



ADD^{UP} THINK

TRAINING
& CONSULTING

CONTENTS

Add ^{Up} Think	5
AddUp Consulting	6
Identify eligible parts	8
Overcome technological barriers	8
Build the strategic roadmap	9
AddUp Academy	10
Introductory level	12
Advanced level	16
Expert level	20
Addup Academy Online	26
Our team	28

BACKGROUND

Support - a key factor to the success of your metal additive manufacturing project

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.

Alongside its production systems offer, AddUp also proposes a large services catalogue that includes consulting and training modules under the **Add^{Up} Think** brand.

ADD^{UP} THINK

Use Add^{UP} Think to make metal additive manufacturing a real growth driver in your industrial strategy.

The **Add^{UP} Think** consulting and training services, relying 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



CONSULTING



ACADEMY





ADDUP CONSULTING

Our sole concern :
the success of your project.

A team of experts ready to guide you towards a successful, long-term integration of the metal additive manufacturing approach.

AddUp Consulting offers you a structured consulting approach designed to make the most of this technology, both now and in the future :



Identify parts eligible for
additive manufacturing



Overcome technological barriers
and innovate



Build your technical and
economic road map



Identify parts eligible for additive manufacturing

AddUp helps you identify which of your parts are eligible for additive manufacturing.

Creating value through additive manufacturing begins with the rigorous selection of relevant parts. Starting with your product portfolio, AddUp Consulting™ supports you by:

- Providing you with a filtering method
- Grouping selected cases into families of economic interest and ranking them
- Defining their technical accessibility
- Compiling economic and technical accessibility issues in order to identify the most promising parts, intended to produce proof-of-concept



Overcome technological barriers and innovate

How can additive manufacturing be used to drive innovation?

While additive manufacturing opens up a whole range of new opportunities in terms of innovation, making the most of these opportunities means having to be receptive to new ways of thinking.

To help you develop radically new applications, AddUp Consulting™ offers a creative approach based on its special expertise in designing with a view to additive manufacturing. We offer a method and an innovative set of tools designed to:

- Study every possible line of development for the technology
- Identify, formulate and prioritise your technical road blocks
- Build technical scenarios that provide a way of by-passing these road blocks
- Select the cases that will be most useful in producing proofs of-concept

Build your strategic road map



We will help you build your strategic road map.

Whether your starting point is an analysis of your existing portfolio or research into a technological breakthrough, we will help you define your “additive manufacturing” road map, including:

- An overview of the gains made with “business cases” in previous steps
- A detailed view of the end-to-end production process
- An objective assessment of the total cost of ownership (TCO approach)
- Informed choices on which steps to outsource (“make or buy” approach)

The whole as part of a dynamic outlook that takes account of projected technological developments.



ADDUP ACADEMY

Think additive. Think differently.

Aware of the importance of supporting you in your adoption of the additive manufacturing approach, AddUp has created a complete training offer, based on an innovative and offbeat format. AddUp Academy™ is a group of hybrid, or blended, training courses that combine online courses with classroom sessions, the content of which is tailored to suit the participants' profile and level of expertise.

AddUp Academy Online, the e-learning site dedicated to metal additive manufacturing, lets you train a large number of employees rapidly, tracking the progress of each e-learner.

Because each business is unique, because each project is different, all our offers are tailored to meet your specific needs.

We offer attendance-based courses via catalogues designed to match your level of expertise:



Introductory level



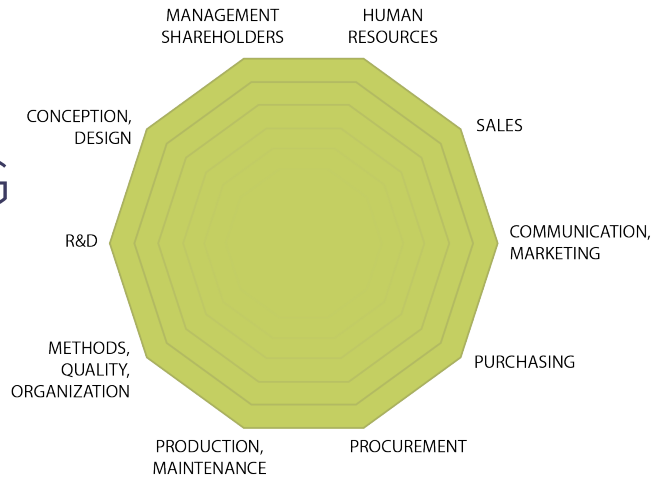
Advanced level



Expert level

FUNDAMENTALS OF ADDITIVE MANUFACTURING

Discover the world of 3D printing and develop your knowledge of metal additive manufacturing.



