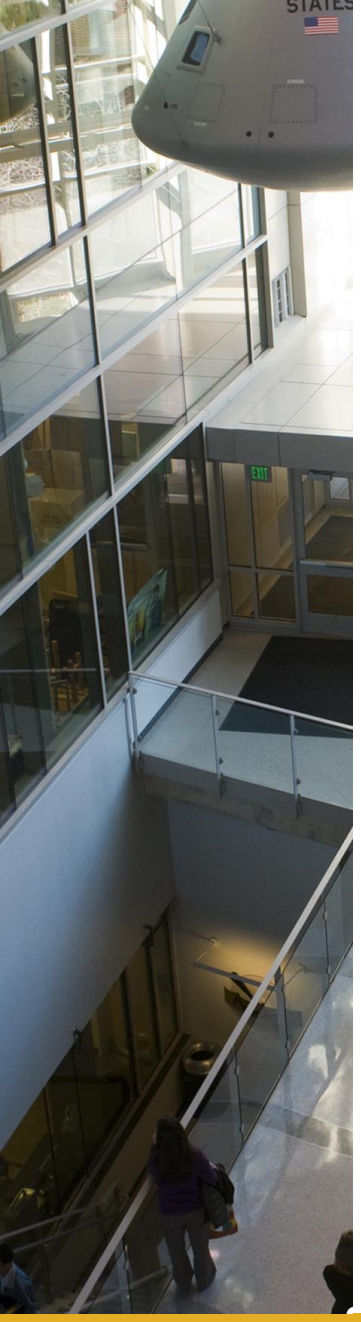
PURDUE
UNIVERSITY

3D Printing



3D Printing:

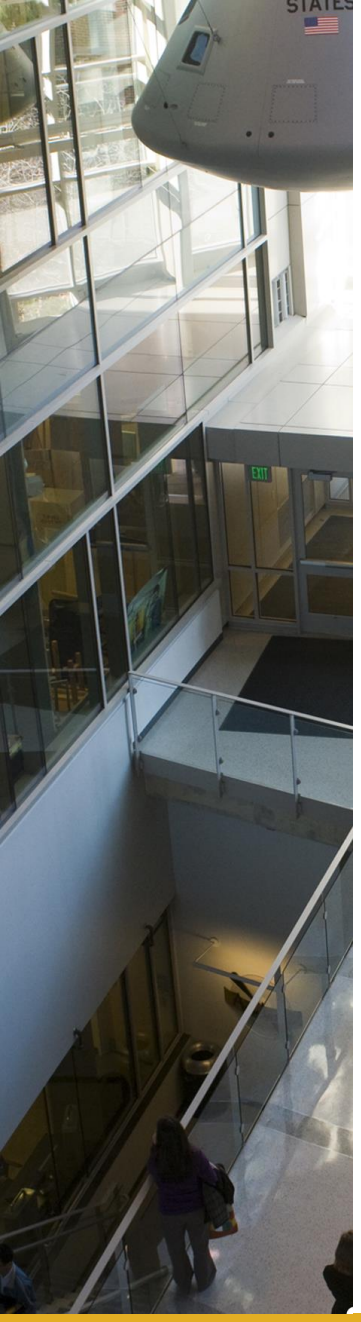
Form of additive manufacturing (AM) that creates physical 3-dimensional objects directly from a digital file

*AM: “layer by layer” process

- coined at MIT in 1993
- also called;

