



Rapid Technologies and Additive Manufacturing

The next competitive Edge

Vesna Cota
SME Toronto
September 13, 2012



-
- What is AM/RP/3D printing
 - Makerbot or factory?
 - NAMII
 - Capabilities
 - Materials, Standards, Process Control - Nano
 - Advantages – Labor, Waste, Volume, Inventory, Design Change
 - Reduction of Part count
 - Remote Production
 - Focus on end part

 - Case studies – cost, time
 - Intro Canadian sources
 - RTAM



MakerBot Industries

- MakerBot Replicator
- MakerBot Thing-O-Matic Kit

Material:

- ABS spools

Cost:

- \$1,100 - \$1,800

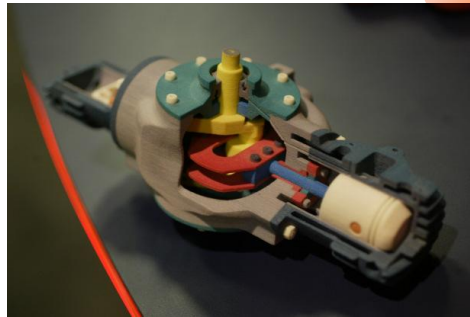


32 production parts from Fortus 900mc



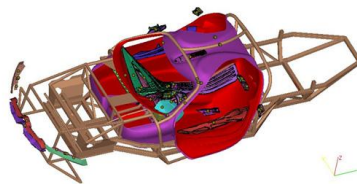
Expediting Product Development

- Visualization helps reduce the likelihood of delivering
 - WRONG product
 - POOR QUALITY product



Citroën GT concept car

- <http://i.materialise.com/blog/entry/3d-printing-a-supercar>



WITHIN

• <http://www.within-lab.com/case-studies/index11.php>

The screenshot shows the WITHIN website's case study page for a 'Chain Mail Glove' heat exchanger. The page features a navigation menu with links for HOME, OVERVIEW, BENEFITS, SOFTWARE, CASE STUDIES, NEWS/PRESS, and CONTACT & LINKS. The main content area includes a large image of the heat exchanger with a play button, the title 'HEAT EXCHANGER', and the subtitle 'HERALDING A NEW ERA FOR ENGINEERING DESIGN'. A 'VIEW IMAGE SLIDESHOW >' link is provided. A small inset image shows the 'Chain Mail Glove' concept, with a caption: 'Chain Mail Glove This chain mail glove concept'. At the bottom, a small text block reads: '3D RFD and Within Technologies have teamed up to produce this radical heat exchanger that heralds'.

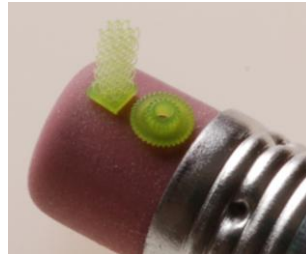
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Micro Resolution – FineLine Prototyping



Micro-Resolution
Best-in-Class Small
Feature Capability



MicroFine Metal
Micro-Resolution Prototypes
in Stainless Steel
and Aluminum



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Materialise Mammoth Stereolithography

- Dimensions up to 2100 x 680 x 800 mm in one piece
- lead times 4-8 days
- 26 SLA machines at Materialise facilities; 8 Mammoth



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Voxeljet

- Continuous 3D printing for molds and cores



- Voxeljet VX 4000: 4000 × 2000 x 1000 mm

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AM (Additive Manufacturing)

ASTM International Committee F42 on Additive Manufacturing Technologies has proposed and accepted "additive manufacturing" as the industry standard term for the process of joining materials to make objects from 3D model data, usually layer upon layer, as opposed to subtractive manufacturing methodologies

- ASTM F2792 – 10e1 Standard Terminology for Additive Manufacturing Technologies



NAMII – National Additive Manufacturing Innovation Institute

- DoD, DoC, DoE, NIST, NSF & NASA investing over \$40M
- Pilot Institute for National Network for Manufacturing Innovation
- Youngstown, Ohio
- **SME's Role**
 - SME is a partner in the National Additive Manufacturing Innovation Institute and will be integral in technology transition and dissemination, and the education and training of practitioners through the institute.



