Origin of Innovation in America

"When a private individual mediates an undertaking, however directly connected it may be with the welfare of society, he never thinks of soliciting the cooperation of the Government, but he publishes his plan, offers to execute it himself, courts the assistance of other individuals, and struggles manfully against all obstacles. Undoubtedly he is often less successful that the State might have been in his position; but in the end **the sum of these private undertakings far exceeds all that the Government could have done**."

-- Alexis de Tocqueville, Democracy in America

n.b. It is not the choice between private monopoly-like approaches that is better than a government-originated monopoly, but the competition, choice, and most importantly **the sum total of multiple, interoperable, and cumulative results**.

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Moore's Cannibal Principle

"The whole point of integrated circuits is to absorb the functions
  of what previously were discrete electronic components,
  to incorporate them in a single new chip, and then to
                    give them back for free,
  or at least for a lot less money than what they cost as individual parts.
  Thus, semiconductor technology eats everything,
  and people who oppose it get trampled."

Source: Gordon Moore (Intel Chairman) quoted in Brent Schlender,
              <u>Why Andy Grove Can't Stop</u> *Fortune*, July 10, 1995, p. 91

The True Cost of "Bad Software"

[However], there [has been] no Moore's law for software.
While computing power falls rapidly in price, software that can make use of that
computing power becomes more complicated, sometimes more expensive
and less reliable, and almost always more difficult to configure and maintain.
*Yet it is software that constitutes the fundamental rules for information
processing*, and thus for an information economy and an information society.
Massive processing power connected by ever-increasing bandwidth
is a skeletal infrastructure. Software determines how information is
manipulated, where it flows, to whom and for what reasons.

--United Nations Conference on Trade and Development (UNCTAD) 2003 p.95

Designing for Difficulty

"Even in 1909, the fundamental limitations of [the Wright Brothers'] design are evident. Much the way a bicycle cannot maintain its balance unless it is moving, the Wrights have purposefully designed their planes to be inherently unstable, believing, mistakenly, that this is an essential factor to control in the air." From Unlocking the Sky by Seth Shulman

"Bad Software" is software that was intentionally designed to hamper or completely thwart rivals, even when such manoeuvres hurt not only the software itself, but the customers of that software; See Breaking Windows by David Bank

- 2001: The Standish Group Estimated $78B/year wasted on "Bad Software"

- 2002: NIST Estimated $60B/year lost in US alone due to "software bugs"

- 2002: Net profits of Fortune 500 is approximately $68B

- 2003: US Federal IT budget set at $59B

  - History suggests 80% will be wasted, not deployed

- 2003: Cost of Worms and Viruses alone range $17B-$55B

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The State of ICT and Software, 2008

- More than $3T USD global IT spend (Gartner 2008 estimate)
  - More than $1T USD IT spend is wasted:
    - 18% of all IT projects abandoned before production
    - 55% of all IT projects "challenged" (late, broken, or both)
- More than 90% of leading IT vendors fail to achieve "good" rating for value from at least 80% of their top customers
  - Measured 4 years in a row
- Proprietary software model destroys 85% of the global innovation potential
- Average proprietary software has defect density 50x-150x higher than OSS
  - Measured 3 years in a row
- Conclusion: proprietary software is not sustainable

http://people.redhat.com/tiemann/STS-Forum-Tiemann-2006.pdf
http://www.techworld.com/news/index.cfm?RSS&NewsID=6718

Out of the Crisis – Deming (1982)

