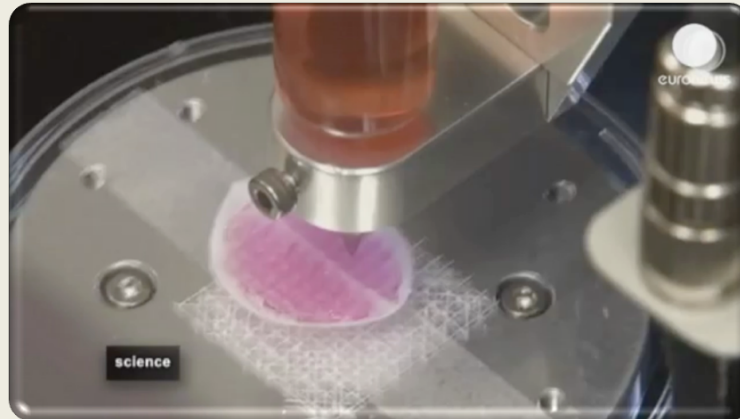




Additive Manufacturing (3D Printing)



Presented By:

Dr.Ahmad Basalah

Department of Mechanical Engineering at Umm Al-Qura University

Contents

1-Overview and History of Additive Manufacturing

2-Generalized Additive Manufacturing Process Chain

3-3D Printing technique

4-Guidelines for Process Selection

5-Applications: Industries , Medical & Dental

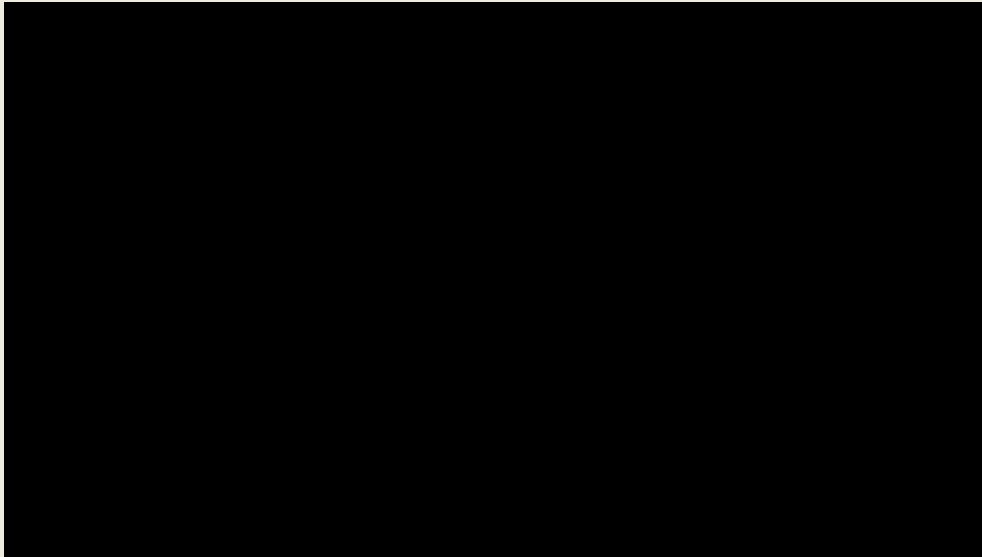
6-Post-Processing for additive manufacturing

7-The Use of Multiple Materials in Additive Manufacturing.

8-Business Opportunities and Future Directions

9 -Project Presentation

Additive Manufacturing



Courtesy of 2020magazine.ca

- Significantly shorten production time and reduce costs.
- Effectively enable customized production with multi-material.
- Economical and viable alternative for fabricating complex assemblies.
- Normally enable better metallic and ceramic parts quality compared to conventionally-made parts.

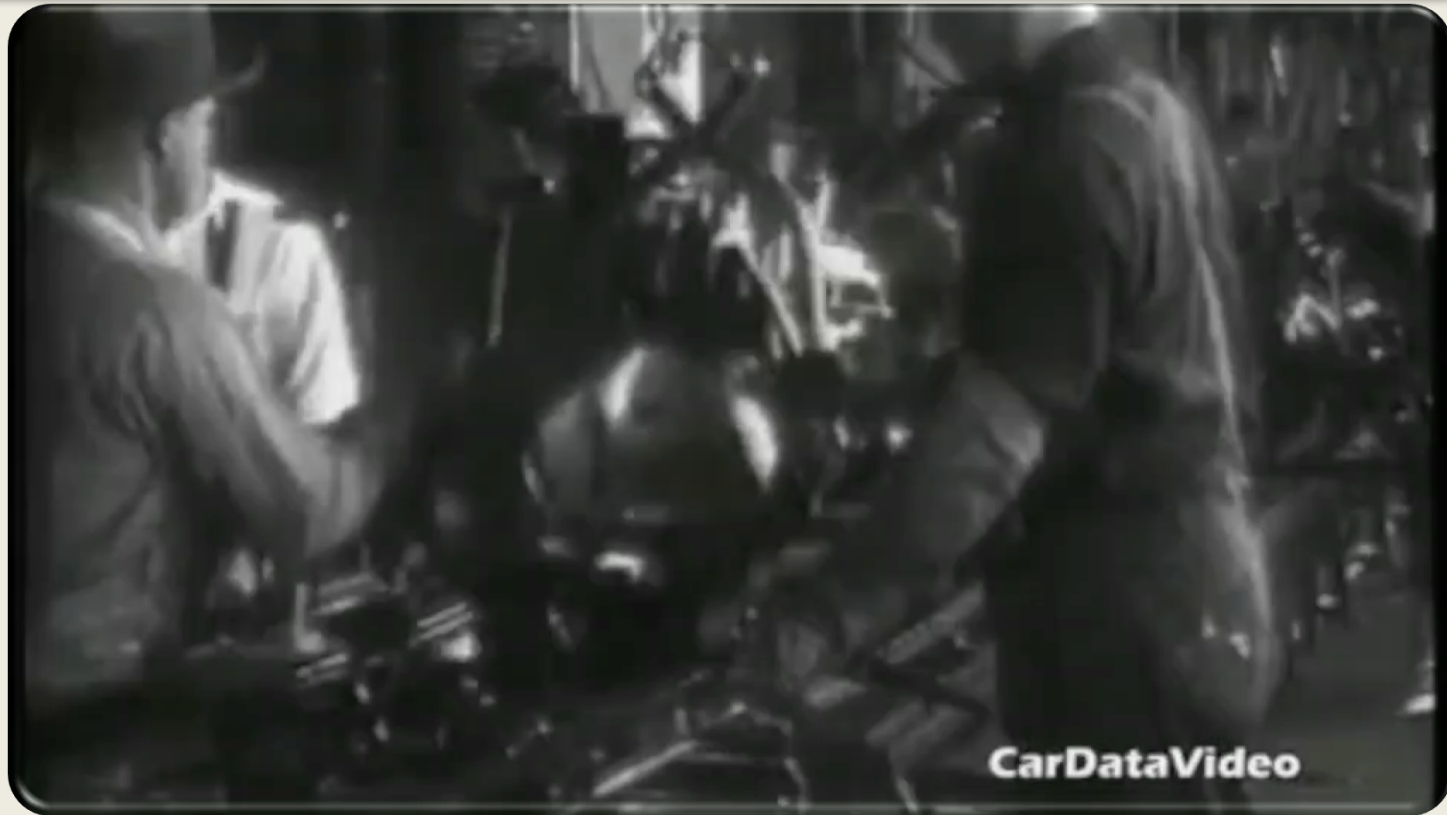
- Additive Manufacturing or 3D printing can accelerate the innovation and save time material and energy.

