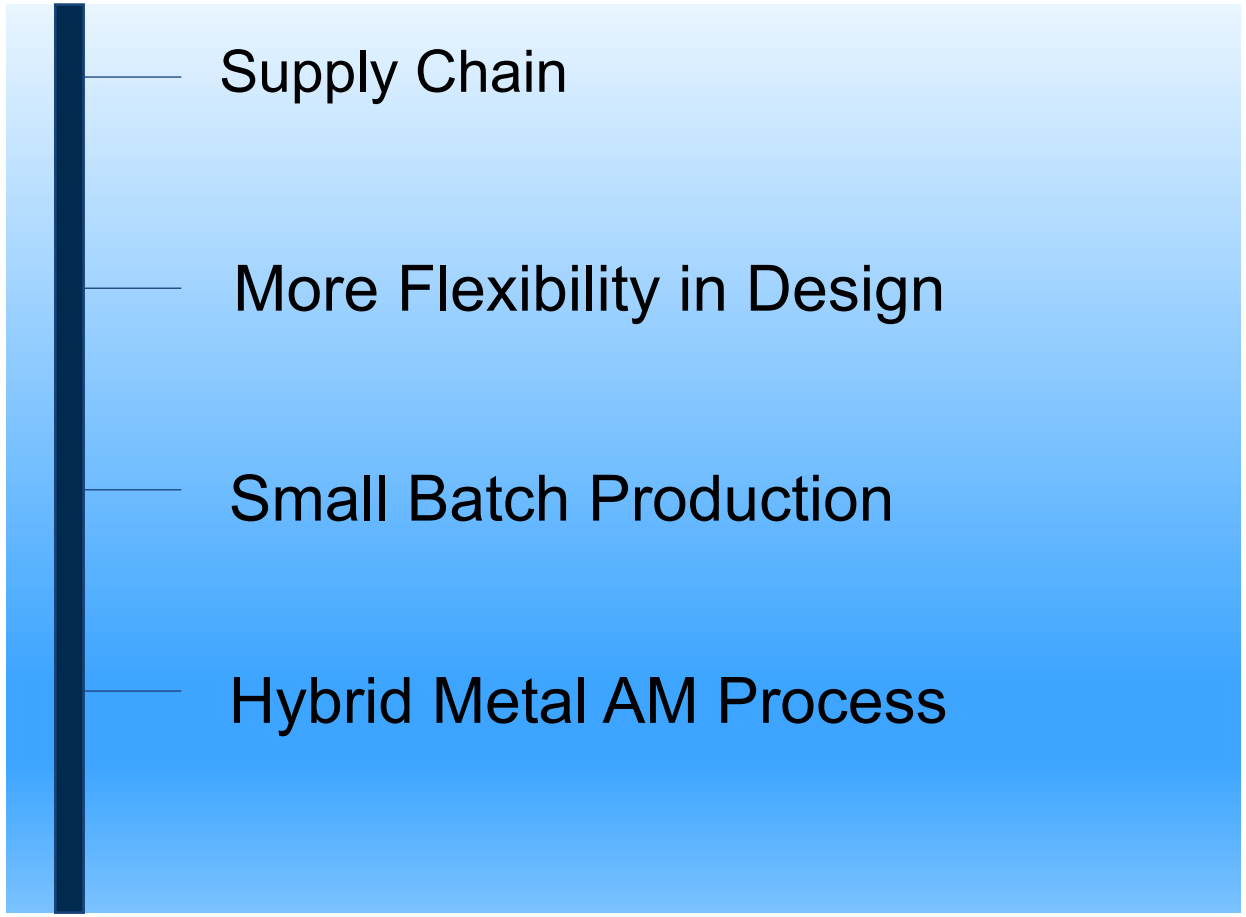
Qualification and Certification of Additive Manufactured (3D Printed) Parts for Marine and Offshore Applications

