IT Evolution & Revolution

Recognizing the “next new thing” vs. “deja vu all over again” in order to divine and define the future of IT.

Terry Gray, PhD
Associate VP, Technology Strategy
University of Washington

April 2010

IT Evolution & Revolution

- Introduction
- Taxonomy
- Drivers
- Trends
- Patterns
- Backlash
- Advice

Information Technology

IT =

Inevitable Tensions? √

Infinite Transitions? √

Ironic Truisms? √

Yep, all of the above!

Technology Vision

Access to all available resources*

– any time, any place, via any device

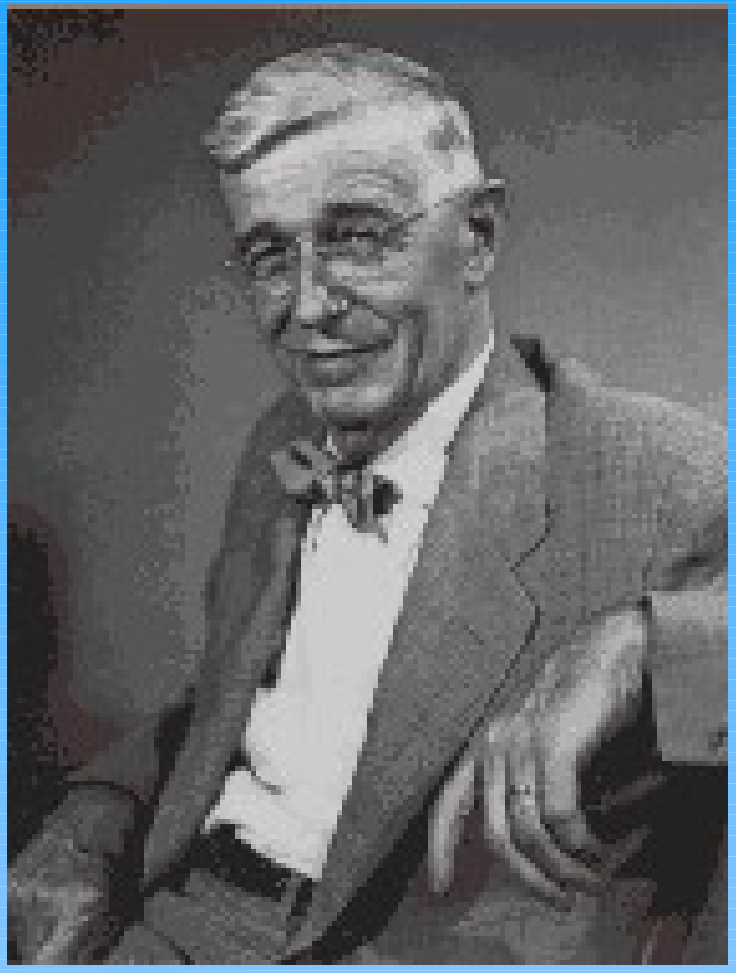
– quickly, simply, safely, surely

* Resources include information, people, services, tools

Building on the work of prior visionaries, e.g. Bush, Licklider, Fuller...

Bush's MEMEX (1945)

anticipating hypertext & the web

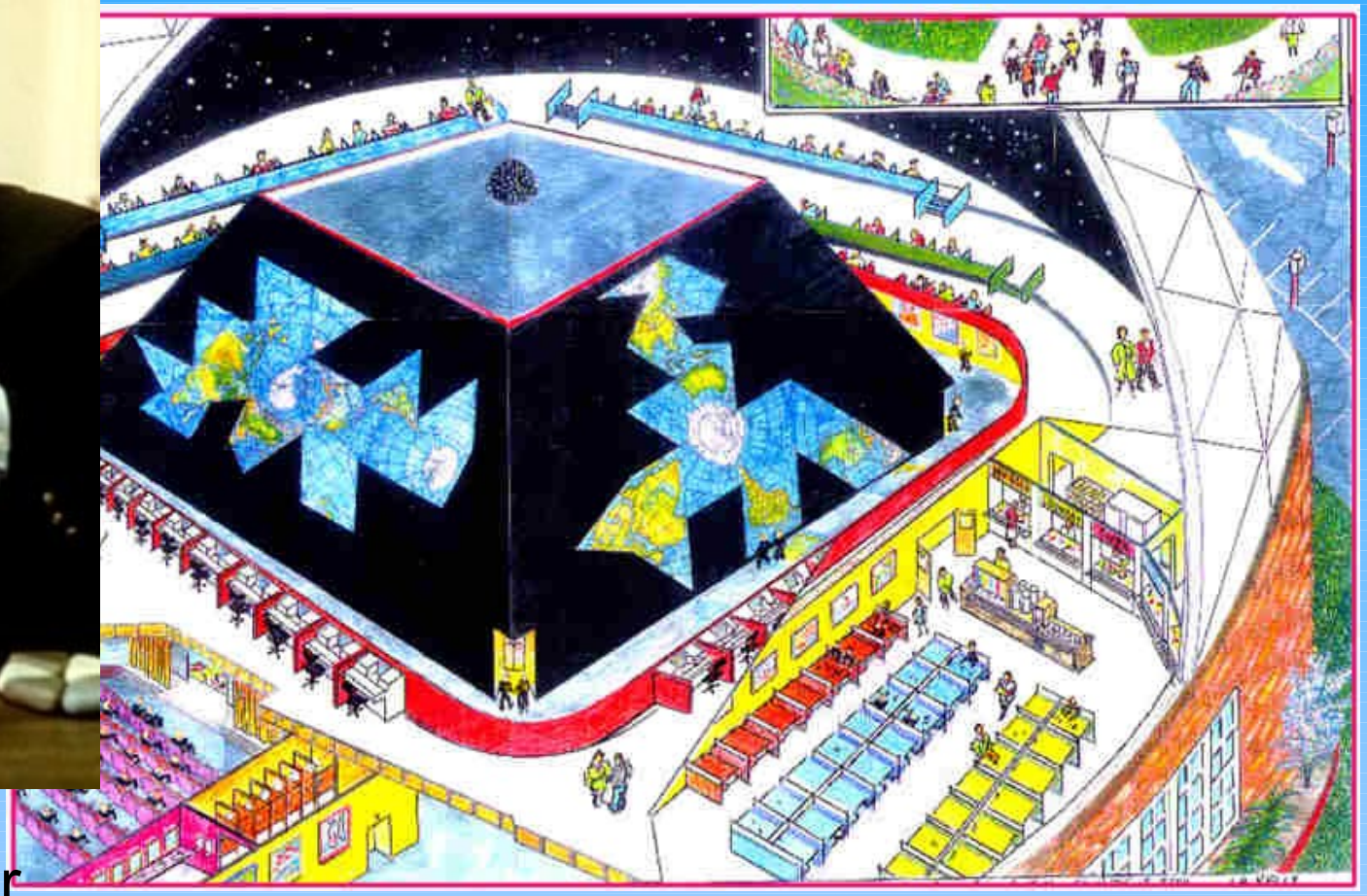


Vannevar Bush

Bucky's World Game (1965)

think “GIS meets the Web”

R. Buckminster Fuller



Defining vs. Divining the Future

- "The best way to predict the future is to invent it."
  (Moliere, Peter Drucker, Alan Kay...)
- Innovation often needs organizational "slush"
  - Tight budgets undermine innovation
  - Tight budgets necessitate innovation

Huh??

- Three kinds of innovation (Judy Estrin)
  - Breakthrough, incremental, orthogonal
- Central IT imperative: avoid insularity & entitlement
  - Exposure to external forces/trends/alternatives
  - Experiment yourself, and watch other's !
  - Listen, lead, challenge assumptions & current patterns

IT Themes & Memes

- Mobile
- Global
- Green
- Open
- Self-service
- 24x7
- Overwhelmed
- Interactive
- Risky
- Community
- Cloud-sourced
- Crowd-sourced
- Collaborative / Social
- Personalized
- Virtualized
- Web-based
- Federated
- Agile

The Yin & Yang of IT

polarity mgt or “schizophrenia is a way of life”

Physical infrastructure – Intellectual infrastructure

Single Standard – “A thousand flowers”

