How IT is Propagating Innovations and Accelerating Competition

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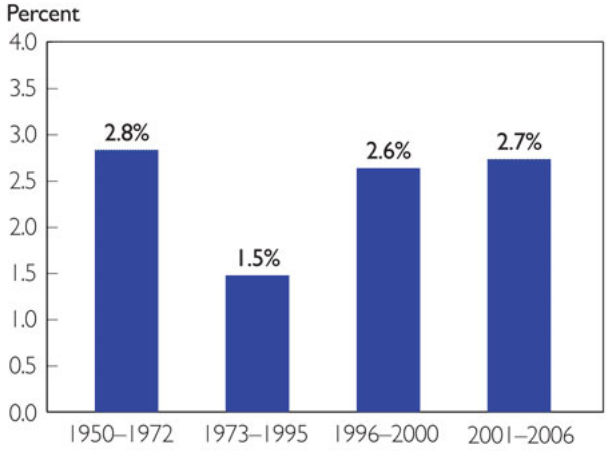
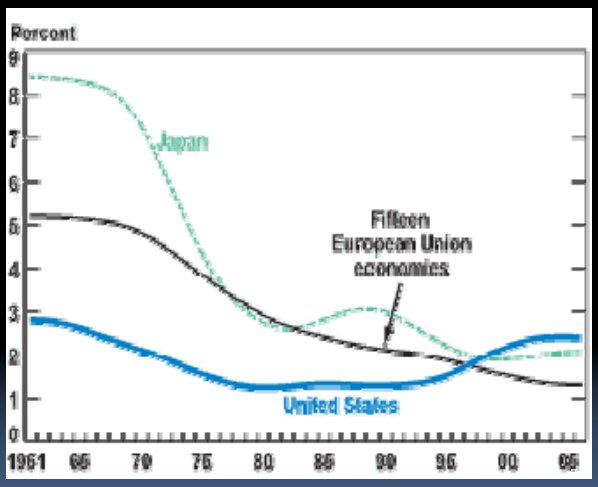
Average Annual Percent Change in U.S. Labor Productivity



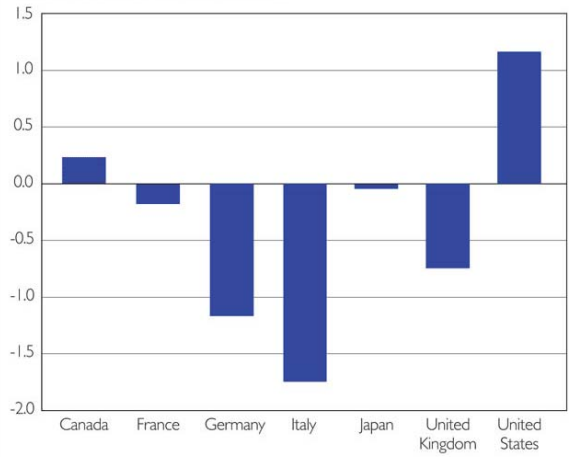
Source: Bureau of Labor Statistics.



Source: The Conference Board and Groningen Growth and Development Centre, Total Economy Database, January 2007, http://www.ggdc.net.Notes: Labor productivity is defined as real GDP per hour worked. Trend estimates are based on a Hodrick-Prescott filter with a smoothing parameter of 100.

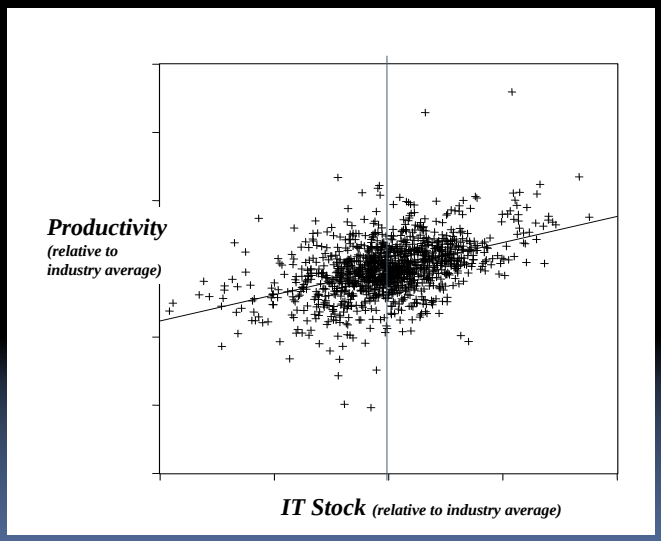
Average Annual Productivity Growth Has Fallen for Most G7 Nations Since 1990

Percentage Point Difference in Annual Productivity Growth Rates, 1990–1995 vs. 1995–2005

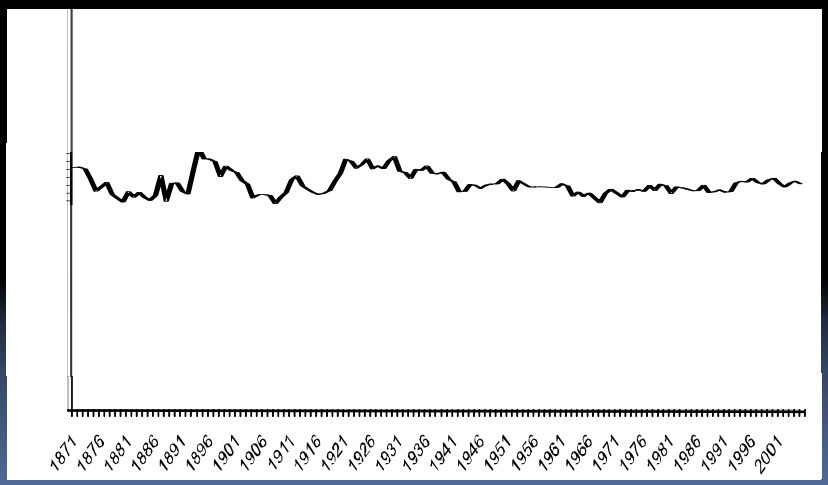


Source: Organization for Economic Cooperation and Development.

