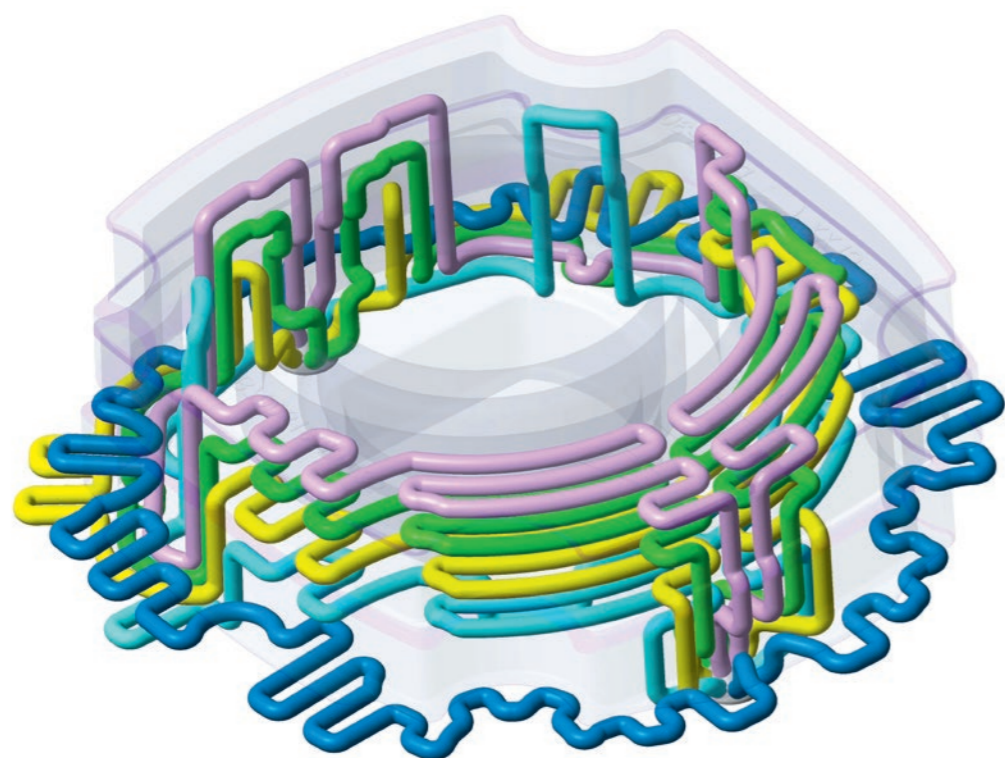


Formnext 2021 showed how the AM industry is advancing with new and improving materials, processes, applications, workflows, and end-to-end solutions. One trend is an emphasis on post-processing and finishing. The most talked about were post-process automation and an increase in efficiency, with the goal of lowering the cost per part and increasing reliability and repeatability. Software companies presented new design platforms and manufacturing execution system solutions. Gen3D's generative design for lattice struc-

tures is one example. We also saw growth in electron-beam powder bed fusion systems from Freemelt, GE Additive's Arcam, JEOL, Pro-beam, and Wayland Additive.

Terry Wohlers  
Head of Advisory Services and Market Intelligence  
Wohlers Associates  
ASTM International's Additive Manufacturing  
Center of Excellence

# AN ADDITIVE REVIVAL IN A TRADITIONAL INDUSTRY



3D-printed inserts have already seen use in making tools and molds for a number of years. Here, tools built using AM techniques can make the production processes involved in plastic injection molding or aluminum extrusion much more efficient. In the rather conservative world of mold-making, however, AM hasn't had the easiest time gaining acceptance in comparison to other industries. This has now changed of late, with new materials and improved machine performance driving an apparent increase in demand for 3D-printed mold inserts. The surrounding market – which has a potential volume of hundreds of millions of dollars – is coming back into the frame for manufacturers of 3D printing systems, as well.

Text: Thomas Masuch

Photos: iQtemp (left), Thomas Masuch (top right)



Meeting of the minds in mold design: Carlo Hüsken (left) heads the start-up iQtemp GmbH, which specializes in conformal cooling. Günther Rehm handles the company's sales and marketing efforts. Hüsken has been working on 3D-printed mold cores for more than 15 years, starting at LaserBearbeitungCenter in Kornwestheim (southwest Germany) in 2006. In late 2019, Hüsken and Rehm joined Listemann Technology AG in founding iQtemp GmbH as an independent member of the Listemann group.

**W**hile 3D-printed shoe soles are considerably more stylish and eye-catching, the world's shoe production methods remain largely conventional in nature. Molds are used to manufacture most soles that aren't made of leather, and corresponding injection molding systems churn them out by the hundreds of thousands (or even millions). That said, this is another area where companies keep AM tools close to hand. To increase the efficiency of their injection molding operations, manufacturers sometimes utilize 3D-printed mold inserts. These are typically produced through powder bed fusion.