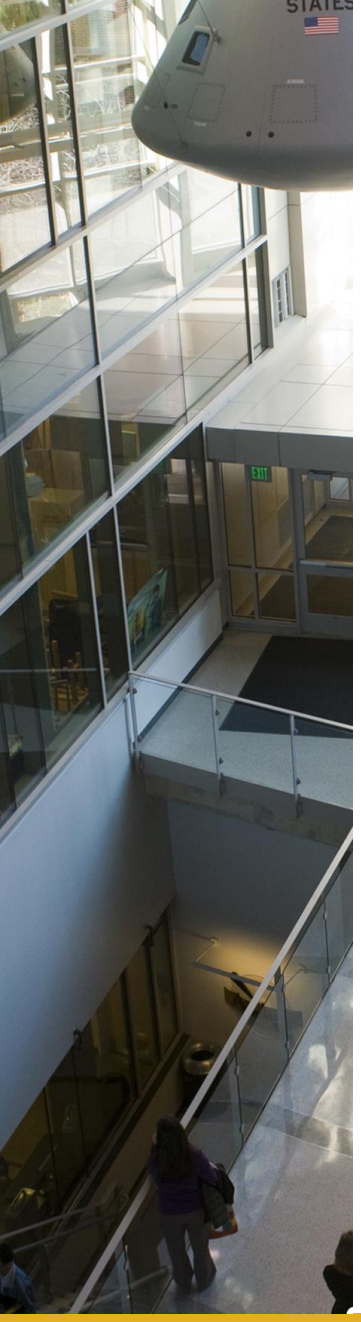
  additive fabrications, additive processes, direct digital manufacturing, rapid prototyping, rapid manufacturing …..

(Guo & Leu, 2013)



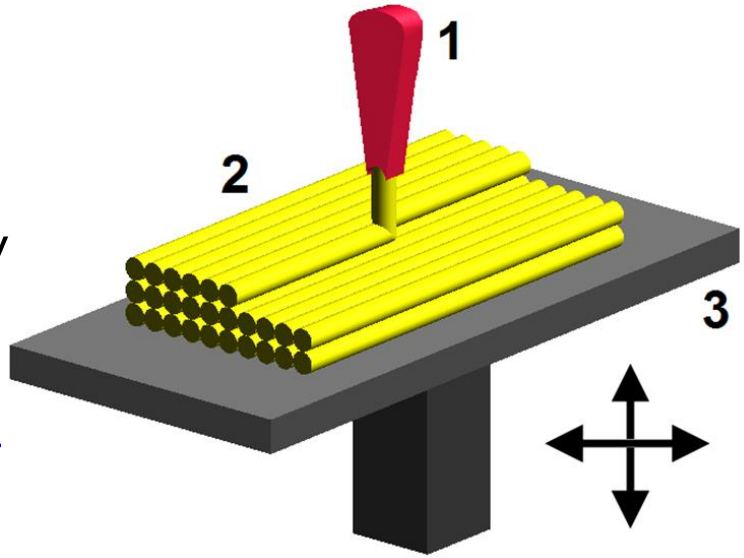
Additive Manufacturing: Terms

- Additive Manufacturing (AM), also known as 3D printing
  - the process of adding material(s) to produce a part by printing material layer by layer
- This definition is in contrast with the process of subtractive manufacturing
  - which removes material to produce a finished part
    - Ex: whittling something from wood
    - Ex. CNC…milling, turning

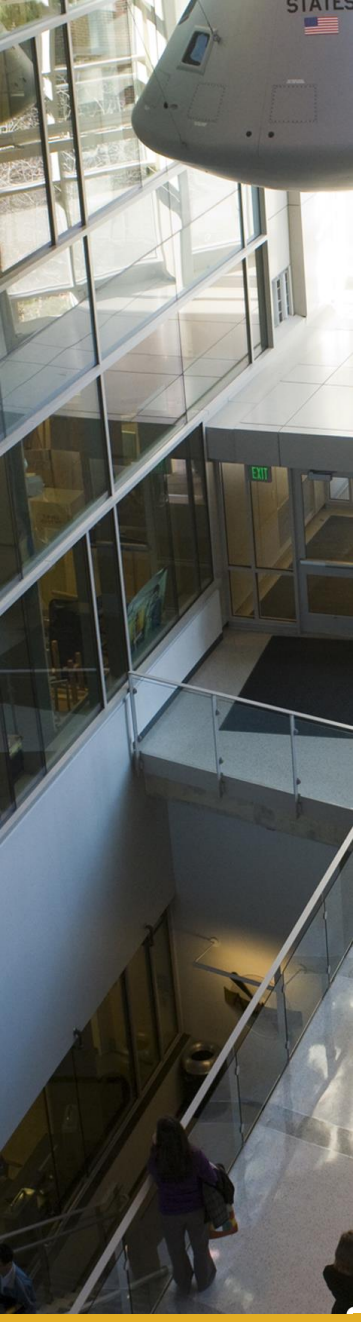


3D printing processes: Fused deposition modeling (FDM)