OBJECTIVES

On completing this course, you will be able to:

- Distinguish between the various additive manufacturing processes.
- Understand how an metal additive manufacturing machine works.
- Identify applicative cases for metal additive manufacturing.
- Get an overall picture of how the process is carried out: design, production, risk management, finishings and inspection.
- List the key costings criteria.

PROGRAMME

- Introduction to additive manufacturing
 - Presentation and definition
 - Study of the various processes
 - Value creation and use scenarios
- The world of metal additive manufacturing
 - AddUp technology
 - HSE risks
 - Metal powders
- Design rules
- Finishing and post-treatment operations
- Economic aspects
- A few remarkable patents

INFORMATION

Prerequisites: No

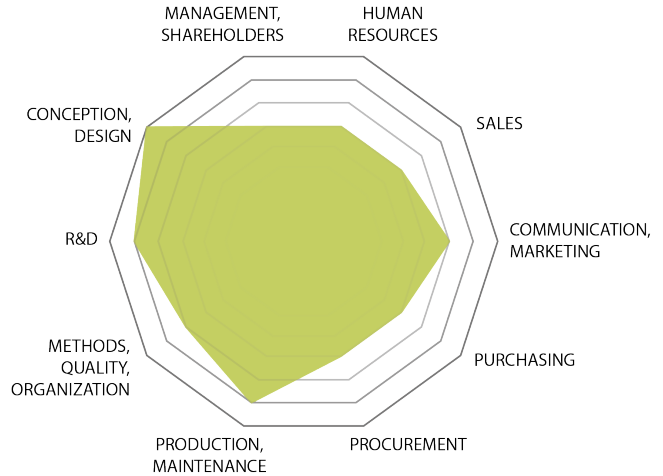
Duration: 2 to 5 days

Location: AddUp site or customer site

Number of participants: 6 to 12 persons

THINK ADDITIVE

Develop the basic reflexes for using additive manufacturing to design parts.



OBJECTIVES

On completing this course, you will be able to:

- Name the main additive manufacturing design rules.
- Identify hard-to-produce areas on a part drawing.
- Apply the principle of integrating functions.
- Explain the limitations of the main metal and plastic additive manufacturing techniques.
- Suggest a preferred orientation for a given part.

PROGRAMME

- Potential of and limits to the main metal additive manufacturing processes
- Adapting part specifications for additive manufacturing
- Integrating functions into an existing part
- Producing a part on a plastic thread deposition machine

INFORMATION

Prerequisites: No

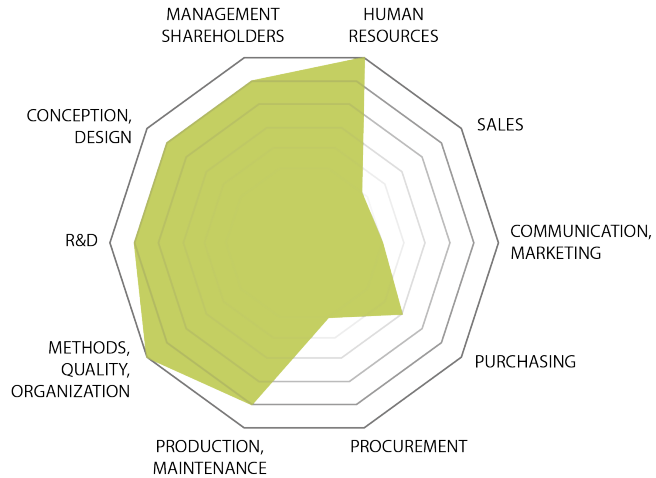
Duration: 1 day

Location: AddUp site or customer site

Number of participants: 6 to 12 persons

ADDITIVE MANUFACTURING: PEOPLE & ORGANIZATIONS

Successfully integrate the additive manufacturing process, taking account of human and organizational factors.



OBJECTIVES

On completing this course, you will be able to:

- Build a cohesive team vision of a business-focused additive manufacturing approach.
- Understand and anticipate the human and organisational changes required for successful roll out of the additive manufacturing approach.
- Explore implementation strategies and initiate the first measures.