In 3D-printed mold cores of this kind, cleverly positioned, flow-optimized cooling channels facilitate much better cooling rates, which in turn makes for shorter cycle times. This ultimately means that injection-molded plastic soles roll off the line faster. It's a fairly simple concept, and it can be applied to everything from shoes to plastic bottle caps or operating controls in vehicles.

You'd think that this would set an ideal stage for AM to see more widespread use in tool and mold making. The mold production industry was, after all, one of the first to realize how it could benefit from this technology. 3D-printed mold inserts have been on the market for more than 15 years now, but at the beginning of that period, traditional mold manufacturers struggled mightily with the technological limitations and lack of economic viability they perceived in these products.

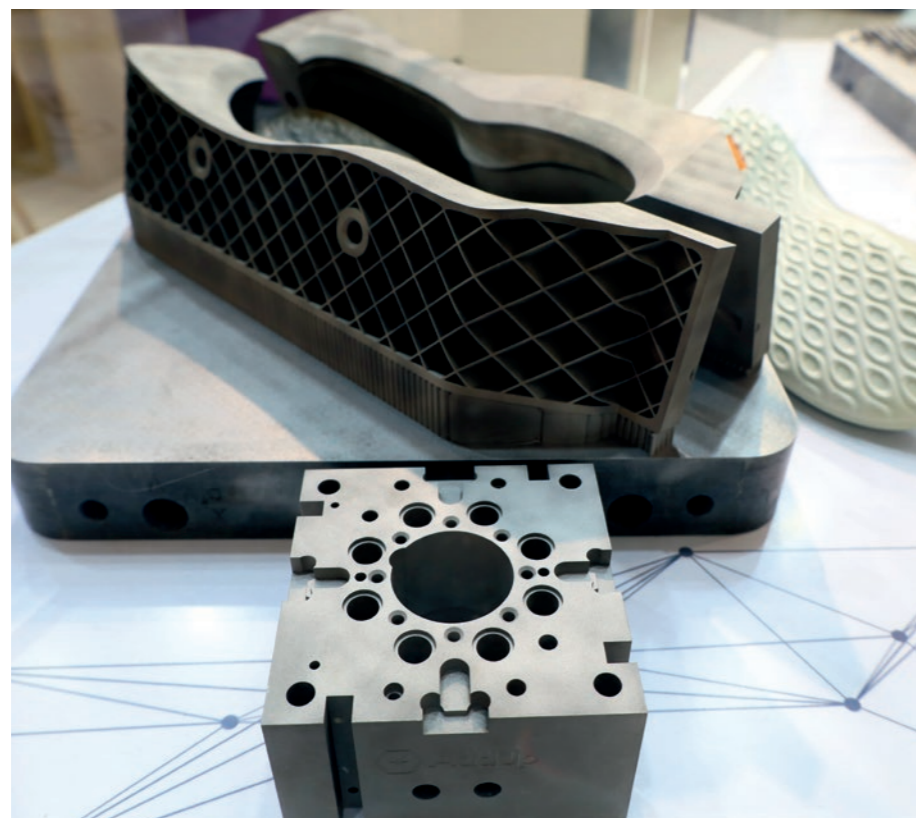
## SHORTER CYCLE TIMES AND MORE CONFIDENCE IN QUALITY

A subtle change in this trend was in the air at Formnext 2021, where a number of manufacturers and service providers dedicated some of their booth space to their latest 3D-printed mold inserts. »Overall, we're seeing stronger interest in the market; 3D-printed mold inserts are becoming more and more popular,« affirms Günther Rehm, sales and marketing manager at Liechtenstein's Listemann group and co-founder of the start-up iQtemp GmbH, which specializes in inserts of this kind. »The mold-making industry continues to gain confidence in the quality of these inserts.«

Meanwhile, Mathias Schmidt-Lehr has observed a similar trend in forming tools. »We've noticed an increase in the use of tools containing 3D-printed components, particularly in the automotive industry,« the co-founder and CEO of the AM consulting firm Ampower (Hamburg) reports. »When hot-forming steel, for example, tools with 3D-printed inserts and active local cooling appear to offer an advantage: Apart from optimizing cycle time, they make it possible to achieve higher degrees of deformation.«

## GREATER MATERIAL DIVERSITY, FASTER AM SYSTEMS

The rise in demand for 3D-printed tool inserts in mold making also has to do with the technological advancements made in 3D printing more broadly, especially with regard to »



The footwear industry is a key market in mold-making. This 3D-printed mold insert was presented by Addup at Formnext 2021.

materials and powder bed techniques. »Around 10 years ago, for example, there was only one material we could use to make molds: 1.2709, which is a martensitic steel that doesn't hold up very well to corrosion,« explains Günther Rehm. He goes on to report that five to seven types of steel compatible with mold construction are now available, and iQtemp uses three of them (in addition to 1.2709). Along with the corrosion-resistant variants M789 and W360 from Böhler, it works with an advanced version of 1.2343 that Rehm says supports extraordinary levels of hardness, which makes it particularly suitable for aluminum extrusion.

