

**Research and Analysis of the additive manufacturing process through Case Studies**

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**IPFW Spring 2014**

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## **Executive Summary**

- Exploratory and Practical case study
  - 3d printing as manufacturing method
  - Ecommerce review through sales
  - Assimilating the “Maker Movement” into academia.
  - Customer-centric design vs. manufacturability

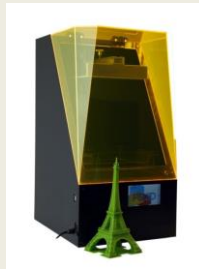
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## Background

- Additive Manufacturing an age-old process
- “3D Printing” the popular contemporary term
- Several types of 3D Printers
  - Extrusion
  - SLA (SLS)



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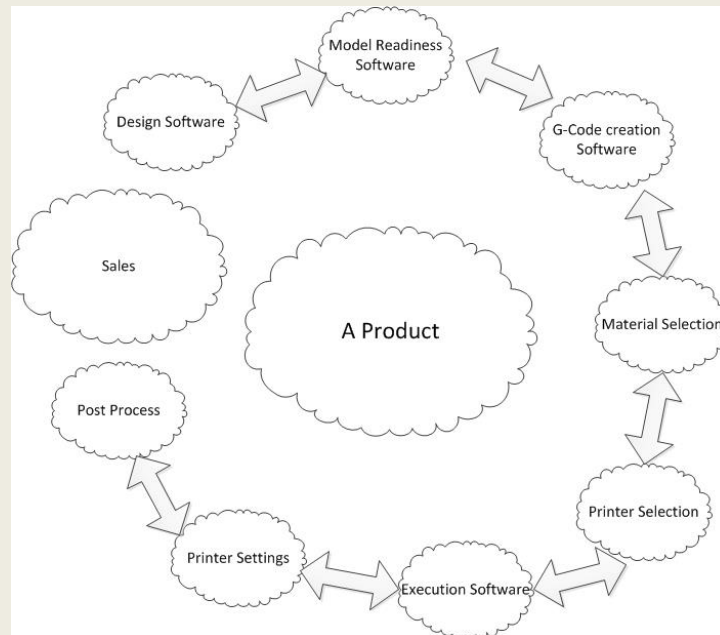


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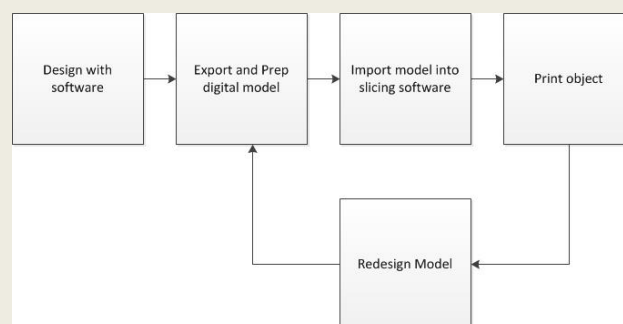
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## Problem Statement

- How does an independent design/engineer create a low cost start-up manufacturing company
- How can that same designer keep up with demand for customized/personalized products.
  - “Entrepreneurs See Rise in Demand for Made-to-Order Goods - WSJ.com.” [5]

