

Software Entrepreneurship

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A look back in history: Cambridge

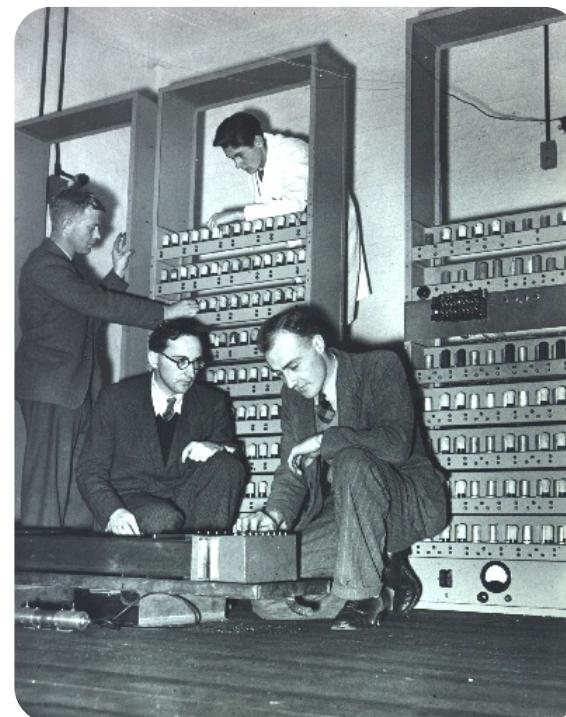
Order bit pattern	Loc	Order	Meaning	Comment
00101 0 0001111011 0	31:	T123S	m[123]=A; ABC=0	The required first word
00011 0 0001010100 0	32:	E84S	goto 84	Jump to start
00000 0 0000000000 0	33:	PS	data 0	For the next decimal digit
00000 0 0000000000 0	34:	PS	data 0	For the current power of ten
00100 1 1100010000 0	35:	P1000S	data 10000<<1	The table of 16-bit powers of ten
00000 0 1111010000 0	36:	P1000S	data 1000<<1	
00000 0 0001100100 0	37:	P100S	data 100<<1	
00000 0 0000001010 0	38:	P10S	data 10<<1	
00000 0 0000000001 0	39:	P1S	data 1<<1	
00001 0 0000000000 0	40:	QS	data 1<<12	00001 in MS 5 bits, used to form digits
01011 0 0000000000 0	41:	#S	data 11<<12	Figure shift character
11100 0 0000101000 0	42:	A40S		End limit for values placed in m[52]
10100 0 0000000000 0	43:	!S	data 20<<12	Space character
11000 0 0000000000 0	44:	&S	data 24<<12	Line feed character
10010 0 0000000000 0	45:	€S	data 18<<12	Carriage return character
01001 0 0000101011 0	46:	043S	wr(m[43])	Write a space
01001 0 0000100001 0	47:	033S	wr(m[33])	Write a digit
00000 0 0000000000 0	48:	PS	data 0	The number to print
11100 0 0000101110 0	49:	A46S	A+=m[46]	Print subroutine entry point
00101 0 0001000001 0	50:	T65S	m[65]=A; ABC=0	Put 043S in m[65]
00101 0 0001000001 0	51:	T129S	m[129]=A; ABC=0	Clear A
11100 0 0000100011 0	52:	A35S	A+=m[35]	A is next power of ten. m[52] cycles through A35S, A36S, A37S, A38S and A39S
00101 0 0000100010 0	53:	T34S	m[34]=A; ABC=0	Store it in m[34]
00011 0 0000111101 0	54:	E61S	goto 61	
00101 0 0000110000 0	55:	T48S	m[48]=A; ABC=0	Store value to be printed
11100 0 0000101111 0	56:	A47S	A+=m[47]	Store instruction 033S
00101 0 0001000001 0	57:	T65S	m[65]=A; ABC=0	in m[65]
11100 0 0000100001 0	58:	A33S	A+=m[33]	Increment the decimal digit held in the MS 5 bits
11100 0 0000101000 0	59:	A40S	A+=m[40]	of m[33]
00101 0 0000100001 0	60:	T33S	m[33]=A; ABC=0	
11100 0 0000110000 0	61:	A48S	A+=m[48]; ABC=0	Get value to print
11100 0 0000100010 0	62:	S34S	A-=m[34]	Subtract a power of 10
00011 0 0000110111 0	63:	E55S	if A>0 goto 55	Repeat, if positive
11100 0 0000100010 0	64:	A34S	A+=m[34]	Add back the power of 10
00000 0 0000000000 0	65:	PS	data 0	This is replaced by either 043S to write a space, or 033S to write a digit
00101 0 0000110000 0	66:	T48S	m[48]=A; ABC=0	Set the value to print
00101 0 0000100001 0	67:	T33S	m[33]=A; ABC=0	Set digit to 0
11100 0 0000110100 0	68:	A52S	A+=m[52]	Increment the address field
11100 0 00000000100 0	69:	A4S	A+=m[4]	of the instruction
00111 0 0000101000 0	70:	U52S	m[52]=A	in m[52]
01100 0 0000101010 0	71:	S42S	A-=m[42]	Compare with A40S and
11011 0 0000110011 0	72:	G51S	if A<0 goto 51	Repeat, if more digits
11100 0 0001110101 0	73:	A117S	A+=m[117]	Put A35S back
00101 0 0000110100 0	74:	T52S	m[52]=A; ABC=0	in m[52]
00000 0 0000000000 0	75:	PS	data 0	To hold the return jump instruction which is E95S, E110S or E118S

The Squares Program (excerpt) written for EDSAC, 1949

<http://www.cl.cam.ac.uk/~mr10/edsacposter.pdf>



M.V.Wilkes, 1913-2010



EDSAC I, 1947/8 P.J.Farmer R.Piggott
M.V.Wilkes W.A.Renwick

Cambridge Cluster - unique

- Cambridge is a special place



- Cambridge technology is the “brains” of every (almost) smartphone (*ARM*)
- Cambridge technology is the “magic” behind both Alexa and Siri (*True Knowledge and VocalIQ*)
- Cambridge technology is making computing in schools cool again :) (*Raspberry Pi*)

Innovation

- Innovation

- converting research into products
 - graphene, printed electronics
- the definition and level is industry-dependent
 - software UI in car industry
- algorithms as innovation vs user experience as utility
 - Google: PageRank AND Simple **and** Quick interface

- How innovative should you be?

- the more real innovation you have the longer it takes to bring it into market

- Sometimes it's about timing

- is the market ready for your innovation?
- what is required to bring the innovation to the market?
 - dependencies on third-parties/ecosystem
 - wireless charging: standards /adoption (Splashpower 2001 - “pioneers are the ones with the arrows in their backs” Steve Blank)

- Can it be protected?

- both your innovation and the market position
- “pioneers have arrows in their backs”

“Research is the transformation of money into knowledge.

Innovation is the transformation of knowledge into money...”

Geoffrey Nicholson, 3M
|| Dr. Bamelis, Bayer

(Software) Innovation

- Innovation
 - provide (software) systems which change the practices of their user communities
- An Innovative Product
 - displays **novelty** - has not been developed before
 - displays **utility** - has some form of application that users value and are prepared to pay for
- This makes it inseparable from the **market the product enters** and means we need to talk about **market analyses**
- Innovation
 - **at a point in time**
 - with respect to a particular **user segment**
- Start ups are much more efficient at getting to new markets
 - have teams of very dedicated and focused people
 - have nothing to loose
 - no established business models to protect
 - no targets to meet

Why Start a Software Technology Company?