First industrial revolution (1760 to 1830)



Transition from hand production to machines, the use of water and steam power in machinery

Second industrial revolution (1840-1940): Technical Revelation



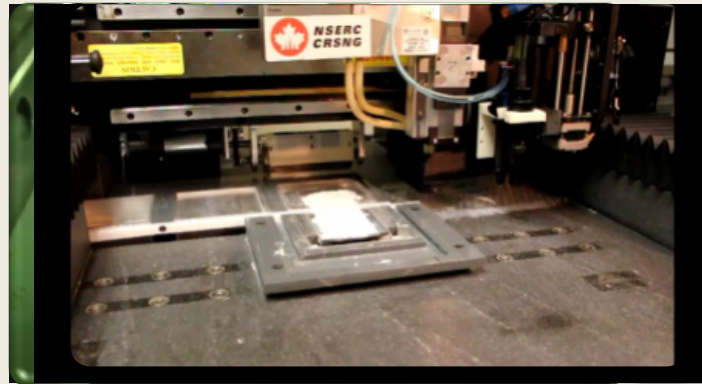
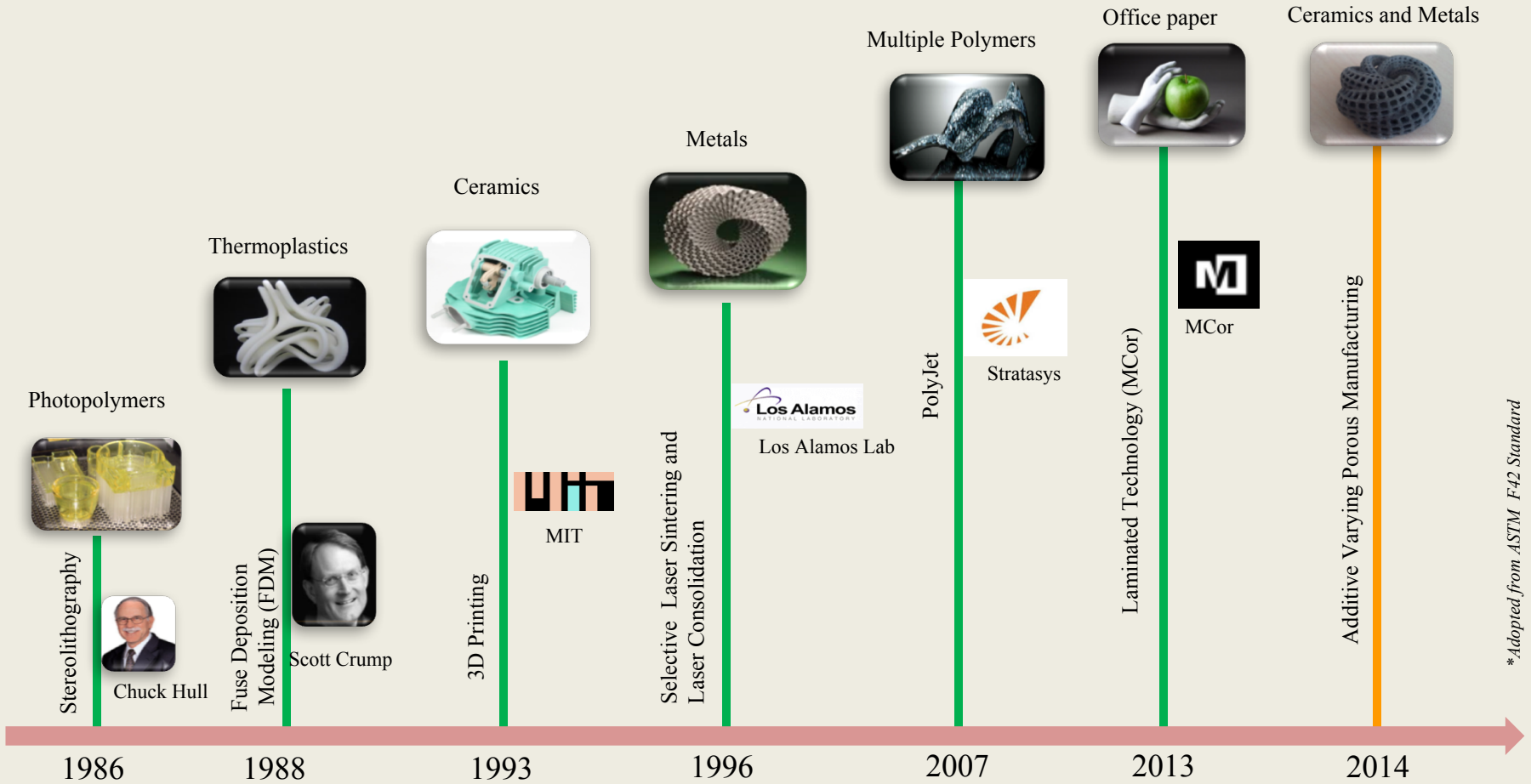
Development of railroads, large scale steel production, widespread use of machinery in manufacturing, use of oil, beginning of electricity

Third industrial revolution (2010 to probably 2040)



