03/2023 | EN

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READ AM I Application stories, interviews, news and insights about Additive Manufacturing

PARTNERING WITH THE NORDIC REGION
Lucrative business opportunities that require a sustainable mindset
Pages 14–29

CASTING IS COOL AGAIN
Römheld & Moelle now relying on printed casting, as well
Page 06

mesago

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Messe Frankfurt Group

EDITORIAL

Economic activity in mechanical engineering is slowing: The OECD countries are forecasting very low growth rates for 2023, and in Germany, stagnation is even setting in. This is affirmed by the latest survey the German mechanical and plant engineering association (VDMA) conducted on the general mood in the sector. The ongoing armed conflict between Russia and Ukraine, disrupted supply chains, high energy prices, uncertain energy supplies, and the increasing geopolitical distance among the USA, Europe, and China are some of the main reasons for the decline in orders in the industry. After years of growth – which only really dipped during the coronavirus pandemic – the world's industrialized countries are no longer quite so optimistic about the future.

This sentiment is filtering all the way through to AM manufacturers. While many of them still have a significant backlog of work, new orders are down in this sector, as well. The AM market itself remains highly dynamic, but there have also been several mergers and acquisitions that indicate consolidation.

At the same time, there appears to be no limit to the ways in which AM can be used. There's been a particular increase in business cases and serial applications, which is very good to see. Staying ahead of the competition is always important, but this is especially true in an environment that's no longer characterized by strong growth.

This makes technology showcases in our industry all the more crucial. From 7 to 10 November 2023, Formnext will once again bring together a who's-who of the fAMily in Frankfurt to spotlight what's already possible (and what will be soon) in Additive Manufacturing and the entire process chain. With the Nordic countries of Denmark, Finland, Norway, and Sweden on board as our partners this year, we'll be focusing in particular on sustainability. This meta-topic will not only be a constant concern going forward, but a key issue in competition, as well. You can find out more about it in this edition of our magazine – and later this year at Formnext, of course! Enjoy the read.

Sincerely, Sascha F. Wenzler
Vice President Formnext

Cover: iStock/Sergdid, zorazhuang

CONTENTS

FORMNEXT NEWS

Image: Mathias Kutt

EVEN MORE EXHIBITORS AND SPECTACULAR CONTENT

With 732 exhibitors and a booked gross area of more than 50,000 sqm 2 months before its start, Formnext 2023 has nearly reached the previous year's figures. In terms of content too, the world's leading trade show for Additive Manufacturing and modern industrial production will set new standards: the Who's Who of Additive Manufacturing will show innovations along the entire process chain. In addition, the supporting program will also present numerous exciting developments. Particular focus will be placed on topics including AM service providers and sustainability.

Contrary to the rather restrained economic development in most industrialized countries, Formnext is enjoying excellent registration figures, thus reflecting the dynamic development of the AM industry. Visitors can look forward to numerous innovations and world premieres at Formnext from November 7 to 10, 2023. Anyone who would like to register as a visitor can still benefit from the attractive early bird discount up until October 10 (formnext.com/tickets).

Renowned AM suppliers from around the world as well as numerous start-ups and established industrial companies will cover the entire Additive Manufacturing process – including materials, software, design, hardware, production solutions, post-processing and quality assurance. The already very high number of international exhibitors has increased even further to more than 60 percent, attracting professionals from the manufacturing industry around the globe.

SPECIAL SHOWCASE »SERVICE PROVIDER MARKETPLACE«

One of the highlights of this year's supporting program is the »Service Provider Market Place.« AM service providers will present examples of applications from the automotive sector illustrating how Additive Manufacturing can be deployed successfully which and role service providers play in the process. There will also be presentations by well-known automotive companies such as Daimler Truck or Brose.

FORMNEXT GOES NORDIC

This year's Formnext partner region is Scandinavia. Denmark, Sweden, Norway and Finland are home to globally leading manufacturers of AM equipment and material suppliers as well as a large number of innovative start-ups and medium-sized AM companies. At the same time, the region in northern Europe is a leader in sustainable thinking and will also present innovative solutions in this field at Formnext. Numerous delegations from the Nordic region have also announced their attendance. There is a great deal of interest in Additive Manufacturing as well as tremendous potential for its development in industries such as oil and gas, fish farming and processing, boat building and others.

EXTENDED, DIVERSE SUPPORTING PROGRAM

Formnext has also made advances in its conference concept. This year, for the first time, the presentation program will be spread across three stages (Industry Stage, Application Stage, Technology Stage) in the exhibition halls.

The supporting program of Formnext 2023 includes very popular, established events with new elements. The Formnext Start-up Challenge is being held for the ninth time and rewards innovative and viable business ideas from young companies. The exhibitors in the Start-up Area will present themselves in short sessions as part of the Pitchnext event.

On the Career Day on November 9, prospective job applicants can find out about career opportunities in the AM industry while also getting job advice and having a CV photo taken. For companies looking to enter the AM industry, the well-established and daily Discover3Dprinting seminars, held in cooperation with ACAM, offer excellent insight and advice.

The Working Group AM at VDMA will be presenting a showcase with valuable AM applications from the world of mechanical engineering. The BE-AM showcase will be making use of real-life applications to demonstrate advanced developments in the increasingly important issue of 3D Printing in the construction industry. At the same time, the BE-AM Symposium will be presenting numerous background scenarios and future developments in this field.

The issue of standards will again be discussed at the renowned ASTM Standards Forum, which will be held in cooperation with U.S. Commercial Service, ASTM International, ISO - International Organization for Standardization and America Makes one day before the start of the trade show, on Monday, November 6.

+ FURTHER INFORMATION:
» formnext.com

»MAKING CASTING COOL AGAIN«

Mainz-based casting manufacturer, Römheld & Moelle, has branched out into a new product area, printed casting, and sees great business potential in casting using 3D-printed molds.

When there's enough space left on the build plate, these cone-shaped air pipes are printed at the same time. During casting, they are placed on the molds to enable the controlled release of the gases inside, which escapes in a colorful flame hotter than a thousand degrees Celsius

Text: Thomas Masuch

Only two doors separate the two worlds. Where a moment ago, we were looking at the touchscreen of the new sand 3D printer in a well-lit building, we are now moving through large, old-time factory halls, their walls and floors covered in a thin layer of gray dust. Lines of steel racks, or mold boxes as they are called, the size of railroad cars span the floor, and now and then rays of sunlight penetrate the hall roof, spotlighting specific areas. At one station, a large, bearded man with tattooed arms stands and fills a molding box with gray-black sand.

Concealed inside the gigantic sand-filled box are delicate 3D-printed sand molds, into which liquid metal will later be poured during the night shift. In other mold boxes, styrofoam molds lie encased in dark sand. Later, liquid iron will also be poured into these, replacing the styrofoam, which gasifies at the high temperatures.

PLENTY OF ORDERS FROM DAY ONE

Casting manufacturer Römheld & Moelle in Mainz has been casting metal since 1859. The technology, which has been used since ancient times, remains largely unchanged: Metal alloys (iron plus carbon and various other metals such as manganese, copper or nickel) are cast in molds made of sand at temperatures of up to 1,400 °C. In this traditional industry, CEO Rudi Riedel started a small revolution last year with the 3D Printing of sand molds.

This technology is, in fact, one of the oldest additive processes (the first 3D printers of sand molds came onto the market around 20 years ago), but »until now, additive sand printing has only been used to produce the mold cores, and not complete molds,« explains Riedel, who has headed the Mainz Zollhafen-based company since 2020. »We, on the other hand, decided from the beginning to print the complete mold.« About a year ago, the company purchased its first system from ExOne, »and received plenty of orders from day one.« Machine capacity utilization was so high that Riedel ditched his prepared advertising campaign and instead ordered a second machine directly from ExOne at Formnext three weeks later. »And we are already working at close to capacity again,« Riedel is pleased to say.

THE POWER CONSUMPTION OF A SMALL TOWN

We climb a narrow ladder up to the foundry's control center: The induction furnace, in which up to 40 tons of cast iron are heated overnight to temperatures of up to 1,450 °C, is controlled from a small booth. The molten cast iron flows one floor down into heavy vessels, which are then transported through the hall on a crane, from where they pour the glowing hot molten metal into the prepared molds.

The reason Röhmheld & Moelle only casts at night is partly due to the lower price of electricity at this hour. »Also, at certain times of the year, we simply wouldn't be able to draw enough power during the day,« explains plant manager Christian Elspaß. The induction furnace has a power consumption of 9 MW, which is about as much energy as a small town of 8,000 inhabitants. »We are energy efficient, nevertheless, especially compared to »

Images: Thomas Masuch (4), Römheld & Moelle (3)

Römheld & Moelle
Römheld & Moelle was founded in 1859 in Mainz, Germany. Since 1906, the iron foundry has been situated in the north of the city. The foundry's 140 employees cast around 5,000 parts each year. An important line of business is the production of tools for car body manufacturing in the automotive industry.

coal or gas-fired furnaces.« In addition, according to CEO Riedel, 100 percent of the electricity comes from hydropower.