- Why start a company?

- to solve a problem/change the world
- to make your own mistakes
- you are unemployable :)
- because you feel you must

“...Because the people who are crazy enough to think they can change the world, are the ones who do.”

- Why start a software tech company?

- can achieve most impact with least resources, i.e. extremely scalable
- the idea / product concept can be validated quicker
- the gross profit margins are high (c. 90%)

“...Economically, you can think of a startup as a way to compress your whole working life into a few years. Instead of working at a low intensity for forty years, you work as hard as you possibly can for four.” Paul Graham/YCombinator

- Why you should not start a company?

- no work/life balance
- binary (almost) outcome
 - though the experience matters
- stress/depression

Start-up Team – Why You?

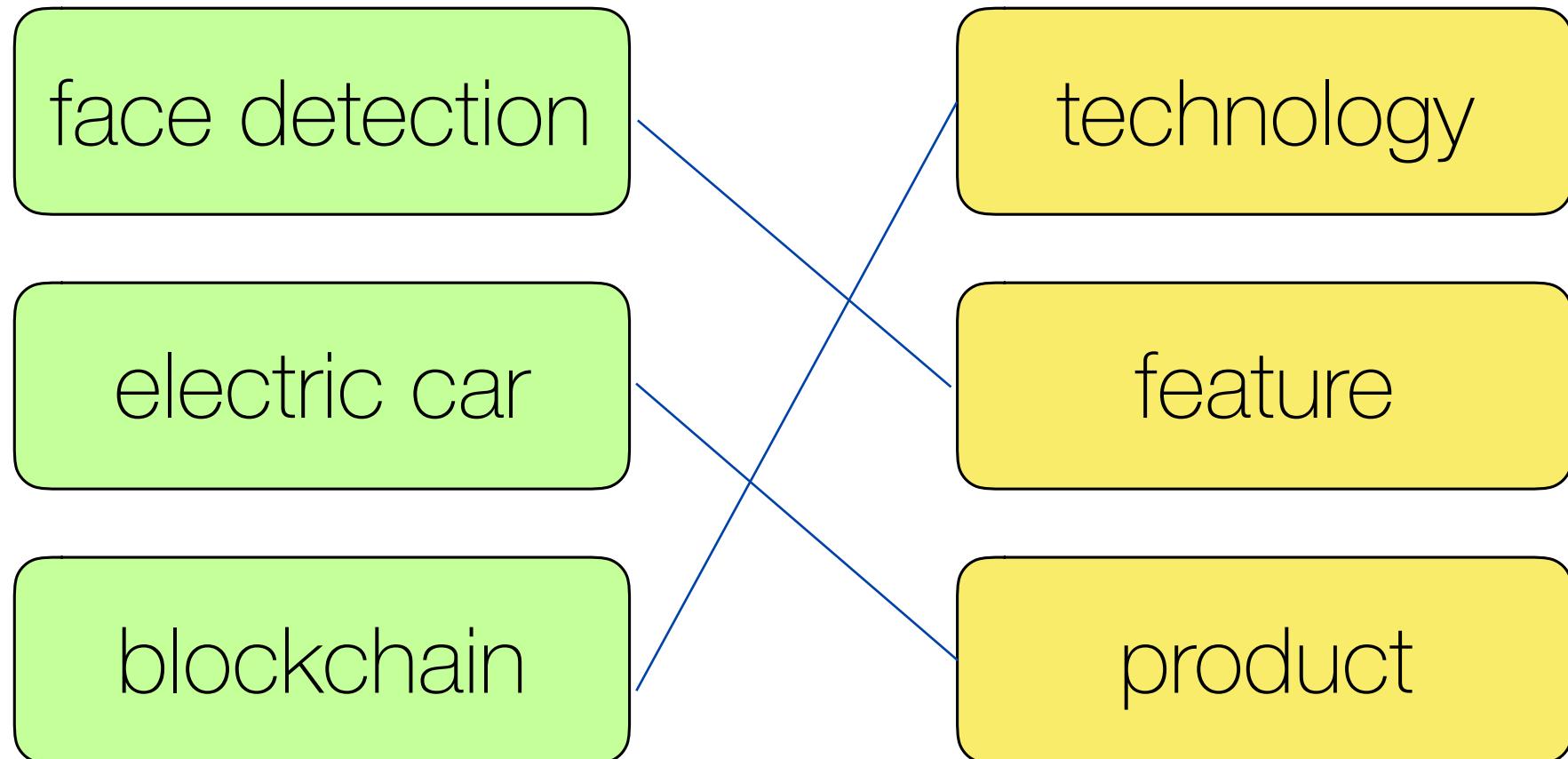
- Sometimes it's just about who has the drive, commitment and resources to spend the next 10 years implementing this idea knowing that 99.99% of startups fail
- It helps however to have the “unfair advantage”
 - “always take a gun to a knife fight”
- Experience helps, e.g. just completed a PhD in Computer Vision and have a idea for the camera based security system
- Typical challenges: engineers (think they) need business co-founders to market/sell things, MBAs graduates need engineers to build things
- Engineers can certainly sell products and run companies
- Yet diverse experience / views help
- Filling the gaps
 - Advisory Board
 - Board of Directors (non-executives)
- Right people at the right time

“When valuing a startup, add \$500k for every engineer, and subtract \$250k for every MBA...” Aaron Patzer, founder of Mint

Defining The Idea – Why This and Why Now?

- Unless based on some very “bleeding edge” research, ideas are cheap and it’s all about **“execution”** – how an idea is brought to life
- It also **doesn’t have to be the “first of”**
 - Facebook wasn’t the first social network
 - Spotify wasn’t the first music streaming service
 - Instagram wasn’t the first photo sharing app
- **HOWEVER** it helps to start with a good (enough) idea, so need to understand:
 - is it a **product or a service** (could be Software as a Service)?
 - affects how you charge for it and how much resources you need to grow
 - is there an **established market** for this product or is it a **new market** to be created?
 - new product/new market is the most challenging
 - if it’s an established market, is it **growing or saturated?**
 - in 2001 iPod was just a new MP3 player product, the market was already established by previous products yet it was a growing market
 - does **someone else** do it already, how **successful** are they, what can be **learnt** from their experience?
 - how big is the total market: no. of user, revenue size and how big is the **total addressable market** for the idea?
 - how could the **market be accessed**: releasing the best game app in the world doesn’t make it instantly popular?
 - hit-based products such as games are difficult to predict/popularise, Angry Birds was Rovio’s 52nd game

