How Additive Manufacturing can Impact Companies

Iowa State University

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Since 1963, we have delivered proven services to enhance the performance of industry. Our approach, Engage. Educate. Embed., creates a specific solution that allows each business, along with its community, to prosper and grow. Coupled with a satisfaction guarantee, our typical client has achieved a 200% return on investment.

A vast network of university and industry experts brings years of professional experience to CIRAS, making us a leading integrator of solutions in Iowa. Clients have reported an economic impact of more than $2 billion over the past five years.
Improving the profitability of businesses through...

**Proven Services**

Our customizable services are rooted in applied research and established best practices. They fall into four main categories:
Our network extends across ISU and the nation

<table>
<thead>
<tr>
<th>ISU Partners</th>
<th>External Partners</th>
<th>Affiliates</th>
</tr>
</thead>
<tbody>
<tr>
<td>• ISU Faculty and Labs</td>
<td>• Federal Programs</td>
<td>• Iowa Economic Development Authority</td>
</tr>
<tr>
<td>• Center for Crops Utilization Research</td>
<td>- DOC/ MEP</td>
<td>• Iowa DOT</td>
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<tr>
<td>• Center for Nondestructive Evaluation</td>
<td>- DOD/PTAP</td>
<td>• UNI</td>
</tr>
<tr>
<td>• College of Engineering</td>
<td>- EDA/UCP</td>
<td>• Chambers of Commerce</td>
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<td>• Community and Economic Development.</td>
<td>• Iowa Area Development Group</td>
<td>• Councils of Governments</td>
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<td>• Environmental Health and Safety</td>
<td>• Iowa Association of Business and Industry</td>
<td>• Local Economic Developers</td>
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<td>• Extension and Outreach</td>
<td>• Iowa Business Council</td>
<td>• Community Colleges</td>
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<td>• Meat Science Extension</td>
<td>• Iowa Farm Bureau</td>
<td>• Public and Private Service Providers</td>
</tr>
<tr>
<td>• Structural Engineering Laboratory</td>
<td>• Iowa Innovation Corporation</td>
<td>• Others</td>
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</tbody>
</table>

- Quad Cities Manufacturing Innovation Hub
- NICC and NIACC
What is Additive Manufacturing?

General functional principle of laser-sintering

1. 3D geometry model
2. Application of a layer of powdered material
3. Powdered material is solidified into a cross-section of the model
4. Building platform is lowered
5. The next layer of powder is applied
6. Laser fuses powder, powder is applied, platform is lowered
7. The process repeats itself until the part is complete
8. Loose powder is removed
9. Completed part
What is Additive Manufacturing?

Additive Manufacturing (AM) Categories

- AM - Plastics
  - Powder Bed
- AM - Metal
  - Powder Feed
- Other
  - Wire Extrusion
AM Technologies

- Binder jetting
- Directed energy deposition
- Material extrusion
- Material jetting
- Powder bed fusion
- Sheet lamination
- Vat photopolymerization
Binder Jetting
Directed Energy Deposition
Material Extrusion
Powder Bed Fusion
CIRAS Metal AM: Leading Iowa Forward

Build Awareness
- Educational events
  - Public & private
  - Statewide

Cooperative Learning
- Pilot using company designs
- Support company R&D
- Shared research

Develop the next generation
- Student class projects
- Class & club access
# AM Metal: State of the Industry

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Build Size:</td>
<td>Under 10” cube (typical)</td>
</tr>
<tr>
<td>Resolution:</td>
<td>0.004&quot; (Thickness of a post-it note)</td>
</tr>
<tr>
<td>Surface Finish:</td>
<td>0.0008&quot; Ra (1000 grit sand paper)</td>
</tr>
<tr>
<td>Hole Diameter:</td>
<td>0.020&quot; (without cleaning)</td>
</tr>
<tr>
<td>Strength:</td>
<td>98% Densities (better than production)</td>
</tr>
<tr>
<td>Tolerance:</td>
<td>0.002&quot; (typical)</td>
</tr>
</tbody>
</table>
Metal AM Benefits

**Product Design**
- Freedom of design (1a – 2)
- Reduced tolerance
- Reduced assembly costs
- Reduce time to market
- Variant options

**Supply Chain**
- Shorter supply chain
- Combining parts: Reduced supplier count

**Business**
- Rapid response to market demands (i.e. service)
- Specialized products

**Process**
- Reduced/eliminate tooling capital
- Minimize material and energy usage
Metal AM: Freedom of Design

Advantages:
- Less Material
- Faster to process
- Same functional strength
Metal AM: Company Parts – R&D
Metal AM: Company Parts - Process

Dispensing Head

Location Fixture
Metal AM: Plastic Tooling

Focus on making the things that make the things.

Note the conformal cooling lines.
Metal AM: Plastic Tooling

Core and Cavity set with sample of the part.
Metal AM: Plastic Tooling
Metal AM: Plastic Tooling

Note:
- Modular concept
- Split cavity due to size
AM: Closing Thoughts

• It’s a complex and ever evolving tool
• Complexity is “free” – Freedom of Design
• Allows you to use the iterative cycles – Fail fast, fail early
• It WILL be a tool used by Iowa Manufacturing going forward
• It can be confusing with all the technology options, so find a partner to help you….like CIRAS
• Many educational institutions have or are obtaining the technology, so students can become more familiar with it
• Companies can be too focused on just moving a part from traditional manufactured to a AM manufactured process without looking at the design and functional requirements of the part (waste)
Questions?