PROGRAMME

- Preliminary analysis
 - Challenges
 - Expected results
 - Critical scrutiny
 - Intervention supervision
- Team commitment
- Group solution-finding effort and construction of a roadmap

INFORMATION

Prerequisites:

- « Fundamentals of additive manufacturing »

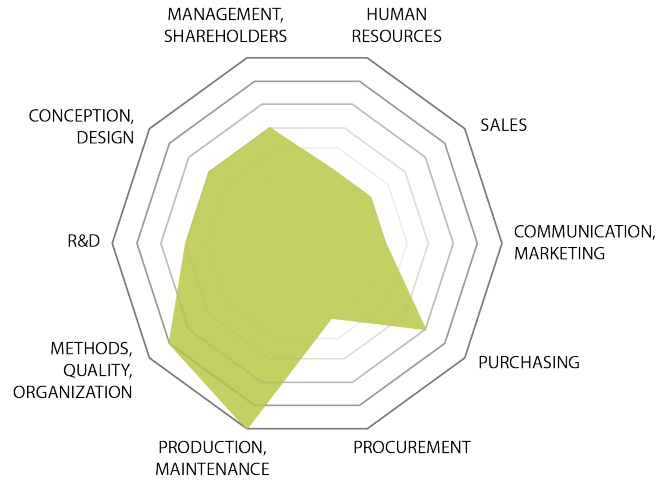
Duration: 1 day

Location: AddUp site or customer site

Number of participants: 6 to 12 persons

PREPARING FOR MANUFACTURE LEVEL 1

Draw the link between design and production using AddUp Manager™ software.



OBJECTIVES

On completing this course, you will be able to:

- Define part positioning and fusion strategies tailored to the application.
- Create customised fusion strategies.
- Modify production parameters according to productivity or material integrity targets.
- Take account of features specific to powder bed additive manufacturing machines.

PROGRAMME

- Part positioning and orientation
- Programming fusion strategies
- Generating media
- Preparing advanced manufacture, based on specific examples
- Creating experimental approaches
- Adjusting the parameters for the production chamber
- Practical case study: production start-up and acceptance

INFORMATION

Prerequisites:

- « Fundamentals of additive manufacturing »
- AddUp Academy Online : Advanced training

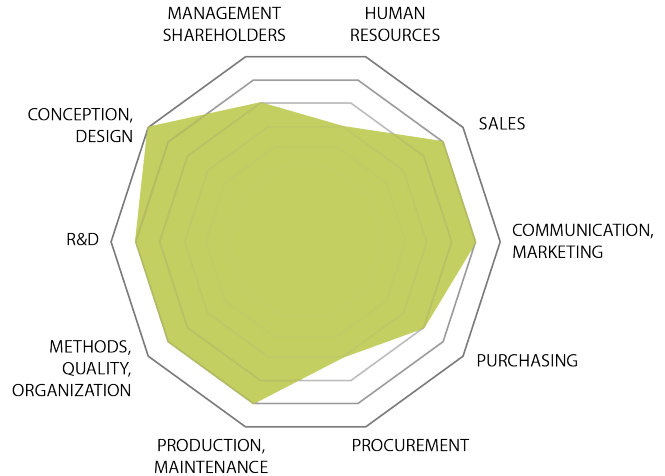
Duration: 1 to 3 days

Location: AddUp site or customer site

Number of participants: 3 to 6 persons

ADVANCED DESIGN

Learn how to design for metal additive manufacture using the laser powder fusion process.



OBJECTIVES

On completing this course, you will be able to:

- List the limitations of additive manufacturing that need to be taken into account during part design.
- Identify the criteria that influence the design decisions made for a model.
- Explain how design decisions affect the manufacturing process and the features of the resulting parts.
- Use the various criteria to meet the specifications.
- Design or redesign parts adapted to the additive manufacturing process.
- Assess the manufacturing risks for legacy parts and propose risk limitation strategies.

