

# Change and the University

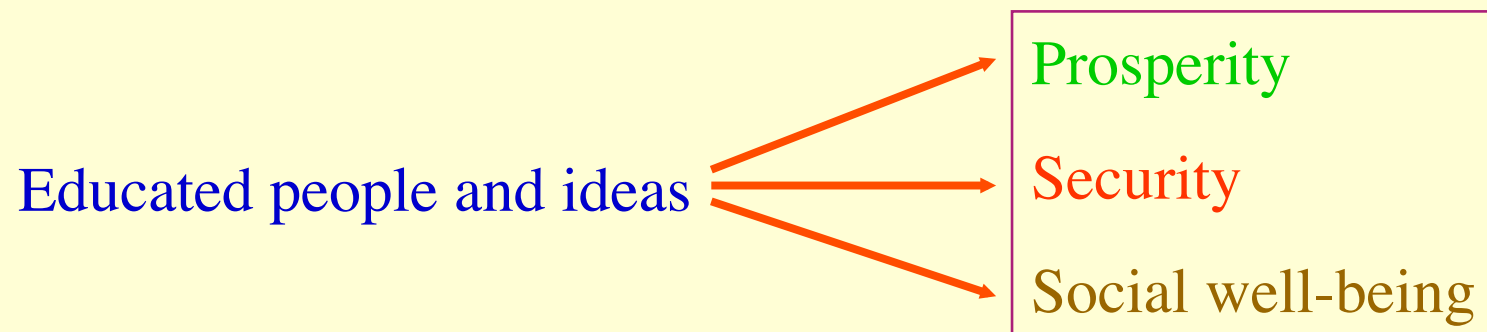
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# Topics

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- The forces of change
- A possible restructuring of the higher education enterprise
- Information technology and the future of the university
- Leadership during an era of change

# The Age of Knowledge



Educated people are the most valuable resource  
for 21st societies and their institutions!!!

# Forces of Change

## A Changing World

Age of Knowledge

Demographic Change

Globalization

Post-Cold War World

Spaceship Earth

## Forces on the University

Economics

Societal Needs

Technology

Markets

Brave New World?

Society of Learning?



# The Forces of Change

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- Financial imperatives
- Changing societal needs
- Technology
- Market forces

# Financial Imperatives

- Increasing societal demand for university services (education, research, service)
- Increasing costs of educational activities
- Declining priority for public support
- Public resistance to increasing prices
- Inability to re-engineering cost structure

*Concern: The current paradigms for conducting, distributing, and financing higher education may not be able to adapt to the demands and realities of our times*

# Changing Societal Needs

- 30% increase in traditional students
- Education needs of high-performance workplace
- The “plug and play” generation
- “Just-in-case” to “just-in-time” to “just-for-you” learning
- Student to learner to consumer

*Concern: There are many signs that the current paradigms are no longer adequate for meeting growing and changing societal needs.*