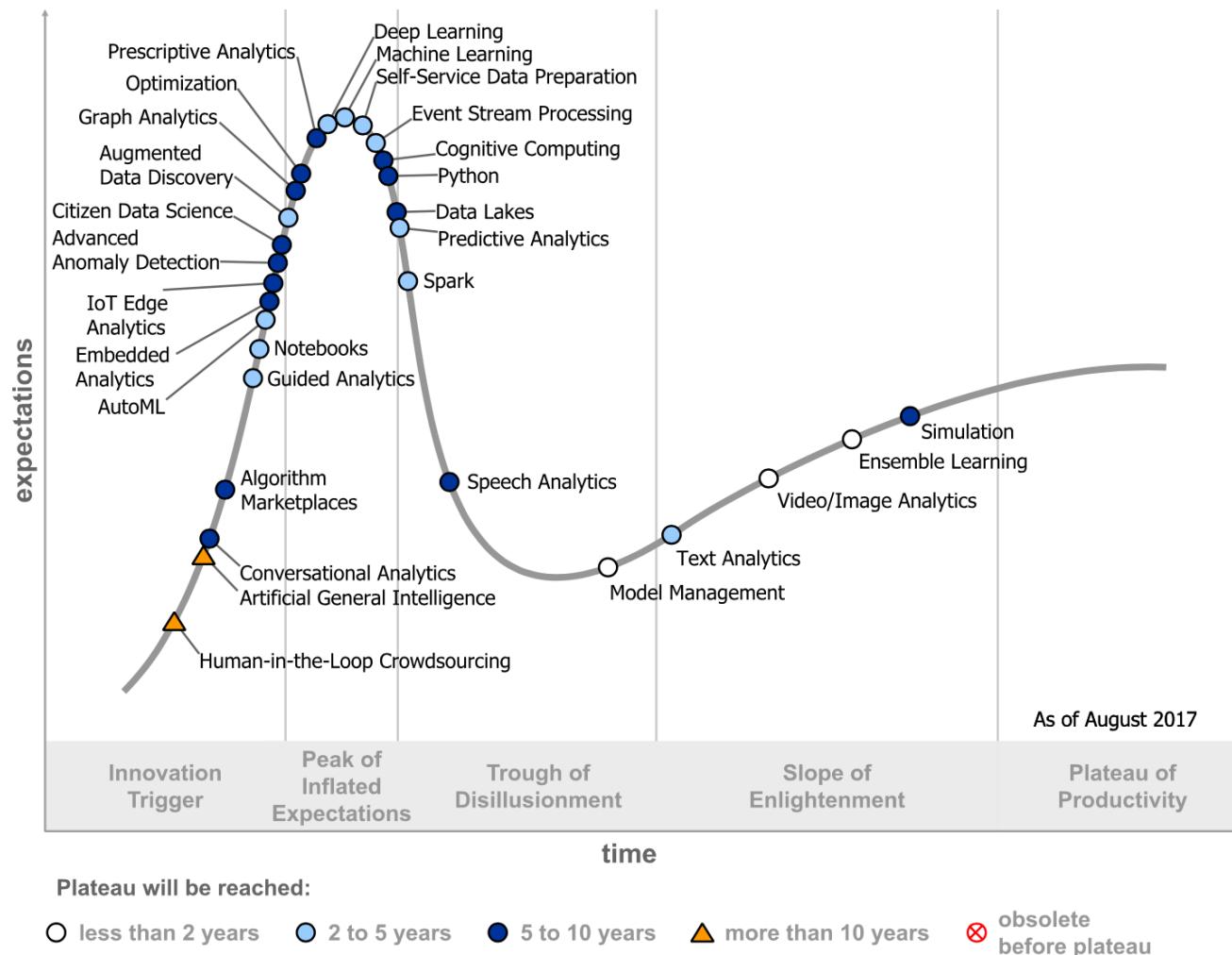
Example: Technology or Feature or Product



Market Research

- Market Analysts – global trends, predictions, key players etc.

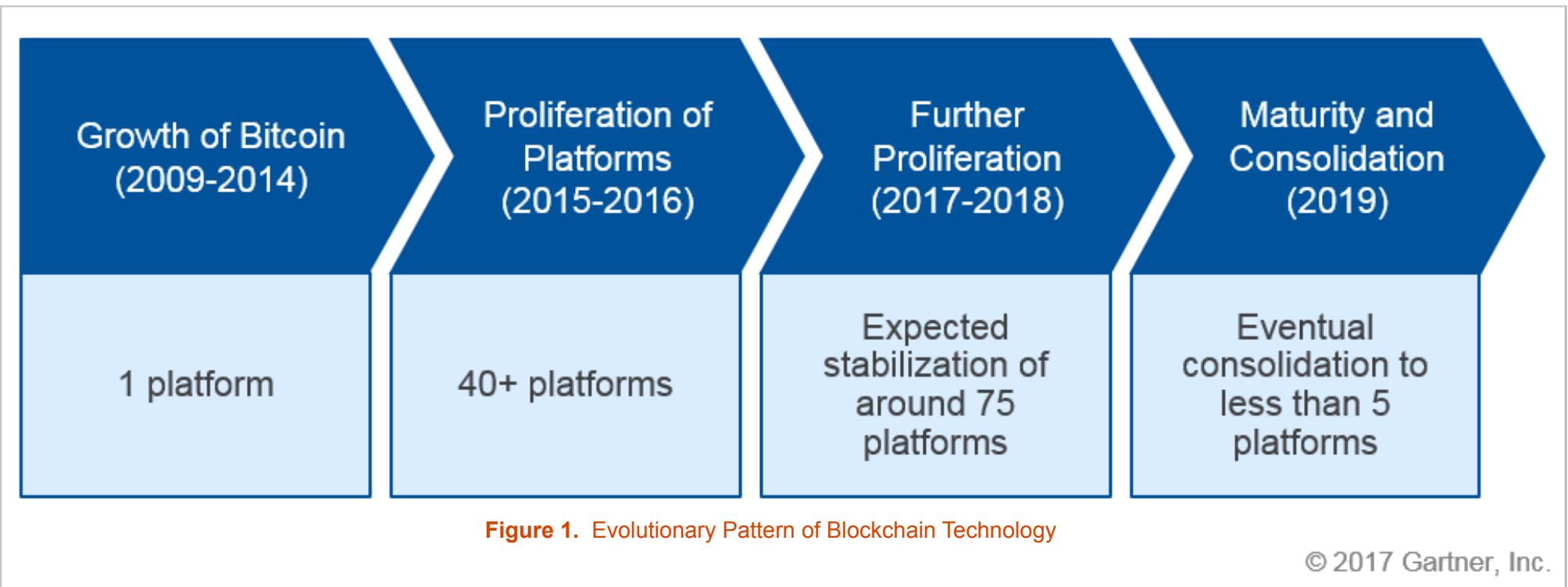
Figure 1. Hype Cycle for Data Science and Machine Learning, 2017



- Access to Gartner is available under the CU site licence – use it while you can!
 - <https://www.uis.cam.ac.uk/resources/gartner>

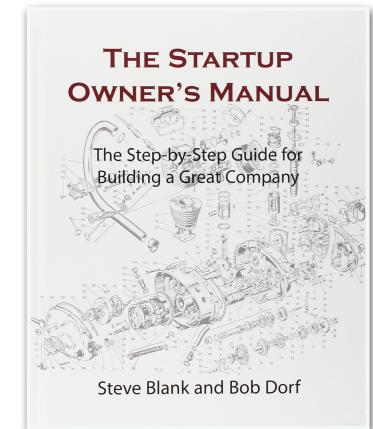
Competitive Landscape

- Understand the competitors, the size, sales etc.
 - public (listed) companies have to publish annual reports with information about their revenue, costs, profits etc.
 - private companies in the UK have to publish annual accounts
 - <http://companieshouse.gov.uk/>
- Understand market trends: growing/consolidating



Market Type

- A new product / an **existing market**
 - improving on a well-defined value-proposition of competing offers
 - example: LED bulb
- A new product / an existing market and re-segmenting as a **low-cost proposition**
 - improving the value-for-money ratio of an existing product
 - finding the “good enough” performance for the price
 - example: low-priced Android phone
- A new product / an existing market and re-segmenting as a **niche proposition**
 - improving on a well-defined value-proposition by focusing on a segment of that market
 - example: craft beer/gin, directly sourced speciality coffee
- **A new product /a new market**
 - customers don't know they need it or what they would pay for it if it did exist
 - example: instant messaging
- **International idea arbitrage** – implementing a proven successful value proposition in a new territory
 - sometimes adapting it to cultural differences/preferences
 - example: professional social networks