PROGRAMME

- The role of design and the potential of additive manufacturing
 - Impact of design on implementing the LBM additive manufacturing process
 - Impact of design on the properties of parts produced using LBM additive manufacturing
- Design rules
 - Design criteria
 - Preparation method

INFORMATION

Prerequisites:

- « Fundamentals of additive manufacturing »
- AddUp Academy Online : Advanced training

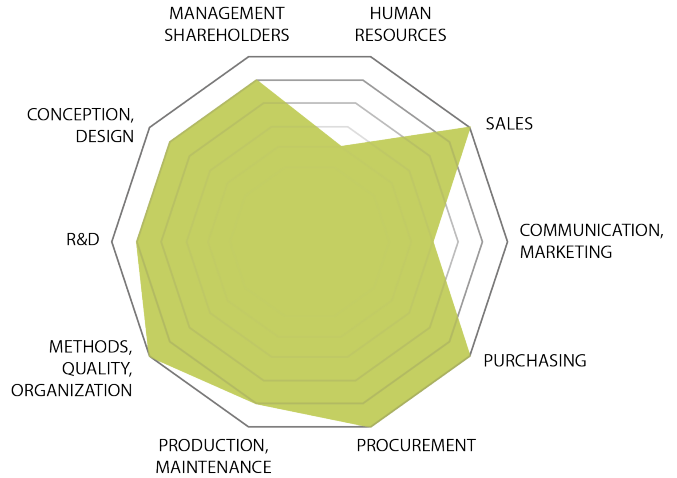
Duration: 1 day

Location: AddUp site or customer site

Number of participants: 3 to 12 persons

COSTINGS LEVEL 1

Learn how to break down the cost of a given manufacture in order to create your first quotes.



OBJECTIVES

On completing this course, you will be able to:

- List the components of an analytical cost breakdown.
- Quantify the impact of costing parameters.

PROGRAMME

- Main costing criteria
- Select the right material characteristics and implementation procedure
- Prepare for and carry out the manufacture
- Case study
- Solutions designed to improve economic performance

INFORMATION

Prerequisites:

- It is useful to have some prior knowledge of AddUp Manager
- AddUp Academy Online: Advanced training

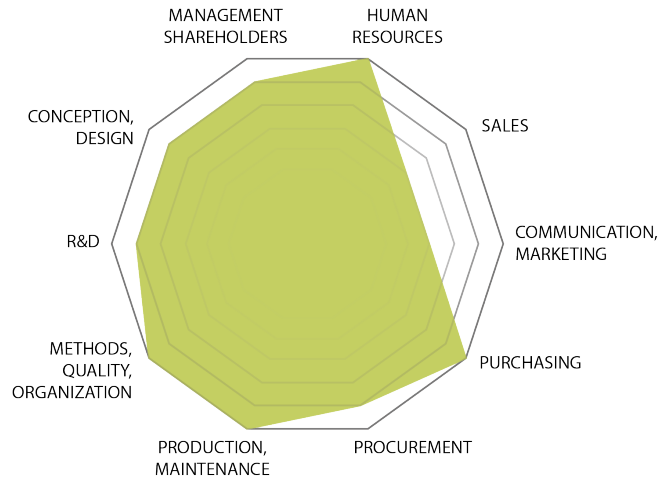
Duration: 1 day

Location: AddUp site or customer site

Number of participants: 3 to 12 persons

HSE RISKS MANAGEMENT

Manage HSE risks relating to the implementation of metal additive manufacturing.



OBJECTIVES

On completing this course, you will be able to:

- List the main Health-Safety-Environment risks relating to the LBM process (Laser Beam Melting).
- Identify the means used to notify such risks.
- Detect the appearance of fault modes likely to generate an HSE risk.
- Cite the response means deployed in the event of a proven HSE hazard, so as to minimise or nullify its effect.
- Deploy preventive actions designed to minimise the occurrence and seriousness of such risks.
- Set up the necessary monitoring systems (key parameters, medical check-ups, monitoring of equipment, etc.)

PROGRAMME

- Description of the risks at a production unit
- Exposure risks specific to each population working at a production site
- Prevention means
- Surveillance means
- Response means

INFORMATION

Prerequisites:

- « Fundamentals of additive manufacturing »