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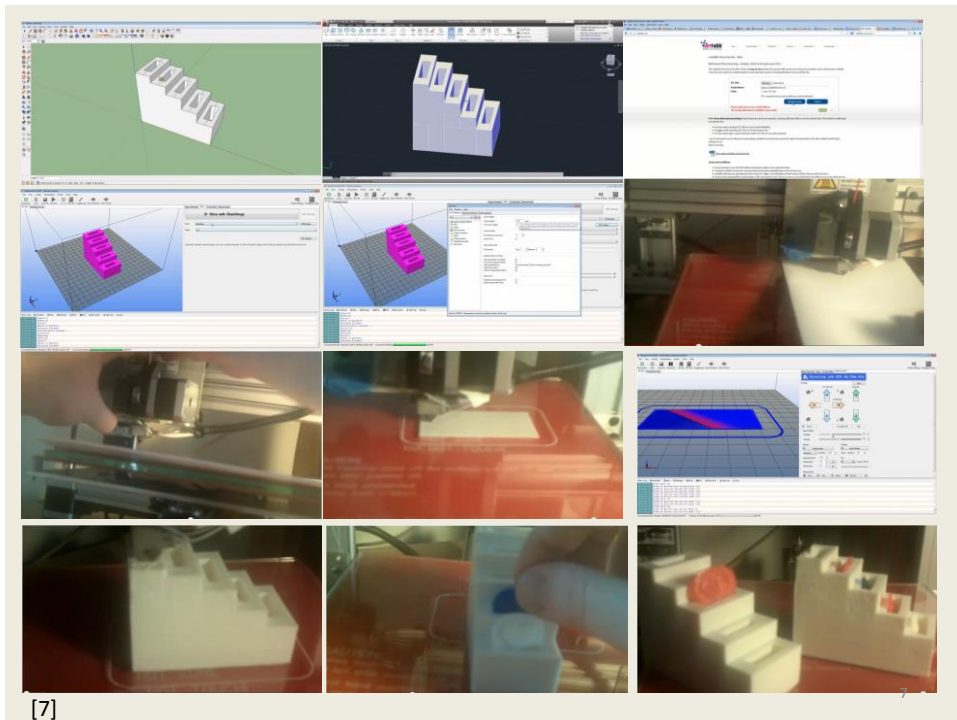
## 3d Printing Process



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- Design, Print, Redesign, Reprint in one day
  - 5 part video series
  - [http://www.youtube.com/playlist?list=PLiWhRm8mmvYSMHtDQAFfHjQ\\_jhOXome5](http://www.youtube.com/playlist?list=PLiWhRm8mmvYSMHtDQAFfHjQ_jhOXome5)

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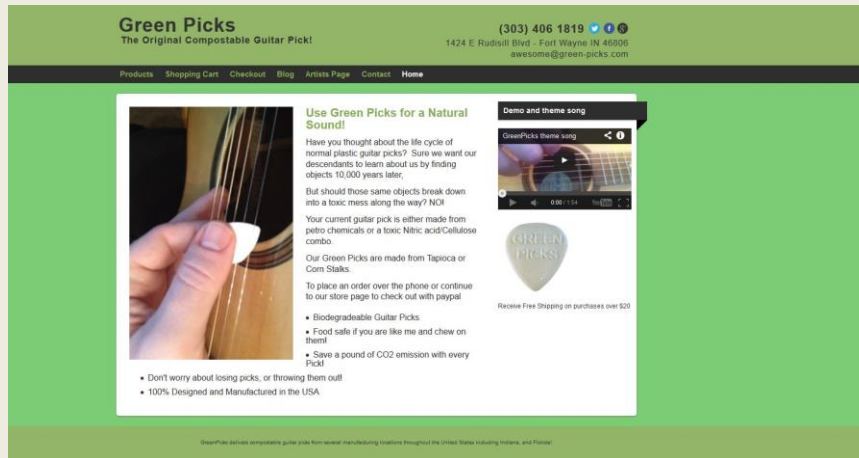


## Feature Case Study: Green-Picks.com

- Product Selection
- Product Testing
- Marketing
- Brand Message
- Production
- Advertising
- Distribution



## Website Version 1 – Dec. 1<sup>st</sup> 2013



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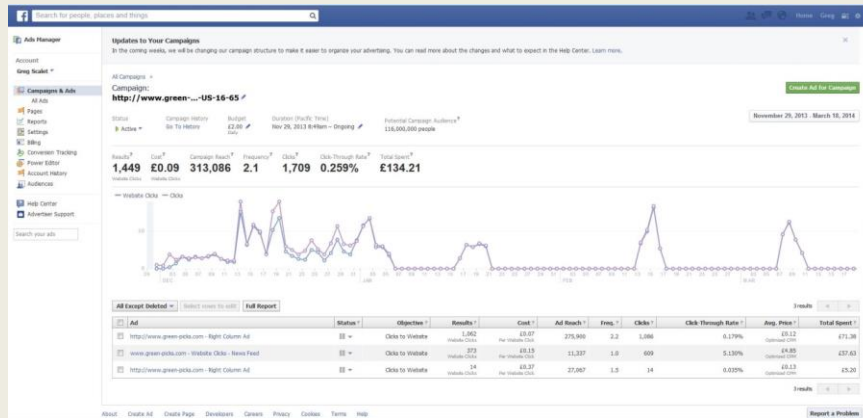
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## Website continued