Homogeneous – Heterogeneous

Monolithic - Modular

Distributed – Centralized

Commodity – Customized

Consumer – Enterprise

High touch – Self service

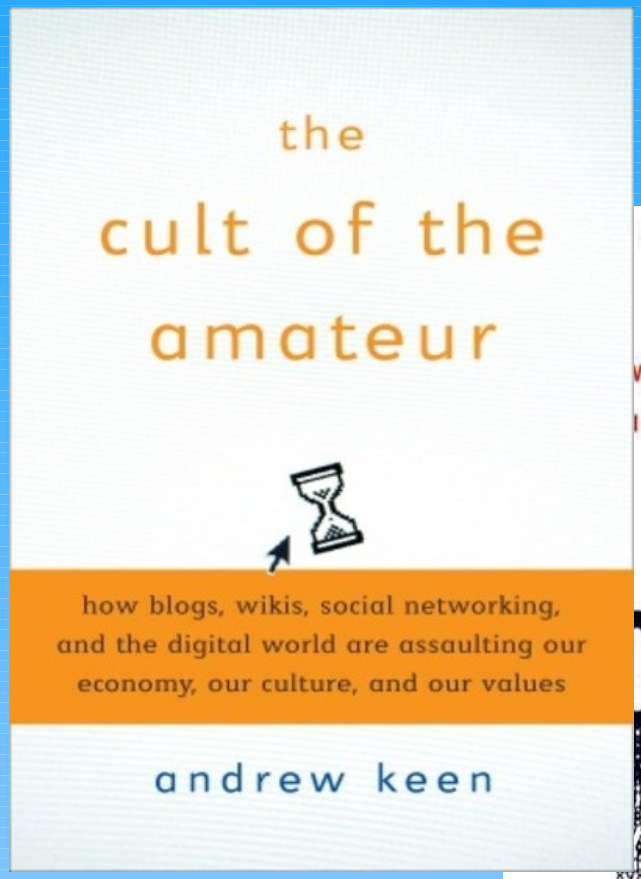
Adequate – Excellent

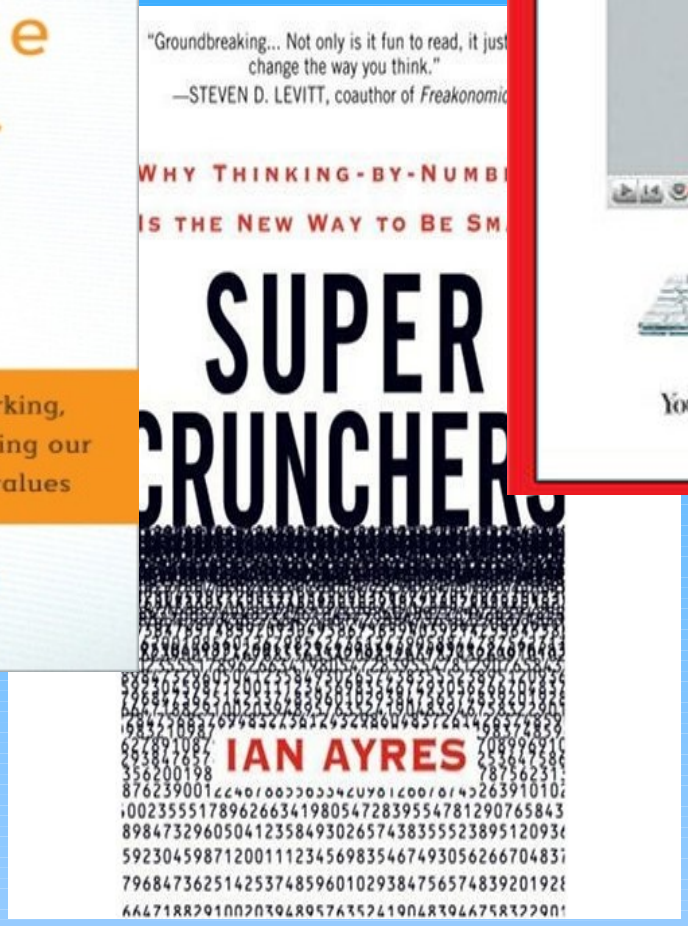
Controlled – Chaotic

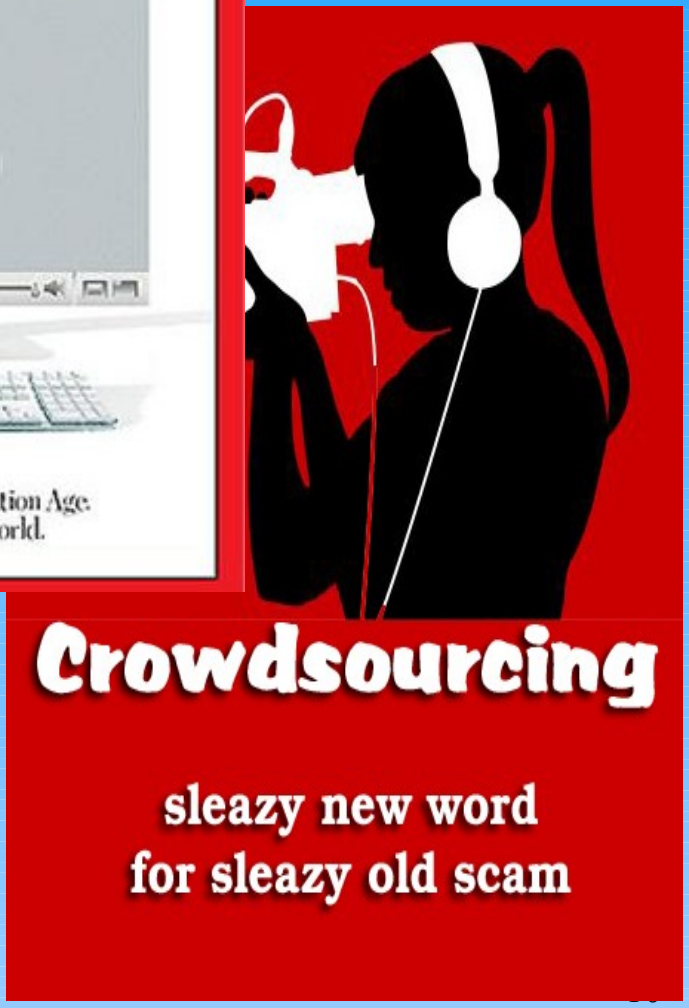
Agile – Fragile

Tiny – Massive

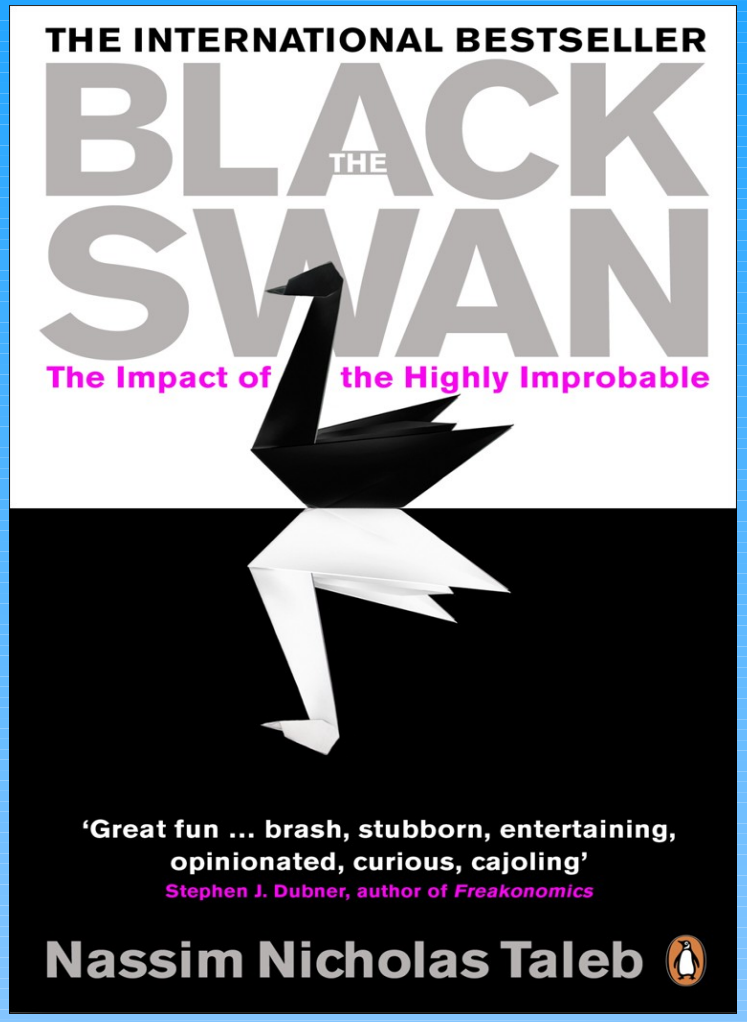
There's something happenin' here







Unknown Unknowns
When is Past Prelude?



Cycles or Singularities?

Technology Revolutions

An instrument of “creative destruction”

(**Schumpeter**: Capitalism, Socialism and Democracy -1942)

Measured by:

In business, the number of stock options that are now worthless

In academia, the size of the closets storing obsolete gear

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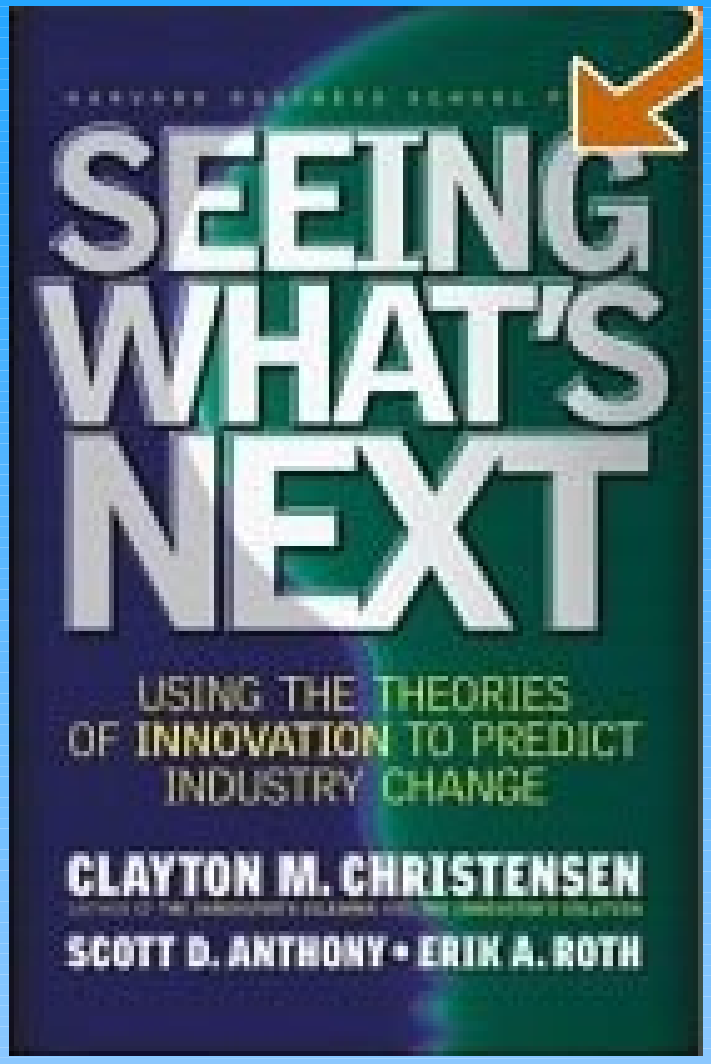
Taxonomy of Change

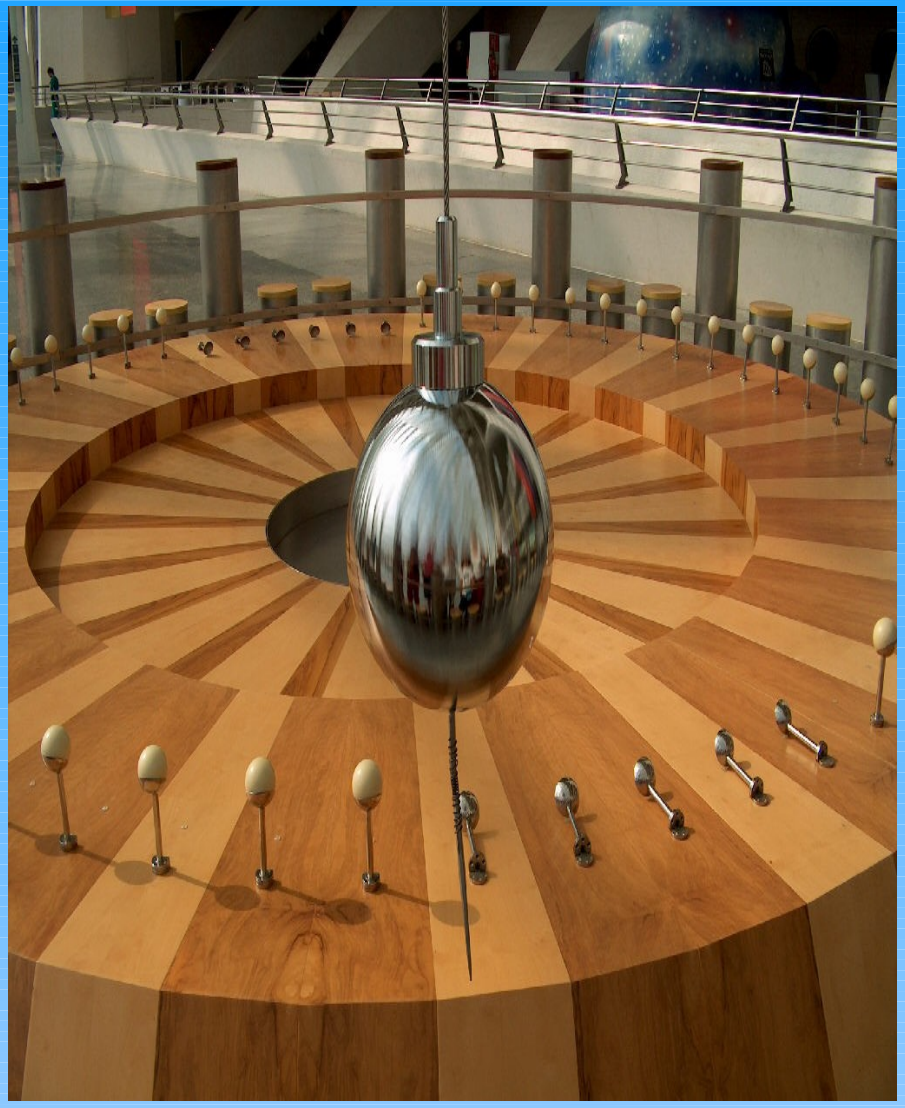


- Constants
- Cycles
- Spirals
- Exponentials
- Singularities
- Tipping Points

IT Constants

- **Exponential change**... is a constant in IT!
  - Capacity & Demand: CPU, storage, network...
  - Rate: Obsolescence, physical to digital conversion
- **Human desires**... for IT:
  - Smaller, faster, cheaper, greener, simpler
  - Better battery life; less weight, fewer cords
- **Human behavior**
  - “Adapt or die”
  - “Everyone wants a seat at the table”
  - “Culture eats strategy for lunch”

IT Cycles



The Eternal Debates:

- Governance & Control
- Optimization
- Risk Management
- Service Models
- Business Models

Governance & Control Cycles

- Carrots vs. sticks
- Monopoly vs. choice
- Agility vs. consensus-building
- Group-think vs. risk-taking
- Consumer vs. expert vs. crowd wisdom (individualism vs. elitism vs. democracy)
- Judgment & intuition vs. algorithms

Optimization Cycles

- Local vs. global
- Tactical vs. strategic
- Efficiency vs. individual effectiveness
- Excellence vs. adequacy (and who decides?)
- Overprovisioning vs. control & accounting costs
- Monolithic vs. modular/component solutions

Risk Management Cycles

- **Cost vs. control**
  - e.g. compliance in the cloud
- **Cost vs. resilience**
  - Converged vs. dedicated infrastructure
  - Homogeneity vs. species diversity
- **Security vs. everything**
  - Restrictions vs. flexibility
  - Technical vs. behavioral focus

Service Model Cycles

- One-size-fits-all vs. custom
- Adapt the business to the software, or vice versa
- Leading vs. responding
- Complexity vs. diversity vs. supportability
- Build vs. buy vs. rent vs. barter

Business Model Cycles

- Content vs. distribution: who brings more value?
- Funding
  - Core vs. taxes vs. fees; CapEx vs. OpEx
  - Freemium vs. subscriptions vs. micro-payments
- Quantity vs. Quality vs. Price
  - Cut costs vs. Increase service (& thus revenue)
  - Reduce prices vs. increase features
- Tragedy of the commons vs. uncommons
  - Pricing too low or too high, leading to death spirals...