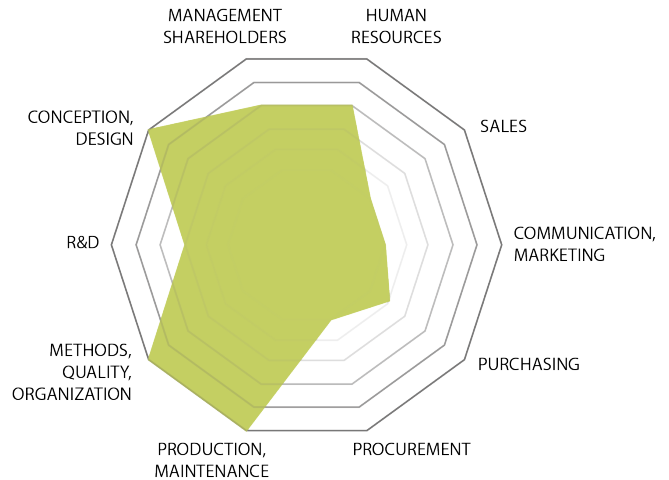
Duration: 1 day

Location: AddUp site or customer site

Number of participants: 3 to 12 persons

OPERATION & MAINTENANCE LEVEL 1

Learn how to use the machine on a day-to-day basis.



OBJECTIVES

On completing this course, you will be able to:

- Lock and tag the machine / release lock and tag on the machine.
- Run the machine safely taking account of all the related HSE risks.
- Carry out level 1 maintenance operations.
- Carry out production start-up and acceptance.
- Identify the main operating anomalies.

PROGRAMME

- Presentation of HSE risks
- The FormUp 350 machine
 - General overview
 - Presentation of the equipment
 - Practical exercises on the machine
- Maintenance of the fluid module
 - Changing fume treatment filters
 - Cleaning the fluid circuit
- Maintenance of the printing module
 - Replacing the filters
 - Cleaning the chamber

INFORMATION

Prerequisites:

- « Fundamentals of additive manufacturing »

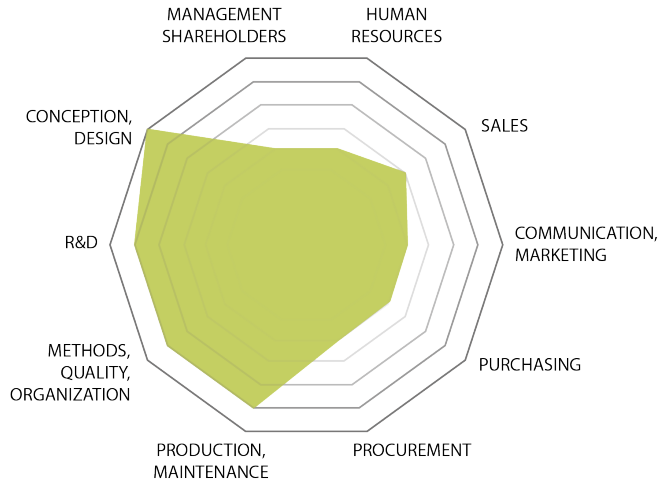
Duration: 4 to 5 days

Location: AddUp site or customer site

Number of participants: 2 to 6 persons

DESIGNING LATTICE STRUCTURES

Learn how to design the lattice structure best suited to your application.



OBJECTIVES

On completing this course, you will be able to:

- Understand the why and the how of using lattice structures.
- List the limitations relating to the use of lattice structures.

PROGRAMME

- Defining lattice structures and architected materials
- Modelling lattice structures
- Designing, simulating and sizing lattice structures according to applications and materials
- Industrial applications
 - Heat exchangers/insulation
 - Energy absorption
 - Scaffold for medical applications
 - Filters and vents
 - Other applications
- Cleaning and finishing lattice structures
- Measuring and inspecting lattice structures

INFORMATION

Prerequisites:

- It is useful to have prior knowledge of materials or metallurgy

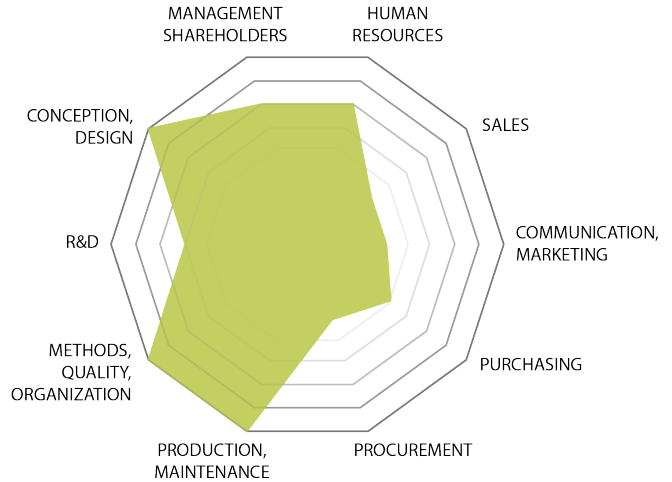
Duration: 1 to 2 days

Location: AddUp site, customer site or CTIF

Number of participants: 3 to 12 persons

OPERATION & MAINTENANCE LEVEL 2

Learn how to change materials on the machine **FormUp 350**.