At the same time, considerable improvements have been made in 3D printers in recent years. Many now come with four lasers instead of one, and some feature heated build areas that mitigate differences in temperature during production. This makes the resulting components less brittle and reduces their residual stress. »This hasn't just lowered the costs involved in 3D-printed mold inserts quite a bit,« Rehm says. »We're achieving an entirely different level of material quality, as well. We can reproduce the structure of rolled steel, and the surface of it can be polished to a shine.«

### AM MAKES SENSE IN 15% OF INJECTION-MOLDED INSERTS

According to Günther Rehm, whether or not a 3D-printed insert is economically advisable »always depends on the application at hand«. He says that in technical terms – that is, when the components involved aren't too big – AM methods can be used to make inserts for around 30% of all molds. Actually doing so is only cost-effective around half the time, though.

If one estimates the volume of the global mold manufacturing market at U.S.\$68.5 billion (2020; source: Business Wire), 15% corresponds to approximately U.S.\$10.3 billion. Since a mold insert accounts for 1–5% of the overall cost of a corresponding tool, 3D-printed inserts have the potential to generate U.S.\$100–500 million every year.

This falls far short of sectors like sporting goods or components for dental, aviation, or automotive applications, but it's enough to make mold construction an intriguing market for companies that build 3D printers – especially in light of the industry's growth rates, which have consistently hovered around 5% per year.

### »WE WANT TO MAKE A DIFFERENCE«

»The field of tool and mold making is definitely one that interests our company,« states Frédéric Le Moullec, sales director at Addup. Le Moullec cites the size of the German market – which is four to five times larger than that of France, where Addup is based – as the reason why he and his team are concentrating mainly on their neighbors to the east. »As a French company, it was crucial that we position our machines in the German market without getting into industries where the competition was already intense,« he continues. »Those industries are also important to us, of course, but we wanted to make a difference. That's why we decided to really focus on tool and mold making.«

This clear orientation was also apparent at Addup's Formnext booth last November. There, the company showcased inserts for shoe molds and mold components that had been 3D-printed on its own FormUp 350 machines, which Michelin has also been using to manufacture tires for many years.

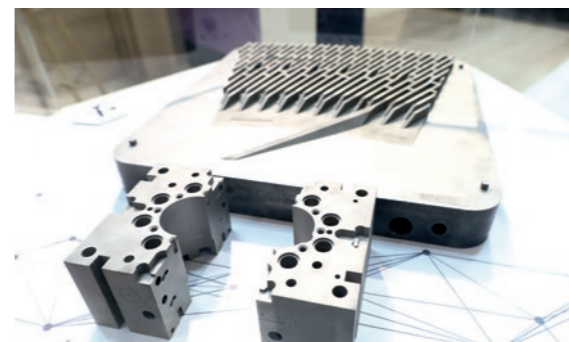
### WEATHERING COVID WITH APLOMB

Meanwhile, Le Moullec is another industry figure who sees material developments as a key

Photos: (3): Thomas Masuch

Above:  
At Formnext 2021, Addup also showed off mold components that Michelin has already been using for years in tire production.

Below:  
Frédéric Le Moullec, sales director at Addup (left), with key account manager Jörg Oster



element of AM's revival in tool and mold making. »Thanks to new and purpose-specific materials, we're now in an even better position to increase the quality of our 3D-printed tools and offer more value compared to those made using conventional techniques,« he reports. This is an important argument from the economic perspective, as well. »After all, that's what ultimately determines whether or not a company invests in additive manufacturing.«

Besides its potential for business, tool and mold making is an interesting field for Addup because it »presents an opportunity to get into real-world applications quite quickly – without having to go through a five- or 10-year certification process like we would in aviation, for example,« Le Moullec explains. Furthermore, the industry seems to have withstood the effects of the coronavirus crisis better than other sectors. »Aviation was an area that saw

significant cutbacks in investment, but the strong demand for tools and molds for things like shoes or new models of cars hasn't let up,« Addup's sales director points out.

### THE DIFFERENCE IS IN THE DESIGN

Along with the technical prerequisites at hand, the question of whether 3D-printing new molds like these is a good idea depends on a number of other variables. »Additive manufacturing alone isn't enough to guarantee a quality mold,« says Günther Rehm. »The designs are what counts, and they can vary quite a lot.« According to Listemann's resident expert on the subject, this is why the differences in performance between 3D-printed mold inserts and those produced conventionally are difficult to quantify. In order to reduce cycle times by 10–30% (thereby increasing output), he says the design phase is where companies in the space will first need to devise sophisticated ways of maximizing the wide-ranging possibilities afforded by AM. »Under ideal conditions, we can even get 50% faster,« claims Rehm, who cites the improved quality that can typically be achieved in plastic components as another benefit.

