# **AddUp** at a glance

AddUp
GLOBAL ADDITIVE SOLUTIONS

# SUMMARY

# WHO WE ARE

**AddUp was established on April 1th 2016 when two industrial groups, Fives and Michelin, decided to create a major player in metal 3D printing. AddUp's main strength lies in its industrial vision for additive manufacturing based on the experience of its two founders.**

AddUp is a joint venture, owned 50 % by Fives, an international industrial engineering group, and 50 % by Michelin, a world leader in the tire industry.

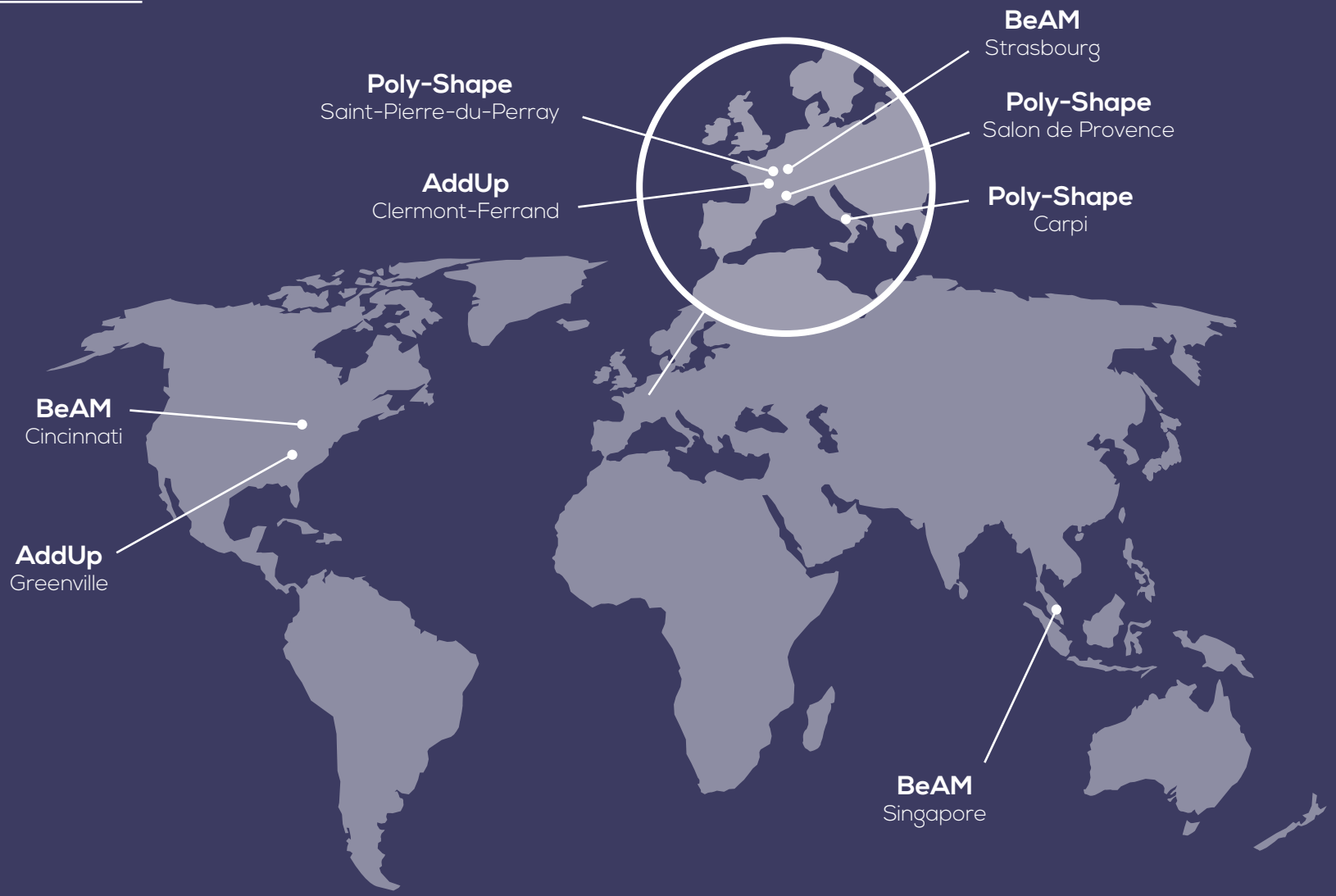
Over many years, Michelin has developed unique expertise in metal additive manufacturing. The group already produces mold parts on an industrial scale, which cannot be obtained using traditional production methods (machining, welding, etc.), at a production capacity of about 1 million parts a year. Through this joint venture, Michelin is leveraging its expertise in innovative industrial processes.

Fives, a 200-year-old group, brings its expertise, its experience and its capacity for innovation in mechanical engineering automation and industrial process control. The group contributes, through AddUp, to create fully digitized machines and systems that meet technological requirements of additive manufacturing, with unreleased reliability and reproducibility objectives.

This experience and expertise, AddUp wants to benefit its customers by developing and marketing, on a global scale, machines and production workshops based on metal additive manufacturing technology, commonly known as metal 3D printing.

In 2018, AddUp acquired 100 % of BeAM, a leader in additive manufacturing technology using metal powder spreading. A major step in the history of AddUp that allows the company to expand its technology portfolio using two complementary 3D metal printing processes to better meet its customers' needs.
In the same year, in further pursuit of expansion, AddUp increased its production capacity by acquiring a stake in Poly-Shape, a leading metal additive manufacturing expert in Europe with a strong presence in the motorsport sector. Thanks to Poly-Shape, AddUp can now offer its customers unique access to a multi-manufacturer, multi-technology, multi-material and multi-application platform to help them determine the best technological solution for their parts production needs.