- Hosted on remote server
- Running WordPress
- E-commerce WordPress plug-in
  - Cashie Commerce
- Offered 3 types of picks for sale
- Landing page for advertisements

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# Facebook Ad Campaign



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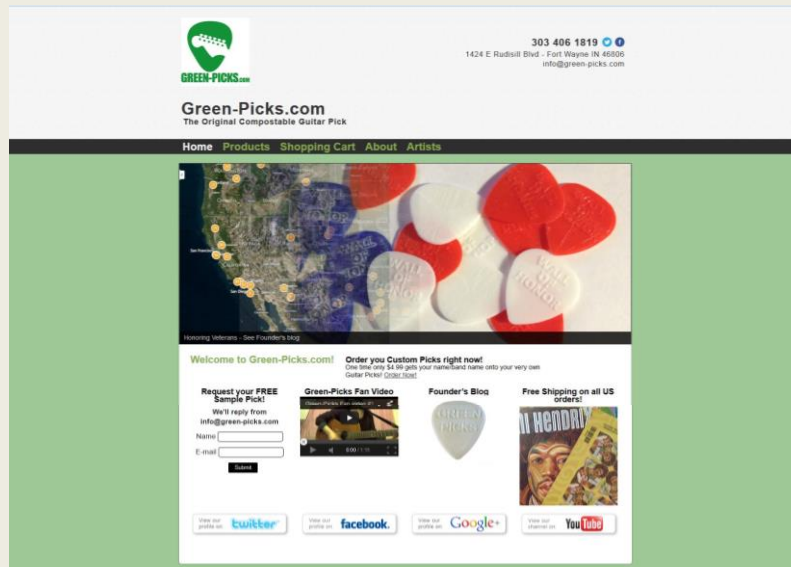
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## Online Presence and SEO

- Facebook Business Page
- Google+
- YouTube channel
- Twitter
- Keywords, Backlinks and becoming an 'Expert'
- First month of Online presence results in 100 free sample requests, little to no organic search results.
- First sale January 1<sup>st</sup>, 2013 through Facebook advertisement redirect

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## Website Re-launch Feb. 1st



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## Fiverr.com and The Pivot

- Customizable Guitar Picks
- Print your name/band name directly on the Pick
- Fiver is responsible for x% of my total sales
- X% of total sales are redirects from Fiverr customers
- X% of all sales are for Custom Picks, while only x% of all sales are for standard guitar picks.

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## Sales Analysis

		1st quarter	2nd quarter	3rd quarter	4th quarter	5th quarter
Sales to customers		226.98	238.33	250.25	262.76	275.90
Cost of goods sold (including shipping)		22.98	24.13	25.34	26.60	27.93
Advertising costs		125.16	118.90	112.96	107.31	101.94
Free Sample Shipping Costs		48.72	46.28	43.97	41.77	39.68
Remote website		15.00	15.00	15.00	15.00	15.00
E-commerce suite		22.00	22.00	22.00	22.00	22.00
3d printer		300.00	300.00	300.00	300.00	0.00
Net Income		-306.88	-287.99	-269.02	-249.92	69.34

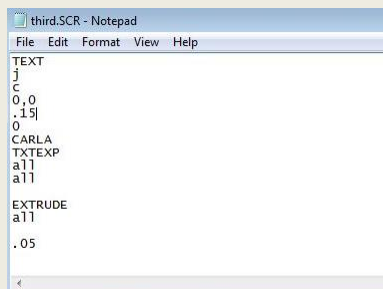
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1<sup>st</sup> quarter real numbers, following quarters project 5% increase in sales each quarter and a planned 5% decrease in advertising and free sample costs. Justified from a series of late first quarter orders that were from customers that found Green-Picks.com 'organically' resulting in 10% of total first quarter sales.