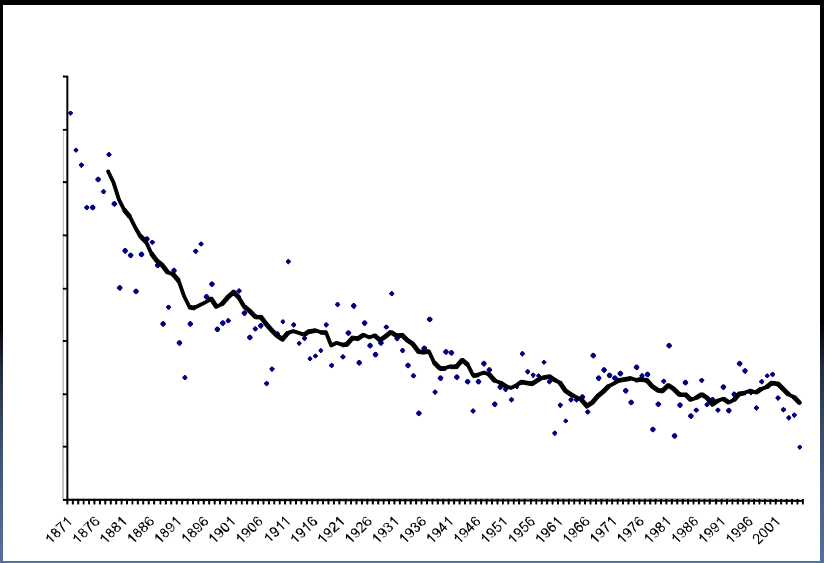
IT and Productivity: The Data Speak



Average Performance over time: Baseball Batting Average



Spread Around the Average



Baseball Data

"… I never dreamed that the decline of variation would be so regular… the decline of standard deviations for batting averages is so regular that the pattern [in the graph] looks like a law of nature… I can assure you that this pattern represents regularity with a vengeance."

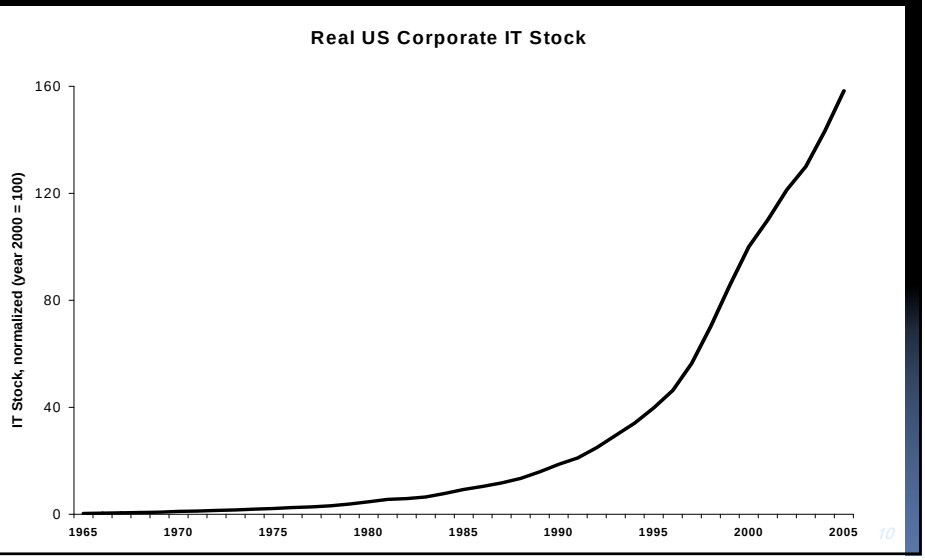
- Stephen Jay Gould, *Full House*

The Full House Hypothesis

"Complex systems improve when the best performers play by the **same rules over extended periods of time**. As systems improve, they equilibrate and **variation decreases**."

- Stephen Jay Gould, *Full House*

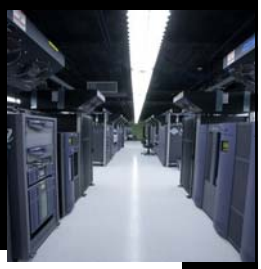
The Real Quantity of IT

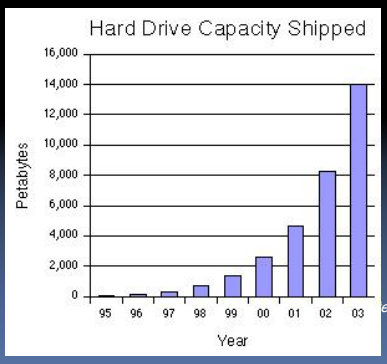


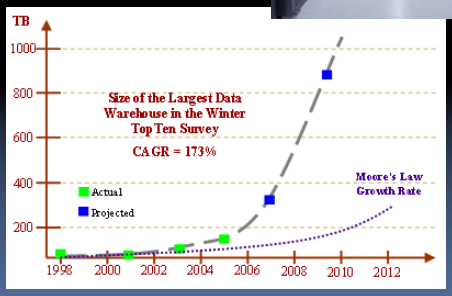
The Information Explosion

- Digital Information is Doubling Every 1.2 years
- The size of the largest data warehouses is tripling every two years