SWOT

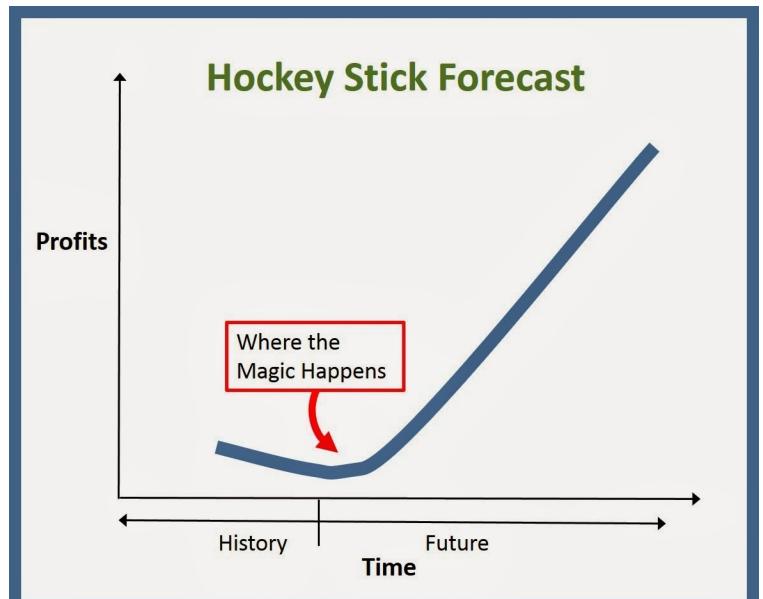


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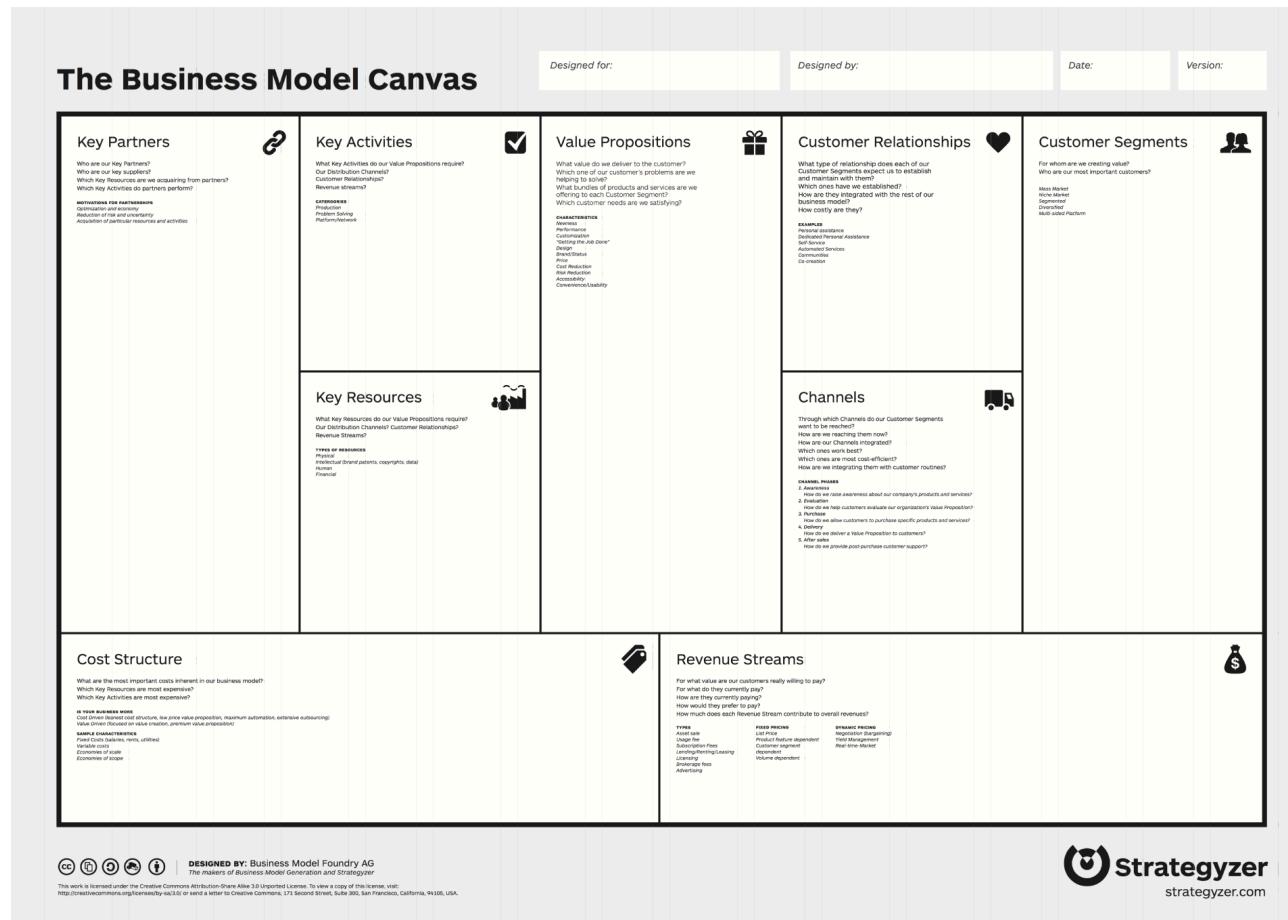
Business Plan

- Two primary purposes:
 - internal: to convince yourself and the team
 - external: to raise funds
- Traditionally, a business will start with a plan showing how it will be developed into a profitable company since in order to start it they needed external capital (e.g. a bank loan)
- The goal was to present a thorough market analysis, prove the ability to execute and forecast the revenue and resources required
 - typical length 30-80 pages
- Every business plan needs to include a “hockey stick” forecast :)
- Rarely asked for today, instead 20-25 slide deck + 1-page exec summary

“No Business Plan survives first contact with customers” steveblank.com



- In 2004, Alexander Osterwalder's PhD in Management Information Systems thesis “The Business Model Ontology - a proposition in a design science approach”, later developed into “Business Model Canvas”

