

Economic Issues in Cloud Computing

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Cloud computing

- “To translate the English term for computing resources that can be accessed on demand on the Internet, a group of French experts had spent 18 months coming up with "informatique en nuage..." WSJ Oct 2009
- Alternatives: cyberinformatique, cybergerance cybermanagement, cybercalcul, cyberservice
- It was rejected by the General Commission of Terminology and Neology in Sept 2009

Economies of scale

- Economies of scale (on cost side) in providing computing services
 - Hardware, software, management (including security), training
 - Applies equally well to
 - User environment
 - Development environment
 - Production environment
 - Also provides benefits on demand side in terms of quality and functionality of services

Returns to scale and uniformity

- Improvement on existing cost structure but constant returns to scale wrt data centers
 - Increase “output” by adding new board, rack, datacenter, etc.
 - Built-in fault tolerance, exception handling, optimization
- Advantage of uniformity; Intel's "copy exactly"
- Disadvantages of uniformity
 - Security, bugs, innovation (plus and minus)
 - Innovation, modularization, standardization
 - GPT: nuts, bolts, chips, motherboards

Switching costs and lock-in

- *Information Rules* and lock-in
 - Now widely recognized
 - Customers very astute, demand data portability
 - Data Liberation initiative
- But still problems with
 - Issues with human capital/learning
 - Tradeoff of ease of entry, ease of scalability
 - “Phase changes” and growing pains

Demand side

- Access data and computation from any device, any time, any authorized user
 - Re-organize and improve knowledge work
 - Just as the assembly line re-organized physical work
 - See next slides

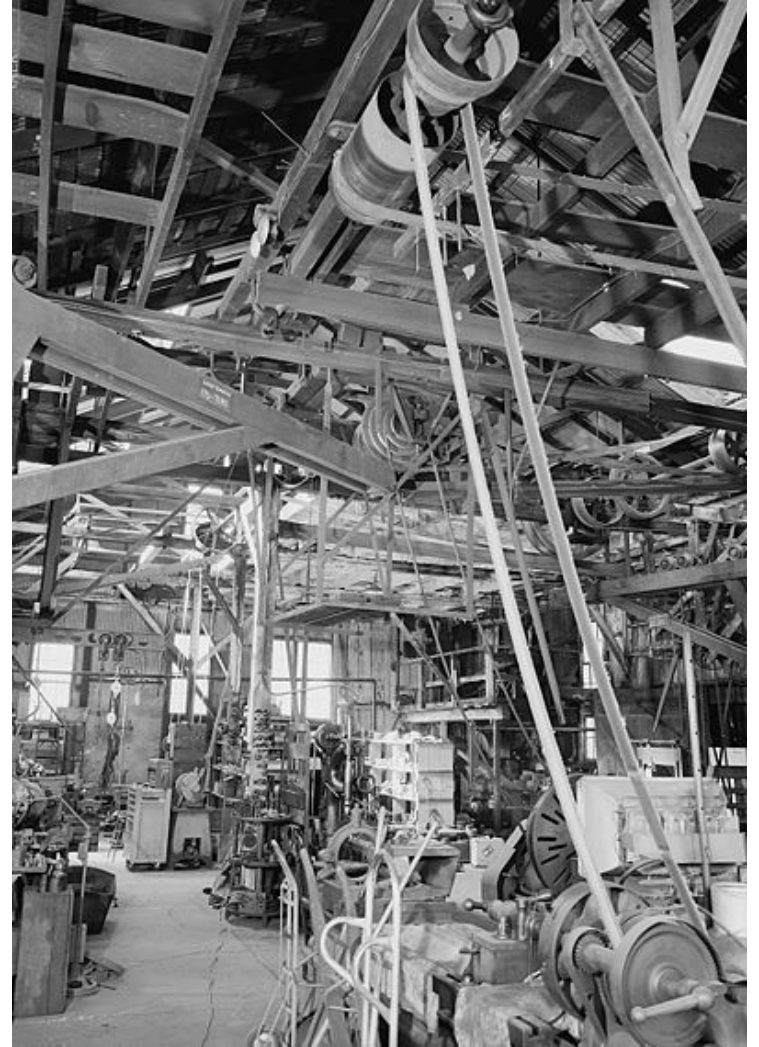
“The computer and the dynamo”

- Paul David on the productivity of electricity
 - In early 1800s waterwheels powered plants
 - All machinery connected to central shaft
 - Clustered machinery by type as in model



Improvements in power

- Steam and then electric motors used same design
- Miniaturization of electric motor made it possible to power each machine separately
- Allowed for rearrangement of production...but no one took advantage. "We've always done it this way."
- Henry Ford and the assembly line broke the mold
- Allowed for dramatic increases in productivity



Disassembly line



Workflow of documents

Creation, circulation and revision of documents

- Shorthand, typewriter, carbon paper, cut and paste, circulation of revisions
- Post It notes, Whiteout, photocopy, physical circulation
- Computer word processing + email, electronic circulation
- Cloud computing
 - Multi-authored documents, revision control, tracking, master copy
 - Initially computer code, now everything

Collaboration at a distance

- Communication and collaboration costs have collapsed
- Micro-multinationals that are “born global”
 - Built on social networks formed during school
 - Trade in ideas, exploit comparative advantage in engineering, design, financing, etc.
 - Machine vision research in Ukraine, French entrepreneurs, American financing
 - Technology transfer in mobile phone models
 - Leads to rapid diffusion of ideas

Productivity improvements

- Nano-economics of business processes
 - “Dogfood” as verb
 - Hard to measure value of productivity improvements (since they typically reduce unmeasured transactions costs) but can be very large
 - Saving a few minutes a day mounts up
- Example: search engine benefits
 - Yan Chen study at UMich, 1000 queries
 - 7 minutes v 22 minutes in library = 15 minutes saved
 - Suppose 1 search per day = $\frac{1}{4}$ hour x \$8 wage = \$2 savings per day
 - $300\text{M} \times \$2 = \600M per day
 - $600 \times 365 = \$220$ billion/year
 - Compensating and equivalent variation