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Additive Manufacturing Goals for Support Equipment and Aircraft Launch and Recovery

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• Support Equipment (SE)
  – Aircraft Servicing
  – Aircraft Maintenance

• Aircraft Launch and Recovery (ALRE)
  – Shipboard Catapults
  – Arresting Gear

• Visual Landing Aids

• Expeditionary Airfields
  – Matting
  – Shore based Arresting Gear
  – Lighting
National Goals:

✓ Manufacture and qualify a flight critical, non-proprietary component at a FRC with minimal “touch” labor using additive manufacturing.

✓ Make AM the preferred process for making tools at the FRCs.

ALRE / SE Goals:

✓ Manufacture and qualify an ALRE “flight safe” component with minimal “touch” labor using additive manufacturing.

✓ Establish systems and procedures necessary for the use of additive manufacturing to be used for the fabrication and documentation of SE and tooling in the fleet.
Additive Manufacturing for ALRE Items

Safe choice to pilot AM for ALRE Critical Safety Items

• In-house cognizance for legacy systems
• High complexity / low quantity
• ALRE CSI's closely managed under "Flight Safe Program"
  – Lakehurst designated as material receipt inspection point
    • Established quality assurance facilities / procedures
    • 100% inspection for new and repaired CSI components
  – Test facility
    • Vet component design / fabrication methods
Additive Manufacturing for SE Items

Support Equipment & Tooling
- Shorter design cycle
- Government and Industry designs
- Starts at the requirement level
  - AM design methods can be injected into part design
- Includes simple tooling
- Less critical
- Diverse

Makes SE ideal to pilot AM
Leveraging Our Resources

New Requirement Identified

Existing Requirement Not Met

Prototype / Manufacturing / Quality Activity

AM Assessment → Design & Engineering for AM Methods → Model Based Definition

Material Evaluation / Selection → Topological Optimization

Prototype / First Article Qualification

Pre-Processing / Planning

AM Fabrication

Final Machining / Post-Processing

Quality Inspection / Testing

Documentation – Work Instruction

PLM

Controlled Release of MBD / Work Instruction

Prototype / First Article Qualification

Product Lifecycle Management (PLM)
• Model Based Enterprise
  – Neutral file format
• Configuration control
  – Utilization of PLM Methodologies
• Asset management
• A common process across multiple sites for TDP / Work Instruction Management

* The above Vision will not be limited to just SE. It should eventually be adopted in all commodities.
Support Equipment and Tooling

Benefits of AM

• Design driven manufacturing
  • Traditional producibility less of a concern
• Design limited only by human imagination
  • Topology Optimization
• Complexity does not increase cost
• Ability for mass customization
• Rapid qualification of small lots of parts
• Potential Reductions in Weight
• Consistency in Lots increase
  • Controlled processes

Hydraulic Manifold used in the V-22 Drag Strut Retract Actuator Test Stand

* The above benefits will not be limited to just SE. They will eventually be realized in all commodities.
Support Equipment and Tooling
Next Steps

• Develop an AM Scoring Rubric
  – Identify which items are most suitable for AM
• Conduct a Design of Experiments for AM Materials
• Establish an AM Design Guide
• Establish Non-Destructive Inspection Requirements for AM Tooling
• Create Training Guides for AM Tooling:
  – Design, Manufacture, Qualification
• Publish an Standard Work Package for AM Tooling

* The Above products will be leveraged for use in other AM commodities.
* NAVAIR AM SE & Tooling group leads: John Schmelzle and Eric Kline
In the future, an Additive Manufacturing device will be installed aboard a ship and will create production parts

- This equipment will support Naval Aviation
- It will need to be acquired, installed and managed like other Aviation Support Equipment in the fleet (Ex. Hydraulic, Electrical and Avionic Benches)