ADDITIVE MANUFACTURING AND THE IMPACT ON THE DEFENSE INDUSTRIAL BASE

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AGENDA

Introduction
Additive Manufacturing
DoD Interest
Industry concerns
Potential approaches
ADDITIVE MANUFACTURING

- AM gaining maturity
- Industry expanding rapidly
- Potential is huge
- NASA has significant investment
- Very attractive to military
WHY IS DOD ATTRACTED TO AM?

- Enable spare parts fabrication at point of consumption
- Address diminished manufacturing sources and material shortage issues
- Potential to:
  - Reduce supply chain & inventories
  - Improve responsiveness
  - Reduce manpower
DEFENSE INDUSTRY CONCERNS

- Loss of spares business
  - Sales volume
  - Historically higher margins

- Additional benefits
  - Stable workforce
  - Feedback on reliability and performance of system
  - Input to future systems designs

- Development of a business plan to remain profitable with DoD using AM
CURRENT STATE OF AM

• Lack of industry standards currently limits use of AM
• Result: A short term solution is not required – now is the time to explore alternatives
• Challenge: If DoD is using AM for spares, what is the model for profitability/return on investment (ROI)
INDUSTRY STANDARDS

• ASTM, ISO, SAE and NIST all have AM standards initiatives

• **Current status:**
  
  • Standardized terminology
  
  • Standard for software format for AM machines
  
  • Limited number of materials
Materials and processes used to produce critical components for defense, aerospace, and medical applications must first be formally qualified. Extensive empirical testing to fully qualify a material often requires many thousands of individual tests, costing millions of dollars and 5 to 15 years to complete. (i) Further, a minor change in the process requires complete re-qualification. The variety of AM processes available to users and the variety of process variables used to produce an individual part make statistical-based qualification through empirical testing particularly burdensome. (ii) Currently no AM processes or materials are qualified for critical defense or aerospace applications...

• OEM concerned about potential liability:
  • Replacement component is made using materials, machines and processes specified by OEM.
  • Standards do not exist for processes and materials
  • Component not formally “qualified” through testing
INDUSTRY OPTIONS

- Stop pursuing DoD contracts
- Increase prices on production items
  - Assuming limited follow-on business for spares/repairs
- Offer contractor logistic support using AM
- Charge high prices to deliver AM design and process data
- Use royalties structured to obtain ROI for each item produced using AM
- Address liability issues in contracts
POTENTIAL APPROACHES

• Contractors install/operate AM machines at depots
• Licensing of software, processes
• Clearly define what will be replicated by services, what will not be
• Use contract options to provide flexibility (spares, licenses, etc.)
SUMMARY/RECOMMENDATIONS

- AM is already used to a limited extent in manufacturing.
- Military logisticians see this as a “panacea” to reduce inventory, provide responsive support.
- Industry is concerned that current models for ROI will not apply.
- Acquisition, life cycle support and IP strategies must consider the future use of AM in support facilities.
BACKUP
INDUSTRY STANDARDS

ASTM, ISO, SAE and NIST all have AM standards initiatives

ASTM:

- Committee F42 ([https://www.astm.org/COMMITTEE/F42.htm](https://www.astm.org/COMMITTEE/F42.htm))
- Three proposed metal material standards:
  - WK51329 Additive Manufacturing Cobalt-28 Chromium-6 Molybdenum Alloy (UNS R30075) with Powder Bed Fusion
  - WK48732 New Specification for Additive Manufacturing Stainless Steel Alloy (UNS S31603) with Powder Bed Fusion
  - WK53423 Additive Manufacturing AlSi10Mg with Powder Bed Fusion
INDUSTRY STANDARDS

ASTM, ISO, SAE and NIST all have AM standards initiatives

ISO:

• ISO/TC 261 – Additive Manufacturing
  (http://www.iso.org/iso/home/standards_development/list_of_iso_technical_committees/iso_technical_committee.htm?commid=6290860)

• ISO/ASTM 52915:2016
  Specification for additive manufacturing file format (AMF) Version 1.2

• Five others on terminology and general principles
ASTM, ISO, SAE and NIST all have AM standards initiatives

SAE:

- Held first meeting on AM standards in July 2015
- Upcoming AM Symposium – Knoxville – March 2017
- Four standards in process for Aerospace Material Specification
  - Three on Ni based alloys
  - One on the laser bed fusion process