- Create constancy of purpose

- Adopt new philosophy/change

- Build quality in the first place

- Build relationships around loyalty and trust, not price

- Improve product and service constantly and forever

- Improve people w/training

- Replace supervision with leadership

- Drive out fear so that everybody can participate

- Break down barriers between departments; work as team

- Eliminate adversarial relationships

- Replace quotas, MBO, etc. with leadership

- Restore pride of workmanship by rewarding quality, not numbers

- Strongly support programs for self-improvement

- Transformation is everybody's job

LOOK INSIDE!™

W. EDWARDS DEMING
Out of the Crisis

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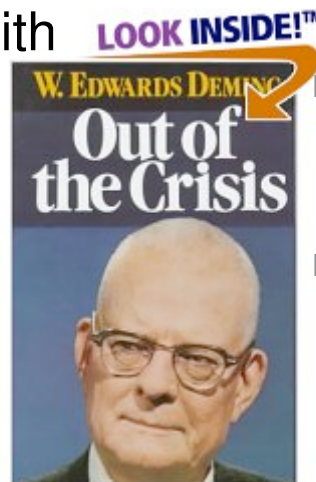
Standards and Control

"The decision to make the Web an open system was necessary for it to be universal. **You can't propose that something be a universal space and at the same time keep control of it.**"

-- Tim Berners-Lee, Creator of the World Wide Web

See http://www.w3.org/People/Berners-Lee/FAQ.html#What2

Open Source Software

Better licenses make better software

- 10 requirements of the OSD (http://opensource.org/docs/osd)

- 60+ approved licenses (http://opensource.org/licenses/alphabetical)

- 100,000+ projects (http://sourceforge.net)

- 2M+ user-developers (http://flossimpact.eu)

- $1.8B combined revenues, accelerating growth to $5.6B by 2011

    (http://www.idc.com/getdoc.jsp?containerId=prUS20711507)

- Over 1B SLOC now licensed as OSS

    (http://www.riehle.org/publications/2008/the-total-growth-of-open-source/)

Runs computers ranging from smartphones to Google-scale supercomputers

"Now that we *can* do anything, what *should* we do?"

— Bruce Mau, Massive Change
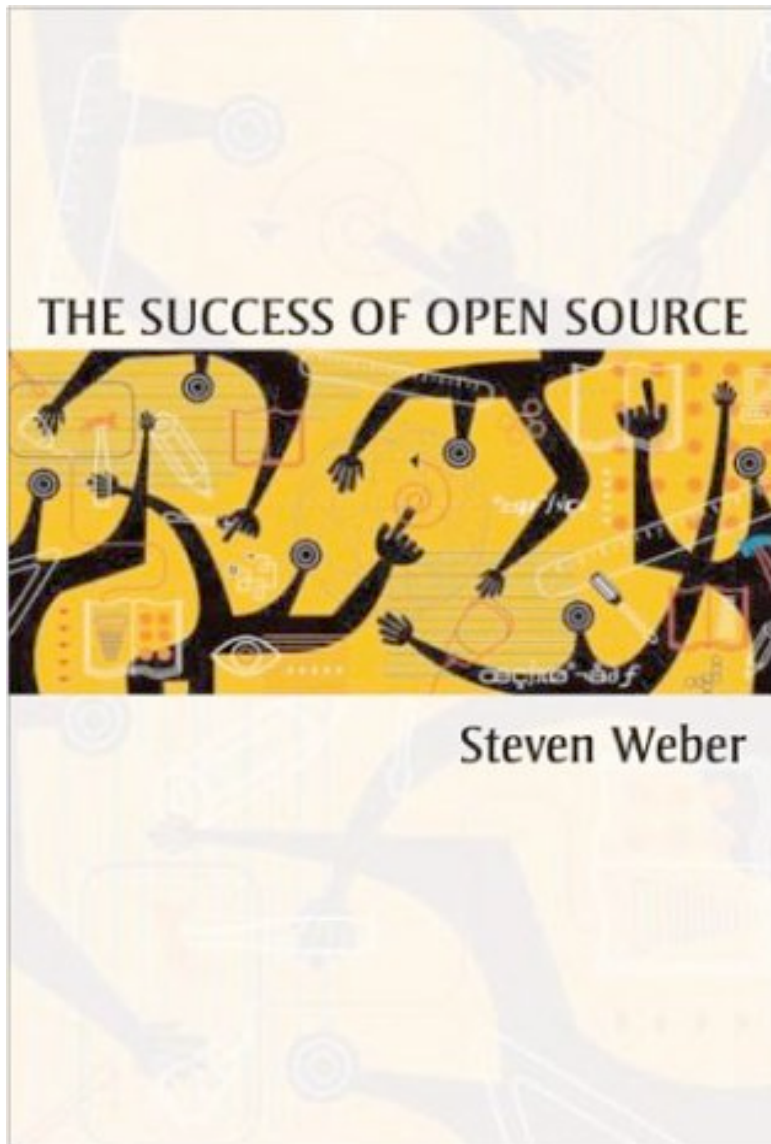
"The conventional notion of property is the right to exclude. Property in open source is configured fundamentally around the right to distribute, not the right to exclude."