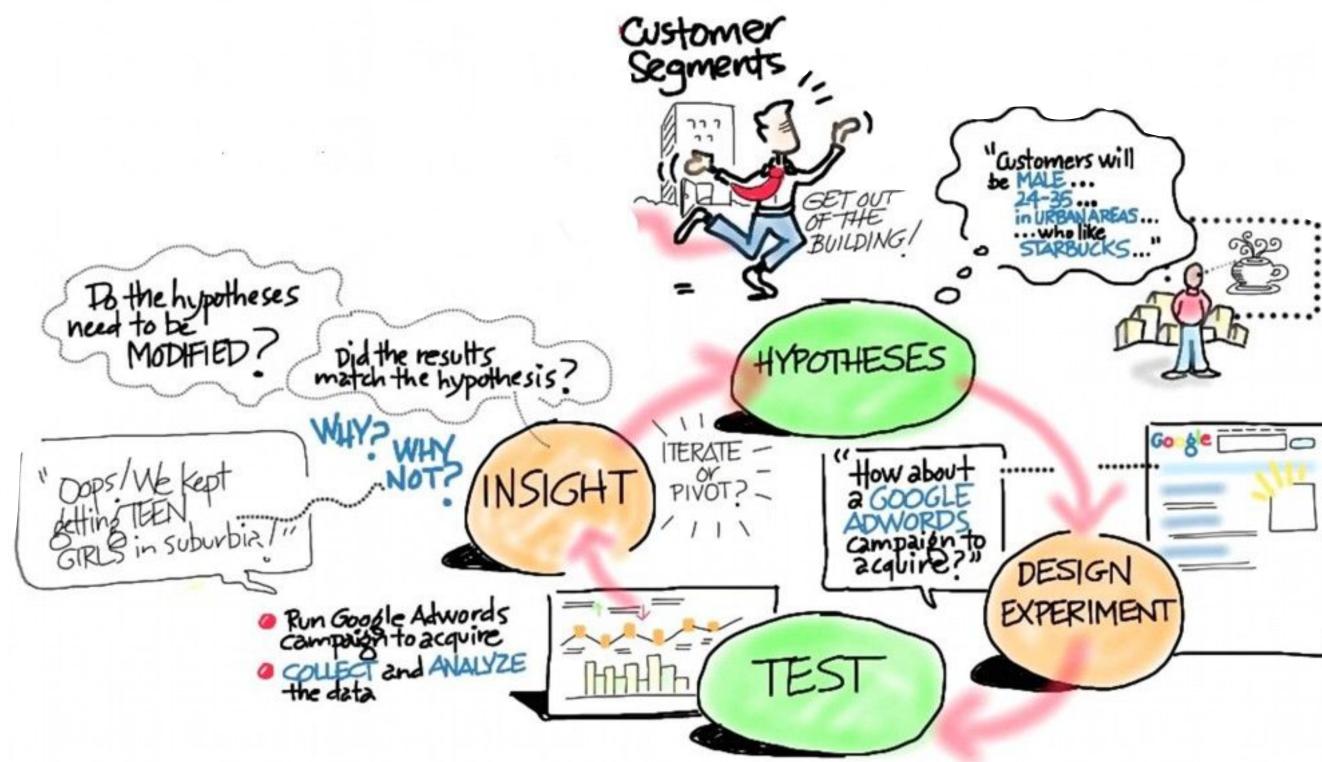
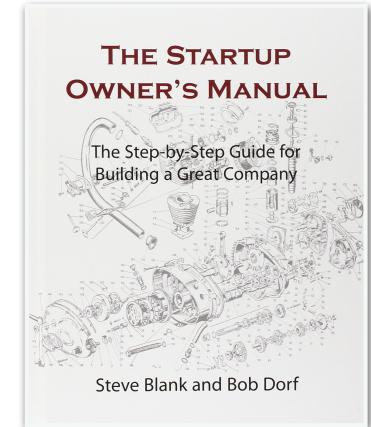


- It's a dynamic view of the business model, relying on constant iterations through the cycle of testing company's hypothesis

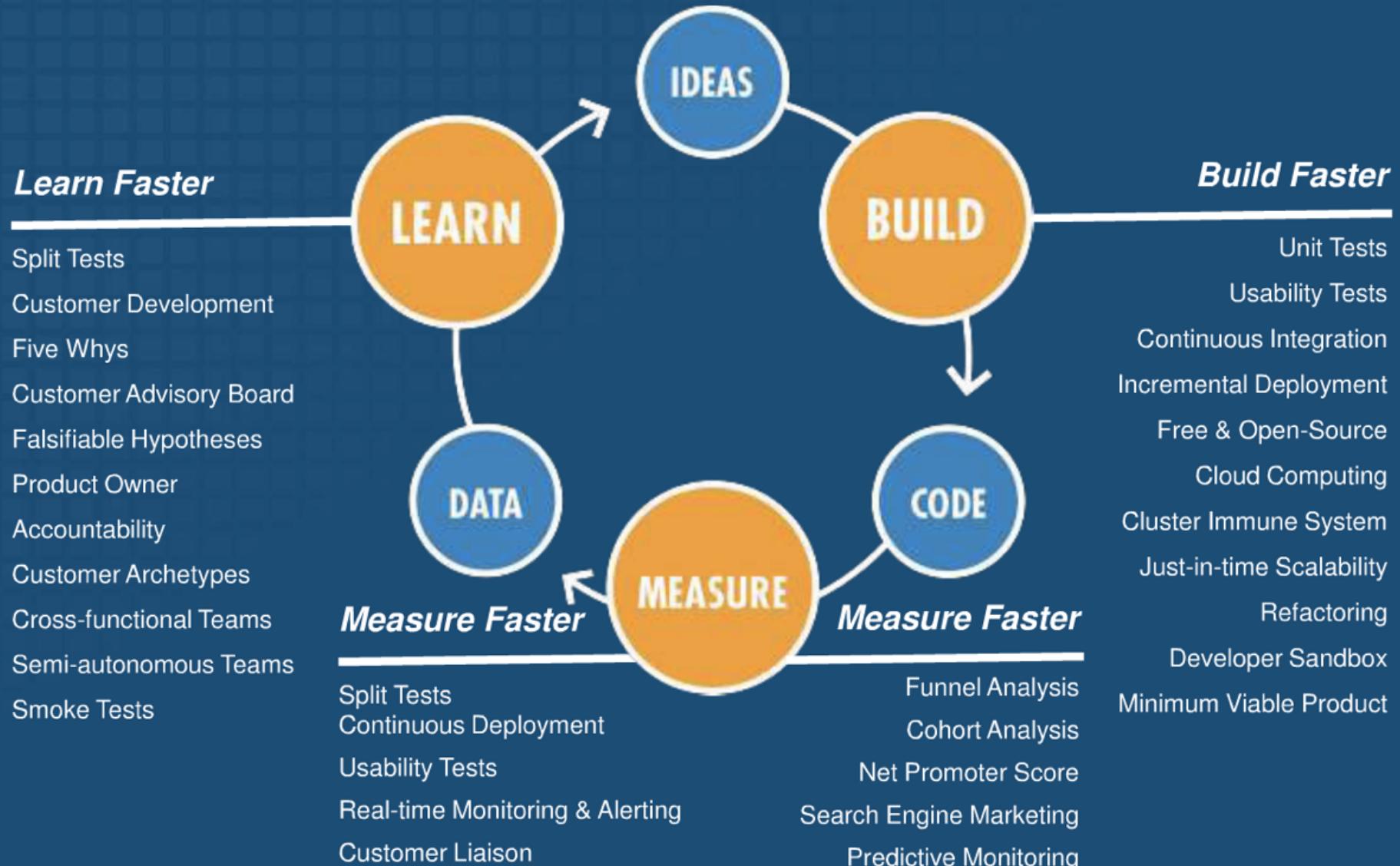
Developing an Idea - Customer Development

- Proving the Product/Market fit:

- who are the customers that need the product?
- does the product solve the problem/need for these customers?
- are these customers prepared to pay the price for the value they are getting?
- is the business going to be sustainable if selling the product to these customers at this price?