Business (Death) Spirals

- **Negative feedback loops** (demand goes to zero)
  - Price goes up → demand shrinks → unit cost goes up
  - Examples:
    - Publications: price increase → subscriptions drop → price ↑
    - Insurance: pool shrinks → fees increase → pool shrinks more
- **Positive feedback loops** (supply goes to zero)
  - Cheap good → unconstrained demand → collapse
  - Examples:
    - Tragedy of the Commons
    - Sub-prime profits grow → more loans → collapse

IT Exponentials

- **Examples**
  - Network capacity and demand
  - Compute capacity and demand
  - Storage capacity and demand
  - Consumer technology choices
  - Viral videos

"Exponentials R Us:
Seven CS Game-Changers" -Lazowska

- Search
- Scalability
- Digital Media
- Mobility
- eCommerce
- The Cloud
- Social networking and crowd-sourcing

“and Seven More to Come”

- Smart homes
- Smart cars
- Smart bodies
- Smart robots
- The data deluge
- Virtual and augmented reality
- Smart crowds & human-computer systems

--Ed Lazowska, in xconomy.org, 12/24/2009

http://www.xconomy.com/seattle/2009/12/24/exponentials-r-us-seven-computer-science-game-changers-from-the-2000%E2%80%99s-and-seven-more-to-come/

Singularities
extreme exponentials!

- Math: functions with undefined results
  e.g. divide by zero
- AI: when computing capability exceeds human brain capability (cf. Ray Kurzweil)
- Business: when a new product or service rapidly destroys an existing one (or an entire industry)

IT Tipping Points

example Futures Market questions

When will 80% of users not care about:

- Desk phones?
- Desktop computers (vs. laptop)?
- Which desktop OS they use?
- Shared drives (vs. cloud collaboration)?
- Email ???

NB: answers will be different for students, faculty, staff, etc

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Drivers

- **Budgets** (department, university, state, federal)
- **Regulations** (local, state, federal)
- **Control** (central → dept → individual)
- **Sociology** (Global social trends / culture)
- **Scale** (geography, complexity, volume of data)
- **Security** (attackers: kids → org crime, nations)
- **Technology** (e.g. wireless, cloud, data mining)

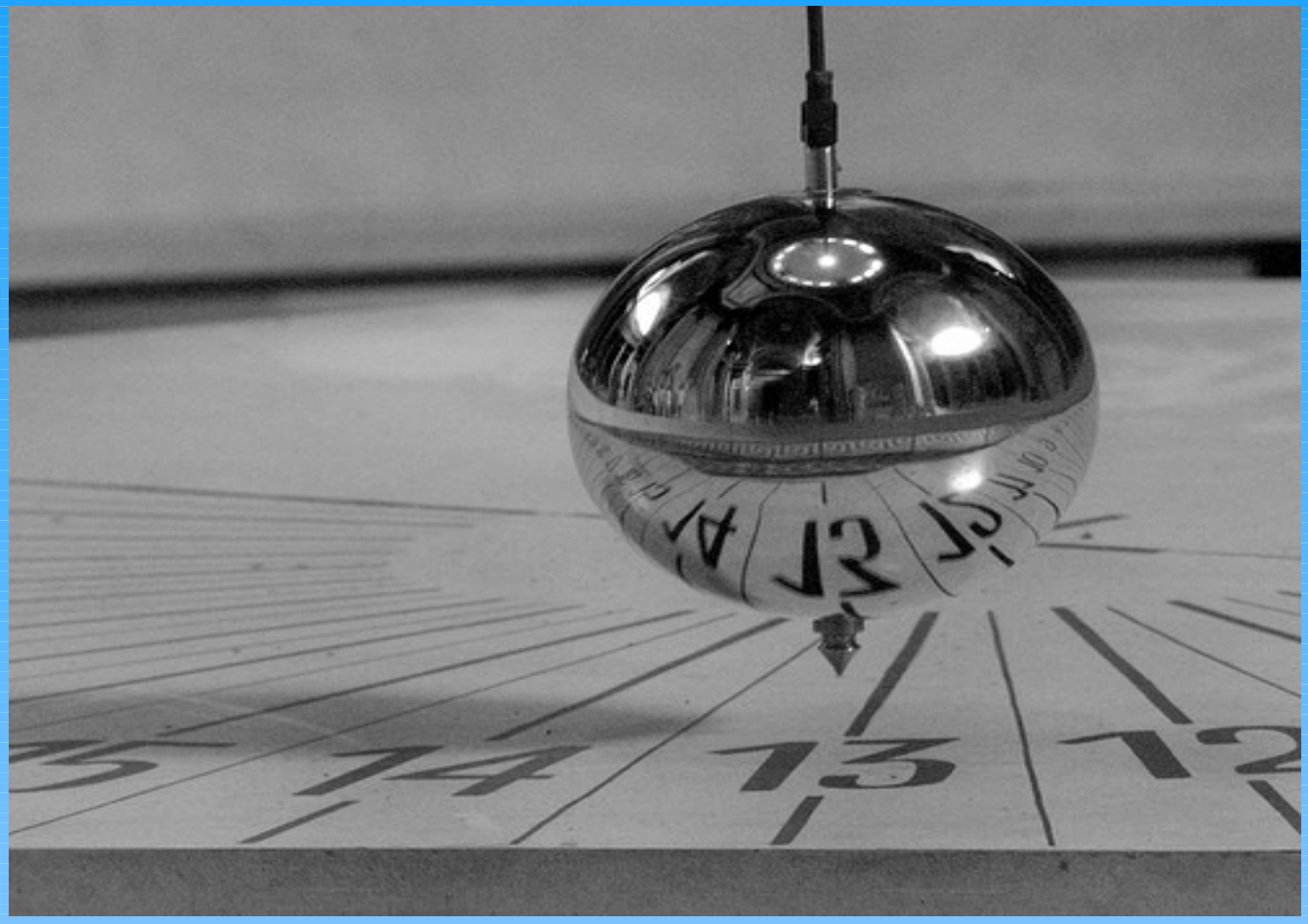
The Budget Earthquake

Former Technology Funding Structure

Regulations
(just a few examples)

- **Federal**
  - FERPA
  - HIPAA
  - CALEA
  - Ediscovery
  - Records management
- **City**
  - Green building codes
  - Energy use codes
- **State**
  - DIS rules
  - ISB rules
  - Efficiency legislation
  - Consolidation efforts
- **University**
  - Data security standards
  - Acceptable use policies

Control



1980s
Decentralized
Chaos

→

1990s
Central
Control

→

2000s
Community
Control

→

2010s
Coordinated
Co-operation?

Sociology

- **Expectations** about
  - Time scales (Impatience)
  - Rich media, mobility, etc
- **Behavior**
  - Ideological Amplification (Group Think)
  - Choice and interaction overload
  - Libertarian Paternalism (Picking good Defaults)
- **Attitudes** toward
  - Governance
  - Privacy
  - Science/Technology, Education
  - Intellectual property
  - Social goods & the public domain

Scale

- **Geography**:
  - Globalization
- **Quantity**:
  - cf. “Exponentials R Us” --Ed Lazowska
- **Complexity**:
  - cf. “The IT Complexity Crisis: Danger & Opportunity” --Roger Sessions

Security

- **Changing threat vectors**
  - Shifting to social engineering (hard to stop)
  - Malware more sophisticated; harder to trace
  - Motivations (no longer teen vandals; now organized crime, nation states, and terrorists)
  - Traditional approaches (e.g. perimeter firewalls) often don't work against new threats
- **Higher stakes**
  - Higher value activities than in previous times
  - Liability consequences increasing (e.g. notification costs after PII disclosure)

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Research University Trends

Increasing

- Contract/grant competition
- Multi-discipline virtual organizations
- Global, 24x7 activities
- Dependence on IT services
- Off-shoring research risks
- Competition for student seats
- Compliance requirements
- Data security risks
- Amount of data to manage

Decreasing

- State support

The Data Tsunami

- Examples:
  - LHC
  - LSST
  - Genomics
  - OOI
  - Dark Matter search

An essential element of research computing support is cyberinfrastructure for managing the coming data tsunami.

Technology Market Trends

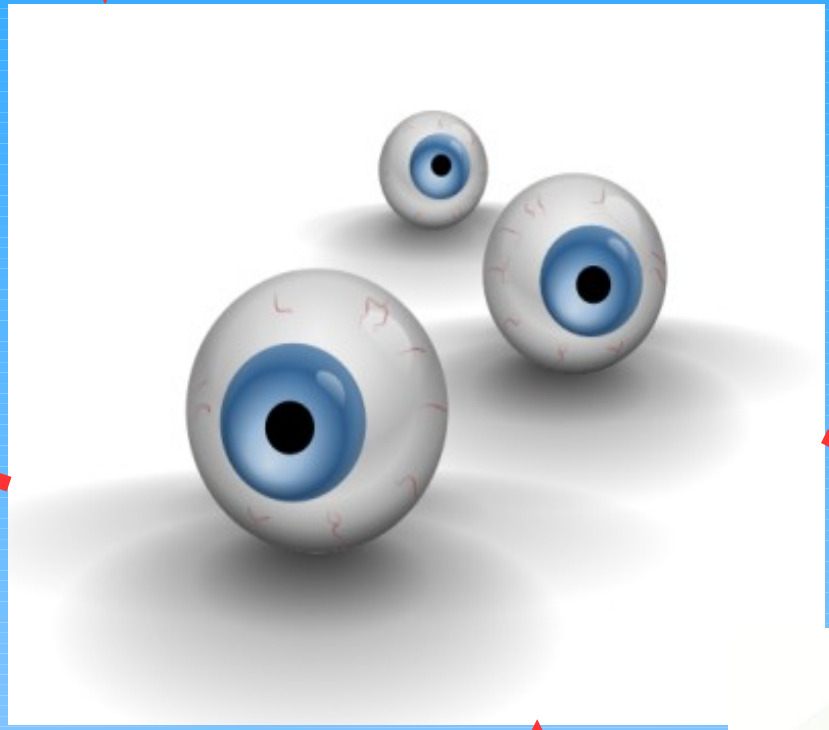
- Smaller/bigger, faster, cheaper, greener
- Drowning in data; sensors everywhere
- Desk-centric → mobile
- Commoditization & consumerization
- Disintermediation; self-service; DIY
- Social networking; user-generated content
- Proprietary silos; market choice & confusion
- Increasing risk (compliance, security)
- Dedicated → virtualized
- Video everywhere
- Thick clients, local hosting → Thin clients, Cloud
- “Three screens and the cloud” --Microsoft

IT Business Trends

- Enterprise driven → Consumer driven
  (Precluding vs. accommodating consumer tech, e.g. netbooks, iPhones)
- Content from consumers
- Standards driven → Proprietary silos
  (attempts by major corps to control all aspects of customer experience, e.g. cell comm & entertainment)
- Energy costs → increasing
- Compute & Storage costs → decreasing
- Commodity IT → large scale out-task options
- One-time purchase → Freemium (ads + subs)
- Focus on devices → focus on function, expertise

The New Currency

cloud concepts are old –but the mashup is new



Inventory!!

Service Bureau + free TV + Personalization

Data Mining

http://www.library.drexel.edu/blogs/librarylog/dollars.gif

http://www.cksinfo.com/clipart/people/bodyparts/eyes/eyeballs.png

http://thomaslarock.com/wp-content/uploads/2009/06/datamining.jpg

Reliability/Responsiveness Trend

Conjecture:

- ***Computers*** are becoming
  more reliable & **more** responsive

- ***People*** are becoming
  less reliable & **less** responsive

Caveat: "All generalizations are false"

Why???

