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formnext magazine

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Luckily, the good thing is that 3D printing is much more complicated than most people think.

[Fried Vancaen, founder and managing director Materialise]

Cover: Mathias Kurt

EDITORIAL

When I think of series production, the first things that come to mind are textile factories in England and Henry Ford's automotive assembly lines. However, the history of techniques like these actually goes back many hundreds – even thousands – of years. The ancient Egyptians used such means to produce blocks for their pyramids, for example. While their methods were entirely manual, they were already following quality principles similar to those we now see in modern series production: The hefty blocks also had to meet precise specifications in terms of material, surface quality, and dimensional stability. Otherwise, they wouldn't have fit together or been able to bear such enormous weight.

These days, many areas of industry would be unthinkable without series production. Also, in the field of industrial use of Additive Manufacturing (AM), it is no longer a question for me whether the path towards series production is the right one, but only with what speed, what technology and to what extent.

More and more applications in series production prove this from very different user industries and using different AM technologies. Futurologists and consulting companies confirm the continuing upward trend for the coming years.

The entire production process, its stability, control and seamless monito-

ring are crucial. The necessary international standards and norms are also a prerequisite. And not to forget continuous automation across all process steps, including pre- and post-processing.

There is still a lot of potential to be tapped, for example, from hybrid production using the advantages of different technologies and materials. And in my opinion, AM in particular offers great opportunities to answer essential questions about sustainability, recycling and resource conservation in industrial manufacturing.

Still in 2020 and beyond, AM remains a »life changing technology« and with Formnext we are pleased to be part of this path and to help shape it. And who knows? Maybe we'll also succeed in creating products that will one day seem as groundbreaking to future generations as the pyramids to us.



Sincerely, Sascha F. Wenzler
Vice President Formnext



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FORMNEXT NEWS

BEST PERSPECTIVES

By showing numerous world premieres and an impressive growth Formnext 2019 inspired with best perspectives for the continuously growing additive manufacturing industry. 34,532 specialists and managers (2018: 26,919) were swept away by an impressive Formnext 2019. 852 exhibitors (2018: 632) made Messe Frankfurt the stage for the ever-increasing fields of application of additive manufacturing.

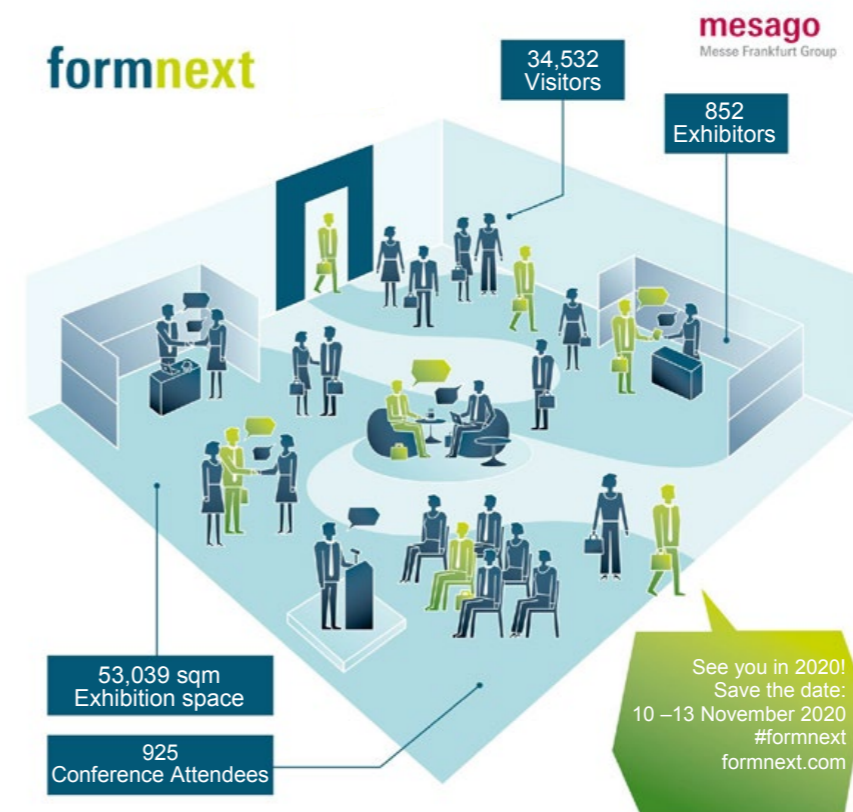
Global market leaders, international corporations and numerous young companies presented world firsts along the entire process chain. With an impressive degree of internationality of visitors from 99 nations, Formnext has once again proven its position as the world's leading trade fair for additive manufacturing and modern industrial production. Also, the move to the modern and architecturally-sophisticated exhibition halls 11 and 12, which was due to strong growth, has thus proved its worth.

»Even in its fifth year, Formnext continues its impressive success story«, states Sascha F. Wenzler, Vice President Formnext at the organizer Mesago Messe Frankfurt GmbH. »Additive manufacturing has definitely arrived in the industry. Together with our enormously dynamic industry, we will continue to accompany, support and advance this development as a trade fair organizer.«

The visitors were also enthusiastic about the development of Formnext and the numerous innovations of the exhibitors. »Formnext is a one of a kind show in the entire world. There is no other place where you can go and meet companies from all across the additive value chain in Europe, United States, China and other market places. The amount of value that we get out of participating and the ROI of visiting is incalculable«, commented Haden Quinlan, Program Manager, Center for Additive and digital Advanced Production Technologies at Massachusetts Institute of Technology (MIT). Lee Bilby, from