The raw materials required by the furnace are stored in ten silos, which contain meter-high piles of shiny metal strips, crushed panels or brake discs. A magnet is used to load the correct mixture into the furnace automatically. »We are one of the most modern foundries in Europe,« explains Elspaß.

DIGITALIZATION AND TRANSPARENCY

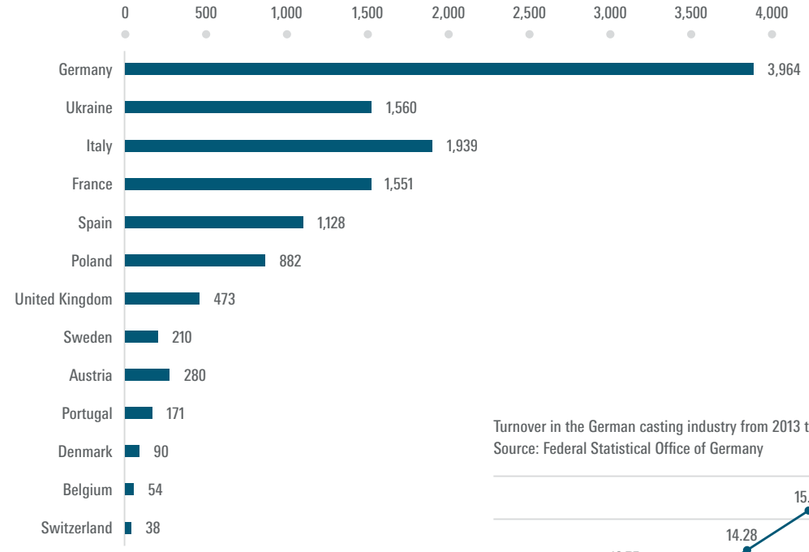
CEO Riedel wants to use printed casting and consistent digitization to further advance the foundry's progress, and update the image of the foundry industry as a whole. One aspect of the modernization is improved transparency of the production status at the company (from design to model creation, casting to delivery), which gives customers accurate information about adherence to delivery dates. »Not only does this help with planning on the customer side, but it also gives employees within the foundry an extra push to meet tight deadlines,« explains Riedel, who previously managed other industrial companies before joining Römheld & Moelle. »Other industries are already accustomed to this transparency; for the foundry industry, however, where little has changed in decades, it's still very new.«

After casting, the cast parts are left to cool for a few days or weeks, depending on their size, and are then finished, first in a 6-meter-high sandblasting machine, which looks like a giant's shoe box. In another hall, some components are several meters in size: Some square and hollow inside, others elongated or round, all usually weighing several tons. Men use angle grinders to remove casting residues or metallic blocks that were integrated into the molds for controlled cooling. The castings made in the 3D-printed molds look comparatively small on the wall opposite, despite also weighing several hundred kilograms.

10 KG TO 25 TONS

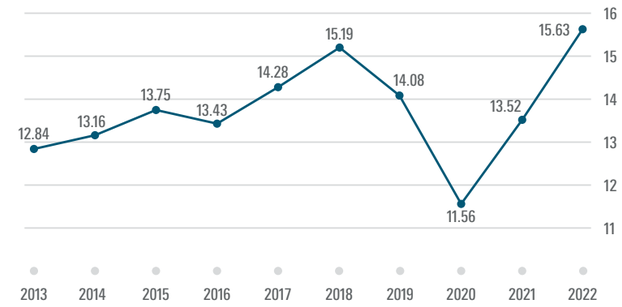
These components are more delicate and significantly more complex in design. The parts are later installed in machine tools or large plants or are used as drilling jigs. »We regularly use printed casting to produce special sizes for one of the largest machine tool manufacturers in the world, for example,« explains Riedel. »Even parts that were previously welded, we now cast.«

Below left:
Chill castings are inserted into a 3D-printed mold to affect the temperature distribution during cooling and improve the solidification process
Below right:
Christian Elspaß, Rudi Riedel, and Marcel Tschillaev (from left) are pleased about the development of their AM department



Casting production in selected European countries in 2021 (in thousands of tons)
Source: European Foundry Association, American Foundry Society

Turnover in the German casting industry from 2013 to 2022 (in € billions)
Source: Federal Statistical Office of Germany



The core business of the large foundry is the production of forming dies weighing up to 25 tons for the automotive industry, but Riedel expects this sector to stagnate in the next few years. The new product area of printed casting therefore represents an interesting prospect for the Mainz foundry. »It means that we can now also handle inquiries for components weighing 10 kilograms or more, although our foundry operators would not previously get out of bed for components weighing less than one ton,« Riedel jokes. Casting such lightweight components is far too time consuming for a traditional foundry.

In this context, Riedel sees printed casting as a complementary manufacturing method, which also competes with casting using wood models as well as additive metal manufacturing. »Our customers can take advantage of the design freedom offered by 3D Printing, while manufacturing at a fraction of the cost of metal 3D Printing.« This was the case for a drilling jig of around one meter high, which, according to Riedel, »could not have been produced using any other casting method.« With many orders, as the CEO explains, the time component is also a very important factor. »With printed casting, we can in some cases deliver within 2 weeks (depending on material and component size).« In an industry where delivery times of several months are the norm, this is very impressive. Thanks to this speed and flexibility, Römheld & Moelle has also become a subsupplier to other foundries to cover high order backlogs that they cannot meet themselves or when they need prototypes before the start of series production.

»TOO FEW FOUNDRY OPERATORS USING THE PROCESS«

For Riedel, therefore, it is unclear why the method is not in more widespread use; for example, for spare parts for the rail industry, construction vehicles or agricultural machinery. »It is often used only for mold cores, although the manufacturers of 3D printers for sand molds have now sold several hundred printers worldwide and also offer sand molds themselves. There are still far too few foundry »

At left:
The 3D printer in the background produces the sand molds and segments. The binder material gives the individual molds their dark color
At right:
At the heart of every foundry is the casting process itself, which only takes place at night at Römheld & Moelle

Cast iron
Despite having the name iron, cast iron isn't pure elemental iron, it is actually an alloy. It differs from steel in its higher carbon content, which changes the properties of the components (e.g. hardness and toughness) and also brings major advantages for casting. The high carbon content prevents significant shape changes during cooling, whereas a cast steel part would shrink considerably.

operators using the process.« The CEO sees further possible applications in engine housings, components for pumps, propellers, valves, or even »in companies that have not yet even considered casting.«

For process engineer Riedel, the casting industry is not even close to approaching the limits of printed casting. As for the potential for casting with 3D-printed molds, Römheld & Moelle considers a market share of 1 percent to be realistic. This may not sound much at first, but in terms of the casting industry in Germany alone, with sales of around € 15 billion, it still represents an amount of around € 150 million (see statistics on page 09). At Römheld & Moelle, according to CEO Riedel, printed casting may even attain a 25 percent share of sales in the near future – »and I don't expect that in ten years, but much sooner.«

Riedel also sees printed casting as an alternative to metal 3D Printing. »Printed casting can achieve equally complex structures, and for at least a tenth of the cost.« Casting with printed AM molds also offers another significant advantage: According to Riedel, this technology and the materials used date back to the origins of cast iron, so »certification is not an issue.«

LARGE MOLDS MADE FROM 3D PRINTED SEGMENTS

The quietest production hall, where segments for the styrofoam models are machined on large gantry machines, is also home to ExOne's two 3D sand printers. To organize 3D-Printing more efficiently, a dedicated AM department was also set up in February 2023. Alongside department head Marcel Tschillaev, who joined Römheld & Moelle in 2021 after completing his mechanical engineering degree, the department includes three design engineers and four production employees.

Next to one of the machines, two employees carefully remove the light-colored sand from tapered vents that are darkened by binder material. »We print these as well, if there is still space on the printing plate. This allows us to further optimize printer utilization,« explains Tschillaev. The vents are placed on the molds during the casting process to allow the gases, which exceed 1,000 °C, to escape in a controlled manner in a colorful flame.

Another colleague carefully inserts a dozen steel blocks, known as chill castings, on a mold suspended from a crane. These later influence the temperature distribution during cooling after casting and improve the solidification process. For the styrofoam models, the molds are placed as carefully as possible on the model by hand at marked positions. »With 3D Printing, the positioning is much more precise. Casting simulation has to perfectly match reality,« says plant manager Elspaß.

Tschillaev and his team have also found a way to 3D print very large molds for castings weighing up to several tons. The process involves printing and fitting together a large number of sand mold segments to create the mold. This requires an extremely well-designed construction, however, to ensure that the molten iron gradually fills the mold from the bottom up. This method has already been used to manufacture castings for Andritz Kaiser industrial presses (as previously reported in issue 02/2023).

DEDICATED PLATFORM FOR CALCULATING PRICES AND CO_2 EMISSIONS

Riedel hopes to use his foundry's own success story and the different possible uses to encourage other foundries to take up printed casting. As he says, the market has enough business for more companies. His motives behind this industry-wide encouragement, which will surely be welcomed by 3D sand printer manufacturers, are not entirely altruistic, however. Riedel and his team have set up a digital platform called Castfast, which automatically calculates prices and CO_2 emissions and significantly simplifies and accelerates the procurement process for casting customers. Orders are currently being accepted in the alloys processed by Römheld & Moelle. Riedel is looking for additional partner foundries to expand Castfast's range of materials.

