Disruption! or Just Innovation?

LARRY LUKIS
Hex Music
LaserMaster/Colorsapan
Proto Labs
Digi Labs Incubator
Four Entrepreneurial Ventures

- Hex Music – 1981-82 – Practice
- LaserMaster – 1985-98 – Trial by Fire
- Proto Labs – 1999... – Smooth Sailing
- Digi Labs – 2015... - Just for Fun
Not just any generic Disruption

The Innovators Dilemma
1997

Clayton M. Christensen

The Innovators Solution
2003
Clayton Christensen’s Disruption

- Incumbent’s sustaining trajectory
- Entrant’s disruptive trajectory

Performance customers will pay for:
- High end of the market
  - Most profitable
- Mainstream

Product performance:
- Higher
- Lower

Time
“Oh, don’t worry about those guys, nobody can make any money on the simple stuff they are doing.”
• Hex Music – 1981-82 – Practice
• LaserMaster – 1985-98 – Trial by Fire
• Proto Labs – 1999… – Smooth Sailing
• Digi Labs – 2015… - Just for Fun
The Mini-Moog (1970-80)
Prophet-5 – had a microprocessor!
HEX Music Digital Synthesizer
Hex Music
Hex Music
Hex Music
Dual Double Density @256kBytes!
“That’s what you can do when you have your own semiconductor production facilities”

Yamaha DX9 Introduced at NAMM 1983

Yamaha introduces the DX9 at list price ~$1350
Hex Music Synth build cost (optimistically) ~$1300
This is the end of Hex Music!
Not Disruptive Innovation
– Just Innovation
Moral of the Story
Intran Corp.

- $5 million VC money
- Met all hiring targets, sales not so much
- Founder ejected from the company
- Ch 11 Bankruptcy 1 year later
• Hex Music – 1981-82 – Practice
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One Minute Laser Plots for AutoCAD

LaserMaster Corp.
Productivity Tools for CAD/CAM & CAP
LaserMaster™ brings the power, versatility and quality of the Laser Printer to PC-Based CAD like no one else. LaserMaster’s XT/P laser printer controller was designed for CAD from the ground up. LaserMaster’s software tools produce unequaled high speed laser plotting, integration of CAD drawings into text documents and upward compatibility with HP’s LaserJet+ Printer Command Language (PCL).
Desktop Publishing

Ventura Scoop

Xerox Shows Off Ventura Publisher at Conference

BEVERLY HILLS (AP) — Xerox Corp. has introduced version 1.1 of its first electronic publishing software product tailored for industry-standard personal computers. Xerox chose the Seybold Conference to announce the price and availability of the new revision to the industry-standard software package. Conference attendees were impressed by the eighty-one new features, all of which were added without compromising the speed of the product and its depth of functionality.

Version 1.1 Redefines Desktop Publishing — Ag
If You Hate To Wait!

LaserMaster™
XT/P CAPCard™
25 sec.

LaserWriter-Plus
(PostScript)
3 min. 35 sec.
Attacking Adobe
LaserMaster Announces a Laser Printing Breakthrough:

TurboRes™
Quality Focus
Fonts!

Digital Typeface Corporation
MasterWorks Type Library, Volume 2

ITC Anna
Araxis
Araxis Italic

ITC Berkeley Old Style Book
ITC Berkeley Old Style Book Italic
ITC Berkeley Old Style Medium
ITC Berkeley Old Style Medium Italic
ITC Berkeley Old Style Bold
ITC Berkeley Old Style Bold Italic
ITC Berkeley Old Style Black
ITC Berkeley Old Style Black Italic
Bernhard Fashion

Bodoni-Antiqua Light
Bodoni-Antiqua Light Italic

Leotraset Caxton Bold
Leotraset Caxton Bold Italic

Choco
COLUMNA SOLID
Leotraset Compacta light
Leotraset Compacta Regular
Leotraset Compacta Bold
Leotraset Corez
Englishe Schriftschrif
Medium
TF Forever Light
TF Forever Light Italic
TF Forever Regular
TF Forever Regular Italic
TF Forever Bold
TF Forever Bold Italic
TF Forever Extra Bold
TF Forever Extra Bold Italic

Futura Light
Futura Light Oblique
Futura Book
Futura Book Oblique

Mistral
ITC Mona Lisa Regal
Jenson Oldstyle
Jenson Oblique
Nicollet Roman
Nicollet Roman Italic
Nicollet Black
Leotraset Shamrock
ITC Stone Sans Medium
ITC Stone Sans Medium Italic
ITC Stone Sans Semi Bold
ITC Stone Sans Semi Bold Italic
ITC Stone Sans Bold
ITC Stone Sans Bold Italic
ITC Stone Serif Medium
ITC Stone Serif Medium Italic
ITC Stone Serif Semi Bold
Innovation: 2 Bits Per Pixel!

“Ah, my GlassPage 1280! How do I love thee? Let me count the ways…”

My Glass Page 1280 Display System from LaserMaster
However...