- Melting a material, squeezing it out of a nozzle, and selectively depositing it
- Material must have relatively low melting point
- https://www.youtube.com/watch?v=WHO6G67GJbM
- Filament Types http://www.makergeeks.com
- Photo: wikipedia.org

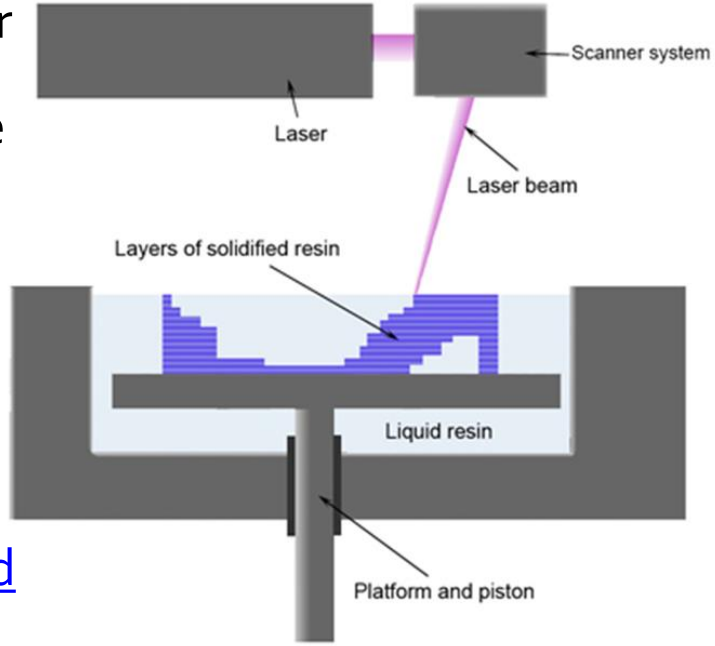


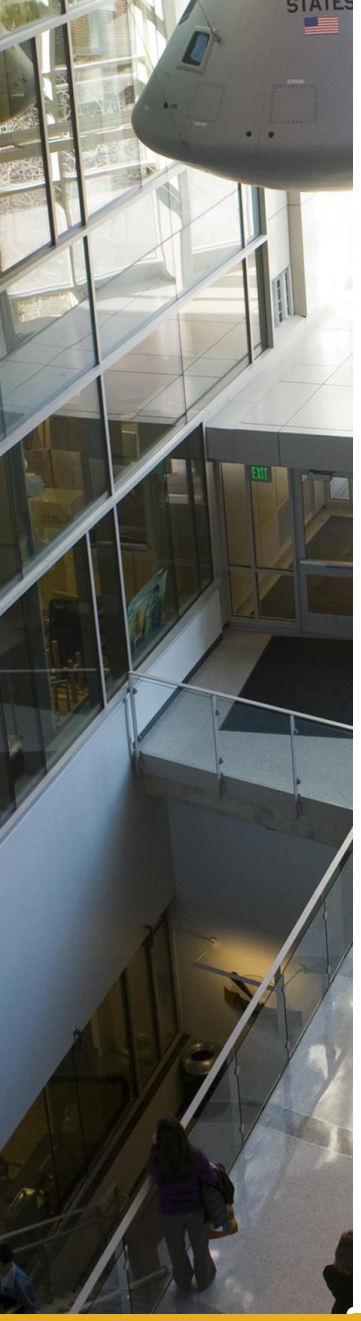
Introduction to the Technology



3D printing processes: Stereo-lithography (SLA)

