Your transformation to AM success

We enable your people
Additive Minds
Award winning team of international AM Experts

Thought leadership that puts you first

Organizations around the world are under increasing pressure to innovate faster and better than competitors. Even so, they are sometimes slow to adopt additive manufacturing (AM) because the necessary expertise is hard to find.

Additive Minds solves these problems and enables your organization to enjoy the full potential of AM by giving you all the know-how you need to outperform competitors. Our mission is to transfer the necessary expertise wherever you need it, whenever you need it. Fast.

Insights into Additive Minds projects
Your key benefits:

→ Enable your people faster and better to become the next industry champions
→ Face lack of competence in additive manufacturing in your existing organization
→ Gain competitive advantage through additive manufacturing
→ Accept economical pressure as a challenge for faster innovation

Your key challenges

How do I start?
→ Which application brings value in AM?
→ What are the possibilities and restrictions of AM?
→ What’s the impact of AM to my organization?
Target group: Executives, Engineers, Project Managers

How do I start production?
→ What is the right facility?
→ What equipment do I need?
→ How to educate employees?
→ How to optimize production?
Target group: Production Engineers, Operators, Quality Engineers

How does my future application look like?
→ How do I achieve radical innovations?
→ What are the design guidelines?
→ How to improve processes?
→ Is AM financially feasible?
→ How to leverage the full AM potential?
Target group: Design Engineers, Process Engineers, Product Engineers

How to go big?
→ What about validation?
→ How to transfer processes?
→ How do I get more efficient?
→ How can I scale my production?
Target group: Quality Engineers, Process Engineers, Executives

Certify and Scale Your Production
page 34-41

Ramp Up Your Production
page 24-33

Develop Your Application
page 14-23

Find Your Application
page 8-13

How do I start?
→ Which application brings value in AM?
→ What are the possibilities and restrictions of AM?
→ What’s the impact of AM to my organization?
Target group: Executives, Engineers, Project Managers

How do I start production?
→ What is the right facility?
→ What equipment do I need?
→ How to educate employees?
→ How to optimize production?
Target group: Production Engineers, Operators, Quality Engineers

How does my future application look like?
→ How do I achieve radical innovations?
→ What are the design guidelines?
→ How to improve processes?
→ Is AM financially feasible?
→ How to leverage the full AM potential?
Target group: Design Engineers, Process Engineers, Product Engineers

How to go big?
→ What about validation?
→ How to transfer processes?
→ How do I get more efficient?
→ How can I scale my production?
Target group: Quality Engineers, Process Engineers, Executives

Target group:
Executives, Engineers, Project Managers

Your key benefits:

→ Enable your people faster and better to become the next industry champions
→ Face lack of competence in additive manufacturing in your existing organization
→ Gain competitive advantage through additive manufacturing
→ Accept economical pressure as a challenge for faster innovation

Your key challenges

How do I start?
→ Which application brings value in AM?
→ What are the possibilities and restrictions of AM?
→ What’s the impact of AM to my organization?
Target group: Executives, Engineers, Project Managers

How do I start production?
→ What is the right facility?
→ What equipment do I need?
→ How to educate employees?
→ How to optimize production?
Target group: Production Engineers, Operators, Quality Engineers

How does my future application look like?
→ How do I achieve radical innovations?
→ What are the design guidelines?
→ How to improve processes?
→ Is AM financially feasible?
→ How to leverage the full AM potential?
Target group: Design Engineers, Process Engineers, Product Engineers

How to go big?
→ What about validation?
→ How to transfer processes?
→ How do I get more efficient?
→ How can I scale my production?
Target group: Quality Engineers, Process Engineers, Executives

Certify and Scale Your Production
page 34-41

Ramp Up Your Production
page 24-33

Develop Your Application
page 14-23

Find Your Application
page 8-13

Your key benefits:

→ Enable your people faster and better to become the next industry champions
→ Face lack of competence in additive manufacturing in your existing organization
→ Gain competitive advantage through additive manufacturing
→ Accept economical pressure as a challenge for faster innovation
<table>
<thead>
<tr>
<th>Additive Minds Portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Find Your Application</strong></td>
</tr>
<tr>
<td><strong>Develop Your Application</strong></td>
</tr>
<tr>
<td><strong>Ramp Up Your Production</strong></td>
</tr>
<tr>
<td><strong>Certify and Scale Your Production</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Services</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trainings</td>
<td>Standardized Knowledge transfer in a short time period, page 10</td>
</tr>
<tr>
<td>Consulting</td>
<td>Industrialized Project support on your specific challenges, page 11</td>
</tr>
<tr>
<td>Packages</td>
<td>Start quickly and save time entering AM Production, page 42</td>
</tr>
<tr>
<td>Academy</td>
<td>Enable your engineers with extensive hands-on educational programs</td>
</tr>
<tr>
<td>Innovation Center</td>
<td>Build your AM Technology Hub with the support of EOS know-how and expertise, page 48</td>
</tr>
</tbody>
</table>
CSP 3DD – Daimler Buses
Case-Study

Project
Comprehensive consulting on efficiently entering the world of additive manufacturing with the aim of establishing a sustainable spare parts management system.

Starting point
CSP 3DD – Daimler Buses, a subsidiary of the Daimler Group, is among the leading manufacturers in the omnibus segment worldwide. In order to continue expanding its pioneering role in times of increasing competitive pressure, CSP 3DD – Daimler Buses is pursuing two strategic aims: a sustainable increase in profitability and an enhanced capacity to innovate.

Consulting services by Additive Minds:
→ Part screening & selection
→ Agile Design development

Results
→ Identification of 2,600 suitable parts from more than 300,000 active spare parts
→ In the first project phase, 35 metal and polymer parts were manufactured
→ Development of flame-retardant polymer materials in order to comply with the strict regulations in the automotive industry
→ Reproduction through special process parameters of typical structured surface of interior parts made with injection molding
→ After only one year, the first parts were manufactured in July 2017, faster than expected

Find Your Application
Find Your Application EvoBus

Find Your Application
Training & Consulting

Training
Innovation with 3D Printing
Your fast-track to understand additive manufacturing (AM), its possibilities and limitations.

