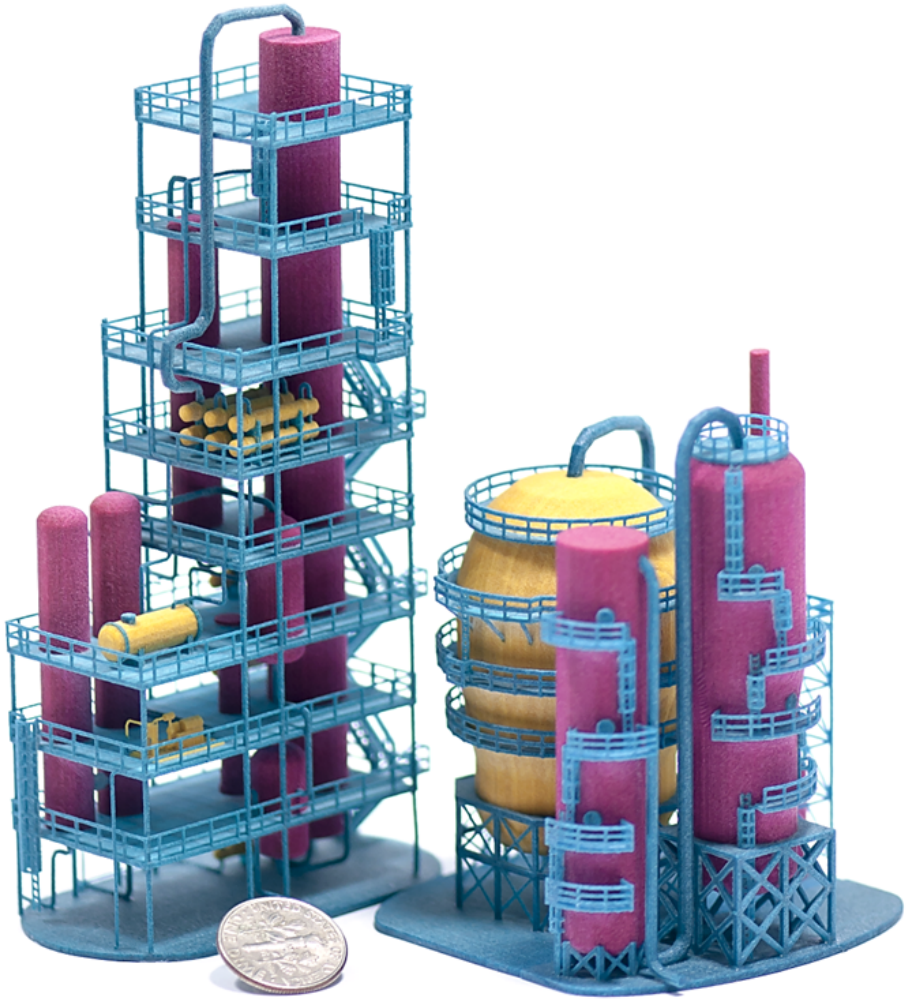
HP 3D Printing Competition at DGDW 2016

New Business Models that Create Meaningful Impact



January 2016

Project Scope and deliverables

Scope

- Provide specific use cases on how 3D printing can make industries more sustainable.
- Quantify the amount of savings and explain how 3D printing will impact the value chain.
- Propose strategies on how HP can take unique advantages of these changes.

Deliverables

- Each team must submit a presentation of 10-15 slides explaining their findings. All explanations should be made in the notes section in the slides. An explanation on how to submit the presentation will be provided later. Teams can start working on the problem as soon as they want.