January 22, 2021

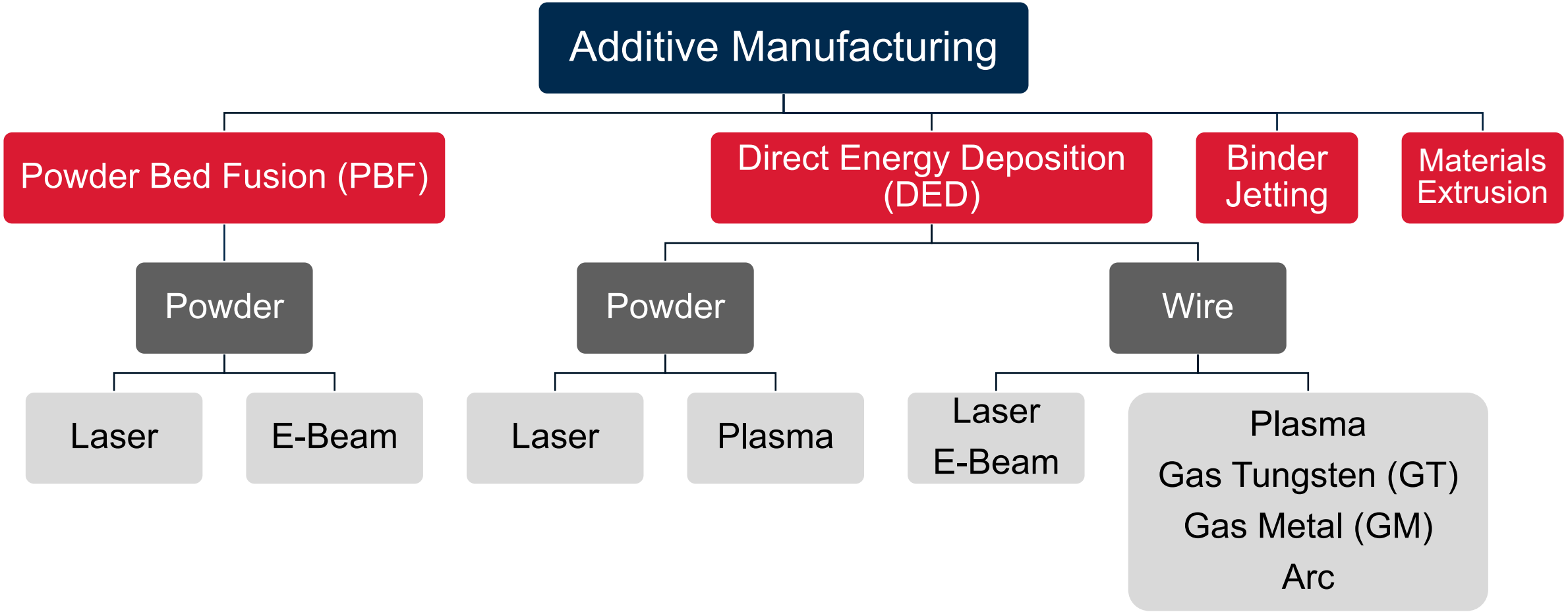
ABS

AM Value

- Spare Parts
- Complex Design
- Obsolete Parts
- Repair
- Potential Marine and Offshore Applications