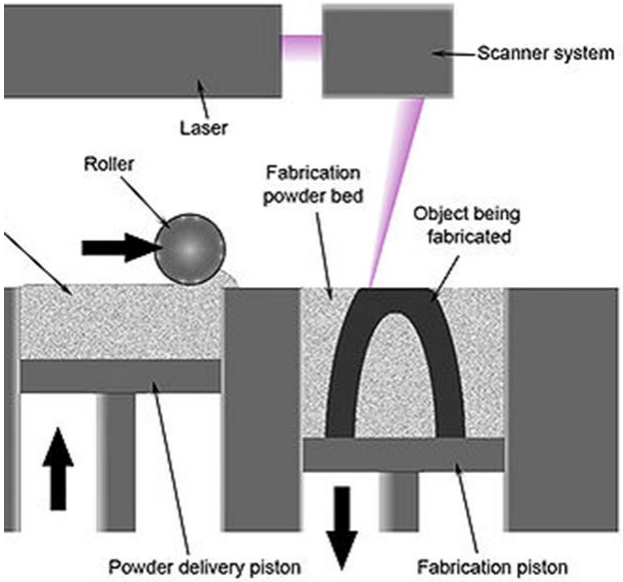
- A highly-controlled light source is directed at a light-curing material such as a photopolymer
- The base of the machine may be moved downward and more material may be added
- https://www.youtube.com/watch?v=NM55ct5KwiI
- Form Labs http://formlabs.com/products/3d-printers/form-2/
- Photo: wikipedia.org

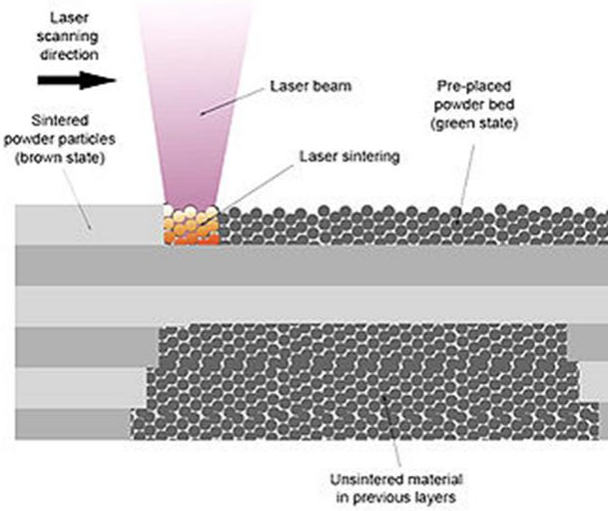


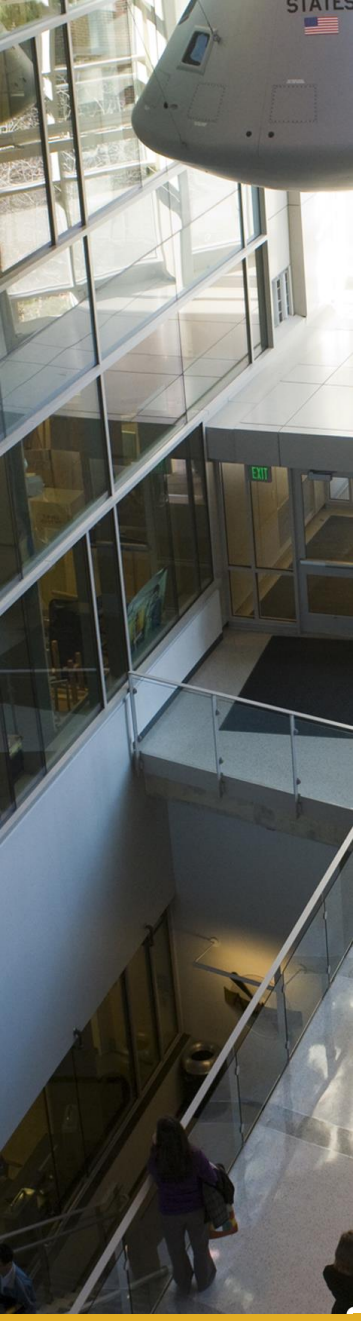


3D printing processes: Selective laser sintering (SLS)

- Also SLM—Selective Laser Melting
- This process uses a laser directed at a powder bed
- The laser sinters the material (ceramic, metal, or polymer)
- The bed then moves down and another layer of material is added