Lean Startup



Incorporation

- Setting up the private Limited Company online at the Companies House (£12)
 - can consider other forms but Limited Company is most common
- Choose Share Nominal Value, the number of Shares to issue and the Shareholders
- Nominate Directors (Board of Directors makes all important decisions)
 - limit the number to 3
- Adopt Memorandum and Articles of Association (templates/model provided)
- Register for Corporation Tax, VAT, PAYE
- Understand responsibilities
 - Annual accounts, Confirmation Statement, VAT returns, pension
- Open the bank account
- Set up your accounting: bookkeeping, payroll, VAT returns, annual accounts
 - online systems: Xero, FreeAgent
 - “virtual financial office” provided by an accounting firm
 - in-house: a part-time bookkeeper, accountant for annual returns
 - any combination of the above

Intellectual Property

- Different types: Patent, Know-How, Registered Design, Trademark
- Patent
 - criteria:
 - invention
 - novelty: an invention is considered to be new if it does not form part of the state of the art
 - inventive step: if it is not obvious to the skilled person in the light of the state of the art
 - strongest protection
 - 20 years from the **application date**
 - can take years to have it granted
 - consists of Abstract/Description/**Claims**
 - a **good** and startup-friendly patent lawyer is essential
 - activities: application (PCT/EPO/UKIPO)/search/designation/translations/renewals
- Know-how
 - keeping the “secret sauce” to yourself
- Trademark
 - TM v [®]
 - keeps the product branding consistent
 - an existing trademark search is useful but not exhaustive

Intellectual Property



US 20040006900A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2004/0006900 A1
Beller (43) Pub. Date: Jan. 15, 2004

(54) ORNAMENT DISPLAY DEVICE

(76) Inventor: Michael G. Beller, Powell, OH (US)

Correspondence Address:
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7632 Slate Ridge Blvd.
Reynoldsburg, OH 43068 (US)

(21) Appl. No.: 10/193,083

(22) Filed: Jul. 10, 2002

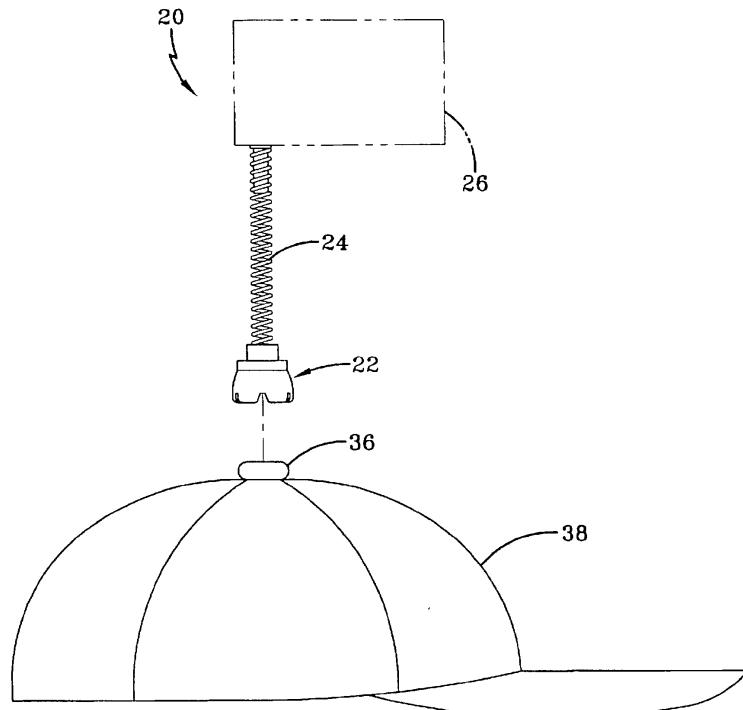
Publication Classification

(51) Int. Cl.⁷ G09F 3/00; G09F 15/00;
G09F 3/16

(52) U.S. Cl. 40/329; 40/666; 40/608

(57) ABSTRACT

An ornament display device configured to be mounted on a button or similar shaped member found on the top of conventional hats or the like. The display device of the present invention includes a base configured to be releasably mounted over the button, a flexible stem mounted on the top of the base and extending upwardly, and an ornament or signage member mounted on the upper end of the stem. The device of the present invention permits the ornament or signage member to be removably mounted on a convention athletic hat or cap in a highly visible manner attracting attention to the displayed ornament.

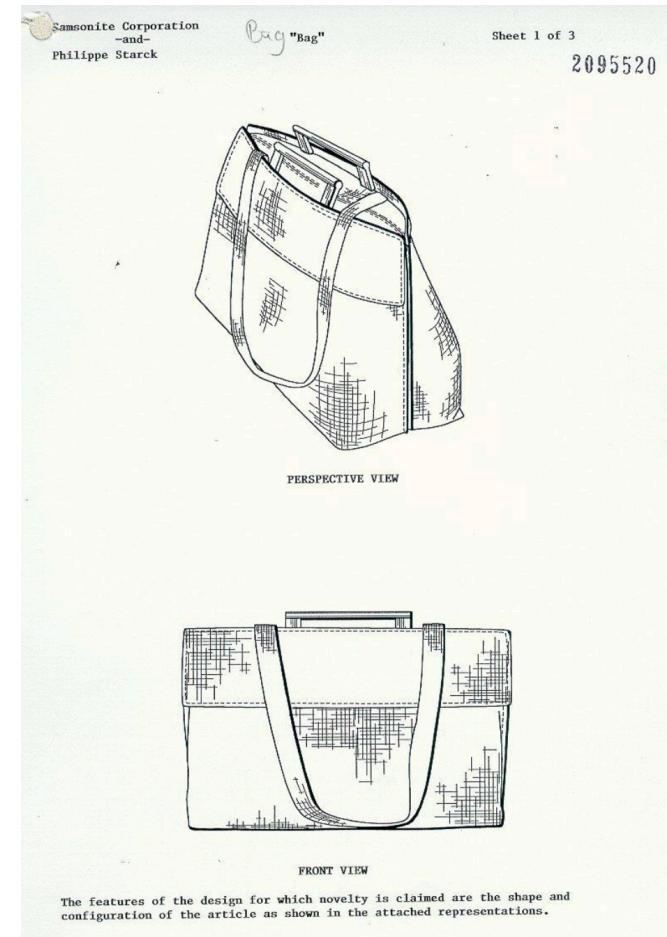
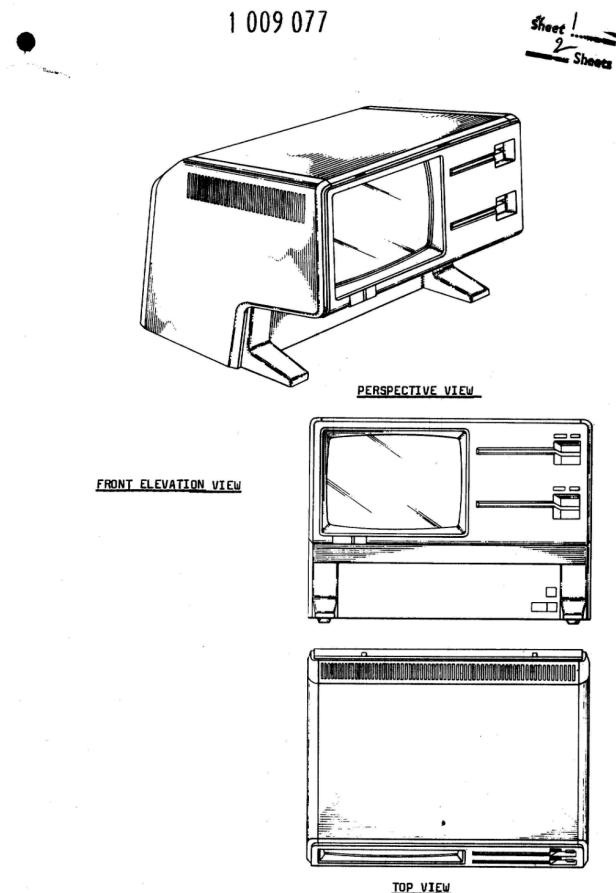


following claims.