MORE INTERESTING THAN SERIES PRODUCTION

»Our aim with 3D Printing and a digital orientation is to make casting cool again,« Riedel explains and laments the fact that this technology and casting design »are unfortunately neglected in apprenticeships and no longer a major focus of mechanical engineering studies.« Printed casting offers much greater scope for designing parts than other manufacturing processes, agrees Marcel Tschillaev, who joined Römheld & Moelle directly after completing his mechanical engineering degree. »We make different parts almost every day, which makes it interesting for us engineers. It is very different from series production.«

On taking our leave, we witness a further change brought about by 3D Printing: Between the factory halls, workers are using jackhammers to tear up the cobblestone floor over which the molds have been driven across the yard for several decades. The rough ground represented a risk in the transport of complex sand molds from the 3D printer. In the future, the route between the halls will be smooth and flat.

FURTHER INFORMATION:
» roemheld-moelle.com
» castfast.com
» formnext.com/fonmag

AN EL DORADO OF AM ON THE PERSIAN GULF

The United Arab Emirates is seeing a huge boom in 3D Printing. For proof, look no further than Al Seer Marine, where the world's largest composite 3D Printing facility was recently built.

The pride of the new production hall at Al Seer Marine is a 40-meter 3D Printing facility the company says is the world's largest setup of its kind. It is designed to build boats using mainly composite materials and Additive Manufacturing technology.

Based in Abu Dhabi, Al Seer Marine originally planned to utilize this 3D Printing machinery in printing molds for boat construction. »Then we decided to produce entire boats using the 3D printers,« explains the head of innovation and capability development, who was in charge of building up the company's additive production line.

Al Seer Marine has already 3D-printed an entire boat at the facility: the Hydra, which will soon be used as an autonomous surveillance vessel. Among other aspects, the company is still determining which material will offer the necessary consistency over long periods of exposure to salt water and high temperatures. It is also developing an environmentally friendly coating for this purpose.

TREMENDOUS DEVELOPMENT

The Additive Manufacturing system at Al Seer Marine, a publicly traded company that employs more than 1,200 people and generated sales of €279 million last year, is also symbolic of AM's development in the Middle East. In recent years, virtually no other region has seen such a rapid upswing in 3D Printing as the United Arab Emirates. »Abu Dhabi and Dubai in particular are developing tremendously. There has been a huge amount of activity in the last five years,« affirms the 3D Printing superintendent at Al Seer Marine. Having been working in the AM industry in the Emirates for eight years, he has witnessed the technology's rise up close – first in Dubai and now in Abu Dhabi. Part of the reason why the AM industry is developing so rapidly here is that the government is heavily promoting and supporting Additive Manufacturing, including with corresponding funding. Its activities range from a strong commitment to universities to the Emirate of Dubai's plan to have at least 25 percent of all new buildings 3D-printed by 2030. One important milestone will be a 2,000-square-meter mosque for up to 600 worshippers in Bur Dubai, which is scheduled to be completed in 2025 (for more, see our 01/2023 issue).

Al Seer Marine uses the world's largest robot-assisted 3D Printing facility, MEGA II, to manufacture boats using composite material

Images: Al Seer Marine, Dimensionics Density

Text: Thomas Masuch

MENTALITY AND FINANCIAL RESOURCES

With projects like these, the Middle East has attracted media attention in the field of 3D-printed construction in the recent past. But Additive Manufacturing has also arrived in the broader manufacturing industry between Dubai and Abu Dhabi. Almost every mold maker in the UAE is using 3D Printing, and the technology is also prevalent in sectors such as ship and boat construction, oil and gas, metalworking, and aerospace.

In addition to the Emirates' financial resources, the mentality in the Persian Gulf has been key to the successful development of large-scale 3D Printing. »People here are open to trying new technologies. And even if you fail, you make another attempt until you succeed,« explains the Al Seer Marine expert, who has lived and worked in the Persian Gulf for many years.

In light of this rapid development, it's not surprising that the United Arab Emirates has become an El Dorado for AM technology providers: Almost all the major manufacturers (and numerous smaller ones) are represented here by at least one reseller. »In the field of Additive Manufacturing, here in the UAE we certainly have one of the highest technology densities per inhabitant in the world,« Al Seer Marine's 3D expert adds.

In addition, there is a very diverse range of service providers in Dubai and Abu Dhabi. »It's really amazing how many there are now,« he continues. At the same time, tough competition has also developed – especially in the area of relatively easy-to-manufacture components. By contrast, he says, there are far fewer suppliers for projects that require a lot of expertise.

SPACE FOR MORE ROBOTS AND STATIONS

In its search for an ambitious project partner in AM production, Al Seer Marine thus looked at numerous suppliers around the world before finding what it was looking for in Europe. At Formnext 2021, the company came across CEAD from Delft (the Netherlands), which designed and installed the new robotic 3D Printing system mentioned at the beginning of this article. Dubbed MEGA II, it has been the world's largest machine of its kind since being put into operation on 10 January 2023.

The exceptional dimensions of the system are designed to allow for the integration of more robots or stations into the production line alongside the two hybrid robots that are already installed. In other words, there's potential for even larger boats – and plenty of scope for further exciting research and development.

+ FURTHER INFORMATION:

» alseermarine.ae

» formnext.com/fonmag

NEWS

BENCHMARK FOR DENSITY DETERMINATION

The density determination of additively manufactured enables manufacturers to ensure the quality and reliability of the parts. It also helps to identify defects, porosity, or voids within the material, which could compromise the strength and durability of the final product. With this in mind, the Fraunhofer IAPT, Hamburg, Germany commissioned an independent study of the various AM density determination technologies available. According to Dimensionics Density, the study found that the company's automated density determination is particularly recommended in areas where a statement on the density has to be made quickly or frequently. The Fraunhofer report, entitled »Analysis of measurement methods for density determination in Additive Manufacturing« also reviewed the use of micrographs, computed tomography, and the manual Archimedes method. All methods are basically capable of determining the relative density of AM parts and components, but the Fraunhofer IAPT report found that there are substantial differences in accuracy, resolution, repeatability and the possibility of defect detection. The Dimensionics Density's process uses the Archimedes method, but in combination with modern automation technology.

For a more detailed report, please visit formnext.com/fonmag.

SPECIAL REPORT: THE NORDIC REGION

Denmark, Finland, Norway, and Sweden are representing the Nordic region as Formnext's partner in 2023. Besides being an exciting market for AM, the northern reaches of Europe are home to many thought leaders in sustainability. Here, we've put together some exclusive market reports, user stories, and much more from these countries.

Claiming global leadership in sustainability

Innovation, ingenuity, and a tangible green transition. With only 6 million inhabitants and limited access to raw materials, it is quite surprising how Denmark can be leading in so many manufacturing disciplines: wind turbines, pharmaceuticals, medical equipment, shipbuilding and refurbishment, food processing, machinery and transportation equipment, textiles and clothing, electronics, construction, and furniture – just to name a few.

The best explanation is the flat hierarchies that allow new ideas, technology, and creativity to flourish. Today, leading Danish manufacturers such as The LEGO Group, Grundfos and Danfoss are facing some of the highest demands for transitioning to a greener production.

NATIONAL HUB FOR AM

Acting as Denmark's national hub for AM, Danish AM Hub was initiated in 2018 by the Danish Industry Foundation with the ambition of making Denmark a world leader in using AM for sustainability and helping Danish manufacturing companies take the first steps towards a future where we produce with less waste, less material, less transport and with lower CO_2 emissions. Every year 100 SME producers create tangible results through Danish AM Hub activities, and with the development of a CO_2e calculator Danish AM Hub aims to establish a world class knowledge base of how to produce more sustainably with AM, enabling manufacturers to quantify the environmental impact of their decisions throughout a product's life cycle.

ENGRAINED ACROSS THE VALUE CHAIN

Among the largest manufacturers such as The LEGO Group, Grundfos, and Danfoss, AM is fully engrained across all parts of the value chain. Among SMEs the use of AM is still largely limited to fixtures and tools. However, trends show that AM is increasingly being used in the production phase as well as in end-products.

Surveys from Jysk Analyse, Statistics Denmark and University of Southern Denmark conducted in 2021 demonstrate that approximately a third of manufacturing companies in Denmark use AM in their operations. Companies that use AM technology generally focus on sustainability and emphasize the green transition as a key driver.

The development of AM and knowledge of the potential of the technology are also demonstrated by the growth of Danish AM Hub's annual AM Summit. From 150 participants at the first conference in 2018, AM Summit welcomed over 450 participants, 45 exhibitors and 40 speakers in 2022 – and has now become the largest AM conference in the Nordics.

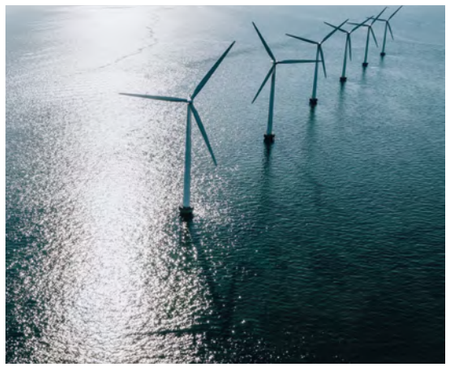
MAIN FIELDS OF APPLICATION AND GREEN GROWTH AGENDA

According to University of Southern Denmark, 85 % of companies using AM use it for product development, including 3D Printing of prototypes. This is typically where companies get started with AM and where competitive advantages are easily realized.