LaserJet III: New version of LaserJet II engine with **PCL5, scalable fonts, REt** (Resolution Enhancement Technology), **HPGL** and all new industrial design. REt gave perfectly (to the eye) smooth characters and graphics although the basic printer resolution remained 300 dpi. 8 ppm, 300 dpi, $2,395, Spring 1990.
However...

• Apple releases scalable True Type fonts. Licenses to Microsoft. Adobe also opens their font format in response.

• Scalable fonts are built into OS.
Tough To Keep Ahead

LaserMaster Fights Back After Loss

By Robert L. Scheler

LaserMaster Technologies Inc. CEO Mel Masters was fighting mad last Wednesday.

His laser printer company was in the process of firing 13 salespeople who weren't, he said, "even paying for the chairs they were sitting in."

Then there were the analysts who, Masters claimed, were spreading misleading stories about the firm's $1.8 million third-quarter loss. "I'm going to make those guys sing soprano in 60 days," he growled.

He later boasted about how his salespeople forced industry giant Intel Corp. to credit LaserMaster for $80,000 worth of unwanted PCs by stacking them in front of an Intel receptionist and walking away.

"I was too weak to defend, so I attacked," said Masters, quoting a favorite saying from Confederate General Robert E. Lee.

So far, it's been hard to argue with his plan.

Battlefield marketing and leading-edge printer technology have helped build LaserMaster from three-person startup to a $50 million company in a few years.

Analysts have high praise for its laser printer add-in printer controllers and "direct drivers" which bypass page-description languages (PDL) such as Adobe PostScript to improve the speed or output of laser printers.

They also praise Masters' brassy marketing techniques, which included handing out slow-to-dissolve caramel candies at Comdex with the words "Adobe PostScript—Just Stay Slow" printed on the wrappers.

LaserMaster also lured Jean-Louis Gasse, the former president of Apple Computer Inc.'s produc

See LASERMASTER Page 12
Not Disruptive Innovation – Just Innovation
LaserMaster becomes ColorSpan

LaserMaster Press Release

LaserMaster Corporation to become ColorSpan Corporation
Name Change Reflects Focus on Large-Format Digital Color Printing

MINNEAPOLIS, MN, August 12, 1997 - LaserMaster Technologies, Inc. (NASDAQ/NMS SYMBOL:LMTS) has been a leader in technology for prepress and graphic arts printing solutions. The subsidiary's core bu
ColorSpan Glory Days

ColorSpan Wins Shootout and other Awards at Photo Marketing Show

MINNEAPOLIS -- VirtualFund.com, Inc. (Nasdaq: VFND - news), a diversified technology company, today announced that ColorSpan Corporation, the principal operating subsidiary of its Digital Graphics Business Unit (DGBU), won DIMA Shootout awards for its 36-inch wide-format printer, software, media and ink for the fourth consecutive year at PMA '99 in Las Vegas, February 18-21. Winning in four categories, ColorSpan received an award for the Giclee PrintMakerFA(TM) in the `36-inch wide'' category, and three DIMA Shootout Awards for ColorSpan® Endura.Chrome ink, ColorMark® Pro 4000 RIP and ColorMark Photo Display Gloss media. In addition to the DIMA Shootout awards, ColorSpan received two Cool2™ Awards from Photo Electronic Imaging (PEI) magazine for the third consecutive year. This year's Cool2 Awards went to the DisplayMaker 7000 digital color printer and Giclee PrintMakerFA.
HP Introduces DesignJet

By mid-1990s, the story repeats.

HP enters market with a great product at much lower price point.

Colorsapn struggles, pushed into smaller and smaller niche.
ColorSpan: Disruptive Innovation
- Not

![Diagram showing ColorSpan and Hewlett Packard's trajectories in product performance over time.](image)
Time for another reinvention

• **ColorSpan** parent name changes to **VirtualFund.com**

• **ColorSpan** sold to **MacDermid** for $50 million

• **VirtualFund** spends all the money, then crashes and burns

• **MacDermid** later sells **ColorSpan** to **HP**
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Protomold: “Simple Parts, Fast”
Disruptive Innovation

![Diagram showing the concept of Disruptive Innovation with a focus on Protomold.](image_url)
Stay Out of Their Way
Early Days

Proto Labs Growth

- Employees: 3
- Revenue: $0.1MM
- Facilities: 1
- Product Developers: ~

INJECTION MOLDING

CNC MACHINING

3D PRINTING
2001: $1MM, Hire CEO

Proto Labs Growth

- Employees: 12
- Revenue: $1.1MM
- Facilities: 1
- Product Developers: 77

The Early Team
Do you really want to be a CEO?

No, I don’t!

Yes, I do!
2003: $6MM Revenue, Profitable

Proto Labs Growth

- Employees: 55
- Revenue: $6MM
- Facilities: 1
- Product Developers: 573
You still have to innovate!

Why are you creating all this custom software? Why don’t you just buy a commercial software package?

Because we are software developers, that’s what we do!
What was our innovation?