# ADDUP AROUND THE WORLD



# ADDUP - A HISTORY

fives

## 2011

### FIRST DED PROTOTYPE

Fives designs and manufactures the first DED (Directed Energy Deposition) laser machine for IREPA Laser.

## 2014

### FACTORY OF THE FUTURE

Fives adds Additive Manufacturing to the programme « Factory of the Future Plan », 34th plan of the French industrial initiative.

MICHELIN

## 2000 ...

### R&D COMMENCES

Michelin becomes interested in additive manufacturing to improve its productivity. At this point, it was just laboratory technology.

## 2007

### FIRST MACHINE & INDUSTRIALISATION

Aware of the technological potential of additive manufacturing, Michelin acquires a machine. Initial tests prove highly conclusive, making it possible to obtain parts that would have been inconceivable up to this point, and the first industrial workshop is established.

## 2014

### AUTOMATION

Michelin designs and installs the first automated production workshop and uses additive manufacturing in mass production for tire molds (Premium and CrossClimate ranges).

## 2015

### ADDUP IS BORN

On September 4th 2015, the two groups of Fives and Michelin agree to create the Fives Michelin Additive Solutions joint venture (to become AddUp in 2016).

### INTEGRATING EBM EXPERTISE

3A (Applications Additives Avancées), established in 2011, adds unique expertise in EBM (Electron Beam Melting) additive manufacturing technology. The company integrates AddUp in 2015.

## 2017

### ADDUP INC.

AddUp expands its metal additive manufacturing activities into the United States and Canada, opening regional technology centers.

### SOGECLAIR PARTNERSHIP

AddUp and Sogeclair announce the future creation of a joint venture dedicated to incubating industrial production projects in metal additive manufacturing for the aeronautical, aerospace and defense sectors.

## 2018

### ADDED PRODUCTION CAPACITY

Established in 2007, Poly-Shape is a leading player in additive manufacturing processes. The company is involved in over a dozen major national and/or European research and innovation projects.

### INTEGRATING DED EXPERTISE

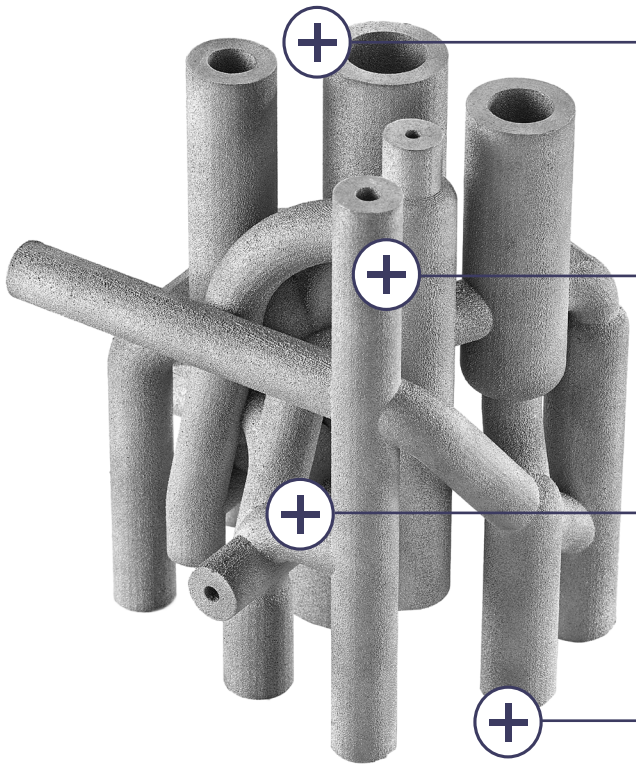
Established in 2012, BeAM is a leader in additive manufacturing technology using metal powder melting by laser (DED), focusing on large parts and the repair market.

# ADDUP TECHNOLOGIES

## Laser Beam Melting (LBM)

FormUp® machine range

Additive manufacturing process in which thermal energy from a laser beam selectively melts certain areas of a metal powder bed.



High precision

Recycling of unmelted powder

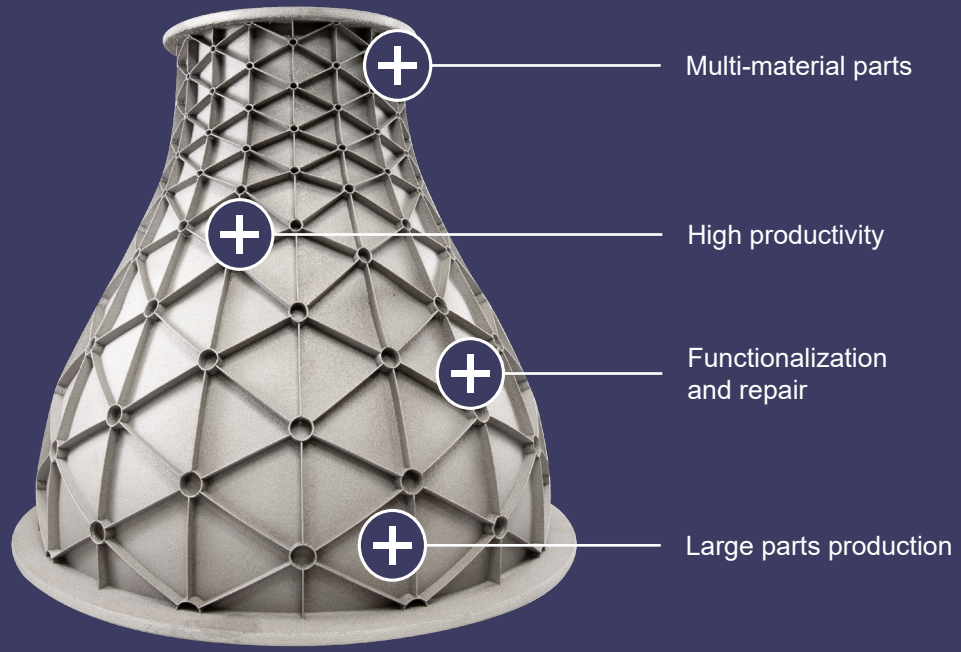
Mechanical characteristics adapted to the most demanding applications