OBJECTIVES

On completing this course, you will be able to:

- Change the powder in a range of configurations.
- Distinguish between which components have to be cleaned and which ones replaced in the various modules.
- Remove and refit machine subassemblies in order to clean them.

PROGRAMME

- **Cleaning the chamber**
 - Components to be changed
 - Cleaning the Z-axis head
 - Cleaning the roller assembly
 - Cleaning the double envelope
- **Cleaning the fluid module**
 - Changing the fume treatments filters
 - Piping upstream of the filters
- **Cleaning the powder module**
 - The standard powder module
 - The baby powder module
 - Racks and dosing mechanisms

INFORMATION

Prerequisites:

- « Operation & Maintenance level 1 »

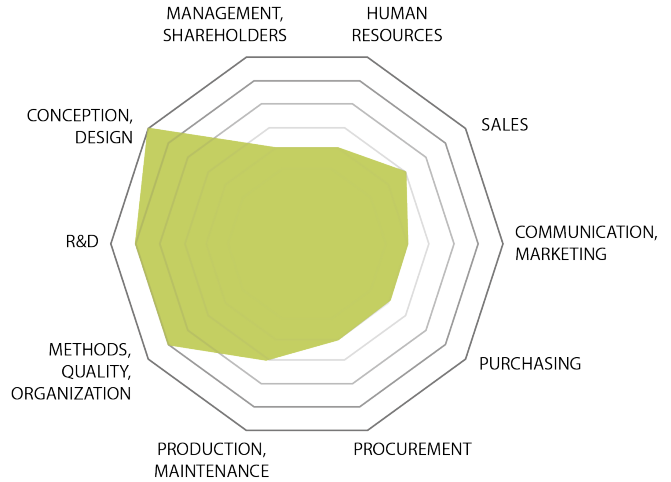
Duration: 2 weeks

Location: Addup site

Number of participants : 2 to 4 persons

TOPOLOGY OPTIMIZATION

Discover topology optimization for metal additive manufacturing, together with its theoretical and practical implementation.



OBJECTIVES

On completing this course, you will be able to:

- Optimize the weight of a given part produced by additive manufacturing.
- Explain how the various parameters affect the strength of a topology optimized part produced by additive manufacturing.

PROGRAMME

- Computation models and principles of topology optimization
- Limitations and parameters inherent to additive manufacturing
- Test specimens
- Phenomena combination
- Taking account of influential parameters from additive manufacturing up to part usage in its end environment

INFORMATION

Prerequisites:

- Use of CAD software
- It is useful to have prior knowledge of materials or metallurgy

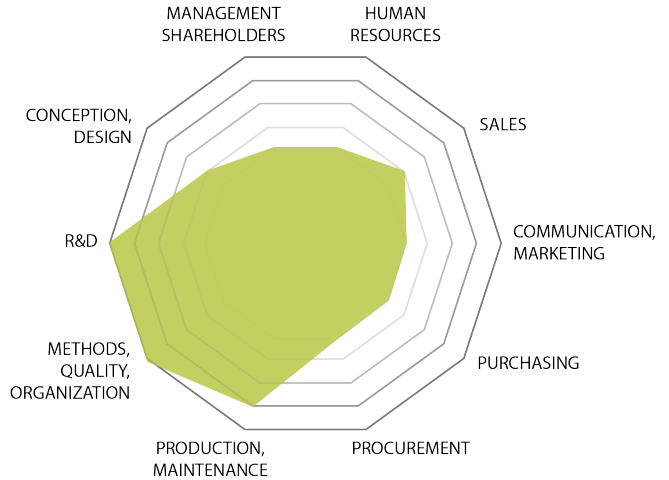
Duration: 1 day

Location: AddUp site or customer site

Number of participants: 3 to 12 persons

MANAGING THE SETTINGS FOR THE LBM PROCESS

Understand the physical phenomena observed in LBM technology and the expected end properties for a part.



OBJECTIVES

On completing this course, you will be able to:

- Recognise the main parameters affecting the LBM process and the related reaction standards.
- Define and apply a test and characterisation plan.