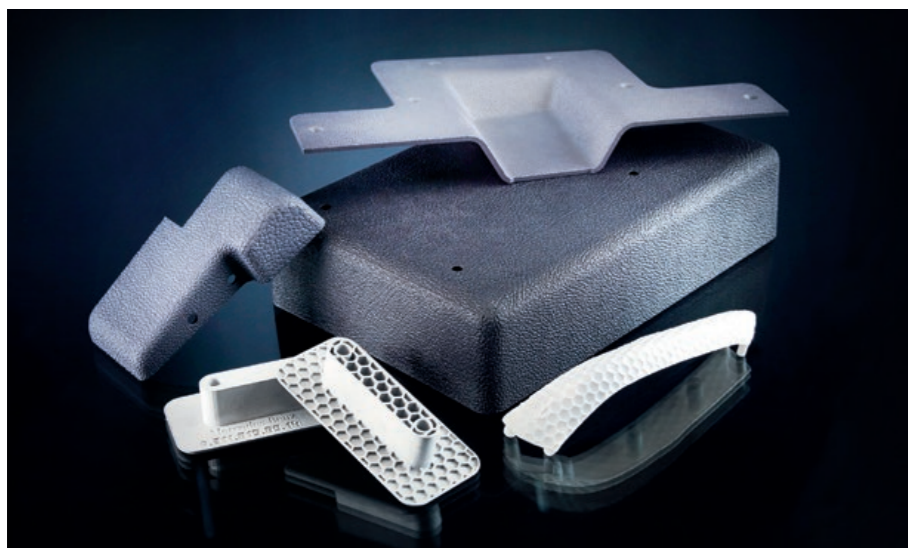
Bilby 3D in Australia, added: »This Event is so worth traveling around the world for!«

For the industry, Formnext is an important business platform at which many companies record concrete business transactions directly on the exhibition floor. The still young world of additive manufacturing is also attracting more and more investors. With the Start-up Challenge and the Start-up Area, Formnext in 2019 was again able to offer these companies an efficient trade fair platform to present themselves to an international trade audience and pave the way to a successful entrepreneurial future through contacts with investors.



Formnext 2019: all figures at a glance.

NEWS



SPARE PARTS AND DECOR COMPONENTS FOR BUSES

Daimler Buses has now announced the next step in spare parts supply using 3D printing: At the end of 2020 these will be manufactured directly in BusWorld Home and customized in accordance with customer requirements. Thus, Daimler's bus division can

quickly and flexibly react to urgent customer requirements, in the case of rarely ordered components or special customer requests, for example.

This includes covers and handles, extending as far as a diverse range of individual brackets. All that at any time, in Genuine Parts quality, and at favorable production costs, as the company says: the 3D parts meet the production standards for injection-molding and

deep drawn parts as stipulated by Daimler AG.

Today, complex, non-safety-relevant 3D printed components, which until now comprised several individual components such as plastic caps for metal fixtures and hinges, are already being used in the bus interior. Furthermore, at present the »Centre of Competence for 3D Printing« is examining over 300,000 current bus spare parts in detail as to their suitability as 3D printed parts – around 200 of them have already been identified for 3D printing.

In the next stage, Daimler Buses wants to continually expand on this business model, with the overall aim of being able to directly print 3D spare parts in-house for customers.

From mid-2020, Omniplus will also be able to supply 3D-printed personalized interior decor components for retrofitting in accordance with specific customer requests. It doesn't matter whether the parts are handle inserts, side panelling for coach seats, top-quality decorative parts for folding tables or eye-catching customer logos for the entrance area – all of these can be designed with their own decor and graphics and ordered with different surfaces (grained, smooth or other alternatives).

FROM FINEST GOLD JEWELLERY TO AN ENGINE BLOCK

The spectrum ranged from the finest gold jewellery from a micro powdered fusion process presented under a magnifying glass to the hip-high sandprinted mould for an engine block: At Formnext 2019, the User Case Area of the Additive Manufacturing (AG AM) working group in the VDMA was a bustling place. In order to demonstrate the variability of binder jetting with sand and a phenol binder, the manufacturer had brought along cast engine blocks in scaled size in addition to the giant sand mold - including a miniature in matchbox format.

»The variety of our exhibits from various AM processes, materials and user industries



had a great attraction for the trade fair visitors and caused noticeable enthusiasm in many discussions«, reports Rainer Gebhardt, Project Manager of AG AM in the VDMA. The concept of the User Case Area also provided for visitors to pick up the fascinating exhibits and literally

feel them. Especially the aspect that additive manufacturing processes usually have to be followed by post-processing and finishing steps and how these are to be managed raised many technical questions from visitors to the User Case Area.

Photos: Daimler (oben), VDMA

NEWS

FINE FRAGRANCES INSTEAD OF TYRES AND PETROL

While in Formula 1 the smell of gasoline, tires and engine oil is more commonly associated with racing, the racing series has created its own perfume brand - as a contrast program, so to speak. Although the launch is planned not before April 2020, the flacons already impress with their 3D-printed design.

Designer Ross Lovegrove utilises the latest digital light synthesis 3D printing technology, creating an intricate and stunning technopolymeric resin-based exoskeleton to house the fragrance bottle. The collection of five exquisite fragrances is then bottled in 3D-printed flacons called Agile Embrace, Fluid Symmetry and Compact Suspension.

Ellie Norman, Director of Marketing & Communications, Formula: »The unique fragrances and bespoke F1 inspired bottles embody the dynamic qualities of the sport.«



RAILWAY: FIRST SAFETY-RELEVANT AM COMPONENT APPROVED

The working group Approval of the network »Mobility goes Additive« has obtained the first-time approval for operational use of an additively manufactured, safety-relevant component in the railway sector. The so-called »brake suspension link« of the brake unit of a metro is now in use at Hamburger Hochbahn AG.

In just under two years, the Approval working group has achieved its goal to obtain a first-time approval for the operational use of an additively manufactured, highly stressed and safety-relevant component. Following a jointly developed approval concept, the suitability of the 3d printed component for real-life has successfully been demonstrated. The necessary quality assurance procedures, extensive tests and corresponding documentations were finally assessed by TÜV Süd Rail GmbH and approved.

After operational approval by the Hamburg Technical Supervisory Authority, Hamburger Hochbahn AG commissioned the system in August 2019. Based on this innovative precedent for the railway industry, a standard for future approvals shall be developed in order to increase the application possibilities of additively manufactured components in the railway sector.



Photos: F1 (oben), Mobility goes Additive

HARD WORK CULMINATES IN M+A AWARD

Based on its outstanding growth since its debut in 2015, Formnext recently received the m+a award in the »Newcomer« category. The key criteria for this award included extraordinary increases in both domestic and international visitors and exhibitors, as well as very strong growth in exhibition space sold.

