MEETING THE FUTURE WITH ADDITIVE MANUFACTURING

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AGENDA

Market Landscape

Customer Use Cases

Enterprise Impact

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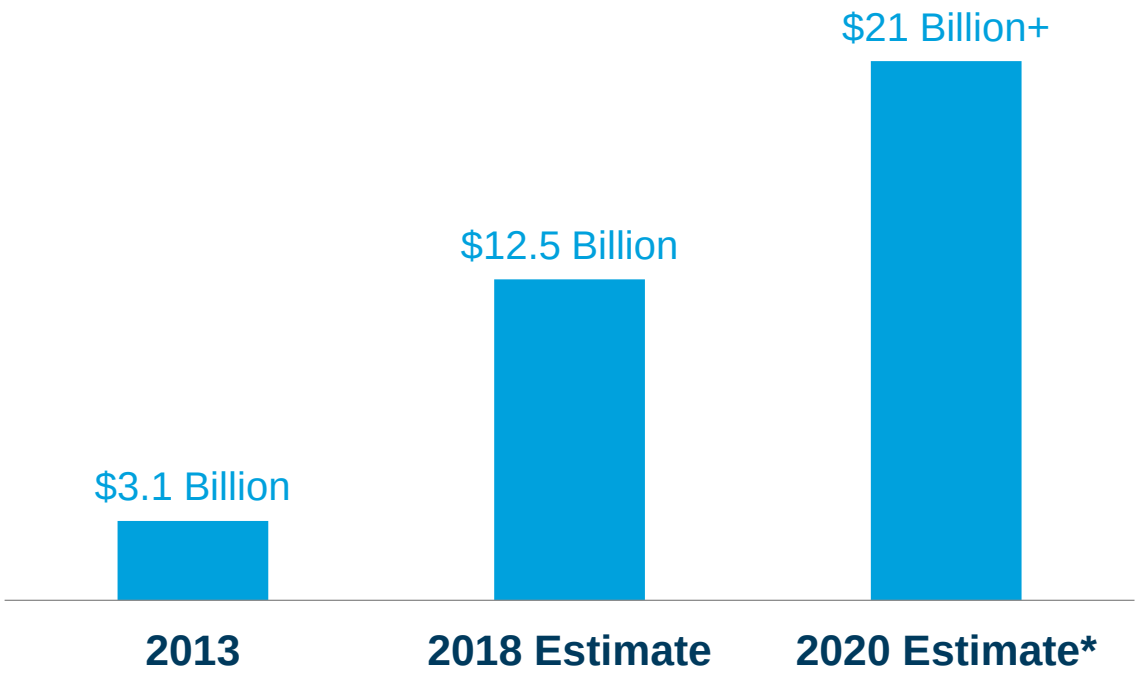
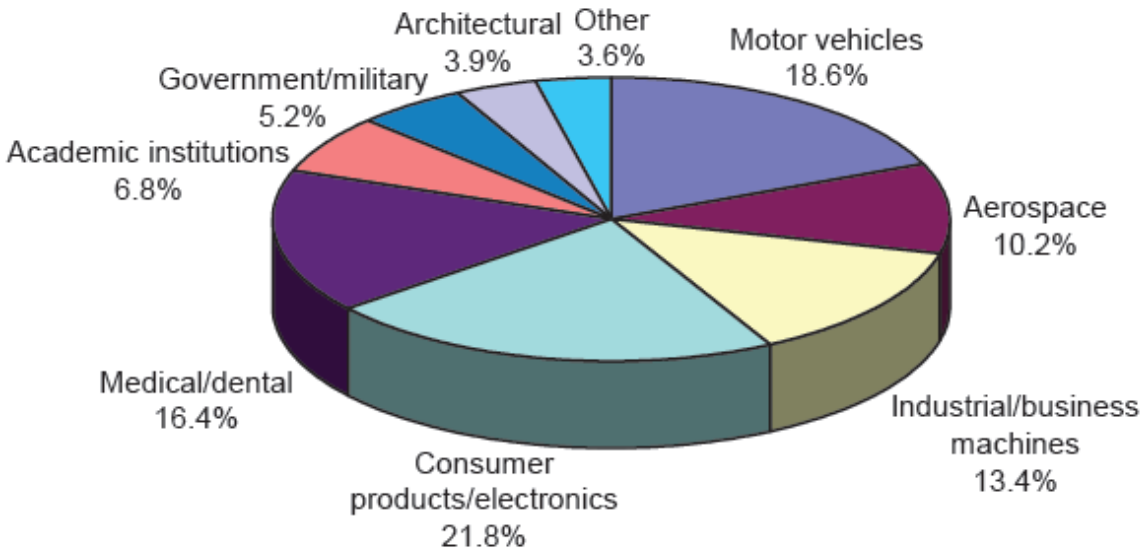
MARKET LANDSCAPE

ADDITIVE MANUFACTURING MARKET



*Estimated global market for additive manufacturing products and services; source: Wohlers Associates

ADDITIVE MANUFACTURING ADOPTION



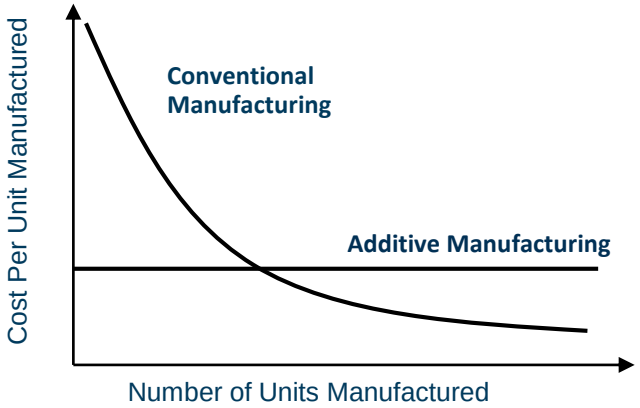
Source: Wohlers Associates Report 2014

KEY BENEFITS OF ADDITIVE MANUFACTURING

1. Changes in the economics of production
2. Design freedom
3. Increased part functionality
4. Product personalization
5. Environmental sustainability
6. New supply chains and retail models