In 2020, the Danish parliament passed the Danish Climate Act, committing Denmark to reduce greenhouse gas emissions in 2030 by 70 per cent compared to 1990 levels, and for Denmark to become a climate-neutral society by 2050. At industry level, AM is seen as vital in contributing to the country's climate targets. As one of 14 industry climate partnerships initiated by the government in 2019, the Climate Partnership for Building and Construction recognizes AM as one of several technologies that can contribute to a lower carbon footprint, providing gains by reducing material consumption, waste, and transport.

By Frank Rosengreen Lorenzen,
CEO of the Danish AM Hub

FURTHER INFORMATION:
» formnext.com/fonmag



Images: AM North, iStock/jonathanfilskov-photography, SeanPavonePhoto, Sergdid

From metal powders to a rocking sofa

Sweden is one of the most important countries in the world in the production of powders for additive metal manufacturing. Rich in various ores, the country is also home to two key manufacturers – Sandvik and Höganäs. Plus, the steel manufacturer SSAB has now also entered the Additive Manufacturing business.

Meanwhile, Sweden features numerous suppliers of Additive Manufacturing solutions along the entire process chain, and even has a publicly listed manufacturer of 3D printers in Freemelt (which is valued at around EUR 27 million as of July 2023). The land of the moose is also a good base for innovative startups – the young company Normada, for example, which has printed a chic rocking sofa from renewable materials such as bio-oil and cellulose. In addition, the government-owned Research Institute of Sweden (RISE) operates a leading application center for Additive Manufacturing in Mölndal.

Compared to other places, Swedish industry is strongly dominated by large corporations. The aerospace and defense company Saab, for instance, is also very active in AM and has successfully tested a 3D-printed hatch panel, among other things. It also completed a large-scale printing project with Ai Build and Airtech to produce a mold as part of the European Union's Clean Sky 2 initiative.

Awareness of AM has continued to grow in Swedish industry, and more applications are emerging. This process is also being supported by AMEXCI, which was founded in 2017 by a group of 12 major Swedish corporations (ABB, Atlas Copco, Electrolux, Ericsson, FAM, Husqvarna Group, Höganäs, Saab, Scania, SKF, Stora Enso, and Wärtsilä). AMEXCI's mission is to accelerate the industrial use of Additive Manufacturing. The organization operates laboratories in Sweden and Finland that conduct research, offer customized training programs, and provide expert support that is designed to help laser-powder-based AM and related processes deliver ready-to-use components. Most recently, AMEXCI announced a collaboration with Ampower in the area of training. (tm)

FURTHER INFORMATION:
» formnext.com/fonmag

A small country with a strong AM industry

Even though Finland is rather small country of only 5.5 million people, it is home to dozens of AM service providers for manufacturing and more than 10 companies that provide design services for AM. Since around 2020, OEM companies have also started to invest more in AM, purchasing their own AM systems in order to produce the most valuable use cases (including both metal and polymer systems) in-house.

One of the best examples of the adaptation of AM is DED-arc technology, which fits perfectly into Finnish industry and its production of heavy metal parts. Finland has a lot of know-how in welding technology and robotics, and DED-arc technology is well suited to the corresponding manufacturing chain. There are many application areas related to the 3D Printing of large metal parts, and even more will arise as companies invest in their own DED-arc cells and universities research the DED-arc process and its productivity.

Thanks in part to the competence development center EOS has established in Turku, Finnish companies have been able to develop their AM expertise at a rapid pace. EOS Finland has been active in FAME (the Finnish Additive Manufacturing Ecosystem) has the support of Business Finland, a national R&I funding agency that believes Finnish industry.

Finland also boasts a high average level of knowledge of design, manufacturing, and the testing of high-quality parts (with regard to fatigue design, for example). Business Finland has also supported a new AM campus in Vaasa, a joint facility where companies can learn by printing through trial and error.

At the moment, the DIMECC DREAMS (Database for Radically Enhancing Additive Manufacturing and Standardization) research project is seeking to produce the world's largest public database for metal AM.

By Eetu Holstein,
FAME Ecosystem Lead at DIMECC

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» formnext.com/fonmag

Image: iStock / Sergdid

From DED innovation to digital inventory

The Norwegian AM industry is creating numerous innovations, with domestic energy and oil and gas companies playing a major role.

Since Norway has an extensive coastline relative to its landmass – along with large deposits of oil and gas under the continental shelf – maritime, energy, and oil and gas companies are obviously fundamental to Norwegian industry. In addition to being application areas in and of themselves, they serve as customers for Norwegian manufacturing companies. However, applications in these areas normally require product qualification and certification. The Norway-based global quality assurance and risk management company DNV thus launched its first classification guideline for the use of AM in 2018, and its portfolio of AM guidelines and standards has continued to grow ever since.

Meanwhile, the local energy giant Equinor has done extensive research on the potential to use AM to produce spare parts and repair and manufacture end-use products. Due to its extensive production installations, Equinor is highly dependent on access to spare parts and currently keeps an inventory valued at approximately €2.5 billion. Maintaining physical warehouses and inventory is very costly, which is why the company has set its sights on reducing its physical inventory by 25% over a five-year period and by 50% within 10 years. The plan is to replace its reduced inventory primarily with localized, on-demand production enabled by AM technology.

FIELDS OF INNOVATION

In addition to AM's inherent capability to facilitate innovative product design, the main fields of AM innovation in Norway include developments in process technology and distributed manufacturing solutions. Norsk Titanium (NTi), for example, has developed Rapid Plasma Deposition (RPD) – its own version of the DED-Arc process for manufacturing large-scale, near-net-shape parts from titanium.

Visitech, a supplier of DLP-based light engines that are used for purposes like vat photopolymerization (VPP) processing, has developed a near-IR light-driven DPL unit for powder bed fusion using polymer materials (PBF/P). Called Direct Image Sintering (DIS), this method promises to combine instant exposure with high precision and resolution. The unit's launch was in November 2022.

Fieldmade, meanwhile, has developed the Nomad series of fully integrated production modules for polymer, composite, and metallic materials. These »micro-factory« modules, which are easily transportable and deployable virtually anywhere, can be ready for production within an hour of arriving at their destination. Enter Fieldnode, a spin-off of Fieldmade that has developed a solution for digital inventory and other such functions in collaboration with leading entities and key stakeholders from the energy sector (see page 18).

Finally, the American-Norwegian Ivaldi Group has been developing solutions for AM-enabled distributed manufacturing for the maritime, off-shore, and mining sectors. Ivaldi wants to replace its physical inventories with digital supply chains and localized production, which will make its existing supply of spare parts redundant (adding to its defective parts, production swarf, and waste from manufacturing). To reduce waste and enable a locally sourced supply of metal powder as feedstock for metal AM processes, F3nice – an Italian company that has established operations in Norway – continues to develop practical solutions with support from stakeholders in the Norwegian energy industry.

By Dr. Klas Boivie, Senior Research Scientist at SINTEF Manufacturing AS

FURTHER INFORMATION:
» formnext.com/fonmag

NEWS

INDUSTRIAL AND ROYAL

For many years, materials and components from VBN Components in Uppsala, Sweden, have been used in industrial applications, but a few weeks ago they were also in royal service. When King Carl XVI Gustaf visited Uppsala with Queen Silvia to mark his 50th anniversary as head of state, he planted a Swedish whitebeam with the help of a 3D-printed shovel. The artfully designed shovel and a matching 3D-printed commemorative plaque were manufactured by VBN Components and now have a place of honor in Uppsala Castle as mementos. The blade-shaped shovel is made of Vibenite 480, a patented cobalt-chromium-based hard metal alloy developed by VBN Components. The Vibenite range of metals is the core of the company founded in 2008 by three engineers eager to revolutionize metal production. »They succeeded in creating something unique: metal materials that last multiple times longer than traditional ones, and that can be shaped with minimal or no machining«, says Isabelle Bodén, who is responsible for customer relations. After several years of development work, the company launched its first materials in 2014. »At the time, we were one of the first companies to work on special metal alloys for Additive Manufacturing,« reports Isabelle Bodén. Today, the company employs ten people and offers five different AM metals: in addition to Vibenite 480, various very hard and ductile

steels with a hardness of up to 72HRC. The metals are used, for example, in the food, energy and packaging industries. VBN's materials are a combination of specific metal powders and specific printing methods. On the one hand, the company acts as a service provider and prints prototypes or finished parts using its own materials. To further improve this process, a URQ-HIP system was recently purchased that will enable the company to both further shorten lead times and improve material properties. On the other hand, the company offers a manufacturing license that allows customers to manufacture Vibenite components on their own premises. In the latter case, VBN Components provides support in selecting the right machine, setting up the process and the manufacturing itself.