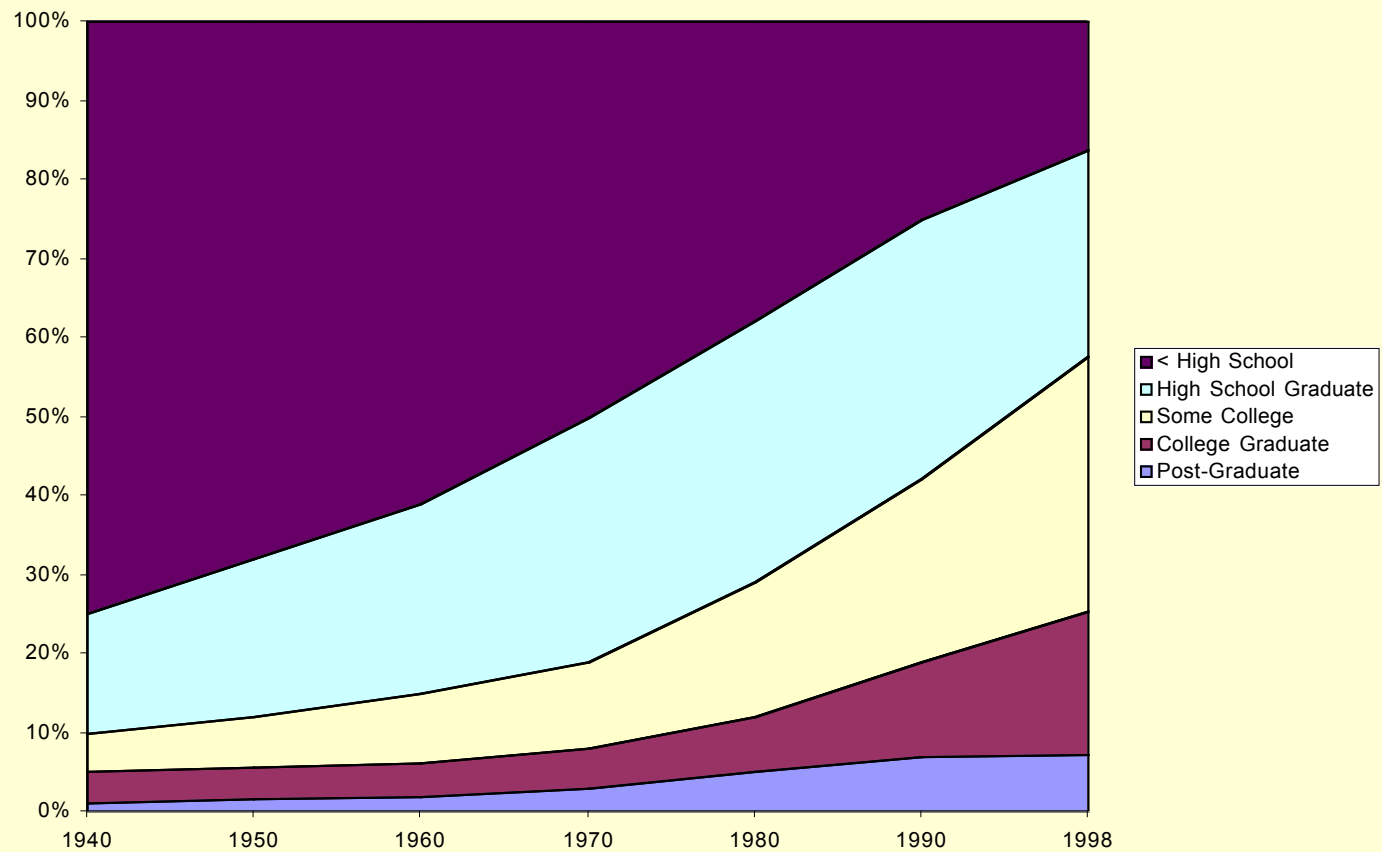
# Some data points

1. 50% of economic growth is driven by **new technology**.
2. 90% of new jobs require college-level education.
3. The single most important factor in determining personal income is the level of one's education, with the most pronounced impact from **graduate education**.
4. Corporate leaders estimate that the “high-performance workplace” will require that **20% of a worker's time** will be spent in formal education.
5. Just ask any governor who will tell you that today America faces a “**skills race**” as challenging as the “space race” of the 1960s.