  Exceeds processor growth predicted by Moore's law







Our Hypothesis

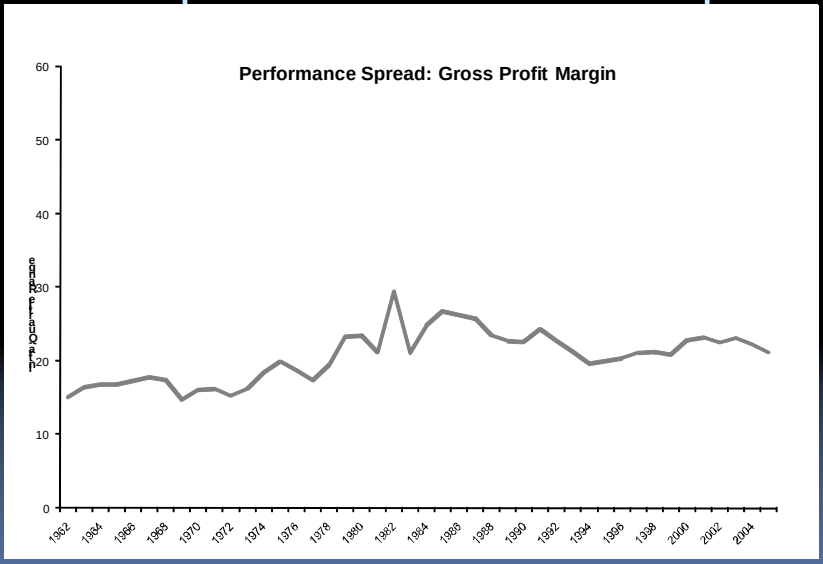
Hypothesis: *The IT discontinuity starting in the mid 1990s represents a significant 'rules change' for business, and is associated with an* ***increase in performance spread***

20 high IT industries

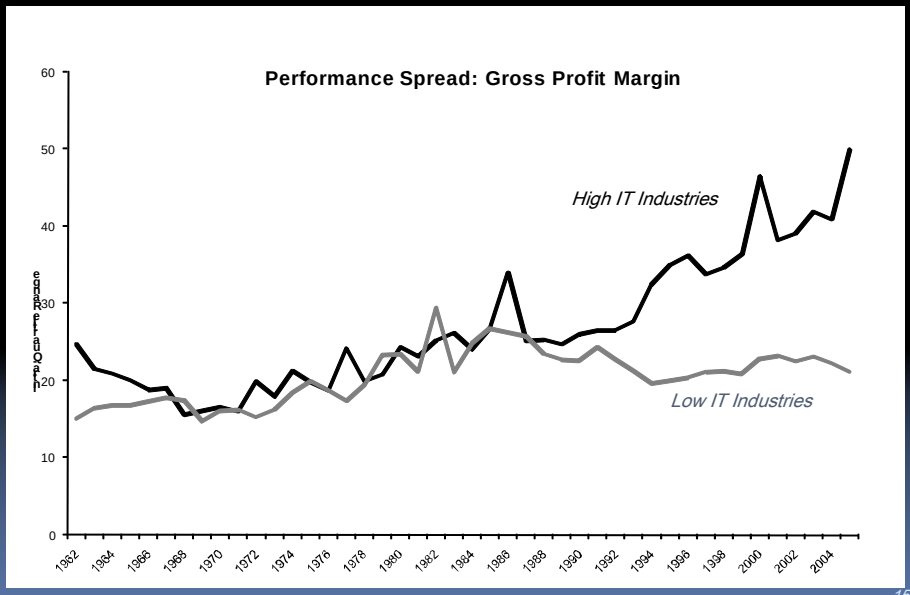
8 Manufacturing
3 Financial Services
6 Other Services
3 Other

20. Fabricated metal product manufacturing
19. Motion picture and sound recording
18. Electrical equipment and appliance mfg.
17. Miscellaneous manufacturing
16. Chemical manufacturing
15. Wholesale trade
14. Motor vehicle, body, trailer, & parts mfg.
13. Machinery manufacturing
12. Computer and electronic product mfg.
11. Credit intermediation and related activities
10. Other transportation equipment mfg.
9. Legal services
8. Rental and leas. serv. & lessors
7. Insurance carriers and related activities
6. Administrative and support services
5. Publishing industries
4. Securities, commodity contracts, investments
3. Other prof., scientific and technical svces
2. Information and data processing services
1. Computer syst. design and related services

