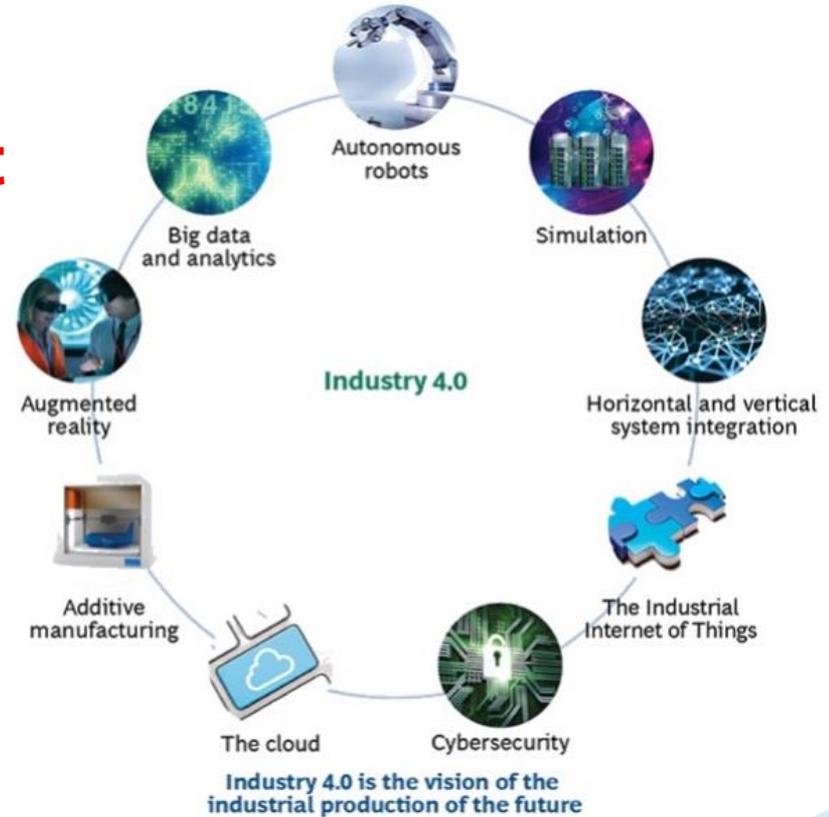


Additive manufacturing in Brainport Eindhoven

From 2D to 3D: Additive Manufacturing in the heart of Industry 4.0

The world is changing from 2D to 3D, from analogue to digital, from push to pull. In the manufacturing industry, this is the 4th industrial revolution. Nine core technologies play a central role in the change of both the manufacturing and business processes and the business models. Additive manufacturing, one of these nine technologies, will have the greatest impact.



The complete Additive Manufacturing ecosystem in Brainport Eindhoven

Successful applications of Additive Manufacturing require a complete AM ecosystem: from experts with knowledge of design for AM to manufacturing companies with knowledge of AM techniques and post-processing. From developers of AM equipment to knowledge centers and service providers. This ecosystem exists in Brainport Eindhoven.

 Professional printer equipment	 Printers and copiers	 Textile and graphic printing equipment	 Printers and copiers	 Printers and copiers	 Lithography	 3D printers and materials	 Industrial metal AM machines	 3D printing service and community
 3D metal printing factory	 Additive ceramic printers	 3d printing of polymeric materials	 Printed electronics	 R&D industrial AM	 University of Technology Eindhoven	 Applied Scientific Research	 R&D centre flexible electronics	 Precision Machinery
 Open supply chain campus	 Labels and packaging machinery	 Material reliability for additive	 Functional inkjet printing	 Printed electronics	 Design Academy	 Idea to manufactured product	 High End Design	 Gases
 Topology optimization software	 Metal AM systems	 PLM software	 Filaments	 Filaments	 Filaments	 Design software	 Scanning hard and software	 Filaments
 Workflow and security software	 Design	 Printhead consulting	 Industrial metal AM systems	 Functional mechatronics/modules	 Opto mechatronics	 Contract manufacturing	 AM Implementation	 Topology Optimization



Solutions our High-Tech Systems & Materials sector can offer

The large amount of successful HTSM companies in the region form a strong ecosystem for additive manufacturing. Aside from the strong direct supply chain, the HTSM sector also provides a large application market for 3D printing solution providers.