STANDARDS FOR DIGITAL SUPPLY OF SPARE PARTS

Some of the world's largest energy companies have signed an industry collaboration agreement to set an industry standard for a digital inventory ecosystem. In doing so, ConocoPhillips, Equinor, Shell, TotalEnergies, Woodside, BP, and Vår Energi – together with the software company Fieldnode – have shown a firm commitment to developing a digital foundation for a network that will supply spare parts produced on demand through Additive Manufacturing technology. The two-year partnership aims to drastically reduce lead times, physical inventories, total cost of ownership, material waste, and shipping distances. According to Fieldnode, the required technology is available; to really scale it up, however, the partners in the collaboration believe it is necessary to establish a standard, fit-for-purpose process. The partners also intend to progressively invite their current suppliers, independent Additive Manufacturers, and other suppliers to collaborate on the platform to both test technical and commercial solutions and fill the network's digital inventory with content. At the heart of the network is the Fieldnode platform, a technical solution the company developed in a joint industry project with Equinor and TotalEnergies.

Images: VBN Components

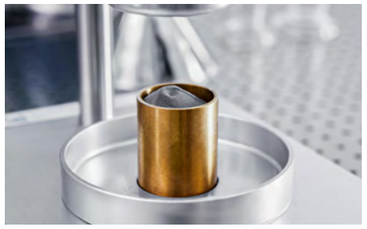
NEWS

LIGHTWEIGHT TITANIUM SUNGLASSES TESTED AT THE GIRO D'ITALIA

For its limited-edition Elicit Ti cycling sunglasses, Swedish manufacturer POC is using titanium recovered from the medical field. Weighing just 22 grams, the goggles are being 3D-printed in a single piece for professional cyclists from Team EF Education-EasyPost. To make these frames possible, the Stockholm-based company has developed a process that recovers and reprocesses unused titanium from the manufacture of surgical instruments. Its approach is based on the idea that »sustainable materials and performance can, and should, be able to live side by side,« says Tilda Håll, eyewear product manager at POC. »If we challenge conventional thinking and methods, there is no need to compromise on performance or sustainability, or to choose one over the other.« The lightweight sunglasses, which sell for around 400 EUR, were already put through their paces by Team EF Education-EasyPost cyclists at the Giro d'Italia in May. One of the riders, Stefan de Bod, appreciates the fact that they are so incredibly light. »I hardly notice them!« he declares. The Elicit Ti feature a titanium construction along the temples that, according to POC, strikes a »perfect balance between stiffness and weight.« Meanwhile, slide-in joints make it easy to change lenses and also allow the temples to break away from the lenses to minimize damage in the event of a fall.

METAL POWDERS ON DEMAND

Through its metal powder web store, Osprey Online, Sandvik now offers standardized alloys for Additive Manufacturing from stock. Its initial offerings include titanium powders, maraging steel, and nickel-based superalloys, as well as duplex and super duplex, austenitic, martensitic, and precipitation hardening stainless steels. The store is currently open for customers in Europe, with additional markets set to follow soon.



PROCESS PARAMETERS SIGNIFICANTLY REDUCE CARBON FOOTPRINT

A Finnish study recently conducted a life cycle assessment of Additive Manufacturing compared to conventional manufacturing based on a filtrate nozzle from the mining industry. The 3D Printing service provider Delva Oy and the VTT Technical Research Centre of Finland Ltd. were involved. The filtrate nozzle, which conventionally consists of an assembly of four separate parts, was 3D-printed by an EOS M 290 machine using AISI316L stainless steel. In the study, parameters ranging from the production of powder and the manufacturing of components to transport routes and means of transport were documented and taken into account. The results indicate that the feedstock material used has a remarkable impact on the carbon footprint of the manufacturing stage, especially in the case of PBF-LB manufacturing. The study also investigated two different scenarios related to powder production by varying the yield of the atomization process in order to better understand its effect. Changing this process parameter in manufacturing also led to a meaningful reduction in carbon emissions in the PBF-LB process.

For a more detailed description of the study, check out fon-mag.com.

Images: POC Titan, Sandvik, Delva

From training to highly optimized components

Training was one of the first activities prioritized at Danfoss on the way to group-wide Additive Manufacturing, and it is still the basis for its AM activities today. »Several hundred employees have learned in detail about different AM technologies in this way, developing a general awareness of the use of Additive Manufacturing,« explains Wladimir Schamai, Head of Digital Engineering Enablers at Danfoss.

»The process continues with ongoing coaching and application identification workshops,« Schamai further explains. This has now resulted in practice communities with several hundred members for simulation and 3D Printing. Best practice examples are discussed at the annual internal conference. Here, it also becomes clear how extensive additive know-how already is at Danfoss: »In the beginning, we almost exclusively invited external experts. But now we have the expertise in-house and can conduct workshops and tutorials in part with our own employees,« says a pleased Schamai, who heads the Digital Initiative at Danfoss and whose mission is, among other things, to further spread Additive Manufacturing throughout the Group, which has more than 40,000 employees.

Danfoss is one of Denmark's largest companies with sales of €10.3 billion as of 2022. Additive Manufacturing is expected to help the company produce more efficiently, develop and improve its products faster and also help achieve the company's sustainability goals.

REMOVING BARRIERS

Danfoss has developed a master plan for the long-term roll-out of Additive Manufacturing. »In a large company, it's not just about investing in 3D Printing hardware, but also about getting the relevant stakeholders on board,« explains Schamai, who has been with the Danish company for more than six years. »Alongside that, it's about removing the barriers created with regard to easy access to 3D-printed parts.« To enable easy access, Danfoss has gradually set up AM hubs at seven locations in the company. Here, various printers are located on which the required components are produced. With a three-digit number of 3D printers, the company has a variety of common technologies - FDM, SLA, MJF, DLP, SLS or plastic with fiber reinforcement. Danfoss has in-house facilities for printing plastic parts while metal components are additively manufactured by external service providers.

About Danfoss
Danfoss engineers solutions that increase machine productivity, reduce emissions, lower energy consumption, and enable electrification. Danfoss solutions are used in such areas as refrigeration, air conditioning, heating, power conversion, motor control, industrial machinery, automotive, marine, and off- and on-highway equipment. Danfoss also provides solutions for renewable energy, such as solar and wind power, as well as district-energy infrastructure for cities. The innovative engineering dates back to 1933. Danfoss is family-owned, employing more than 42,000 people, serving customers in more than 100 countries through a global footprint of 95 factories.

Text: Thomas Masuch

Images: Danfoss

PROTOTYPES, TOOLS AND FIXTURES

Additive Manufacturing was initially used for prototyping, which was very successful at first. »Since we were also developing simulation within the company at the same time, the number of printed prototypes is expected to decrease in the future,« explains Schamai. Instead, the use of Additive Manufacturing increased in production and operating equipment, for example, for tools and fixtures.

Using a company-wide platform, employees can upload components quite easily and decide on the material and printing method. A central team advises on print material, process, design and print location (internal or external) in the EU, North America and Asia Pacific regions and processes orders – either on internal printers or using external suppliers. »This lean and 'hybrid' approach suits Danfoss because it is material and process agnostic. For example, there is access to more than 1000 3D Printing materials,« explains Niklas Franke, Head of Production Simulation and ADM at Danfoss Climate Solutions.

The next stage will be Additive Manufacturing of final components, where Danfoss has already taken initial steps. »We started with less critical components that are relatively easy to implement,« Franke says.

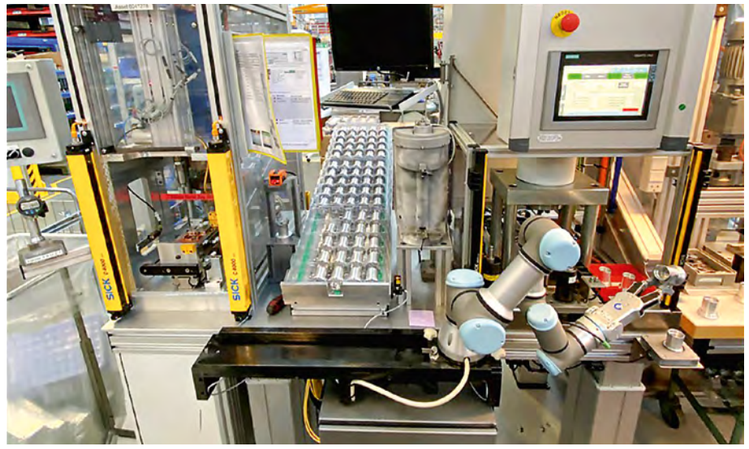
In addition to these »low hanging fruits,« however, numerous other applications have since been identified where Additive Manufacturing makes economic sense – for example, less critical components in low volumes (up to several thousands) such as limiters in thermostats. »We have a lot more in the pipeline there.«

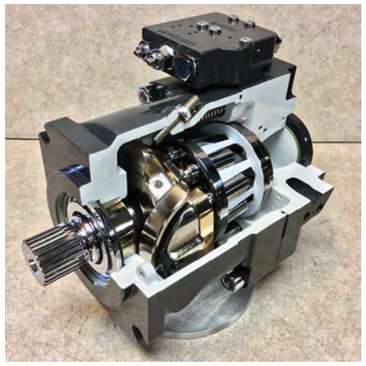
»FINDING HIGHLY OPTIMIZED COMPONENTS«

The design of the end-components was adapted for 3D Printing. Schamai and Franke expect significantly more additive applications when components are designed for Additive Manufacturing in product development and optimized bionically, for example. »The long-term goal is to find and print highly optimized components that significantly improve the performance of the system they are part of,« says Schamai. »That makes it even more important to take as many design engineers with us as possible to spread additive design thinking.«