1. An ornament display device adapted to be removably mounted upon conventional hats or caps which include a generally round button fixed to the top thereof, comprising, in combination;
 - a) a base configured for releasable engagement with a generally round button;
 - b) an elongate flexible stem having first and second ends opposing one another, said first end connected to said base and said second end extending vertically away from said base; and
 - c) an ornament member connected to said second end of said flexible stem and disposed vertically above said base.

Design

- **Design right** – automatic, 10 years after first sold or 15 years after created
- **Registered design** – up to 25 years



Design number
1009077

Status
Expired

Registration date
10 June 1982

Expiry date
10 June 1997

Design number
2095520

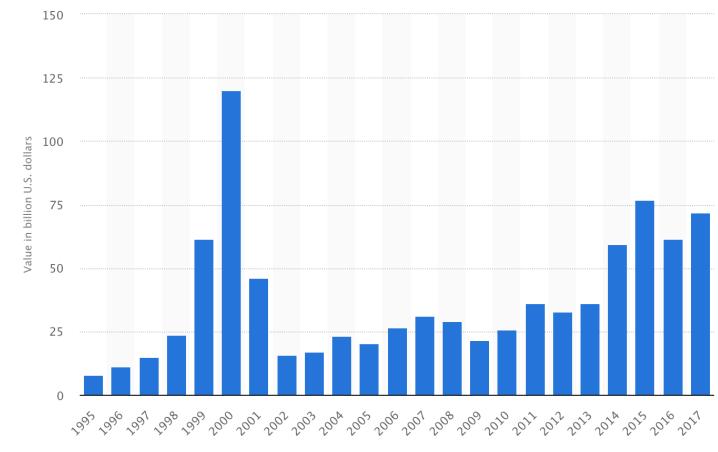
Status
Expired

Registration date
9 March 2000

Expiry date
4 September 2015

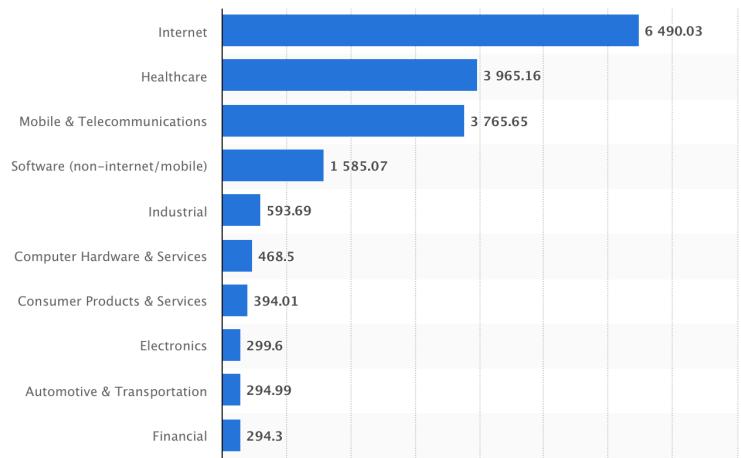
Funding

- Types: equity, convertible loan, loan, grants
- Sources:
 - Friends & Family
 - Angel Investors
 - Crowdfunding
 - Seed funds
 - Enterprise Capital Funds
 - Venture Capital funds
 - Private Equity funds
 - Banks
- Innovate UK grants/loans
- Small Business Innovation Research (SBIR)
- Funding requirements needs to be matched to the idea/team/market etc.
- Balancing the need for funds to survive vs what it's being committed for



Data visualized by tableau

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Term Sheet

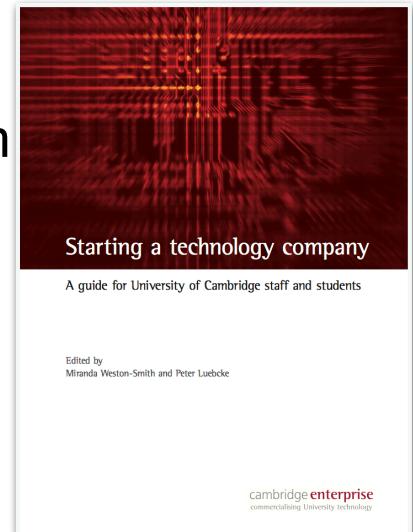
- Valuation: “*I am offering 10% of my GreatCo for £50,000*”
 - post-money: £500K
 - pre-money: £450K
- Option Pool 10-15%
- Shares and rights
 - Ordinary/ Preferred/ Participating Preferred
 - drag-along, tag-along
- Board
 - Non-executive director
 - Observer
 - Meetings schedule
- Expenses and fees
 - due diligence
 - legal (Shareholders Agreement)
 - “arrangement/transaction” fees
- Warranties: ownership, liabilities, tax etc
- Exclusivity period



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Investment Example

- £100m fund = 10 companies x £10m
- 10 companies x 50% success x 20% share x £100m = £100m
- => 1x return



History of an investment									
Shareholders	Share purchase price/£	£ invested	shares issued	share	Round 1	Round 2	Round 3	Round 4	Exit value
Founders share of co.			1,000,000	100%	80%	44%	28%	22%	£17,600,000
Seed investors	1	£250,000	250,000		20%	11%	7%	5%	£4,000,000
Series A investors	2	£2,000,000	1,000,000			44%	28%	22%	£17,600,000
Series B investors	3	£4,000,000	1,333,333				37%	29%	£23,200,000
Series C investors	4	£4,000,000	1,000,000					22%	£17,600,000
Total shares issued			<u>4,583,333</u>						
Money invested		<u>£10,250,000</u>							
Company value (investment)			n/a		£1,250,000	£4,500,000	£10,750,000	£18,333,333	
M&A value of company									£80,000,000
Investment multiples (exit value/value of company)					64	~18	~7	~4	

Explanation of columns

Shares issued
Share – Round 4
Exit value

£ invested/share price in £
shows the percentage change in shareholdings with the investment rounds
The amount the shareholders receive when the company is sold for £80 million

Explanation of rows

Company value (investment)
M&A value of the company
Investment multiples

The total number of shares issued up to that round multiplied by the share price of that investment round
Value of the company when it is sold, in this case £80 million
Exit value/value of company at an investment round

Revenue Forecast

- Any forecast attempts to create a model generating £X turnover vs £Y operational costs
 - Management accounts/Annual statements show the actual performance
- Key terms
 - Revenue
 - Cost of Good Sold (COGS)
 - Gross Profit
 - Operating Expenditure (OpEx)
 - Earnings Before Interest, Tax, Depreciation and Amortisation (EBITDA)