PROGRAMME

- The optical chain
 - General information
 - Galvanometric head
 - Setting the marking speed
- Powders
 - Layering
 - Depowdering
 - Sieving
 - Sustainability
- Fusion
 - Principles
 - Define a development plan
 - Analyse reaction standards and behaviours
 - Effects of addition components
- Post-treatments
 - Stress relief heat treatment and production of mechanical characteristics

INFORMATION

Prerequisites:

- « Fundamentals of additive manufacturing »
- It is useful to have prior knowledge of materials or metallurgy
- It is useful to have prior experience with a 3D printer

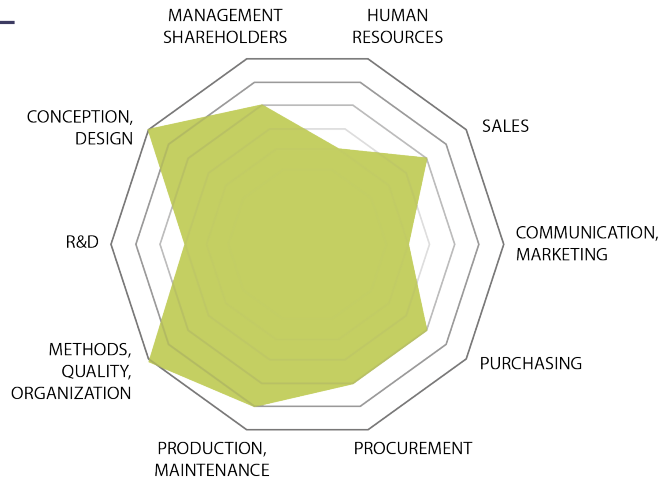
Duration: 1 day

Location: AddUp site

Number of participants: 3 to 12 persons

BECOME EXPERT IN THE LBM PROCESS

Acquire all the skills you need to ensure the success of your project using LBM technology.



OBJECTIVES

On completing this course, you will be able to:

- Master all the subtleties of Laser Beam Melting (LBM) technology.
- Ensure your project gets off to a good start through in-depth understanding of the potential of and limits to the LBM process.
- Give meaning to your project through a comprehensive understanding of the issues and challenges.
- Identify the risks relating to your specific application.

TOPICS ADDRESSED

- Operational keys to Laser Beam Melting (LBM) technology
- Subtleties, special cases and management of trade-offs
- Mastering every aspect of your project
 - Design
 - Programming
 - Manufacturing process
 - Economic aspects
- Adapting design decisions to fit your application
- Adapting manufacturing parameters to fit your application
- Identifying sources of value added for your project

INFORMATION

Prerequisites:

- Prior knowledge of the introductory level modules
- Initial experience of using an LBM machine would be useful

Duration: To be defined according to need

Location: AddUp site or customer site

Number of participants: To be defined according to need

To be followed...

DEVELOPMENT PHASE MODULES

As 3D metal printing is a fast-developing technology, our training offer may change to reflect the latest developments.

The development of new modules is therefore one of our team's key focus areas, thus ensuring that we are always ready and able to meet your needs and address your issues.

The following modules will be available as from 2019. Please don't hesitate to get in touch to request a training programme tailored to your needs.

Introductory level

- The why and how of innovating with additive manufacturing

Advanced level

- Quality assurance in metal additive manufacturing
- Change management
- Materials

Expert level

- Costings Level 2

Production automation

- Quality assurance in additive manufacturing
- Production automation
- Additive manufacturing and intellectual property

FREE TRAINING



Discover the world of industry-specific additive manufacturing.

OBJECTIVES

On completing this course, you will be able to:

- Determine the potential for transforming your industry using additive manufacturing
- List the opportunities generated by these technologies.
- Ask yourself the right questions before planning to deploy such technology.