Excellent surface quality

# Directed Energy Deposition (DED)

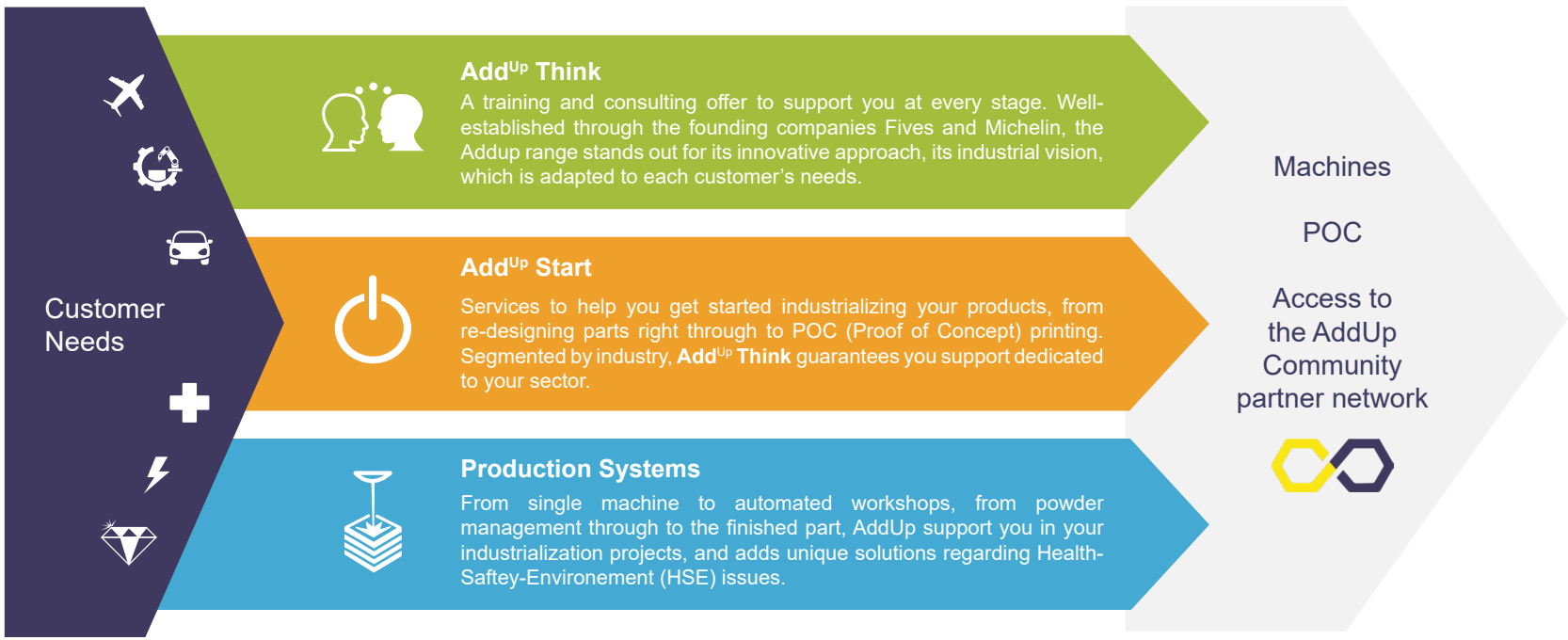
## BeAM machine range

Additive manufacturing process in which metal powder is deposited selectively and melted by means of a focused thermal energy source (here, a laser)

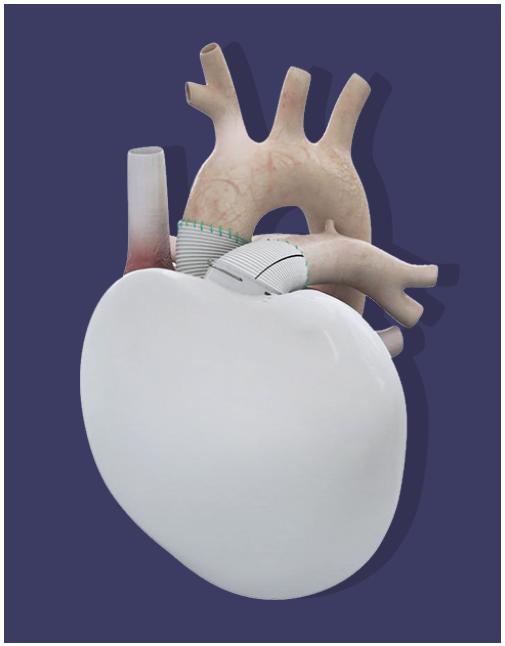


# THE ADDUP RANGE

**AddUp provides industrial metal 3D printing solutions with a comprehensive support offering organized into 3 key areas.**



# SUCCESS STORY : CARMAT



*« With a partner as prestigious as AddUp, I am confident in our ability to speed up industrialization and secure our project »*

Stéphane Piat,
CEO of CARMAT

## Carmat, the world's most advanced artificial heart project.

For speeding up the industrial project phase, AddUp is helping Carmat conceive and design new parts and optimized solutions to increase its hearts production capacity. Through various **Add**$^{Up}$ **Think** and **Add**$^{Up}$ **Start** stages, we are collaborating with Carmat on a version of its artificial heart that takes full advantage of metal 3D printing technologies.