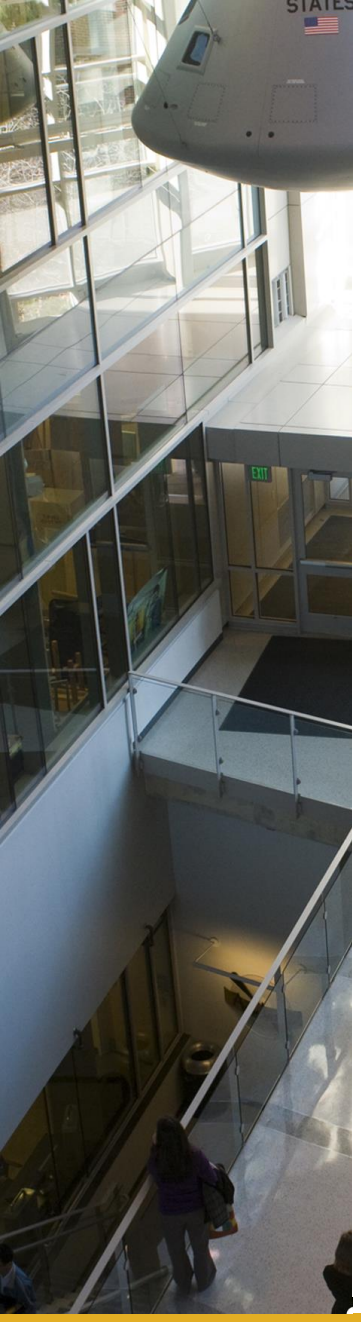
A M : Advantages and Disadvantages

Advantages

- Small cost for low-volume parts
- Little or no tooling costs
- Quick design-to-produce time
- Complex shape creation
- Quick proto-typing

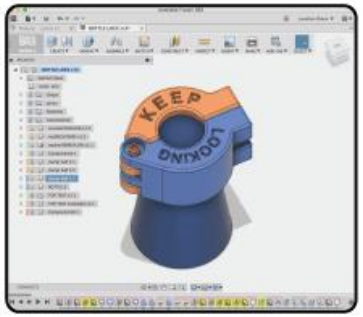
Disadvantages

- Manufacturing with metals limited and expensive
- Relatively new—may not have market acceptance
- Forged parts can be stronger due to different manufacturing process
- Cost / technology involved in manufacturing input materials



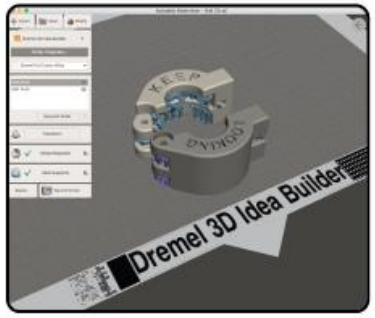
General Workflow

CONCEPT SKETCH

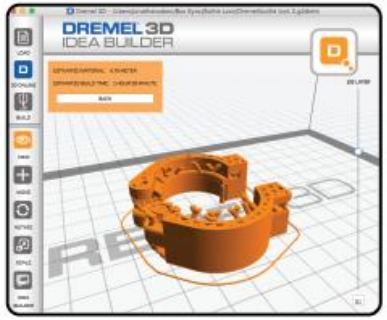


3D DESIGN

STL FILE(S)