Prof. Steven Weber
Director of the Institute of International Studies
UC Berkeley

How Paradigms Affect Innovation Models

Closed Innovation

(Microsoft)

- The smart people in our field work for us.

- To profit from research and development (R&D), we must discover it, develop it and ship it ourselves.

- If we discover it ourselves, we will get it to market first.

Collaborative Innovation

(Red Hat)

- We need to work with smart people inside and outside our company.

- External R&D can create significant value; internal R&D is needed to claim some portion of that value.

- We don't have to originate the research to profit from it.

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Collaborative Innovation Framework

Open Content

Access to Knowledge
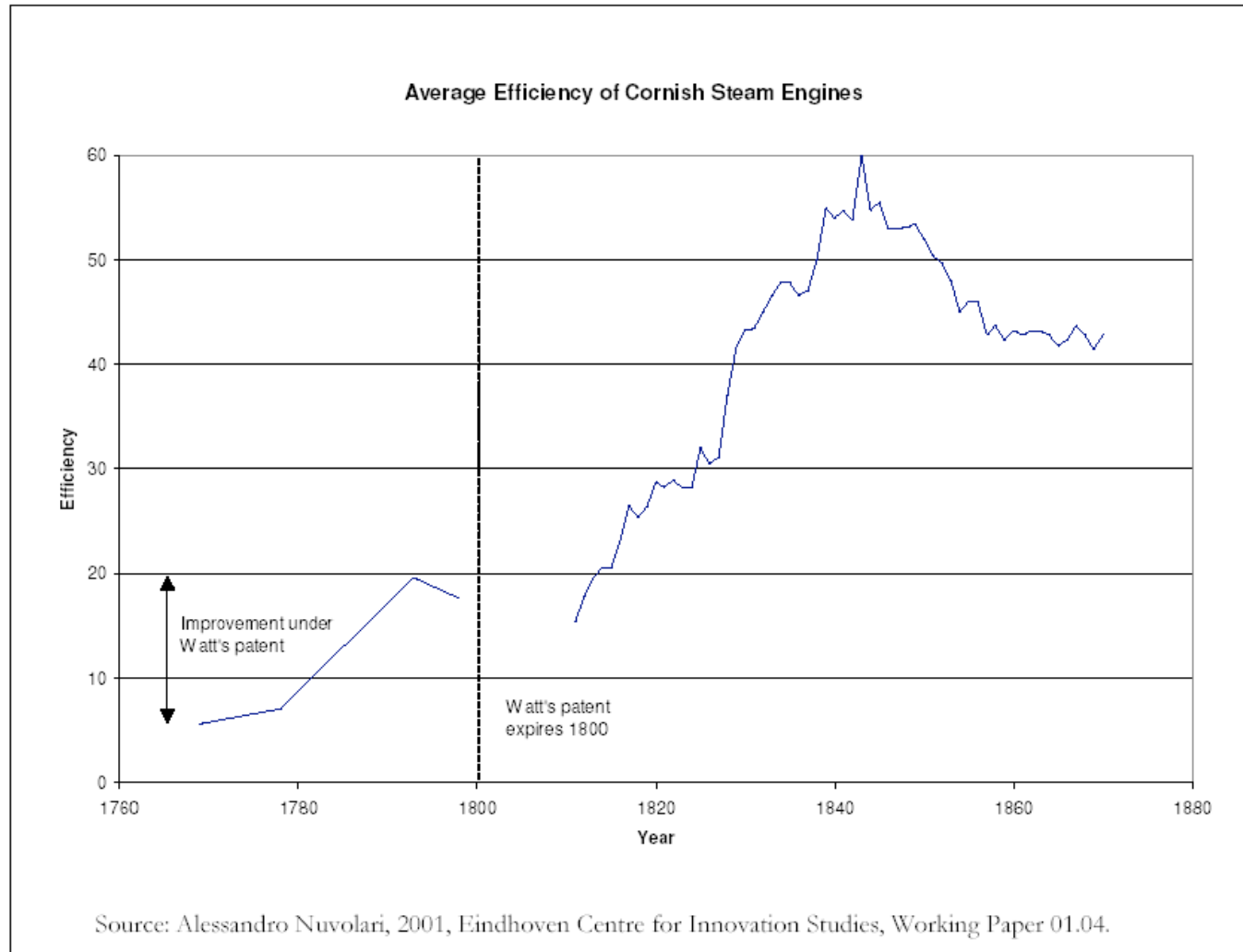
(Creative Commons, Wikipedia)