In Brainport Eindhoven high-tech OEM-machine builders, manufacturers of AM-equipment as well as suppliers find the ecosystem for:

- the acceleration of AM innovation
- testing of AM concepts with industrial cases
- accelerating application development
- the integration of AM technology into existing workflows
- tailoring AM-equipment and production processes to the end-user application
- developing dedicated next-generation AM-equipment

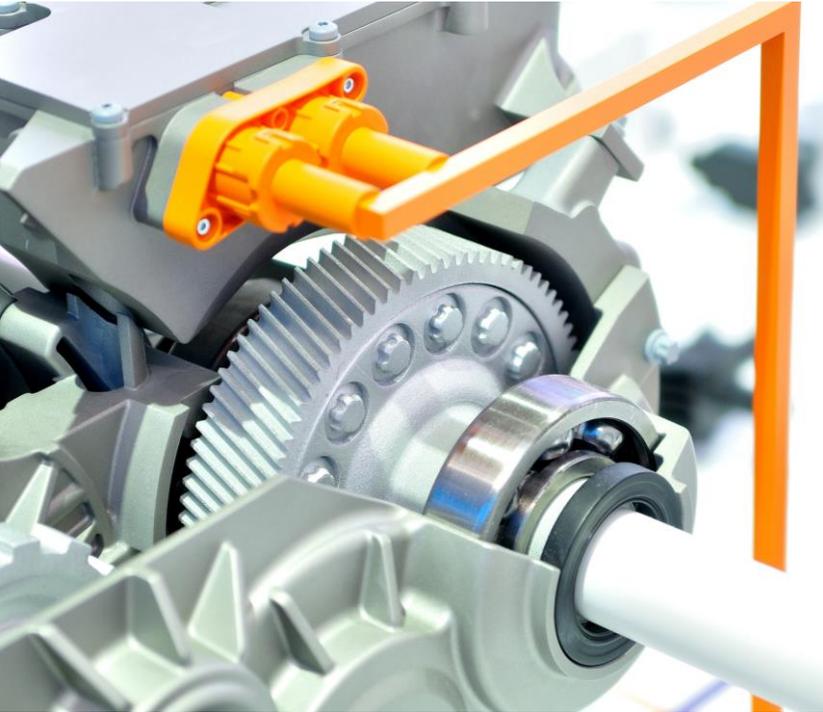
NUMBERS	BRAINPORT	%	NETHERLANDS	%
People	773.000	4,5	17.282.000	100
HTSM Companies	5.673	6,0	94.801	100
Jobs in HTSM	67.454	11,2	601.689	100

Brainport Eindhoven: for OEM high-tech machine builders

The region has an ecosystem of high-tech system and parts suppliers, who:

- Are used to working together in a multidisciplinary way and in an open supply chain
- Have state-of-the-art production facilities (including AM)
- Can take the lead in a project and manage for their customer the supply chain for a specific project or product

Brainport Eindhoven for suppliers



Additive manufacturing changes the existing supply chains in a disruptive way with digital manufacturing. This will lead to:

- Manufacturing on demand;
- Customizing of products
- Distributed manufacturing models
- Changing business models

Knowledge of only additive manufacturing technology is not enough, because AM is part of a process. Medium- and smaller-sized suppliers will find in Brainport Eindhoven the right partners and facilities for developing AM applications. These partners and facilities share their knowledge and AM equipment. This way the threshold for stepping into Additive Manufacturing is lowered.

AM service providers: from idea to printed product

Companies who wish to collaborate with an AM service provider, will find partners in Brainport Eindhoven who offer a wide range of services and AM production techniques, for example:

- **K3D**: offers shared facilities both in hardware as in knowledge for developing and manufacturing AM products. Their MetalFab1 3D metal printer is located at the Brainport Industries Campus.
- **Additive Centre**: several AM experts with many years of experience work together to support companies with the implementation of additive manufacturing. They have gained experience at companies such as Shapeways, Additive Industries, FMI, MakerPoint and Fontys University of Applied Science. With the Additive Application Program, they help companies in a very structured way to identify key applications for AM.
- **Shapeways**: you find here the roots of one of the global pioneers when it comes to on-demand 3D printing. One of the larger 3D printing service centers with various AM technologies and, above all, knowledge of the AM process, is located in Brainport Eindhoven.