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## Automation

- AutoCAD command line script

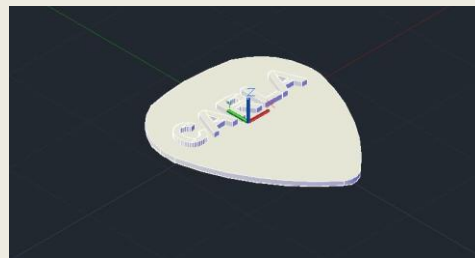


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## Accelerator Program

- GigTank 2014
- First “3d Printing” focused accelerator program
- 36 applicants, Green-Picks made it to the final review of 12, however only 6 were chosen.
- Notes: Encouraged to expand product line

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## Shapeways.com

- SLS printers featuring dozens of materials and instant quotes.
  - Multiple types and colors of Nylon
  - Multiple colors of Acrylic
  - Brass
  - Bronze
  - Sterling Silver
  - Stainless Steel
  - Ceramic
  - Sandstone

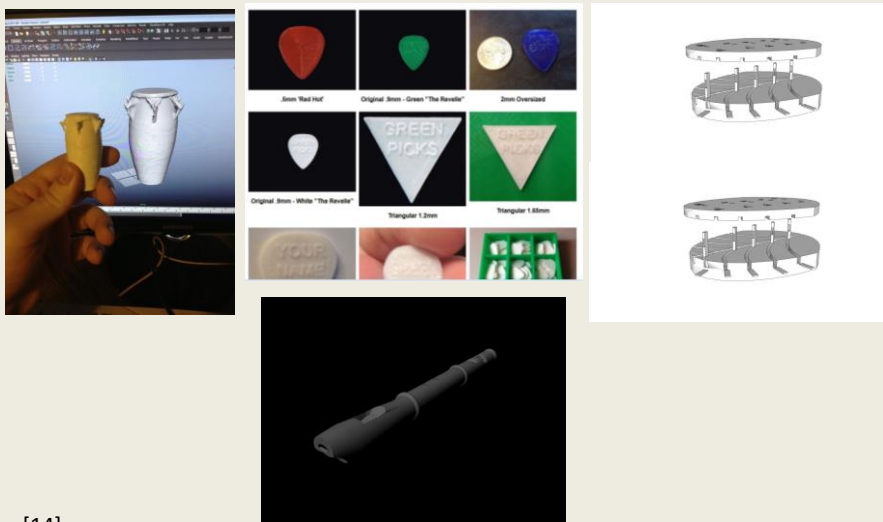
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## Kickstarter Campaign

- Green-Picks.com to launch campaign seeking 5,000 in seed funding.
- Offers custom picks to backers
- Increased material value at increased level of backing
- Zero risk
- Sells the Big Picture for Green-Picks