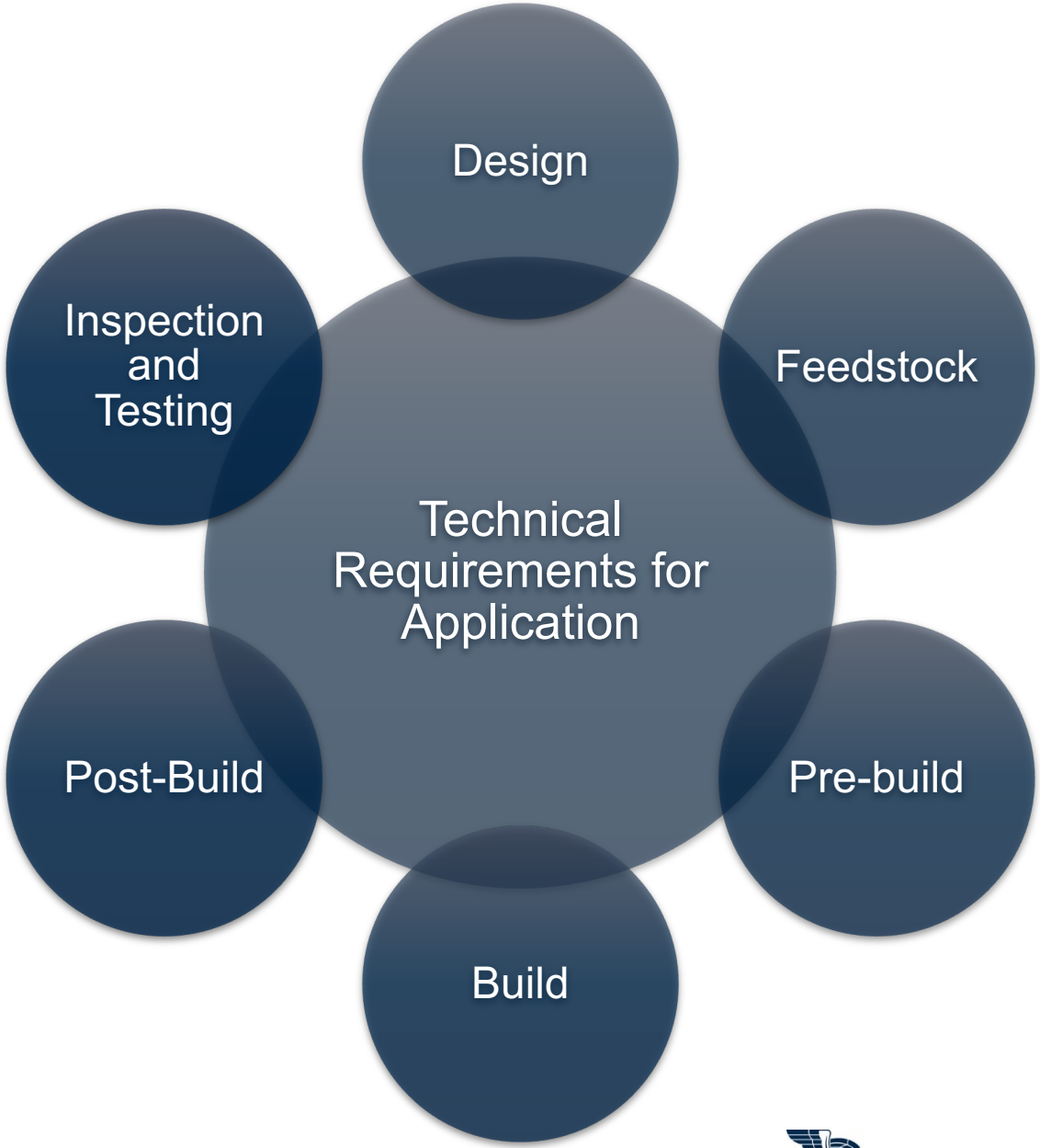


AM Process

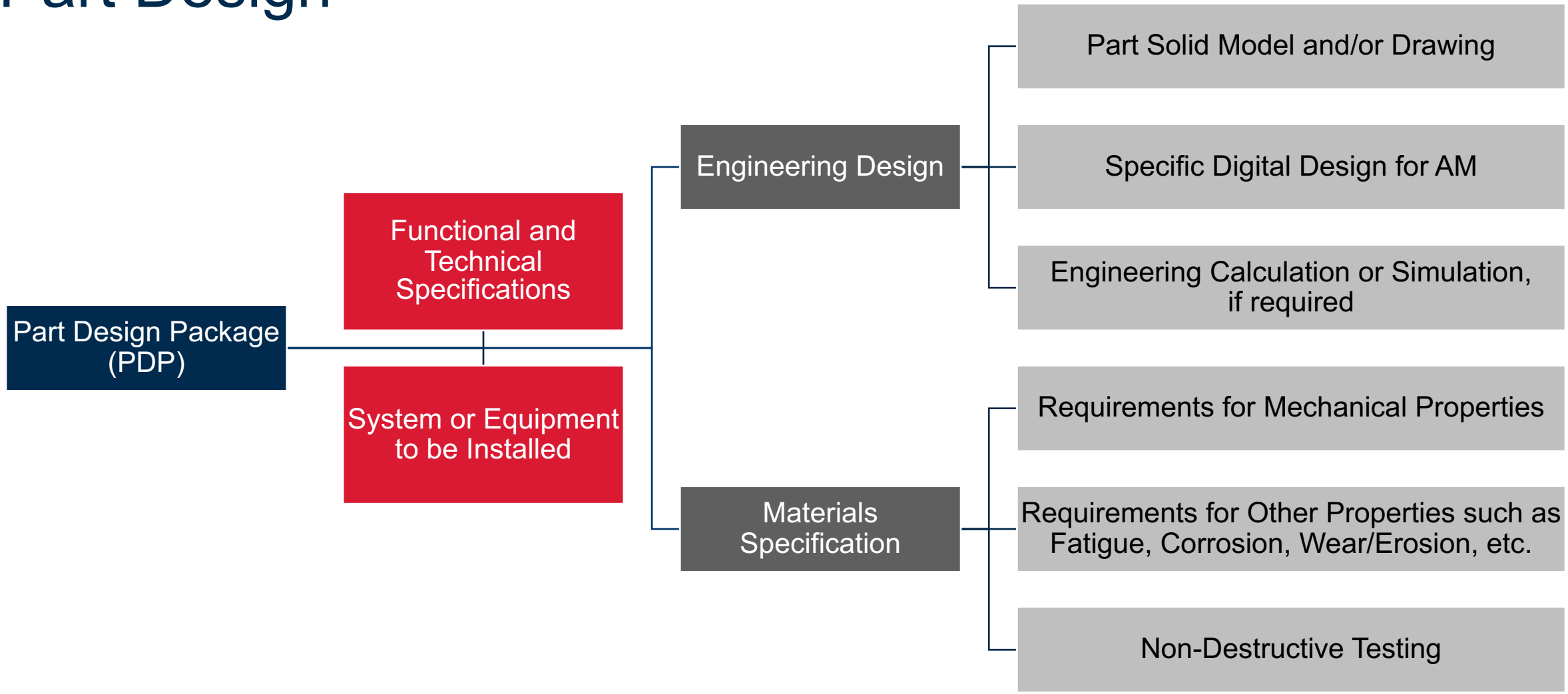

Additive Manufacturing
Powder Bed Fusion (PBF)
Direct Energy Deposition (DED)
Binder Jetting
Materials Extrusion
Powder
Powder
Wire
Laser
E-Beam
Laser
Plasma
Laser
E-Beam
Plasma
Gas Tungsten (GT)
Gas Metal (GM)
Arc