Corporate Performance Spread



Corporate Performance Spread

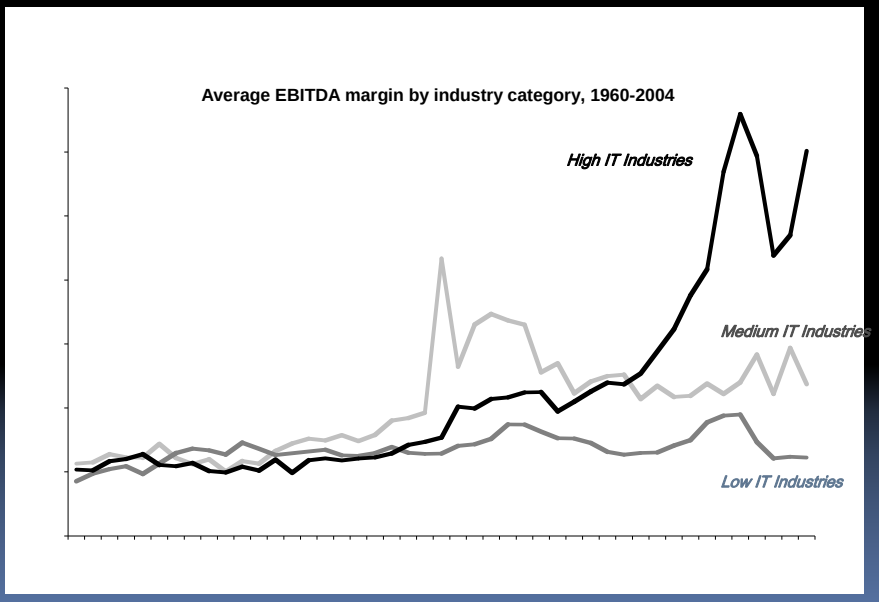


Other Performance Measures

- Gross Profit Margin
- EBITDA Margin
- Profit Margin
- ROA
- ROE
- Tobin's Q
- Market value / revenue

For each metric, there has been a statistically significant increase in performance spread in IT intensive industries

Performance Spread (IQR) Increased



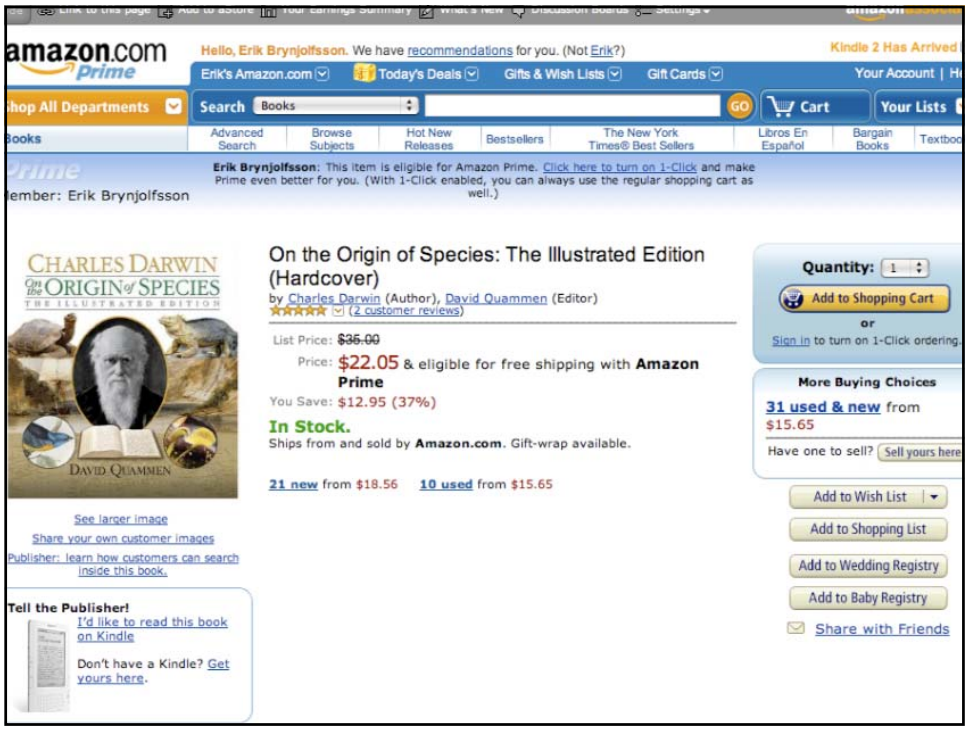
What Do the Winners Do?

Experiment

&

Scale

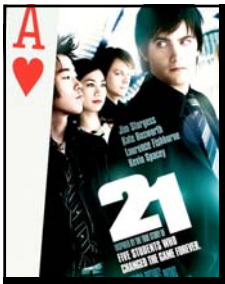
Experiment



Experimentation has never been easier

- A-B experiments at Amazon (and at MIT E53-313)
- Question:

  How often does Google run field experiments?



From *21* to … $30.7 Billion

- Gary Loveman
  - Zero executive experience
  - Zero background in Casinos
  - But, an MIT PhD who knows how to make numbers talk

Results

- Transformed Harrah's from second tier to number one gaming company in the world
- Completed a $30.7 Billion LBO
- Introduced a culture of pervasive field experimentation
  - *"There are two ways to get fired from Harrah's…"*

"We have come out on top in the casino wars by mining our customer data deeply, running marketing experiments and using the results to develop and implement finely tuned marketing and services strategies that keep our customers coming back."

