



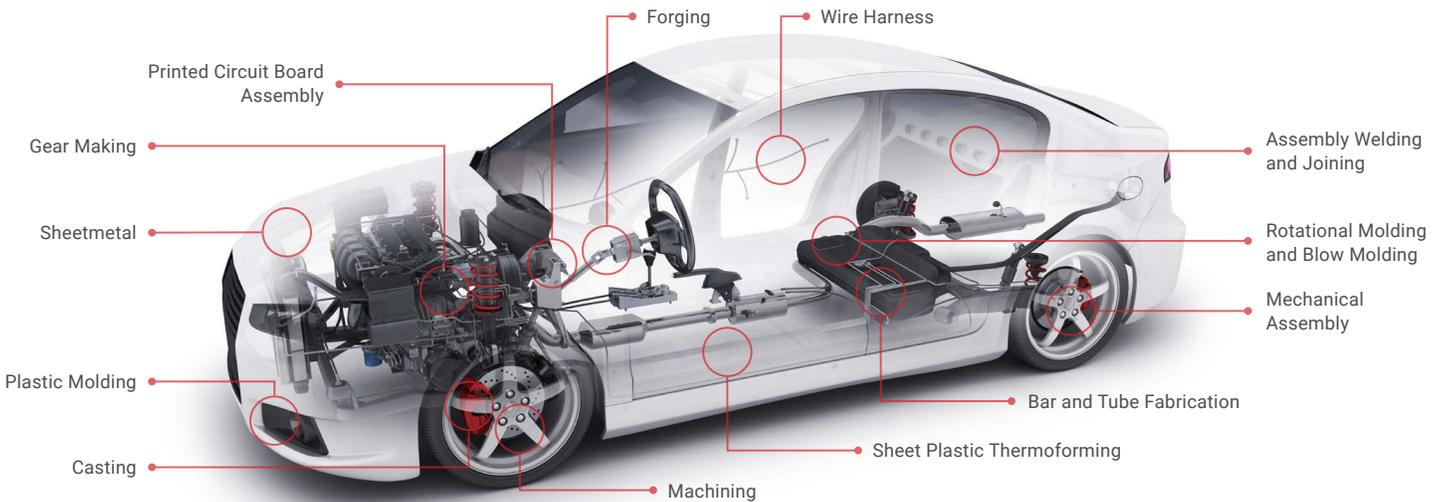
# Manufacturing Process Models for Automotive

## Physics-Based Process Models



### Overview

aPriori's Manufacturing Process Models simulate manufacturing processes and deterministic routings to optimize production based on cost, sustainability, and manufacturability requirements. Our physics-based manufacturing process models allow engineering, manufacturing, and purchasing professionals to explore production alternatives down to the machine level. Use aPriori to unlock insights during early design stages to accelerate time-to-market and address market needs rapidly.



Manufacturing Process Group	Supported Sub Processes and Operations	Automotive Application and Example Components
 <p>Sheetmetal</p>	<ul style="list-style-type: none"><li>• Soft Tooled Process</li><li>• Basic Stamping</li><li>• Progressive Die Stamping</li><li>• Transfer Die Stamping</li></ul>	<p>Pre-Production Builds or Small Production Volumes for Body Structures, Chassis Components, and Associated Brackets</p> <p>Small Components, Brackets, Internal to Larger Assemblies, or Unique to Certain Model Variants</p> <p>Smaller Stampings, Brackets, Inserts, Clips, Fasteners, many Small Structural Reinforcements, Seat Structure, Nut Plates, Electronic Components</p> <p>Large Stampings - Body Side, Hood, Door Panel, Floor Pan</p>