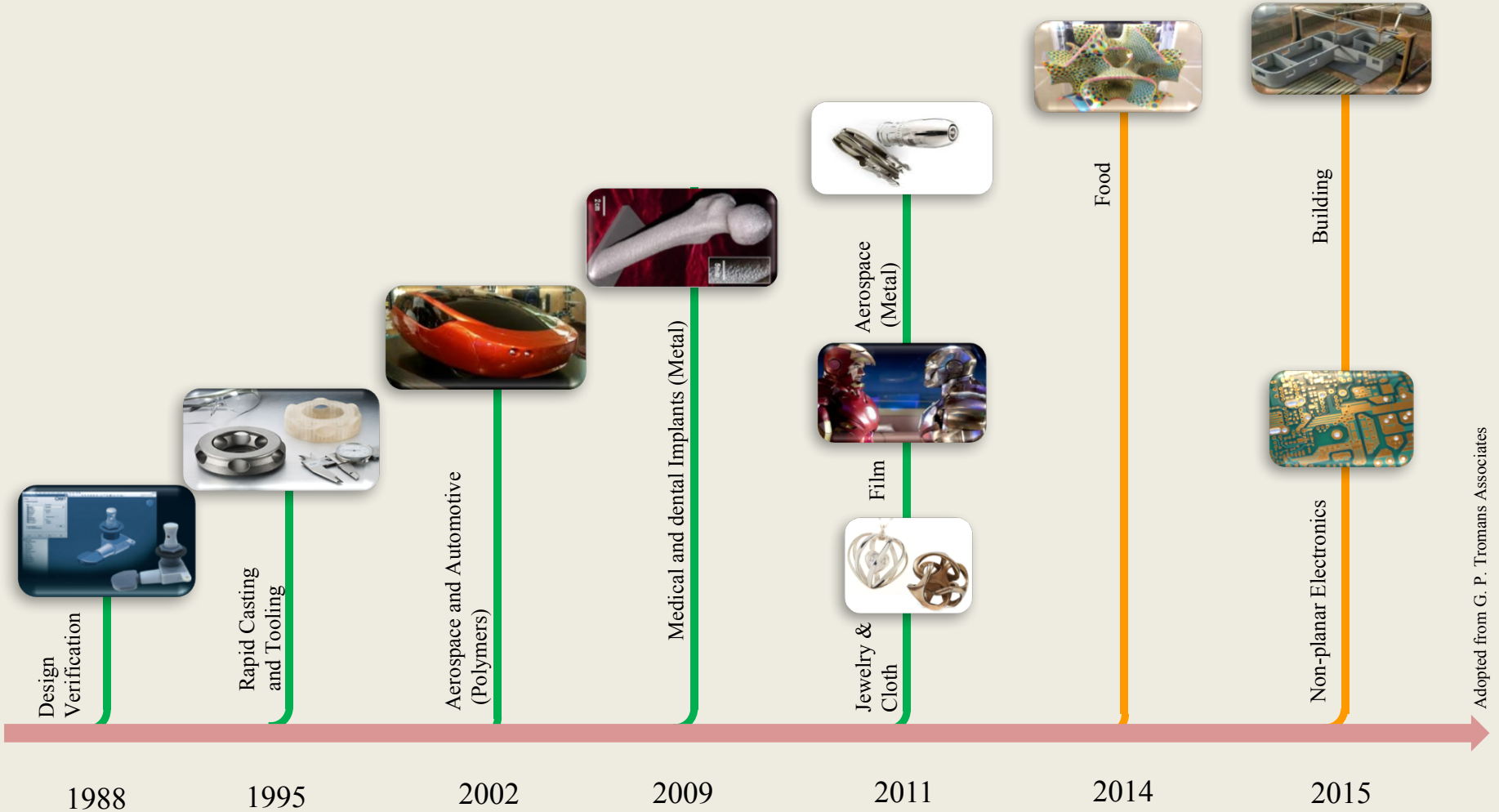
Digital and distributed manufacturing, customized goods, manufacturing on demand; all will change the politics of jobs