Changes antithetical to collaboration

- Information Overload → “Attention Crash”, unplug
- Interaction Overload → “Facebook Fatigue”
- Needing a zillion different logins to do anything
- Different tools for each role & each new info stream
- Shift from 2D to 4D media (text → audio/video)
- Demise of email → telephone tag (async → sync)
- More choice → more stress, chaos

Trends or Cycles?

- **Governance**: Central → Community → Individual
- **Resources**: Central → Departmental
- **Priesthood** → DIY, disintermediation, social net.

- **Engineering** driven → Customer driven
- **Excellence:** Technical → Resource & Risk Mgt
- **Build** → Buy, borrow, barter
- **Create** → Consult, broker, Integrate

- **Public** → Proprietary (info, stds, and technology)
- **Prescriptive** rules → Measuring results
- Internet **wild-west** → More regulation

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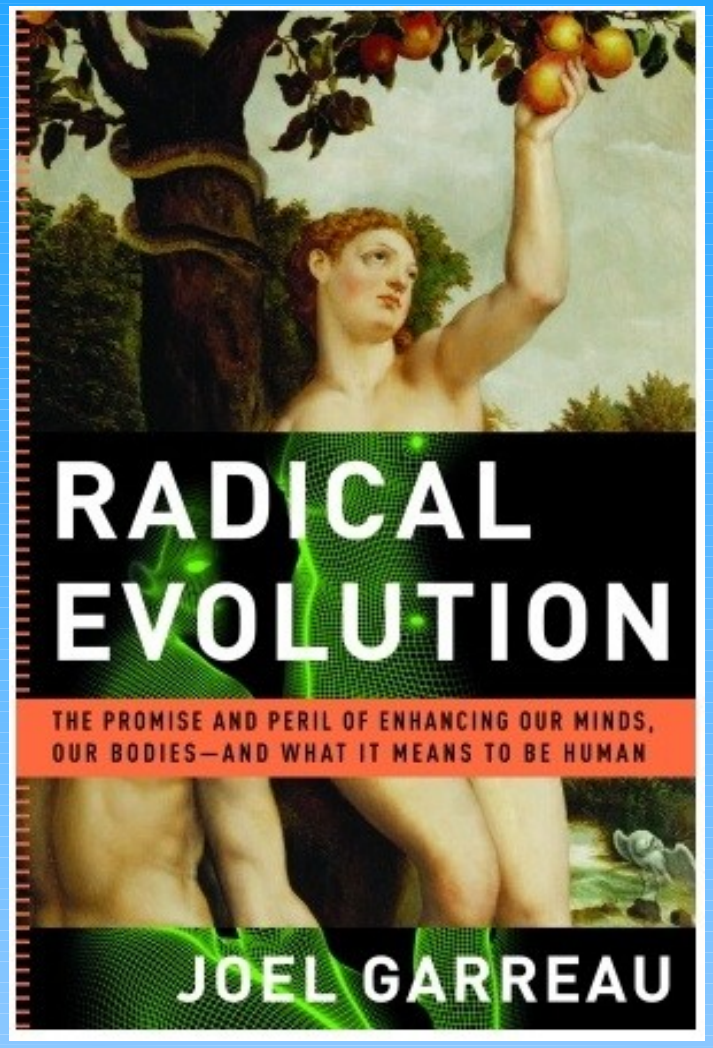
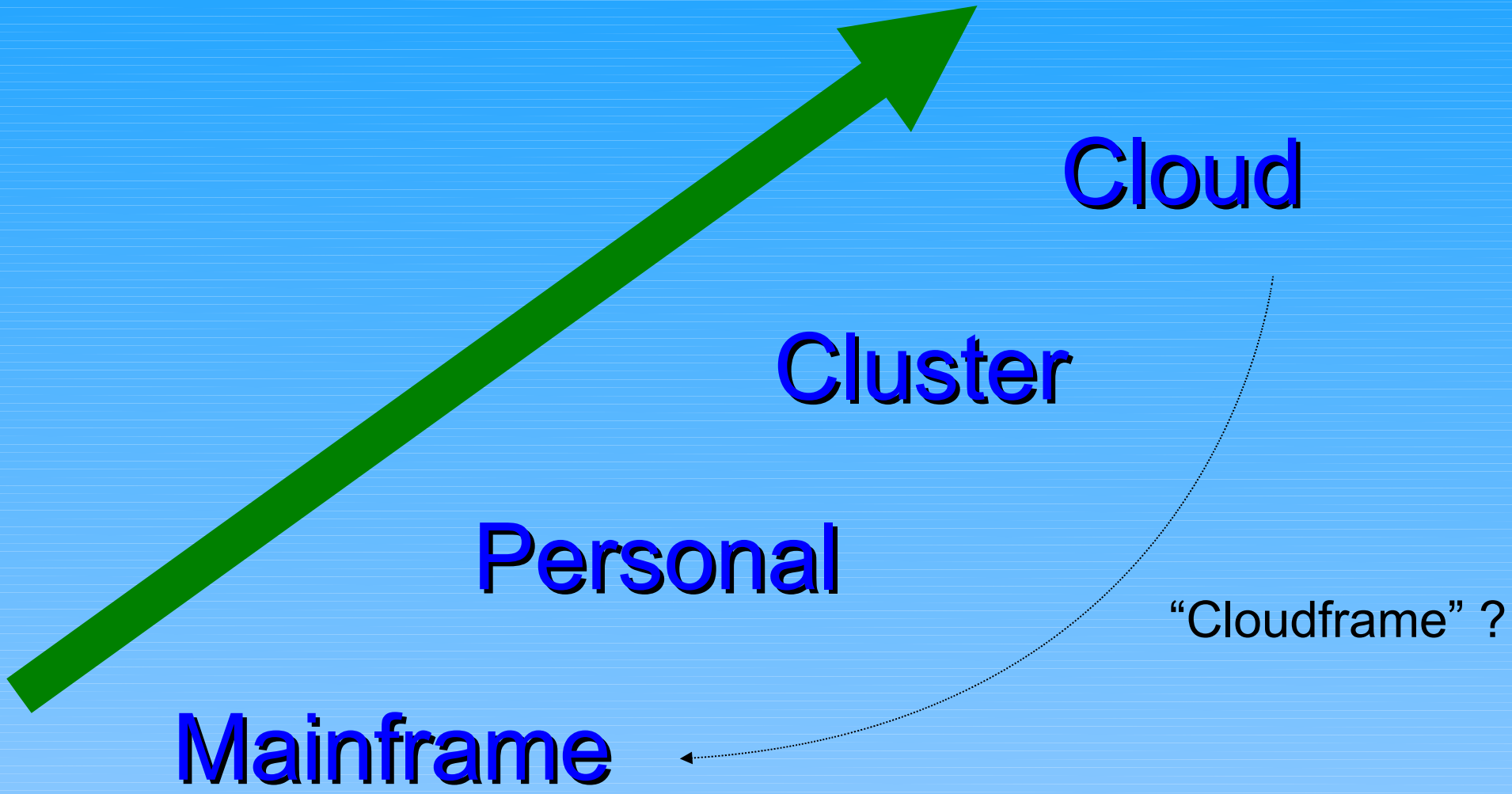
Patterns
cyclic and acyclic evolution

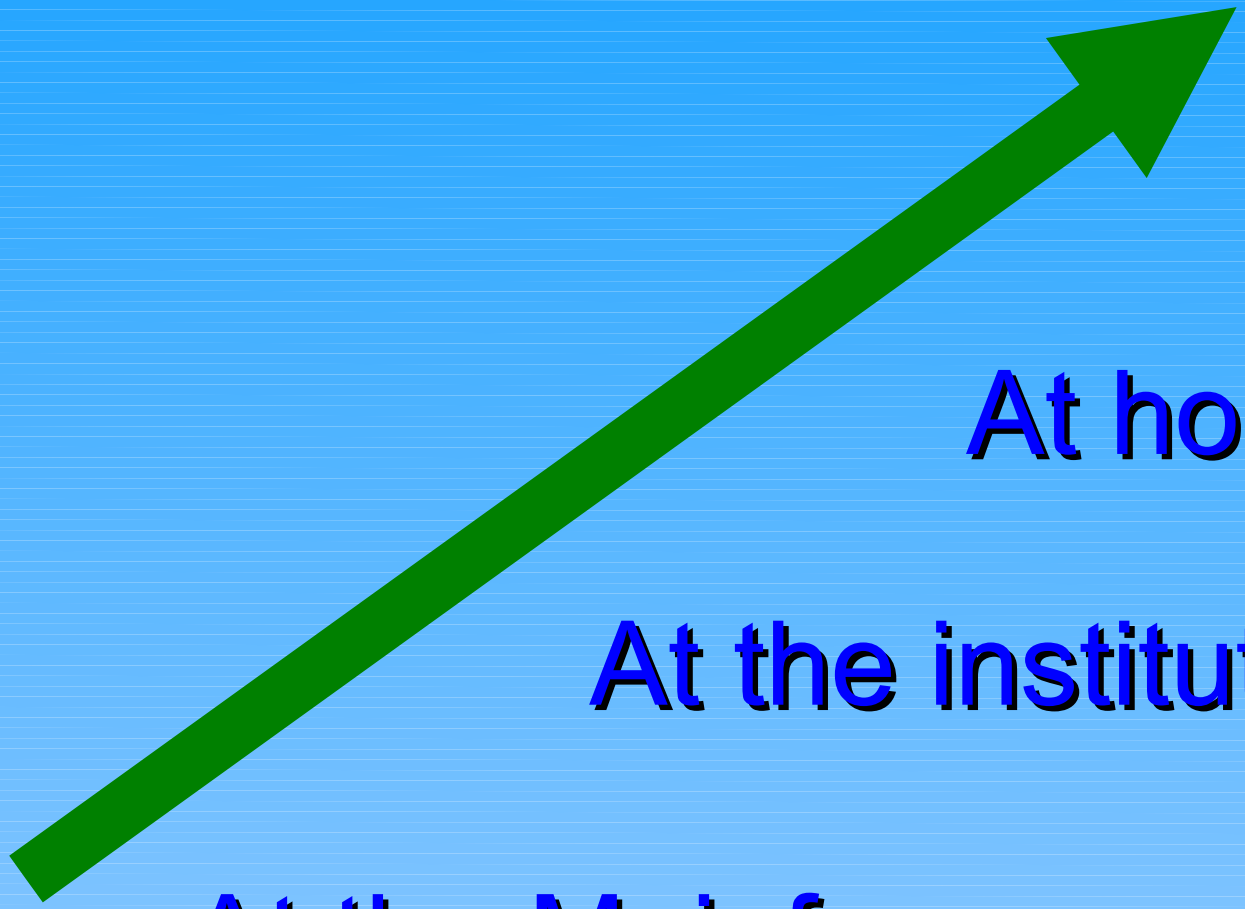


- Computing
- Mobility
- Customer
- Market
- Expertise
- Governance
- Organization
- Applications