»We're absolutely thrilled to have received this fantastic award. It's a fitting reward for the outstanding achievements of our Formnext team, which put a great deal of hard work and dedication into launching Formnext in 2015 and has continued to outdo itself ever since«, says Petra Haaburger, President of Mesago Messe Frankfurt. »Without the incredible commitment of the entire additive manufacturing community; our exhibitor advisory board; our science and research partners; and our parent company, Messe Frankfurt, with its global network of media and opinion leaders, winning this award would never have been possible«, adds Sascha Wenzler, Vice President of Mesago and the person responsible for Formnext. »All those involved in Formnext have truly earned it through their superb collective efforts.«

In her speech at the awards ceremony, Christiane Appel – editor-in-chief of m+a report – recalled the hurdles Formnext encountered in its initial stages. »Mesago Messe Frankfurt really went all-in on Formnext, and the exhibiting industry followed suit«, Appel stated. »This level of involvement has paid off for all those involved. When people talk about an exhibition that reflects its market, this is what they mean.« Meanwhile, m+a report also inaugurated its »Project of the Year« award to mark its 100th anniversary. The accolade will be presented to outstanding exhibitions in Germany to recognize the achievements of the project teams behind them.

MORE THAN JUST MONEY

While young AM companies like Carbon, Formlabs, Desktop Metal, and Markforged have impressive stories to tell about how hundreds of millions in venture capital have fueled their growth in the United States, investments in German and other European start-ups remain comparatively modest. Sometimes, even with a slimmer financial portfolio, however, up-and-coming firms can certainly hit the ground running on the international stage. This prompted us to ask investors from the U.S. and Europe about related strategies and the criteria that are key to success. Our discussions turned to much more than just money.

Over the past five years, Arno Held and his team at AM Ventures have visited more than 1,400 start-ups across the globe. These investment experts, who specialize in additive manufacturing and normally work at offices on picturesque Lake Starnberg (near Munich), have looked over all the business and financial plans; they've spoken with the founders and their teams. For Held, the personal relationships that arise from these meetings are one of the most influential factors when it comes to deciding whether to invest in a young company. »You have to be able to trust one another«, he says.

That said, the fact that AM Ventures has invested in 18 start-ups in those five years – a rate of 1.2% – has to do with more than a mere lack of trust in so many entrepreneurs. »You can rule out 70% of them pretty quickly«, chief venture officer Held continues. »For us, the important thing is seeing an opportunity to work with a young company and its team on building something successful and sustainable. That's why the team aspect plays such a big

part in our investments. We don't invest as much in technology as we do in minds.«

Before committing to an investment, AM Ventures evaluates the company in question and buys shares in it. It usually takes part in the first or second round of financing, investing between €500,000 and €5 million. »We mainly acquire minority stakes«, Held reveals. »We want the entrepreneurs to stay entrepreneurs, after all.«

BETWEEN 10 AND 25%

AM Ventures currently has holdings ranging between 10 and 25% in companies like 3YOURMIND and DyeMansion (Germany); Lithoz, Cubicure, and Incus (Austria), and Sintrotec and Spectroplast (Switzerland), as well as others from the U.S., Great Britain, Australia, and Sweden. »Stakes of less than 10% aren't worth the effort we make«, explains Held, who worked for EOS for eight years before joining his current company. Among other positions, he was an assistant to EOS founder Dr. Hans Langer – the man who founded AM Ventures in

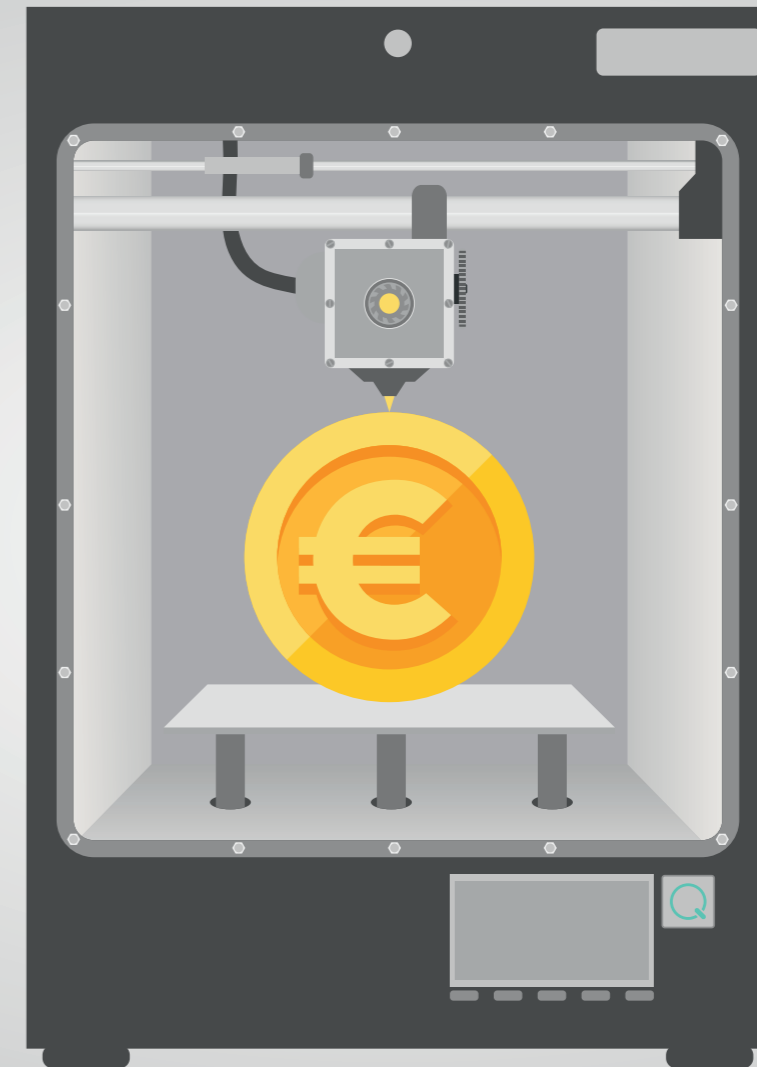
2015 (see info box). AM Ventures sometimes offers other types of financing as well, such as when a target's financial needs exceed the value of its available shares.