He goes on to describe how technological advancements in production systems have driven down the cost of 3D-printed mold inserts, leaving less and less of a difference between these and their conventionally manufactured counterparts. »This is also due to the fact that AM components usually don't require nearly as much post-processing after the hardening phase because AM gives us more of an ability to compensate for the warping that can occur during heat treatment,« Rehm reveals. »That's why 3D-printed mold inserts don't always have to be more expensive when you consider all the factors in play.« And even if AM does result in 10–30% higher costs, Rehm says the technology pays for itself in just a few weeks or months through the resulting increase in production output.



#### Powder Bed Fusion

For further information on this procedure, check out the AM Field Guide at [formnext.com/amfieldguide](https://formnext.com/amfieldguide)

### + FURTHER INFORMATION:

» [formnext.com/fonmag](https://formnext.com/fonmag)

» [addupsolutions.com](https://addupsolutions.com)

# IN THE FUTURE, TESA IS PLANNING TO STICK THE LANDING



Text: Thomas Masuch

Photos (4): Tesa SE

*Left:*

These test strips on a base plate of ABS show how well corresponding adhesive products will perform.

*Right:*

Tesa experts Frank Virus (left) and Manuel Bendeich work on a contact adhesive with their Freeformer.

While adhesives seem rather unspectacular at first glance, industrially made products from smartphones to entire vehicles would now be virtually unthinkable without them. This is why the industrial significance of the adhesives industry is so great – and the pressure to innovate so high. It's no wonder that this is another field in which companies are relying on the inventive power of additive manufacturing. One of the industry's leading companies, Tesa, recently joined forces with Arburg to develop 3D-printed adhesive solutions that could pave its way into new markets and open up fresh business opportunities.

Adhesives are nearly as old as the cultural history of humanity itself. It was more than 100,000 years ago that our Stone Age forbears started affixing knives, spearheads, and axe blades to wooden shafts using tree sap and birch pitch. Today, the strong demand for adhesive bonds has given rise to a major industry that has a fundamental influence on how modern industrial products are made. »A smartphone can contain up to 70 Tesa tapes, and an electric car as many as 130,« points out Frank Virus, who works in technology and product development at Tesa SE. Headquartered in Norderstedt (near Hamburg, Germany), this subsidiary of Beiersdorf AG employs around 4,800 people and specializes in self-adhering solutions of this kind.

In its development of new products, Tesa has also had an eye on 3D printing for several years now. Its first related ideas and concepts date back to 2011. »The technology hadn't advanced far enough back then, though, and it didn't support industrial use,« Virus recalls, noting that this has since changed. »The prerequisites in terms of technology and acceptance are very different now.« Tesa dusted off the idea of 3D-printing tape a few years ago and has now been using a Freeformer from Arburg in product development since 2019. After borrowing a 200-3X at first, the company eventually purchased a larger 300-3X unit. It also uses machines from the Arburg subsidiary innovatiQ for some of its material recipes.

#### »REACTIVE 3D PRINTING« OF TAPE

3D-printing tape requires a sophisticated system. After all, adhesives contain a large amount of basic chemicals that are processed into the desired sticky substance. »Our process involves reactive 3D printing, which means the adhesive is produced during the process itself,« Virus explains. Tesa's 3D-printed tape thus exhibits certain process-related properties. Unlike liquid adhesives, they have a specific thickness and retain their form, for example, which Virus says is necessary in manufacturing smartphones or parts of vehicle chassis.

To print tape using a Freeformer, granulate is first produced in a special procedure known as underwater granulation. This initially cools the granulate and keeps it from drying out, which »

#### About Tesa SE


Tesa is a multinational company that develops innovative adhesive tape and self-adhering system solutions for both end consumers and customers in industry and commerce. Since the age of adhesive tape designed for technical purposes began in Hamburg 125 years ago, Tesa has expanded to 100 countries and now has plants in Germany, Italy, China, and the United States (with another currently planned in Vietnam). Industrial applications account for approximately three-fourths of the Tesa Group's revenue, which amounted to just over €1.3 billion in total in 2020. Since 2001, Tesa SE and its around 4,800 employees have been a fully owned independent subsidiary of Beiersdorf AG (which also owns brands such as Nivea, Eucerin, and La Prairie).





Left:  
Frank Virus works with a Freeformer.

Right:  
Among other applications, these adhesives make it possible to bond smartphone components without any waste.