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<p>Bar and Tube Fabrication</p> 	<ul style="list-style-type: none"> <li>• Bar Forming</li> <li>• Expansion</li> <li>• Flanging</li> <li>• Flaring</li> <li>• Flattening</li> <li>• Knurling</li> <li>• Notching</li> <li>• Reduction</li> <li>• Slotting</li> </ul>	<p>Brake Lines, Fuel Lines, Structural Tubing</p>
<p>Aluminum Extrusion Fabrication</p> 	<ul style="list-style-type: none"> <li>• Die and Billet Preheating</li> <li>• Release Agent Application</li> <li>• Cooling</li> <li>• Rough Cutoff</li> <li>• Straightening</li> <li>• Racking</li> <li>• Aging</li> <li>• Secondary Material Removal</li> </ul>	<p>Engine cover, fuel distribution pipe, radiator beam, engine mount, turbo air intake, longitudinal beam, running board, dashboard beam, strut brace, anti-intrusion beams, roof console, roof rail, tailgate frame, seat backrest, seat tracks, airbag housing, toe link, under body space frame.</p>
<p>Casting</p> 	<ul style="list-style-type: none"> <li>• Sand Casting</li> <li>• High Pressure Die Casting</li> <li>• Gravity Die Casting</li> <li>• Permanent Mold</li> <li>• Investment Casting</li> </ul>	<p>Engine Mounts, Shock Tower, Engine Components, Radiator Supports, Hand-off Brackets</p>
<p>Plastic Molding</p> 	<ul style="list-style-type: none"> <li>• Single Shot Injection Molding</li> <li>• Over-Molding</li> <li>• Insert Molding</li> <li>• Structural Foam Molding</li> <li>• Reaction Injection Molding</li> <li>• Rubber Molding (Small Plugs for Body Holes, Grommets, O-Rings, Seals)*</li> </ul>	<p>Interior &amp; Exterior Class A Components (with or without paint), Door Handles, Badging, Buttons, etc.</p>
<p>Rotational Molding and Blow Molding</p> 	<ul style="list-style-type: none"> <li>• Extrusion Blow Molding</li> <li>• Material Grinding/Pulverizing</li> <li>• Trimming/Routing</li> </ul>	<p>Gas Tanks, Ducting/Ventilation</p>
<p>Sheet Plastic Thermoforming</p> 	<ul style="list-style-type: none"> <li>• Vacuum Forming</li> <li>• Drape Molding</li> </ul>	<p>Head Liner Reinforcements, Bedliners, Cargo Mats, Interior Panels</p>
<p>Forging</p> 	<ul style="list-style-type: none"> <li>• Closed Die Hammer Forging</li> <li>• Ring Rolled Forging</li> </ul>	<p>Steering Arms, Gears, Drive Components</p>

Manufacturing Process Group	Supported Sub Processes and Operations	Automotive Application and Example Components
<p><b>Machining:</b> General Milling</p> 	<ul style="list-style-type: none"> <li>• 3-4-5 Axis CNC Milling</li> <li>• Sawing/Cut-to-Length</li> <li>• Gun Drilling</li> <li>• Wire EDM</li> <li>• Drill Press</li> <li>• Deburring</li> <li>• Jig Boring</li> <li>• Assembly Milling (User-Guided)</li> </ul>	
<p><b>Machining:</b> General Turning</p> 	<ul style="list-style-type: none"> <li>• 2-3-Axis CNC Conventional Lathes</li> <li>• 2-3-axis Bar Feed lathes</li> <li>• Mill-Turn</li> <li>• Deep Bore/Trepanning</li> <li>• Lathe Finishing</li> <li>• Lathe Roughing (on castings)</li> <li>• Single Point Threading</li> <li>• Single Plunge Grooving</li> <li>• Multi-Plunge Grooving</li> </ul>	<p>Engine and Drive Train Components, EV Battery Components, Tooling for Body Shop and General Assembly, Fixtures, Robot end Effectors</p>
<p><b>Machining:</b> General Grinding</p> 	<ul style="list-style-type: none"> <li>• OD Grinding</li> <li>• ID Grinding</li> <li>• Surface Grinding</li> <li>• Rotor Grinding</li> <li>• Jig Grinding</li> <li>• Cylindrical Grinding</li> </ul>	
<p><b>Gear Making</b></p> 	<ul style="list-style-type: none"> <li>• Hobbing</li> <li>• Shaping</li> <li>• Broaching</li> <li>• Rolling</li> <li>• Bevel Gear Cutting</li> <li>• Shaving</li> <li>• Profile Grinding</li> <li>• Threaded Wheel Grinding</li> <li>• Spline Rolling</li> </ul>	<p>Transmission Components, Steering Systems, Axle Shafts</p>
<p><b>Printed Circuit Board Assembly</b></p> 	<ul style="list-style-type: none"> <li>• Component Preparation</li> <li>• Kitting</li> <li>• Surface Mount Assembly</li> <li>• Plated through Hole Assembly</li> <li>• Depanelization</li> <li>• Testing</li> <li>• Conformal Coating</li> </ul>	<p>Powertrain Control Modules, ECU, Body Control Module, Instrument Panel Electronic, Entertainment Systems</p>
<p><b>Wire Harness</b></p> 	<ul style="list-style-type: none"> <li>• Wire/Bundle/Conduit Prep</li> <li>• Wire Termination</li> <li>• Connector Assembly</li> <li>• Splice</li> <li>• Branch Covering</li> <li>• Braid</li> <li>• Harness Layout</li> <li>• Labeling</li> <li>• Testing</li> </ul>	<p>Engine and Powertrain Control, Lighting, Seating, Entertainment Control, Instrument Panel Harnesses</p>