HP 3D printing will enable sustainability by scaling the circular economy for the world's industries

3D printing will transform supply chains and industries because it digitizes manufacturing --- offering the ability to locally produce — both rapidly and inexpensively — short runs or one-of-a-kind parts. There are four key sustainability benefits:

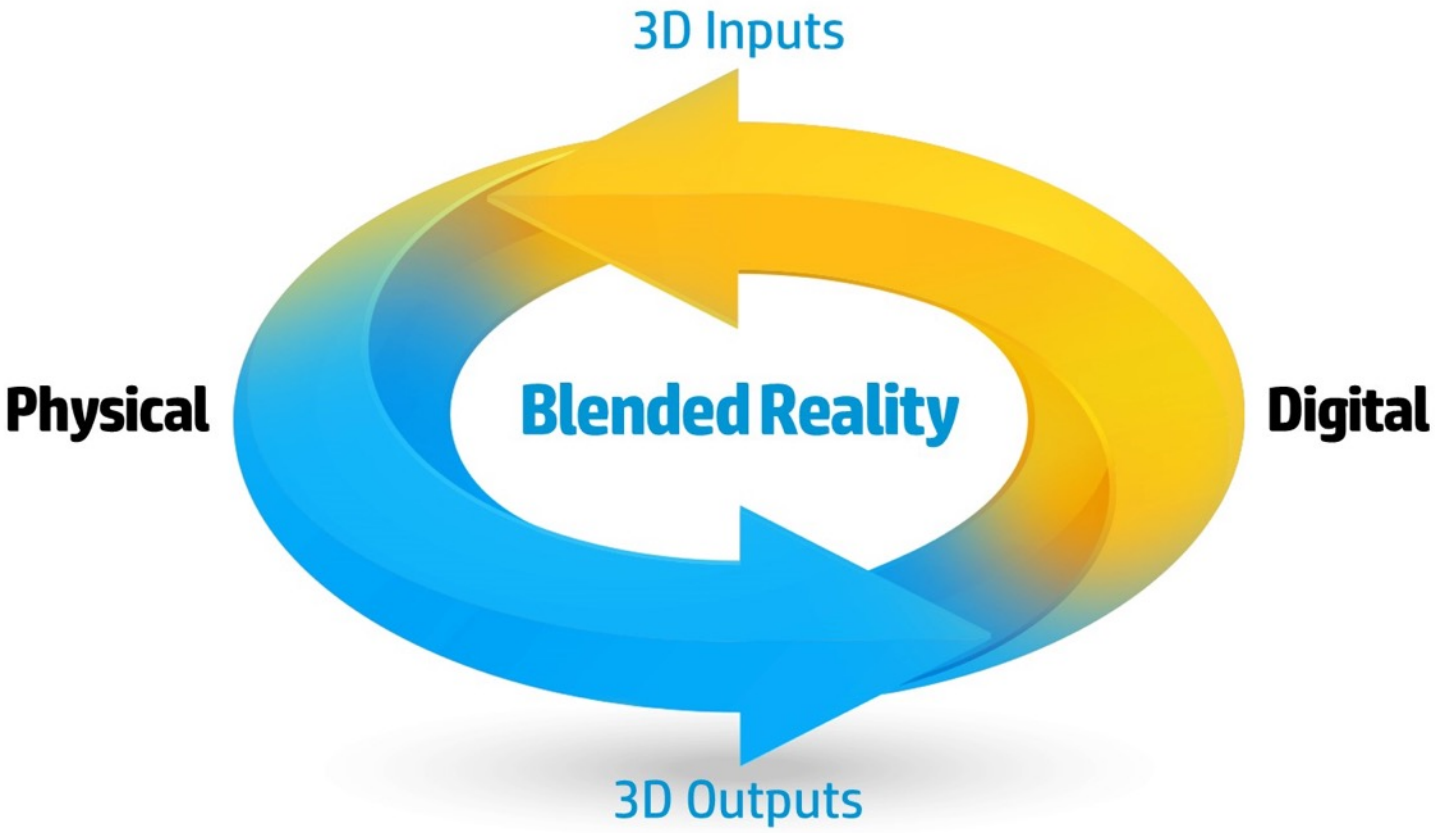
- 3D printing allows perfect matching of supply and demand, dramatically reducing the waste associated with building products and spare parts that are never used.

