










# REDUCING LEAD TIME WITH IN-HOUSE SUPPLY CHAINS

How Industrial leaders around the world are leveraging large-format additive manufacturing to eliminate up to 94% of lead times by cutting out third parties and taking control of their supply chains.

 <b>Ford Motor Company</b> Production Tooling	 <b>JC Steele &amp; Sons Inc.</b> Metal Casting	 <b>Steelcase Inc.</b> Product Development
 <b>Villeroy &amp; Boch AG</b> Showroom Prototypes	 <b>Geiger Group</b> Concrete Casting	 <b>Boyce Technologies Inc.</b> End-Use Batch Production
 <b>Airbus SAS</b> On-Demand End-Use Parts	 <b>JAMADE Germany GmbH</b> Consumer End-Use Product	 <b>BigRep GmbH</b> Functional Prototypes

By adopting large-format 3D printing technologies designers and manufacturers in a variety of industries have created incredible efficiencies in their usual project timelines. Industrial leaders around the world like Ford Motor Company, Airbus SAS and Steelcase have leveraged BigRep's large-format additive manufacturing (AM) systems to tackle traditional production bottlenecks and created valuable opportunities for increased testing and iterating to realize a massive reduction in time-to-market and increase to product quality.

Design teams at every level have used industrial 3D printers to avoid the pitfalls that often hamper the early stages of product development. Whether overcoming supply chain bottlenecks like

outsourced prototypes and tooling, or the limitations of labor where traditionally hand-built solutions cannot be further expedited, it's vital that design teams use tools proven to deliver results.

In this eBook we'll tell you how successful companies from a variety of industries are utilizing additive manufacturing technology in their product development processes to overcome challenges, cut costs, iterate faster, design better, create full-scale functional prototypes and fast, efficient tooling or end-use parts with BigRep's industrial AM systems so you can get in on one of their secrets to success.

# FORD MOTOR COMPANY



With AM,  
**Ford Motor  
Company** reduced  
lead times for  
manufacturing  
tooling by 94%



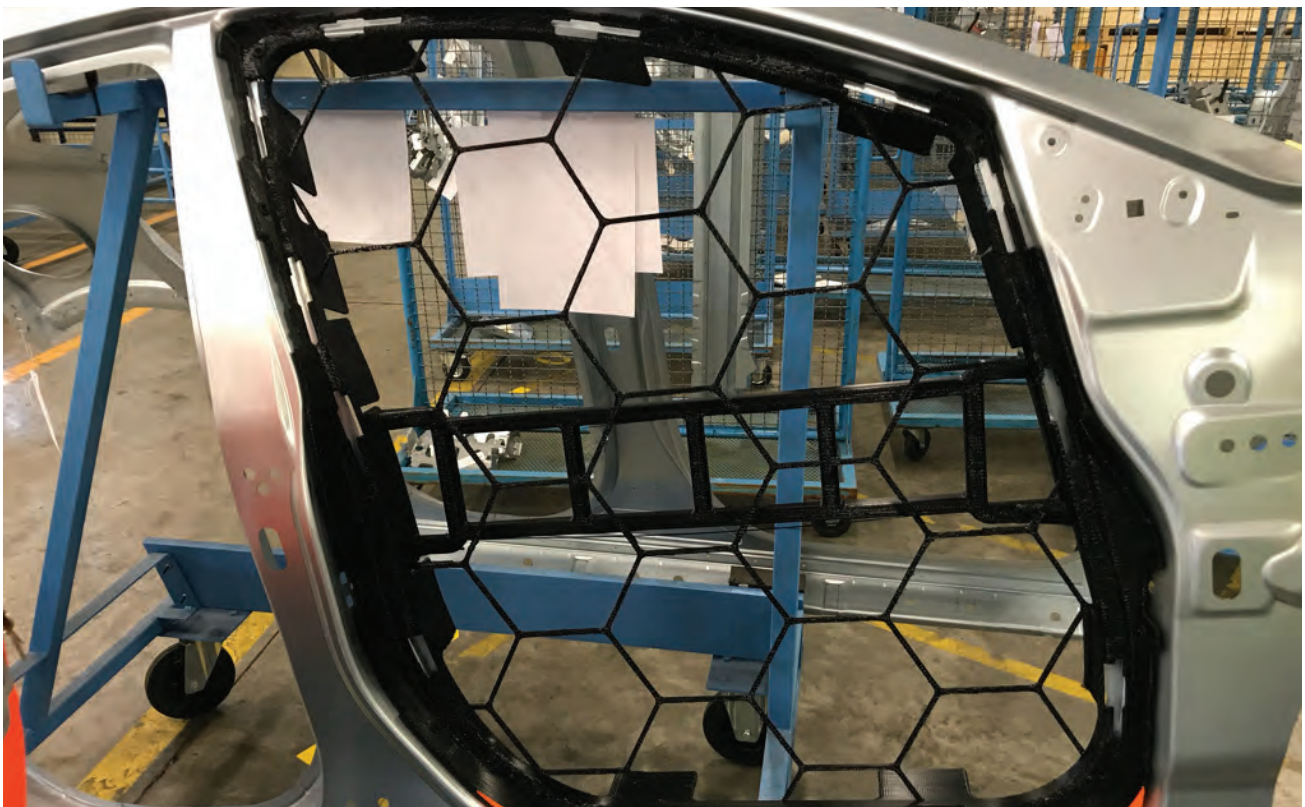
## Production Tooling

In the highly competitive automotive industry, manufacturers invest generously in prototyping processes and facilities that ensure their products are leading the market in innovation by introducing new designs and features before competitors. Being the first automotive manufacturer to release a ground-breaking feature in the consumer market can drastically increase a product's desirability and raise public opinion of a company for years to come. But falling behind in an innovative release leaves companies playing catch up, returning significantly less on their investments into research and development.

Before delving into large-format, Ford was no stranger to additive manufacturing. In fact, Ford purchased their first 3D printer – the third SLA 3D printer ever to hit the market – back in 1986. Since seeing the results of additive manufacturing early on they have continued to invest heavily into additive technologies, integrating it into automotive workflows through research and design carried out at facilities like the Germany-based Ford Research & Advanced Engineering Europe in Cologne. With over three decades of experience investing in additive manufacturing technologies, it's clear that Ford's dedicated experts know what they're looking for.

Working primarily with jigs and fixtures, tool tryout-parts, and manufacturing equipment that would otherwise need to be outsourced – thereby creating long bottlenecks in prototyping processes, extending time-to-market and severely limiting iterations – Ford's BigRep printers are used in many of the day-to-day necessities of a busy automotive manufacturing and research center.