Computing Evolution



Mobility Evolution



Anywhere

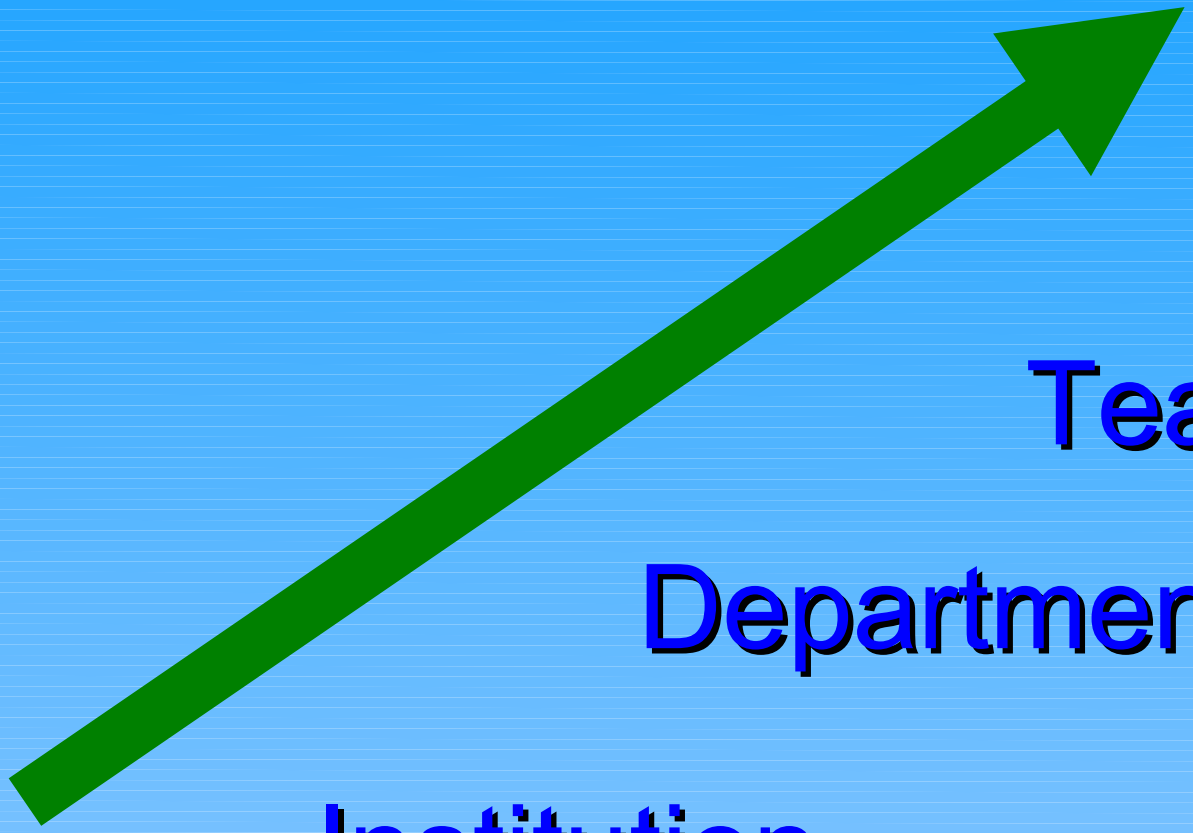
At home

At the institution

At the Mainframe

Counter force:
"Cacooning"

Customer Focus Evolution



Individual

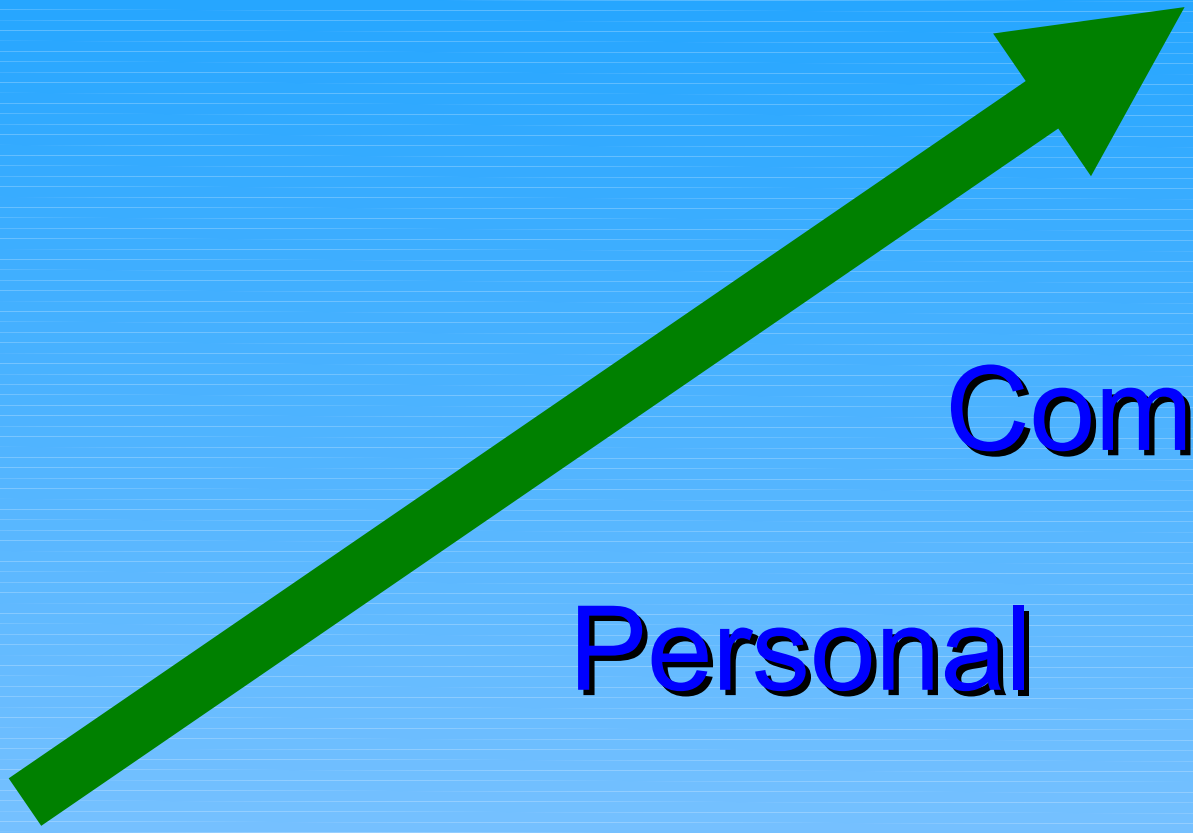
Team

Department

Institution

Counter force:
Institutional focus
& centralization
via budget cuts

Market Evolution



Consumer

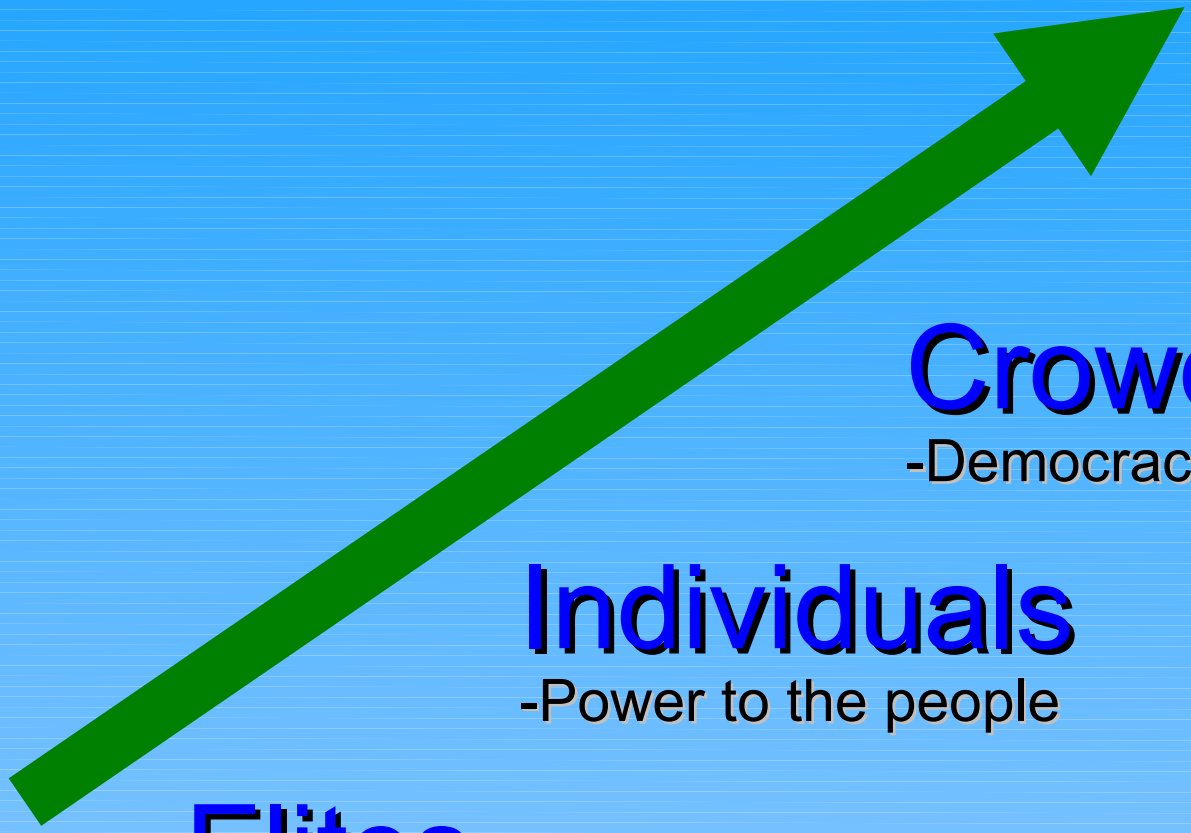
Commodity

Personal

Priesthood

Counter force:
Market
Consolidation;
Less choice

Expertise Evolution



Algorithms
-Death of Intuition

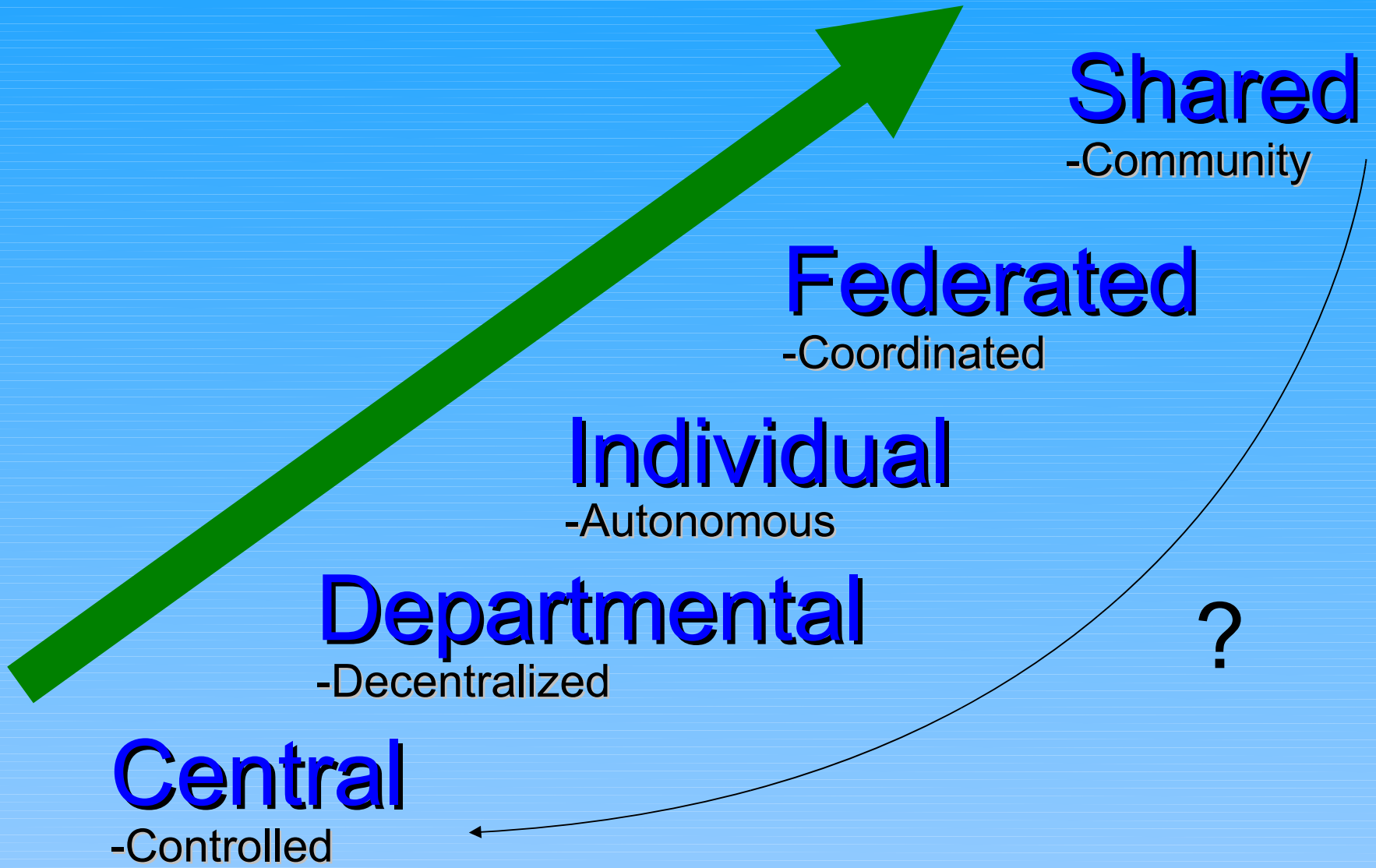
Crowds
-Democracy now!