Dayna Grayson, partner of the US venture capital company NEA, invests significantly larger volumes. With an invested capital of around 3 billion dollars, it is one of the largest venture capital companies in the world. »Initially, we are investing between 5 and 20 million dollars. Later, we can increase that to 50 to 100 million dollars.« NEA joined Desktop Metal in its founding year, among other reasons because Grayson and her colleagues were and are convinced of the potential of »affordable and fast 3D printing for the mass market.«

For Dayna Grayson, who with NEA also invested in the Boston-based AM heavyweight Formlabs, the decisive factor in selecting investments in additive manufacturing is that the products »are ready for the market and suitable not only for prototypes but also for end-use parts.« It is also important to the investor that the technology differentiates itself from exis-

Text: Thomas Masuch

Illustration: feedbackmedia.de, iStock / Denis Mailugin, iStock / IkonStudio



Initially, we are investing between 5 and 20 million dollars. Later, we can increase that to 50 to 100 million dollars.



Photo on top:
Arno Held, Chief Venture Officer AM Ventures
Photo center:
Dayna Grayson, partner of the US venture capital company NEA
Photo below:
Avi Reichental, founder and CEO XponentialWorks.

ting solutions and is ideally protectable. »And third, we also look at the team: whether they have experience and the ability to become great entrepreneurs.«

»LONG-TERM SUPPORT«

NEA is shaping the future development of »its« companies as both an owner and member of the board. AM Ventures combines its investment activities with »long-term support« for the companies it works with. For Held, this approach has shown that the start-ups' success »correlates directly with the amount of attention we give them.« Take DyeMansion, for example, whose founders started out making colorful cell phone cases before coming up with successful color-finishing solutions for 3D-printed parts. That said, Held also stresses the fact that he still gives company founders the freedom they need to make entrepreneurial decisions. »We put people in contact with one another, but we don't push our holdings to work together«, he asserts. This is also reflected by DyeMansion, which sells its products through HP – a direct competitor of EOS.

Even in the USA, with its enormous investment resources, there are models that want to build start-ups as efficiently as possible and with lower investment volumes. »Not everything can be solved by money«, explains Avi Reichental, who with his company XponentialWorks in California offers young companies a complete package of investment, consulting and technical support and sees a clear advantage over conventional investment models. »At an early stage companies can do it more efficiently. If companies get so much money upfront, there is a risk of deploying the money in areas that may not give the same return of investment.« Although Reichental, who led 3D Systems as CEO from 2003 through 2015, is also convinced that money helps to grow businesses, »in some cases it also creates inflative evaluations that are much more difficult for the companies than to grow and to create maximum exit optionalities.«

The business concept of investors usually includes a successful exit and a profitable sale of the investments. In its investment in additive manufacturing, even a large investment company like NEA pursues a long-term strategy:

»As an early-stage investor, we typically don't have a short time horizon, like investors who joined at a later point in time or even after the IPO«, says Dayna Grayson. »We have to be patient and want to drive the company as far as it takes. We are very excited about Desktop Metal, it could be a multi-billion dollar company.«

Meanwhile, a venture that proves fruitful can quickly become a »problem« for smaller investment firms, as Held points out. When start-ups find success, they typically want to take their business global, which entails a greater need for capital. »Before you know it, you need €5 million or more«, Held says. »That's when it gets tricky for a comparatively small venture capital firm like ours.« This is why AM Ventures cooperates with industry partners on making larger investments. At the same time, Held doesn't see these partners merely as sources of funds. »They also have to bring something more to the table – the ability to open doors in certain sectors, for instance.«

»SPRAY AND PRAY«

The initial financial aspect of the development of »his« start-ups isn't Arno Held's top priority, however. »We're not bankers; we're full-blooded engineers who love interesting ideas«, he declares. »If you only want to make money, you're in it for the wrong reason.« Instilled in AM Ventures by owner and EOS founder Langer, this credo continues to guide the company today.

On the subject of the hundreds of millions of dollars that numerous AM companies in the U.S. have raked in over several financing rounds, Held has mixed feelings. While AM Ventures does have its own stake in Elementum 3D (Colorado), he describes himself as »always

AM Ventures
Headquartered in Starnberg near Munich, Germany, AM Ventures Holding GmbH (AMV) is an independent strategic investment company that focuses on industrial 3D printing. It was founded in 2015 by Dr. Hans J. Langer, CEO of the EOS Group. AMV has since expanded to Asia, having opened an office in Busan, South Korea, in 2019.

Photos: AM Ventures, NEA, XponentialWorks

The business concept of investors usually includes a successful exit and a profitable sale of the investments.

very careful with investments in the U.S.«, citing valuations that are sometimes quite high in the country. »As far as money is concerned, they do tend to operate on a hair trigger in the U.S. You might say that the motto of the investment scene there is »spray and pray«,« Held continues, adding that the U.S. is investing much more money than Europe in a large number of companies. He also notes that when a few companies achieve major success, it compensates for a large number of investment flops.

FERTILE INVESTMENT GROUND

Avi Reichental, on the other hand, tries to combine the advantages of the fertile investment ground in the USA with an efficient strategy by bringing start-ups from Poland, Italy, India and other countries to California. »In terms of investment, if you want to make a company investable, most of the will require that the company is US entity. Because the will not safe investing in companies that are not governed by US corporate law.«

This principle has convinced Kuba Graczyk, CEO of NXT Factory. Born in Poland, Graczyk followed Reichental to California, as his experience in Europe not a lot of knowledge to proper found start-ups and let them grow. »There is a bigger barrier of risk. European investors are less likely to invest in projects on early stages. People here are not afraid of losing their money, but they are aware that 1 of 10 or 20 will succeed. The culture of investing here

come from Silicon Valley and has a tradition of 30 or 40 years.«

Held affirms that the investment culture in Europe is a conservative one, but adds that while people tend to take their time, they have a higher rate of success, as well. »More deals are made in the U.S., but not as many of them pan out on average«, he explains. He doesn't consider this an inferior approach – just a different strategy. »In the end, the results might even be more or less the same.«

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Contact

Guangzhou Guangya Messe Frankfurt Co Ltd
Tel: +86 20 3825 1558
Fax: +86 20 3825 1400
Email: formnext-pm@china.messefrankfurt.com

Uniris Exhibition Shanghai Co Ltd
Tel: +86 4000 778 909 / +86 20 8327 6389
Fax: +86 20 8327 6330
Email: formnext-pm@unirischina.com



TALKING ABOUT

»THE COMPLEXITY OF MANUFACTURING IS REALLY UNDERESTIMATED«

In the past 30 years, Materialise has developed from a start-up at the University of Leuven into one of the largest companies in the AM world and has also been listed on the NASDAQ stock exchange since 2014. In its Software, Medical and Manufacturing divisions, the company employs 2,000 people at locations around the world. To mark its 30th anniversary (June 28, 2020), we visited founder and managing director Fried Van Craen at Materialise's headquarters in Leuven to talk about current trends and challenges for the future.