The production aids that Ford creates on their industrial 3D printers need to fit large, vehicle-sized spaces to reduce time spent working with manual tooling as much as possible. For example, Ford created the sensor fixture pictured below for the manual placement of door sensors – the kind that provide dashboard alerts when your door is not properly closed. While Ford could create a smaller handheld fixture, repeatedly aligning the tool would be time consuming and repeating alignments creates opportunity for human error. Instead, Ford creates large-format fixtures that fit the entire door frame. It's a one-to-one match of the frame, leaving little margin for error and significantly reducing the time it takes to place sensors.



Before investing in large-format additive, Ford's welding fixtures had to be manufactured from metal in a highly manual machining process. Ford requires about 190 fixtures for a single prototype – without any potential for reuse – and lead times for machined fixtures were often as long as 3 weeks. The process

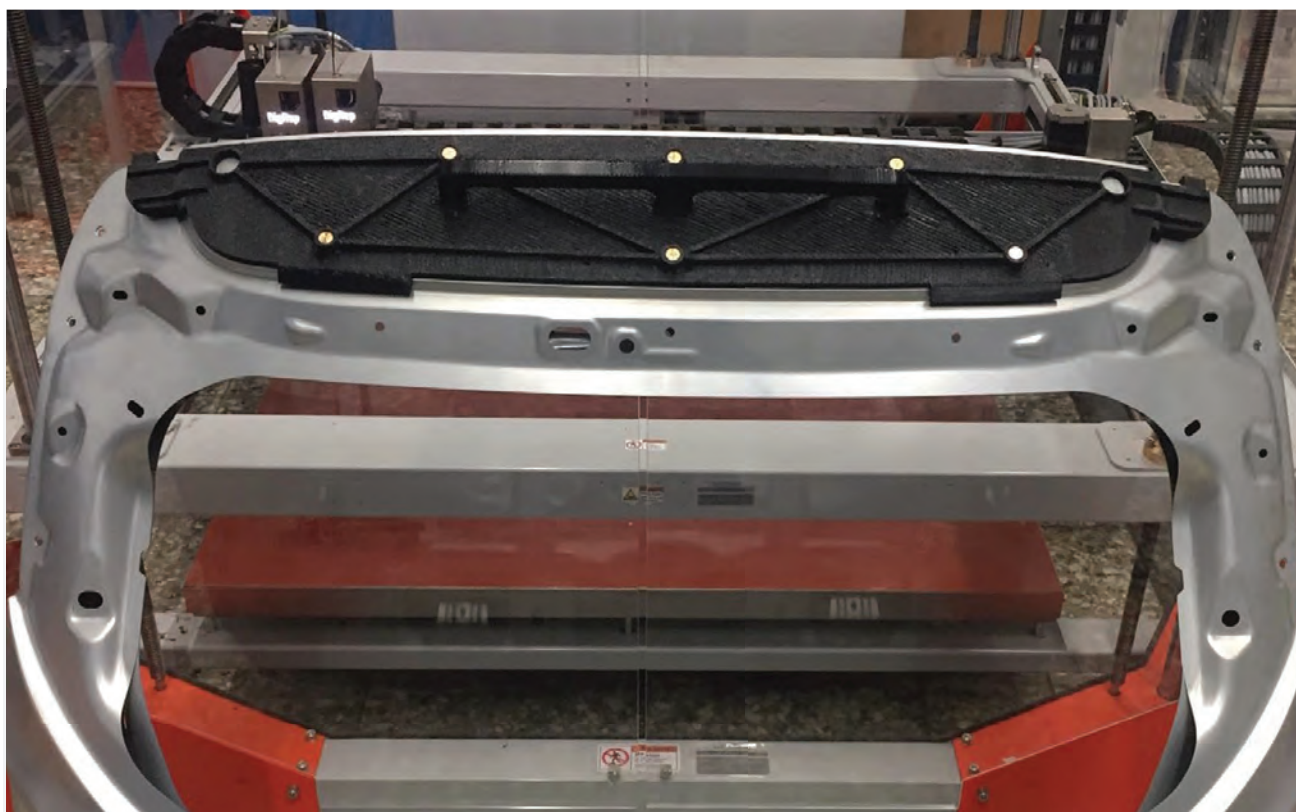
created a significant time sink and left their design and production processes vulnerable to severe bottlenecks. Once finished, Ford's team still had to wrestle with setup and tear-down processes that proved labor intensive with heavy machined metal parts.

**“After two or three successful prints, the BigRep printer was already paid for.”**

**Lars Bognar** - *Research Engineer - Ford Motor Company*

With BigRep's additive manufacturing systems, the team was able to design and print new fixtures at a fraction of the previous cost using strong BigRep materials with high heat deflection. Rather than waiting on secondary processes, the team could print their own fixtures and have them in use on the welding table the next day.

Traditionally made jigs and fixtures require many iterations and an 8-10-week lead time. By 3D printing them in-house, Ford has significantly decreased the time between iterations – creating tooling in just 2-3 days for an astounding 94% decrease in lead times. In a telling result on Ford's first use of their BigRep ONE, the production of welding fixtures, their savings paid for the investment in its first application and the team was able to consider more uses for added value on their investment.





# JC STEELE & SONS INC.



With AM,  
**JC STEELE** has  
increased annual  
production by 50%  
and reduced  
expenses by  
75%



## Metal Casting

In house JC Steele & Sons, a 130-year-old industrial manufacturer located in Statesville, North Carolina known for their stiff extrusion equipment, maintains a foundry, pattern shop, and machine shop to create their massive heavy machinery. The foundry and pattern shop work closely in a process called sand casting: a casting method where positive patterns are created from a variety of materials – usually hard woods like mahogany and maple carved by hand, but sometimes pressure cast aluminum – to form a negative cavity in sand. The negative cavity sand molds are then used to create large, durable parts from metals like ductile iron for use with industrial equipment.

As advanced as JC Steele's facilities are, they found the high time and fiscal costs associated with traditional pattern making processes restricted the company's ability to invest in research and development. For a company that knows the importance of innovation and growth from a over century of experience, that was too big of a problem to ignore. Amid growing competition, JC Steele was missing opportunities to continuously improve their casting wear life and efficiency.