•-- Gary Loveman, CEO, Harrah's

Other Examples

Google
- **Page rank algorithm 2008 is very different from 1999 algorithm**
- **Advertising auctions are continuously fine tuned**
- **Even HR – are you a record-holder in something?**

Netflix
- **How do YOU pick your next movie?**

Tesco
- **From #2 to #1**

VA Hospitals
- **"Evidence based medicine"**

Capital One
- **Credit card offers tests**

Call Center
- **Employee incentives and customer service**

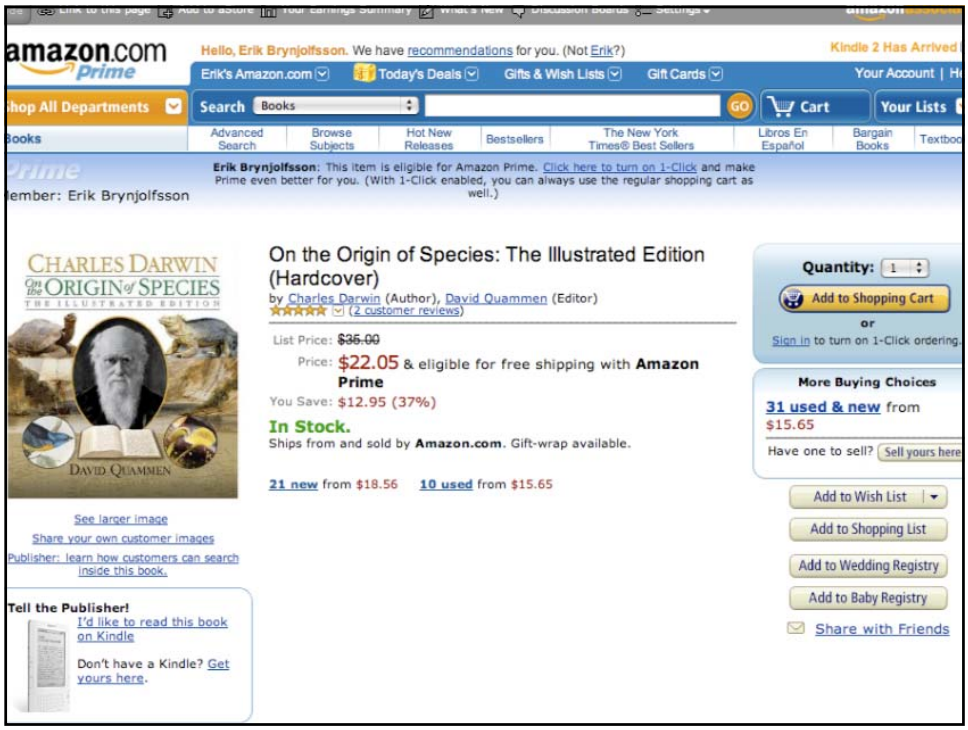
Schools in Africa
- **Digital cameras reduce teacher absenteeism**

Field Experiments with rapid feedback = R&D

Scale

What Does IT Do?

1. Replicate Bits

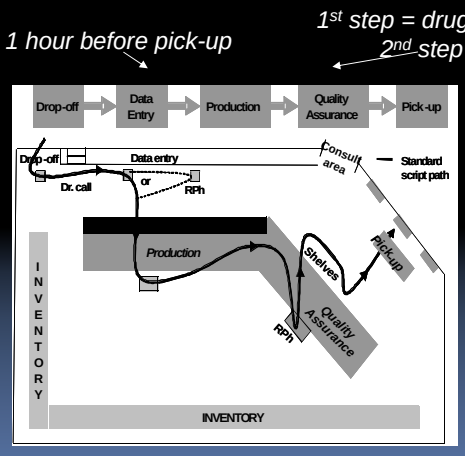


What Does IT Do?

1. *Replicate Bits*
2. *Replicate Processes*

Case Study: CVS

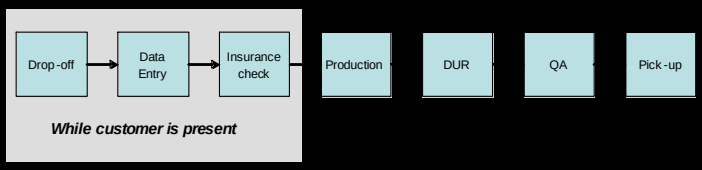
Basic 'script fulfillment process:



- 27% of scripts encountered a problem
- 16% of customers disappointed at pick-up

CVS: Scale without Mass

New fulfillment process:



- Short-term results: customer satisfaction scores
  - Wait time satisfaction: 76 → 86
  - Overall pharmacy satisfaction: 86 → 91
- New process embedded in Enterprise IT (EIT)
  - 100% compliance
- Rapid roll-out to over 4000 retail pharmacies

Emerging Technologies

Cloud Computing

- *From Custom to Components*
- *Conway's Law*
- *Scale* and *Flexibilty*

Enterprise 2.0

- *Enterprise Wikis*
- *Social Networks*

Many-to-many knowledge sharing within a companies community of employees, customers and suppliers