- Localized manufacturing eliminates the environmental impacts associated with transportation from large regional or global factories and warehouse operations.

- Product lives will be extended because of the ability to manufacture repair parts on demand that would otherwise not be available, or expensive, or require advanced warehouse and logistics systems.
  - OEMs will be able to retain the economic incentives to provide spare parts on demand, better competing with aftermarket alternatives.
  - They will be able to iterate part design more easily – thus improving customer experience, serviceability, and better competing with alternatives.

- Additive manufacturing dramatically reduces the amount of material needed to make a finished part by realizing complex shapes or redesigning complex assemblies into a single part (e.g. heat exchangers, engines) and reducing waste from traditional manufacturing methods (e.g. machining).

HP’s Blended Reality vision



3D Printing

Final Part Manufacturing

- Accessories
- Jewelry
- Medical/dental
- Sport equipment
- New products
- Repairs

Prototypes

- Concepts
- Models
- Fit test
- Functional test
- Training
- Jigs
- Molds

Consumer/ Prosumer Apps

- Personalization
- Toys
- Hobby
- Gadgets
- Deco/Art
- Jewelry

Why 3D Printing

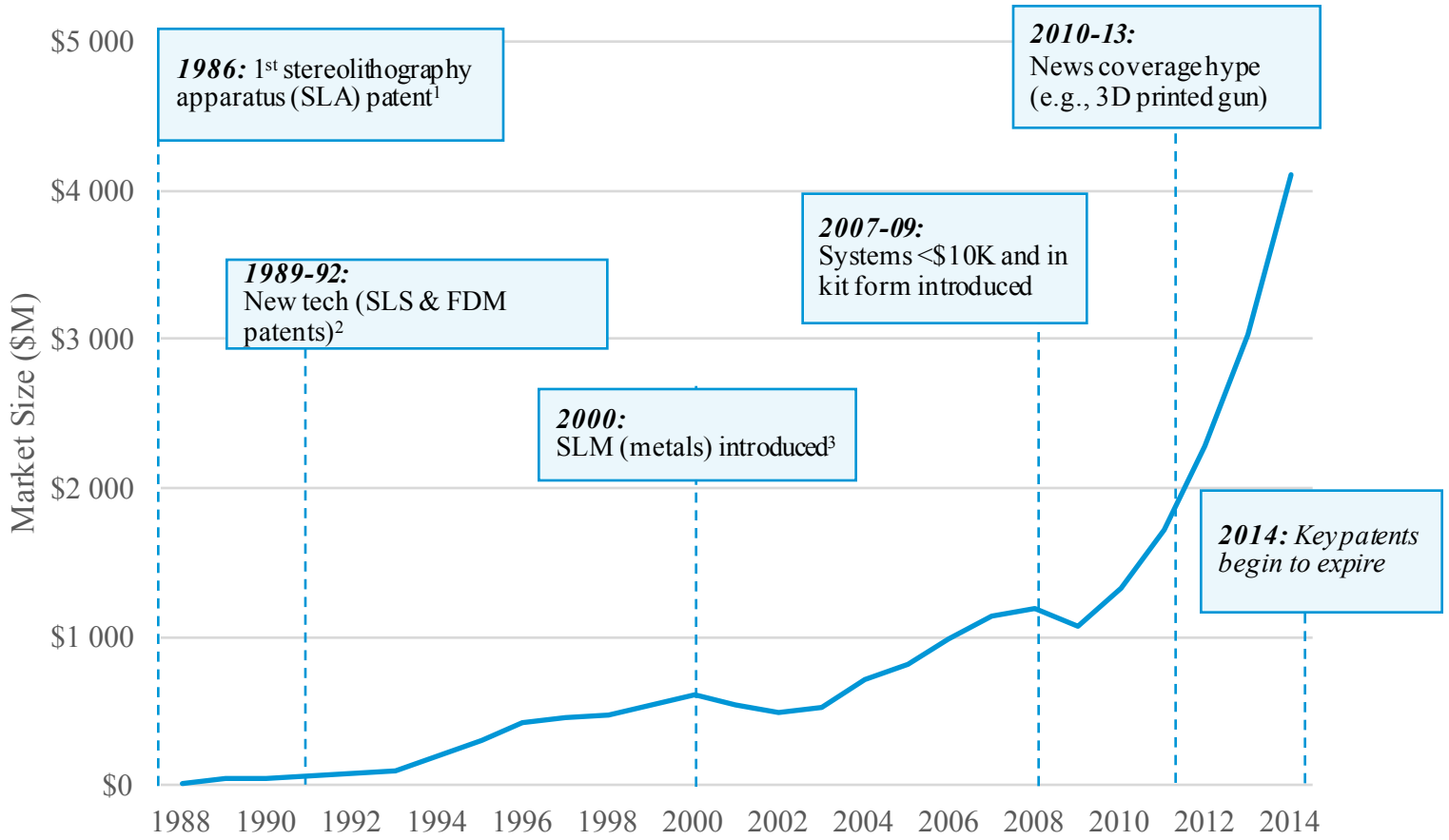
- Produces **one-offs efficiently**, without tooling
- Eliminates almost all **setup time**
- Creates **complex geometric** forms