Open Source

Freedom to modify the code

(Fedora, Software Patents Issue)

Open Standards

Enabling access to data

(ODF, Royalty Free Standards)

Anytime, Anywhere, Anyhow access to knowledge

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Necessity is the mother of invention...

Average Efficiency of Cornish Steam Engines

Source: Alessandro Nuvolari, 2001, Eindhoven Centre for Innovation Studies, Working Paper 01.04.

Collective Invention and User-Driven Innovation

- A new opportunity opens from published invention or expiration of patent

- Quiet period of assimilation

- Collective invention institutions form

- **A flow of adaptations (microinventions) follows**

- New firms appear, applying technologies

- Profits of these firms leads to R&D investment

- If R&D is structurally expensive, few firms survive

(Episodes of Collective Invention, Peter B. Meyer, US Dept. of Labor, Bureau of Labor Statistics)

- Learning what customers want is a costly and inexact science

- Even when customers know what they want, they cannot communicate the information to suppliers

- The drive to serve the "market of one" leads to a deadly spiral of costs and frustrations

- Innovation toolkits are a radical rearchitecting of the customer value equation

Sometimes (some industries, always) the best tools are created by users

Customers As Innovators: A New Way To Create Value, Stefan Tomke and Eric Von Hippel, Harvard Business Review, April 2002

