3D Printing:
A Review and Synthesis

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Outline

- Historical Evolution

- Common Applications

- Research Plan

- Findings

- Implications for Business

- Wrap Up

Historical Evolution Part I
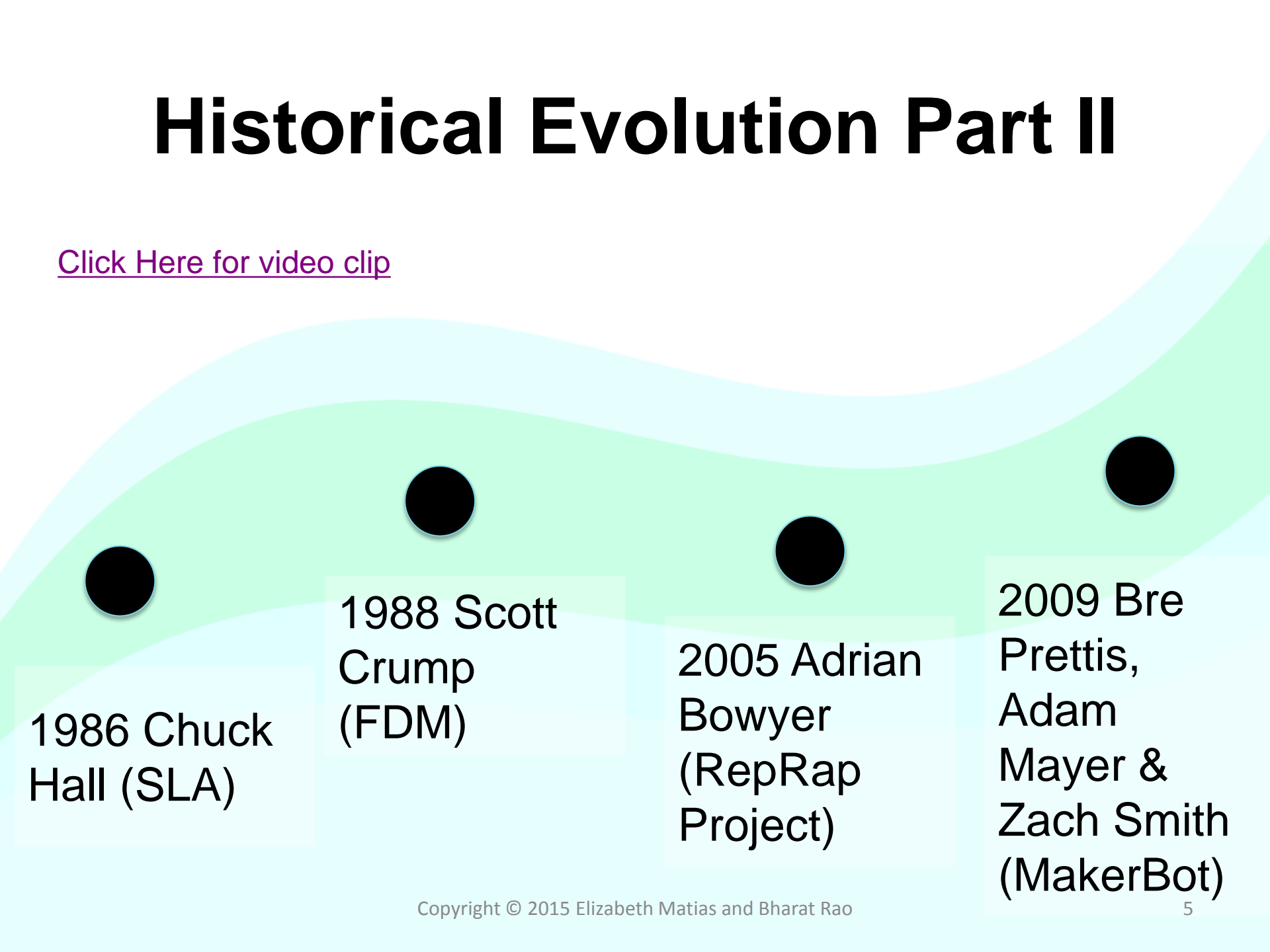
19th Century Topography

1972 Ciraud

1981 Hideo Kodama

1982 Alan Hebert (3M)

Historical Evolution Part II

Click Here for video clip

1986 Chuck Hall (SLA)

1988 Scott Crump (FDM)

2005 Adrian Bowyer (RepRap Project)

2009 Bre Prettis, Adam Mayer & Zach Smith (MakerBot)

Common Applications

- Rapid Prototyping

- Tinkering

- Personal Manufacturing

- Small Batch Production

- On Demand Manufacturing

Rapid Prototyping

- Process of designing a 3D model with computer aided design software (CAD), and producing a prototype, typically out of plastic, via 3D printing technology