Fried, when you look back on the beginning of Materialise, what was your motivation as a founder?

VAN CRAEN I dare say I am passionate about applying research. And it's not only me: Materialise as a whole, thinks it's not only about technology – it's about the meaningful applications that can make this world a better and healthier place. That was our starting point in setting up Materialise, it was the mission declared at our opening session, and it's still what we're pursuing today. We started from applications in the healthcare industry and those that make people healthier in general. In a nutshell, that's the philosophy behind Materialise, and it's still our philosophy today.

If you split these 30 years into three decades, how would you title the first one?

VAN CRAEN It was about making it work. We worked on connecting a 3D printer to a CT scanner, for instance. We had to make it work on a somewhat consistent basis. It was a time of big inventions. It was when SLS, FDM, and metal sintering were invented. And let's not forget: We started at a time when the internet was not present. We were lucky that we were housed on the university campus, so there was



Text: Thomas Masuch

Photo: Materialise

some kind of e-mail system. Still, the market study for setting up Materialise was done by fax machine – state-of-the-art technology at that time.

And your first machine was an SLS A-5 from 3D Systems?

VAN CRAEN Yes, we bought it for about €250,000 at that time. The frame is still in use in our production. Of course, the computers have changed, the lasers have changed – everything inside has been upgraded and changed.

What were the boldest decisions in the history of Materialise that led to the development of the company we know today?

VAN CRAEN One of the deliberate choices that we made – and it was a tough decision, but one we were very happy with afterwards – was to commercialize our software. At the beginning, the only thing that brought us money was the service industry. Our competitors were model-makers who could 3D print models and also do the finishing. When we started, we'd never made such a model. Our competitive edge was that we were more computer-minded. We were young people used to working with the first generation of PCs; we were better at translating CAD data into a 3D printable model. And then we decided to start selling our biggest competitive edge to our competitors. It was a painful decision, but one that made sense.

What was your motivation for taking this step?

VAN CRAEN We started selling our software in 1992 based on our belief that this would become a bigger opportunity, although it was a very small market at that time. However, we also believed that we would never be able to maintain this software development just for internal use in the long term. After all, the software has allowed us to become a global company and not just a local service provider. But it took quite a few years for the software to become a profitable business because it was in such a small market.

How did going public affect the development of Materialise?

VAN CRAEN Well, it definitely meant that we had to go through some major changes. But I want to say that it was not the first time. If you are a growing company, you have changes at many steps – when you grow from one to two people, from two to 10 people, from 10 to 20, and so on. Each time, you have to restructure yourself. When we debuted on the stock market, we were a company with 1,000 people, and now we have twice that many. That change is important, and going public was part of it. It means that today, yes, we have to be

And it's not only me: Materialise as a whole, thinks it's not only about technology – it's about the meaningful applications that can make this world a better and healthier place.

much more rigid in our financial processes, we need to be SOX-compliant, and that's not always a pleasant thing. But it's also leading to opportunities to structure things in a better way. We now have much more structured processes that are required for all the certified applications Materialise is bringing to market, including in the aerospace and medical sectors.

To stick to the stock market issue: In contrast to most other listed AM companies, Materialise's share price has performed exceptionally well over the past five years, having risen by almost 100 percent. What is Materialise doing differently?

VAN CRAEN I've tried, together with our team, to set realistic expectations. During the last few years, we thought it was feasible to grow our company at a rate of 20% over five years. Up until now, if you take our starting position in 2014, we have been able to meet that growth rate. I think that's what the stock market is appreciating. In other words, we've always been pushing back against the growth expectations. At the beginning it was a struggle, though, including with the bankers who wanted to bring us to the stock market.

So, they wanted to improve your story?

VAN CRAEN They wanted to, yes. They wanted to market our story with enormous growth rates like they have done with other public AM companies. Some investor relations stories predict an average annual growth rate of 50% over five years. This is unmanageable. Maybe these kinds of growth rates exist in the purest forms of internet business, where you have a model that is very scalable. If you do this in machine development or manufacturing, the same scalability isn't possible.

Moving on to the current situation, which challenges do you face in your daily work, especially regarding the fact that the AM industry is making even more progress in the process of industrialization?

VAN CRAEN Something we have to accept is that in quite a lot of product lines, people keep thinking that the cost of a product is the pure, actual production cost. But they are totally »

wrong. You have all your planning, as well as the quality system around it that ensures you always produce the same medical device or aerospace part that works and doesn't make the plane crash. That costs much more than the actual production.

That reminds me of the traditional automotive industry, where the suppliers of the big OEMs are really pushed to produce their parts for less every year.

VAN CRAEN There is absolutely a tendency toward this in 3D printing, and it's accelerating. Even in the «old» manufacturing industry, a supplier had protection in the sense that it had the tools and know-how necessary to operate them. Since the supplier had the tools, the OEM was linked to it (at least for the entire series of a car), and it was not so easy to find a replacement. Now companies – and there are examples in the 3D-printing sectors themselves – offer one-year contracts. After that year, they put you back in a competitive situation. For the 3D printing industry, this is a dangerous evolution because it means the service providers are making less profit. And they have to be careful about how their machines will pay for themselves.

That sounds like a business that isn't really enjoyable, at least for one side...

VAN CRAEN It's really a challenge protecting our intellectual property and effort. At the same time, the reason why manufacturing is not going faster in 3D printing and not being adopted more is because it's so difficult, and it takes so much investment to turn a prototype into a manufacturable product. It really does take months to fine-tune your machine, stabilize your process, make the documentation, and much more.

But how can you secure your expertise as a service supplier?

VAN CRAEN We believe it's very important that industrial users of the systems are protected, and that they can put some process know-how into their software systems so their manufacturing cannot be copied by everybody. That is, I would say, the battle between the closed and open systems.

That sounds like the battle between

Microsoft and Apple during the 1990s and the early 2000s...