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From #1 in industry to a whole new industry
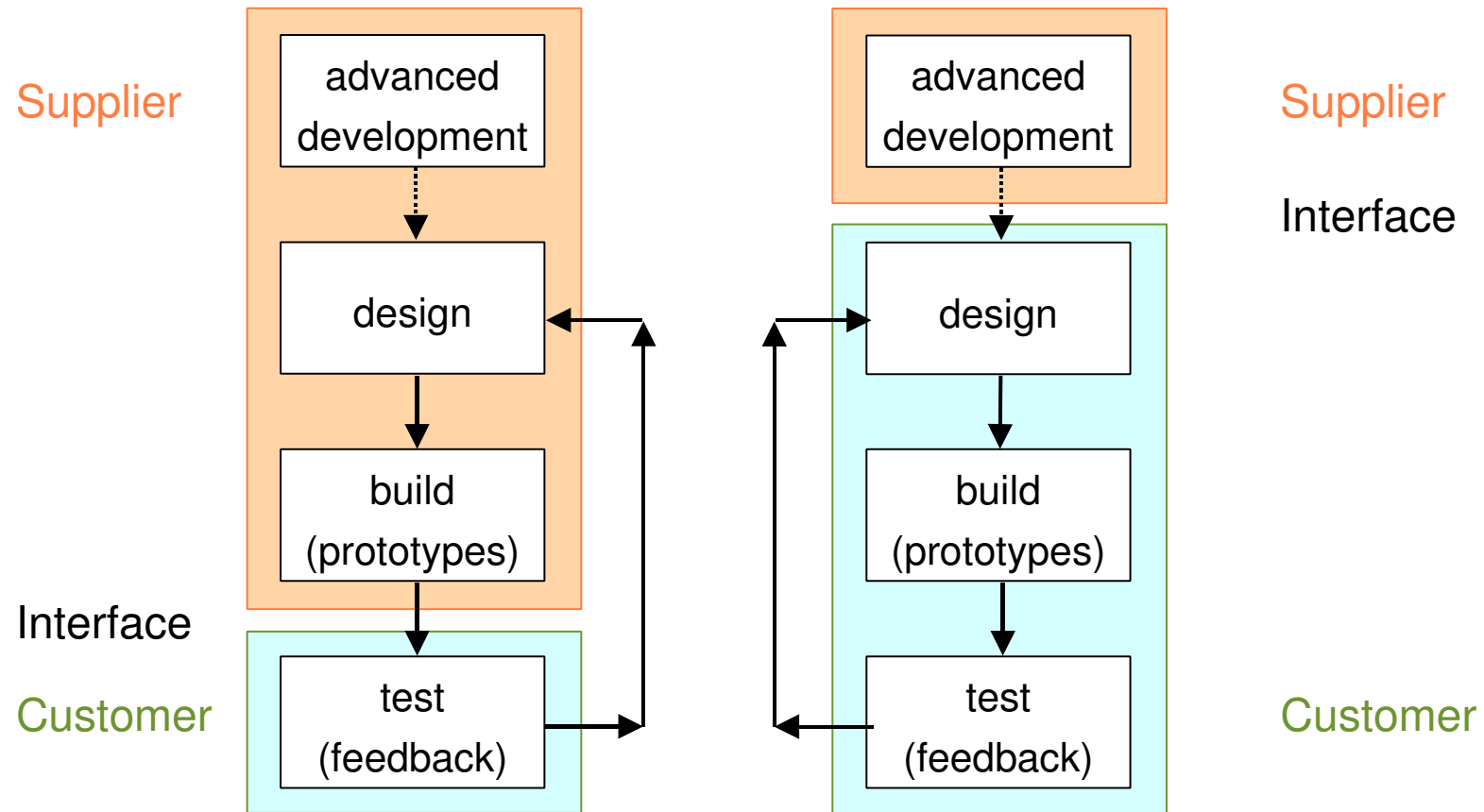
Thomke, Stefan and Eric von Hippel (2002) „Customers as Innovators:
A New Way to Create Value"Harvard Business Review, Vol 80 No. 4 April pp 74-81.
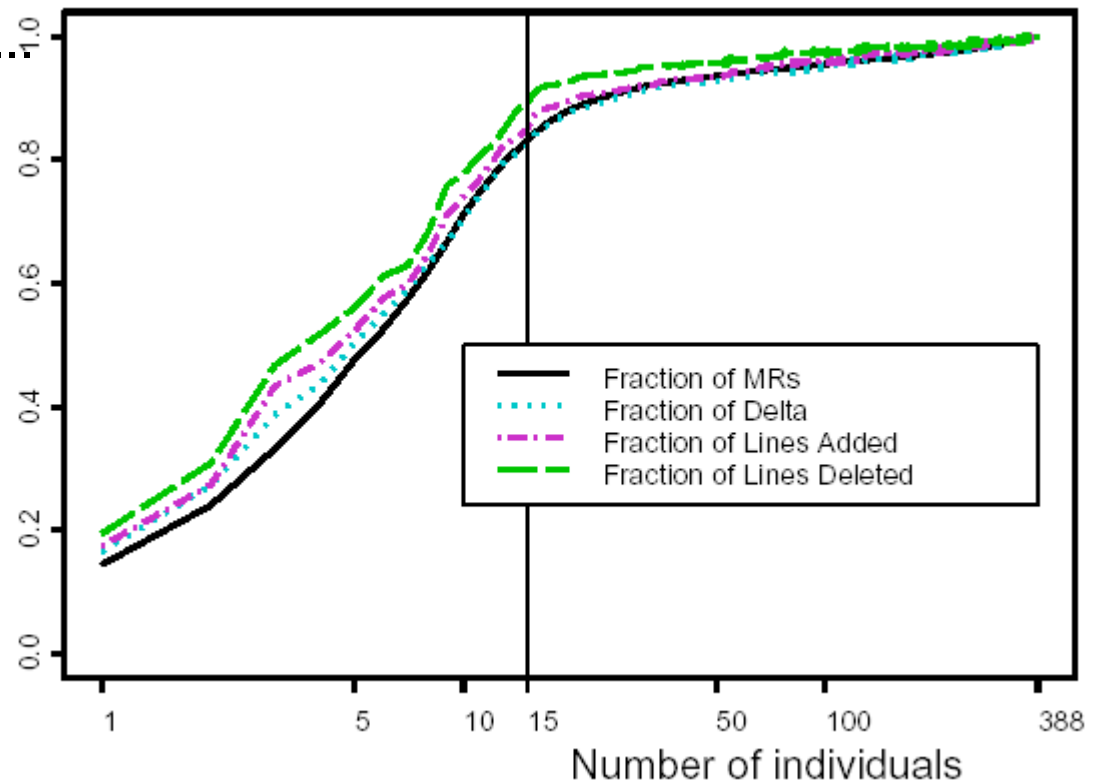
The Long Tail of Open Source