Events to keep in mind



3D Delta Week:

A week full of additive manufacturing events in the Benelux region, where many companies demonstrate their products, services and new technologies



Rapidpro:

Annual event for solutions for prototyping, product development, customization and rapid, low volume & on demand production.



3D Printing Electronics Conference:

Annual event at the High Tech Campus Eindhoven about the full electronics AM supply chain.



Additive World:

Annual event organized by Additive Industries on the latest trends in industrial additive manufacturing.



Automotive 3D Printing Conference:

Annual event at the Automotive Campus in Helmond about the full automotive AM supply chain.



Dutch Design Week:

The biggest design event in Northern Europe presents work and ideas of more than 2600 designers to more than 350,000 visitors.



Dutch Technology Week:

A full week for technology companies to open their doors and demonstrate their innovations with the objective to raise interest in technology.

Additive manufacturing is no longer a promise in Brainport Eindhoven

Automotive

- **DAF Trucks**

Application: Improving the performance of the trucks, engineers continuously work on new product designs. To shorten the time between CAD-modelling and testing prototypes, DAF Trucks uses FDM-technology to 3D print parts. By doing this, the engineering team has a (functional) prototype the next day after an iteration is done.

Benefits: 3D printing speeds up the PDCA cycles and better feedback on designs.

- **Lightyear**

Application: The prototype of their solar charged vehicle, Lightyear needed more than 60 parts in a short time. The company sourced all these parts through the Dutch platform DiManEX.

Benefits: Shorter lead times, no investment in expensive tooling because parts are not milled. Building up an AM supply chain that automatically connects to the supplier with the right AM technology and capacity

- **BMW Mini**

Application: The BMW Mini, build in The Netherlands, is more than a car. Buyers express their lifestyle with this car. BMW offers customers the possibility to customize their Mini by designing some parts. These customized parts are then 3D printed. The software platform that's used for this, is developed by Twikit.

Benefits: Customizing a mass product, new business model for the car manufacturer and direct interaction between OEM'er and the end user.

High-tech OEM

- **Machinefabriek De Valk**

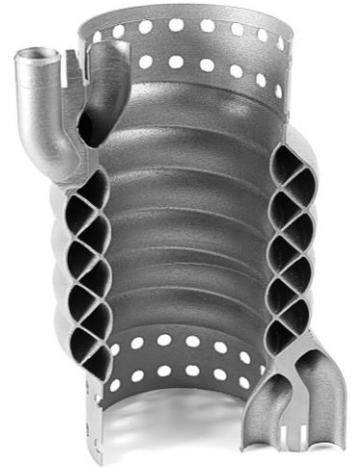
Application: Already in a very early stage, Machinefabriek De Valk, a parts supplier, got involved in additive manufacturing by participating in Addlab. Recently De Valk made together with several partners in Brainport Eindhoven a complex manifold for ASML. 3D metal printing was the only technology that could meet the requirements.

Benefits: Better performance due to less turbulences, because critical parts of the manifold are 3D printed in an extreme short lead time (8 systems in 12 weeks), made possible due to the collaboration on the AM ecosystems of Brainport Eindhoven

- **Kaak Group**

Application: The family owned Kaak Group invested in the MetalFab1 3D metal printer from Additive Industries to print parts for their industrial bakery lines. Kaak now benefits from functional integration thanks to additive manufacturing and reduces assembly costs, needs fewer robots per line and increases for the customers the uptime of the production line.

Benefits: Less assembly costs and weight reduction of the knife, which leads to faster movements of the robot and thus less robots needed in one bakery



Medical

- **FMI Additive**

Application: FMI is a small Dutch contract manufacturer of metal devices and implants. It gained knowledge of Additive Manufacturing by participating in Addlab and has now started FMI Additive. Here every day several hundred implants are 3D printed and post-processed. The company plans to enlarge the additive production facility as more and more customers ask for 3D printed implants.

Benefits: Lattice structure that is printed. Human tissue can grow faster in this structure.

- **Next Dent & Lake 3D**

Application: In the fieldlab MM3D (Multi Material 3D Printing) both companies made an existing 2D printhead (developed by Océ) suitable for 3D printing dental implants. With that, they can print in countless color variations. As a result, the artificial teeth match exactly with the colors of the natural teeth of the patient.

Benefits: Disrupt the existing supply chain, less stressful workflow for the patient and better color match with natural teeth of the patient.