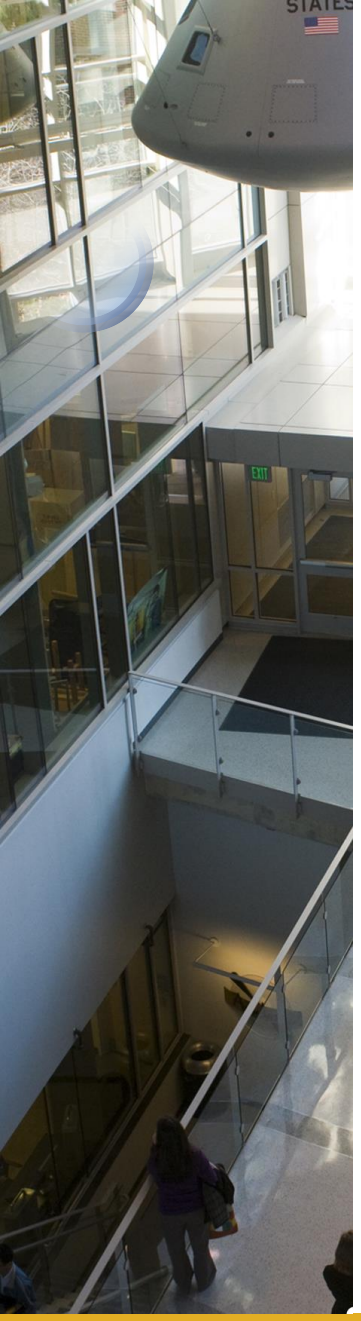
LAYOUT / REPAIR / SUPPORTS



SLICING SOFTWARE

3D PRINT

Introduction to the Technology



Fashion

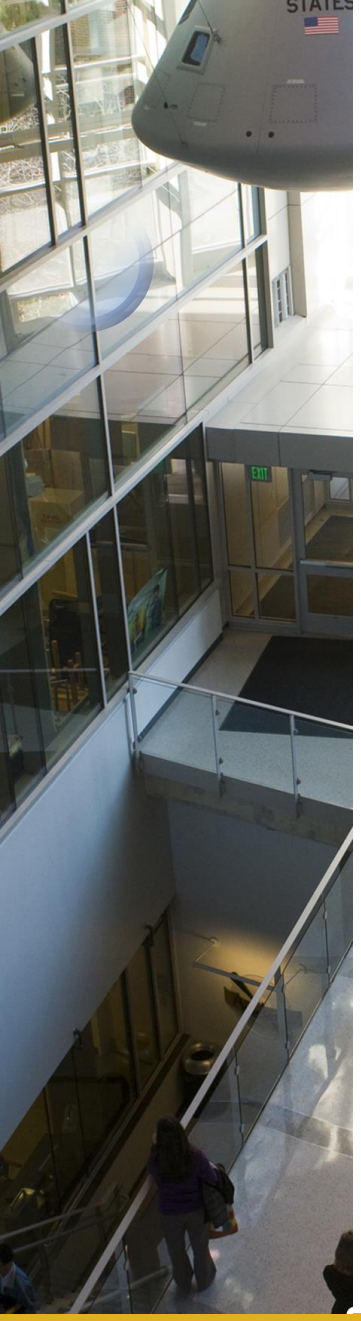
Jewelry - Hot Pop Factory
Shoes – New Balance
Sunglasses – Ron Arab

“With 3D printing we are able to pursue performance customization at a new level to help our elite NB athletes and eventually all athletes, “New Balance President and CEO Robert DeMartin said in 2013.”We Believe this is the future of performance footwear and we are excited to bring this to consumers.”

Reduce financial costs for small designers

Edision Fashion Design
https://www.youtube.com/watch?v=oZPEaPSSMKY

Applications

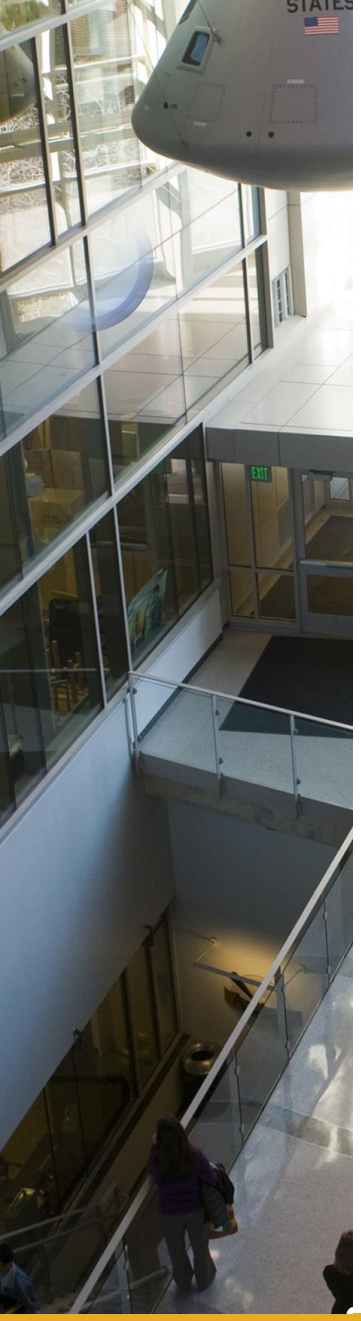


Medicine

3D printing – life saving technology

University of Michigan
A baby had tracheobrochomalacia, the tissue of
one portion of his airway was so weak that it persistently collapsed
Printed a splint that goes into the sutures that would fit over the the weakened section of an airway