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## Expanded Product Line

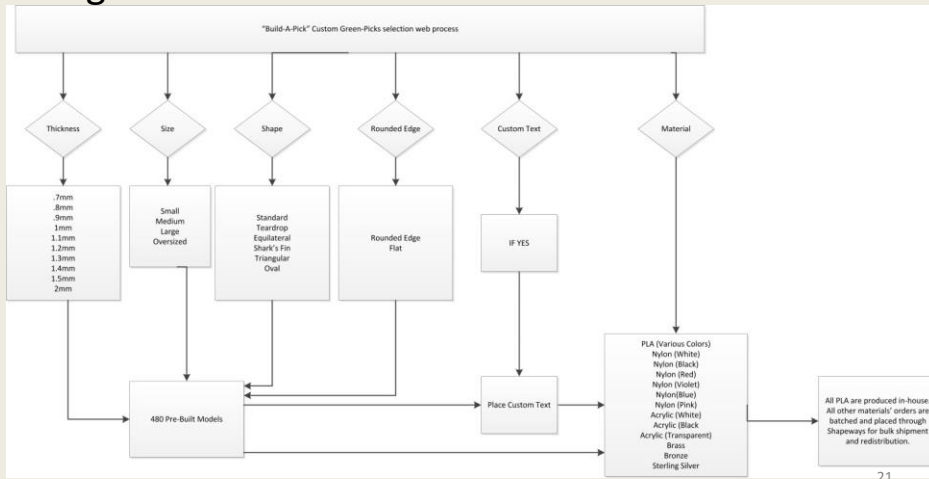


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## Customized goods

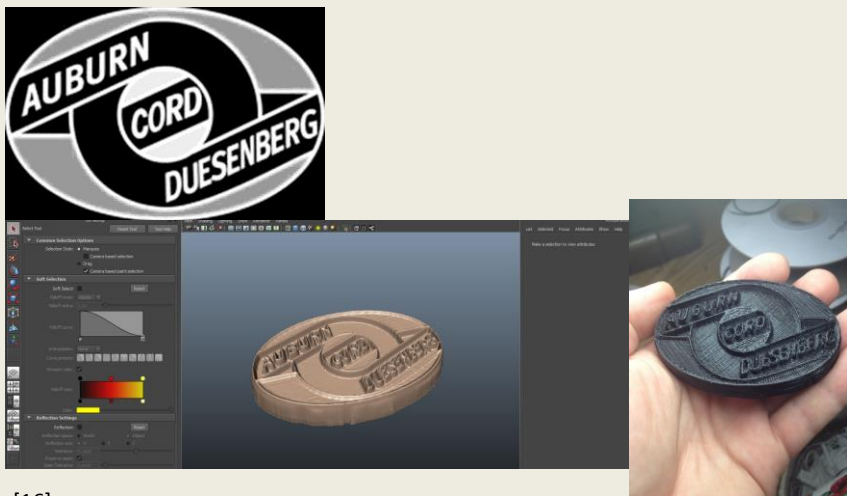
- Proposed solution to capitalize on custom goods



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## Secondary Case Study

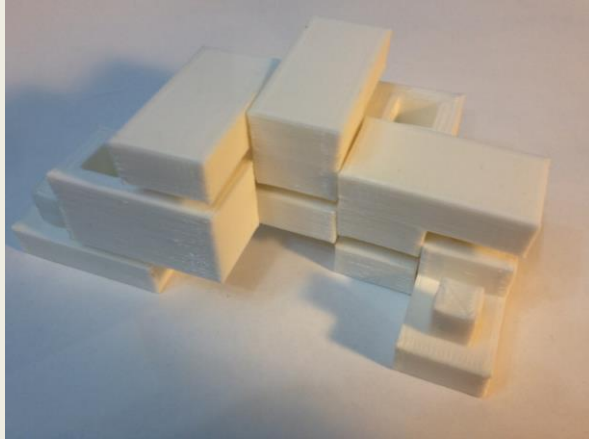


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## Secondary Case Study

- Philippines disaster relief



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## Academic Case Study



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## Architectural Case Study



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## Manufacturing Recommendation

- In order to capitalize on customized goods and reduce digital model creation time, invest in web-based solution that allows the customer to manipulate digital model directly
  - Utilize web application of OpenGL, Python on front end and MEL or Dxf on back end.

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## Academic Recommendation

- Introductory
  - Student hand drafts mechanical drawing including orthographic and isometric views
  - Student drafts the object in AutoCAD
  - Object is printed
- Accelerates 3d visualization
- Introduces the student to manufacturing concepts on Day One

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## Curriculum Proposal

- Advanced
  - Students divided into 3 groups
    - Design, Manufacturing, Sales
    - One from each group is paired with 2 from the other groups
    - Design is lead
  - Semester is divided into 3 sections
    - Each section the role of each individual rotates

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## Conclusions

- An independent designer can successfully start a business by managing software:
  - Design software
  - E-commerce software
  - 3d printing software/hardware
- The designer can capitalize on a growing custom goods market (somewhere in between mass produced and luxury)
- Develop simple methods of automation while the 'Big Picture' is to put the task of customization into the hands of the customers.

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## Conclusions continued

- 3D printers should be welcomed into classrooms and used to enhance existing curriculum
- Most objects can now be produced with a 'customer-centric' intent over manufacturability
- The way we make things will forever be changed.

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## “Form follows Function”

"It is the pervading law of all things organic and inorganic, of all things physical and metaphysical, of all things human and all things superhuman, of all true manifestations of the head, of the heart, of the soul, that the life is recognizable in its expression, **that form ever follows function.** *This is the law.*"

– Louis Sullivan

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Is it any wonder that in an age of the unique person with their personal Facebook site, their twitter feed, their YouTube account, that they should not have their customized iPhone case, personalized trinket, or even their own personalized guitar pick.

Or rather...

A father makes a prosthetic hand for his son using a 3d printer at a public library. Changes can be made to the hand as the boy grows. The prosthesis costs less than 2\$ in material to produce.



<http://www.timesfreepress.com/news/2014/mar/16/the-father-of-invention/>

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## Thank You

- Professor Paul Lin, Professor Gary Steffan, Professor David Momoh
- Indiana University-Purdue University Fort Wayne
- College of Engineering, Technology, and Computer Science department of Computer Engineering Technology.

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