To find a solution, JC Steele turned to large-format additive manufacturing to quickly produce the massive patterns their business

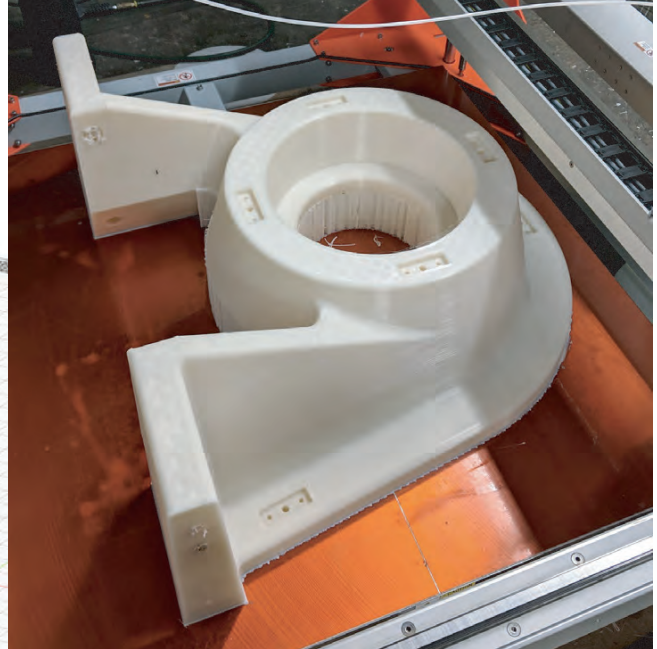
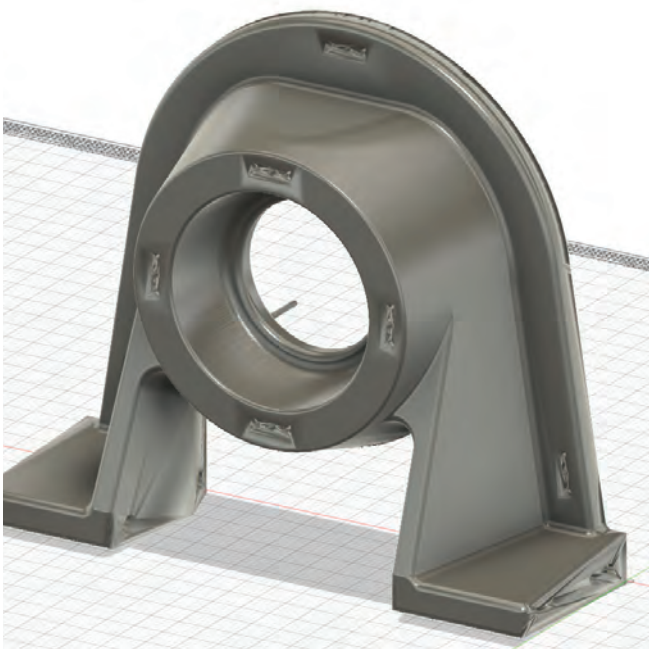
is centered around. JC Steele's pattern makers devised a creative solution in their new workflow by applying traditional techniques used in patterning with mahogany to 3D printed plastic parts. Realizing that 3D printed layer lines aren't unlike the grooves in a wooden pattern, parts are finalized by post-processing with a coating of wood filler that smooths the printed pattern's surface, ensuring that parts can be easily removed from sand cavities without risking damage to the mold.

By implementing additive manufacturing into their patterning workflows, JC Steele reported an 75% cost reduction and 50% increase to annual productivity for their geometrically complicated patterns. Watts credits the increase to their additive technology, and when you compare traditional pattern making to JC Steeles faster additive workflows the reason why is clear.



“We make a whole range of parts, from something that can fit in your hands to something bigger than your car,” said Jeremy Kauffman, JC Steele’s Engineering Manager, as he explained why a large-format printer meets their variety of needs rather

than being a niche machine for massive parts. “If we need a large quantity of a smaller part, I can nest 100 parts on the BigRep ONE that I can only fit a few of on another printer.”



**“As far as comparing plastic to wood, I think it’s just as durable in sand casting and our other applications. The possibilities are really endless as to what you can achieve with a plastic part.”**

**Chris Watts** - *Pattern Shop Supervisor - JC Steele & Sons*

## Product Development

Steelcase is known worldwide as the world's largest designer and manufacturer of high-end office furniture. Their expert team is adept at creative innovative, comfortable pieces. Before investing in large-format additive manufacturing, Steelcase's prototyping processes were limited to expensive outsourcing, dollhouse-sized design models, or non-functional full-scale prototypes adhered together from smaller pieces. Unless Steelcase invested in the very expensive outsourcing, their early prototypes were limited to visual aids. That didn't cut it for Steelcase, who know that the function of their furniture is of equal importance as its aesthetic appeal.

Since November 2016, Steelcase's Munich Learning + Innovation Center has been equipped with the BigRep ONE, which can print complex geometric forms in scales of up to 1 cubic meter. Early in the design process, Steelcase can quickly print a full-scale, detailed prototype from a CAD file for testing and development. As a design progresses, designers can rapidly iterate and print different variations of their idea to compare and gather the

information they need to make detailed decisions. With traditional prototyping methods and outsourcing this level of testing would be impossible as an abundance of iterations would not only rapidly eat away at project budget, but also create a massive bottleneck in the process as the design team repeatedly waits for their prototype iterations. By using large-format additive manufacturing in-house for their furniture prototyping process, Steelcase iterates their designs quickly and affordably until they've reached the quality the company has come to expect.

"You can now take a 3D printed shell and get it upholstered by an upholstery specialist," said Michael Held, Steelcase's Director of Design. "Somebody can already develop the patterns, the kind of Stitching, the kind of padding that you would need around the 3D shell, before we even have a tool made."

With AM,  
**Steelcase** is  
decreasing prototype  
lead times by up to  
90% completely  
in-house