Part Screening & Selection
Know which parts of your product portfolio can be manufactured additively and create additional value for your business.

Business Case Development
Detailed analysis of all processes that are required for production of selected parts. In the end, customers gets a business case and a basis for production planning in the form of total machine hours, value streams and costs.

Dynamic Strategy Development
Understand the impact of additive manufacturing on your business and extract your strategy by simulating customized market scenarios.
Innovation with 3D Printing

Your fast track to understand additive manufacturing (AM), its possibilities and limitations.

Objectives

→ Identify and understand the key benefits of AM
→ Become the AM thought leader within your company and inspire others
→ Discover how to optimize for the AM production process by learning from best-in-class business cases
→ Unleash your creativity and find innovative AM applications
→ Analyze your value chain and see how AM can positively influence it
→ Know how to screen and select parts from your portfolio

Part 1
Introduction to additive manufacturing

→ Experiencing 3D printing
→ Getting to know the different materials, systems and technologies

Part 2
Development & production with AM

→ Freedom of design and production
→ Understanding the advantages and potentials of AM
→ Discussing case examples taken from industry

Part 3
Analyzing the value chain

→ The impact of AM on the participants’ industries, companies and competitors

Part 4
Fundamentals of the production process

→ Detailed consideration of the process chain in AM
→ How technology works

Part 5
Design for additive manufacturing

→ Introduction to the design rules for AM
→ Design Thinking method

Part 6
Component selection

→ Introduction to the methodology of component selection
→ Unit cost calculation
→ Assessing the potential
→ Technology trends and developments

Part 7
Technological implementation roadmap

→ Production planning from the idea through to manufacturing
→ Organization and team set-up
→ Employee training
→ Change management
→ Technology development

Part Screening and Selection

Know which parts of your product portfolio can be manufactured additively and create additional value for your business.

Objectives

Helping customers to find the right AM application by:

→ Providing methodology for part screening and selection
→ Gathering know-how for prioritization and categorization of parts
→ Identifying the AM benefit for customer parts and business
→ Compiling the results on an AM part scorecard
→ Rating selected parts by technical and economic objectives
→ Developing customer AM roadmap

Module 1
Introduction to additive manufacturing

→ Main influencing factors
→ Possibilities and challenges of additive manufacturing

Module 2
Methodology of part selection

→ Introduction to the methodology of part selection
→ Unit cost calculation
→ Technology outlook

Module 3
Analyzing the value chain

→ Determining the specific customer focus
→ Deriving the added value

Module 4
Part selection

→ Joint part screening
→ Assessing and classifying application fields in the EcoTec matrix

Module 5
Evaluating selected parts

→ Detailed consideration of the value chain for the application fields selected

Module 6
Principles of design for additive manufacturing

→ Basic principles of converting conventional engineering designs for additive manufacturing

Module 7
Summary and outlook

→ Summary of workshop
→ Definition of next steps

Great tool and methodology, which enabled us to select applications out of our portfolio in a structured and efficient way.
Business Case Development

Objectives

3-step approach to analyzing selected parts:
→ Comparison of different production scenarios
→ Planning criteria for serial AM part production
→ Business case for selected applications
→ Visualization of all processes needed for part production in the form of value streams, total production time and costs.

Modules

Module 1
AM data preparation
→ Data preparation and orientation for specific AM build jobs

Module 2
Evaluation of specific build scenarios
→ Evaluation of different build scenarios on selected AM machines (single-part/batch/assembly)

Module 3
Production setups
→ Configuration and selection of production setups and sensitivity analysis

Module 4
Business case analysis
→ Overall value analysis
→ ROI calculation

Module 5
Strategy implementation report
→ Revised outcome of the war game with customized recommendations for your AM journey

Dynamic Strategy Development

Objectives

Helping customers to understand the implementation of AM arising from a changing technological environment.
→ Understand the disruptive potential of additive manufacturing on your business
→ Develop a base for thorough strategic decision-making
→ Stay ahead of your competition by focusing on future market developments
→ Differentiate yourself by conceptualizing innovative business models

Modules

Module 1
Impact of additive manufacturing
→ Product innovation vs. supply chain improvement

Module 2
Disruption case study
→ Experience the disruptive potential of AM

Module 3
Strategic war game
→ Disrupt your own businesses’ value chain based on a customized war game

Module 4
Extraction of key learnings
→ Extract and prioritize your key strategic elements

Module 5
Strategy implementation report
→ Revised outcome of the war game with customized recommendations for your AM journey
Linde Case-Study

Starting point
Linde needs to build up design and manufacturing competencies for industrial 3D printing in short time. And they need to deliver quick results and present a proof of concept. Furthermore, the newly acquired know-how has to be anchored permanently in the Linde organization.

Consulting services by Additive Minds:
- AM Part Screening and Selection Workshop & Methodology Transfer
- Proof of Concept: significant optimization of an existing product (gas burner)
- Linde AM Development Center

Results
- Significant expansion of the own competitive position:
  → Better performance of the Hydropox burner
  → Ability for mass customization
  → Total cost of ownership
  → Secured IP

Competitive strategy:
- Comprehensive build-up of know-how in the fields of additive manufacturing and design within Linde.
- Internal competence to spread additive manufacturing to other business units and products

Linde AM Development Center

Develop Your Application

Training

Topology Optimization
Learn how to design combining topology optimization for additive manufacturing (AM) in a hands-on workshop.

Design for AM
Learn how to design for additive manufacturing (AM) in a hands-on workshop for metal or polymer.

Parameter Editing
Unleash the full potential of additive manufacturing by tailoring and customizing exposure strategies to make great products even better.

Lattice Structures
Using lattice structures to generate the next generation of medical implants, bionic-inspired lightweight components, etc.

Advanced Orientation and Support
Learn how to master the challenge of orientation and support for best part quality and process stability.

Consulting

Agile Application Development
Get support from AM design experts to leverage on the full potential of AM’s “freedom of design” with the goal to redesign applications or develop radical new parts.

