Small Business
Data Management
Pain Points

Empowering Small and Medium Size Enterprises Through Effective Additive Manufacturing Data Management

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NIST National Cybersecurity Center of Excellence
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Slade Gardner, PhD
Big Metal Additive, Denver CO
Introduction

Slade Gardner, President, Big Metal Additive
- Industrial AM since 2000
- Equipment, Materials, Process, Methods and Priorities
- 2022 SME Additive Manufacturing Industry Achievement Award

Big Metal Additive, Denver, CO
- We make parts
- Products: Prototypes, First Articles, Low-Rate Production, Full-Rate Production
- Factory of 100 Machines
- Aerospace, Space, Maritime, and Oil & Gas
- + Value added engineering
Insufficient availability of castings, forgings and billet

Replacements produced with wire-arc DED
  • Up to 95% reduction in schedule
  • Up to 63% reduction in cost
  • Designs integrate multiple pieces into single components
  • Higher evolution of multifunctional design
  • Digital inventory ALWAYS ready to respond

Adoption has been slow, but people are moving faster
  • Technology Readiness Level (TRL) has been popular focus
  • Manufacturing Readiness Level (MRL) is the key
Additive Manufacturing is more difficult than people think

- Making a shape is easy
- Making a part is difficult

AM does not replace the machine shop

AM replaces the foundry

- Plate, bar, casting, forging
- Material certs

Material creation

- Process specification driven
- 100% focus and purpose required
Manufacturing is a Key Word
Manufacturing goes way beyond just “3D Printing”
Qualification – Does it satisfy requirements?

- Facility – control plan (specification)
- Equipment – control plan (specification)
- Personnel – employee training and education (records and certificates)
- Materials (feedstock) – origination, composition, repeatability (specification)
- Process – fixed controllable process (specification)
- Materials (product) – properties, statistical control
- Product – 1st article qualification & lot acceptance criteria

- Inspection – NDE is always required – what is the standard?
- Testing – witness coupons often required

Certification – Does the authority agree?
Quality Management System

Without a QMS, you are irrelevant in the manufacturing world
- ISO 9001:2015
- AS9100 D (2016)
- API Spec Q1

QMS provides a documented plan for:
- Customer focus
- Leadership
- Engagement of People
- Process Approach
- Improvement
- Evidence-based decision making
- Relationship management
Manufacturing Myths

 Expedionary Manufacturing
   • How do you pass a QMS audit (?)
   • Where is the facility control plan (?)

  Depot Sustainment / Battle Damage Repair (maybe)

 Laboratory Manufacturing
   • Specifications and procedures (?)
   • Purpose of a lab is to experiment (not QMS)

 Casual Part Time Manufacturing
   • How do you certify workforce (?)
   • Quality assurance / Inspection & test (?)
Technology Development has been good for AM

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<th>Technology Readiness Level</th>
<th>Acquisition Phase</th>
<th>Goal</th>
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<td>1  Basic Principles</td>
<td>Science &amp; Technology</td>
<td>Science</td>
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<td>2  Concept</td>
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<td>Invent</td>
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<td>3  Proof of Concept</td>
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<td>4  Component in Lab</td>
<td>Solution Analysis</td>
<td>Demonstrate</td>
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<td>5  Component in Relevant Environment</td>
<td>Technology Maturation &amp; Risk Reduction</td>
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<td>6  System in Relevant Environment</td>
<td>EMD</td>
<td>Satisfy increasing levels of testing &amp; performance validation</td>
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<td>7  System in Representative Environment</td>
<td>Production</td>
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<td>8  System Qualified</td>
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<td>9  System Mission Ops</td>
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Plea to DoD: Don’t stop at Sustainment – Finish the development to Manufacturing!
It’s Time to Focus on Manufacturing

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<th>Manufacturing Readiness Level</th>
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<td>1 MFG Implications</td>
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<td>7 System in Representative Environment</td>
<td>7 Produce System in a Production Environment</td>
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<td>9 Low-Rate Initial Production (LRIP)</td>
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<td>10 Full-Rate Production (FRP)</td>
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It’s Time to Focus on Manufacturing

Technology Readiness Level

1. Basic Principles
2. Concept
3. Component in Relevant Environment
4. System in Relevant Environment
5. System Representative Environment
6. System Qualified
7. System Mission Ops

Published papers and technology.
Transferable from one group to another.

Manufacturing Readiness Level

1. MFG Implications
2. MFG Prototype
3. Produce System in a Production Relevant Environment
4. Pilot Production
5. Low-Rate Initial Production (LRIP)
6. Full-Rate Production (FRP)

Products and the people who make them.
Nontransferable.
Every milestone from investment.
People are the Key to Manufacturing

Expertise, skill and training

- Years and decades of dedication are necessary
- Procedures, knowledge and certifications
- Practice makes perfect – and perfect is required

Essential Professional Manufacturing Roles

- Quality Manager / Inspection Lead
- Project Manager / Team Manager
- Business Development / Customer Support
- Finance / Accounting
- Vendor Supply Chain Manager / Maintenance / Shipping & Receiving
- Manufacturing Personnel / Support Personnel
People Feel Pain

SP 800-171 Rev. 2

Protecting Controlled Unclassified Information in Nonfederal Systems and Organizations

- Personnel to execute all requirements
- Cost associated with implementation
- Our contracts don’t cover hardware / software
- Infrastructure investments required to comply
  - Capital
  - Staffing
- Many, many websites to navigate just to understand
More Pain

Cybersecurity Maturity Model Certification (CMMC) 2.0 Program

- Hygiene aspects
- Implementation aspects
- CUI isn’t firmly defined
  - Customers don’t portion mark
  - The ‘over classification’ conundrum
  - Cost?
- Some requirements of CMMC are not applicable to SME
Small Company working for a large corporation or government entity
- Comply with all contractual items
- Flow down of universal Ts & Cs
- Referenced by code or FAR/DFAR
- Documents reference documents, layer upon layer…
- Due diligence takes forever
- Getting paid can take way too long

Small innovative company
- We have latest software, our customers do not
- We can pivot at a customers request but then they break their payment system
Standards vs Branding

ISO/ASTM 52900:2021
- Additive Manufacturing
- DED-arc
  - Arc –DED
  - Wire arc DED

US Patent and Trademark Office
- WAAM - Branded Mark
  - Marketing
  - Advertising
  - Serial Number 79336338
  - International Registration Number 1651331