### Add$^{Up}$ Think

This unique approach enables the project teams to 'think additive' by designing parts of the prosthesis in new ways, enhancing anatomical interfaces for added compatibility and surgical ease. For example, brainstorming sessions resulted in a reduction in the number of components, streamlining the assembly of the device.

### Add$^{Up}$ Start

Initial prototypes have been produced in POC tests to verify the feasibility and reliability of envisaged solutions. This phase will continue until all the production parameters have been defined, along with the associated production recipes, so that all required parts can be produced industrially.

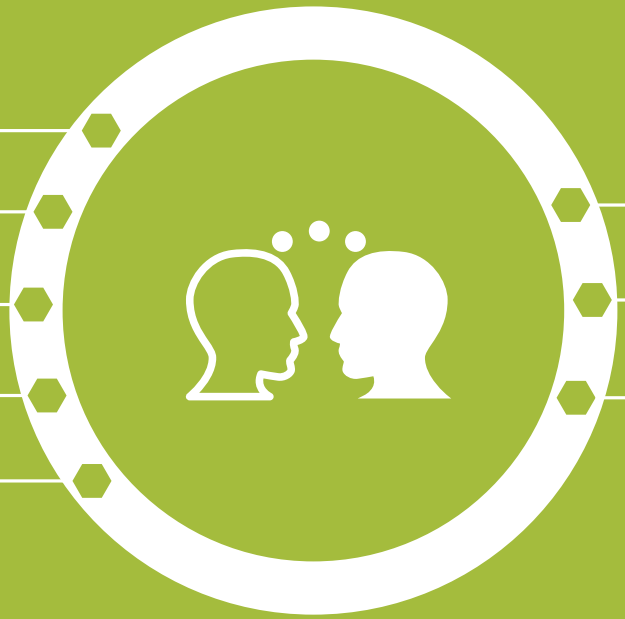
### Production Systems

In the industrialization phase for the prosthesis, AddUp will help Carmat set up an industrial additive manufacturing unit meeting all the quality, reproducibility and reliability requirements for approval in the medical sector.

# ADD[UP] THINK

## CONSULTING

- Strategic roadmap
- Change management
- Brainstorming sessions
- Identifying eligible parts
- Economic analyses



## ACADEMY

- Online learning
- Blended learning
- Classroom training

## Use AddUp Think to make metal additive manufacturing a real growth driver in your industrial strategy.

Metal additive manufacturing is winning over more and more companies. For manufacturers, it brings the promise of new design freedom, allowing them to offer unrivaled product performance and to conceive of new, previously inaccessible features.

But above all, metal 3D printing represents a major technological breakthrough. Needs in terms of training and support are immense. Yet few companies have anticipated and geared up to the new skills required for their employees.

For all those generations trained in production processes that involve removing material, there is a profound shift in paradigm, requiring entirely new ways of thinking.

For the promise of additive manufacturing to be transformed into concrete applications for your company, for the technology to find its rightful place alongside traditional production processes and realize its full potential, a whole new approach needs to be developed. This new approach involves all stages of production, from design to producing and finishing the parts created.

The **AddUp Think** consulting and training services, relaying on its multi-technology know-how (LBM and DED), are designed to help you understand all the challenges involved while identifying criteria for successfully integrating metal additive manufacturing. Paying particular attention to the economic equation of the technology, we focus on the parameters of added value, time to market of innovations and production costs so as to make metal additive manufacturing a real growth driver in your industrial strategy.

Our objectives:

- To impart an additive manufacturing culture through an original, fun and quirky approach, focused on putting ideas into practice
- To provide you with all the technical expertise needed to design and produce parts uniquely suited to additive manufacturing and taking full advantage of its possibilities
- To help you integrate the technology into your organization and to provide you with all the tools needed to generate value from it

# ADDUP CONSULTING

## Our unique priority : the success of your project.

AddUp Consulting offers a structured consulting approach that lets you take full advantage of metal additive manufacturing – today and tomorrow. A dedicated team of experts will guide you towards achieving lasting success with this innovative technology.

- **Identifying parts eligible for additive manufacturing**
  Creating value from additive manufacturing starts with carefully selecting parts that matter for your industry.

- **Tearing down technological barriers for innovation**
  To develop radically new applications, AddUp Consulting offers a creative approach based on specific design expertise for additive manufacturing.

- **Defining your technical and economic roadmap**
  Whether your starting point is evaluating your existing portfolio or searching for a technological breakthrough, we define your additive manufacturing roadmap together with you, taking economic aspects into consideration.

- **Make or buy: choosing between insourcing and outsourcing**
  Whatever your industry, AddUp Consulting helps you decide whether producing in-house or outsourcing best meets your needs, using economic and strategic criteria.