Even though there is still a way to go before the highly optimized final component is available, Danfoss is already seeing considerable success from the AM initiative: over 220,000 prototypes and production tools have been 3D printed since 2017. Franke and Schamai have calculated savings of several million euros for the company as a result. »Moreover, in addition to the systematic use of simulation, Additive Manufacturing has helped to implement projects twice as fast,« says Schamai, who is pleased to emphasize the continuous use of the new technologies: »The theoretical training is a good basis, the daily learning by doing is what helps us evolve.«

Crucial to Danfoss' additive journey is also the top management's commitment to the technology. The quantifiable successes also help Schamai and Franke to further solidify this commitment. In addition to the usual KPIs such as cost and time savings, Franke can report other softer benefits that are harder to quantify: »For example, when Sales visit customers, the cutaways 3D-printed models help the dialog because we can explain and show the product function more effectively.« In addition, deceptively real product models have been 3D-printed from plastic and can easily be taken to trade shows. And this is another way to reduce the cost of transportation and improve the carbon footprint in small steps.

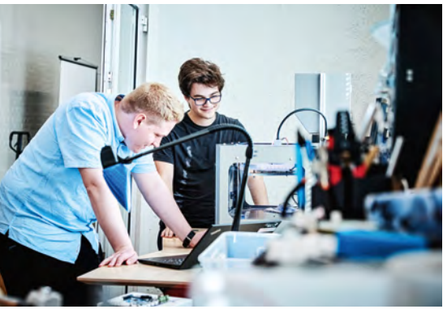


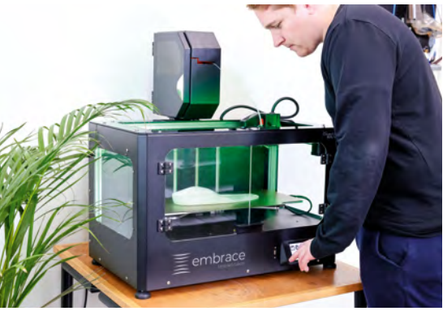


Above:
A lot of 3D Printing in a small space: For this production station, an entire ball bearing feeding machine, the 40 cm frame of an inspection station and a depositing platform were printed in PA12 along with a gripper made of titanium.
At right:
3D-printed plastic product models like this look just like the real thing, which makes them ideal for trade fair appearances

FURTHER INFORMATION:
» danfoss.com
» formnext.com/fonmag

From slicers to foamed soles





Text: Thomas Masuch

Create it Real's initial position was actually more in the background: the software developer from Aalborg in northern Denmark, founded in 2009, had been supplying »white-label slicers« to numerous 3D printer manufacturers for around 10 years and had established itself in the market. »For us, even back then, it was about helping our customers by overcoming technological hurdles,« explains founder and CTO Jeremie Gay. That attitude has since ensured that Create it Real has massively expanded its product portfolio, supplying medical supply stores as well as printer manufacturers.

»Slicers have always been part of our DNA,« Gay explains. Starting from this base, he and his then 12 comrades-in-arms had the idea of offering even more and opened a new chapter in the company's history: »We focused more on applications and developed a technology to produce programmable foam,« explains Jeremie Gay. This allows areas with different hardnesses to be produced in a component using the same material. Among other things, this has resulted in insoles – »which are not prototypes but end products.« Other products for which the company has developed a special production solution are seats (for wheelchairs, office chairs or car seats, etc.) and corsets.

In a further step, the company developed its own dedicated solutions for orthopedic applications. These solutions all feature FDM technology. »However, we are not a manufacturer of 3D printers. We offer system solutions for insoles and other primary orthopedic areas,« CEO Jacob M. Nissen explains. These solutions typically include the 3D printer, CAM software, and certified material.

EASY-TO-USE SYSTEM SOLUTION

It is important to the company that the additive system solution is easy to use. »With our Embrace Insole solution, we are primarily targeting orthopedic workshops and medical supply stores,« explains Jeremie Gay. »They're not 3D Printing experts. They just need a product.« The Danish company has since convinced numerous medical supply stores of the benefits of 3D-printed insoles: around 150 machines are already in use, according to Create it Real.

Even though the founders know that applications with programmable foam are manifold, they are currently focusing strongly on the healthcare sector. »A lot of things here are still done manually and require custom solutions. In addition, the industry is suffering from a shortage of skilled workers. That's where 3D-Printing fits in perfectly,« explains Jeremie Gay.

Thanks to product expansion, Create it Real has now grown to 20 employees. »Our team consists mainly of software and electronics engineers and is very international, with seven nationalities represented,« says Gay, who is himself from France. Growth was also helped by two rounds of financing (2018 and 2020). »You simply can't do it without external capital,« explains CEO Nissen. »The market is developing so fast, and you simply have to be fast to keep up.« And to drive development even further, the next step is to expand the network of resellers even further.

Material Extrusion:
For further information on this procedure, check out the AM Field Guide at:
» formnext.com/amfieldguide

FURTHER INFORMATION:
» createitreal.com
» formnext.com/fonmag

Images: Create it Real

3D Printing among reindeer and polar bears

Text: Thomas Masuch

Directly at the harbor of Hammerfest, the northernmost city in the world, many would say that AM North has developed into the most northern center of 3D-Pinting. The far northern part of Norway, whose heraldic animal is the polar bear, lives mainly from the oil and gas and fishing industries. Hundreds of salmon farms line the rocky coastline, producing millions of tons of salmon each year. Because space in coastal waters is becoming scarce, some farm operators are moving further offshore.

As the fishing industry expands, so does oil and gas production. In addition to the existing oil and gas fields around Hammerfest, further fields are to be developed in the next few years. An LNG terminal that was inaugurated in 2007 liquefies the extracted natural gas for transport to Central Europe, among other places. One of the lighthouse projects of this development is the 313-meter-long oil production vessel Johann Castberg, which will be deployed at the oil field of the same name around 240 kilometers northwest of Hammerfest at a water depth of 360 to 390 meters.

To operate the Johann Castberg as self-sufficiently as possible, the software startup Fieldnode is building a digital warehouse for spare parts for the oil production vessel, also making use of AM North's expertise and production capacity for this purpose (see page 18). In addition, the northern AM hub will support the local fishing industry. The use of 3D Printing is also expected to strengthen other companies in the Finnmark region and make them more competitive, including by reducing lead times. In addition, AM North wants to enable the industry in this remote part of the world far north of the Arctic Circle to produce important spare parts in a self-sufficient manner.

Roman Fredriksen, head of AM North, also believes there are good opportunities for suppliers and partners in the AM sector. »While the oil and gas industry requires a high level of technical expertise and develops many solutions internally, the fishing industry takes a different approach: here, you work almost exclusively with partners and help them develop further,« he explains.

AM North wants to further support this process. In addition to design and production support, training plays a major role. For example, Fredriksen and his team show engineers and technicians at partner companies how to identify parts for Additive Manufacturing, calculate costs and savings, and select the right AM technology.

AM North was founded by NorSea Polarbase together with GSG, a subcontractor for the fishing industry; and Pro Barents, a business incubator. Financial support also came from the oil and gas companies Equinor and Vår Energi, as well as Innovation Norway.

Major seafood companies such as Grieg Seafood, Cermaq, and Jangaard are part of the AM North network, which has already implemented initial use cases for some of its members. This has involved activities like 3D Printing spare parts or improved components. To meet these technological challenges, AM North has acquired a fairly broad portfolio of printers, including various desktop printers and metal printers such as a Lasertec 30 SLM from DMG Mori.

The partners have big plans for AM North and are currently engaged in an extensive marketing effort. The network, which launched in February 2023, plans to be highly visible at the prestigious Arctic Race of Norway in August, for example. »We want to significantly increase our presence and show companies throughout the region that we can support them with cutting-edge technology such as Additive Manufacturing,« Fredriksen explains.

FURTHER INFORMATION:
» formnext.com/fonmag

AM North's activities focus on the fishing industry and oil and gas production (at right: the oil production ship Johann Castberg)

Images: AM North

Natural bone replacements from a 3D printer

With 3D Printing technology for patient-specific, resorbable bone graft substitutes that reform into real living bone, the young Danish company Ossiform is aiming to improve patient health and reduce treatment costs. The company expects its first product to see use in humans by next year.

Martin Bonde Jensen got involved in 3D Printing bone graft substitutes while studying medical engineering at the University of Southern Denmark in Odense. After talking to surgeons, it was clear to him that there was a significant need for better solutions for bone defects that might be met using 3D Printing technology.