- OSS achieved first article sooner...
  - With fewer bugs...
  - That were fixed sooner...
- The trend continues...
  - Xen Virtualization
  - SE Linux
  - GRASS/R/PostgreSQL
  - MySQL
  - JBoss ecosystem
  - Eclipse
  - Blender, Inkscape, GIMP, Ardour, Audacity, etc.

    Source: http://opensource.mit.edu/papers/mockusapache.pdf

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Protection v. Innovation

Developer 2

Developer 1	Don't Work	Work
Don't Work	0,0	v, v-c
Work	v-c, v	v-c, v-c

v: value to developer

c: cost to developer

Developer 2

Developer 1	Don't Work	Work on A	Work on B
Don't Work	0,0	.5v, .5(v-c)	.5v, .5(v-c)
Work on A	.5(v-c), .5v	.5(v-c), .5(v-c)	v-.5c, v-.5c
Work on B	.5(v-c), .5v	v-.5c, v-.5c	.5(v-c), .5(v-c)

- Game theory predicts: more modules and more option value leads to more developers (http://www.people.hbs.edu/cbaldwin/DR2/BaldwinArchPartAll.pdf)

- More than 2M OSS developers working on more than 1B SLOC proves game theory is good theory (http://www.springerlink.com/content/q551lwg63762n24l/)

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Upton's Path-based Model

	Installation Based	Path Based
Role of IT	Supportive/Peripheral to Operation	Integral part of Operation
Project Size and Number	Large, few, infrequent	Small, many, frequent
Development Approach	Build, then install	Prototype and evolve
Delivery of Value	When a project is complete	On-going
Source of Technology/ Software	Heavy use of proprietary interconnection code, proprietary standards	Standards in common use
Primary Funct'l Concerns	Control, efficiency, accommodating all requirements at once	Integration, interconnection, flexibility, progressive delivery of req's
Locus of Technical Control	Vendor/IT group	Operation itself
Experimentation	Limited	Frequent opportunities

See http://www.people.hbs.edu/dupton/papers/pathbased-it/PATH.PDF

Revised May 27, 1997

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Architecture Matters

- Moore's Law defines a new market economy

  - 2x price/performance every 18-24 months

  - Moore's Law is an *input to* not an *output of* performance

- Amdahl's Law limits the benefit of Moore's Law

  - Benefit = 1/(s + p/N)