Thousands of small ideas from hundreds of users

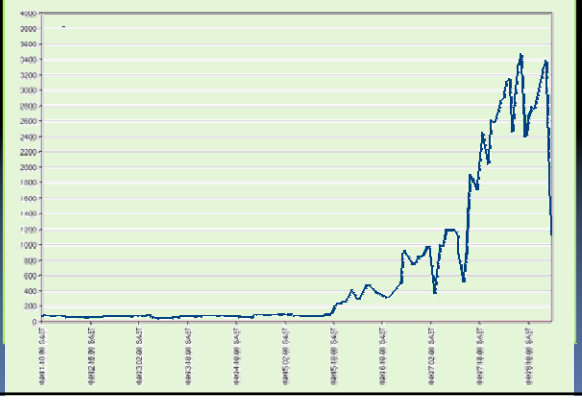
Cloud Scalability

Amazon Customer: Animoto

http://blog.animoto.com/

On April 14th 2008 Animoto provided a new plugin for facebook …

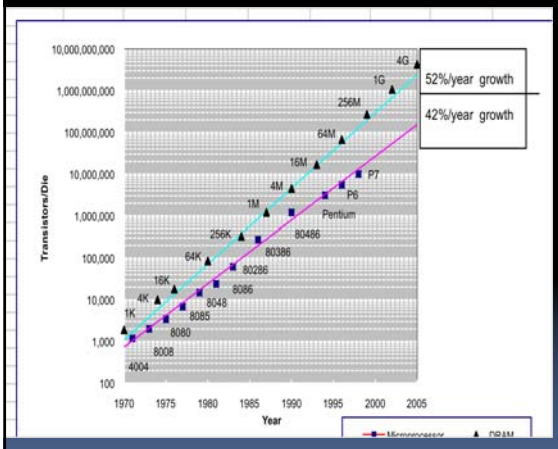
	Mon Apr 14th	Tue	Wed	Thu	Fri
Animoto Members	25,000	50,000			250,000
ec2 Server Instances	100	400	900	2800	3400

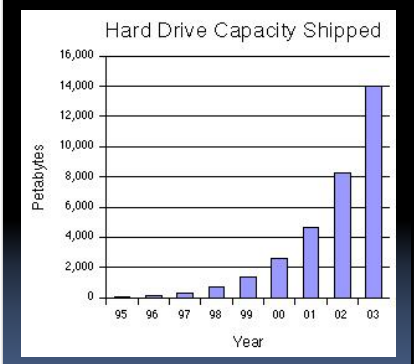


Case Study: Cisco Mac Wiki

- *Over 10,000 Macintosh users at Cisco, but no central IS support*
- *A few users established a wiki, where users could post tips, tricks, files, links and other content*
  - *Example: tip for using the Linux printers which were ubiquitous at Cisco*
- *Many users all over world got up to speed entirely via Mac Wiki*
- *Thousands of small ideas from hundreds of users*

IT Has Reduced the Costs of Experimenting and Scaling





Synergies Amplify their Benefits

4 Facts → 3 Hypotheses

1. IT makes it easier to experiment and then replicate innovations
   - Experimentation Platform
   - Share successes and insights
   - Propagate best practices
   - Monitoring and compliance
2. Boundary of firm remains important
   - Brynjolfsson, Hitt and Yang, 2004, etc
   - B&N vs. Amazon; K-mart vs. Wal-mart, etc.
3. IT discontinuity
   - Soaring MIPS, bps, storage, etc.
   - Enterprise IT (ERP, etc)
   - Cloud computing and Web 2.0
4. Business Innovation continues
   - Alta Vista vs. Lycos vs. Yahoo vs. Google
   - Merrill/Schwab/Merrill/Schwab

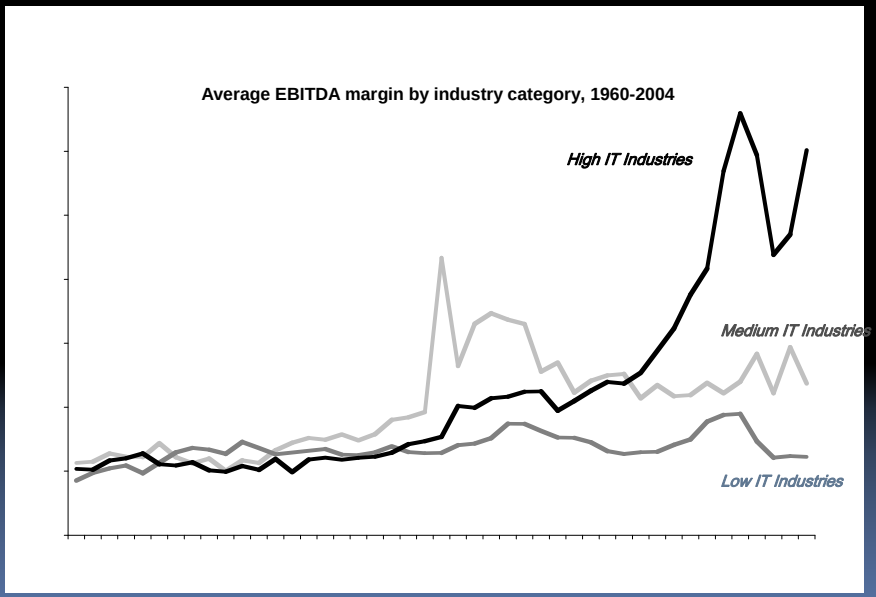
1. High IT industries should have experienced greater *Performance Spread*
2. High IT industries should have experienced greater *Turbulence*
3. High IT industries should have experienced greater *Concentration growth*

==> More "Schumpeterian" competition throughout economy, not just high tech industries