When bone needs to be reconstructed, patients in Denmark typically receive bone that has been harvested (grafted) from the patient themselves. »Through dialogue with surgeons, we quickly learned that the current gold standard isn't ideal for patients or the healthcare system, as these patients are often admitted for longer periods due to the extensive bone harvesting process and post-surgical complications,« Jensen recalls. Though the benefits of customized implants are widely recognized, current customized solutions generally use non-resorbable or permanent materials such as polymers or titanium, which are foreign to the human body and carry a high risk of infection, Jensen says.

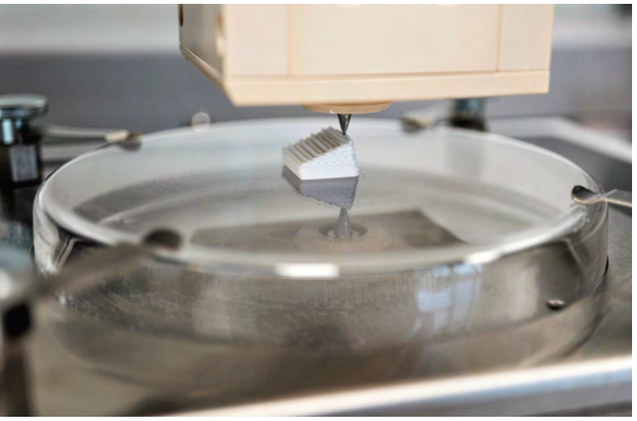
He therefore started working on a bioceramic material that would not only replace damaged bone, but facilitate the formation of new bone. Jensen's solution involves technology for 3D Printing customized bone graft substitutes that resorb over time and transform into living bone tissue. In doing so, he has focused on improving both patient outcomes and hospital cost-effectiveness. »With our solution, we expect to see a minimal risk of complications and readmissions, shorter hospital stays, and faster recovery,« Jensen explains.

SECURING FUNDING AND REACHING THE MARKET

Ossiform received its first funding from Danish investors in 2018. In two further funding rounds (in 2020 and 2022, respectively), the young company from Odense succeeded in raising equity capital amounting to EUR 10 million. It has invested the funds in developing its technology further, as well as in production facilities, personnel, patent approvals, and regulatory clearance procedures, including numerous test series and preclinical studies.

Since raising its initial capital in 2018, Ossiform has hired 15 employees in areas spanning quality assurance, regulatory affairs, production, R&D, marketing, and sales. In addition to founder Martin Bonde Jensen, who also serves as CTO, the company is led by group CEO Thea Wulff Olesen, who brings extensive experience from her past leadership roles at several life science companies.

Bringing Ossiform's bone graft substitutes to its target markets is going to be a highly complex affair. The regulatory approval processes involved are especially challenging – and even more demanding in Europe than in the United States, which is why the company intends to apply for approval in the US first. To apply for FDA approval, Ossiform has still had to conduct numerous series of laboratory tests and in vivo studies to verify the safety and efficacy of its solution. Once approved in the US, Ossiform plans to use the clinical data it has obtained to ease the process of securing approval in the EU. »So, we're going across the Atlantic first, and then coming back later,« Jensen affirms.



PRINTING BONE USING A NOVEL EXTRUSION PROCESS

In its technical work, Ossiform focuses primarily on the development of 3D-printed bone implants. Jensen explains that strictly speaking, his company doesn't produce implants, but bone graft substitutes that gradually resorb in the body and transform into new bone tissue. For its hardware and software, Ossiform works with well-known partners from the AM world: Its 3D printer comes from ETEC (formerly EnvisionTEC) and is supported by Mimics Innovation Suite, a software solution from Materialise that can transform patient scan data into bone graft designs.

Images: Ossiform

Ossiform's bone graft substitutes are made of beta-tricalcium phosphate (β-TCP) – a material that has been used in bone reconstruction for decades, but normally comes in blocks that surgeons have to manually carve into implants for patients. To produce its bone substitutes, Ossiform uses a process called paste extrusion modelling using the company's novel bioink, which combines β-TCP with a binding agent. The printed parts are then thermically debinded and later sintered in a furnace at over a thousand degrees Celsius. This creates a pure ceramic part that can be implanted into the body and become a natural part of it. In doing so, Ossiform takes advantage of the human body's natural bone-forming ability: The ceramic material, which is water-insoluble and naturally found in the human body, is broken down and restored by bone cells. »This natural process happens in all of our bones every day,« Jensen explains.

A VAST NEED FOR BONE REPLACEMENT SOLUTIONS

Three million bone graft substitutes are used clinically every year. The need for bone replacement occurs when natural bones are partially destroyed or removed – due, for example, to congenital birth defects, accidents, or diseases that affect the bones.

The value of this market is estimated at around USD 4.8 billion, with the US accounting for around 40 percent. It's no wonder that the evident demand has attracted other young companies that are looking to produce bone substitutes with a 3D printer. Nevertheless, Jensen is convinced that Ossiform not only has several technological advantages, but is very well positioned in terms of its ongoing patents and approval processes. »Still, we have to continue to be smart and fast,« he points out.

Ossiform intends to produce and sell patient-specific bone graft substitutes directly to clinics and hospitals starting in 2024. That said, Jensen also has further-reaching ideas for the future: »It's also conceivable that we could install our system at hospitals and only supply the material.« This is not feasible in the short term, however; according to Jensen, some issues (such as liability) have not yet been conclusively clarified.

FURTHER INFORMATION:

» ossiform.com

» formnext.com/fonmag

At left:
Ulf Qviberg (right) and his team
At right:
Along with the usual powder-removal features, AM Efficiency integrates surface smoothing into its systems

Text: Thomas Masuch

Sailboats and sintered parts

Ulf Qviberg's way to the office takes him through the Swedish archipelago with its thousands of small islands to the marina in Västervik. Here he moors his boat and then walks past the campsite to the nearby industrial area of the small town in eastern Sweden. In the small resort town, also known as the Pearl of the East Coast, the engineer has built up a company that manufactures equipment for post-processing 3D-printed components. He has worked in the AM industry for 12 years.

Just a few years ago, Qviberg had been selling machines from other manufacturers: For years, he was a reseller of SLS machines in Sweden for 3D Systems, Prodways, HP and Sinterit, among others. Three years ago, however, the entrepreneur repositioned himself: He founded AM Efficiency and focused on post-processing of SLS polymer components – and developed his own system for this purpose.

HAMMERED INTO THE SURFACE

On the technology side, AM Efficiency combines surface smoothing and conventional powder removal in its machines. Coloring in a dark gray is also possible for some types of plastic. To do so, the company uses a process that does not use chemical liquids at all: »The color pigments are hammered into the surface with a sandblaster,« explains Qviberg.

To succeed in the already competitive AM market, the avid water sports enthusiast's top priority is to offer an attractive price-performance ratio, helped by the company's picturesque location on the Baltic Sea, where it has 2,000 square meters of manufacturing space at a fairly reasonable price. As Qviberg explains: »Other suppliers sometimes overcharge for their post-processing technology, which does not help the further development of the industry. We want to be much cheaper on price, and at the same time we try to build good machines.« And AM Efficiency has already delivered several dozens of these – with a target of more than 100 by the end of 2023.

MORE AND MORE END-USE PARTS

Although all this may sound ambitious, Qviberg is confident it can be achieved by his very efficient six-person team. Sales and service are handled by partners in numerous European countries. The leap across the Atlantic to the USA is already being planned. Qviberg sees clear potential in the increasing demand for industrial solutions. »At present, around 50 percent prototypes are produced on our lines, and 50 percent end-use parts – the latter with an upward trend. And the finished parts area requires an industrial solution in post-processing, as this is the only way to offer more consistent quality.«

Qviberg founded and built up AM Efficiency using his own resources without relying on external financiers or venture capital. »It certainly also helped me that I had already established companies in other industries.« That is because at the end of the day, in addition to qualified employees, one thing counts most for the successful founder: contacts to customers, partners, suppliers. »Formnext has also helped me a lot in this. Simply the best way to find new customers. Without it, we would not be where we are now,« Qviberg enthuses. »Especially for us in Sweden, where the distances are quite long – we drive four hours to the nearest airport – it's extremely important to meet partners and customers efficiently.« And with this network, one can also build a business where others go on vacation.

FURTHER INFORMATION:
» amefficiency.com
» formnext.com/fonmag

Images: AM Efficiency

Developing the additive imagination

Text: Thomas Masuch

Innovation has been Pekka Ketola's business for 25 years. With his company Ideascout, the doctor of philosophy has been offering Additive Manufacturing training, seminars and conferences for various industries since 2012. »Our goal in the beginning was to bring Additive Manufacturing of metal to Finland, because almost ten years ago there was nothing in the field.«

Ketola had also learned at these events that there was a real need for 3D printed components in Finland. »Part of the reason for that is that the volumes in Scandinavia, and Finland in particular, are often so low that it's even more profitable to use this technology here than in other countries.«

And since no one seemed to want to start such a business in Finland at the time, »We asked why not just do it ourselves,« Ketola recalls. »The need was quite easy to see, however it's not so easy for companies to get into this technology.« A spin-off from Ideascout, 3DStep was created in the Tampere region, the industrial center of Finland in 2016. It gradually acquired a small pool of industrial 3D printers and established itself as an additive services provider. The company now has machines for metal and polymer manufacturing (including two SLM 280 machines, two HP Jetfusion machines, EOS technology and a Mimaki Full Color printer), among others. In addition to Pekka, the company has three other owners and now employs 10 people.