Standardization

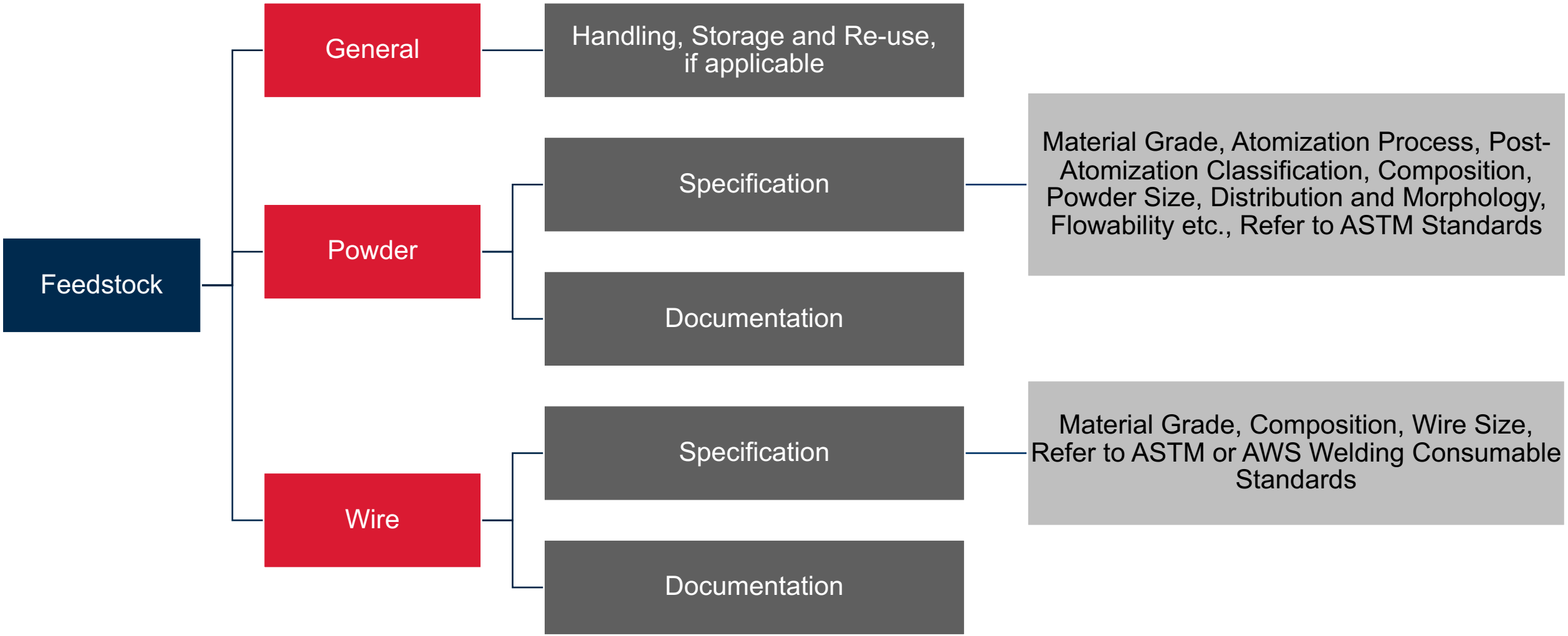
- Specifications with Revision
- Documentation
- Production