    - 10% 90x faster = 1.1097 improvement

    - 90% 10x faster = 5.2631 improvement

  - Benefits from Moore's Law dominated by *applicability* of improvement

- Christensen's definition of Disruptive Technology implies that

  - There will be some industry-changing innovation in the future

  - Nobody knows what, when, how, where, or who...*only why*

- Upton's work on Path-based innovation predicts flexibility is key to maximizing value of IT (and even capital) assets
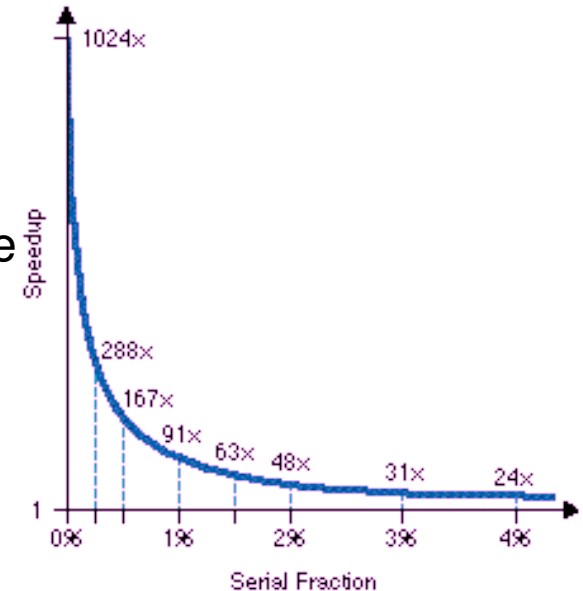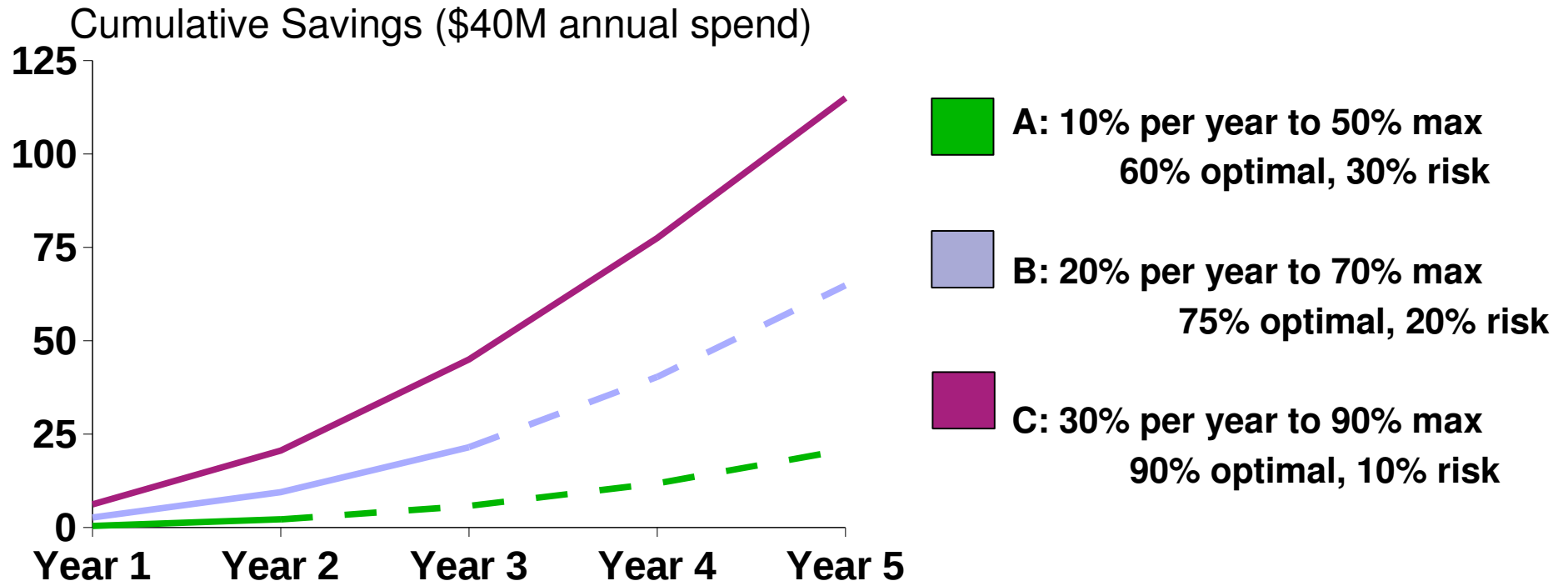
FIGURE 1. Speedup under Amdahl's Law