VAN CRAEN To some extent, it is. The manufacturer of the machine controls all the parameter settings and standardizes everything. But that means if you, as a manufacturer, use that machine, and tomorrow your competitor wants to print the part, they can – so it's a race for the bottom. Or you have a machine with which you can optimize the product yourself, and somebody else with the same machine will at least have to make the same effort in optimizing that production process. But if you use the closest system, you don't need any specific knowledge anymore. You just need a machine and push the button.

How do you want to solve that?

VAN CRAEN Well, luckily, the good thing is that 3D printing is much more complicated than most people think, in that you really have to develop and invest in quite a lot of know-how in order to produce parts in a consistent way. Also, we try to automate to make things efficient. We don't want to close our ecosystem, but we also recognize at Materialise that giving a lot of openness to users has a couple of pitfalls – for example, the risk that users will get lost in a huge number of variations or different parameters. We have to take more than just the printing conditions into account. During your print, you also determine the starting conditions of the post-processing, which is also a very important element to consider. So the complexity of the manufacturing is really underestimated, and many people run into problems because they believe the story that is told and sold – that you 3D-print an entire series like you would a prototype.

So, AM is not as mature in every field as the media, sales, and marketing departments tell us?

VAN CRAEN I think the experienced companies, like us and EOS and Concept Laser, and others have noticed that. But there are a lot of new entrants to the market that keep claiming they have solved the problem. They make very bold statements that seduce quite a lot of customers, but later, they can't deliver on their promises. We are in a transition phase where there are indeed a lot of promising announcements, but they sound like they have already arrived. In

our experience, there are still a couple of miles to go before we get there.

Having started with the history of the last three decades, the only thing missing is your outlook for the next 10 years.

VAN CRAEN Today, 3D printing still needs to conquer many more products and markets because the technology is still rather new and has to compete with the traditional technologies. And it's not just the 3D-printed piece that is considered in the price; entire companies are built around the best processes for these traditional technologies, which makes them efficient. This means that a digital backbone is lacking. You have to create it, and it has to be paid for. These days, it is paid for by high-end applications, but I see that equilibrium shifting. Once you are in the right environment – like here at Materialise, where we have made the investment, established that digital backbone, and fine-tuned our production to it – it becomes cheaper to introduce your next project on that backbone. That is when many new applications become possible. It opens up a new world.

Fried, thanks you so much for talking to us

A detailed background report on the industrialization of AM at Materialise can be found at fon-mag.de

+ FURTHER INFORMATION:

- » materialise.com
- » fon-mag.com

Photos: Materialise



Materialise is not only one of the world's leading software providers in the AM world, but also one of the largest service providers using around 190 industrial 3D printers.



Fried Van Craen und Materialise

After working for a Belgian research center for four years, Fried Van Craen started Materialise in 1990 at the age of 28. The founding team also included his wife, Hilde Ingelaere, as well as Bart Van der Schueren (now CTO), Johan Pauwels (now vice president international), and Phillippe Schietecatte, (currently one of the lead design engineers in additive manufacturing). Together with his wife, Fried Van Craen is still the main shareholder of Materialise. The Leuven-based company now employs around 2,000 people and has subsidiaries on five continents.

»WE'RE NOT FIXATED ON THE AUTOMOTIVE INDUSTRY«



Photos: GKN

Text: Thomas Masuch



Together with VW and HP, GKN has already presented the first serial 3D printing. (right). Applications from other industries, such as fashion (left), were showcased by the company at Formnext 2019

The upheaval in the automotive industry is also posing serious challenges to suppliers. After all, vehicles with electric drive systems require significantly fewer components. This is why one of the world's largest automotive suppliers, GKN Powder Metallurgy, is relying on additive manufacturing in an effort to expand its presence in other areas of industry, as well. In recently acquiring Forecast 3D, the group has even brought technology for plastics into the fold.

To respond to the changes taking place in the automotive industry, GKN already established a new division (GKN Additive) six years ago. According to Guido Degen, who leads the division as president of additive manufacturing, GKN has since made an »intensive investment in technology and development« in this field. This is expected to pay dividends quite soon, with Degen planning to have his division in the black starting in 2020.

Just how important additive manufacturing is to this international corporation is also evident in the fact that the GKN Additive division – whose current staff of 200 employees is relatively small – has the same formal status as divisions like GKN Hoeganaes (which produces around 300,000 tons of metal powder each year) and GKN Sinter (which manufactures 10 million metal components per day). Guido Degen is also a member of the executive team at GKN Powder Metallurgy.

For the AM president, the electrification of vehicles presents a tremendous challenge for a global automotive supplier like GKN. »Around 85% of the parts we make are for the automotive industry, and half of them go into the engine or transmission«, he reveals. »For

vehicles with purely electric drive systems, there's a huge drop in the number of components required.«

GKN took the plunge into the world of AM back in 2013. At its location in Radevormwald, Germany, the group spent the first four years developing qualified and secure processes for laser sintering. These processes are now used in production at GKN's plant in nearby Bonn. There, GKN Additive produces prototypes and series comprising as many as a thousand components for numerous areas of industry. While some of them are for motorsport, the short-term demand for AM is »coming more and more from areas outside of automotive«, as Degen explains. Diversifying across various user industries is a cornerstone of GKN's strategy for the ongoing development of its AM division. »We're not fixated on just the automobile industry«, Degen affirms. Indeed, GKN Additive has been tasked with applying the group's knowledge to other sectors, especially when it comes to powder and sintering. GKN's established and certified production line in Bonn serves as a prototype for other AM production operations around the world. This is »

Instead of having to take a greenfield approach and build new factories, we can establish AM plants at existing facilities.



The production of metal parts is the industrial home of GKN. With the acquisition of Forecast 3D, the portfolio is also expanding into the plastics sector.

an area where GKN Additive benefits from its parent company's global network. »Instead of having to take a greenfield approach and build new factories, we can establish AM plants at existing facilities«, Degen says. He goes on to describe how GKN's production site in Bonn has already provided the template for three AM plants – in Detroit, Philadelphia, and Danyang (near Shanghai).

As the next step in its development, GKN Additive is planning to assemble an innovative additive production line in cooperation with BMW and other project partners. It will be based on laser sintering technology and offer outstanding cost efficiency thanks to digitalization and the way it largely automates production and post-processing. The first pilot lines are expected to commence operations at GKN (Bonn) and BMW (Munich) in 2021.