Applied Process Optimization
Transfer parameters or create your own parameter sets for metal materials, to meet your specific part or material requirements.

Application Sprint
Develop innovative and radical applications by leveraging on the full potential of AM within a short time period.
Develop Your Application Training

Topology Optimization

Objectives
- Knowing the possibilities and limitations of AM
- Learn innovative design approaches and processes applicable to AM technology
- Learn how to apply simulation technology in order to design lightweight structures
- Learn the background and theory of design optimization
- Understand the design workflow
- Learn and apply organic design approaches to produce bionic like structures
- Learn technical and design guidelines
- Using AM design on practical exercises

Part 1
Awareness session
- Design challenges and opportunities for AM
- Optimization-driven design and use cases

Part 2
Introduction to stress analysis
- Theoretical background
- Setting up a linear static stress analysis and practical exercises

Part 3
Introduction to optimization
- Theoretical background of computational optimization
- Optimization types
- Application of topology

Part 4
Topology optimization for AM 1/2
- Common strategies
- Generation of concepts
- Practical exercises

Part 5
Topology optimization for AM 2/2
- Evaluation of concepts
- Orientation definition and manufacturing process design

Part 6
Introduction to topology re-engineering
- Organic design
- Approach to organic design
- Software
- Practical exercises optimization
- Practical exercises

Part 7
Practical session for organic design
- Apply concepts learned regarding organic design approaches

Part 8
Open lab and conclusion
- Open discussion
- QA session

Design for Additive Manufacturing

Objectives
- Knowing the possibilities and limitations of AM
- Learn how to successfully design, optimize, build and apply AM
- Discover the AM Design Thinking methodology
- Experience AM process chain with a hands-on approach
- Understanding the design workflow
- Learn technical and design guidelines
- Learn innovative designs like bionics and lightweight
- Using AM design on practical exercises

Part 1
Possibilities and limitations of AM
- Functional integration
- Mass customization
- Complexity for free

Part 2
Workflow
- Design and data processing
- Job preparation and building
- Post-processing

Part 3
Material, system and process fundamentals
- Material properties
- System set-up
- Thermal process
- Layer building
- Shrinkage and distortion
- Laser and powder interaction

Part 4
Design guidelines
- Wall thicknesses
- Gap dimensions
- Removability of powder

Part 5
Mindset AM design
- Methodology
- Way of thinking
- Case examples

Part 6
Part optimization
- Parts and job analysis
- Redesign potentials through bionic and topology optimization

Part 7
Best practices and insights into the application
- Optimized data handling
- Part quality
- Cost reduction by design

Information
Duration: 2 days
Training level: beginners and advanced
Seminar size: maximum of 8 participants
Venue: at EOS HQ
**Parameter Editing**

**Objectives**
- Enabling use of the parameter editor and understanding the cause and effects of parameter modifications
- Helping customers to help themselves by utilizing parameter editing functionalities to develop individual problem-solving strategies for challenging objects

**Part 1**
Getting started with parameter editing
- Enabling use of parameter editing functionalities, optimized to customer’s application goals (surface roughness, strength of material, stress management, etc.)

**Part 2**
Overcoming challenging objects with parameter editing
- Helping customers to help themselves by utilizing parameter editing functionalities to develop individual problem-solving strategies for challenging objects

**Lattice Structures**

**Using lattice structures to generate the next generation of medical implants, bionic-inspired lightweight components, etc.**

**Objectives**
- Analyzing the customer’s application goal
- Definition of the optimization potentials
- Selection of critical parameters for test scope
- Definition of “test scope” based on several iterations and execution of test
- Documentation of results and follow-up

**Part 1**
Possibilities and limitations of lattice structures
- Lattice design
- Cleaning methods
- Software packages

**Part 2**
Analysis of customer’s application goal
- Understand specific needs
- Highlight limitations of standard parameters

**Part 3**
Highlight lattice exposure strategies
- Parameter modification cause and effect
- Limitations and optimization opportunities
- Manufacturability
- Laser-driven design

**Part 4**
Definition of optimization potential related to selected application levers
- Build rate
- Mechanical properties
- Surface roughness

**Part 5**
Selection of critical parameters for test scope
- Lattice design
- Exposure strategies
- Cleanability
- Mechanical properties
- Manufacturability

**Part 6**
Definition of “test scope” based on several iterations and execution of test
- Lattice porosity
- Lattice roughness
- Manufacturability
- Mechanical properties

**Information**
- **Duration:** 2–4 days
- **Training level:** advanced, EOS metal system installed, Exposure Editor Training completed
- **Seminar size:** maximum of 5 participants
- **Venue:** at EOS HQ or at your site
### Advanced Orientation and Support

**Objectives**
- Know different support types in Magics
- Learn which support to use for which purpose
- Learn how to avoid job crashes
- Use a workflow to approach complicated parts
- Practice on lots of cases
- Build a job over night, do hands on post processing and evaluate it

**Modules**

#### Module 1: Laser Driven Design
- Achieve highest possible resolution
- Develop new part properties
- Reduce part weight and material consumption

#### Module 2: Agile Application Development
- Experience a fast and innovative methodology
- Think additively

#### Module 3: Topology Optimization
- Experience functional driven design
- Apply AM Design rules for the radical new design concept

#### Module 4: Biomimicry
- Apply problem solving inspirations from nature
- Transform ideas to an applicable design approach

#### Module 5: Lattice Structures
- Apply different lattice structures to any part
- Reduce part weight and material consumption

#### Module 6: Textures
- Apply any texturing to complex surfaces
- Increase visual and haptic part performance
- Reduce manufacturing complexity

#### Module 7: Functional Integration
- Observe microscopic and macro part environment and integrate parts
- Increase part performance
- Reduce manufacturing complexity

---

### Information

**Duration:** 3 days  
**Training level:** beginners and advanced with basic data preparation experience with Magics  
**Seminar size:** max. 4 participants  
**Venue:** At EOS or at your site*  
*(if an EOS M machine is available)
Applied Process Optimization

Develop your own parameter sets for metal materials to meet your specific production requirements.