Makerbot Bio Printing
https://www.youtube.com/watch?v=Zfl_tFdt2D4

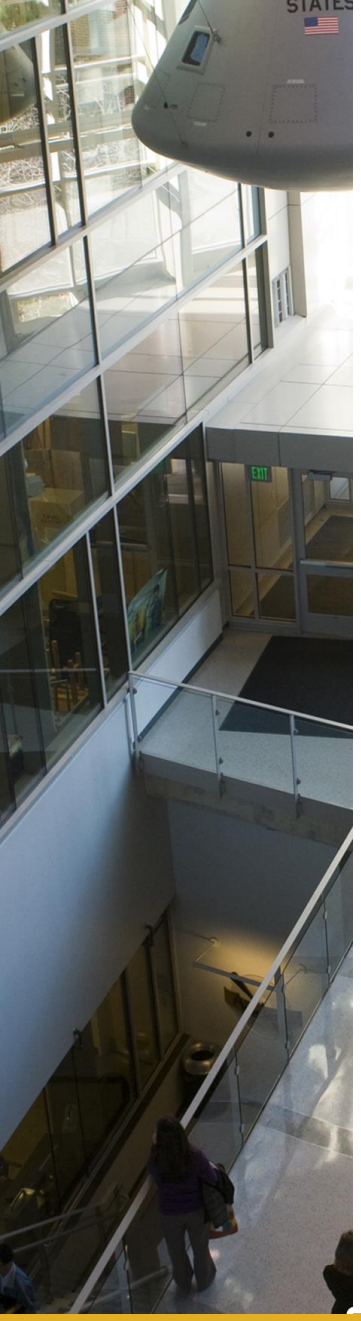


Food

Foodini – 3D-printed invention

Users first select a recipe, then the machine make the individual components of the dish from scratch and put the components into Foodini's stainless steel ingredient capsules

Practical examples: edible, wedding cake toppers, easily eaten Vegetables for seniors with problem chewing



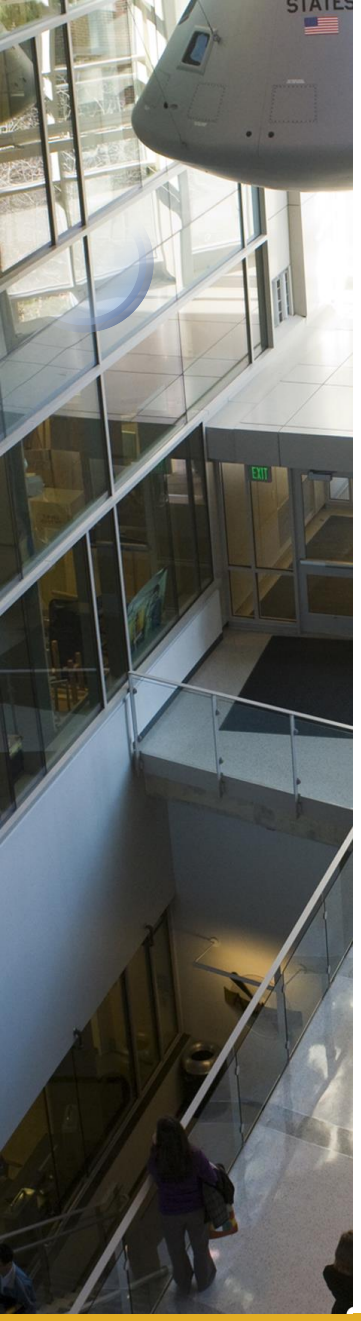
Forensics / Diagnosis

- Creating replicas of pieces of evidence
- Although not admissible in court, it can be clues to law enforcement and enhance juries' understanding

Diagnosis

http://makezine.com/2015/01/14/hands-on-health-care/

www.highsnobiety.com



Socio-economic transformation:
Era of User Manufacturing

Paradigmatic shift in manufacturing

- From factory manufacturing of patented and standardized goods to user manufacturing of patent free and customized goods
- Active user manufacturing through empowered user innovation
- Huge impacts on retailing and logistics as well as manufacturing

Leadership of the market will be given to individuals

(Bogue, 2013)

Business Impacts