The Evolution of 3D Printing



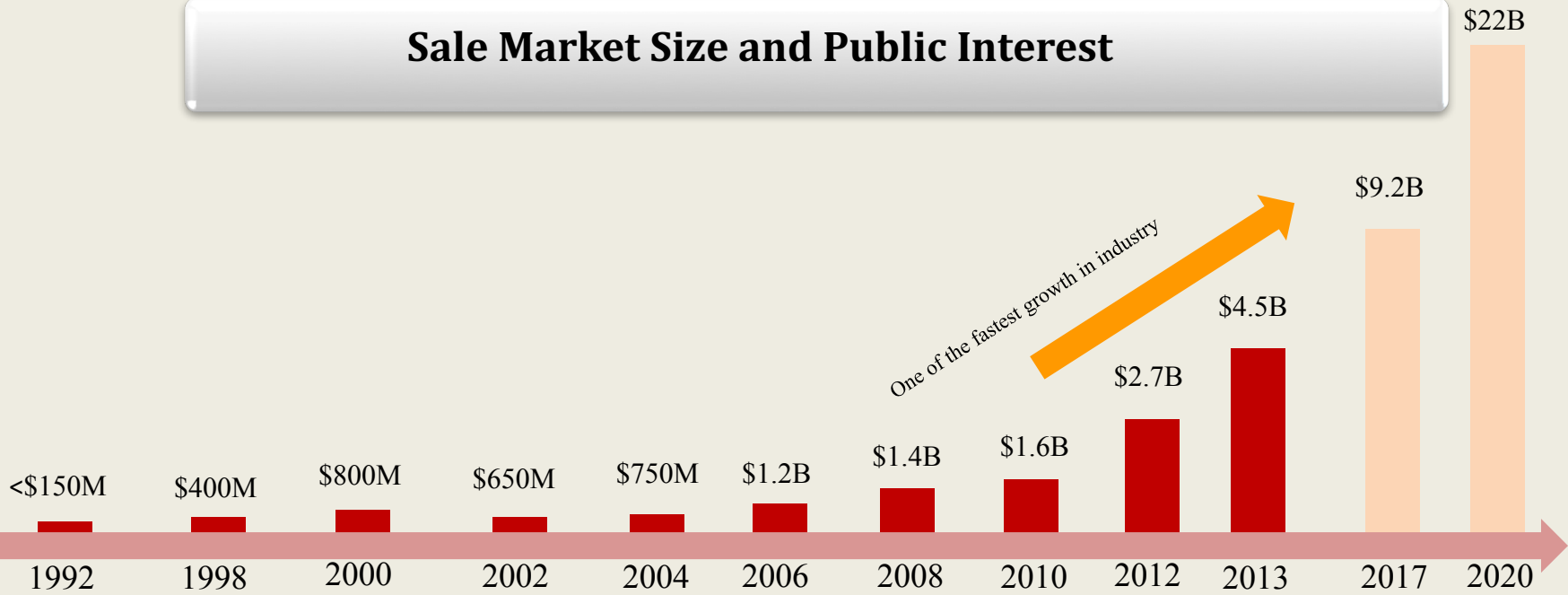
**Adopted from ASTM F42 Standard*

Additive Manufacturing Applications

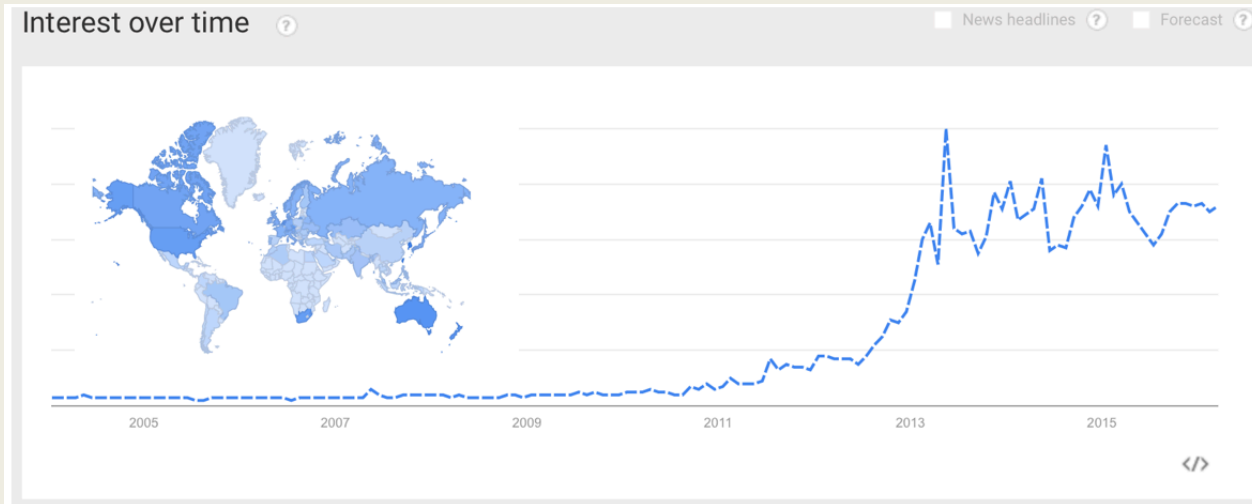


Adopted from G. P. Tromans Associates

Sale Market Size and Public Interest



Adopted from Wohler Report 2014



Google Trend, taken on March 7, 2016
Search word "3D Printing"

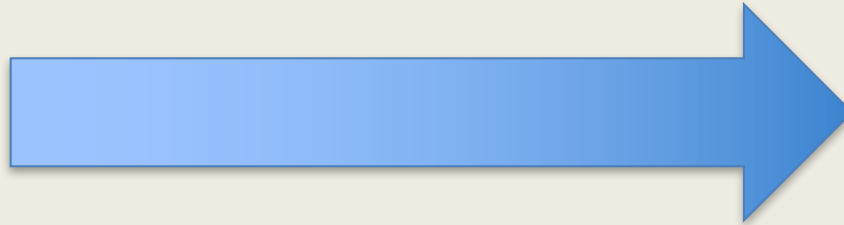
What is the reason behind this growing interest and increased 3Dprinting market size!



2010
\$12000



2013
>\$250000

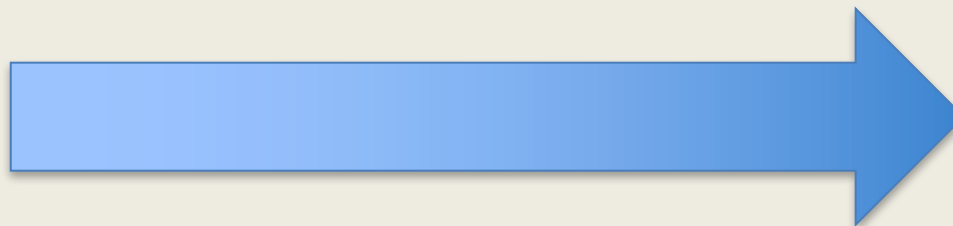
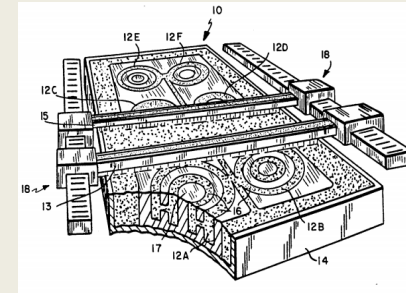


Excerpt from ExOne Co. to UNITED STATES SECURITIES AND EXCHANGE COMMISSION, Dec 2012

- *“Certain of the MIT Patents under which we are licensed will expire over the next 24 months. We believe that the expiration of these licenses will not impact our business, however the expiration may allow our competitors that were previously prevented from doing so to utilize binder jetting 3D printing.”*