# ADDUP ACADEMY

**When adopting additive manufacturing, you will need all the support you can get. That is why our AddUp Academy offers a range of dynamic and relevant training formats – online, blended or classroom, tailored to all levels of maturity, regardless of participant profiles.**

AddUp Academy

**Clasroom learning**:
Catalog-based or tailor-made training designed to address all business roles, with content at every level:

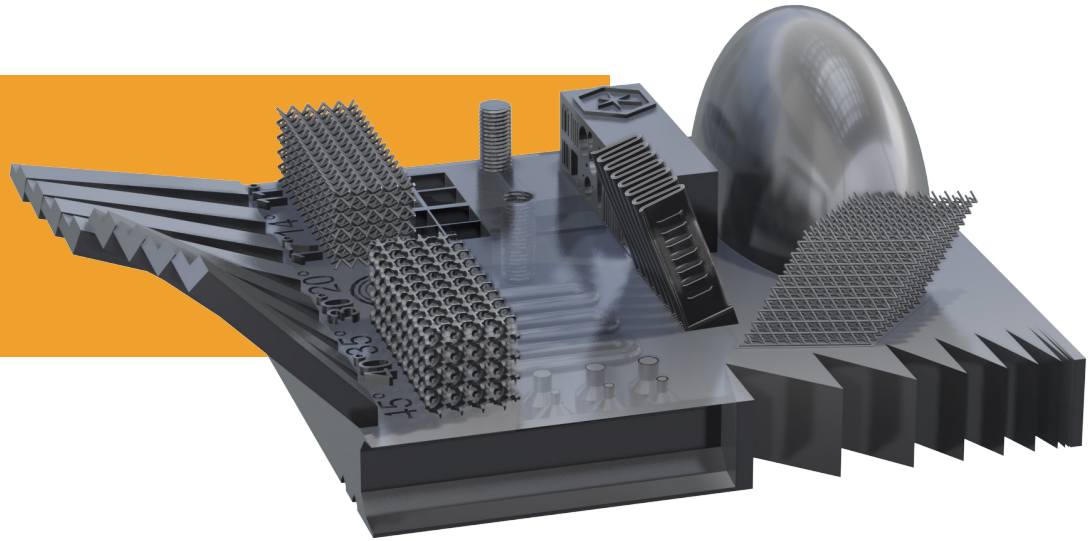
- Introducy
- Avanced
- Expert
- Production automation

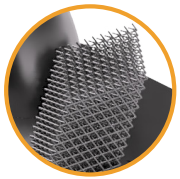
**Online learning:**
Digital solutions to train large groups simultaneously:

- A **free training** to discover the world of additive manufacturing applied to industry
- An **advanced training** to enhance your knowledge of metal additive manufacturing

# FOCUSED LBM EXPERTISE

Based on this part, which cannot be produced using traditional methods, AddUp illustrates both the capabilities of additive manufacturing and the added value of the FormUp® machine.



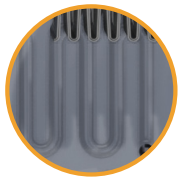


## WEIGHT REDUCTION

Lattice structures are made up of repetitive shapes. They allow you to produce lighter parts without degrading their mechanical properties.

## MOBILITY

3D printing lets you create one-piece assemblies to enhance system reliability and streamline assembly. Even mobile elements can be integrated.



## FLUID TRANSFER

Complex internal channels can be created to enhance fluid exchanges (conformal cooling).

## HEAT EXCHANGES

Additive manufacturing enables complex shapes that optimize heat exchanges.


## DIMENSIONAL ACCURACY

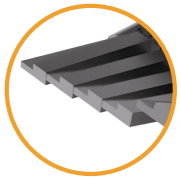
Using fine powders allows the FormUp® machine to achieve accuracy levels down to one hundredth of a millimeter.

## MANUFACTURING WITHOUT SUPPORT

Using a roller to spread the powder makes it possible to reduce the support angle and produce parts with overhangs.

## SURFACE QUALITY

Using fine powders and spreading by roller, good surface quality can be achieved regardless of orientation.



## STREAMLINING OPERATIONS

By achieving smooth, high-quality surfaces and producing parts without supports, post-production processes can be reduced.

# DED EXPERTISE

## Accessible through BeAM machine range

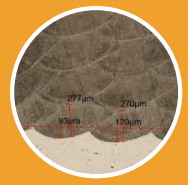
DED technology allows you to produce large parts up to 1x1x1m while reducing production times and optimizing material usage.

## FUNCTIONALIZATION

Parts are produced layer by layer using a nozzle to melt the metal powders with the energy of a laser. This makes it possible to add complex features without needing support structures.

## NEAR NET SHAPE

Programming an optimized deposition strategy and performing 5-axis movements means high geometric precision can be achieved, minimizing post-machining needs.



## METALLURGICAL QUALITY

Mastering the key process parameters ensures the reliability and repeatability of the manufacturing process. In particular the material integrity of titanium parts is greatly enhanced by working in a controlled atmosphere.

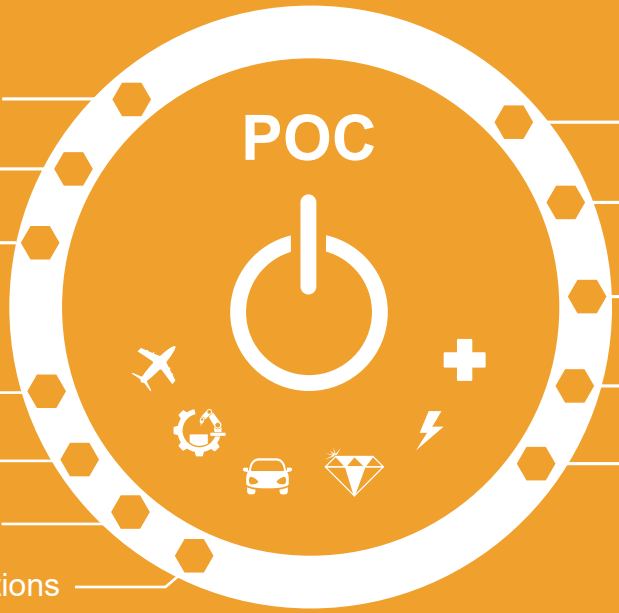
# ADD^UP START

## MATERIALS

- Choice of materials
- Materials development
- Materials characterization

## PROCESSES

- Additive technologies
- Machines and production lines recommendations
- Qualification/certification, machines and processes
- Technical and economic performance
- Parts qualification and certification