- Viewable model to envision final product

Sample Prototypes
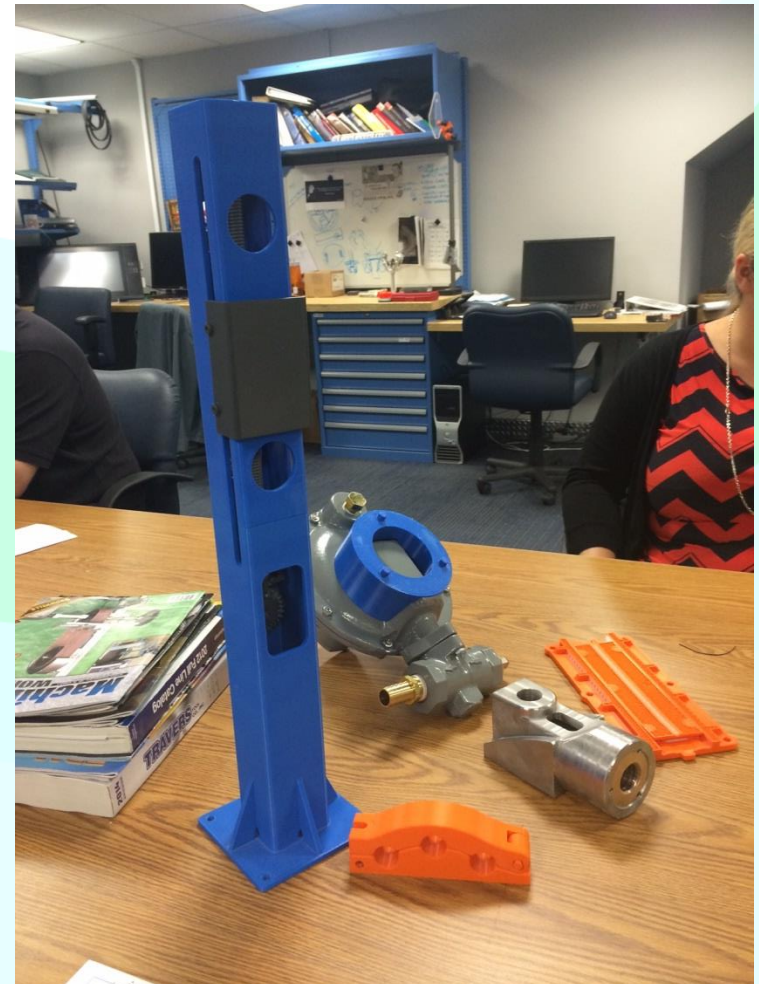
Tinkering

- The process of casually playing with or futzing with a product design in hopes of improving or repairing the product.

Ben Franklin: Michael J Deas

Small Batch Production

- Manufacturing process whereby an entrepreneur or business determines a low volume of a particular product is economically viable
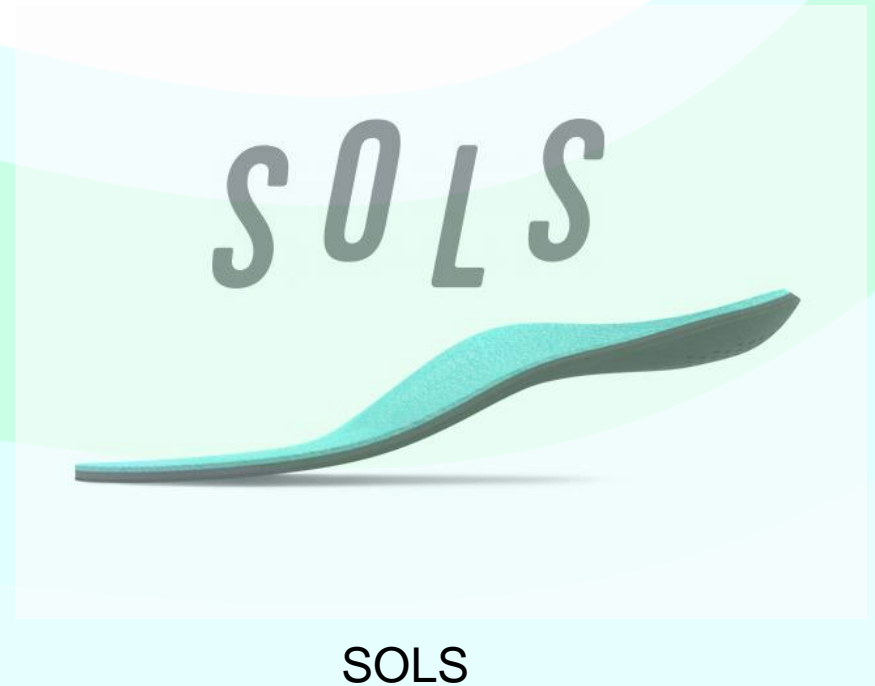
Etsy

