Research and Analysis of the additive manufacturing process through Case Studies

Gregory F. Scalet

IPFW Spring 2014

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

Background

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











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]

3d Printing Process



- [6]
- Design, Print, Redesign, Reprint in one day

– 5 part video series

http://www.youtube.com/playlist?list=PLiWhRm8mmvYSMHiTDQAFFhJq_jhOXome5

6



Feature Case Study: Green-Picks.com

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



[8]

Website Version 1 – Dec. 1st 2013



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

Facebook Ad Campaign

Ads Manager	Updates to Your Campaigns									100
	sphaters to your companyages at the common you while, we will be dubling our company iductions to make it saves to organize your advertising. Two con read more about the changes and while to legacet in the Hello Contex. Learn novel.									
ount 19 Scalet * Campaigne & Adv	Al Campaigns + Cempaign:								Create	e Ad for Campany
All Ads	http://www.greenUS-16-65 /									
Pages Reports Sattings Billing	Extrait Chrosopy metary bulget Duration (Such Trind) Foreign Chrosopy Advecs* Bit T1 Heavy III Bit # Minus Chrosophy # 115,003,000 people T15,003,000 people							November 29, 2013	3 - March 18, 291	
Conversion Tracking Power Editor Account Hatory Addences	Heads/s Cast.* Cast.apple Cast.apple <td></td> <td>34.21</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>		34.21							
Help Center Advertier Support	- weaks can - day						Å			
	18 V F	A part ba		page			4		1 8	
			<u></u>		000000000	2 10		**************************************		
	All Except Deleted + [Select user to edit] Full Report								ar an ar an a Jree	de e e
	100	Status 7	Objective † R	Results 1 C	Ad Reach 7	Fres.*	Gkis 7	Cicki-Through Rate *	Jres Areg. Price 7	da a s
	All Except Debted * [Select cover the off) [Ad Report]	Status * II ~ Oct	Objective F R	Results 7 G	41.7 Ad Reach 7 .07 .027, 940 .15	Freq. 7	Clicks 7	Citcle Through Rate *	Tree	da a b Total Spent 671.
	All Except Deleted + Select rose to offic All Report All Except Deleted + Select rose to offic All Report All Introduces press pelacem - Rels Column All	Status * II ≠ Ock II * Ock	Objective ? R ka to Website web	Results † C 1.062 is onde Cotta 373 dealer Cotta Fer Handre	et * Ad Reach * .07 .02 .03 .03 .03 .04 .05 .04 .05 .05 .05 .05 .05 .05 .05 .05	Fres.*	Clebs 7	Click Through Rate * 0.179%	Jie of an	du e e Total Spent 671.3 637.6
	All Exception of the set of the s	Status * II ~ Ock II * Ock	Objective ? R ka to Website web	Results * G LL 02 Int I LL 02	et * Ad Reach * .07 .02 .03 .03 .03 .04 .05 .04 .05 .05 .05 .05 .05 .05 .05 .05	Freg.* 2.2 1.0	Cicks 7 1,006 609	Click:Through Bate * 0.129% 5.130%	Area, Price * Area, Price * 2012 Comment City 2013 Comment City 2013 Comment City 2013 Comment City	da + + Total Spent (71.3 437.4 633.2 da + +
	All Exception of the set of the s	Status 1 II + Ock II + Ock II + Ock	Objective ? R ka to Website web	Results * G LL 02 Int I LL 02	et * Ad Reach * .07 .02 .03 .03 .03 .04 .05 .04 .05 .05 .05 .05 .05 .05 .05 .05	Freg.* 2.2 1.0	Cicks 7 1,006 609	Click:Through Bate * 0.129% 5.130%	Area, Price * Area, Price * 2012 Comment City 2013 Comment City 2013 Comment City 2013 Comment City	da a 1 Total Spen 671. 637. 635.

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 1st, 2013 through Facebook advertisement redirect

12

Website Re-launch Feb. 1st



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.

14

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
	220.50	250.55	250.25	202.70	275.50
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

[11]

1st 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.

15

Automation

AutoCAD command line script

third.SCR - Notepad	
File Edit Format View Help	
TEXT j c 0,0 .15 A CARLA TXTEXP all	and have been a second
EXTRUDE all .05	
[12]	[13]

-

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

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

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

Expanded Product Line



Customized goods

Proposed solution to capitalize on custom goods



Secondary Case Study



23

Secondary Case Study

Philippines disaster relief



[17]

Academic Case Study



Architectural Case Study



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.

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

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

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.

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.

"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

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/ 32

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.