## DESIGN

- Functional integration
- Topology optimization
- Operational optimization
- Simulations and calculations

**QUALITY**
**APPROVAL**
**REPEATABILITY**
**INDUSTRIAL ROBUSTNESS**

**Add$^{Up}$ Start helps you get started with metal 3D printing by working with you to plan all the stages prior to industrialization, taking into account all the requirements of your industrial sector.**

To support you in your industrial implementation of metal 3D printing, AddUp offers a range of services, from identification of a need right through to setting up series production.

For some areas of industrial activity, the **Add$^{Up}$ Start** service is organized into 'hubs', where specialized partners apply their indispensable expertise to the integration of 3D printing in the respective sectors. Here are some hubs :

- Automotive: Addup through its partner Michelin
- Automotive racing: Poly-Shape with its huge expertise in the motorsport industry

## DESIGN

You can choose between us taking on the complete redesign of the part in consultation with your technical team or us providing advice to your design and engineering department and working together on the redesign that way. AddUp brings people together in the Hub:

- Experts from your industry to facilitate the design or redesign your parts, integrating your specifications
- Experts in metal additive manufacturing to facilitate exploitation of all the possibilities of this new technology

## MATERIALS

To round off the preparation of your project, we also provide you with advice regarding the materials to help you make the best choices that are most likely to achieve the results and functionalities you seek.

## PROCESSES

To finish, AddUp will guide you towards the best choice of additive technology for your dimensional, quality and economic requirements and objectives.

In order to offer objective and transparent services, AddUp proposes unique access to a multi-supplier, multi-technology, multi-material, multi-application platform through Poly-Shape. **Add$^{Up}$ Start** ends with the production of one or more POC (Proof Of Concept).

# Proof Of Concept

The POC (Proof Of Concept) or 'Demonstrator' is one of the key deliverables of **Add**Up **Start** to demonstrate the potential of additive manufacturing and its technical and economic feasibility.

The POC also makes it possible to validate all settings parameters control as well as the technical and economic choices made. POC printing is also a key stage for obtaining the product and process certification necessary for your industrialization to succeed.

The POC (LBM and DED) are printed at AddUp production centers or in hubs such as Poly-Shape.

# EXAMPLE OF POC

## Benefits of additive manufacturing for the aeronautical industry

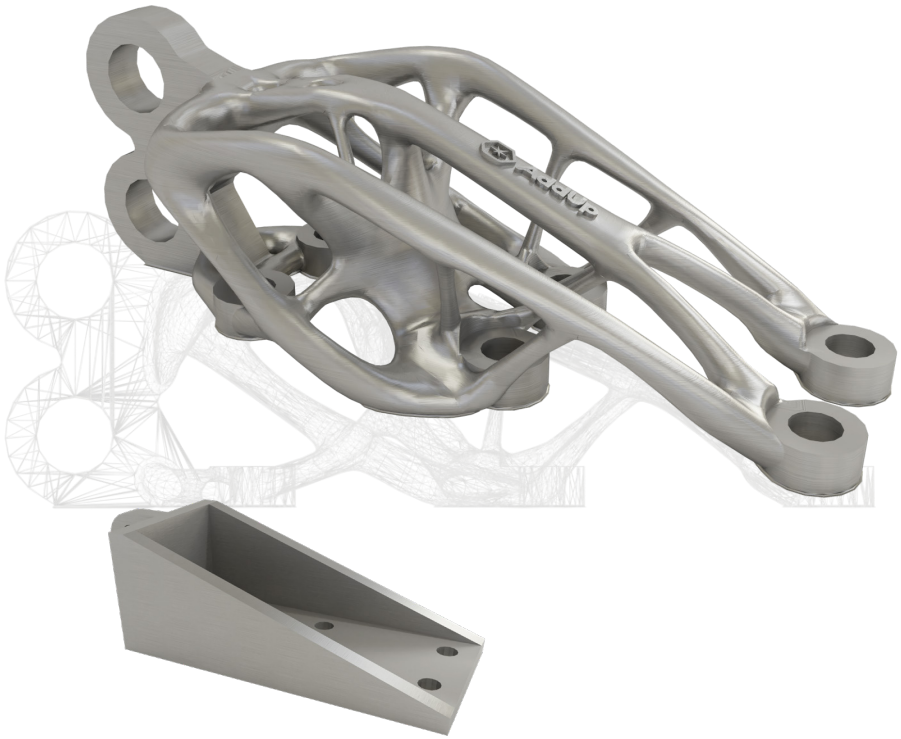
With 3D printing, we can obtain shapes that cannot be created with traditional machining. These new designs make it possible to optimize material usage, reduce the weight of the part or achieve better mechanical performance.

In aeronautics, a 1 kg reduction in airplane weight equates to a €2,000 saving because the weight of the airplane affects its fuel consumption. Additive manufacturing is a real asset for reducing weight.

Thanks to additive manufacturing, most of structural parts of an aircraft can benefit from a rigidity/mass or rigidity/ improved footprint ratio. This explains both consumption reduction and more free space availability within the aircraft.