Objectives

Allowing the customer to apply parameter editing strategies:

→ Understand how to transfer parameter sets between different machine types
→ Learn strategies to create new parameter sets for existing materials or new applications
→ Understand the cause and effects of parameter modification
→ Create robust processes
→ Qualify own materials

Modules

Module 1 Definition of development targets
→ Clarifies targets and scope of parameter development
→ Initial planning of complete project

Module 2 Methodology of parameter transfer
→ Shows how to transfer processes between different machine types

Module 3 Methodology of parameter development
→ Explains how to create new parameter set to meet customer-specific targets like increased productivity or special surface properties, mechanical properties, etc.

Module 4 Methodology of material development
→ Teaches tips and tricks for creating processes for new materials

Module 5 Practical examples and test jobs
→ Applies know-how to diverse test jobs to show cause and effects of different parameter modifications

Module 6 Definition of development roadmap
→ Contains the planning of the whole development cycle including test jobs
→ Evaluation procedures and validation processes

Module 7 Qualifying for serial production
→ Shows approach of how to qualify optimized parameters or own materials
→ Requalification scope due to process optimization

Module 8 Quality correlation matrix
→ Interdependencies of parameter variation and effects on different features

Module 9 Lean testing methodologies
→ Approach to optimize testing effort

Application Sprint

Develop innovative and radical applications by leveraging on the full potential of AM within a short time period.

Objectives

Supporting customers to develop radical AM applications by:

→ Providing a unique method to completely rethink your application approach
→ Developing an innovative customer- and user-centric application in a very short time
→ Transferring know-how of the AM technology and identifying the AM benefit for applications and business
→ Working iteratively to get a prototype and many iterations within a short time
→ Developing an AM roadmap to become successful with the new application concept

Modules

Module 1 Understand application “problem space”
→ Clarify relevant requirements
→ Involve different stakeholders to understand real needs and gain insights

Module 2 Sketching the idea
→ Introduction to idea sketching methodologies
→ Develop first concept of new design

Module 3 Decide
→ Determining evaluation criteria
→ Evaluate various concepts
→ Final decision of concept

Module 4 Prototype
→ Build specific design requirements
→ Build a prototype

Module 5 Feedback
→ Interview stakeholders
→ Analysis of requirement fulfillment
→ Evaluate feedback

Module 6 Summary and outlook
→ Summary of workshop
→ Definition of next steps or iterate parts of application sprint if required

Now I have a deep understanding of the parameters and how I can apply them to my process.
Ramp Up Your Production Ariane Group

Project
Production of a propulsion part for rocket engines with as few components as possible and lower unit costs. The challenge was to qualify a mission critical part for rocket launches.

Starting point
The injection head is one of the core elements of the propulsion part. Its traditional design consists of 248 components, produced and assembled in various manufacturing steps: casting, brazing, welding, and drilling. It is a time-consuming and complex process. The Ariane Group achieved a new design that integrates 122 nozzles into one part. The challenge was to calculate the optimal production setup from the right EOS system and factory layout to part orientation and post-processing.

Consulting services by Additive Minds:

Business Case Development:
→ Risk analysis
→ Cost-per-part optimization
→ Scenario analysis and total cost calculation
→ Production Planning:
→ Production layout planning & visualization
→ Production flow planning & optimization

Results
→ Cost benefit of more than ~ 60%
→ Very economic AM production setup taking into account multiple variables
→ Higher quality in comparison to casting and welding
→ Lead time reduction of ~ 80%
→ Insourcing of production

Ramp Up Your Production Training & Consulting

Consulting
Facility Layout
Define a facility layout customized to your specific process chain and production site.

Advanced Manufacturing Production and Layout Planning
Based on your process chain, we provide a detailed production and layout plan that will help you achieve the optimum output from EOS machines in a short period of time.

EOSSTATE Exposure OT and MeltPool Process Phenomena
Implementing process monitoring tools in existing QA/QC frameworks and on providing a deep understanding of the DMLS process and its possible effects on defects.

Advanced User Training
Level 1
Cross check your first AM experiences with our experts for a deeper understanding of the system, material and process.

Level 2
Expand your skills to build successful AM parts by choosing the modules you are most interested in.

EOSSTATE MeltPool Monitoring
Implement EOSSTATE MeltPool monitoring in your quality assurance chain to generate true value-add.

EOSSTATE Exposure OT (optical tomography)
Implement optical tomography in your quality assurance chain to generate true added value.

Training

Subject specific modules
Reference Point Calibration
Enable customer to carry out absolute placement of parts, using the EOS Reference Point Calibration functionality in PSW/EOSPRINT.

EOS Technical Training
New machine operators receive intense training on the safe and efficient operation of EOS polymer or metal systems.
Advanced User Training

Level 1

Objectives

→ Deepen your skills of machine set-up
→ Evaluate the cause-effect relationship of build jobs
→ Gain insight application knowledge through our AM experts
→ Broaden your knowledge of orientation, part placement and support
→ Revue your AM build experiences so far and get practical tips and techniques
→ Experience a hands-on workshop with 1 build job over night

Part 1

Advanced system handling

→ Repetition of machine set-up
" "
→ Efficient handling of EOS laser sintering systems and their peripheral components
" "
→ Improve dimensional-accuracy with fine-tuning
" "
→ Powder handling
" "
→ Only metal: Understand the dosing factor and how to adjust it properly

Part 2

Advanced data preparation

→ Match orientation with technical requirements
" "
→ Efficient and productive part placement
" "
→ Choose the right parameters/best fitting for part demands
" "
→ Advanced handling of EOSPRINT processing software
" "
→ Only metal: Broaden your skills of support structure generation e.g. cones, volume, angled support

Part 3

Basic trouble shooting

→ Learn how to find underlying causes for application problems
" "
→ Build a finetuning or customer job
" "
→ Measurement topics – dependency on process and data preparation
" "
→ Time for questions on parts you have built so far

Cross check your first AM experiences with our experts for a deeper understanding of the system, material and process.