Impact

- Design freedom
- Quick re-design
- Reduced lead times
- Reduced inventory
- Lower part count
- Lower Capital Investment
- No tooling, no tool retention

- **Material waste reduction**
- **Simplified supply chains**
- **In-situ production**
- The benefits of functionally graded materials
- Composite materials, composite parts

- Economic batches of one, Mass Personalization



Materials

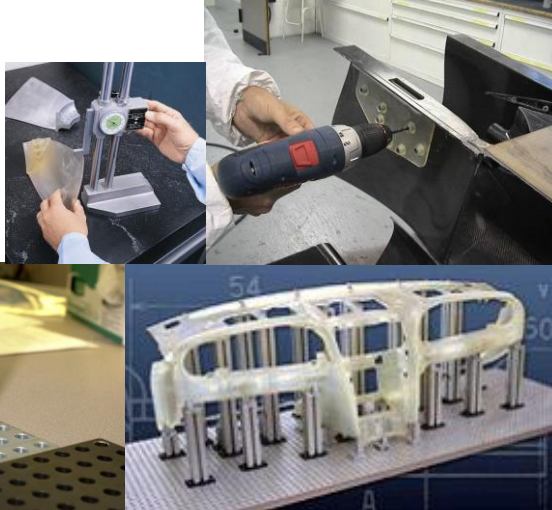
- Photosensitive resins
- Plastics
- Powders
- Paper
- Ceramics
- Metals
- Composites
- Digital Materials

- polyamide, polypropylene, polystyrene, and ABS—plastics



Fixtures & Guides

- Assembly
- Inspection
- Packaging
- Secondary Operations
 - Drilling, etc.

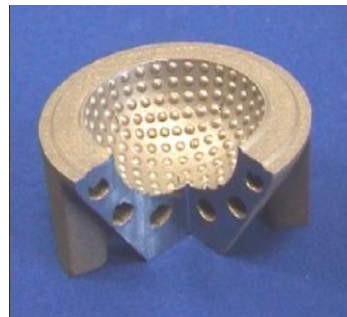
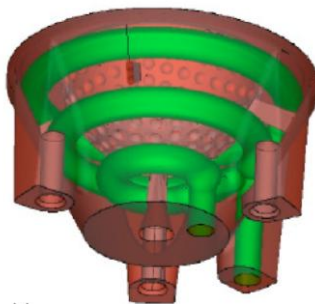


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Conformal Cooling Channels

- Production rates greatly improved with cooling channels closely surrounding the mold cavity
- no secondary operation




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Boeing

- Boeing On-Demand Manufacturing (ODM) since 2002
 - Rapid and low-cost fabrication of small volumes of complex, hard-to-manufacture parts
 - “Removing just one pound of weight from each aircraft in American’s fleet would save more than 11,000 gallons of fuel annually”
 - Environmental control system (ECS) ducts for F18
 - Eliminated 16 individual components
- 



University of Exeter, UK

- EADS Innovation Works
- CALM (Centre for Additive Layer Manufacturing)
- The research team already identified ~ 1,000 aircraft parts that could be made using additive manufacturing
- will eventually enable to “print” full aircraft wings



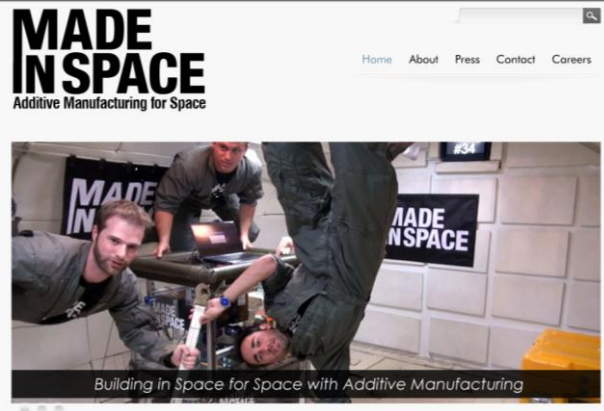
NASA and AM

- **NASA LaRC Solicitation: In-Space Additive Manufacturing Systems**

- PROPOSAL NUMBER:11-1 03.02-9753
- SUBTOPIC TITLE:ISS Utilization
- PROPOSAL TITLE:ISS Additive Manufacturing Facility for On-Demand Fabrication in Space