# Fixing Bracket made without support

Material: 316L stainless steel
Sector: Aeronautics
Layer thickness: 50 µm



## Advantages of additive manufacturing

- **Raw material economy**
  Quantity of raw material for machined part: 10.85 kg

- **Mass of the final parts**
  Machined part: 3 kg; additive part: 1.15 kg
  Weight reduction: -1.85 kg

## Advantages of the FormUp® 350 machine

- **No need for supports**
  The accuracy of the machine combined with the use of a roller makes it possible to reduce the minimum angle of support:

  No support needed for this part (minimum angle of 22°, 18° or 8° depending on materials)

- **Material savings**
  No need for supports: -250 g

- **Time savings**
  Removal of supports: -30 minutes

  No fusion of supports: -3 heures

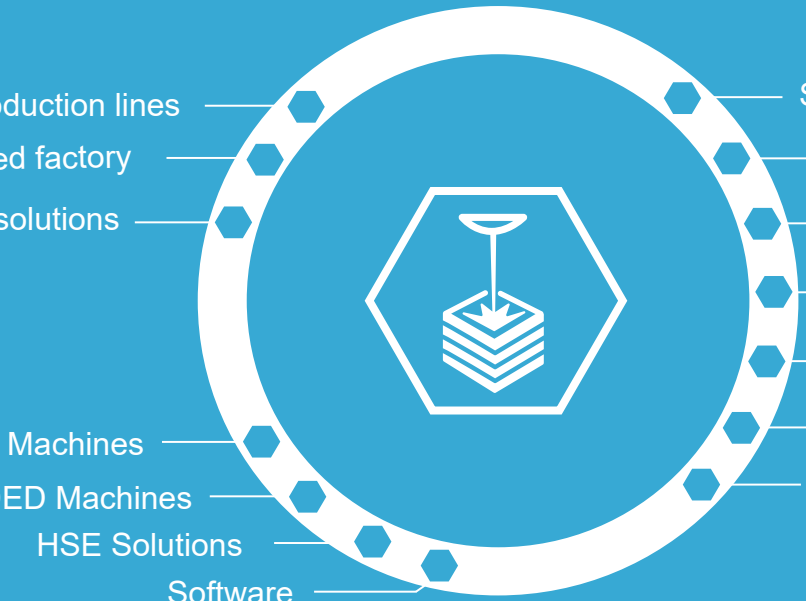
# PRODUCTION SYSTEMS

## AUTOMATED WORKSHOPS

- Production lines
- Automated factory
- Tailored industrial solutions

## CUSTOMER SUPPORT

- Spare parts
- Maintenance
- Hotline
- Upgrading
- Digital service
- Funding
- Operational training



## PRODUCTION SYSTEMS

- LBM Machines
- DED Machines
- HSE Solutions
- Software

**AddUp offers a range of automated machines and workshops with a unique HSE protection solution (Mobile and Flexible). These products go hand in hand with a range of operational service and support options.**

AddUp supports its customers throughout the entire product life cycle, providing services tailored to each situation, from the pre-acquisition phase right through to the use, maintenance and upgrading of additive machines and production lines.

Our objective: to help you get the best availability levels from your equipment and maintain its initial performance level.

Using AddUp (FormUp® et BeAM) machines, lines and systems guarantees you access to experts who can rely on:

- Michelin's extensive experience, having been running additive manufacturing on an industrial scale 24/7 for many years,
- The experience of the AddUp teams who run FormUp® machines every day producing POC (Proof Of Concept) parts,
- The experience of the BeAM teams who run their range of Modulo and Magic machines, and
- The experience of the Poly-Shape teams who have been using additive manufacturing for over 10 years on a large fleet of machines with most of the materials available on the market, and possessing of a strong experience in starting mass production.

# AVAILABLE MACHINES


LBM

## FormUp® 350

High-precision
Additive manufacturing.

Based on laser powder bed fusion technology, the FormUp 350® is designed for reliability and productivity.

- Effective production volume: 350 x 350 x 350 mm
- Laser: 500 W - 1 or 2 lasers


DED

## Modulo 250

Economical, compact, for
small parts.

Specially designed for R&D activities, training and producing small parts, the Modulo 250 combines a compact design with a high-performance work tool.

- Effective production volume: 400 x 250 x 300 mm
- Laser: 500 W


DED

## Modulo 400

Versatile, transportable
and scalable.

Developed on the basis of customer experience and feedback, the Modulo 400 is revolutionary when it comes to DED machines. All the necessary peripherals are fully integrated into the machine cabinet.

- Effective production volume: 600 x 400 x 400 mm
- Laser: 2 kW


DED

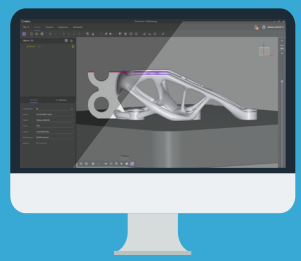
## Magic 800

High capacity,
adaptable.

The Magic 800 has been developed for high-tech industries that need specific work areas for continuous 5-axis manufacturing or repair of large metal parts.