Consulting also continues to be an important pillar for 3DStep. »Many of our customers have heard of 3D Printing, but they don't know exactly what they can do with it. They simply need help on imagining potential applications.« That was the case when 3DStep was founded in 2016, he says, and »To this day, not much has really changed,« Ketola explains. »Except that there was media hype back then, today it's more sober and about real business. In that respect, Finland is no different from other countries in Europe.«

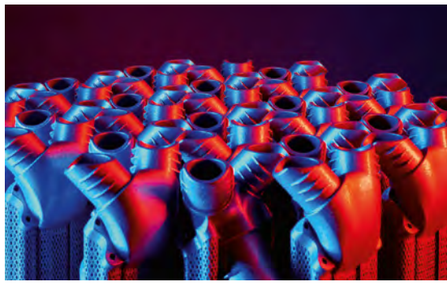
To address this shortcoming, 3DStep continues to offer AM events and innovation workshops, but they now focus on individual companies. »Our approach is to develop the idea of where AM can be used in a concrete fashion to create value for the company now or in the future, and then implement that with our customers,« Ketola explains. »And in our events, we actually always find an application that makes sense and from which a business case emerges. This is reflected in our brand statement: Imagine and implement!«

These are now very diverse: for example, after collaborating with the Automation Systems division of the Finnish Valmet group on the development of aluminum air deflectors, 3DStep then went on to manufacture the products. The company is also supplying Y-distributor components 3D-printed from aluminum, a product frequently required by Mirka, the Finnish surface specialist.

3DStep has established a very close collaboration with OptoFidelity, a provider of robot-assisted test and measurement solutions for electronics. It is in such relatively young companies and start-ups that Ketola also sees the greatest growth potential for his company and for 3D Printing in Finland: »These companies are very open to new technologies and much more willing to use them for themselves.«

Overall, most of 3DStep's customers also come from Finland, although Ketola is also increasingly looking to other European countries: »Our advanced know-how and efficiency in 3D Printing of aluminum, which is otherwise difficult to find in this form, helps us here.«

FURTHER INFORMATION:
» 3dstep.net
» formnext.com/fonmag



In addition to AM production, consulting continues to be an important line of business for 3DStep

Images: 3DStep

Drawing a bead on the traditional construction industry

After a few sentences, most conversations with Morten Bove inevitably return to the topic of sustainability no matter what question you asked before. The topic seems to be really close to the heart of the 55-year-old, who states with conviction: »We are the generation that can save the climate and the world.«

Bove is not an idealist, however, but an entrepreneur with clear ideas. He's all about making a real impact. »For that, you need a good product. If the product doesn't outcompete the incumbent offerings, maybe the climate believers will buy it, but it will always be niche,« he points out. »To make a real difference, you need volume and mass adoption.«

With his startup, WOHN, Bove has developed 3D-printed load-bearing structures for home construction and so-called »grand structures« for special-purpose applications. He says this is sustainable in a number of ways: a mixture of sawdust and recycled plastic is used as the material, and the structures are also comparatively lightweight and can later be produced locally wherever needed. According to Bove, the solution can reduce the carbon footprint of home construction by 90%.

Bove founded WOHN together with Matúš Uríček, who wrote his thesis on the 3D Printing of modular housing at the University of Alborg in 2020. Friends had brought the two together after hearing them both go on and on about their sustainable ideas. »But we didn't really get going with our startup until 2021,« Bove explains. An initial round of seed funding followed shortly thereafter, enabling the creation of an initial prototype and further material experiments. A second prototype with a revised design is currently being created on the WOHN's 6x6x4-meter gantry machine, which it custom-developed along with an extruder.

Below and top right:
WOHN uses its large gantry machine to manufacture load-bearing structures for home construction and other large structural elements

Text: Thomas Masuch

Above:
Matúš Uríček and Morten Bove (right)

Images: WOHN

DRIVING SUSTAINABILITY FORWARD

At present, Bove (sales and marketing) and Uríček (technology) are still working in tandem on all the challenges facing the startup, whose opportunities continue to grow. Following a number of media reports, including on regional Danish television, the company already has orders and requests for more than a hundred home modules. It soon plans to hire additional employees to fulfill them. »We also want to switch from the gantry to a robotic arm platform, which will give us more design freedom and flexibility,« Bove explains.

Upon commencing production, the startup plans to push its own sustainability metrics even further. Its sawdust, which makes up half or more of its secret material recipe, is currently still being acquired from Sweden, while the recycled plastic comes from Germany. Both are to be sourced from the Danish market as soon as possible. This won't be easy, though: in contrast to its Scandinavian neighbor, Denmark barely has a wood industry, and the recycling rate for plastic in Denmark is only around 23 percent (as of 2020).

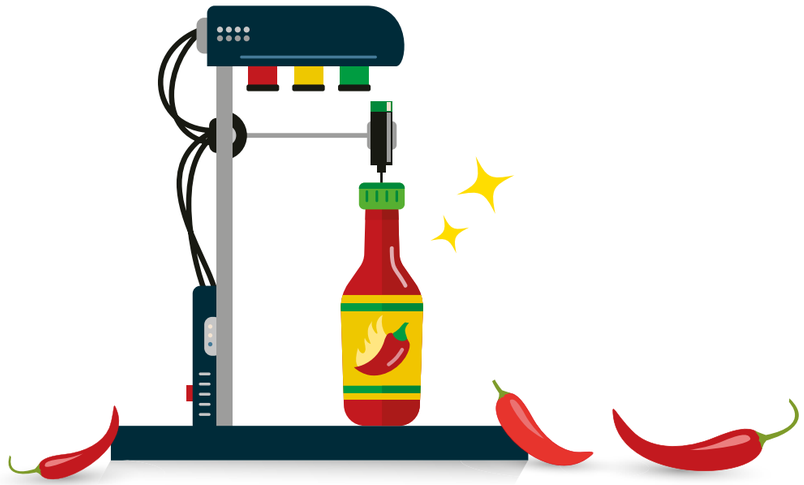
Bove nevertheless believes that WOHN, which is based in Herlufmagle about 80 kilometers southwest of Copenhagen, is well positioned in Denmark. Here, automated construction processes are compensating somewhat for the shortage of skilled workers in the country. »Sustainable thinking is also widespread here, even if some solutions seem like greenwashing,« Bove adds. »The younger generation in particular is leading the way and has a high awareness of these topics.«

Younger homebuilders also happen to where Bove is placing his hopes for his company's business prospects. In sales, he has primarily had discussions with project developers, but also with construction companies and builders. Meanwhile, Bove wants to do nothing less than declare war on building practices that use concrete and produce a large amount of CO_2. »The traditional construction industry is the best opponent for us because their arguments and metrics will always be defeated,« Bove proclaims.

FURTHER INFORMATION:

» wohnhomes.com
» formnext.com/fonmag

OUTSIDE THE BOX



When supply chain problems are a matter of taste

Not all that long ago, a microscopic virus managed to bring the whole world to a near-complete halt. Countless factories fell silent, while those who were willing and/or able to work often found themselves bereft of the necessary materials. There wasn't enough metal, paper, or plastic (to name just a few essentials), which sent prices soaring. Memory chips in particular were in short supply, and over the past two years, this had perhaps the most sustained impact on the development of a number of industries.

A recent survey conducted by the German ifo Institute found that even now, around 60 percent of the companies in the automotive industry are dealing with supply bottlenecks. In mechanical engineering, that figure has only just fallen below 50 percent again. The situation is less fraught in other sectors, though: The chemical industry is even reporting issues in moving product because customers are working through their existing stocks and (in the opinion of some chemical executives, of course) not ordering enough to replenish them.

Meanwhile, a less prominent branch of industry was dealing with a supply chain problem of its own in recent weeks – and this one must be the first of its kind. A leading company in the sector had to scale back production at its plant in California due to a shortage of a very specific raw material: chili peppers. Huy Fong Foods is one of the world's biggest producers of sriracha sauce, which is a well-known way to give a spicy kick to almost any dish, especially in the United States.

The red jalapenos that go into sriracha mainly come from Mexico, which has been suffering from a drought. The sauce has become so hard to find (particularly in Mexico's neighbor to the north) that some devotees have been willing to pay more than a hundred U.S. dollars for a bottle bearing that famous white rooster – or to simply steal one from a restaurant.

Thankfully, the sriracha shortage hasn't reached us here in central Europe yet, perhaps because brands like Thailand's Flying Goose are here to guarantee an uninterrupted supply of spicy sauces. Should that ever change, we'll need to remember one of the lessons we learned during our last major crisis: Stick to decentralized production, ideally with the help of 3D Printing and locally sourced materials. While the technologies and recipes this would require are more or less ready to go, the local sourcing aspect would probably prove considerably more difficult. In Germany, no one in their right mind would have thought to grow red jalapenos this summer. Mainly all through July and well into August, we had rain almost every day and temperatures between 15 and 20 degrees Celsius (60–70° F). Come to think of it, adding some spice to our diets would have been a very good idea – if only to keep warm!

Text: Thomas Masuch

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