Aerospace

- **GKN Fokker Aerostructures**

Application: As a Tier 1 supplier for the aerospace industry, GKN Fokker Aerostructures is investigating how to improve the buy-to-fly ratio off metal parts. AM is one solution for using less resources for manufacturing structural parts for airplanes.

Benefits: Additive Manufacturing can shorten lead times and produces less waste of resources because of a better buy-to-fly ratio.

- **NLR**

Application: The Dutch research institute for aerospace and aeronautics has developed and 3D printed a bracket for one of the NH90 helicopters of the Royal Dutch Army. This bracket is 40% lighter than the one manufactured with traditional technologies and delivers the same performance.

- **Benefits:** Weight reduction



Consumer products

- **3D Mouthguard & DSM**

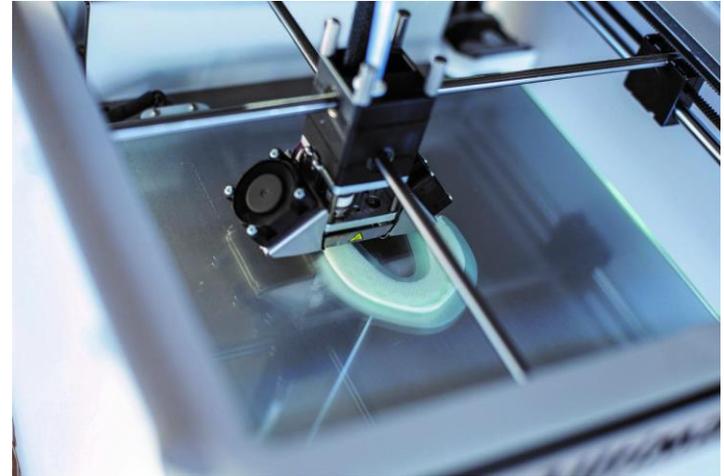
Application: Every year quite a lot of hockey players suffer from broken teeth. 3D Mouthguard developed an automated workflow to scan the teeth, generate the correct STL-file from the scan data and then 3D print a customized mouth protection device. Together with Royal DSM the right material was developed for these devices.

Benefits: Personalized protection for athletes, low-cost workflow that doesn't require high-end skills to deploy and fully digitalized workflow.

- **Luxexcel**

Application: After starting to 3D print optical lenses for the LED-industry, Luxexcel is now capable of 3D printed ophthalmic lenses. Because of this method, semi-finished blanks are not needed anymore, customized lenses can be produced more efficient and even customized cosmetics are possible.

Benefits: Luxexcel disrupts with their technology and software the ophthalmic industry, possibility to 3D print personalized lenses and manufacturers of smart glasses can manufacture these with prescription lenses.



New: Brainport Industries Campus



The Brainport Industries Campus provides a unique high-tech supply infrastructure where manufacturing companies, knowledge institutes, field labs and educational institutes operate under one roof. The co-operation shortens the time to market for OEM machine builders. They can focus on their core business.

A unique proposition of 200 hectares advanced manufacturing

Brainport Industries Campus is a brand-new campus near Eindhoven Airport. The manufacturing companies involved in the high-tech supply chain, research institutes, fieldlabs and educational institutes co-operate here under one roof and share facilities.

The campus is destined to become a leading hub where innovation and competitiveness in high-tech manufacturing reach the highest level of excellence:

- Testing and experimenting with end-users, industry and students
- Integrating AM in smart industry / industry 4.0 programs
- Launching your AM technology in a major network of high-tech suppliers
- Possibility to showcase your use cases within a complete setup of the digital manufacturing process with well-known brands like Siemens, Yaskawa, Additive Industries, DMG Mori, BT Brammer/Rubix etc.

R&D centres: shorter time to market

In Brainport Eindhoven OEM machine builders can work with several R&D campuses. With the knowledge and R&D capacity you can shorten time to market for your new products and AM applications.

- **Brightlands Chemelot Material Campus:** development of polymer technology for 3D printing
- **AMSystems Center:** The joint venture between TNO and the High Tech Systems Center of the Eindhoven University of Technology. AMSystems Center focusses mainly on the development of next generation multi-material/multi-technology AM equipment, and the integration of AM technologies towards mass-customization production chains.
- **Objexlab:** As part of the University of Applied Sciences Fontys, the ObjexLab is one of the first additive manufacturing labs in Dutch educational institutions. In addition to the training of the new generation of AM engineers, ObjexLab is also open for companies to co-develop applications or conducting applied research.
- **Holst Centre:** A joint venture of TNO and Imec, is a world-leading, open-innovation R&D centre that creates technologies for large-area flexible electronics. It focuses on printed conductive structures on flexible substrates with the aim to develop simple printing-based processes that will keep production costs low and be scalable.