Macro trends

- Personalization
- Faster concept and product development cycles
- Short runs

3D printing has been a revolution ~30 years in the making

3D printing market (1988-2014)



Why acceleration?

1. **Decent tech at reasonable price**
2. **Prolific high-value use cases**
   (e.g., GE fuel nozzle, Invisalign "braces")
3. **Significantly increasing prod'n focus**
   (early adopters include Airbus, GE, Nike, BMW)
4. **Increase in funding**
   (e.g., gov't such as US, China, EU; VCs)

(1) SLA = Stereolithography; (2) SLS = Selective Laser Sintering, FDM = Fused Deposition Melting; (3) SLM = Selective Laser Melting
Source: Wohlers Report 2015, BCG analysis, IDC 2013

HP 3D printing vision

HP views this as an opportunity to disrupt the process of innovation

HP 3D printing vision

HP views this as an opportunity to transform industries

HP transforms manufacturing from analog to digital…

3D printing is transforming manufacturing across industries

Aerospace

50% lower cost

12 mths to **3** hrs prod'n

Industrial

25% lower dev cost

52 to **25** wks time[1]

Consumer Goods

70% less waste

36 to **6** mths time[2]

Automotive

Order of magnitude lower cost

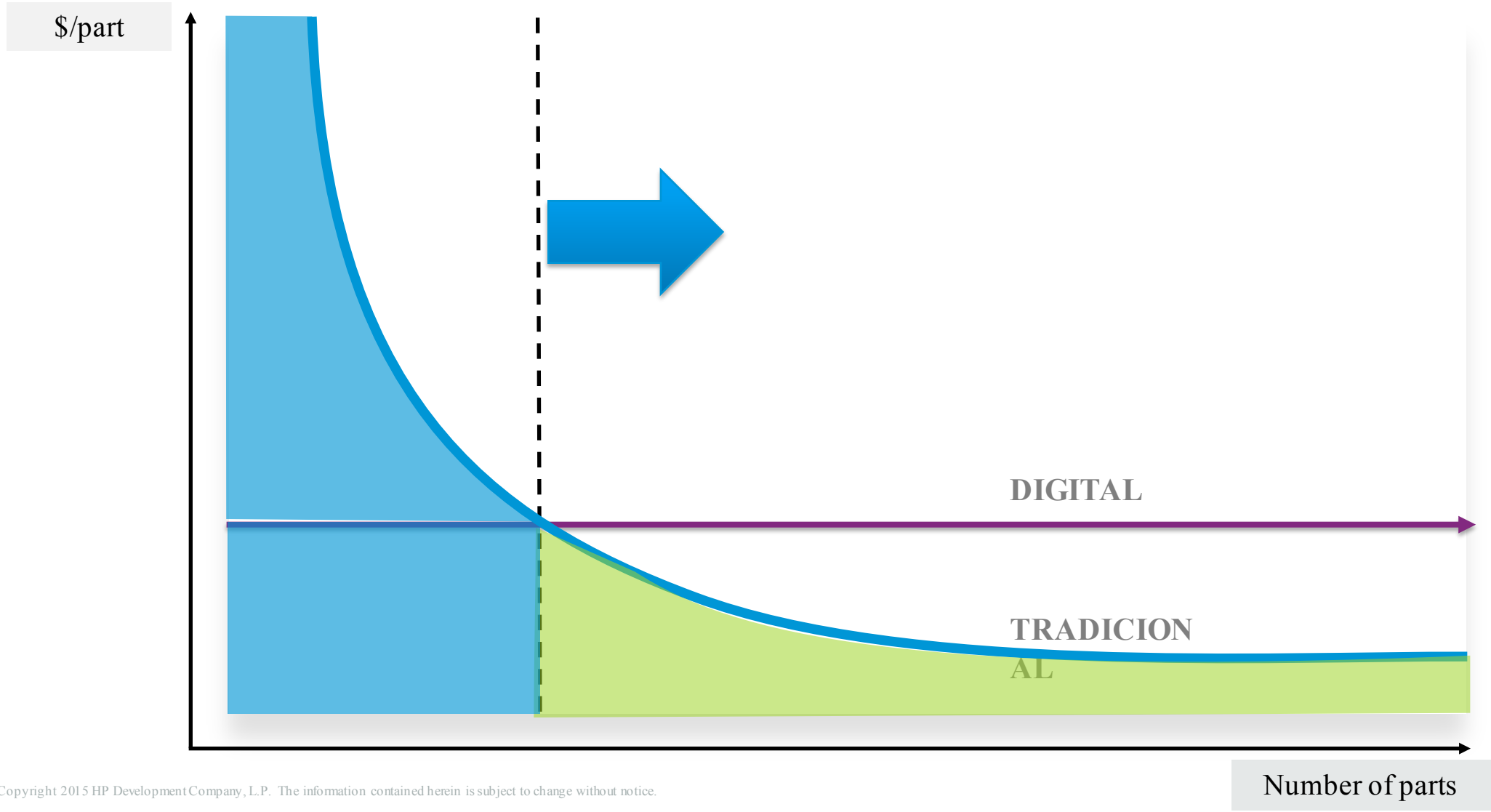
4 mths to **3** days prod'n

Healthcare

>$600M

new application created

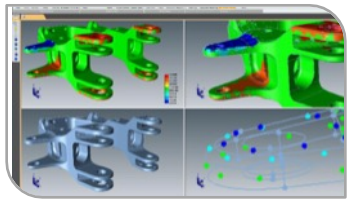
Break-even point for fabrication



Market acceleration requires design-to-delivery transformation

1 Design shift

New design tools and approach to optimize for 3D printing



2 Manufacturing upgrades and integration

Improved price & performance (e.g., throughput, quality), new work flows, and interfaces across 3D & traditional processes