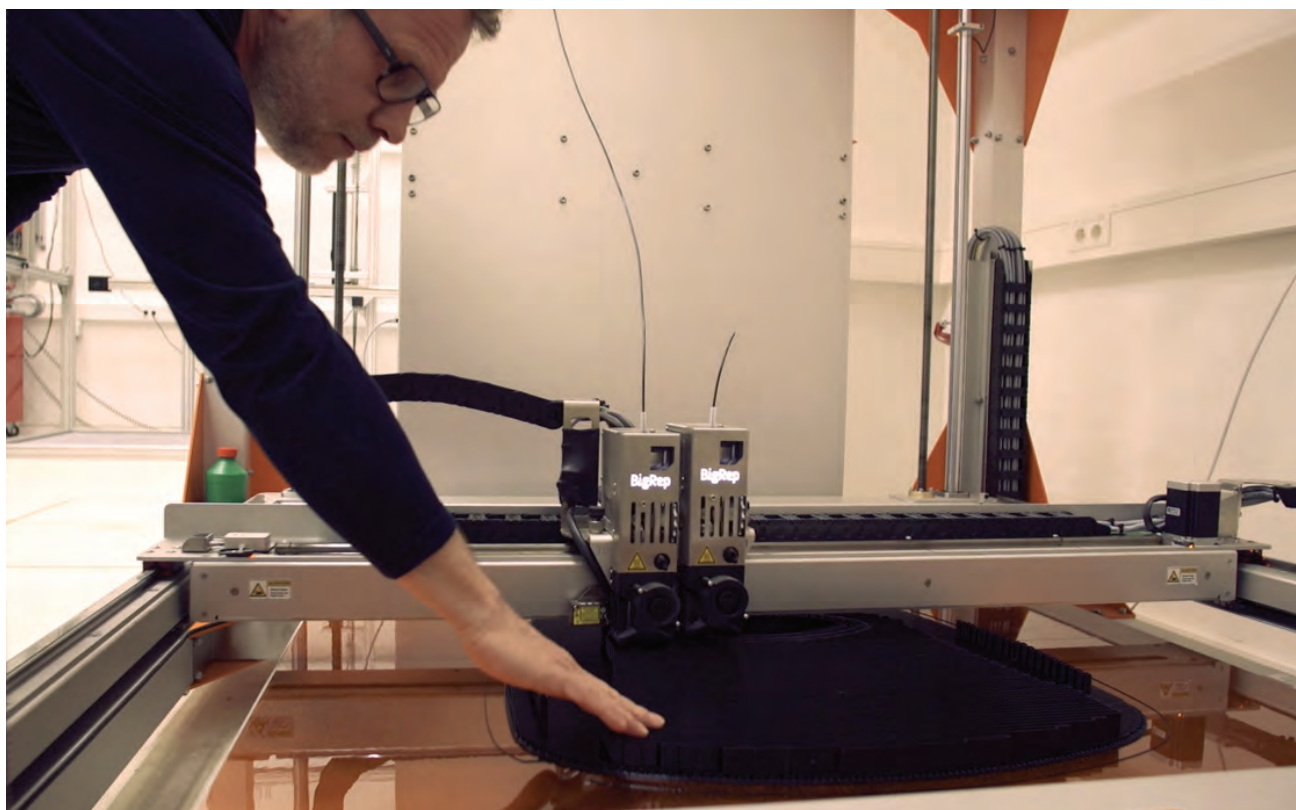




With the BigRep ONE, Steelcase produces functional, full-sized models up to 90% faster than before. The company demonstrated with a seat shell prototype that's able to bear a user's full weight they printed in just four days on their large-format 3D printer. Alternatively, producing this quality prototype with traditional methods would have taken around two months at significantly more expense. While the same form could be produced using smaller glued-together prints from a desktop 3D

printer, the material would not allow the item to be sat on and the design unable to be tested in use.

As added value, Steelcase routinely uses their large-format 3D printers to produce parts that would previously have required 2-3 weeks of subcontracted production, creating incredible savings, keeping processes in-house and all their highly dedicated designers moving.



**“It allows you all of a sudden to see the concept live, to see the light go through, see the assembly of the product and allows you to validate or not a concept direction.”**

**Albin Moriniere** - *Senior Industrial Designer - Steelcase*

# VILLEROY & BOCH AG



## Showroom Prototypes

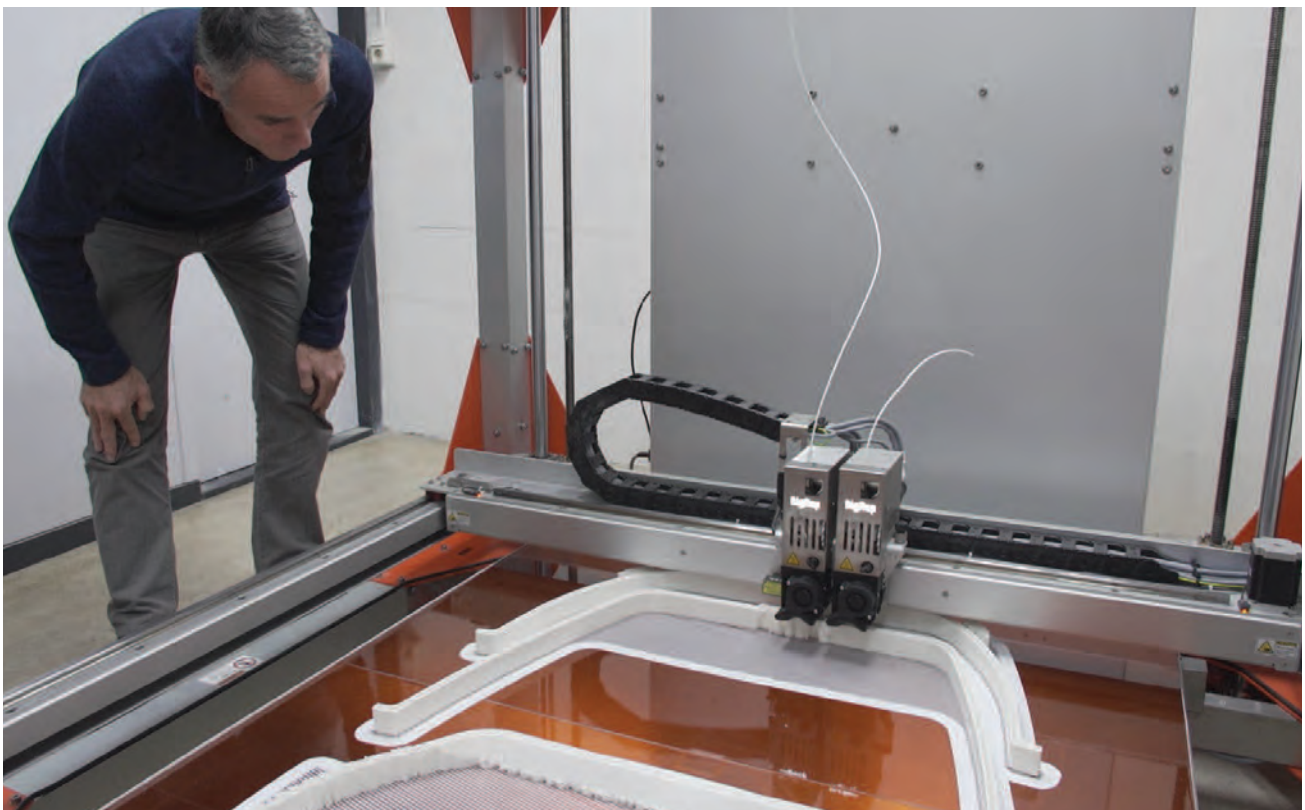
Villeroy & Boch is a large international ceramics boutique and premium lifestyle brand that first opened its doors in 1748. With headquarters in Mettlach, Germany, one of the company's core product areas is innovative, stylish ceramics for bathrooms.

Company product designers working on new concepts start with initial sketches but move into the model-creation phase quite early in the process. Once they're happy with a design they need to present a polished, full-sized prototype to the company's decision-makers. Johan de Groot, Product Designer at Villeroy & Boch, said, "Before we had the printer, we needed to explain to

our model makers what they needed to make with wood and foam and polyester."

Both commissioning and waiting for completed models was time consuming. The nature of hand production also meant that models often didn't quite match what the designer specified. This would have an impact on the direction design ideas took or, in extreme circumstances, require an extra time-consuming iteration to get right.