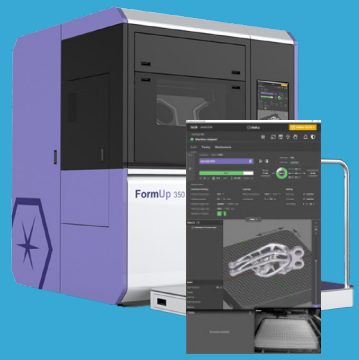
- Effective production volume: 1200 x 800 x 800 mm
- Laser: 2 kW

# SOFTWARE RANGE



## AddUp Manager™

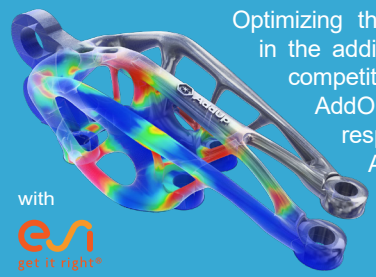
Preparation software for additive manufacturing of metal parts, AddUp Manager™ lets you import your 3D files and ensures liaison with the printer driver. All the manufacturing parameters can be defined within just a few moments. The trajectories are then generated and encapsulated in a file to be sent to the machine.




## AddUp NCore

NCore is the control software for controlling the FormUp® 350 machines. With similar ergonomics to the AddUp Manager™, it allows you to launch production of the part via addproj file reading, to display statuses and events, or to control machine modules.

## Distortion Simulation AddOn



with esi get it right

Optimizing the process parameters is a fundamental step in the additive manufacturing process and is a marker of competitive differentiation. Thanks to Distortion Simulation AddOn, you can improve your operational efficiency and responsiveness. Accessible, Distortion Simulation AddOn is designed for a wide range of users and lets you concentrate on exploiting the full potential of your FormUp® 350 machines.

Available as an additional AddUp Manager module.

# HSE ISSUES

Thinking about additive manufacturing on an industrial scale, it's also a guarantee for the security of employees. The chemical components contained in certain alloys, and the particle size of the powders (< 100 microns) are risks for both people and buildings. HSE (Health-Safety-Environment) issues have to be taken into account at a very early stage.

AddUp benefits from the experience of Fives and Michelin who share the same values when it comes to the health of operators and the safety of the work environment.

Right from conception, FormUp® machines address HSE issues in order to limit operator exposure.

Besides advice regarding the infrastructure for setting up an additive manufacturing workshop, AddUp also offers specific protection solutions that allow customers to produce in complete safety.

The innovative (patented) ergonomic solution AddUp FlexCare System™ comprises one or more transportable 'plug&play' HSE modules with all the elements required for production with complete peace of mind.

# SOLUTION HSE

## AddUp FlexCare System™

AddUp FlexCare System™ is a flexible and easily transportable controlled atmosphere solution for protecting operators and surrounding buildings from the risks associated with the industrial use of metal additive manufacturing machines.

Overall dimensions: 12.192 x 2.438 x 2.896 m
Container + case total area: 33.72 $m^2$
Ceiling height: 2.48 m


This compact and modular protection solution can be configured according to the number of additive manufacturing machines in your workshop.

The module is designed to accomodate:

- Machine(s)
- Inerted vaccum cleaner: Vac Clean+
- Wet vacuum cleaner
- Washing machine: Flex Wash+
- Filter passivation station
- Sifter: Powder Prep+
- New/recycled powder container storage
- Handling and lifting trolley: StackUp+


A solution that allows gradual transition to the industrial phase at your choice of investment pace in compliance with the health, safety and environmental requirements and standards.

# INDUSTRIAL PRODUCTION

## Automatization ajusted to your needs

AddUp benefits from Michelin's strong heritage in the first generation of workshops lines fully dedicated to additive manufacturing:

- 2 series workshop in production since 2014
- 1 million parts produced every year
- 1 fully automated production line demonstrator

AddUp is now designing the second generation of solutions for additive manufacturing mass production:

- 1 customer for delivery of full Additive manufacturing production line in 2020
- Customized approach based on customer needs and context (HSE, parts typology, volume…)
- 360° approach when it comes to the production line: overall equipment effectiveness, production flow and bottleneck management, level of mechanization or automation, HSE management, extended workshop perimeter (additive manufacturing and post treatment), parts total cost optimization

Capitalizing on AddUp FormUp® range DNA matching industrial requirements:

- Open Environment: Software, Parameter settings, all powder suppliers
- Best in class regarding high quality of the parts (precision, geometry, smooth surface roughness, metallurgy, « supports » limitation)
- Tune Quality/Productivity (able to deal with small and large powders), roller or blade system
- Industrial robustness: mechanical architecture, layering system, ergonomic, gas flow, fully inert environment
- Repeatability of the process


FormUp 350
AddUp

# ADDUP COMMUNITY

**The objective of the AddUp Community ecosystem is to connect the supply with the demand for the production of parts.**

AddUp Community consists of companies producing parts in additive manufacturing which AddUp offers to support by means of a label that validates their membership of this community and their adherence to a very high standard of requirements and excellence.

Since each sector has specific approval and quality requirements, the ‘labeled’ companies will generally be specialists and approved by their industry sector.

The AddUp Community label is a guarantee of confidence for your parts printing customers (level 1, 2 or 3) because it will not be issued until several key elements have been validated, such as:

- Production on AddUp machines
- Staff trained by the AddUp Academy
- Absolute mastery of the machines
- The capacity to master the technology while complying with HSE requirements in parts production
- Compliance with the requirements associated with the respective sector (standards, approval, qualification, etc.)

# WHERE TO FIND US IN THE WORLD ?

## Our distributors

### United Kingdom & Ireland

**Kingsbury**
Quay Lane, Gosport
Hampshire, England, PO12 4LB
+ 44 2392 580 371
**solutions@kingsburyuk.com**

### Spain & Portugal

**Delteco**
Cruce de Malzaga S/N
20600 EIBAR, Spain
+ 34 943 707 007
**delteco@delteco.com**

### Russia

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# CONTACT US

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