Personal Manufacturing

Consumers fill a personal need, thereby executing their own product development cycle.

"eggbot"

On Demand Manufacturing

- Customer designs or customizes a product. Then orders product, which is manufactured upon order

SOLS

Research Plan

- User Types
- Five Factors
- Underlying Assumptions of the study
- Methodology

User Types

Businesses

- Engineers, designers, architects
- 3DP SMEs
- 10+ year w/ the technology

Consumers

- Broad demographic
- Students & professionals
- Potential users & actual tinkerers

Five Factors

- Hardware Familiarity
- Software Familiarity
- Hardware Specifications
- Cost
- Interest in Customization

Underlying Assumptions

Businesses

- All users are interested in technology for prototyping

- Exploring other applications

Consumers

- Half of all consumers understand basic concepts

- 10% have utilized the technology

- 60% are not willing to pay more than $299/3DP

Methodology

Businesses

- 5 Interviews w/ lead users
  - NRI
  - Cycling Sports Group
  - Shapeways
  - Richards Manufacturing Co
  - Con Edison

Consumers

- Survey administered via SurveyMonkey
- 66/115 survey responses

Business Findings

Factor	NRI	Cycling Sports Group	Shapeways	Richards	Con Edison
Hardware Application	service for customers	prototyping, decal testing	service for customers	prototypes	prototypes
Software	n/a*	PTC Creo	TinkerCad, Scuptris, SketchUp	MakerBot MakerWare	Inventor, Autodesk
Printer Model	Various	Dimension SST 1200es (Stratasys)	Various	MakerBot Replicator 2	Fortus 250mc (Stratasys)
Cost	Various	$35,000	Various	$2,000	$70,000

* Not answered during interview

Business Findings Continued

Stratasys Dimension SST 1200 ES

Stratasys Fortus 250 MC

Consumer Findings

- 10% have used 3D printers
- Most have basic understanding of 3DP
- Only 45% were not will to pay >$299
- 15% were willing to pay a higher price for a 3D printer than expected

Implications for Business

- Consumer 3D Printing Companies
- 3D Software Companies
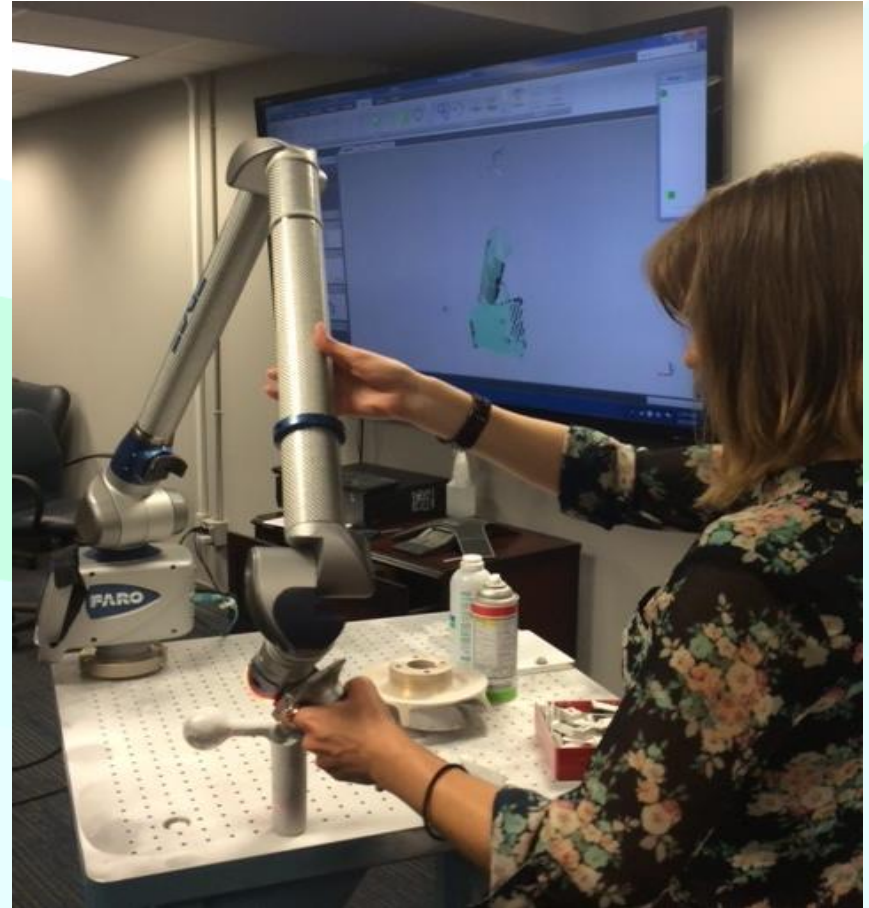- 3D Printing Services