Information

Duration: 1.5 days
Training level: Beginners and advanced, EOS metal system has been installed 4-6 before, basic training completed
Seminar size: maximum of 4 participants
Venue: at your site

Level 2

Objectives

→ Use your system more efficiently
→ Get quickly your newest part up and running
→ Discuss your AM experience with our AM Experts and get direct feedback
→ Learn the most common mistakes and techniques how to avoid them
→ Experience a hands-on workshop

Expand your skills to build successful AM parts by choosing the modules you are most interested in.

Module 1

Evaluation of existing parts

→ Bring your existing part and discuss the success and improvements with our AM Experts
→ Focus on machine and data preparation (excl. parameter)

Module 2

Troubleshooting

→ Learn about the most common mistakes in machine handling and how to avoid them
→ Get help to build challenging parts

Module 3

Support and orientation for customer specific applications

→ Understand advanced data preparation in Magics
→ Learn how to achieve better results for your requirements
→ Enable easier support removal
→ Reduce powder consumption

Module 4

Deep Dive EOS Software

→ Upgrade from EOSPRINT 1.0 to EOSPRINT 2.0, understand the new features
→ Be able to use EOSPRINT 2.0 for your application
→ Understand EOSSTATE

Module 5

Post processing for AM

→ Learn about the possibilities of post processing specific to AM
→ Understand the implications it has on building parts
→ Discuss options for post processing chains for your application

Expand your skills to build successful AM parts by choosing the modules you are most interested in.

Information

Duration: depending on the chosen modules
Training level: advanced, EOS metal system has been installed
Seminar size: maximum of 4 participants
Venue: at EOS HQ or at your site
Ramp Up Your Production Training

EOSTATE MeltPool Monitoring

Objectives
- Knowing what EOSTATE MeltPool monitoring is and how it works
- Introduction to the physics of the MeltPool, signal theory and algorithms
- Understanding the complexity of correlations between part quality, process and MeltPool data
- Awareness of evaluation job geometries, design of experiments and possible pitfalls
- Strengthening basic knowledge of about analysis and correlation. Know-how, including destructive and non-destructive test methods

Part 1
First steps
- Software set-up and calibration
- Introduction to EOSTATE MeltPool online software

Part 2
Analysis Toolbox
Expert Training day 1
- Introduction, revision
- Algorithms, theory
- First steps
- General parameters and settings

Part 3
Analysis Toolbox
Expert Training day 2
- Visualizations
- Analysis parameters
- Indications
- 3D visualization
- Extra features

Implement EOSTATE MeltPool monitoring in your quality assurance chain to generate true value-add.

Information
Duration: 2–3 days
Training level: advanced, EOS metal system installed, Exposure Editor Training completed
Seminar size: maximum of 4 participants
Venue: at EOS HQ or at your site

Content

EOSTATE Exposure OT

Objectives
- Knowing what EOSTATE Exposure OT is and how it works
- Introduction to the physics of the process, detection mechanisms and analysis methods
- Holistic understanding of usage of the OT client
- Awareness of evaluation job geometries, design of experiments and possible pitfalls
- Strengthening basic knowledge of analysis and correlation. Know-how, including introduction to common destructive and non-destructive test methods

Part 1
First steps
- Software set-up and calibration
- Introduction to EOSTATE Exposure OT

Part 2
Analysis Toolbox
Expert Training day 1
- Introduction, revision
- Process basics, measurement set-up
- Algorithms
- First steps

Part 3
Analysis Toolbox
Expert Training day 2
- Visualizations
- Analysis parameters
- Indications
- 3D visualization
- Extra features

Implement optical tomography in your quality assurance chain to generate true added value.

Information
Duration: 2–3 days
Training level: advanced, EOS metal system installed, Exposure Editor Training completed
Seminar size: maximum of 4 participants
Venue: at EOS HQ or at your site

Content
Facility Layout

Objectives

Define a facility layout:
- 2D and 3D (VR) facility layout
- Project coordination by an Additive Minds expert
- Customized AM system-related production setup
- Facility layout of AM production and AM-related premises
- Health and safety risk assessment

Module 1
Factory layout planning
- 2D, 3D (VR) layout planning
- Project coordination
- Argon, nitrogen setup
- Radiator setup
- Fire protection
- Transport
- Escape route

Module 2
Facilities
- Doors, room size, etc.
- Separation of polymer and metal area
- Contamination prevention
- Flooring
- Disposal and exhaust

Module 3
AM-related facilities
- Microscopy
- Metallography
- Office space
- Powder warehouse
- Powder handling
- Heat treatment

Module 4
Housing technology
- Air-conditioning
- Energy supply
- Compressed air
- Network technology

Module 5
Health and safety
- Risk assessment
- Operating instructions
- Safety at work

Additive Manufacturing Production Layout Planning

Objectives
Based on your manufacturing process, Additive Minds provides a Production Layout Plan that will help you achieve the optimum output from EOS machines as a part of your production facility in a short period of time.

Module 1
Process planning
- Business Case Analysis
- Define Key Performance Indicators
- Value Stream Mapping
- Production Costs - Various Scenarios

Module 2
Concept layout
- Production Costs Scenario Comparisons
- Area Feasibility Calculations
- Concept 2D & 3D Production Layout - Various Scenarios
- Updating the Business Case

Module 3
Detailed layout
- Production Layout Scenario Assessment & Decision
- Detailed 2D & 3D Production Layout
- Production Walk-through Video & VR Possibilities
- Updating the Business Case
Ramp Up Your Production Consulting

**EOSSTATE**

**Exposure OT and MeltPool Process Phenomena**

**Objectives**

- Awareness of critical process variables and their influence on part quality
- Deep dive into process physics, measurement devices and analysis algorithms
- Insight into correlation methodologies and approaches for different industry demands
- Advanced DOE setups
- Alternative analysis and visualization strategies

**Implementing process monitoring tools in existing QA/QC frameworks and providing a deep understanding of the DMLS process and its possible effects on defects.**