Part Design

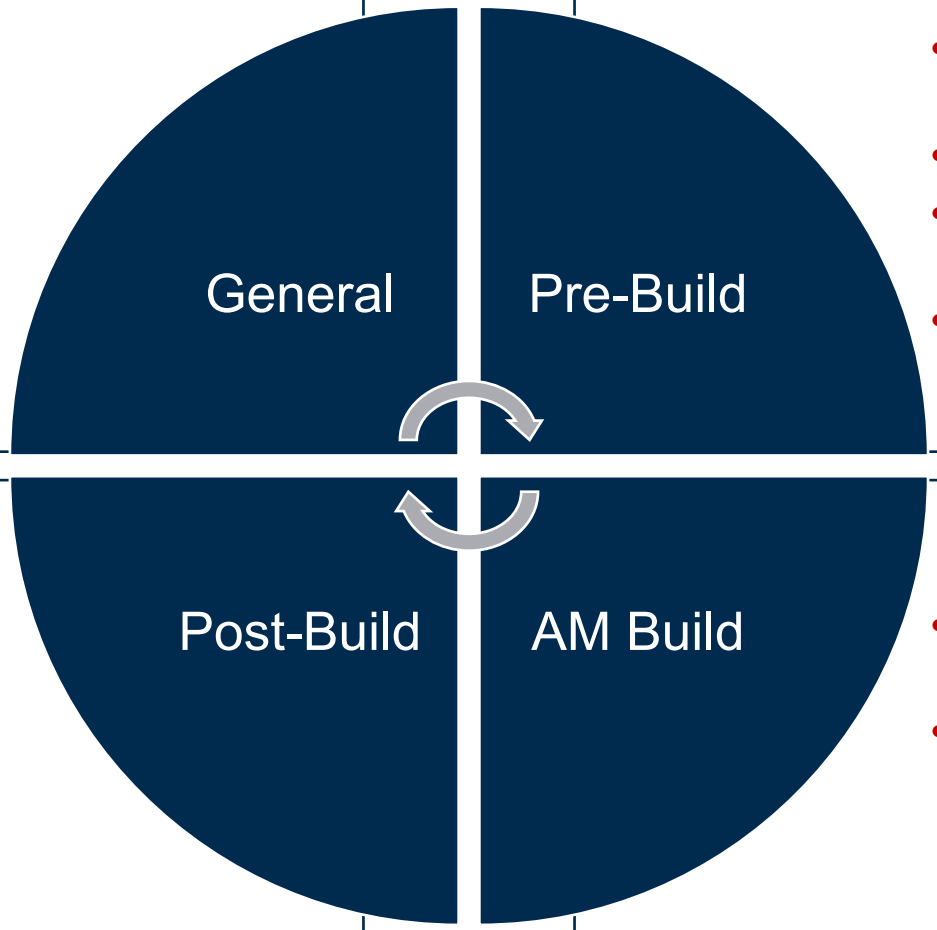

Part Design Package (PDP)
Functional and Technical Specifications
System or Equipment to be Installed
Engineering Design
Materials Specification
Part Solid Model and/or Drawing
Specific Digital Design for AM
Engineering Calculation or Simulation, if required
Requirements for Mechanical Properties
Requirements for Other Properties such as Fatigue, Corrosion, Wear/Erosion, etc.
Non-Destructive Testing

Feedstock


Feedstock
General
Handling, Storage and Re-use, if applicable
Powder
Specification
Material Grade, Atomization Process, Post-Atomization Classification, Composition, Powder Size, Distribution and Morphology, Flowability etc., Refer to ASTM Standards
Documentation
Wire
Specification
Material Grade, Composition, Wire Size, Refer to ASTM or AWS Welding Consumable Standards
Documentation

AM Manufacturing Process

- Machine (Hardware and Software)
- Procedure
- Operator



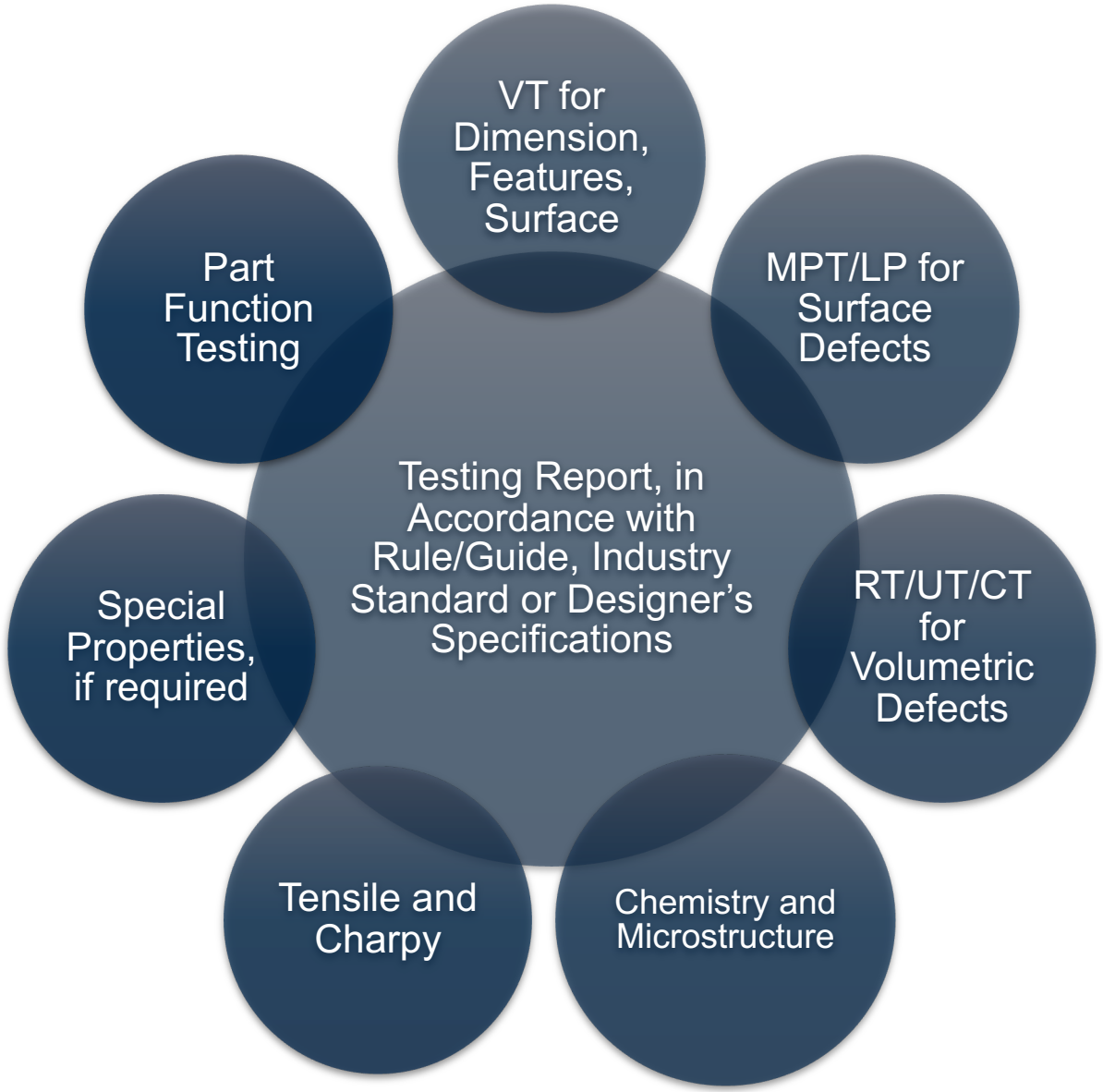
- Part Location and Orientation
- Test Coupon Location and Orientation
- Machining Allowances
- Others such as Support, Infill, Contour, Transition, etc.
- Digital Build Model