 **Material Extrusion**  
For further information on this procedure, check out the AM Field Guide at [formnext.com/amfieldguide](http://formnext.com/amfieldguide)

would cause it all to stick together. In a subsequent step, the granulate is coated with powder so that it can be stored. Using it in the Freeformer heats it back up and mixes it together, which reactivates its adhesive properties.

**PROMISING WAYS TO GENERATE FURTHER VALUE**

Tesa's methods of 3D-printing tape have already advanced to the point that a large part of its current portfolio could theoretically be produced using AM techniques. Compared to traditional tape production, however, these methods are significantly more complex. »When it comes to manufacturing our established products, we usually can't be competitive doing it that way,« says Virus, who sees more possibilities for 3D printing in the development of new products. He considers it crucial that such offerings be able to offer additional value compared to previous adhesive solutions.

Virus sees the demand growing for more advanced products like these, particularly with Tesa's customers increasingly looking for more than a simple adhesive bond between two surfaces. They need solutions that also provide insulation, work as a sealant, or offer thermal or electrical conductivity. »3D printing is an excellent way to realize special characteristics like these,« Virus reveals. As an example, he says it would be possible to make tape based on a sandwich design involving middle layers made of ABS and TPU or TPA, which would give the tape much stronger mechanical properties. Due to these wide-ranging possibilities, Virus is convinced that 3D-printed adhesive solutions will be much more than mere niche products in the future.

Another advantage of the tape printed on Tesa's Freeformer is significantly greater sustainability. Using the company's conventional method of stamping tape out of sheets, up to

90 percent of the material it starts with ends up in the garbage. »With 3D printing, 100 percent of our adhesive material goes into our products,« says a happy Frank Virus.

Those who stopped by Arburg's booth at Formnext 2021 had the chance to marvel at an example of a 3D-printed adhesive application involving smartphone displays. Outside of electronics, Virus sees the most potential for applications like these in the automotive industry – and this may be the most promising area of all. »3D printing has been a topic of interest for a while now in that field, and the level of acceptance is somewhat higher as a result.«

It's clear that AM technology is likely to play a key role in Tesa's development of new products going forward. Here, Virus is also contemplating other potential benefits, including the possibility of printing honeycomb structures or various materials in different

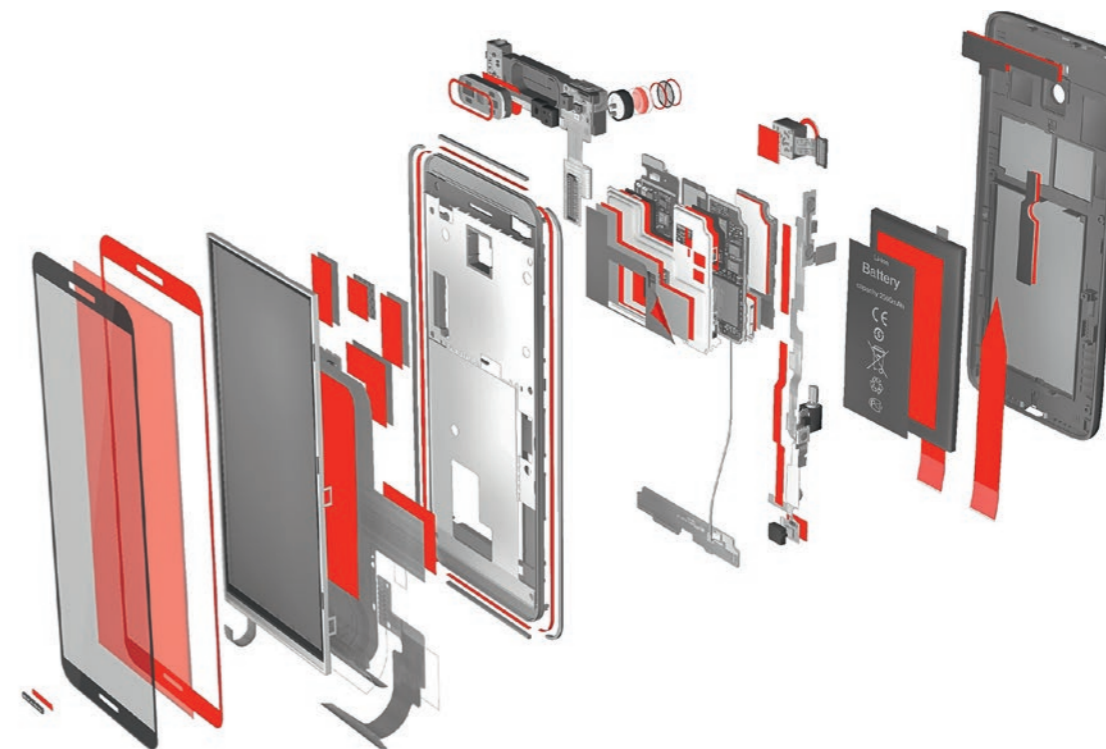
layers. »With the Freeformer 300-3X and its three discharge units, these things are definitely possible,« he says.