<table>
<thead>
<tr>
<th>Modules</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Module 1</strong> Revision of MPM/OT hardware/software setup</td>
</tr>
<tr>
<td><strong>Module 3</strong> Correlation methodologies</td>
</tr>
<tr>
<td><strong>Module 2</strong> Process Variables and their influences</td>
</tr>
<tr>
<td><strong>Module 4</strong> Deep-dive process phenomena</td>
</tr>
<tr>
<td><strong>Module 5</strong> NDT/DT method, norms and standards</td>
</tr>
<tr>
<td><strong>Module 6</strong> Application specific process optimization</td>
</tr>
</tbody>
</table>

**Reference Point Calibration**

**Enable customer to carry out absolute placement of parts, using the EOS Reference Point Calibration functionality in PSW/EOSPRINT.**

**Customer Objectives**

- Introduction into Reference Point Calibration functionality including practical exercises
- Overview of "best practice" cases
- Analysis of customer’s production set-up
  - Infrastructure (machine equipment, measurement devices)
  - Resources, workflows
  - Status of data preparation workflows (AM related + "neighbour" technologies used at customer)
- Analysis of concrete customer application case(s)
- Analysis of current know-how status in customer production organization
- Recommendation on how to integrate AM solution into existing production processes

We also offer machine trainings to all our metal and polymer systems:

<table>
<thead>
<tr>
<th><strong>EOS Technical Training</strong></th>
</tr>
</thead>
</table>

**New machine operators receive intense training on the safe and efficient operation of EOS polymer or metal systems.**

**Customer Objectives**

- Work safety instructions
- Laser-Sintering process basics
- Data preparation
- Operation of machine and peripherals
- Daily system care
- Handling and refreshment of EOS laser-sintering materials
- Check and adjustment of machine settings
Certify & Scale Your Production

Permedica Case-Study

Project
Fast-track development of a new hip cup system with a highly porous titanium structure to promote new bone formation and fast osseointegration. In this project, Additive Minds lead the team from start to serial production with a special focus on quality as well as the production setup and the qualification process.

Starting point
The Italian manufacturer of implantable medical devices wanted to enter additive manufacturing and build up know-how within the organization. The task was to develop a state of the art hip cup system and lead the company through validation of the equipment and the process. From start on, the project was intended in order to acquire know-how in industrial metal 3D printing.

Consulting services by Additive Minds:
- Business Case Development
- Design for AM
- Lattice Structures Consulting
- Applied Process Consulting
- 360° Assessment
- Organizational Qualification (OQ)
- Production Qualification (PQ)

Results
- New technology know-how implemented in the company
- Fast validation of the equipment and the process
- Increased market share
- Successful transfer of knowledge to other implantable products (shoulder replacement and custom-made implants)

Certify & Scale Your Production

Operational Qualification Support (OQ)
Implementation and validation of robust processes according to legal requirements to ensure stable production.

Performance Qualification Support (PQ)
Detailed evidence that equipment and processes are working well within the defined ranges and specific parts under condition of serial production.

Additive Manufacturing Quality Program (AMQ)
The AMQ program prepares you to implement best-in-class practices for additive manufacturing (AM) on top of a previous installed quality management system to be prepared for high demand expectations.

360° Assessment
Analysis of the entire AM process chain from powder handling through part building, post-processing and quality testing. Not only does this 360° assessment optimize the elements of the process chain, but also we support benchmarking the entire chain with our best-practice solutions.

Supplier Ramp up
The Supplier ramp-up program offers a holistic approach for OEM’s to select and ramp up their AM supplier using the extensive experience of Additive Minds.

Additive Minds Certified Trainer – Licensing Program
The Additive Minds Certified Trainer – Licensing Program, allows you to offer best-in-class Trainings in the field of additive manufacturing to your clients. Gain the necessary know-how within a short time period and get access to all needed material and our online platform.

The Jump System Tracer® Cup with different inserts. The inner surface is post-processed by milling and polishing.

Highly porous trabecular network characterized by fully interconnected irregular pores in a process that have high strength.
### Operational Qualification Support

**Objectives**
Giving the customer a shorter time to market in the qualification of his production through:

- Fixing the AM production process
- Preliminary PFMEA
- Preliminary work instructions and checklists
- Definition of critical process variables, including documentation and in-depth understanding of challenging strategies
- Comfort zone definition and quality control objectives

**Implementation and validation of robust processes according to legal requirements to ensure stable production.**

**Modules**

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Initial assessment and project planning</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Analysis of situation at site</td>
</tr>
<tr>
<td></td>
<td>Gap report</td>
</tr>
<tr>
<td></td>
<td>Project definition and project planning</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 2</th>
<th>Risk management</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Validation master plan</td>
</tr>
<tr>
<td></td>
<td>Risk evaluation</td>
</tr>
<tr>
<td></td>
<td>Risk assessment and mitigations</td>
</tr>
<tr>
<td></td>
<td>Creation of Control Plan</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 3</th>
<th>Document implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Creation of documents</td>
</tr>
<tr>
<td></td>
<td>Customizing of documents</td>
</tr>
<tr>
<td></td>
<td>Implementation of mitigation actions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 4</th>
<th>Process Qualification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operational Qualification (OQ) test</td>
</tr>
<tr>
<td></td>
<td>Process capability analyst</td>
</tr>
<tr>
<td></td>
<td>OQ test report</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 5</th>
<th>Validation and project closure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Validation master report</td>
</tr>
<tr>
<td></td>
<td>Project closure</td>
</tr>
</tbody>
</table>

### Performance Qualification Support

**Objectives**
Giving the customer a shorter time to market in the qualification of his production through:

- Actual product and process parameters and procedures established in OQ
- Acceptability of the product
- Development of equivalent test coupons
- Assurance of process capability as established in OQ
- Process repeatability, long-term process stability

**Detailed evidence that equipment and processes are working well within the defined ranges and specific parts under condition of serial production.**