- Automated toolpath generation (Software: PMD)
- Automated quoting (Software: PMQ)
- Only CNC machined aluminum molds
- Standardized minimal tool set – Constraining the problem
Innovation: Focus

• If a customer’s part does not fit our process, we won’t make it
• But we will graphically illustrate the nearest part we can make that does fit the process (Software: PMQ)
• By focusing exclusively on what we can do well, we are always better than the competition for anything we can quote
2005: $17MM, Expand to Europe

Proto Labs Growth

- Employees: 106
- Revenue: $17MM
- Facilities: 2
- Product Developers: 1,265
2006: $25MM, Expanding Facilities

Proto Labs Growth

- Employees: 170
- Revenue: $25MM
- Facilities: 3
- Product Developers: 1,810

US facilities expand to 160,000 sq ft
2007: $36MM - CNC Machining Introduced as Firstcut

Proto Labs Growth

- Employees
- Revenue
- Facilities
- Product Developers

2007:
- Products Developers: 2,696

CNC Machining Introduced as Firstcut
2009: $44MM, Expand to Japan

Proto Labs Growth

- Employees: 276
- Revenue: $44MM
- Facilities: 5
- Product Developers: 4,746
2010: $65MM, Meet the Queen

Proto Labs Growth

- Employees: 347
- Revenue: $65MM
- Facilities: 5

Proto Labs Limited receives the Queen’s Award
Awards and Rewards

The Master of the Household has received Her Majesty’s command to invite

Mr. Lee Ball
to a Reception to be given at Buckingham Palace
by The Queen and The Duke of Edinburgh
for Winners of the Queen’s Awards for Enterprise 2010
on Monday, 19th July, 2010 at 6.00 p.m.

In Confirmation

Dress: Lounge Suit / Day Dress

Guests are asked to arrive between 5.30 and 5.50 p.m.

Proto Labs Growth

- Employees: 3
- Revenue: 5
- Facilities: 10,427

UK facilities expand to 130,000 sq ft
2012: $126MM, more awards, IPO

Proto Labs Growth

- Employees
- Revenue
- Facilities
- Product Developers

Proto Labs has seen significant growth over the years, especially in 2012 with revenues exceeding $126MM. The company received more awards and went public (IPO) in 2012.
2014: $210MM, Vicki Holt CEO, Additive Services Added to Portfolio
Disruptive Innovation

Incumbent Molding and Machining

Proto Labs
Disruptive Innovation: Results

- $250+ million annual revenue
- 1250 employees
- ~60% gross margin
- Still growing like crazy after 15 years
- No competition from incumbent players
- $1.5 billion market cap
Disruptive Innovation: Rewards
- Hex Music – 1981-82 – Practice
- LaserMaster – 1985-98 – Trial by Fire
- Proto Labs – 1999… – Smooth Sailing
- Digi Labs – 2015… - Just for Fun
Digi Labs (digilabs.io)
Virtual Reality for Architecture
The Wild Goose Chaser
Deep Learning/Neural Networks

Machine Intelligence & Deep Learning: The Next Innovation Network?
Deep Learning/Neural Networks

Google Scholar Citations

“deep learning” + “neural network”

Image classification

Classification error

ILSVRC year

2010 2011 2012 2013 2014
Deep Learning/Neural Networks
Deep Learning/Neural Networks

Machine Learning Skills Pyramid v1.0

Will the real “Data Scientist” please stand up?

Machine Learning Researcher/Scientist:
- Research novel machine learning problems
- Creates new mathematical models and algorithms
- Publishes papers on research results
- Skills: Builds mathematical models, breaks ground in research, establishes new paradigms, Scientific Formalism, Experiment design

Machine Learning Engineer:
- Solves business/data learning problems
- Creates ML solutions to achieve an organization’s objective
- Applies established algorithms
- Uses ML algorithm libraries
- Understands strengths and weaknesses of different algorithms
- Typically BS/MA Level: Computer Science, Math, Other Technical
- Skills: Software Eng, PLUS Data Analysis, ML Algorithm Selection, Cross Validation, Metrics/Scoring, Feature Engineering

Data Engineer:
- Develops code in support of Machine Learning Solutions
- Data extraction, transformation, scraping, joining, cleaning
- Summary Statistics, counting, sampling on request
- Skills: Platform/DB/Language specific expertise, Performance, Parallel and Distributed Computing, Quality, Reliability, Map/Reduce-Hadoop, VMs/Cloud, SQL/noSQL, Production Scaling, etc.

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Deep Learning/Neural Networks

Goose!

No Goose.
Ocean Discovery XPRIZE

ONLY 5% OF THE OCEAN HAS BEEN EXPLORED YET IT FEEDS OVER 2 BILLION & PROVIDES MORE THAN 50% OF OUR OXYGEN

3 MILLION SHIPWRECKS ARE LYING ON THE SEAFLOOR

WE KNOW MORE ABOUT THE SURFACE OF MARS THAN WE KNOW ABOUT OUR OCEAN FLOOR

THERE’S A PLANET WE’VE YET TO UNDERSTAND OURS.

WATCH THE VIDEO
So Much Cool Stuff!

- Internet of Things
- The Cloud
- Maker Movement – smart, ambitious people-concentrator
- Raspberry Pi - $5 – runs Linux
- Computer Vision
- Deep Neural Networks
- Robotics
- Open Source
The End

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