With AM,  
**Villeroy & Boch** is  
creating showroom  
prototypes in just  
1/3 of traditional  
lead times



Villeroy & Boch purchased a BigRep ONE to tackle their handmade prototyping bottleneck. De Groot still starts designs with sketches, but he uses the ONE for working out designs and creating their prototypes. "Nowadays it's just bringing your product on the USB and the machine makes our

product exactly the way we wanted it to be," said de Groot. The design process at Villeroy & Boch has been transformed with the introduction of the BigRep ONE and given the company a competitive advantage by seriously reducing their time-to-market for new designs.



There's also significant cost savings in 3D printed model-making and prototyping. De Groot estimates that the full cost of a large model made with earlier methods was around five times that of the major variable cost element of a printed model, the filament material. De Groot says that a free-standing bath prototype, which now takes just three weeks to complete,

would have taken 6-7 weeks to create using the earlier techniques. Furthermore, when it comes to producing earlier stage models – often on a 1:2.5 scale – they take just 1/3 of the time they used to, saving valuable designer time an enabling generous iterations to unlock designer creativity and excellence like never before.



**“The final product looks terrific! We have a ‘one-to-one’ in three weeks and on a high level. That was unthinkable without this 3D printer.”**

**Johan de Groot** - *Product Designer - Villeroy & Boch*

With AM,  
**Airbus SAS** is  
changing lead times  
exceeding two years  
into on-demand  
production



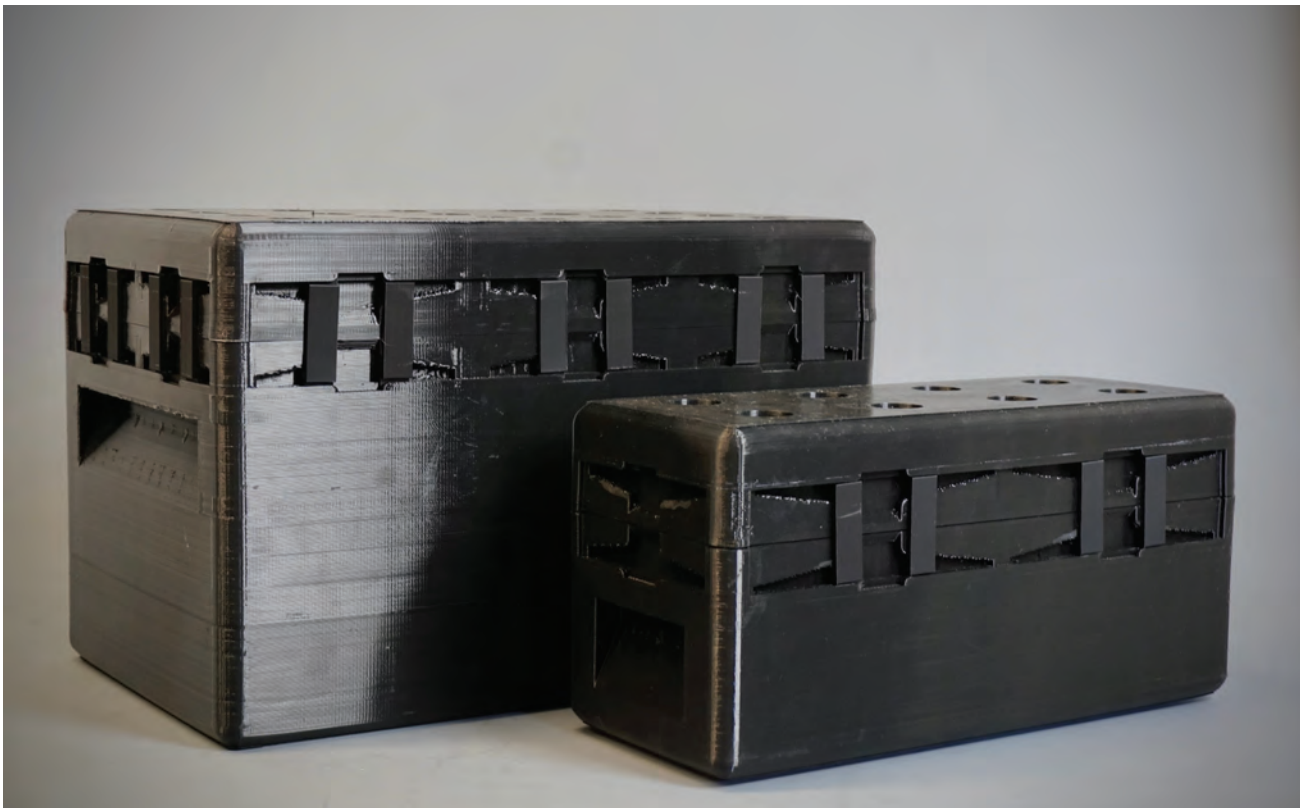
## On-Demand End-Use Parts

As delicate equipment breaks down or otherwise requires off-site maintenance, organizing its transportation takes detailed consideration and significant investment. When complicated technical equipment for industries like aviation is involved, the expenses required just for logistical preparation are startling sums long before any solutions are actionable. In large part, high costs surrounding the transportation of delicate equipment are due to longstanding inefficiencies in the manufacturing of “investment shipping cases:” specialty, high-quality secure custom cases that are individually manufactured in a highly manual process and certified to transport sensitive equipment safely.

Acquiring investment shipping cases can be a complicated process as businesses plan not only for the equipment’s safe transportation, but also the time their advanced tools – often representing a significant investment – aren’t available for use. Businesses transporting equipment like aerospace imaging cameras must accurately predict their need for investment cases

years before the problems they’re meant to solve even begin. But for case manufacturers, investments in productivity must be balanced between meeting demand and spending on highly skilled laborers to create their complicated, high-standard product. Unfortunately, due to the limited number of suppliers, manufacturers’ balancing is rarely in the purchaser’s favor. As a result, wait lists for the cases often exceed two years – a disastrous lead time for businesses with unforeseen complications.

Airbus and Ralf Schlueter, Managing Director, of Flugzeug Union Süd (an Airbus subsidiary), have turned to additive manufacturing and digital design solutions to modernize the investment shipping case industry. By enabling overnight production and eliminating manual labor, the new process promises a massive reduction to the cases’ manufacturing costs and lead times – creating an attractive solution for businesses stranded by its current problems.