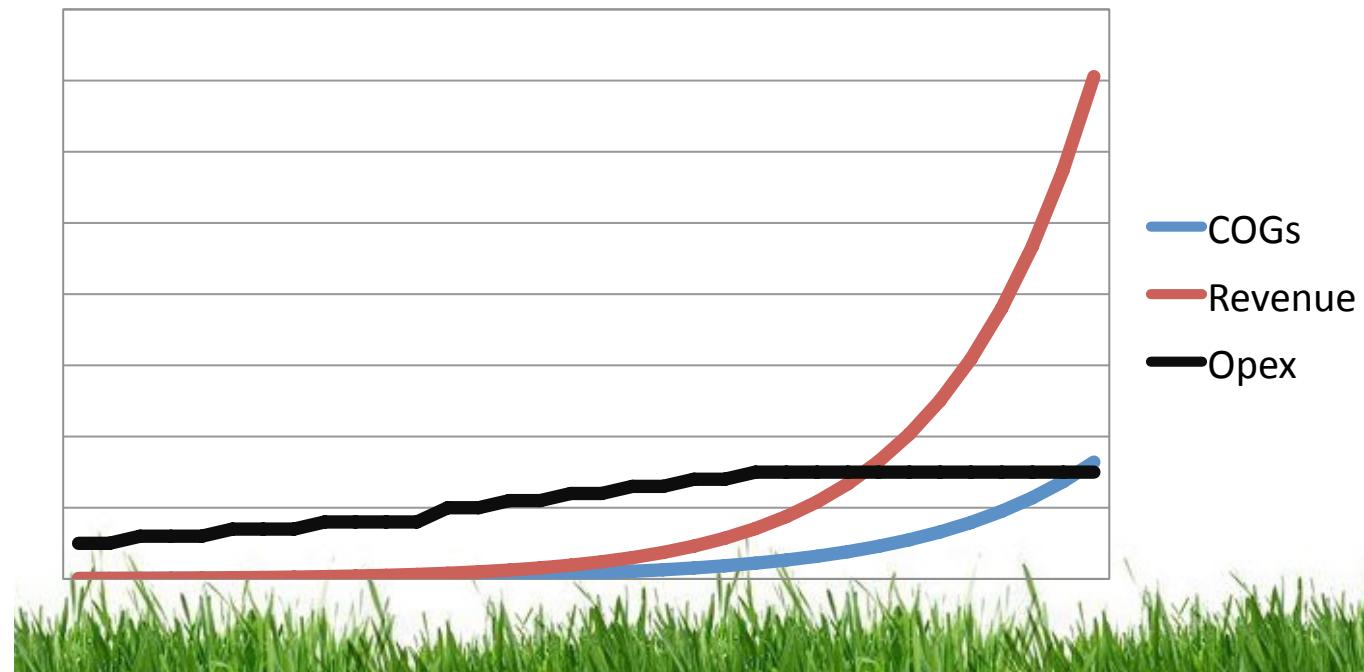
	Three Months Ended	
	December 30, 2017	December 31, 2016
Net sales	\$ 88,293	\$ 78,351
Cost of sales ⁽¹⁾	54,381	48,175
Gross margin	33,912	30,176
Operating expenses:		
Research and development ⁽¹⁾	3,407	2,871
Selling, general and administrative ⁽¹⁾	4,231	3,946
Total operating expenses	7,638	6,817
Operating income	26,274	23,359
Other income/(expense), net	756	821
Income before provision for income taxes	27,030	24,180
Provision for income taxes	6,965	6,289
Net income	\$ 20,065	\$ 17,891

Apple Q1Y18 statement

Revenue Model

- Understand the profit/cost per user
 - customer acquisition cost
 - widget manufacturing
- Goal – the revenue ramp up is exponential vs costs

Revenue vs. Expenses

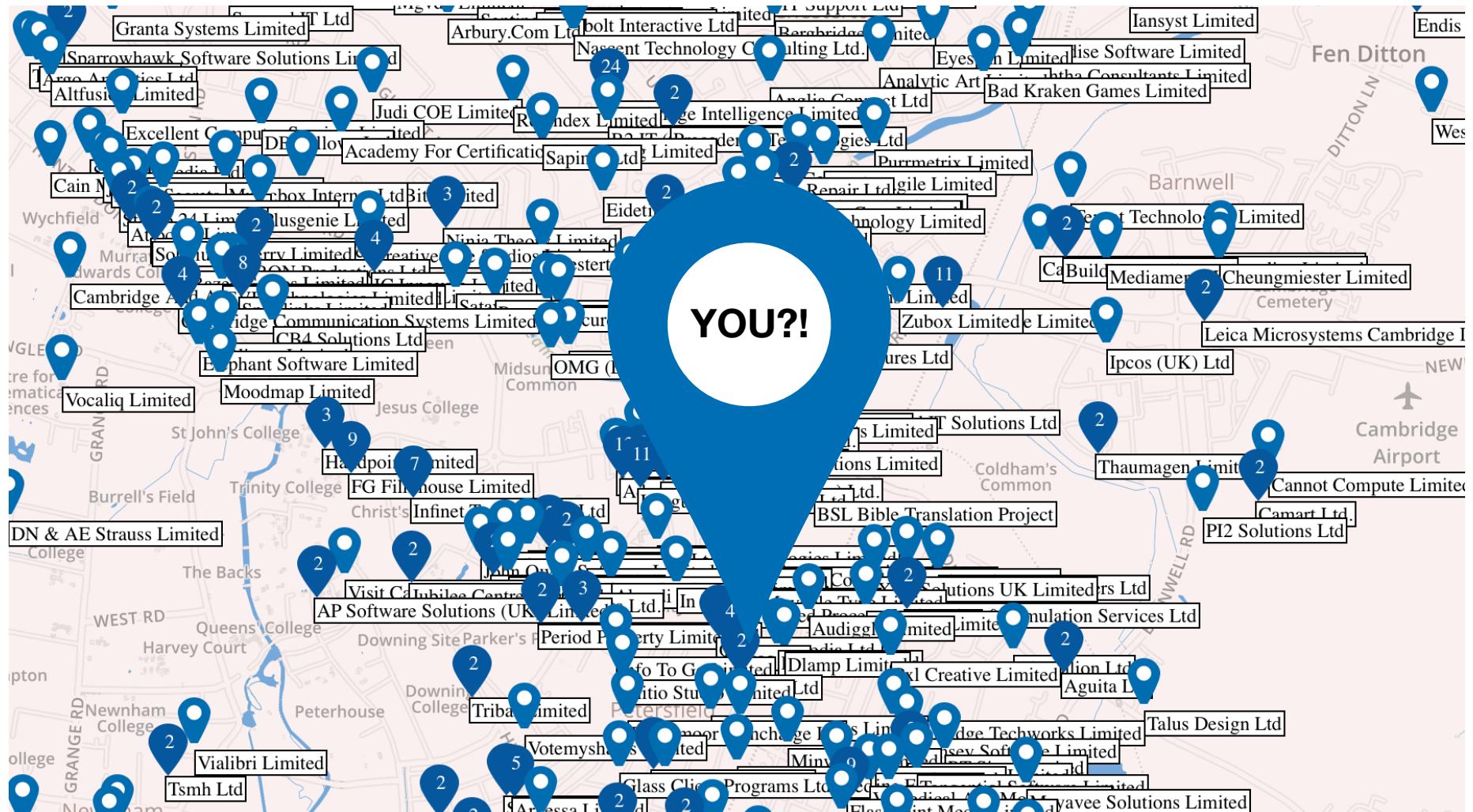


<http://www.labouseur.com/courses/techent/mint.pdf>

Exit Considerations

- Investors need returns
 - understand their return timeline and expectations as it may affect the company future
- Exit event
 - Mergers and Acquisitions (M&A)
 - technology
 - IP
 - team
 - Management Buyout/Restructuring
 - early investors cashout, capital table restructured
 - Listing on a stock exchange (NASDAQ, LSE, AIM)
 - regulatory constraints
- M&A
 - Non-Disclosure Agreement (NDA), Information Package, Letter of Intent (LOI)
 - Due Diligence Questionnaire / Dataroom
 - Share Purchase Agreement (SPA)
 - consideration/escrow
 - earnout
 - warranties
 - employment

Cambridge Cluster



www.camclustermap.com

Further Reading