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Quantifying the Value of IT Architecture

- Time to market
- Range of new applications
- Effective benefit of new technologies
- Risk and Risk Mitigation

- 75% HW Cost Savings
- 60% SW Cost Savings
- 90% HW Maint Savings
- Risk Mitigation of $2M Migration Project

Cumulative Savings ($40M annual spend)

A: 10% per year to 50% max
60% optimal, 30% risk

B: 20% per year to 70% max
75% optimal, 20% risk

C: 30% per year to 90% max
90% optimal, 10% risk

http://www.redhat.com/advice/best_practice_arch.html

Proof:

TOP 10 FOR ENTERPRISE SOFTWARE 2007

RANK 07	RANK 06	RANK 05	VENDOR	OVERALL 07	VALUE	RELIABILITY	WOULD CONTINUE TO DO BUSINESS (%YES)
1	1	1	**RED HAT**	80%	80%	80%	97%
2	2	2	Citrix Systems	76%	76%	76%	93%
3	-	-	Adobe	73%	71%	76%	91%
4	7	6	SAP	64%	66%	62%	89%
5	6	7	Microsoft	62%	62%	61%	84%
6	8	3	Business Objects	61%	60%	62%	83%
7	5	5	Novell	60%	60%	60%	70%
8	8	10	Oracle *(Including Hyperion)*	58%	57%	59%	79%
9	11	9	CA	52%	51%	54%	68%
10	10	8	Cognos	51%	50%	52%	80%

See http://www.redhat.com/promo/vendor/

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Now Open Source Software Is Pervasive

- Biggest OSS project: The Internet (http://www.ietf.org/)

- Fastest: IBM Roadrunner (http://en.wikipedia.org/wiki/IBM_Roadrunner)

- Smartest: Classified (Secured with NSA and Red Hat-developed SE Linux)

- Significant impact:

  - Weather Services: AWIPS (http://awips.raytheon.com/)

  - Health Sciences: PubMed Central and Entrez (http://www.ncbi.nlm.nih.gov/)

  - FAA: (http://www.fcw.com/print/12_15/news/94234-1.html)

  - NASA (http://opensource.gsfc.nasa.gov/)

- Around the world:

  - Japan's IPA (http://www.ipa.go.jp/software/open/ossc/english/index.html)

  - Brazil's Software Livre (http://www.softwarelivre.gov.br/)

  - Ireland's Health Atlas (http://www.bettergov.ie/eng/index.asp?docID=440)

  - Denmark's Software Exchange (http://softwareborsen.dk/)

  - Australia's Census: http://www.agimo.gov.au/archive/better_practice/ecensus

  - Australian Taxation Office:
    http://www.statistik.uni-dortmund.de/useR-2008/slides/Williams.pdf

  - See http://osor.eu/ for comprehensive news and case studies in EU

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Open Source Adoption

- By 2011, Gartner predicts that at least 80% of all commercial software solutions will be based on open source

- Gartner surveys show 49.7% of open source used for mission-critical applications

IGNORING OPEN SOURCE IS NO LONGER AN OPTION

"Open source is the biggest change in corporate IT since distributed computing. It is not a niche, not a fad. Competing against open source is like tilting at windmills."

- Gartner Open Source Summit, September 2007

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The giant 400-pound Resonant pendulum can only be given tiny tugs with weakly attached magnets on strings. A big swing can result if the tugs are timed with the swing of the pendulum.

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