When Airbus SAS examined the supply chain and logistics problem, they found the combined expenses unbelievable. Still, the process is generally considered the cost of doing business in the aerospace industry. Rather than accept this traditional expectation, Airbus has challenged it with a

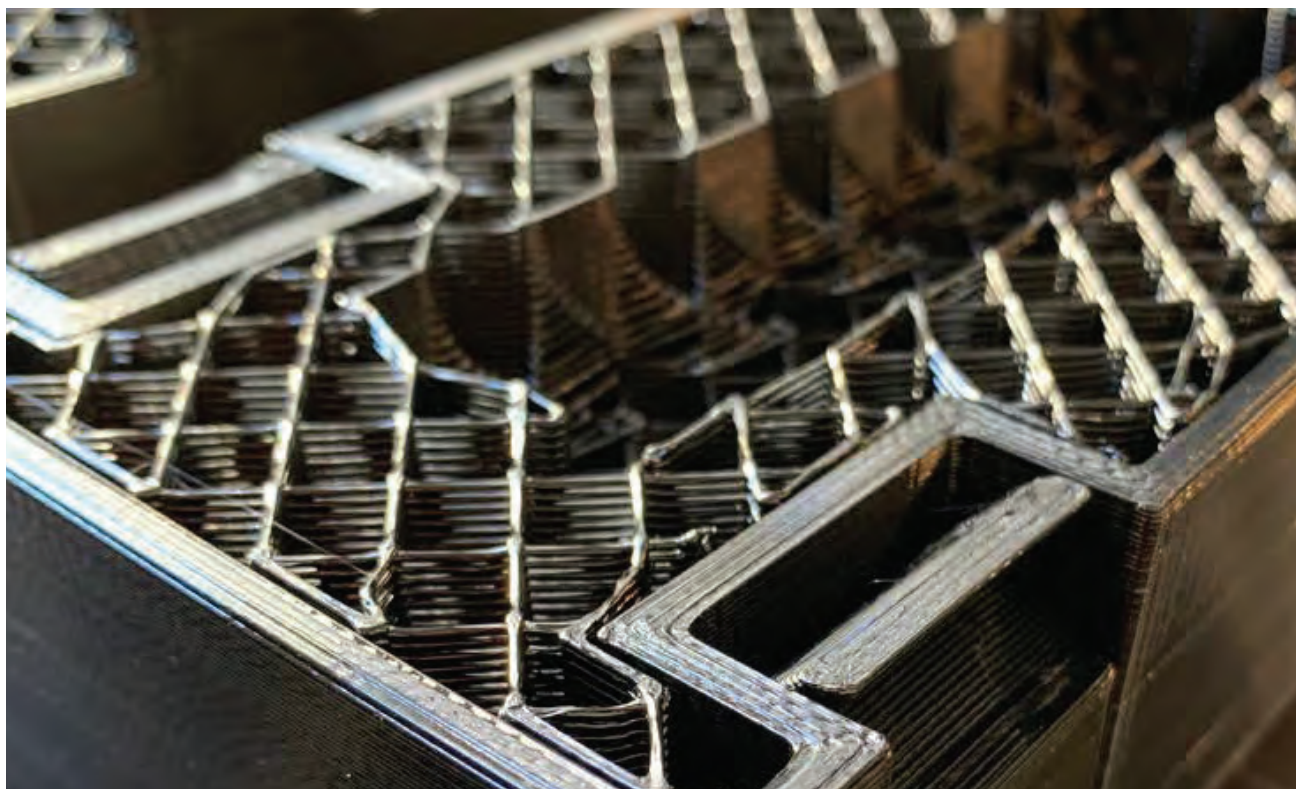
modern additive solution. By working closely with BigRep's Engineered Solutions department, the additive manufacturing consultancy, NOWLAB, Airbus designed a delicate equipment shipping case that could be created with a single material on-demand.

**“We’ve seen companies with over 300 refab units stuck waiting for shipment because they don’t have these cases. Some companies have even risked damaging very sensitive equipment further by transporting them in an unsecure case – just carboard and Styrofoam.”**

**Ralf Schlueter** - *Managing Director - Flugzeug Union Süd (Airbus subsidiary)*

The design process takes advantage of the versatile qualities of BigRep's TPU filament which has firm material properties when printed in a thick wall but soft, flexible qualities in thinner compositions that make it highly shock-absorbent. The design of additive investment shipping cases has capitalized on Fused Filament Fabrication's (FFF) common internal infill patterns and TPU's dynamic material properties to replace the traditional foam cushioning of shipping cases. Instead, the equipment's shape is simply left empty in the infill resulting in a design that can be manufactured as a single piece in a completely automated process. Latches are created simultaneously in a second firm material and can be easily added to cases by end users.

By redesigning the investment shipping case manufacturing process around large-format additive manufacturing technology, Airbus reduced the production workflow by an astounding 50%. Coupled with the ability to create cases in-house on-demand and thereby sidestepping waiting lists, Airbus has reduced the lead time for acquiring the cases an unimaginable amount. Their vision is to provide all necessary facilities with a BigRep 3D printer to create the cases as needed, eliminating not just the significant lead time when ordering these cases, or the high cost of production, but also freeing up a generous amount of storage space that had been indefinitely allocated to these cases as nothing more than a necessary precaution.





With AM,  
**Geiger Group**  
reduced production  
time by 45% for  
complex concrete  
casting



## Concrete Casting

Geiger Group, founded in 1923, specialises in property development, construction, civil engineering and more, but they faced a difficult challenge as they approached the restoration of a listed Kempten building in southern Germany. This restoration project, the conversion of an old brewery into an office and events space, was one of numerous similar projects the group carries out per year. The challenge facing them was to replace five large stone window frames on the property whilst retaining the original impressive aesthetic.

In replacing these stonework elements there were two standard options that Geiger could have considered. They could opt for a traditional method of stone masonry, a highly skilled activity that produces exquisite results but is highly time- and cost- intensive.

The second option would be to cast concrete from a resin-coated foam formwork.

The depth of the pattern meant that milling a single piece of foam to the desired shape wasn't possible, and production using several pieces would have increased costs and extended the duration. A more general drawback to this method and process was the toxicity and waste involved.

Instead, Geiger decided to invent their own option by trying something new. Working with NOWLAB, the company explored additively manufacturing concrete molds with BigRep's large-format additive manufacturing systems.



Geiger provided NOWLAB with CAD files containing full specifications of the frames. NOWLAB worked from these files to generate a digital pattern for a cast formwork. They then printed the formwork on a BigRep ONE, taking advantage of its 1-cubic-meter build volume to print a single-piece solid mold. The printed formwork, made from bio-degradable PLA, was then sent to a fabricator to cast concrete sections. Assembly of the window frames from various sections was performed on the construction site, prior to a successful installation.

Geiger estimates the elements produced with BigRep had a production time 45% shorter than if they had opted for resin-foam cast productions and cost 50% less than it would have from a stonemason. Geiger was also able to considerably reduce staff resources needed for the project. Combined with its high-quality finish that satisfied Geiger's customers, this was the perfect 3D-printed solution.