**FROM ADHESIVE PRODUCTS TO SYSTEM SOLUTIONS**

Thinking even further down the road, Virus can imagine an entirely new approach to product design in which Tesa bids farewell to the very idea of tape – at least in part. It would involve 3D-printing adhesive material directly onto components, which would significantly expand the company's business model. Instead of producing sheets of tape and delivering them to customers on rolls, for example, Tesa would offer an entire process including a 3D printer, material, and control components. This would

enable firms like automotive manufacturers or suppliers to print their own custom adhesive solutions onto vehicle chassis.

It's hardly surprising that this idea is currently attracting a lot of attention at Tesa: After all, the company would go from exclusively offering adhesive solutions to delivering entire systems – and potentially tap into all-new opportunities in the process. This would require a great deal of development effort, though. At the moment, Frank Virus and his team are working on a variety of technical feasibility studies. The next step toward a decentralized production solution would entail certification and the need to ensure both data security and consistent product quality – all significant hurdles that Tesa would need to overcome.



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# TIMBER, GREENHOUSES, AND 3D PRINTING

For Vicente Guallart, sustainability is about much more than recycling and green electricity. The internationally renowned architect designs model cities in which renewable raw materials, a circular economy, and a new social coexistence are the guiding principles of planning. 3D printing also plays an important role as a means of reusing plastic locally and turning it into everyday objects. We talked to Guallart about exactly how this will work.



Guallart's plans for the future city of Xiong'an

China is a very good location to witness innovative urban planning right from the drawing board. After all, it's the only place in the world where so many new cities are springing up seemingly out of nowhere: In the last two decades, there have been an average of 20 of them each year. It's no wonder, then, that Vicente Guallart's plans to rethink city life have also met with approval in the country. At the end of 2020, the Spaniard won an international competition to build a neighborhood of one planned city of the future, Xiong'an. This sustainably planned metropolis

is located around 120 kilometers south of Beijing in a so-called National New Area that will be under the direct control of the central government. New urbanization concepts that combine high technology and sustainable living are to be used to create a new home for 2.5 million people under one – or rather, many – roofs. According to forecasts by Morgan Stanley, 290 billion U.S. dollars will be invested in the next 15 years.

In the self-sufficient neighborhood he is planning, Guallart is banking on his favorite building material – wood – which he intends to use as the main material for the four-block

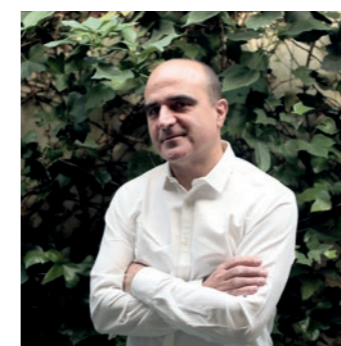
Photos: Vicente Guallart

Text: Thomas Masuch

building complex. At the same time, he intends to change the way people live together. Production and small trades, for instance, are to return to this residential quarter instead of being relegated to the suburbs as they have been in the past, as Guallart explains. »With this holistic approach, we're making a fundamental statement: We're building a city where we produce everything that's needed – energy, food and other things.« The first floor of the buildings will thus feature offices and workshops where 3D printers will create everyday items such as shoes, tables, chairs, and bags. But Guallart

doesn't see recycling as the ultimate solution to sustainable living. »Additive manufacturing isn't everything, and it's not just about recycling and keeping plastic further in the cycle,« he says. »Ultimately, we just have to use other materials.«

The idea of people living and working in the same building is reminiscent of everyday life in the cities of the Middle Ages and ancient times. However, Guallart's back-to-the-future urban planning encompasses even more: The top floors feature greenhouses in which the neighborhood's some 3,000 residents will grow fresh



vegetables. On the large south-facing balconies, which also serve as heat regulators, these future citizens will be able to relax or work from home via 5G.

Whether Guallart's plans will be implemented to the letter remains to be seen over the next few years. Until then, the technical implementation of material recycling for 3D printing will probably be further refined. Guallart also wants to offer his concept to other cities around the world. He has already implemented parts of it working as chief architect in Barcelona. Meanwhile, his familiarity with 3D prin-

ting technology is well established: In 2016, the Institute for Advanced Architecture of Catalonia (IAAC, which Guallart founded) 3D-printed a concrete pedestrian bridge that now beautifies the Castilla-La Mancha urban park in Madrid.