Consumer 3D Printing Companies

- Expand marketing and education efforts on 3D design process

- 3D printer repair shops (Spivey)
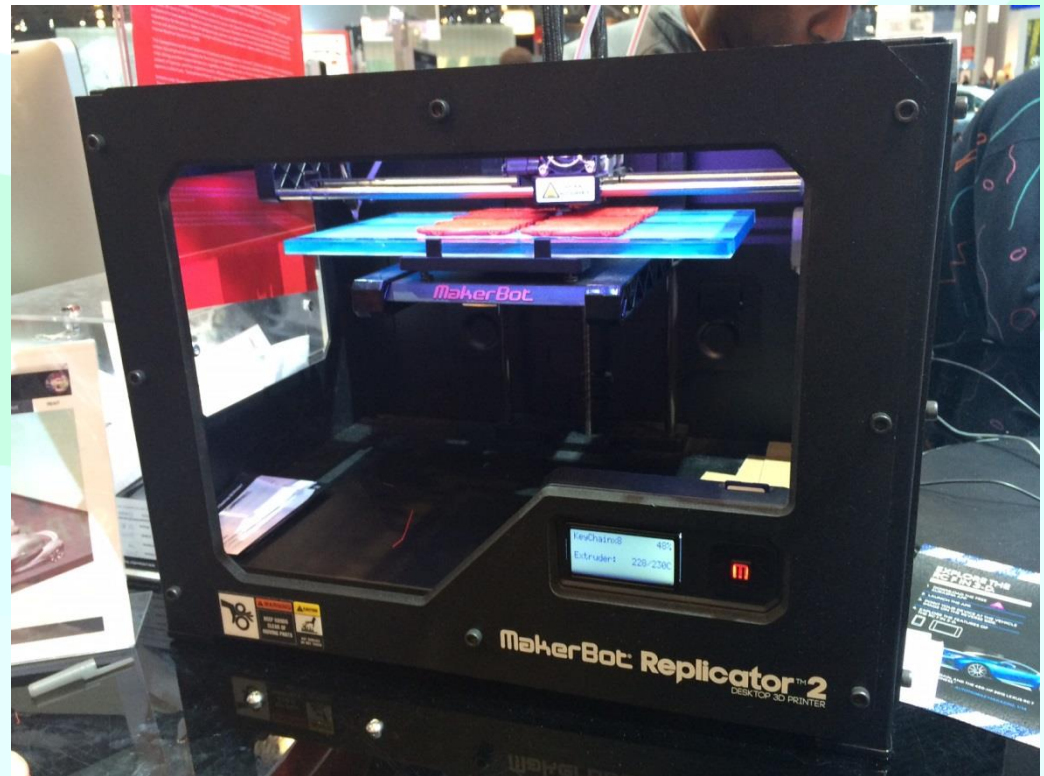
3D Software Companies

- More user friendly CAD software options
- Continue to improve usability of existing apps – Sculptris, Tinkercad

3D Digital Scanner & Software

3D Printing Services

- Continue partnerships like #madeincode, Hasbro, & Wix

- Continue to facilitate 3DP applications – tinkering, personal manufacturing, small batch production, on demand manufacturing

Google & Shapeways

Wrap Up

- 3DP is ideal for intricate, complex designs
- 3DP is new in consumer space
- 3DP is not new for engineers/designers
- Prevalent application is still prototyping
- Additional user analysis is required to project tech adoption

Questions?
Thank You

Matias, Elizabeth and Bharat Rao (2015), '3D Printing: On its Historical Evolution and the Implications for Business,' Portland International Conference on Management of Technology (PICMET), Portland, Oregon, August 2-6th.