**“In the end you use less concrete because the structure is enabled through a more complex geometry, and with the print cast we see a clear possibility for architects to have direct control on what you design in your computer and how you produce it on site.”**

**Jörg Petri** - *Director of Innovation - NOWLAB*



With AM,  
**Boyce Technologies**  
has reduced the size  
of post-processing  
teams from  
12 to 2



## End-Use Batch Production

Boyce Technologies, prominent designer and manufacturer of products for public safety, security and communications systems, is an expert on manufacturing technology. In their 250,000-square-foot state-of-the-art facility in New York City, the company uses a variety of technologies to deliver necessary products that range in application from emergency response systems to radio and wireless networks, along with intercom systems, security alarm systems, customer information display systems, and integrated software systems.

Boyce Technologies has long been familiar with traditional manufacturing processes, offering expertise with multi-axis CNC machining, laser technologies for cutting and welding, multi-axis industrial robots, and multi-axis water jet cutting. But these were not enough for some of the company's more recent projects that required more iterations and complex geometries.

Initially company leadership was hesitant to bring additive manufacturing into their facility but after repeated success and process innovation with additive manufacturing, intimately

familiar with the technology's value. "I used to think the fastest way to do something was to do it out of a piece of metal," said Charles Boyce, President of Boyce Technologies. "I didn't think I needed 3D printing and now I can't live without it."

When purchasing their first BigRep 3D printer, the planned workflow integration was for about 90% prototyping and 10% production. What ended up happening was exactly the opposite. The team has seen its usage shift to 90% production and 10% prototyping. Today, Boyce sees great use for its BigRep large-format 3D printers across a variety of applications including prototyping, manufacturing end-use parts, and creating vacuum forming molds.

When Verizon approached Boyce with a "cartoon sketch" of a digital kiosk, the various experts across Boyce were all engaged in the interdisciplinary project. Since the 5G structure is designed for installation outdoors in dense urban areas, its





needs are highly complex – and it fell to Boyce to engineer it. Through the testing and building at a rate of 10 kiosks per week, the team noticed some non-structural aluminum elements were deforming and needed to be replaced with a more suitable solution. Boyce looked to the BigRep 3D printer they

had previously installed for prototyping applications for a solution. A form factor and fit test showed that 3D printing was perfectly suited to create the new part. Costs in terms of time and personnel were cut significantly from the traditional workflows Boyce previously relied on.

After running into signal issues created by a metal part,

ASSOCIATED MATERIAL COSTS:	TIME TO PROGRAM / PREP:	POST FINISHING / POST-PRODUCTION / SECONDARY OPERATIONS
<ul style="list-style-type: none"><li>- Storing 60 – 80% less material</li><li>- Waste Disposal</li></ul>	<ul style="list-style-type: none"><li>- 3-6 Hours for CNC Aluminum</li><li>- 15-30 Mins for 3D Print Plastic Print</li></ul>	<ul style="list-style-type: none"><li>- 12 people working for Metals Parts (e.g., deburring, sanding)</li><li>- 2 people working for Plastics Parts</li></ul>

Discovered “not by design, but after developing a more intimate relationship with the printer itself,” as Ajmal Aqtash, Boyce Technologies’ Director of Advanced Robotics, put it, the Boyce team began to understand that their in-house 3D printing capabilities could create end-use parts.

into operations. This was exponentially increased when they invested in a BigRep PRO; a fully enclosed large-format printer with a one cubic-meter build volume capable of printing engineering-grade materials with high repeatability.

With more experience in 3D printing throughout a variety of in-house applications, the team at Boyce Technologies found across-the-board benefits to bringing their BigRep AM system

“With the PRO, we are now much more competitive because we’re able to produce large proofs of concepts faster than anyone else in the industry,” said Aqtash upon the installation.

“At the beginning we understood 3D printing as primarily a prototyping tool, that quickly shifted into production.”

Ajmal Aqtash - Director of Advanced Robotics- Boyce Technologies



With AM,  
**JAMADE** is  
keeping their serial  
manufacturing of  
consumer products  
100% in-house

## Consumer End-Use Products

When Jamade began operations creating their consumer underwater scooter, AMAZEA, they knew they didn't want to abide the pains of an external manufacturing partnership. The complicated relationships are notoriously difficult to manage, expensive, and create a need for further negotiation during design updates or while a business, and its demand, grows. Most importantly, manufacturing the AMAZEA through a third party would have taken production lead times out of Jamade's hands.

By opting for a full additive manufacturing serial production process, Jamade has created a 75% additively manufactured water sports mobility device for the first time ever. The AMAZEA scooter's body and front parts are produced on three BigRep ONE large-format 3D printers using BigRep's engineering-grade filaments. Produced and post-processed in-house, AMAZEA scooters are then consumer-bound without any third party bottlenecks.

The large-format BigRep ONE 3D printer was key to a successful product launch, providing the high flexibility and speed AM offers, and making the development process much more time-efficient. Jamade started on white paper and progressed through product development. Offering a large, one-cubic-meter, print volume, the BigRep ONE 3D printer provided unmatched cost efficiency, operational reliability and excellent technical qualities during Jamade's prototyping and the end-use parts' serial production.

Jamade uses BigRep's PRO HT material to produce the AMAZEA, an easy-to-use filament designed for end-use applications. With a softening resistance of up to 115 °C, it offers a significant increase in temperature resistance compared to average PLA and minimal warping and shrinkage, which makes it perfectly



suited for marine environments. As a material derived from organic compounds, PRO HT is biodegradable under the correct conditions, CO2 neutral and environmentally friendly. 3D printing offers Jamade real customization and high flexibility for product updates. Changes in size or shapes, and customer feedback or requests are able to go straight

into the product. Large-format printing also helps to ensure the scooter's water-resistance: If the front or body were assembled using several smaller parts, openings would be a potential risk for leaks. For Jamade, large-format 3D printing enabled the quick turnaround and quality they needed for this first-of-its-kind underwater scooter.



**“We opted for the BigRep ONE due to its cost efficiency, accuracy and quality when compared to the extremely high investment for traditional tools, particularly in the first year’s lower quantity.”**

**Janko Duch** - *Martin Oser & Detlef Slages - JAMADE Founders*



With AM,  
**BigRep GmbH**  
built a functional  
e-motorcycle in just  
12 weeks from only  
15 parts



## Functional Prototypes

We know our what our industrial 3D printers can accomplish because we push them to their limits ourselves.

BigRep created the world's first fully 3D-printed electric motorcycle in just 12 weeks from sketch to final product. Designed by BigRep's Engineered Solutions consultancy, NOWLAB, the NERA e-Motorcycle hit the road in Berlin before garnering international attention and traveling the world.