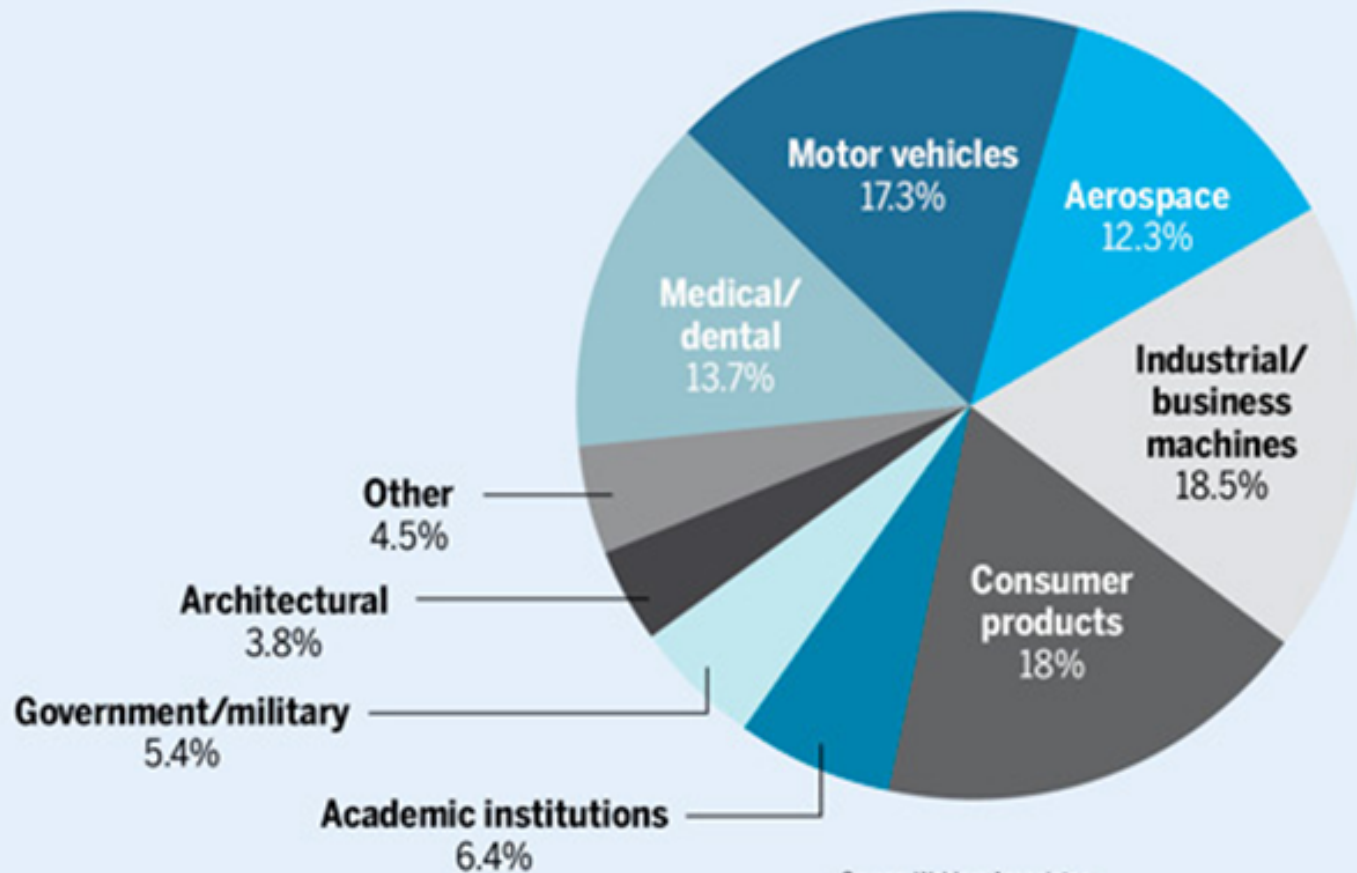


2016
\$300



2016
<\$10000

Industries embracing additive manufacturing



Source: Wohlers Associates

MIT Technology Review

Subtractive Manufacturing

Traditional Manufacturing



Additive Vs. Subtractive Manufacturing



Lockheed Martin is streamlining satellite production with 3D titanium printing to lower cycle times and reduce cost.

HOW 3D PRINTING WORKS

- STEP 1**
We input 3D computer-aided design data into the printer controller.
- STEP 2**
We load titanium powder into the printer, close the door and create a vacuum atmosphere.
- STEP 3**
A wiper layers powder across a platform and an electron beam melts the powder at XY coordinates.
- STEP 4**
The platform is lowered, and the process is repeated until the 3D object forms.
- STEP 5**
We cool the part and put excess powder back into the hoppers for reuse.

BENEFITS OF 3D PRINTING

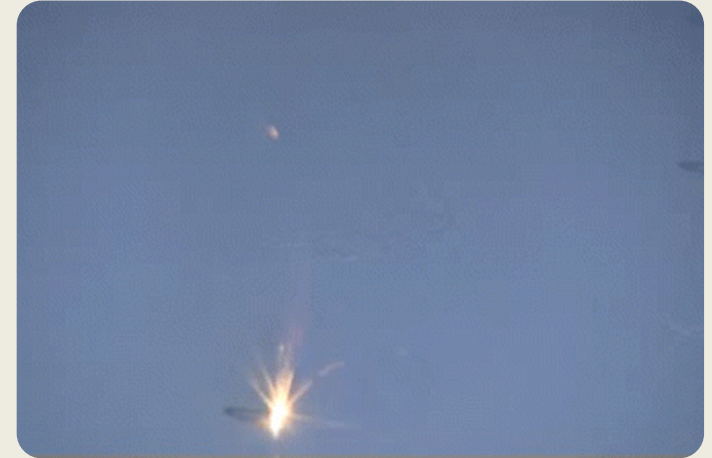
TRADITIONAL	3D PRINTING	TRADITIONAL	3D PRINTING
	43% CYCLE TIME REDUCTION		48% COST REDUCTION

FUTURE OF 3D PRINTING

3D PRINTING PARTS TODAY...STREAMLINING SATELLITE PRODUCTION FOR THE FUTURE

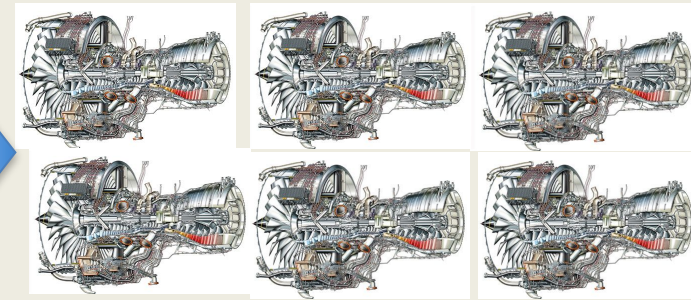
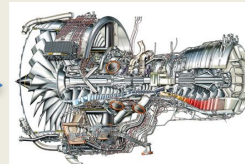
www.lockheedmartin.com

Additive Vs Subtractive Manufacturing

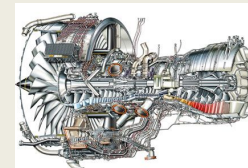
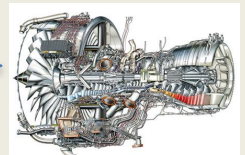


- Trent XWB-97 Designed for the AIRBUS A350-1000.
- Time required to produce the airfoils was reduced by a third.
- Compared to the previous model, thrust at takeoff increased:
- 84,000 lbf \longrightarrow 97,000 lbf