PROGRAMME

- Introduction to additive manufacturing
- Design and development in additive manufacturing
- Mass customisation
- Industrial agility
- Environmental impacts
- Touch the unreachable
- New professions in additive manufacturing
- Additive manufacturing materials
- Arts and architecture

INFORMATION

Prerequisites: No

Duration: Approx. 2 hours

Location: By appointment
www.addup-academy.online

ADVANCED TRAINING



**Expand your knowledge
of metal additive
manufacturing.**

OBJECTIVES

On completing this course, you will be able to:

- Identify the main rules for implementing metal additive manufacturing.
- Determine major application cases of metal additive manufacturing.
- Explain how additive manufacturing can affect business organisation.
- Determine the main material selection criteria.
- Identify the practical rules for implementing the technology (particularly HSE rules)

PROGRAMME

- Materials
- Design
- Methods
- Manufacture
- Finishings and inspection
- Economic aspects
- Markets
- Organisation
- HSE
- Application of additive manufacturing at Michelin

INFORMATION

Prerequisites:

- AddUp Academy Online: Free training

Duration: approx. hours of 8

Location: By appointment

www.addup-academy.online

OUR TEAM



Toinou BLANC, Ph. D.

Toinou is an engineer with a PhD in materials and processes, specialising in metal additive manufacturing.

He started out as an additive manufacturing research engineer in 2010. He then joined a collaborative industrial project aimed at developing metal additive manufacturing technologies for key clients in the aerospace industry (Groupe Airbus, Groupe Safran, Dassault Aviation, MBDA).

Toinou joined AddUp in 2017, where he is now responsible for managing and leading metal 3D printing training modules through a range of novel approaches, targeting a wide public ranging from beginners to experienced users.



Pascal GOUMAUULT

Pascal started out in the Oil & Gas industry. From 1998 to 2003, he ran the maintenance and operations dept. for cryogenic and conventional ground systems for Ariane 4 and Ariane 5 launchers in Kourou, French Guiana. He was involved in some 47 launch campaigns.

In 2006, he joined Michelin as a Research Programme Manager for high-tech tyres for aircraft, mining trucks and agricultural machines worldwide. He was involved in the first experimental use of additive manufacturing for industrial needs in curing moulds for tyres.

Since Michelin became one of the first companies to industrialize additive manufacturing, producing over 1 million parts per year by 2014, he went on to manage the additive manufacturing programme aiming to ensure appropriate investments and push innovation.

In 2017, he joined AddUp as training & consulting manager to offer customers the benefit of his experience in this breakthrough technology.



Frédéric PARISOT

Frédéric joined AddUp in 2017 as a training engineer. This industry enthusiast has degrees in both mechanical engineering and technology journalism, a job he did for around ten years. First for the magazine Mesures, specialising in industrial machines, and then for the magazine L'Usine Nouvelle, where he reported on the latest news in production technologies, industrial organisation, professional software, and the Industrie du Futur programme, among other things.

Now in charge of developing the training offer for the "Introductory" modules, Frédéric works on making the technology accessible to the greatest number of people. He is also responsible for developing the online training offer (AddUp Academy Online).



Pierre PAYS

Pierre has been working in the metal additive manufacturing domain since 2009. Having managed the industrialisation of this technology at Michelin, he qualified the LBM process for mass production of the first curing mould strips produced entirely through additive manufacturing.

Prior to this, he was responsible for the specialised tools unit at injection moulds and stamping tools dept. He was project manager on several projects for clients across a number of industrial domains, automotive, aerospace or medical.



Nathalie PÉCOUL

Nathalie is building on twenty years of experience at major industrial groups such as Saint-Gobain and Michelin in the areas of materials development and related strategies. For two years, she led the deployment of the additive manufacturing approach for the SEB Group, with a focus on rapid tooling and the manufacture of spare parts.

Since 2018, she has been helping d'AddUp customers to identify the business impacts of this technology and the technological road blocks that need to be by-passed in order to achieve maximum benefit.



Philippe VANNEROT

Having started out as manager of industrialisation processes & methods for plastics and rubber, in 2010, Philippe discovered additive manufacturing following a trip to Germany. A short while after, he created the company 3A, specialising in electron beam additive manufacturing (EBM).

Since then he has won several awards: Best Design Award (AUGM), exhibitor award (implants trade show), Assises Européennes de la Fabrication Additive award (best development category due to its production of the first serial production of parts for the business aviation sector), Best Functional Part Award (ArcamUGM), Talent INPI and lastly the prize Enim 2015. In 2015, L'Usine Nouvelle ranked him among "the top 50 innovators in France".

Following Michelin's acquisition of 3A, Philippe joined AddUp as Senior Pre-Sales Manager, going on to join the Consulting & Training Dept. as a senior consultant, aiming to provide AddUp customers with the benefit of his vast experience of the additive manufacturing and industrialization sectors.

NOTES

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AddUp
GLOBAL ADDITIVE SOLUTIONS