**Modules**

<table>
<thead>
<tr>
<th>Module 1</th>
<th>Set-up production run</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Part orientation</td>
</tr>
<tr>
<td></td>
<td>Part location</td>
</tr>
<tr>
<td></td>
<td>Definition of minimum and maximum build jobs and production run</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 2</th>
<th>Test coupons, strategy and SPC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Development of test coupons</td>
</tr>
<tr>
<td></td>
<td>Development of test strategy</td>
</tr>
<tr>
<td></td>
<td>Development of SPC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 3</th>
<th>Performance Qualification (PQ) test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PQ test plan</td>
</tr>
<tr>
<td></td>
<td>Execution of PQ test</td>
</tr>
<tr>
<td></td>
<td>PQ test report</td>
</tr>
</tbody>
</table>

"EOS has met all my expectations. From installation to validation, EOS has held my hand every step of the way. I feel comfortable going to production with this equipment."
Additive Manufacturing Quality Program

The AMQ program prepares you to implement best-in-class practices for additive manufacturing (AM) on top of a previous installed quality management system to be prepared for high demand expectations.

Objectives
Supporting customers to certificate their additive manufacturing processes:
→ Identify the matching norm
→ Analyse the additive manufacturing (AM) processes
→ Identify gaps to the matching norm
→ Compare to best-practice solutions
→ Create a plan of implementation

The AMQ project helped us to set up a total quality management and business process system which contains the AMQ standards. My company will keep on moving to be an expert in industrial 3D printing.

Possible types of certification:
AMQ: Industry norm ISO 9001 required
AMQ+ Aerospace: ISO 9001+ Industry norm ISO 9100 required
AMQ+ Medical: ISO 9001+ Industry norm SAE 13485 required
AMQ+ Automotive: ISO 9001+ Industry norm IATF 16949 required

Objectives
Supporting customers to certificate their additive manufacturing processes:
→ Identify the matching norm
→ Analyse the additive manufacturing (AM) processes
→ Identify gaps to the matching norm
→ Compare to best-practice solutions
→ Create a plan of implementation

The Supplier ramp up program offers a holistic approach for OEM’s to select and ramp-up their AM Supplier using the extensive experience of Additive Minds.

Objectives
→ Get your individual “cook book” to easily source for multiple suppliers and ensure a comparable level of quality and deliverables according to your functional specification and URS.
→ Get a head start once you decide to in-source your production, thanks to your holistic enablement.
→ Make use of EOS know-how in product development, process development and qualification/validation
→ Increase your and your service providers success.

Part 1
Initial assessment
→ Identify the customer needs and know-how gaps through an thorough assessment

Part 2
Project Execution
→ Application Development through re-design and process development
→ Generate the supplier cook book which the supplier needs to fulfill

Part 3
Supplier Cook Book
→ Generate an AM application specification to minimize ambiguity
→ Generate Quality Control requirements
→ Generate a suggested process flow

Deliverables
→ Kick off meeting at customer site
→ Decision on type of certification
→ Assessment of customer’s AM processes
→ Evaluation of gaps between AM processes and norm
→ Identification of possibilities to close the gaps
→ Creation of final report

→ Get your individual “cook book” to easily source for multiple suppliers and ensure a comparable level of quality and deliverables according to your functional specification and URS.
→ Get a head start once you decide to in-source your production, thanks to your holistic enablement.
→ Make use of EOS know-how in product development, process development and qualification/validation
→ Increase your and your service providers success.

The Supplier ramp up program offers a holistic approach for OEM’s to select and ramp-up their AM Supplier using the extensive experience of Additive Minds.

Part 1
Initial assessment
→ Identify the customer needs and know-how gaps through an thorough assessment

Part 2
Project Execution
→ Application Development through re-design and process development
→ Generate the supplier cook book which the supplier needs to fulfill

Part 3
Supplier Cook Book
→ Generate an AM application specification to minimize ambiguity
→ Generate Quality Control requirements
→ Generate a suggested process flow
Additive Minds Certified Trainer – Licensing Program

Objectives
→ Offer best in class AM trainings from the market leader to your clients
→ Become a certified “Additive Minds Certified Trainer”
→ Ramp up your AM Know-how with a defined and proven Train-the-Trainer process
→ Gain access to state-of-the-art training material and get constant updates
→ Use the Additive Minds visuals for marketing purposes

The Additive Minds Certified Trainer – Licensing Program, allows you to offer best-in-class Trainings in the field of Additive manufacturing to your clients. Gain the necessary know-how within a short time period and get access to all needed material and our online platform.

Module 1
Intro into AM (Innovation with 3D Printing)
→ Key benefit of AM
→ Become a AM thought leader
→ Optimize for AM production
→ Unleash your creativity

Module 2
Design for AM (Metal/Polymer)
→ Understanding the design workflow
→ Learn technical and design guidelines
→ Learn innovative designs like bionics and lightweight
→ Using AM design on practical exercises

Module 3
Application Sprint
→ Design thinking for AM
→ Deep understanding for an AM design concept for the part
→ Develop ideas for AM transformation
→ Holistic design evaluation
→ Specifications for future design

Module 4
Orientation and Support Structures
→ Advanced lessons in generating and manipulating supports
→ Understanding and editing support parameters
→ Best practices for orienting a part

Module 5
Exposure strategy
→ Basic understanding exposure strategy principles
→ Overview about the different exposure strategies and parameters
→ Best practices to calculate energy input

360° Assessment

Objectives
Helping customers to optimize their production
→ Identify the production targets
→ Understand the entire value stream
→ Define KPIs
→ Compare to best-practice solutions
→ Identify potential for improvement
→ Create a plan of implementation

Module 1
360° assessment of the entire process chain
→ Kick off meeting at customer site including target definition
→ Definition of target-relevant key performance indicators (KPI)
→ Assessment of the customer’s entire process chain

Module 2
Analysis of strength and weakness in customer’s process chain and compare with best practice
→ Evaluation of customer’s defined KPIs
→ Comparison of entire process chain and KPIs
→ Identification of possibilities for improvement

Module 3
Define key improvement actions and decide with team on prioritization and responsibilities
→ Finalization of implementation plan, including timeline, prioritization and responsibilities with team
→ Initiation of quick wins together with team
→ Presentation of final report to management