Subtractive Manufacturing



Additive Manufacturing

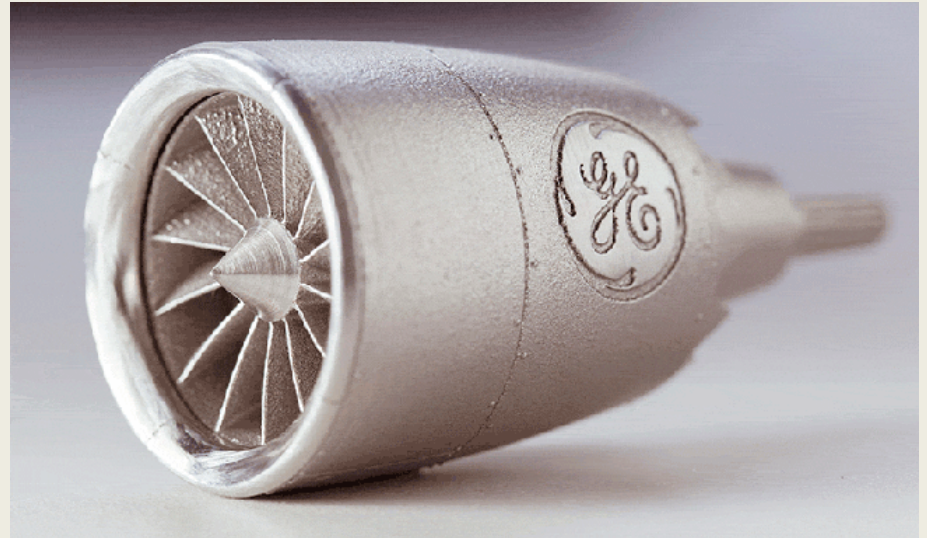


Additive Vs Subtractive Manufacturing



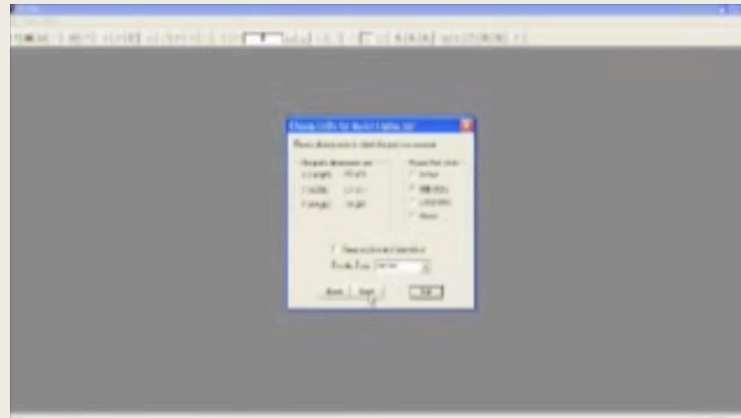
“Additive manufacturing has huge advantages from a cost standpoint, It also eliminates the time needed to develop tooling.”

Pratt & Whitney’s CEO David Hess.

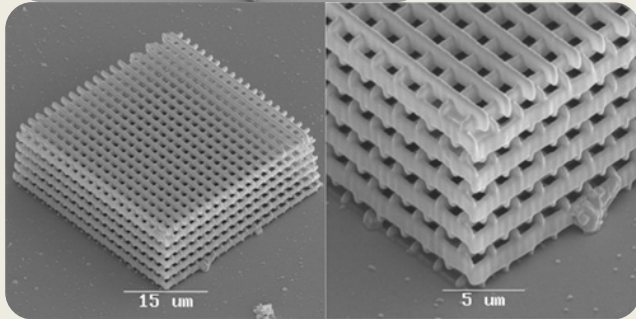
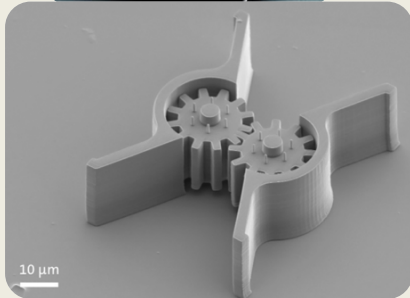
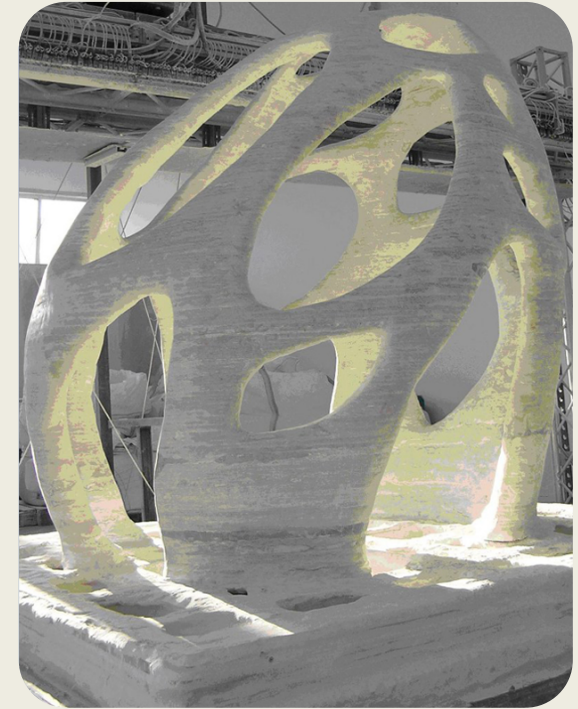
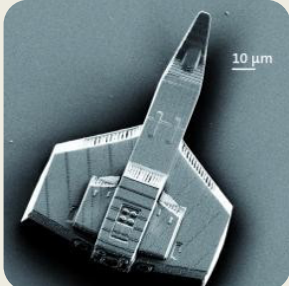


100k Additive parts will be manufactured by GE Aviation by 2020

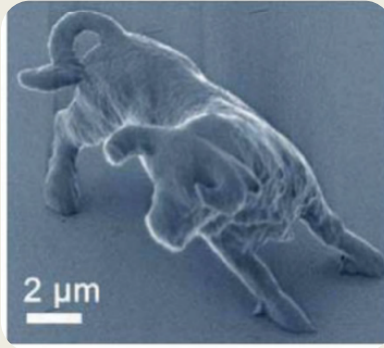
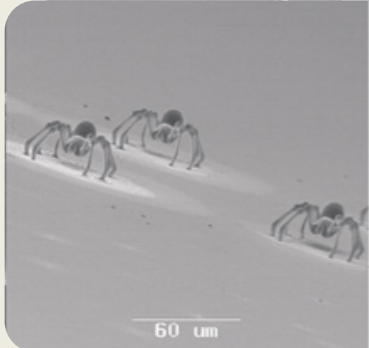
3D Printing or Additive Manufacturing Process