»STILL NOT ENOUGH APPLICATIONS«

For two years, Degen and a team of around 50 employees who work on metals within GKN Additive have been striving to find new applications for AM technology or develop them along with customers. »We're well



Guido Degen
Guido Degen began working at GKN Sinter Metals as a product development engineer in 1996. A mechanical engineer by training, he held roles as site manager, operations director, and vice president of operations from 2001 to 2012. He was then appointed vice president of business development and strategic planning in 2013. Degen has now been involved in additive manufacturing at GKN since 2017 – first as senior vice president of additive manufacturing and business development, and since 2018 as president of additive manufacturing.

Photos: GKN

situated here, but unfortunately, there still aren't enough specific applications«, Degen reports. He believes one of the most important reasons why has to do with the additive mindset, which has yet to reach a sufficient number of designers and engineers. Even though GKN has been shaped by AM as much as it has, Degen says only around 20% of its engineers take the technology into account as a solution process – and that figure is even quite a bit lower at other companies. »There's still a lot that needs to be done. After all, additive manufacturing only makes sense when it offers added value«, he continues. »If we don't optimize our components, all the efficiency gains in the world won't make AM affordable enough when it comes to laser sintering.«

Degen nevertheless sees a large amount of potential in laser sintering, thanks in part to the automotive industry's focus on electric drive systems. VW alone wants to bring 80 new electric models to market by 2025. Since the initial stages of this trend are requiring rather small quantities of designs that are often complex, Degen is predicting strong growth in the share of 3D-printed components. Furthermore, running on batteries generates a massive amount of heat that needs to be dissipated by intelligent heat management systems. »This will lead to a lot more copper and aluminum being built into vehicles«, Degen points out. These materials are highly compatible with powder bed production processes. Meanwhile, Degen thinks that many new applications of AM technology are on the way with respect to vehicle interiors and chassis.

To tap into further additive potential, GKN has been developing binder jetting technology along with HP since 2018. Here, GKN is mainly contributing its expertise in powders and sintering.



Forecast 3D was founded in 1994 by brothers Corey and Donovan Weber. Today, the Carlsbad (California)-based company runs over 45 industrial 3D printers in three facilities.

ring. When HP begins marketing 3D printers equipped with this technology, its partner will not only gain access to an intriguing area of business for its specialized powders; it will already know a great deal about a technology capable of additive mass production, as well.

In October 2019, GKN Additive took another significant step in expanding its business activities in AM in acquiring the service provider Forecast 3D. The Californian company has been 3D-printing plastics for 25 years, and the addition of its 150 employees quadrupled the division's workforce in one fell swoop.

»The idea of an organization with our metal DNA buying up a company focused on plastics probably seems unusual at first glance, but it definitely makes strategic sense«, Degen says.

For one thing, he points out, the move has enabled GKN Additive to tap into an extensive portfolio of customers that are mainly based on the west coast of the United States, which is presenting cross-selling opportunities in metals. »On top of that, we've secured new expertise in plastics that we'll be gradually transferring to our other production sites around the world«, Degen adds.

+ FURTHER INFORMATION:

- » gknpm.com
- » fon-mag.com

TRENDS

MOON BUILDINGS MORE SOLID THANKS TO UREA

3D printing is playing a crucial role in the future space and moon missions of NASA and ESA. It enables materials in space to be either recycled or used locally, including on the moon. In view of the high transport costs in play – it costs around €20,000 to put a kilogram of material into orbit – 3D printing on other planets can certainly make future missions more economical.

But while building materials on Earth are usually mixed with water, future inhabitants of the moon will likely have very limited access to the precious liquid. That's why scientists from Østfold University College (Norway) and the Advanced Concepts Team of the European Space Agency (ESA) have been working on a mixture for future lunar buildings. In their Aridana study, they are looking at using urea mixed with lunar rock (regolith).

This type of biological secondary use



makes sense to the researchers because urea is a component of human urine (amounting to around 1–2%) that is available everywhere people live. Compared to the use of polycar-



boxylate- and naphthalene-based superplasticizers, urea has even proven capable of increasing the strength of the regolith samples.

AWAKING THE 17TH CENTURY IVORY FLUTE



Unfortunately, many of these instruments are either too fragile to be played and risk being irreversibly damaged, or have been shown to be contaminated by old pesticides treatments used to prevent damage from museum pests.

To offer an acceptable alternative to playing historic musical instruments, the museum has started a project to 3D printing replicas. The goal is making the instruments as authentically as possible, so it not only looks and feels like the original, but sounds like it, too.

Thanks to funding from the Oxford University IT Innovation Challenge the museum has the opportunity to test the latest in 3D printing technology to see which materials and methods can closely reproduce the sound and feel of the original.

This project will CT scan a playable 17th

Century ivory flute, and print a range of replicas using the latest resins and composites, using a number of different 3D printing methods. The replicas will then be compared to the original, assessing the sound quality, appearance and playability.

Photos: NASA (oben), Pitt Rivers Museums

The Pitt Rivers Museum, Oxford, UK, collection is home to over 7000 musical instruments from around the world, from archaeological bone flutes to electronic keyboards. Over 400 instruments are made from bone or ivory, such as ivory blast trumpets and bone flutes and they are often requested to be played by members of originating communities, researchers and students.

TRENDS

THE FIRST 3D-PRINTED VILLAGE

Elegantly arranged pillows on the veranda, designer leather chairs, and a sophisticated reading lamp in the living room: The first 3D-printed houses – the results of a development project involving New Story, Icon, and Échale in Mexico – look like they were taken from a brochure for furniture or refined vacation homes.

Currently under construction in the southeast Mexican state of Tabasco, the world's first 3D-printed village is actually being

built for the poorest of the poor. It will offer affordable housing to people who, according to New Story, previously lived in simple shacks and subsisted on less than three dollars (U.S.) per day. For the next seven years, families selected based on need will be able to rent these chic domiciles for 400 pesos (around U.S.\$20) per month.

A total of 50 bungalows are to be 3D-printed in Tabasco, each of which will include two bedrooms, a living room, a kitchen, and a

bathroom across 46.5 square meters. The walls take just 24 hours to build thanks to Vulcan II systems provided by Icon. These printers use a nozzle to apply successive layers of a special concrete mixture called »Lavacrete«. Meanwhile, the foundations, doors, roofs, and appointments of the houses are all being installed using traditional manual methods. New Story declined to provide information on the cost of each house.