## Vicente Guallart

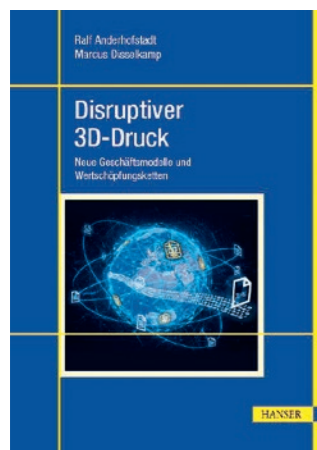
Vicente Guallart is an architect from Barcelona who develops projects for ecological cities and buildings across the globe through his company, Guallart Architects. He has won numerous international competitions, including Housing Post-COVID in Xiong'an (2020) and the Xianmi Hu Master Plan in Shenzhen (2018). As the city's chief architect (2011–15), he also spearheaded major transformations in Barcelona, which was named the European Capital of Innovation in 2014. In addition, Guallart founded the Institute of Advanced Architecture of Catalonia in 2001; there, he is currently working on the development of biocities at the Vallldaura Labs center. Finally, he is the author of numerous books, such as The Self-Sufficient City, Geologies, and Plans and Projects for Barcelona.

## + FURTHER INFORMATION:

- » [formnext.com/fonmag](http://formnext.com/fonmag)
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## TALKING ABOUT

# In »Toxic« Models, Opportunities Abound



The new book *Disruptiver 3D-Druck* (»Disruptive 3D Printing«), which is scheduled to be published this summer by Hanser Verlag, deals with how AM is shaking up some of the world's value chains. Authors Ralf Anderhofstadt, head of the Center of Competence 3D-Printing at Daimler Truck and a lecturer on the subject of AM, and Dr. Marcus Disselkamp, a university professor, specialized author, and business coach, explore subjects like toxic business models and new business opportunities while also covering the technical aspects of 3D-printing a wide variety of materials. Among other contributors, our own Sascha Wenzler (Vice President of Mesago Messe Frankfurt GmbH) offers insights into the current developments and what the future might have in store for this exciting technology. We recently had the chance to talk with Ralf Anderhofstadt about the new book.

*The announcement of your new book refers to the many new business models in this field – some of them toxic. Could you give us some specific examples?*

**ANDERHOFSTADT** A lot of bank-related and financing transactions can be considered toxic in cases where innovations aren't leveraged in time to create value that rewards customers for these transactions. 3D printing results in toxic business models like these, as well. Take warehousing, for instance: In areas where decentralized production and the creator economy continue to gain ground, we're only going to need storage services for the raw materials required for additive manufacturing – not for finished products. There's probably going to be a significant decline in the amount of goods being warehoused – and, for that matter, transported – because instead of physical products, data on how to make them will be sent around the world and stored temporarily. That doesn't mean »game over« for all the logistics companies out there, though. Toxic business models are those that don't change with the times to offer new value to other business partners in the various new roles they're playing.

*And what kinds of business models are going to present new opportunities?*

**ANDERHOFSTADT** Well, let's stick with the topic of the creator economy. In our understanding of the term, the users and customers typically targeted by companies don't just provide their own ideas for new products and services; they create and sell these things themselves. When consumers become the manufacturers (or even developers) of products, it gives rise to unprecedented opportunities and roles for their respective companies.

*The wide-ranging prospects offered by 3D printing have been an exciting topic for years. Why are you publishing this book now, and why is it important at the current moment?*

**ANDERHOFSTADT** Industrial 3D printing has made significant strides in recent years, and it's already being used in serial production in some sectors. This is resulting in more and more intriguing business models across the individual industries in play. At the same time, however, additive manufacturing is still only viewed through the lens of prototyping, and there's a strong focus on construction design. As interesting as the facets and possibilities in this area are, we need to perceive the potential of 3D printing in its entirety, meaning all along the value chain. And there's no time like the present!

*And finally, who is this book geared toward?*

**ANDERHOFSTADT** It's meant for managers and decision-makers at service providers, logistics companies, and industrial firms, as well as for professors and students of economics, law, IT, and business administration.



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Text: Thomas Masuch

Photos: Disselkamp/Anderhofstadt

## TRENDS

## 3D HOME BUILDER BEGINS IPO

**A**pis Cor, which specializes in 3D-printing real estate, has become the first AM firm in construction to be listed on a stock exchange. The Florida-based start-up was given the green light by the U.S. Securities and Exchange Commission in January. According to Smartech Publishing, the global market for 3D printing in construction is expected to grow beyond U.S.\$40 billion within the next five years. In the process, this somewhat traditionally minded industry will gradually step ever further into

the digital age. »Our goal is to automate the entire process of building homes and reduce the overall construction time required from three months to just five days,« revealed an exuberant Anna Cheniuntai, CEO of Apis Cor, as she presented the company's plans for the future. The tremendous advancements the underlying technology has made and the possibilities it now affords were showcased in the special exhibition BE-AM (Built Environment Additive Manufacturing – see image) at Formnext 2021.