- Part and Support Removal
- Stress Relief
- Hot Isotropic Pressure (HIP)
- Other Heat Treatment
- Surface or Feature Finish

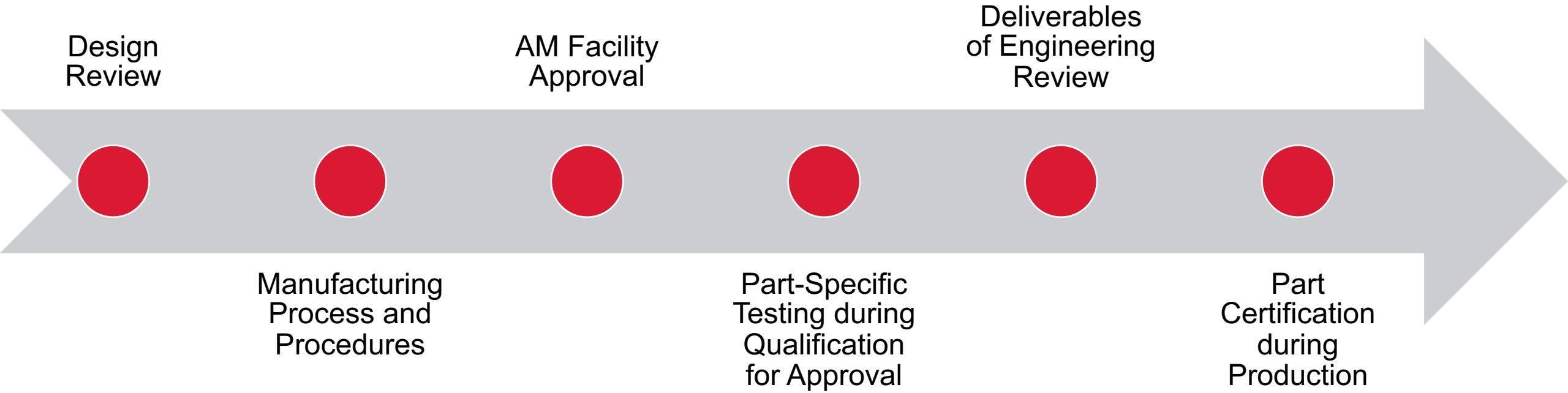
- Heat Input: Beam/Arc Power and Size
- Heat History: Scan Pattern, Travel Speed, Hatch Overlap and Distance, Layer Thickness, Edge and Surface Control
- Build Environment

Inspection and Testing

- ABS Rules for Materials and Welding and the applicable sections enclosed in other ABS Rules for application
- ASTM A751 for Chemical Analysis
- ASTM A370 for Mechanical Testing
- ASTM E8 for Tensile Testing
- ASTM E23 for Notched Bar Impact Testing
- ASTM E10 for Hardness
- ABS Guide for Non-Destructive Inspection or ASTM WK68731
- Other recognized industry standards in accordance with ISO/ASTM