HEAVY-LIFT-VESSEL ALTERNATIVE

With its modular 3D-printed concrete foundations for offshore wind turbines, the US company RCAM Technologies wants to offer a true technological alternative to heavy-duty vessels for the construction of offshore wind turbines.

The US National Offshore Wind Research and Development Consortium has selected RCAM Technologies for contract negotiation as part of its second round of wind research and development projects. RCAM's award, which is one of two totaling \$ 1,865,000, will support development of its innovative offshore wind turbine support structure.

The project goal is to prove the feasibility and advance the design of RCAM's modular concrete foundation and. The two-year project scope includes the conceptual design, preliminary design, and feasibility assessment of the fixed-bottom, suction-bucket support structure and heavy-lift-vessel alternative for the U.S. Department of Energy's National Renewable

Energy Laboratory (NREL) 15-megawatt reference turbine. As RCAM reports its foundation lowers the cost of support structures, develops an alternative solution for heavy-lift vessels, mitigates installation noise concerns, readily scales to larger turbines and deeper installations, and increases local content, manufacturing, and jobs.



Photos: Joshua Perez for New Story

»OUTSIDE THE BOX«



Technology or Absti- nence?

If you measure the importance of new technologies by the amount invested in young companies, the future of humanity lies in the hands of pizza delivery services, city guide agencies, e-scooters, dating networks and various ride-hailing services. Fortunately, this is just a snapshot of the current moment and not the only way to look at it.

What will play a more decisive role in the future of our species is the development and use of intelligent, sustainable technologies. After all, we've been consuming significantly more resources than the planet can regenerate for some time now. As the world's population continues to grow apace and more and more people seek to improve or maintain their standard of living, not much is likely to change in that regard in the coming years. Over the long-term, however, a decision will have to be made: Either we start using technologies that require much fewer resources to provide the comforts we are used to, or we learn to live without them.

The aforementioned delivery services, city guides, and e-scooters seem to indicate that we should get used to the idea of doing without – but luckily, there's additive manufacturing, as well. Probably it holds quite a bit more potential to solve the issues we'll face in the future. Even as this technology's sustainable approach commands more and more attention in the public discourse, however, young AM companies seldom find themselves at the top of the shopping lists of the real heavy hitters in the investment scene. This is due in part to the fact that additive products and applications are often technologically complex and involve business concepts that are difficult to implement at scale. It's a field where you simply have to do more than develop a slick app and expand across the globe based on a strong marketing effort.

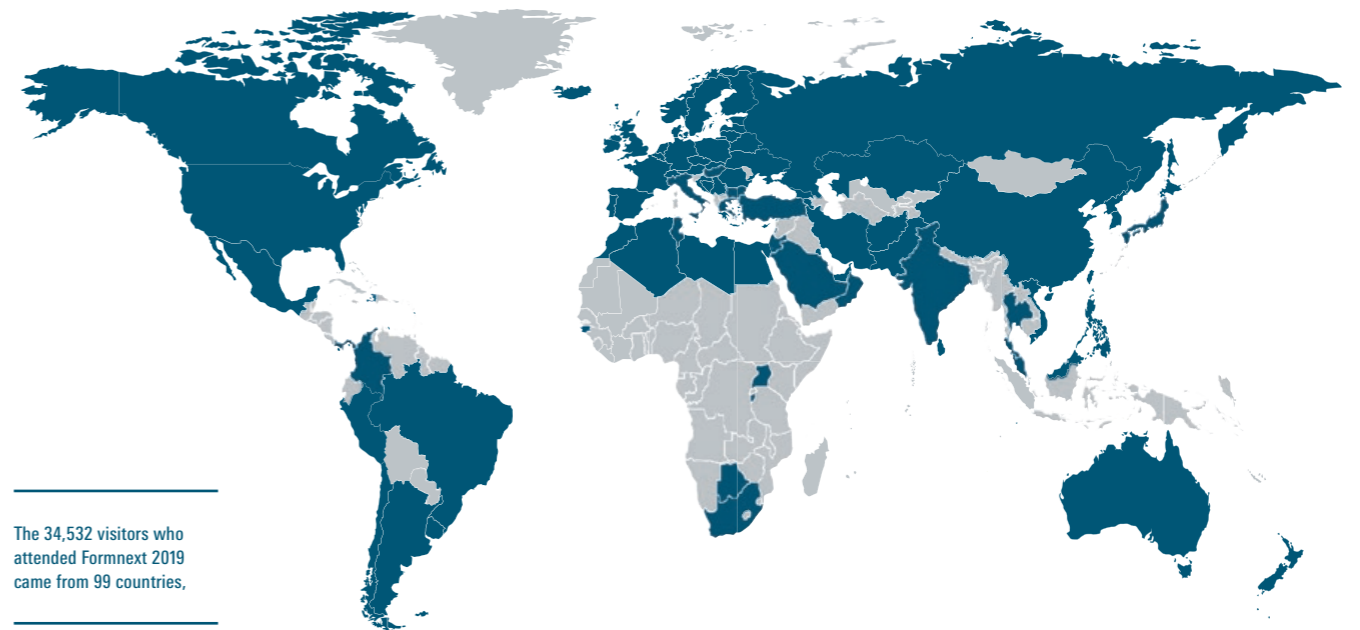
On the other hand, this enabling technology does open the door to nearly unlimited (and thus sustainable) applications in all areas of industry – from improved insulation in architecture to lighter and more efficient airplanes. While additive manufacturing obviously isn't going to solve the world's problems in a day, the Internet didn't change the world in the space of a few months either; it merely laid the foundations for future technological advancement. And this secretly comprises a much higher value than a fast delivered pizza does.

Text: Thomas Masuch

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VISITORS OF FORMNEXT 2019 CAME FROM THE COUNTRIES SHOWN ON THE MAP



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@ CONTACT:

- » Hotline: +49 711 61946-810
- » formnext@mesago.com

INSIGHTS AND INTERVIEWS:

- » formnext.tv

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mesago

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mesago.com

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Bernhard Ruess

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EDITED BY
ZIKOMM – Thomas Masuch
thomas.masuch@zikomm.de

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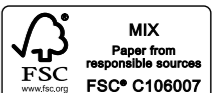
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