Manufacturing Processes: Machining, Forming, Casting and Additive Manufacturing

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Amsterdam - Zuidas business district hotel



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Introduction:

Manufacturing processes chosen by habit rather than evidence leave plants with parts that are costly to machine, castings that need rework, tolerances no process can hold and additive builds that never pay back. This Core Concept course gives engineers a practical method to compare machining, forming, casting, moulding, joining and additive manufacturing routes on cost, volume and quality, to redesign parts for manufacture and assembly, and to prove the chosen route with measurement and capability data. Participants build a Process Selection and DFM Review Pack for a part from their own product range.

Course Objectives:

- Classify a part's candidate manufacturing routes across shaping, material removal, joining and additive process families
- Specify turning, milling and drilling operations, CNC setups, tolerances and surface finish that a machining cell can hold
- Choose between forging, rolling, sheet metal forming, sand, investment and die casting and plastic injection moulding for a given geometry and batch size
- Select metal and polymer additive manufacturing processes and judge where a printed part beats a conventional route
- Apply DFM and DFA rules to cut part count, setups and tolerance cost before design release
- Verify a production route with inspection plans, gauge checks and Cp and Cpk capability studies

Target Audience:

- Manufacturing engineering staff who define process routes, tooling and work instructions for new parts
- Product design engineering staff who release drawings, tolerances and material callouts to production
- Production engineering staff who run machining, press, foundry or moulding cells and resolve process problems
- Quality engineering staff who plan first-article inspection, measurement and capability studies
- Industrialisation and new product introduction staff who move parts from prototype to volume supply
- Supplier development engineering staff who assess whether vendors can make a part to drawing

Course Outline:

Day 1: Manufacturing Process Families and Route Assessment

- Process Family Map: Casting, Forming, Material Removal, Joining and Additive Routes
- Shape Complexity, Material Form and Batch Size as Route Selection Drivers
- Drawing Review for Manufacture: Datums, Critical Features and Material Callouts
- Cost Structure of a Part: Material, Tooling, Cycle Time and Setup Cost
- Current Route Assessment Sheet for an Existing Product Part

Day 2: Machining, CNC Setups, Tolerances and Surface Finish

- Turning, Milling and Drilling Operations: Cutting Speed, Feed and Depth of Cut
- CNC Machine Axes, Work Coordinates, G-Code Structure and CAM Toolpaths
- Workholding, Fixturing and Setup Reduction to Limit Part Flips
- Tolerance Grades, Limits and Fits and the Cost of Tight Tolerances
- Surface Roughness Parameters Ra and Rz and the Machining Routes That Achieve Them

Day 3: Forming, Casting and Injection Moulding Routes

- Open-Die and Closed-Die Forging: Grain Flow, Draft and Flash Allowance
- Hot and Cold Rolling, Sheet Metal Blanking, Bending and Deep Drawing Limits
- Sand Casting and Investment Casting: Patterns, Gating, Shrinkage and Machining Allowance
- High-Pressure Die Casting Cycle, Porosity Control and Tool Life Economics
- Plastic Injection Moulding: Wall Thickness, Draft, Gate Location and Sink Marks

Day 4: Joining Choices, Additive Manufacturing and DFM/DFA

- Joining Method Comparison: Mechanical Fastening, Adhesive Bonding, Brazing and Welding Routes
- ISO/ASTM 52900 Categories: Powder Bed Fusion, Directed Energy Deposition and Binder Jetting for Metals
- Polymer Additive Routes: Material Extrusion, Vat Photopolymerization and Material Jetting
- Build Orientation, Support Structures and Post-Processing Cost in Additive Parts
- DFM and DFA Analysis: Part Count Reduction, Self-Locating Features and Tolerance Relaxation

Day 5: Metrology, Process Capability and the Process Selection Pack Build

- Inspection Plan and Gauge Selection: Calipers, Micrometers, CMM and Surface Profilometer
- Cp and Cpk Capability Study Build from Sample Measurement Data
- Process FMEA and SPC Control Chart Set for the Chosen Route
- Route Cost Comparison Model: Break-Even Volume Between Machining, Casting and Additive
- Process Selection and DFM Review Pack Assembly and Peer Challenge

Skills You Will Gain:

- Manufacturing Route Selection
- CNC Machining Specification
- Tolerance and Surface Finish Specification
- Forming and Casting Route Evaluation
- Additive Manufacturing Application Assessment
- Design for Manufacture and Assembly
- Dimensional Inspection Planning
- Process Capability Analysis

Why Attend This Course:

- Return with a Process Selection and DFM Review Pack for a real part, with a costed route comparison and capability evidence
- Challenge drawing tolerances and material callouts that add cost without adding function, using figures production accepts
- Decide with data when additive manufacturing, casting or machining is the cheaper route at your actual volumes
- Compare process practice with engineers from automotive, oil and gas equipment, consumer products and industrial machinery plants

Conclusion:

A part is only as economical as the manufacturing route chosen for it and the capability data that proves the route holds its tolerances. The course moves from process families and route drivers, through machining, forming, casting and moulding, to joining, additive manufacturing and DFM/DFA redesign, then to inspection planning, capability studies and cost comparison. Participants leave with a Process Selection and DFM Review Pack ready for their next design review or new product introduction gate.