Solutions provided by suppliers: from AM-concept to post-processing

Both tier 1 and 2 suppliers and parts suppliers in Brainport Eindhoven have experience with additive manufacturing. This ranges from manufacturing AM applications for third parties to develop and build modules for AM equipment as well as to the necessary post-processing. Because they are used working together in an open partnership, in a short time they find the right partners with the necessary knowledge for your AM project, no matter how complex the case is. Tier 1 suppliers are used to manage bigger projects for OEMs in semiconductor (ASML) and printing (Oce, Fujifilm, SPGprints, Fuji Seal). A few examples are given below:

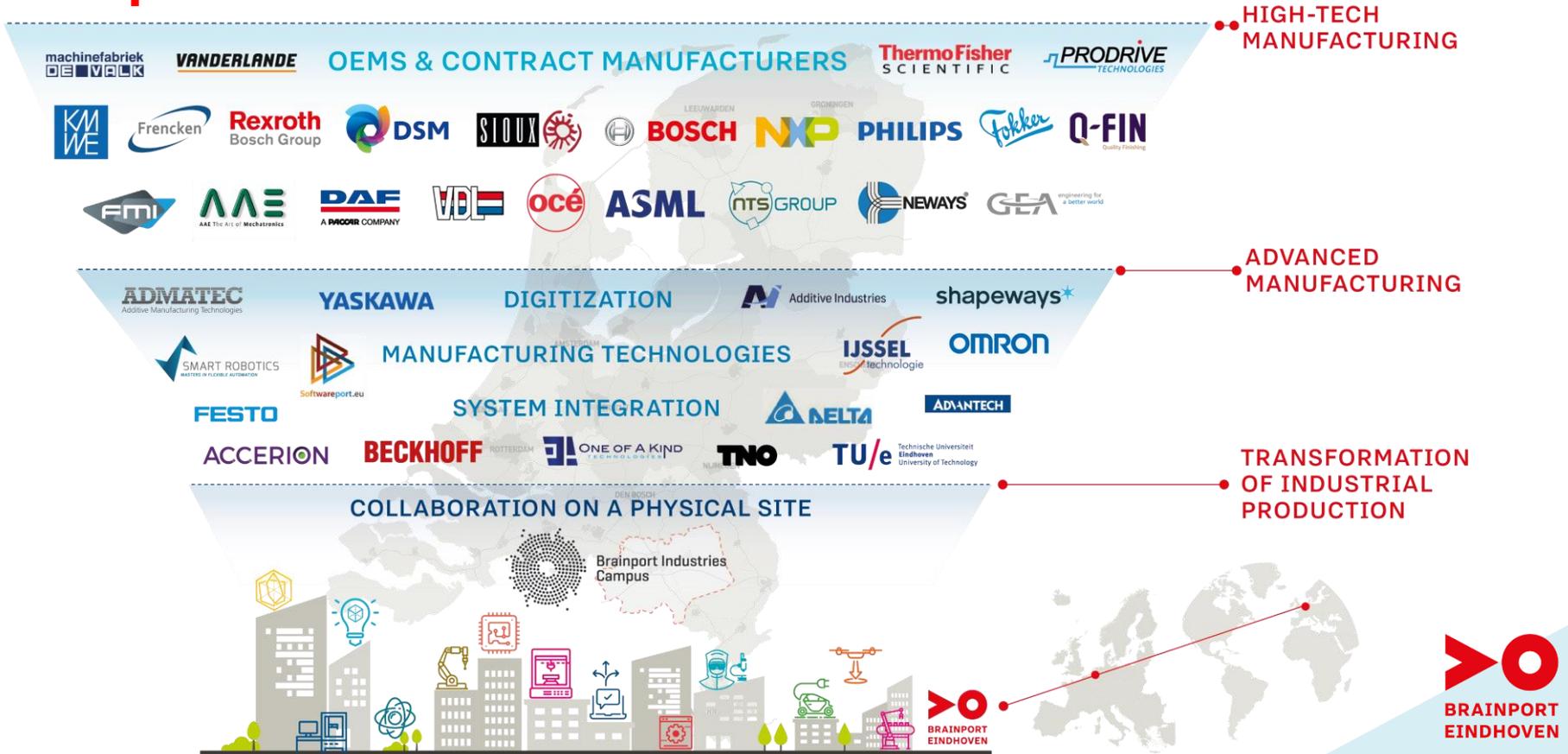
- **NTS Norma**: Develops high precision system modules and components for high-tech industries like the semiconductor industry. Has knowledge of AM and builds modules for Additive Industries
- **AAE**: Uses additive manufacturing for their own precision machines
- **Demcon**: High-end technology supplier with focus on high-tech systems and medical devices. Demcon shares their R&D facility with Bond3D, a start-up developing high-end AM systems for engineering plastics like PEEK and PEKK
- **KMWE**: Supplier specialized in high mix, low volume and high complex CNC machining. Has started a joint venture with TNO for developing an AM system for mass customized footwear (IAM)
- **VDL ETG**: Manufacturer of precision parts and systems for several high-tech industries. Part of the VDL Group. 3D printer manufacturers like byFlow (3D food printing) and Autumn 3D (DLP print technology) have outsourced their production to VDL.