Individuals
-Power to the people

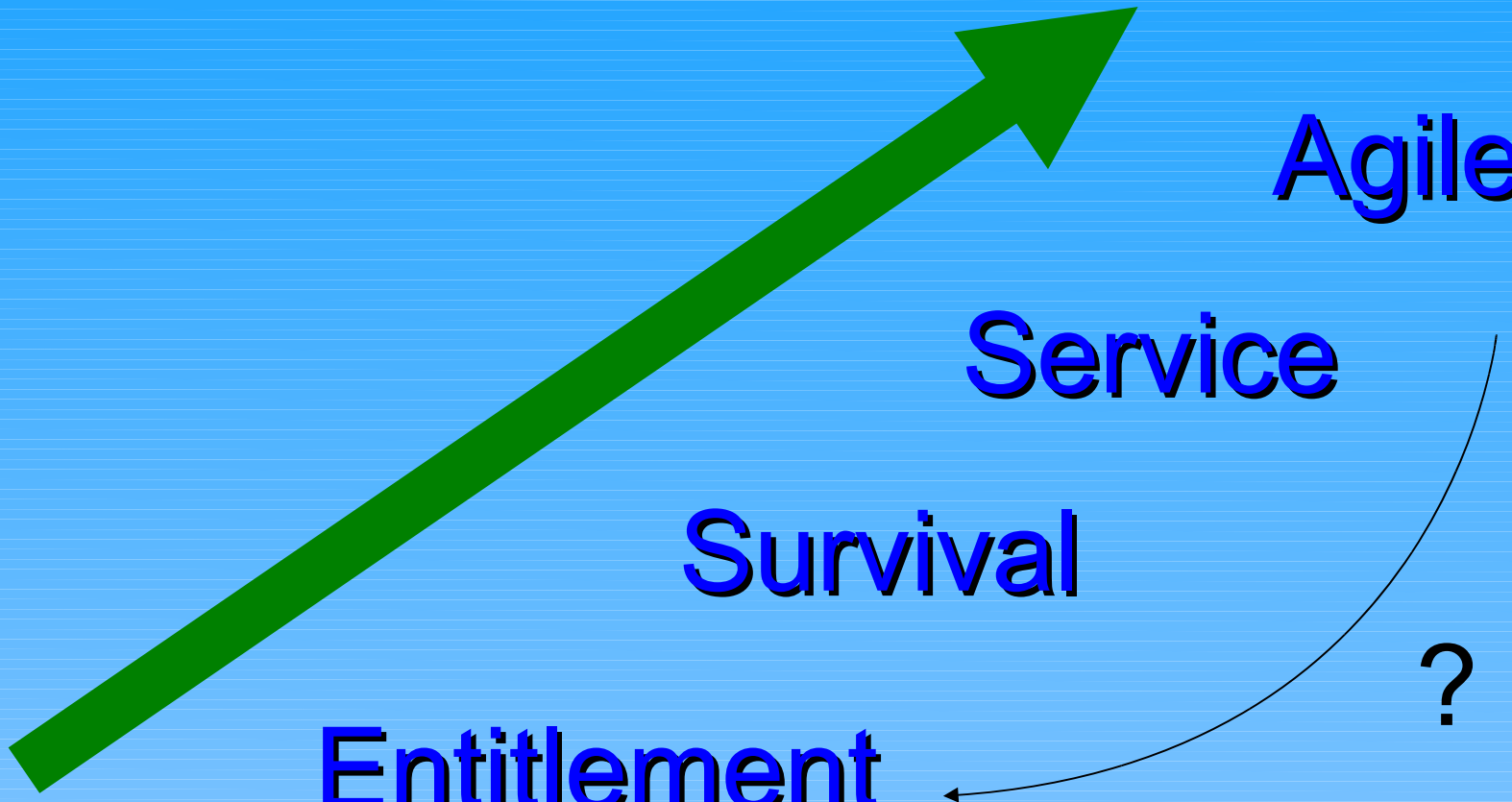
Elites
-Cabals and experts

Algorithm authors become the **new** "IT Priesthood"

Governance Evolution



Organizational Evolution



Focused (Startup Mode)

Application Evolution

Moving from software to services

- **Build** *e.g. Pine*
- **Buy** (a right to use) *e.g. Outlook*

- **Borrow** (open source) *e.g. Thunderbird*
- **Barter***/Rent (cloud svcs) *e.g. Gmail*

The evolution repeats at different layers of the stack

The last two are transformational, especially in tight times

*** eyeballs for ads**

SW Development Evolution

- Market survey: nothing suitable found
- Build it locally
- Share it: market develops
- Off-The-Shelf solutions become available
- Feature race begins
- Local investment becomes unsustainable
- O-T-S solution adopted;
  local staff redeployed for the next new thing

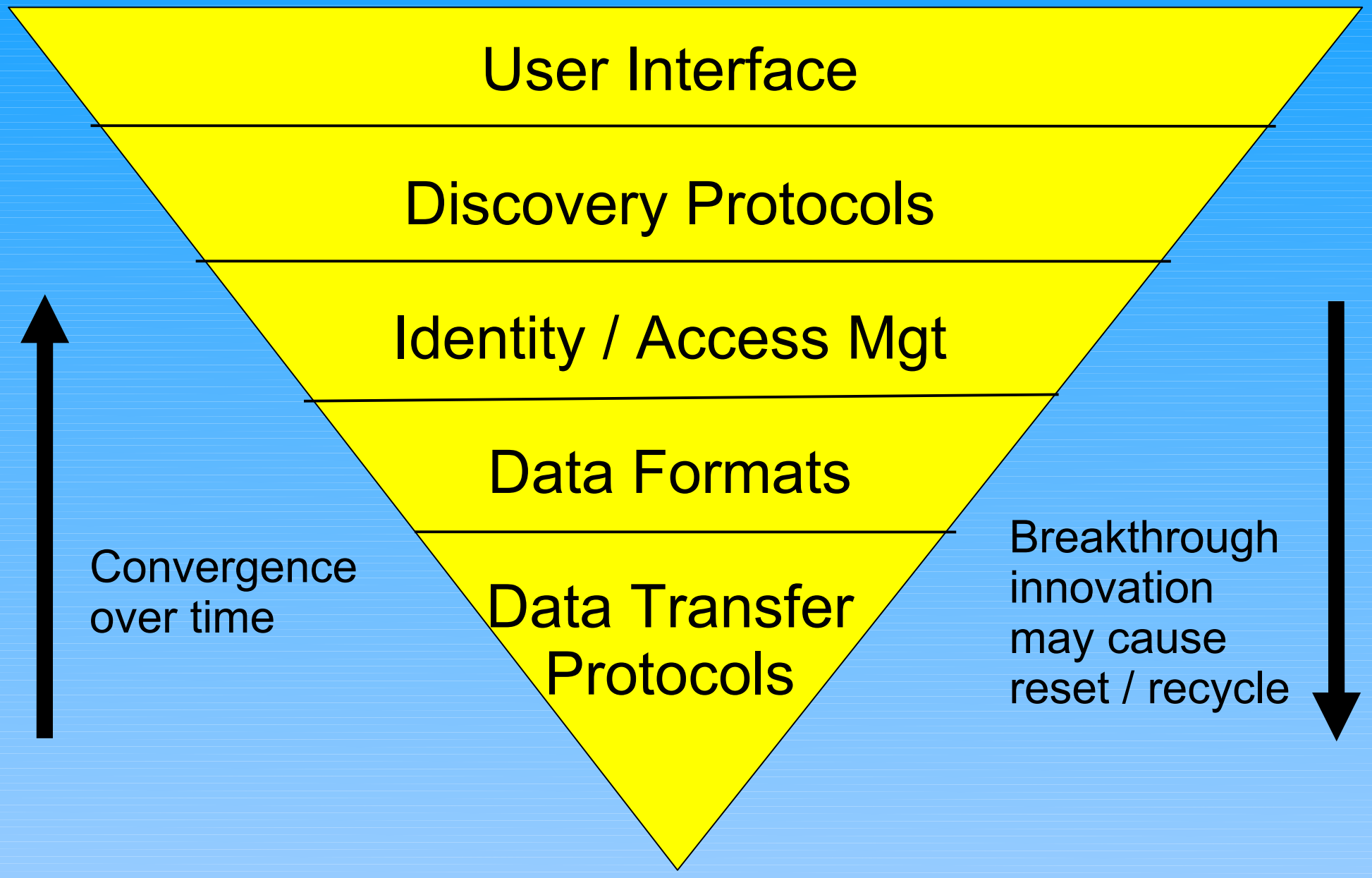
Q: How does a niche solution become a commodity? When do you let go?

Interoperability Evolution
Issue: adding value vs. inhibiting choice

- Multiple vendors create similar but non-interoperable solutions
- Tension develops between vendor desire for $$ via proprietary lock-in and customer desire for choice or integration via interoperability & stds
- Weaker players embrace standards to grow mkt
- Absent full monopoly, mkt standard overtakes proprietary solution (e.g. Sony Memory Stick)
- Vendors refocus on higher-level differentiation

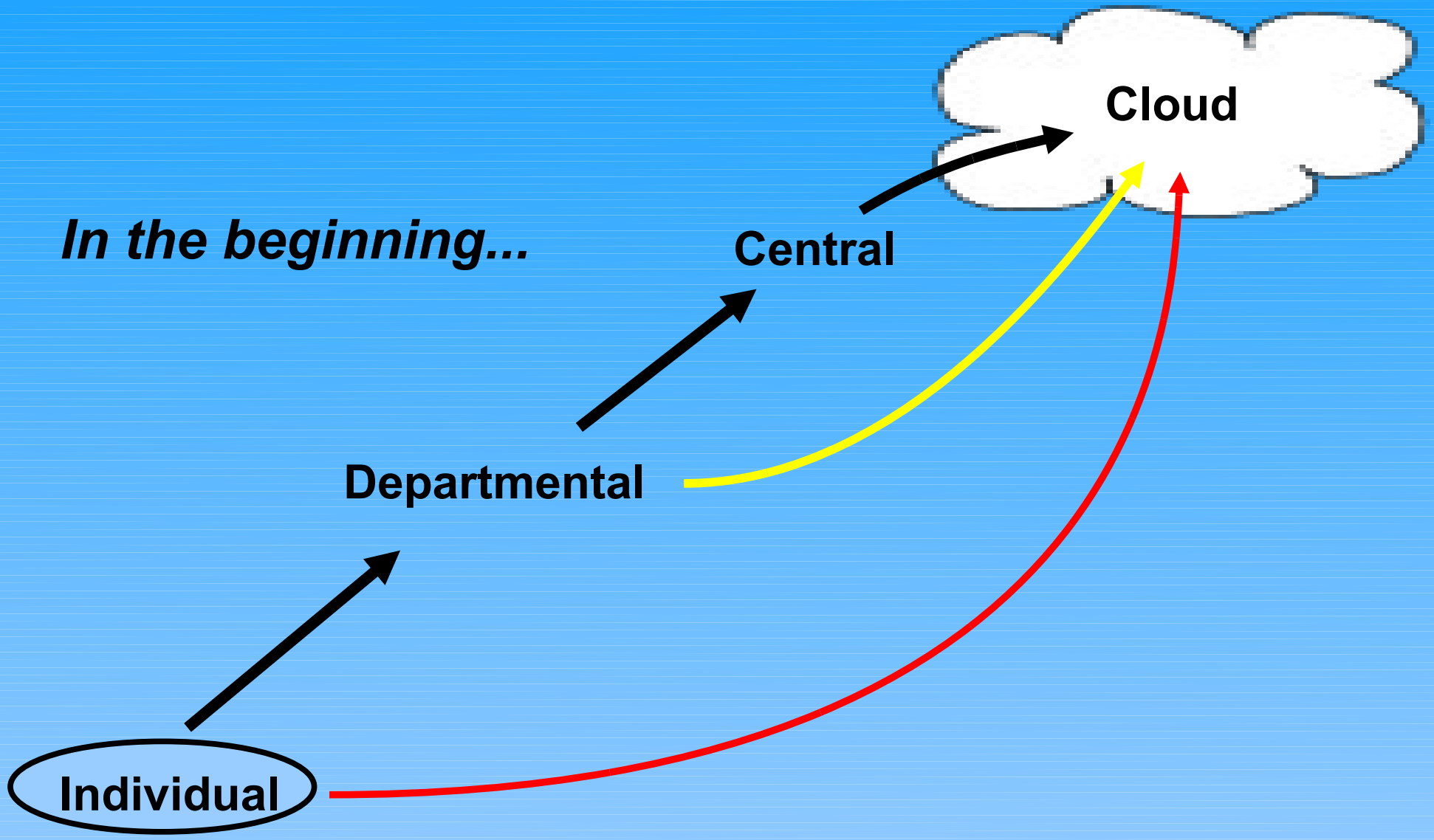
Vendors want to compete on proprietary features;
Consumers want vendors to compete on price

Interoperability Hierarchy



IT Sourcing Evolution

Who ya gonna call (for commodity IT)?