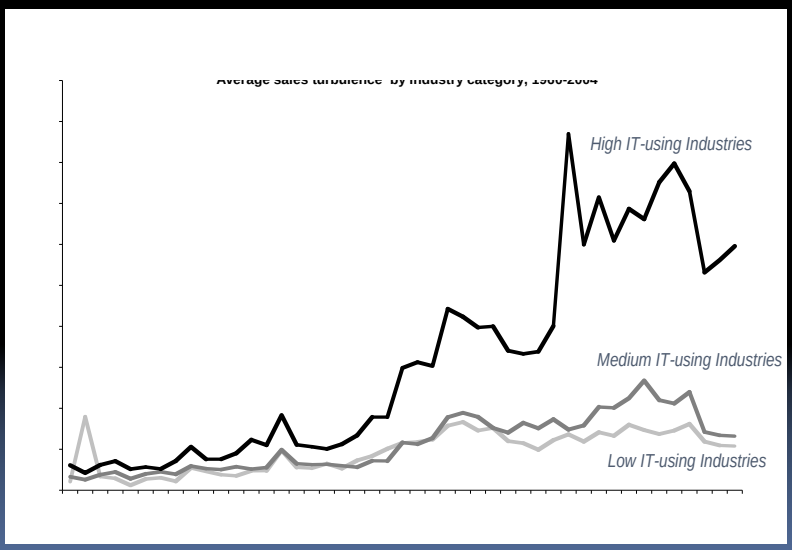
Data

- Industry Concentration, Performance and Turbulence (Compustat)
  - Revenue (SALES) and enterprise value (EV)
  - Turbulence: the average rank change of all firms in that industry
  - Concentration growth rate: % change in Herfindahl index (HI)
- IT Intensity of an Industry (Bureau of Economic Analysis)
  - IT capital service flow as a share of total capital service flow (1987-2004): 63 industries
- Weights (Bureau of Economic Analysis)
  - Full-time employees (FTE)
  - National Income and Product Accounts

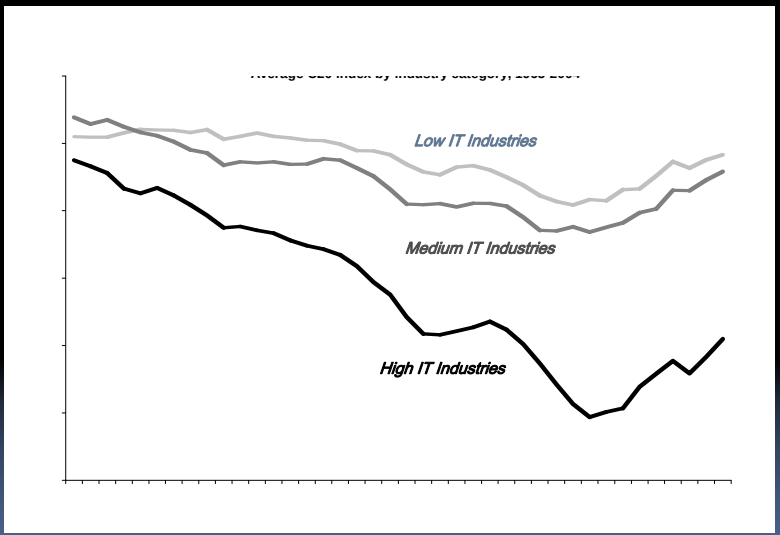
Performance Spread (IQR) Increased



Sales Turbulence Increased



Concentration Increased



Break Year

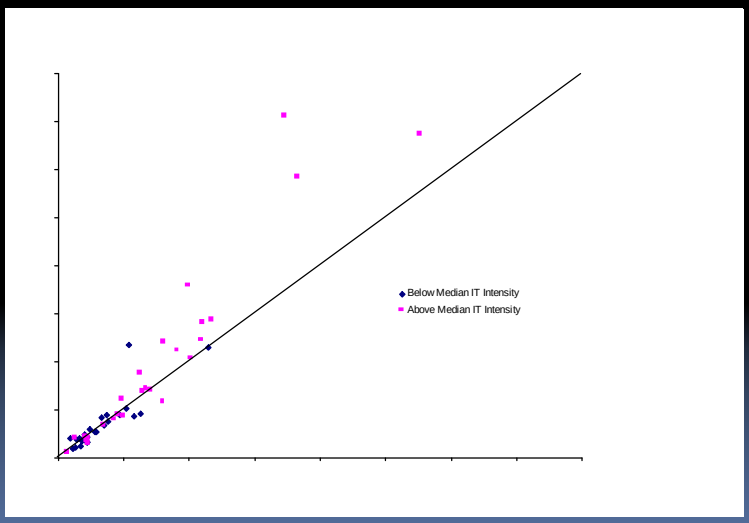
- Chow-test indicates 1996 is a break year
  - This finding is consistent with the replication story
  - 1995 and 1997 are also break years