With Marco Mattia Cristofori as the design team lead BigRep engineered the NERA e-bike from the ground up, disrupting traditional design, engineering and production in every conceivable way. The result is a 100-percent, fully customizable, functional prototype designed and produced with more

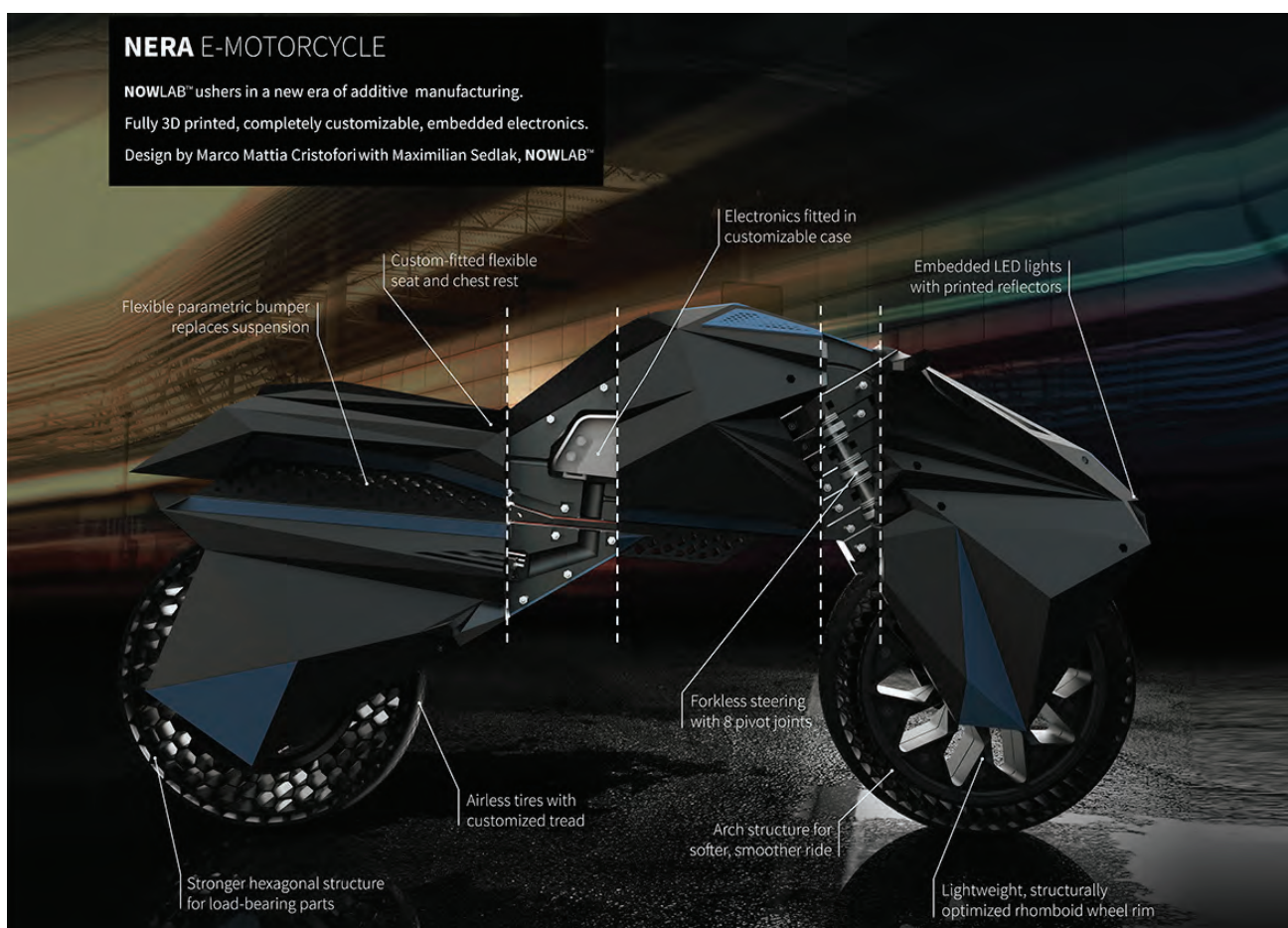
time- and cost- efficiency than previously imaginable.

The NERA is just one example of how large-format additive manufacturing has dramatically changed production capabilities, not just in terms of what's possible but also in terms of speed. Creating a functional prototype in just 12 weeks is a feat of design, and would be unthinkable without the powerful additive manufacturing tools at modern designers' disposal. Large products like the NERA e-bike and LOCI podcar would be impossible to functionally prototype in this time frame without suitable large-format additive manufacturing.



In building the NERA, our designers and engineers didn't simply adapt existing motorcycle designs. Instead they envisioned a bike designed for large-format FFF technology, demonstrating how design teams can increase their efficiency by reengineering to benefit from additive manufacturing's strengths. With the NERA and other additive innovations from NOWLAB, the exceptional possibilities of industrial AM have been demonstrated, and a benchmark for truly creative design has been set that breaks free of traditional limitations.

The NERA shows not just what can be achieved with 3D printing – and specifically FFF 3D printing with BigRep's industrial technology – but also the low cost and fast results of AM that allows designers to immediately test prototypes and rapidly produce iterations of experimental engineering at an unmatched pace. By creating the NERA entirely in-house, the design also serves to illustrate the massive benefits that 3D printing offers to production of functional parts, particularly in unique to small-series production, by optimizing supply chains and limiting dependency on supplier networks – further reducing lead times and costs.



# Conclusion

By evolving traditional workflows with large-format additive manufacturing solutions, industrial leaders all over the world have created up to an astounding 94% reduction in lead times and value-added cost reductions of 85% compared to traditional manufacturing methods or external suppliers. With these incredible reductions, early adopters of large-format additive manufacturing are well ahead of competitors – expediting their product time-to-market and vastly increasing their capacity for new business.

But companies who have invested in large-format 3D printing have seen benefits to their process in more than just reductions. With their increased design freedom, removing the constraints of slow or hard-limited iterations, companies are seizing the

opportunity for increased quality and creativity, delivering products their previous production limitations may have impeded.

It's clear that those companies who have chosen to adopt large-format additive manufacturing are benefiting in an abundance of ways, meeting targets of reduced time-to-market, cutting costs, taking full ownership of their supply chains, and so much more. All the companies you've read about here have created these incredible efficiencies with a BigRep large-format additive manufacturing system – industrial 3D printers that have been proven time and time again. Contact BigRep today and find out how you can optimize your industrial processes with one of our award-winning machines.





## REDEFINING **ADDITIVE**

**bigrep.com**



### **EUROPE**

Gneisenaustraße 66  
10961 Berlin  
Germany  
Phone +49 30 20 84 82 60

### **NORTH AMERICA**

400 West Cummings Park Suite  
1675  
Woburn, MA 01801 United States  
Phone +1 781 281 0569

### **APAC**

120 Lower Delta Road #04-04/05  
Cendex Centre Singapore 169208  
Phone +65 6909 8191