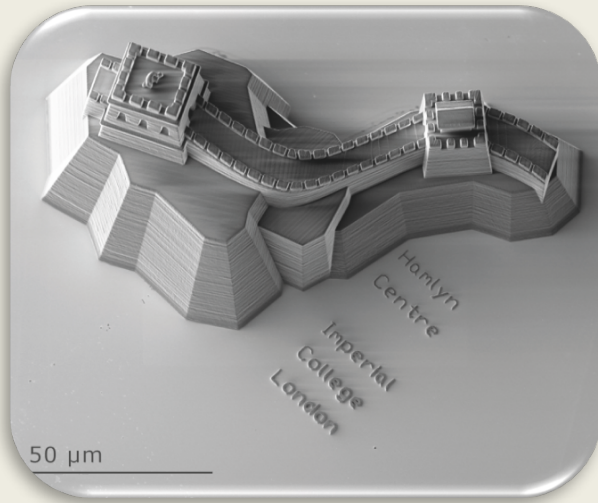
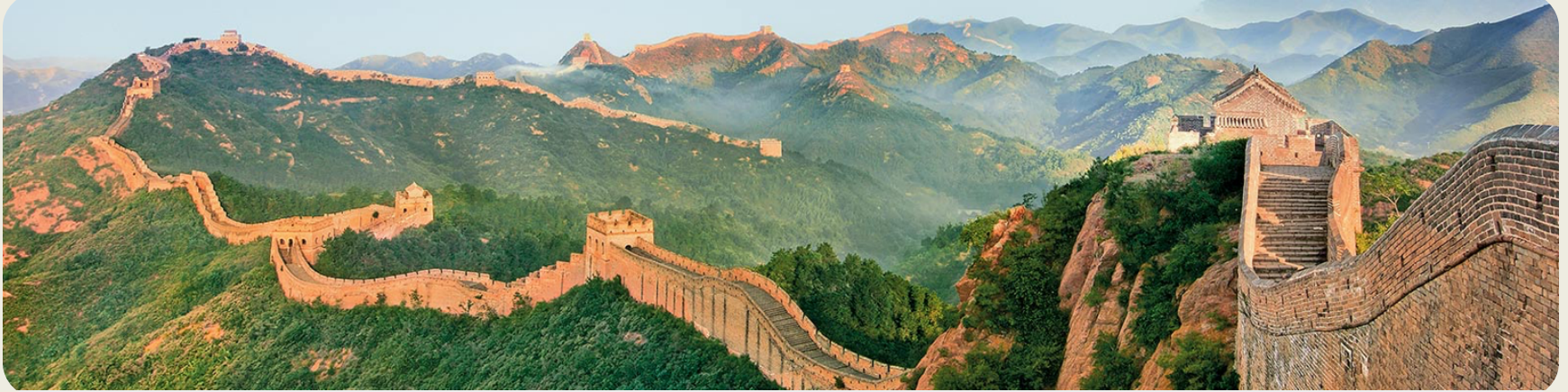
Additive Manufacturing Scale



**BEYOND
IMAGINATION**



Additive Manufacturing Scale

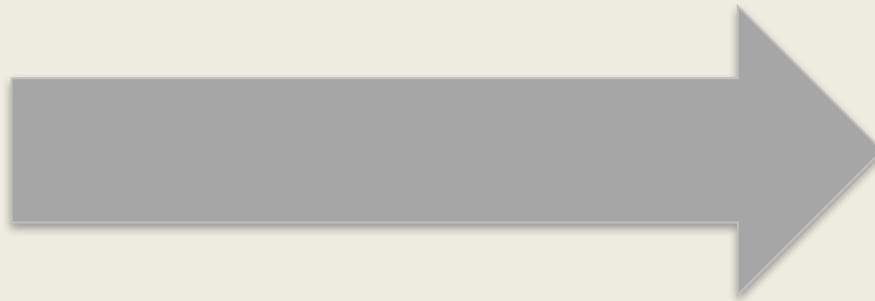


Strand of hair



What is the cost of a 3D printer?

- Machines can cost anywhere from a few hundred dollars up to a million dollar.



How it works?

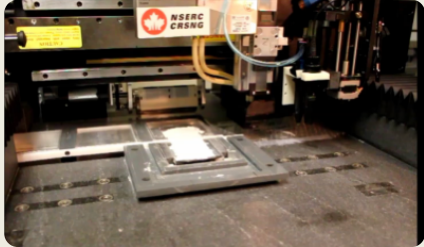
PART

to



Post-processing

Layered
Manufacturing

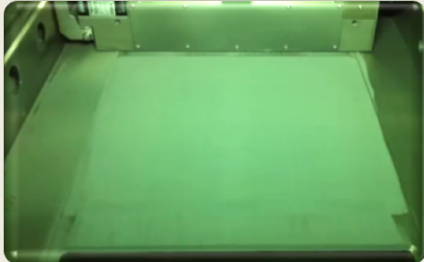


Binder-based
AM process

Pre-processing



Laser-based AM
process



ART

Model design

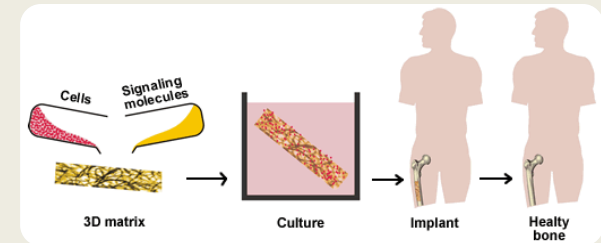


3D Printing in Medical /Dental Industry

Plan for surgery and
Research purposes

Medical and dental
devices

Tissue Engineering



Dental Implant and Abutment

Bulk vs Porous Metal Implant

Commercially Available



3D Printed Implant



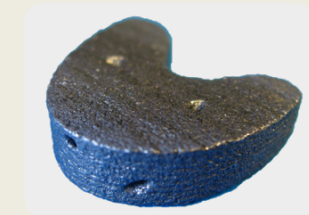
Lumbar Spine Surgery

(Interbody fusion devices)