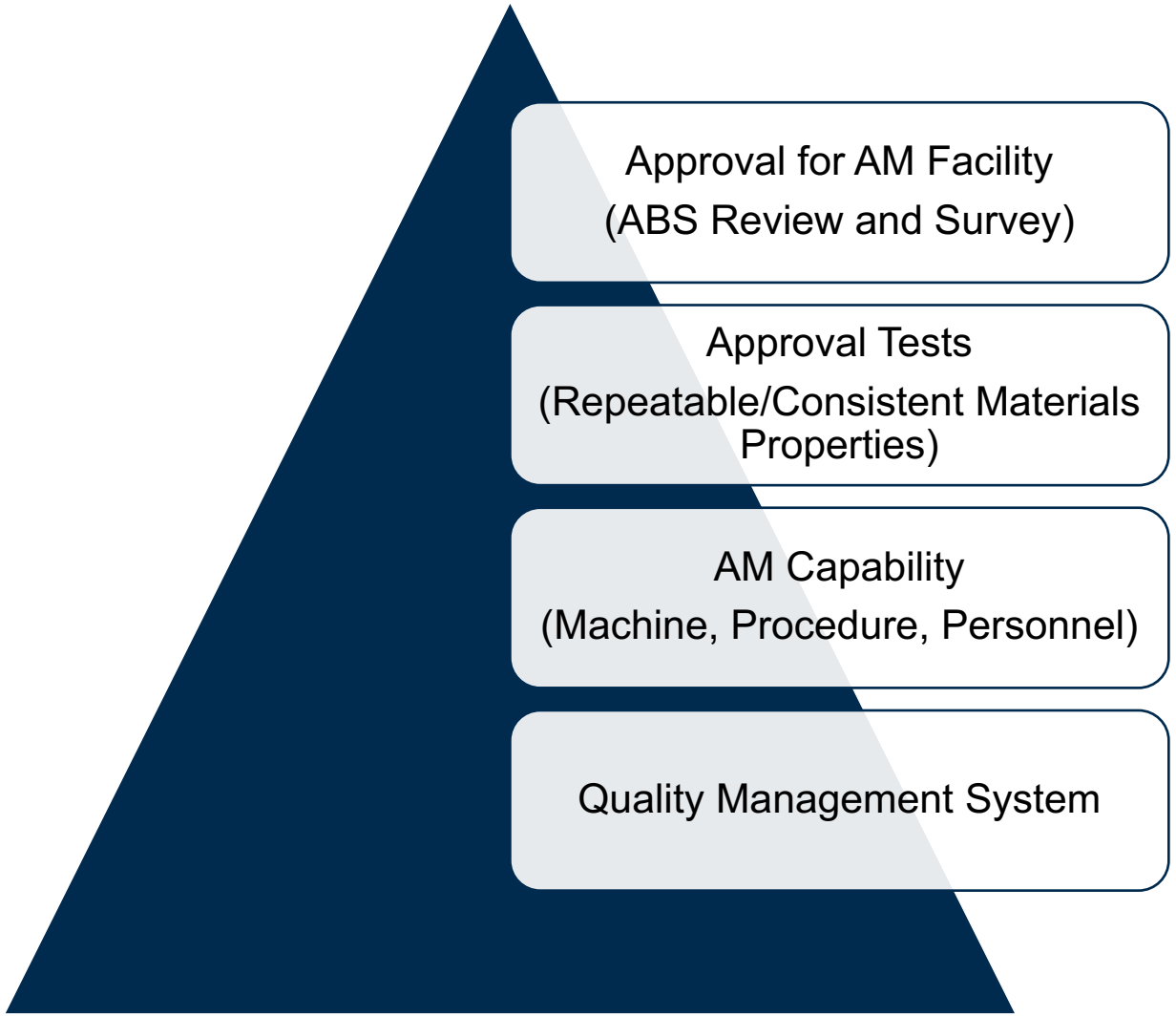


ABS Approval and Certification Process



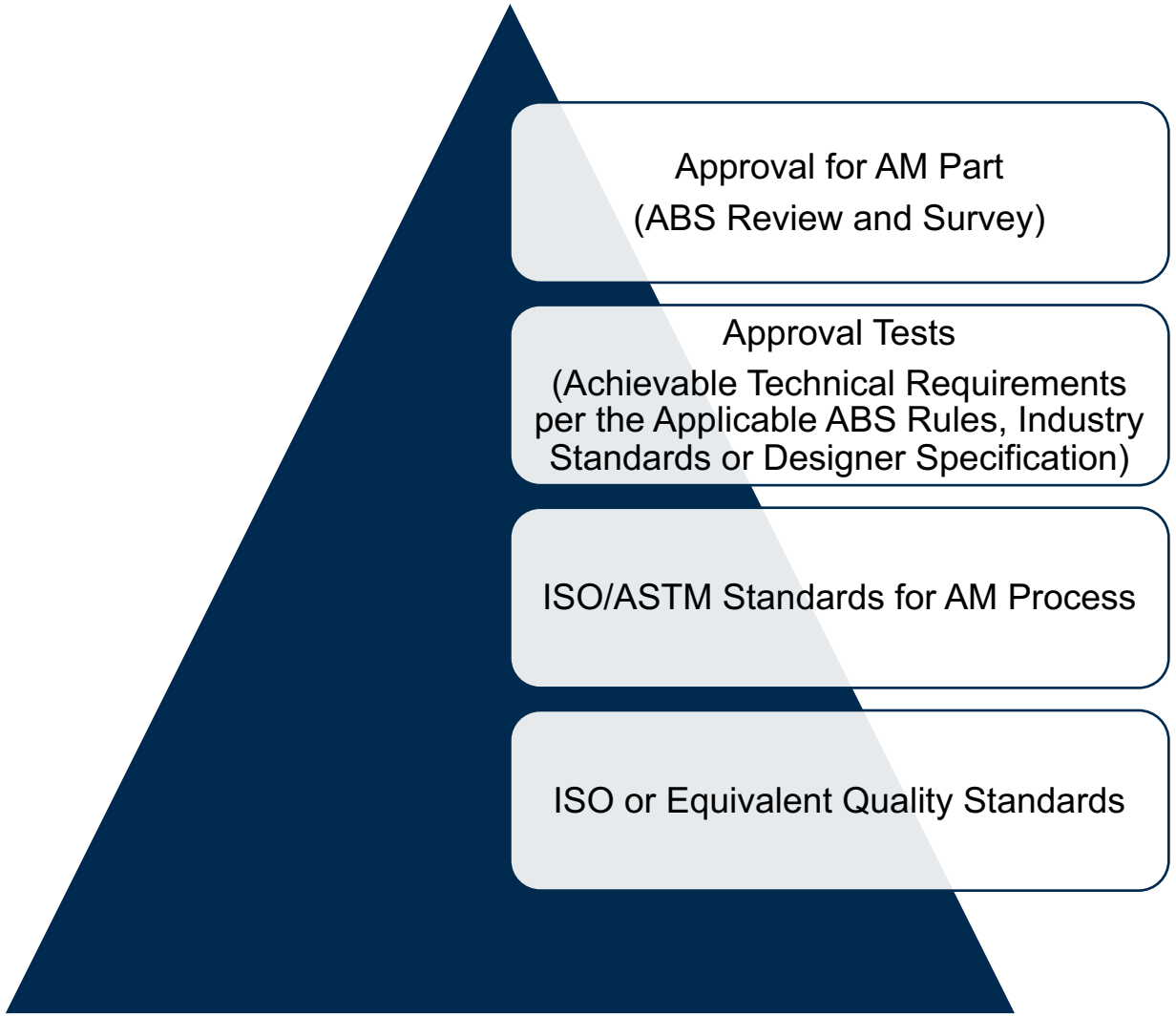
Approval for AM Facility

- Quality Management System
- AM Capability
- Machine, Procedure, Operator Qualification
- Approval Tests
- Submittals
- Approval for AM Facility
- Range of Approval

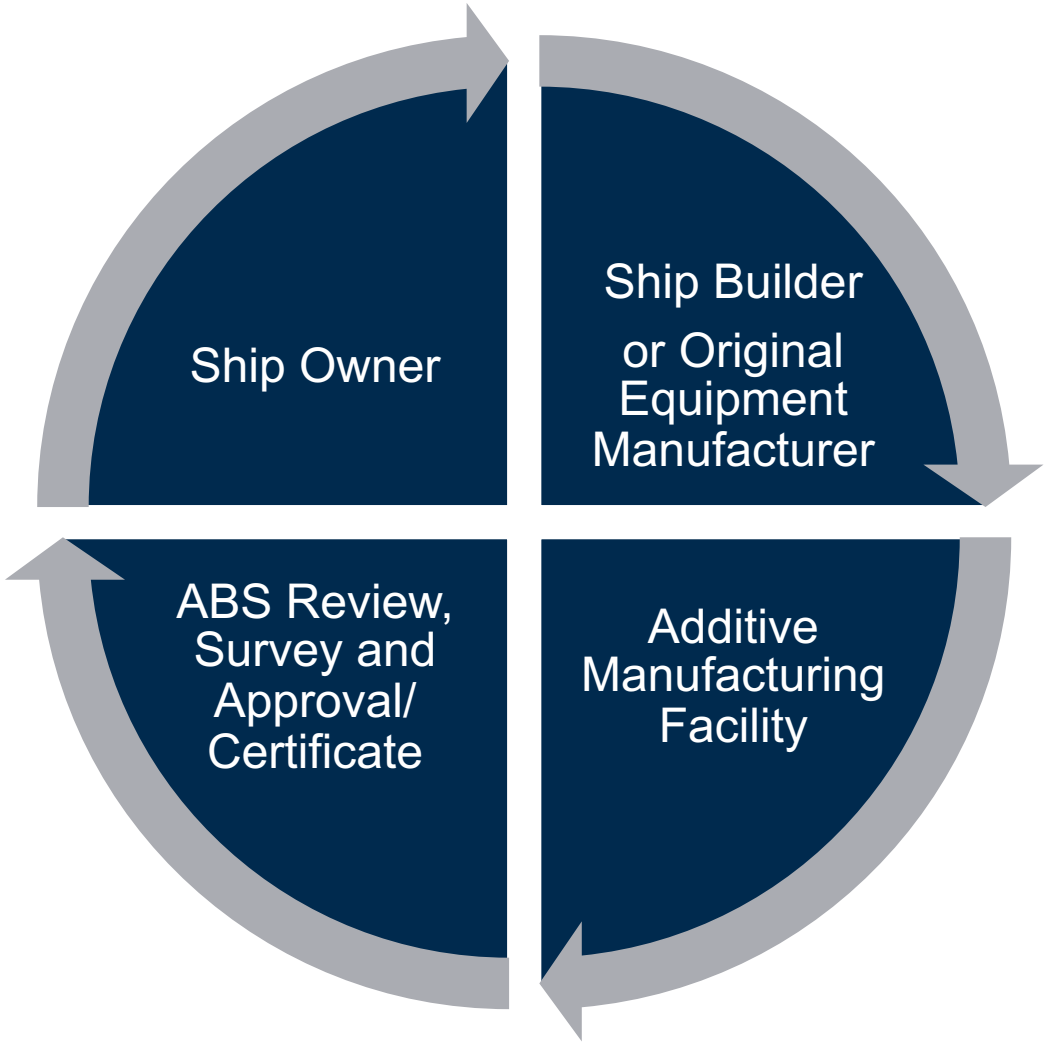


Approval for AM Part

- ISO Standards
- ASTM Standards for AM Process
- Approval Tests
- Submittals
- Approval for AM Part
- Range of Approval
- Fabrication Plan



ABS Review and Survey



- Adoption and Expansion by Collaboration
- Input by Ship Builder or Original Equipment Manufacturer
- Pre-building, Building, Post-building, Inspection and Testing by Additive Manufacturing Facility
- Design Review, Manufacturer Survey and Approval by ABS
- Onboard Performance and Close-Loop Feedback for Continuous Improvement

Thank You

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