OEMs of AM equipment

Brainport Eindhoven is home to various manufacturers of industrial AM equipment and dedicated equipment for niche applications. This is partly based on the 2D printing and the semiconductor heritage of the region. Well-known AM manufacturers of the Brainport Eindhoven ecosystem are:

- **Additive Industries**: developer and manufacturer of the MetalFAB1, an industrially integrated AM system for high-value applications in metal.
- **Admatec**: develops and builds industrial 3D ceramic printers for the precision and medical industry. Has also developed a 3D metal printer.
- **Ultimaker**: manufacturer of desktop filament printers for engineers who want to have prototypes quickly. The applications are moving further in the direction of 3D printing of tooling and jogs and fixtures.
- **byFlow**: the world's first 3D food printer that is used worldwide by, among others, chefs at top level restaurants. byFlow collaborates with producers of food ingredients to build an ecosystem for 3D food printing.
- **AM-Flow**: by using Artificial Intelligence, AM-Flow solves the logistic problem of 3D print service companies, by automatically recognizing and sorting the thousands of parts produced per day.
- **Luxexcel**: the world's first company that developed industrial AM equipment for printing ophthalmic lenses

Transformation of high-tech manufacturing requires competences and collaboration



Collaboration: the power of Brainport Eindhoven



Cooperation is the strength of Brainport Eindhoven. Additive Industries is a striking example of how cooperation throughout the entire value chain leads to an internationally successful company.

Eight manufacturing companies (KMWE, NTS Group, Frencken, De Valk, FMI, MTA, Philips Innovation services and Kaak Group) together with Additive Industries teamed up in AddLab. Here they have gained application-driven experience in additive manufacturing. By sharing knowledge, every partner in Addlab shortened the learning curve of AM.

Additive Industries used this knowledge for the development of their MetalFAB1, the world's first industrial 3D metal print production system. Additive Industries now has more than 80 employees and has several dozen AM systems installed at companies such as Volkswagen, GKN, APWorks, Alfa Romeo Sauber F1 Team and several suppliers to the aerospace industry.

The manufacturing companies have developed their use cases and profitable business models at the same time. FMI Additive and K3D were created directly out of Addlab.

Brainport Development: gateway to the additive manufacturing ecosystem

It is essential to develop and create market- and application-oriented value chains.

Brainport Development, the economic development agency of the region, is your gateway to end-to-end additive & digital manufacturing value chains for:

- Starting with basic industrial AM
- Accelerating development of high-end and disruptive use-cases through consortia with regional, national and international relevant companies
- Tailoring AM-equipment and production processes to the end-user application
- Developing dedicated next-generation AM-equipment

Brainport Development supports you in connecting to the right network, with which you can develop your next AM project.

BRAINPORT DEVELOPMENT
economic development agency

Contact us

For more information on the additive manufacturing industry in Brainport Eindhoven, please contact Ruben Fokkema, international business developer of Brainport Development.

E: r.fokkema@brainportdevelopment.nl

M: +31 6 1053 8038