- Use a difference-in-difference approach

$$d = \beta_0 + \beta_1 D96 + \beta_2 IT + \beta_3 D96 \cdot IT + \varepsilon$$

D96 equals 1 if year > 1996 and 0 otherwise

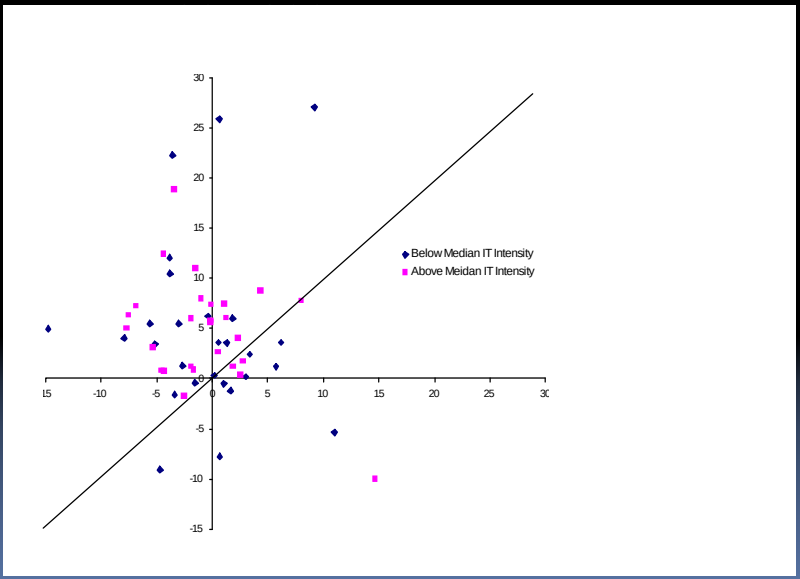
Average yearly changes in Sales Turbulence, 1987-1996 vs. 1997-2004



Turbulence: Sales

Model	1	2	3	4	5	6
IT-intensity	0.56***	0.30***	0.93***	0.23	0.68***	0.36
	(0.17)	(0.08)	(0.15)	(0.18)	(0.25)	(0.64)
Post-1996 dummy	0.99**	0.68***	1.20***	0.81***	1.16***	-0.77*
	(0.42)	(0.24)	(0.42)	(0.28)	(0.40)	(0.47)
Post-1996 dummy * IT-intensity				0.57**	0.787**	0.77***
				(0.27)	(0.36)	(0.18)
# of firms	0.041***	0.04***	0.033***	0.04***	0.032***	0.05***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Weights			yes		yes	yes
Industry fixed effects						yes
Drop Outliers		yes	yes	yes	yes	yes
Drop low-density industries		yes	yes	yes	yes	yes
Observations	1096	936	936	936	936	936
Number of industries	61	52	52	52	52	52
R-squared	0.74	0.77	0.91	0.77	0.90	0.94

Average yearly changes in the Herfindahl Index of sales, 1987-1996



Concentration Growth: Sales

Model	1	2	3	4	5	6
IT-intensity	-0.165	-0.207	-0.843	-0.576	-1.853***	-0.55
	(0.32)	(0.31)	(0.52)	(0.40)	(0.72)	(3.54)
Post-1996 dummy	4.685***	3.534***	4.335***	3.172***	3.601***	-9.380***
	(0.81)	(0.82)	(0.90)	(0.92)	(0.92)	(3.47)
Post-1996 dummy * IT-intensity				0.833	2.066**	6.034***
				(0.57)	(1.02)	(1.49)
# of firms	0.001	0.002*	0.058***	0.00	0.007***	-0.008*
	(0.00)	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)
Weights			yes		yes	yes
Industry fixed effects						yes
Drop Outliers		yes	yes	yes	yes	yes
Drop low-density industries		yes	yes	yes	yes	yes
Observations	1098	954	954	954	954	954
Number of industries	61	53	53	53	53	53
R-squared	0.04	0.03	0.01	0.02	0.06	0.19

Conclusions

1. We're in the midst of a discontinuity in the economy
   - Leaders are pulling away from laggards
2. The improved ability of firms to experiment and then replicate business processes, via IT, appears to be associated not only with productivity, but also with changes in the nature of innovation and competition
   - More turbulence
   - More concentration
   - More performance heterogeneity

   ➔ ***More "Schumpeterian"***
3. Other explanations (e.g. R&D) may also be factors.
4. These trends may not persist
   - Investments in IT and EIT may tail off
   - Replication may become easier *across* firm boundaries

Questions?

To learn more, see

http://digital.mit.edu/erik

and

Brynjolfsson and McAfee "The Future of the Web: Beyond Enterprise 2.0", *MIT Sloan Management Review*, Vol. 48. No. 3, 2007.

McAfee and Brynjolfsson "Investing in the IT That Makes a Competitive Difference" *Harvard Business Review*, July-August 2008 (Special Centennial edition)

Implications for Managers

1. Heightened value of innovation
   - Adjust recruiting, retention and incentives systems
   - Innovations can be big or small
2. Invest in technologies and platforms that encourage, aggregate, codify and/or propagate innovations
   - ERP/SCM/CRM etc.
   - Cloud computing, Enterprise-strength Web 2.0 and Social networking
3. Manage for innovation and agility
   - Adjust recruiting, retention and incentives systems
   - Innovations can be big or small
   - Run field experiments to test your ideas

Experiments at Harrah's

Critical Success Factor at Harrah's: Acquiring and upselling customers

Flexible IT platform for:

1. Microtargeting - not blanket offers
2. Continuous Experimentation
3. Computing and maximizing *lifetime* total value, not just transaction value
4. Indentify *marginal* behavior, not average behavior
   - Info Econ 101: "*Information is only valuable if it changes behavior*"
5. Loyalty program: 15% revenues returned as incentives

Total Gold Program at Harrah's

$11k	Diamond
$7K	Platinum
Start	Gold

What are Critical Success Factors at Novartis?

What types of experiments could you enable?