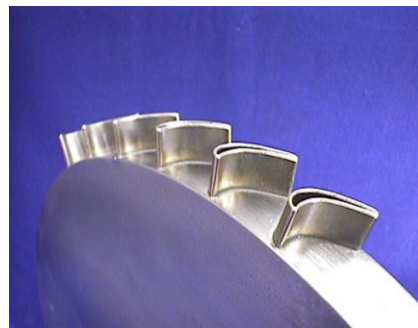
- **Made in Space**

- www.madeinspace.us



Features on Existing Parts

LC: adding complex features to components such as building airfoils on a turbine disc to form a blisk.



IN 625 LC
Propeller blades
on shaft

Medical

- 83-year-old has jaw replaced by 3D-printed mandible
- Artificial blood vessels created on a 3D printer
- Engineers pioneer use of 3D printer to
- 'Printing out' new ears and skin
- Surgical guides
- Substrates for living tissue
- Implants
- Organs – work on printing a kidney

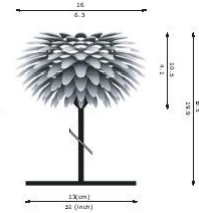


You think it ...

- Materialise-MGX
- Bathsheba Grossman
- FoC (Freedom of Creation)

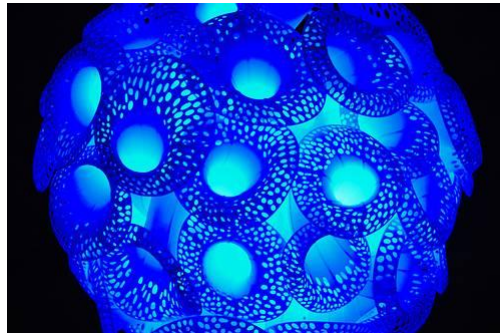


FIG. 2 Layer is a company established in Bangalore that manufactures footwear for 2000-3000 men. It is represented by top design firm world's top designers through their own e-commerce platform. In the middle of the year, 10000 pairs of shoes were made using 3D printing. www.pricedown.com





Taber, LED luminaire, 2003 (Design: Lionel T. Dean, courtesy of FutureFactories)



Pallavi LED luminaire, 2007 (Design: Lionel T. Dean, courtesy of FutureFactories)



3D printers & DIY

Printer produces personalised 3D chocolate
<http://www.bbc.co.uk/news/technology-14030720>
The printed future of Christmas dinner
<http://www.bbc.co.uk/news/technology-12069495>



DAVID MARTIN





Future with RM

- From Design-for-manufacture (DFM) to “Manufacture to Design”
- Designs previously impossible to manufacture
- Elimination of parting lines and draft angles
- Variable wall thickness
- Assembly-in-one
- Embedded components
- Varied material characteristics
- Lattice structures
- Re-entrant shapes
- Complex surface textures
- CUSTOMIZED MASS PRODUCTION

- Materials, materials, materials



Next

- Economy
- Standards
- Courses
- Certifications
- Centres

- In your hands – never so easy to mfg complex parts

- LEARN, GET INFORMED!





Sources

- www
- Magazines:
 - Time Compression Magazine (free)
- Associations:
 - Society of Manufacturing Engineers **(SME) RTAM**
 - **SME Toronto Chapter 26**
- Conferences:
 - Rapid 2013

www.hyphen.com Hyphen Grand Opening!



RTAM

(Rapid Technologies and Additive Manufacturing Community)

- SME (Society of Manufacturing Engineers)
- RTAM Technical Groups
 - 3D Imaging
 - DDM (Direct Digital Manufacturing)
 - Education and Information Exchange
 - Medical
 - NanoManufacturing
 - Bright Minds
 - Design for Direct Digital Manufacturing Competition
- RAPID Conference



KEEP YOUR EYES OPEN!

Thank you!

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