## MBJ TECHNOLOGY PASSES AEROSPACE TESTS



**A**erospace supplier JPB Système has been putting metal binder jetting (MBJ) through its paces for several months and the results have been extremely positive. The French company, which provides its products to well-known manufacturers such as Safran, Pratt & Whitney, GE, and Rolls-Royce, was able to cut its production time by 80 percent for some parts during the tests and, even more importantly, achieve weight reductions of 30 percent. »As we anticipated, our trials with MBJ technology have underscored

how its versatility and ability to reduce time and costs offer huge benefits to both our company and our customers,« explains Jocelyn Vecchio, director of engineering and innovation at JPB Système. »Along with limitations on the geometries we can achieve, we usually have to deal with expensive tooling that can entail long lead times of around six months – or even longer if the geometries change and a new mold is required. The additive MBJ process has reduced our manufacturing time from about six months to around just four weeks.«

## PROCESS DEVELOPMENT WITH STATE-OF-THE-ART LASER SYSTEMS

**T**he Fraunhofer Institute for Laser Technology ILT in Aachen and Trumpf Laser- und Systemtechnik GmbH from Ditzingen / Germany have signed a cooperation agreement. They want to cooperate more closely in the field of Laser Material Deposition and accelerate the transfer of the technology to industry. Customers will benefit from the unique combination of leading laser system technology and many years of application-specific process know-how. »When we transfer our technologies to indust-

rial applications, our customers are increasingly focusing on the questions of systems engineering implementation, especially with regard to the availability, stability and suitability of the components,« explains Dr. Thomas Schopphoven, head of the Laser Material Deposition Competence Area at Fraunhofer ILT. For process and application development in Aachen, Trumpf provides the team at Fraunhofer ILT with state-of-the-art laser systems that have various optical systems and powder feed

nozzles. »In this way, we research our processes directly on industrially relevant systems. This enables us to transfer our research into customer applications particularly efficiently,« says Schopphoven. The plant will be installed at the beginning of this year and available for the first tests in the spring. Numerous promising applications are already in sight, such as the economical coating of passenger car brake discs or the wear and corrosion protection of hydraulic cylinders.

Photos: Mesago/ Mathias Kurt, JPB Système

## »OUTSIDE THE BOX«



## No scaling? No problem

The notion that working just for the sake of it is contrary to human nature isn't exactly new. In fact, the English physician and philosopher John Locke (1632–1704) was doing his best to get the word out over 300 years ago. The beliefs of this renowned pre-Enlightenment figure nevertheless seem more current than ever in the industrialized nations of the West. In the United States, millions of people decided to quit their jobs last year in a wave that has been dubbed the »Great Resignation«. Rarely have so many been looking forward to the day they'll be able to put their feet up for good, as well: According to a survey conducted by the New York Federal Reserve, the share of U.S. citizens who can see themselves working beyond their 62nd birthday has fallen to 50.1 percent. This means around half of the country's 150 million employees are planning to retire early.

One reason why that sweet idleness has become (even) more attractive may have to do with how bullish the stock market has been of late, which has surely plumped up the pensions

many people have to look forward to. Last year, it almost didn't matter which shares you bought, especially in the U.S. The market was booming behind big tech companies like Apple, Microsoft, Amazon, Alphabet, Facebook, Tesla, and Nvidia, which are close to having monopolies in some areas of their respective sectors. You could practically take the Homer Simpson approach – that is, make investments without any particular expertise and watch the money roll in.

Those holding shares in 3D printing companies, however, were probably somewhat less enthused. While these stocks also rose along with the rest of the market, their long-term performance has been rather modest compared to the likes of Apple and Tesla. In spite of the AM market's growth, which has averaged around 20 percent for a number of years now, most companies' share prices are currently well below their all-time highs.

Part of the reason why is surely that, for all its cutting-edge characteristics, additive manufacturing is still more »industry« than

»tech«. An integral element of success in the latter realm – namely the art of scaling up – is considerably harder to achieve in the world of AM. The applications are complex, after all; they often require a lot of expertise, and they can't be reproduced as many times as one wishes.

This may have disappointed many investors, but it does come with a silver lining for the AM industry: In the world of 3D printing, individual companies don't have monopolies. An atmosphere of fair competition has emerged, and the sector tends to stick together like one big »fAMily«. Meanwhile, the market is still healthy and growing thanks in part to the young, innovative companies that join it every year. That's great to see at any scale.

## AM4U

Technical and economic changes are setting a rapid pace, especially in our industry. Exchange, knowledge transfer and inspiration is therefore also our mission before and after Formnext. Throughout the year, you'll find exciting AM-related content.

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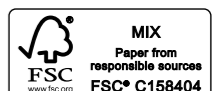
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