The 360° improvement program increased my overall productivity and part quality, which results in customer enthusiasm and production cost reduction.
Consulting Packages

Choose one of our packages to start your AM journey more quickly and use our expertise instead of developing by conventional "trial & error" system (with a mix of training and consulting offerings):

AM Starter Package

AM Sprinter Package

AM Runner Package

AM Starter

Package for a quick proof of concept

Your requirements

→ Check the potential of AM for your organization
→ Support developing your first AM application concept
→ Low investment risk prior to purchase of a system

Our offering

→ Transfer of AM know-how
→ Part selection: identification of a suitable application
→ Development of an application concept
→ Design support
→ Preparation of your business case, incl. calculation of costs & evaluation of value added

+ Your first application built on an EOS system at the EOS technology center

Benefits

→ You are "ready-to-develop"
→ Effective risk reduction thanks to technical & economic proof of concept
→ Special discounted package price

Time saving: 3 months\textsuperscript{*}

\textsuperscript{*}compared to conventional "trial & error" development
**AM Sprinter**

Package for building an application on your own system

**Your requirements**
- Speed up your AM journey with first system purchase
- Development of AM expertise
- Accelerated production of first application on own system

**Our offering**
- Transfer of AM know-how
- Part selection: identification of a suitable application
- Development of an application concept
- Design support
- Preparation of your business case, incl. calculation of costs & evaluation of value added

+ EOS support building application
+ Your first application built on your own EOS system

**Benefits**
- You are “ready-to-produce”
- Accelerated AM entry
- Special conditions with purchase of EOS system

**Time saving: 6 months**

**AM Runner**

Package for complete support until final part production

**Your requirements**
- Quick realization of identified application
- Get ahead of the competition
- Qualify & ramp up your AM production

**Our offering**
- Transfer of AM know-how
- Part selection: identification of a suitable application
- Development of an application concept
- Design support
- Preparation of your business case, incl. calculation of costs & evaluation of value added

- Full support building and developing an application on your own system
- Optimization of build job & parameters
- Industry-specific qualification support: set-up and qualification of process chain for part delivery & reduction of production risks

**Benefits**
- You are “ready-to-print”
- Optimized final application
- Comprehensive support until final part delivery
- Special conditions with purchase of EOS system

**Time saving: 10 months**

*compared to conventional trial & error development*
Before the introduction of our Additive Minds Academy most engineers learned AM the old fashioned way, through trial and error. This method is expensive, time consuming, and no longer necessary.

Our three programs – AM Engineer, AM Development Expert and AM Manager – build specific technological and economical skills in a structured, time-efficient manner. They can also be combined to match individual profiles and roles of employees.

**AM Academy**

**AM Engineer**
- Main learning steps:
  - AM Process
  - Additive Thinking
  - AM Benefits & Opportunities
  - Design for AM
  - Support and Orientation
  - DMLS Laser Scan Strategies
  - Part Screening and Selection
- 2 weeks at EOS

**AM Development Expert**
- Main learning steps:
  - Metallurgy
  - Parameters
  - Material Properties
  - House of Quality
  - Advanced AM Design
  - Post-Processing
- 2 weeks at EOS

**AM Manager**
- Main learning steps:
  - Cross Functional Implementation
  - Business Cases & Models
  - Internal Value Chain
- 2 weeks at SRH Berlin

---

**EOS Headquarter Krailling near Munich**
- More than 200 specialists for industrial 3D printing on site
- Courses are run by experienced application specialists and consultants
- Dedicated pool of systems to guarantee a lot of hands-on training
- AM Design and Technology Enabler

**SRH Hochschule Berlin**
- Location in Berlin with students from 60 nations
- Focus on International Business Administration & International Management
- Top Ranking for International Orientation
- More than 60 partner Universities worldwide
- AM Implementation Enabler

**University of Wolverhampton**
- Offers over 500 courses through its 18 schools and institutes
- EOS Partner for over 14 years with deep know-how in AM technology & research
- Focus on Industrial Applied Research for broad customer base (e.g., Formula 1 Teams)
- Graduate employment rate of over 95%
- AM Technology Enabler

---

**Engineers; Quality/ Measurement Engineers**

---

**Teammanager, Change Agent, Sales**
At EOS Innovation Centers, we address the challenges of your company:

→ Your workforce has difficulties in understanding additive manufacturing technology, processes, limitations, and possibilities

→ Your existing in AM is limited and the learning curves of application engineers are difficult to predict

→ Your perceive a possible investment risk due to an unknown productivity curve in the first years with new applications

→ You are missing knowledge and methodologies in developing AM applications and optimizing the entire AM process chain

→ Your AM resources were merely used in R&D, which is not fully production- and supply-chain-orientated

Concentrate all your AM projects in one place

With 7 global EOS Innovation Centers, we support you where ever you are, whenever you need it

Benefit from intense enablement to develop and produce serial parts with additive manufacturing. In seven EOS facilities we offer you the closest possible access to our expertise throughout the whole project. You can train your workforce and prepare your organization to achieve faster success with additive manufacturing.

Visit your regional EOS Innovation Center and get inspired:

amc@eos.info
Would you like to establish your own Innovation Lab?

We support you in:

→ Developing the Business Case for your Innovation Lab
→ Planning the Lab configuration out of a set of pre-defined modules
→ Adapting the necessary auxiliary installations and equipment, and optimizing the Facility Layout
→ Identifying customer’s most promising applications
→ Developing innovative products and application improvements
→ Designing customer specific processes, driving optimization along the entire process chain
→ Transferring knowhow to your own and your customer’s engineers in customized courses and workshops
→ Enabling your trainers to carry out AdditiveMinds certified training courses

EOS Innovation Center Düsseldorf offers dedicated customer areas and shared spaces:

→ EOS Showroom M (with M-290)
→ EOS Showroom P (with P-396)
→ Specific Customer Areas with room for your own system
→ Specific powder handling areas
→ Machine shop and quality lab
→ Specific powder handling areas
→ Training room and office