Goodbye “IT priesthood”... Hello “Consumer Computing”

Data Point: Cloud Apps @ UW

64K UW users!

50% of our students ALREADY forward their UW email!

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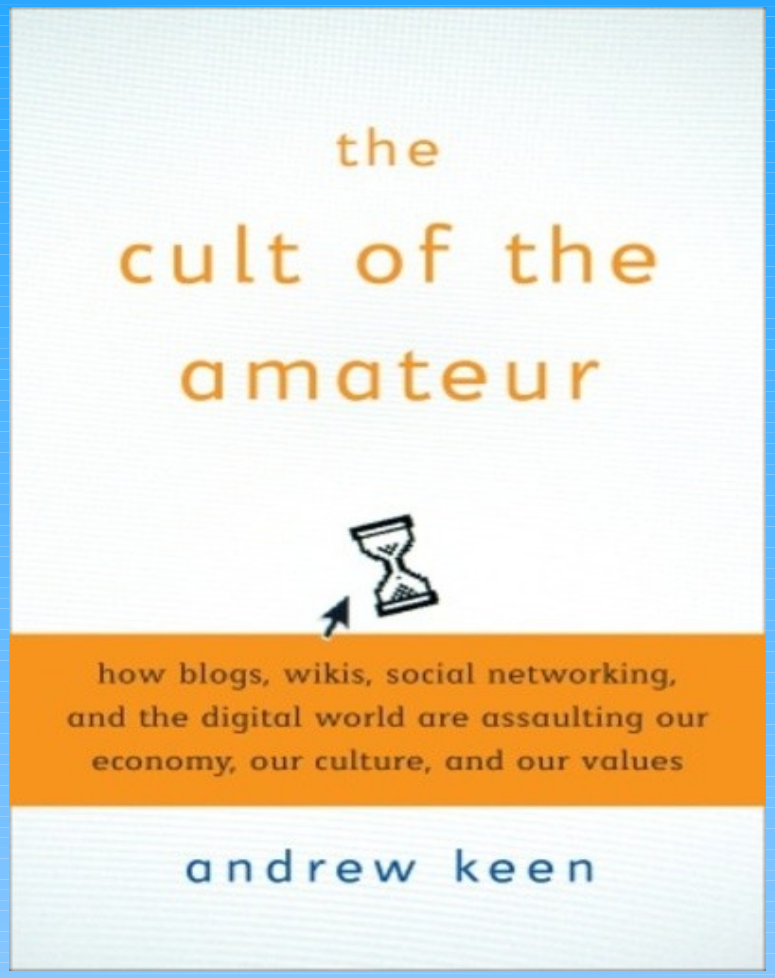
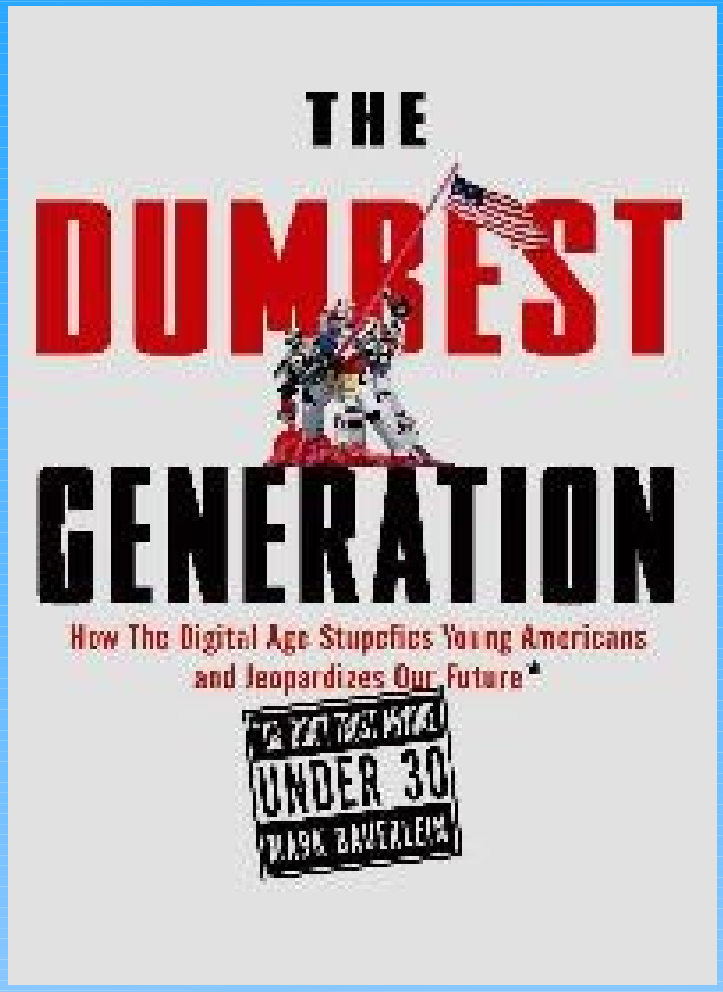
Pain & Pushback

- Social networking
- Proprietary silos
- Moving targets
- Support Costs
- Privacy & Trust
- Interoperability

Social Networking Backlash

The Dark Side of Crowd-Sourcing





Jefferson, meet Hamilton...

"I had my own blog for a while, but I decided to go back to just pointless, incessant barking."

REBOOTING THE WORKFORCE

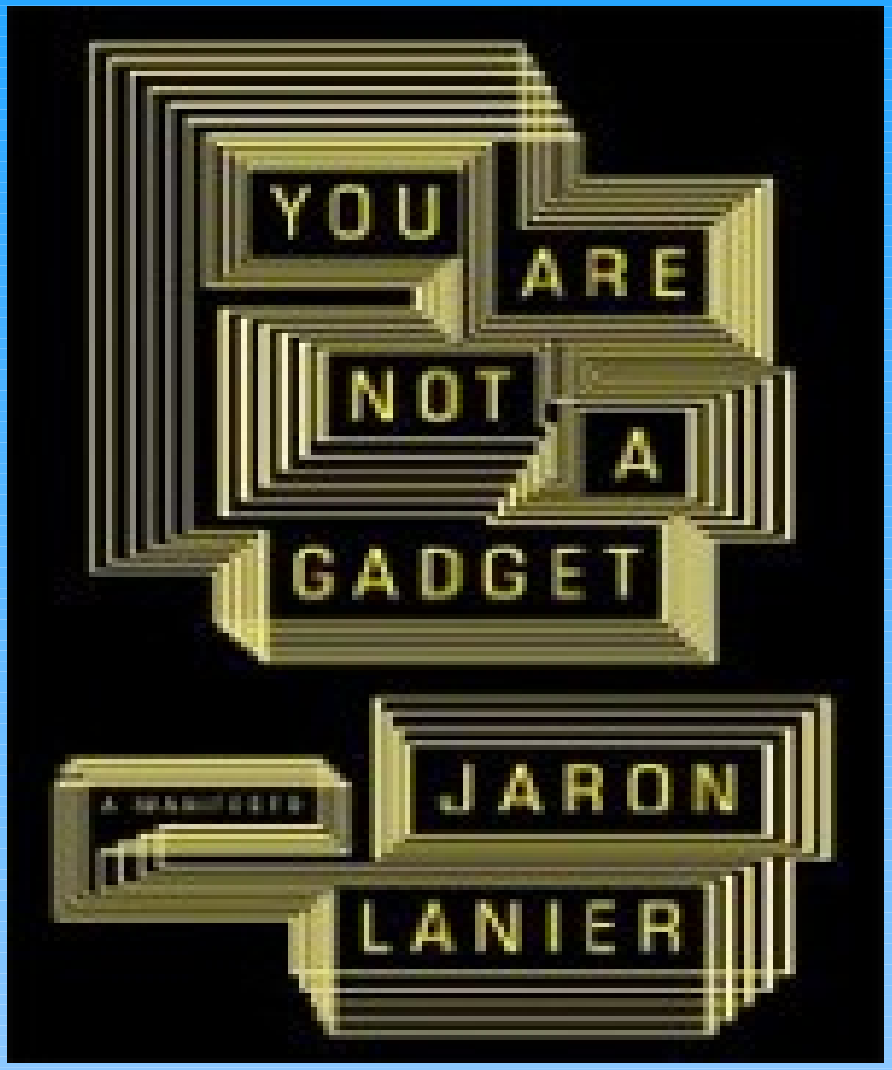
WEB WORKER DAILY

A GIGAOM NETWORK SITE

Social Networking: Modern Tulip Mania?

March 9th, 2008 (8:55am) Mike Gunderloy | 8 Comments

More Backlash

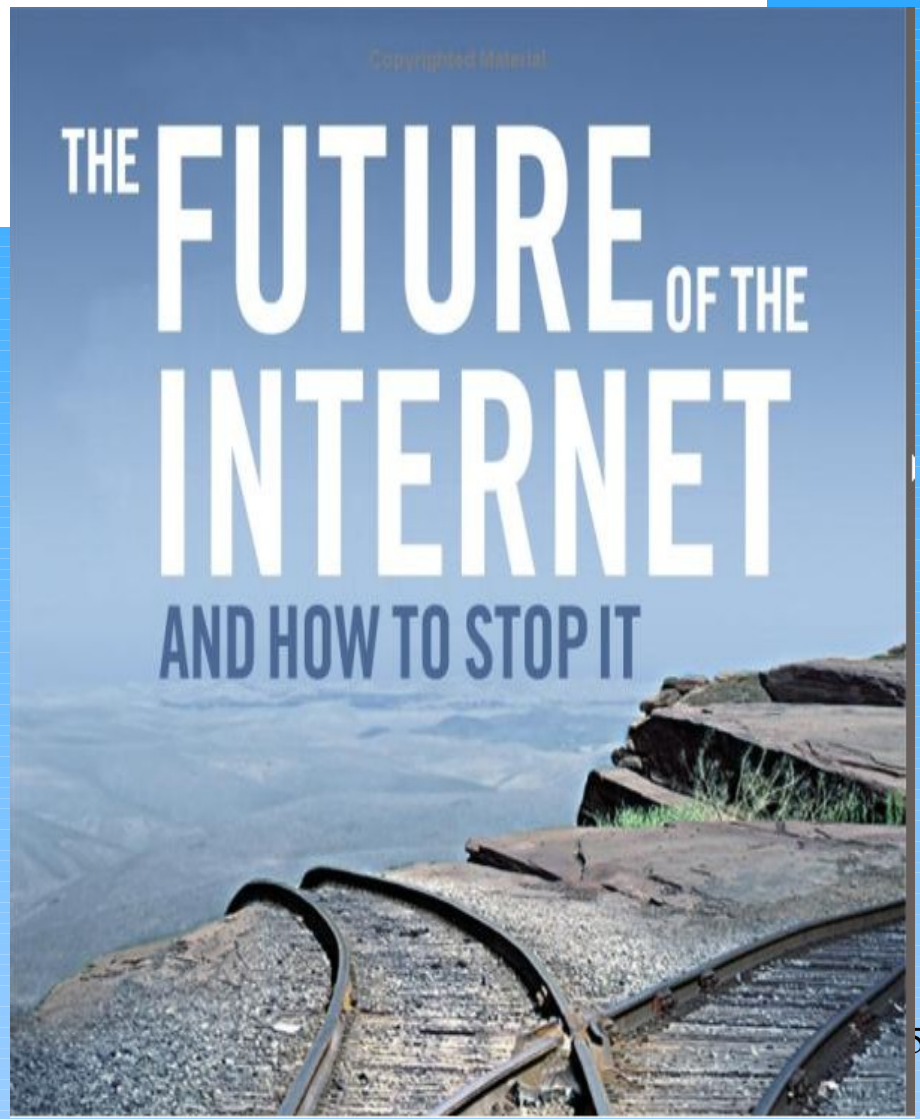


Newsweek

A Killer Product

Will closed devices like Apple's iPhone murder the Web?