Manufacturing Process Group	Supported Sub Processes and Operations	Automotive Application and Example Components
<b>Additive Manufacturing</b> 	<ul style="list-style-type: none"> <li>• SLA</li> <li>• SLS</li> <li>• DMLS</li> <li>• Material Jetting</li> <li>• SLM*</li> </ul>	Prototypes, R&D Assembly and Packaging Studies
<b>Assembly Welding and Joining</b> 	<ul style="list-style-type: none"> <li>• Manual MIG Welding</li> <li>• Manual Spot Welding</li> <li>• Robotic MIG Welding</li> <li>• Robotic Spot Welding</li> <li>• TIG Welding, Laser Welding</li> <li>• Electro-Beam Welding</li> <li>• Adhesive Bonding</li> <li>• Resistance*</li> <li>• Ultrasonic and Friction Welding*</li> <li>• Brazing*</li> <li>• Soldering*</li> </ul>	POA (Part of Assembly) Welds on Stamped Sub-Assemblies, Full Vehicle Assembly for Body in White Joining, Chassis Components, Sub-Frames
<b>Mechanical Assembly</b> 	<ul style="list-style-type: none"> <li>• Manual Screw</li> <li>• Power Screw</li> <li>• Press Fit</li> <li>• Snap Fit</li> <li>• Rivet</li> <li>• Tab Bend</li> <li>• Nut Insert</li> <li>• Pick &amp; Place</li> <li>• Helicoil Insertion</li> <li>• Lock Bolt</li> <li>• Grease Packing*</li> <li>• Wire Routing*</li> <li>• Most Mechanical Assembly Procedures*</li> </ul>	Body, Chassis, Drivetrain, Interior and Exterior Assembly
<b>Heat Treatment</b> 	<ul style="list-style-type: none"> <li>• Aging (4 types)</li> <li>• Annealing (3 types)</li> <li>• Cryogenic Freezing</li> <li>• Solutioning</li> <li>• Stress Relieving</li> <li>• Surface Hardening (3 types)</li> <li>• Tempering (2 types)</li> <li>• Through Hardening</li> <li>• Hot Isostatic Pressing</li> <li>• Normalization*</li> <li>• Chromizing*</li> <li>• Borizing*</li> <li>• Most Heat Treatments—both whole part and localized*</li> </ul>	Structural Components, Engine Components, Drive Components
<b>Surface Treatment</b> 	<ul style="list-style-type: none"> <li>• Shot Blast</li> <li>• Degreasing</li> <li>• Basic Painting (e.g., cost per surface area)</li> <li>• Powder-Coat Cart Painting</li> <li>• Wet-Coat Line Painting</li> <li>• One-Sided Fraction Painting</li> <li>• Plating (4 types)</li> <li>• Silk Screening</li> <li>• Passivation</li> <li>• Vibratory Deburr</li> <li>• Chem Film*</li> <li>• Booth Painting*</li> <li>• Protective Coat*</li> <li>• Most Surface Treatments—both whole part and localized*</li> </ul>	Many Interior and Exterior Painted Components
<b>User-Guided Processes (for costing without CAD)</b>	<ul style="list-style-type: none"> <li>• Turret Press</li> <li>• Bend Brake</li> <li>• Stage Tooling</li> <li>• Progressive Die</li> <li>• Injection Molding</li> </ul>	Early Costing without CAD

\*Additional cost required to develop and deliver the processes listed with an asterisk. The aPriori Applied Services team may also be able to deliver processes not in this list after evaluating the requested processes and confirming the capability to develop a solution.

## WANT TO LEARN MORE?

[CLICK HERE](#) to schedule a demo of the aPriori Manufacturing Insights Platform.

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