Commercially
Available



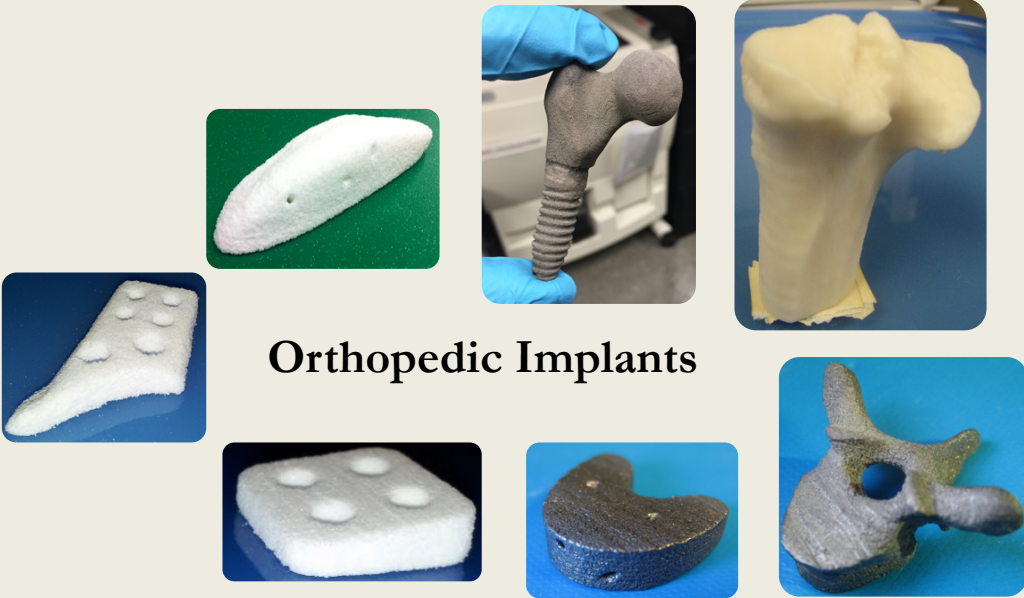
3D Printed



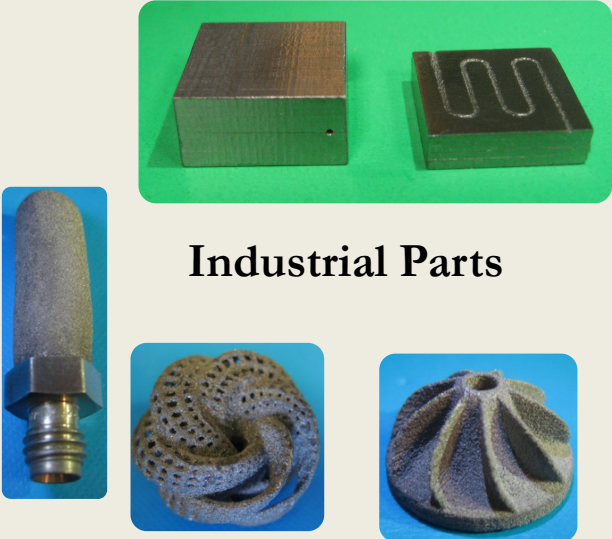
*Courtesy of Zimmer™

Printed in University of Waterloo

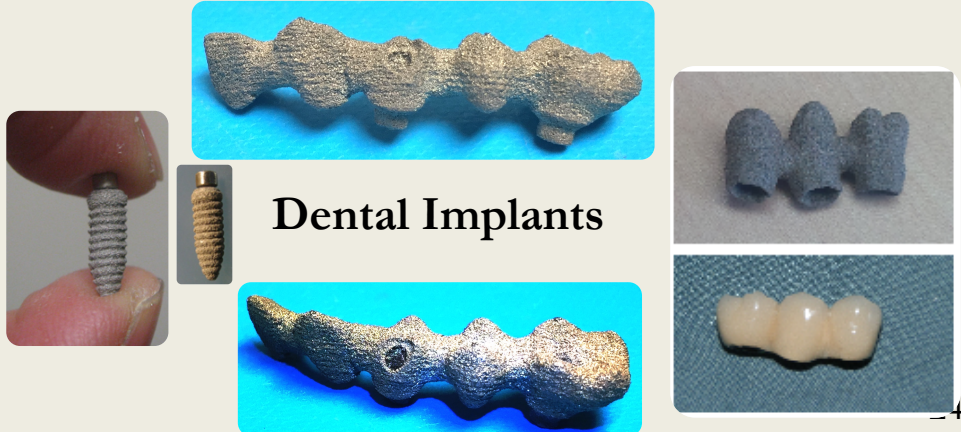
Orthopedic Implants



Industrial Parts

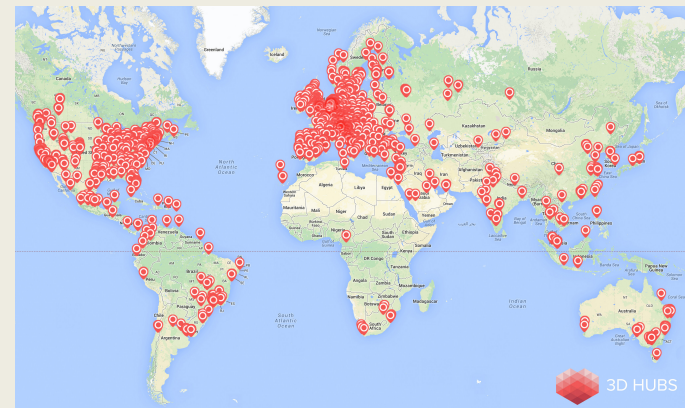
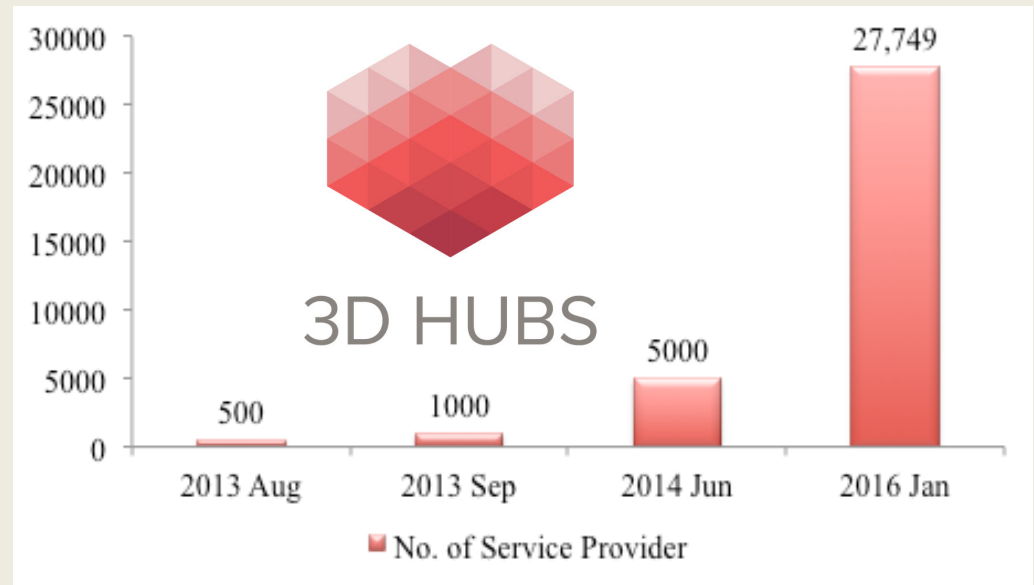


Dental Implants



Future Direction

Manufacturing On Demand



Thank you
for
your listening



Application Video: 3D μ -Printing

Dr. Ahmad Basalah
Department of Mechanical Engineering
Umm Al-Qura University
Email: aabasalah@uqu.edu.sa



Twitter : @engaab