Brian Braiker
NEWSWEEK WEB EXCLUSIVE
Updated: 1:56 PM ET May 2, 2008



Proprietary Silos:
Innovation at the edge
vs. controlling the core

Jonathan Zittrain

Moving Target Backlash

Support staff concerns:

-Rework (integration code, user docs)

-Stuck in the middle...

-Can't dodge incoming flak from users when a favorite feature or service changes (or disappears!)

http://mrgadget.co.za/catalog/images/Moving_Target.jpg

Cloud Conundrum

Does Cloud Computing Reduce Support Costs?

Minimizing **software** support costs...

→ Implies minimizing service integration

→ Implies minimizing utility for users

Minimizing **user** support costs?

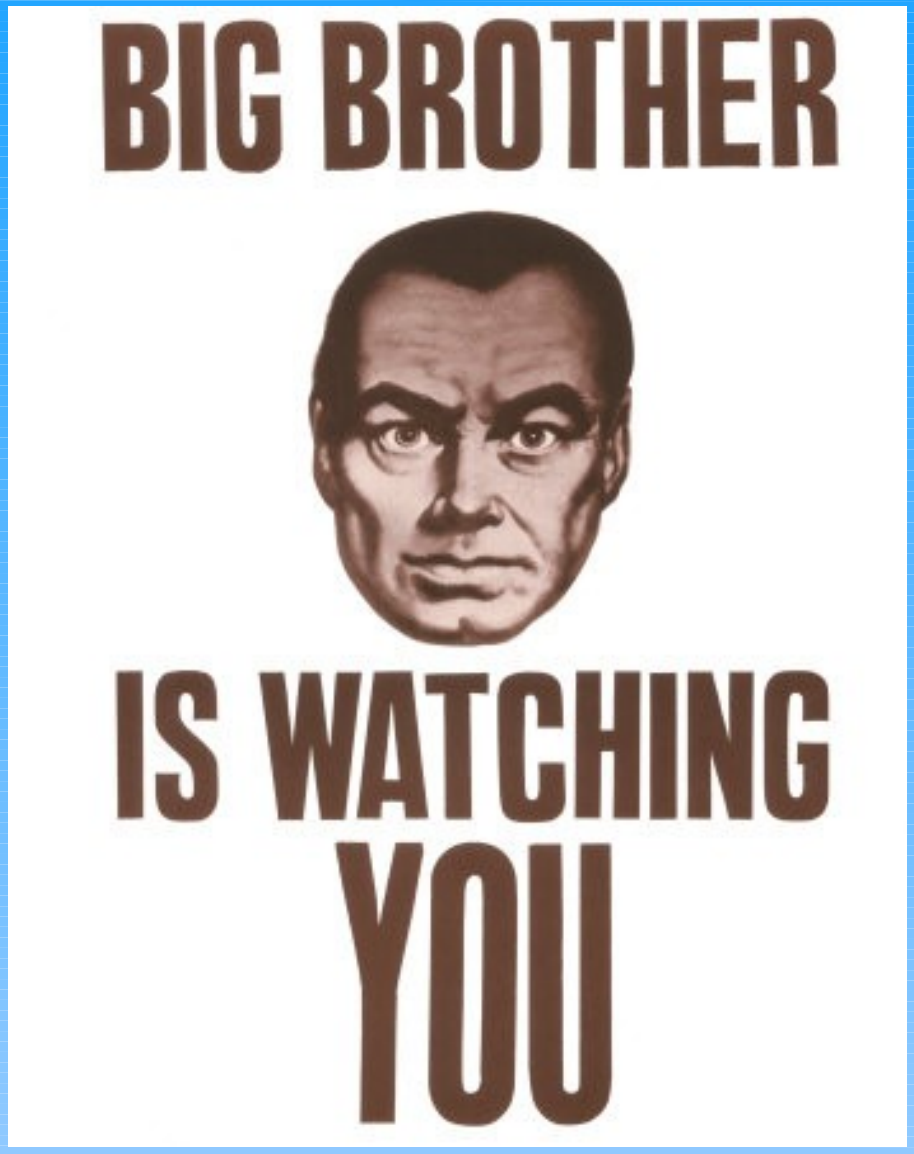
→ Implies more self-service

(which is only good if the system is easier!)

Savings?

"It's cloud illusions I recall
I really don't know clouds at all"

Privacy & Trust



Study Shows Targeted Ads Make Users Uneasy

* By Terrence Russell
* April 10, 2008

WIRED

Even without ads, many are worried!

http://www.wired.com/epicenter/2008/04/study-shows-tar/

Total Information Awareness

Google

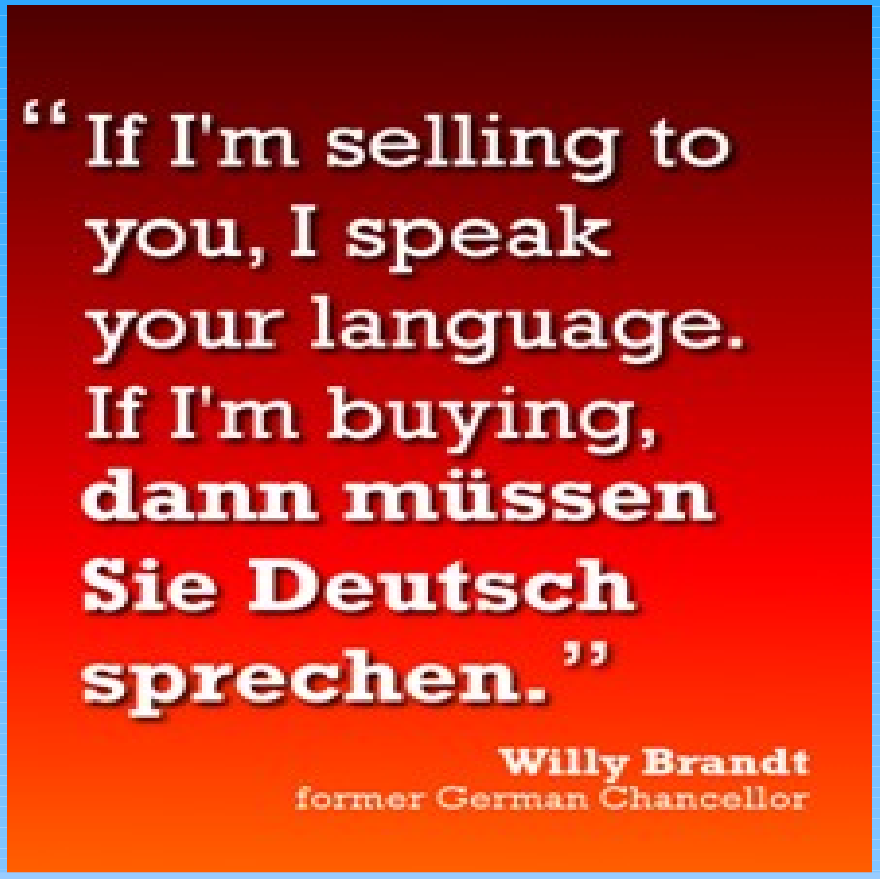
amazon.com

LexisNexis
ChoicePoint

Microsoft®

Interoperability Matters

for both collaboration & market share

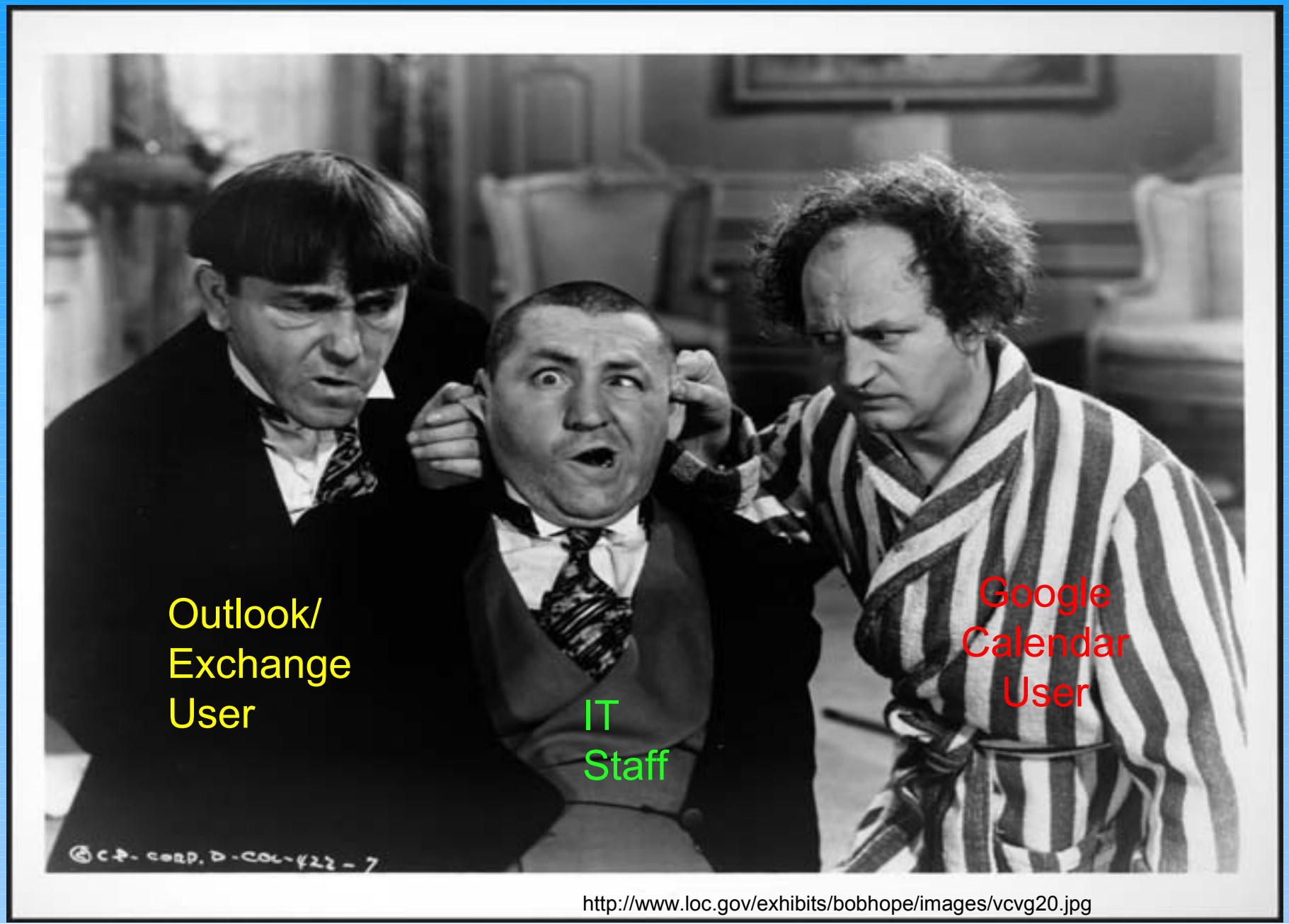


http://blog.law.cornell.edu/tbruce/files/2008/03/8b731795-a600-44f7-a744-9b7a501ede5b.jpg

http://gilbane.com/globalization/content%20matters.png

Non-interoperability Backlash

example: the calendaring challenge



http://www.loc.gov/exhibits/bobhope/images/vcvg20.jpg

IT Evolution & Revolution

- Introduction
- Taxonomy
- Drivers
- Trends
- Patterns
- Backlash
- Advice

Advice
for coping with IT change

- **Remember:**
  - Past is (***not*** *always*) prologue
  - Technology is *(always)* a two-edged sword
  - IT = Inevitable Tensions & Infinite Transitions
- **Distinguish:**
  - What is cyclical vs. transformational.
  - Things you control vs. externalities that control you.
  - Innovator / early adopter, Fast follower, Slow follower
- **Avoid:**
  - Insularity, entitlement, arrogance
  - Solving problems that are being overtaken by events
- ***Listen, lead, experiment, challenge assumptions***

Feedback

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