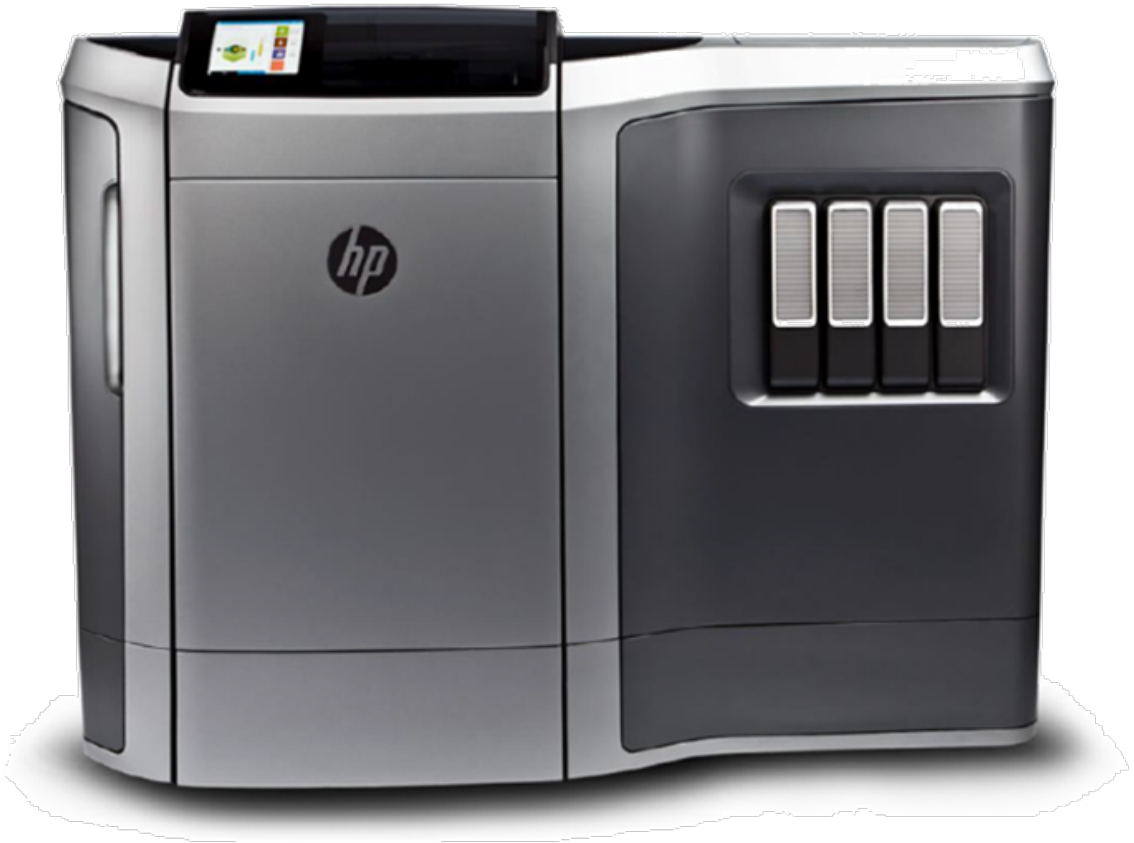
3 Supply chain re-engineering

Optimization for mass customization, inventory, rapid turnaround, etc.

4 Supporting ecosystem

Broader materials, value-added solutions & services, seamless file-to-print

HP Multi Jet Fusion



Performance

10x faster (2)

Quality, Strength, Durability

Accuracy Detail

Saves time and cost

Achieves break-through economics

Unifies and integrates various steps of the 3D print process to reduce running time, cost and waste(3) to significantly improve 3D printing economics (1)

(1) HP Multi Jet Fusion™ technology leverages proprietary HP Thermal Inkjet technology, enabling lower cost systems that output similar quality to more expensive devices -- such as selective laser sintering (SLS) -- and speed.

(2) Based on internal HP testing of part build time, for a set of representative parts in batch process comparing HP Thermal Inkjet based Multi Jet Fusion™ technology to the leading 3D printing technologies in the U.S. -- selective laser sintering (SLS) and fused deposition modeling--as of October 2014.

(3) By selectively combining multiple fluid agents, HP Multi Jet Fusion™ technology reduces the system requirements for large, vacuum-sealed ovens. In addition, the same support material for a given set of objects is aged less simply because the exposure to the adverse thermal and environmental conditions is shorter. These technology characteristics enable HP Multi Jet Fusion™ technology to help minimize waste and reduce energy use.

Thanks!

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