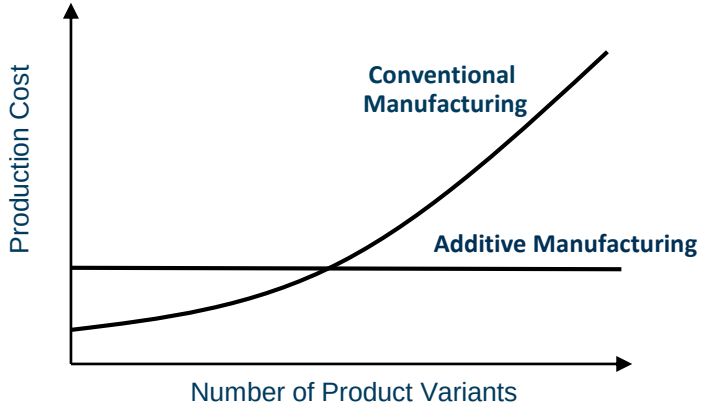
CHANGES IN THE ECONOMICS OF PRODUCTION

Economies of Scale



- **Marginal costs** do not change with **volume**
- 3D printing reduces the **minimum efficient scale**
- Efficient alternative for **low-to-medium-sized production** runs

Economies of Scope



- Production of **multiple product variants** using the **same equipment**, **materials** and **processes**
- Manufacturing of **complex shapes** with no additional costs
- Enablement of efficient **product individualization/personalization**

SECTION TWO

Why 3D Printing in Automotive?



To keep pace with today's key challenges…

- Increasing regulatory requirements
  - Tighter corporate average fuel economy and emission requirements
  - More mandated safety-related features, such as automatic breaking and backup cameras
  - Higher usage of composite materials to "lightweight" the vehicle
- Rising component costs
  - Driven by consumer preference and increased regulations
- Increased electronics and software content
  - Cost of electronics and software was less than 20 percent of the total cost a decade ago
  - Electronics systems contribute more than 90 percent of innovations and new features
- Increased consumer preference for customization
  - Low volume and high level complexity

Additive Manufacturing

Rapid Prototyping

- Concept Modeling
- Functional Prototyping

Manufacturing Applications

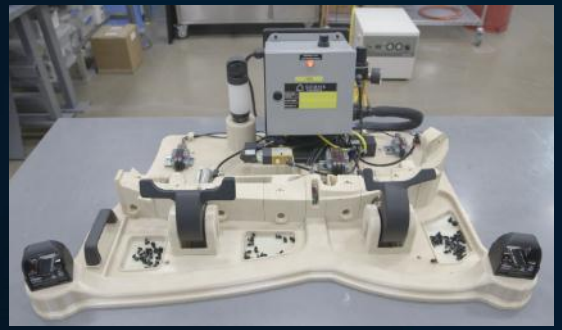
- Jigs & Fixtures
- Tooling
- Production Parts





Compliance Verification

Solaxis



- Decreased the design and manufacturing cycle by two-thirds
- Used ULTEM 9085 and FDM Nylon 12 materials to produce a jig that is over 100 pounds lighter than a typical jig
- Supplier saves hundreds of hours in labor time
- Increased the reliability of the door seals with zero compliance issues in the last two years

Manufacturing Jigs and Fixtures

BMW

- Produced more than 400 jigs and fixtures with Fortus 3D Printers
- Cut weight by 72 percent with sparse fill feature
- Cost savings of 58 percent
- Reduced lead time by 92 percent
- Improved productivity, worker comfort, ease-of-use, and process repeatability

Optimized Tooling

Opel

- Uses 3D printed production tools on manufacturing floor
  - attach rocker molding and roof spoilers
  - position nameplate
  - assemble glass roof
- Reduces tooling costs up to 90 percent
- Drastically shortens design time of production tools – can print overnight and use the next day
- Creates individualized tools for workers and vehicle models
- Enables production workers to provide input for creating or optimizing assembly tooling

On-Demand Production

Daihatsu

- Created 15 effect skin designs for Daihatsu Copen automotive brand
- Empowered customization project that would not have been financially feasible with traditional manufacturing
- Enhanced customer satisfaction through individual vehicle customization
- Used ASA thermoplastic for creating vehicle exterior production parts
  - Durable
  - Minimal wall thickness

“We started with one Stratasys 3D Printing System, and now we’re up to five. In the automotive industry, 3D printing is really moving from prototyping to manufacturing applications”

François Guilbault, Solaxis

ENTERPRISE IMPACT

BARRIERS TO WIDER ADOPTION TODAY

1. *Design-for-additive education and automated tools*
2. Analysis methodologies, modeling and simulation tools
3. *Broader material portfolio with design allowables*
4. *Improved system accuracy, reliability and repeatability*
5. In-situ process monitoring and control
6. Process implementation and workforce training

DESIGN-FOR-ADDITIVE KNOWLEDGE IS CRITICAL

PERFORMANCE BENEFITS

- Increased stiffness
- Reduced mass

MANUFACTURING BENEFITS

- Reduced cost
- Reduced lead time
- Reduced material consumption

THANK YOU

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