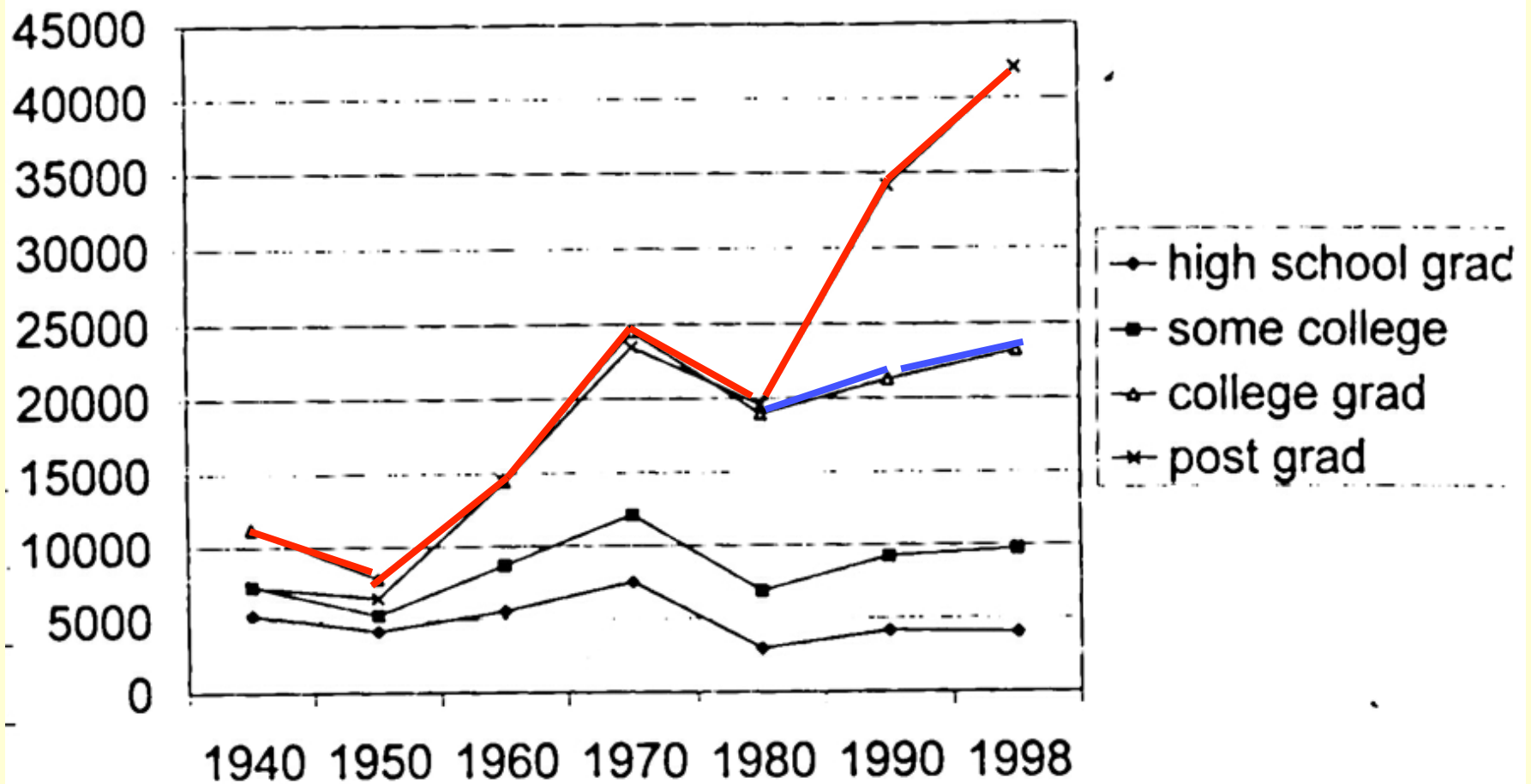


# Educational attainment of U.S. Population

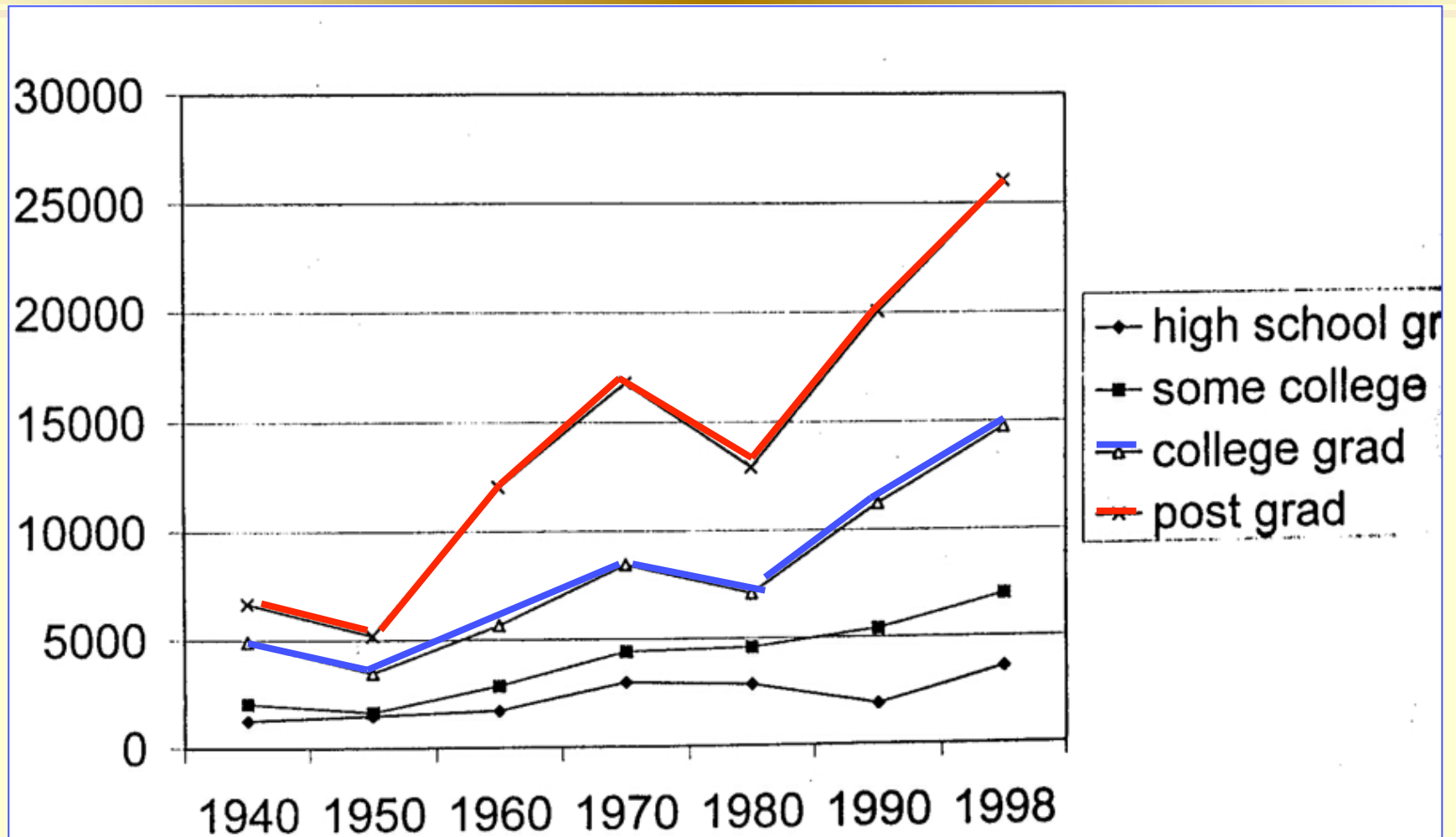
Highest Level of Education Attained by Year



## Monetary returns for education, 1940-98 (men)



## Monetary returns for education, 1940-98 (women)



## Another issue ...

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Over half the world's population is under 20, including two billion teenagers!!! Yet higher education in most of the world is mired in a crisis of access, cost, and flexibility. The United States may have the world's strongest university system, but our high-cost, campus-based paradigms and our belief that quality in education is linked to exclusivity of access and extravagance of resources is irrelevant to the rest of the world.

# Technology

Since universities are knowledge-driven organizations, it is logical that they would be greatly affected by the rapid advances in knowledge media (computers, networks, etc.)

We have already seen this in administration and research.

But the most profound impact could be on education, as technology removes the constraints of space, time, reality (and perhaps monopoly ... )

*Concern: The current paradigm of the university may not be capable of responding to the opportunities or the challenges of the digital age.*

# A Detour: The Evolution of Computers

Mainframes (Big Iron)  
...IBM, CDC, Amdahl  
...Proprietary software  
...FORTRAN, COBOL  
...Batch, time-sharing

Minicomputers  
...DEC, Data Gen, HP  
...PDP, Vax  
...C, Unix

Microcomputers  
...Hand calculators  
...TRS, Apple, IBM  
...Hobby kits -> PCs

Supercomputers  
...Vector processors  
...Cray, IBM, Fujitsu  
...Parallel processors  
...Massively parallel

Networking  
...LANs, Ethernet  
...Client-server systems  
...Arpanet, NSFnet, Internet

*Batch* → *Time-sharing* → *Personal* → *Collaborative*

# Implications for Research Universities

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Activities: teaching, research, outreach

Organization and structure: disciplinary structure, faculty roles, financing, leadership

Enterprise: markets, competitors, role in evolving national research enterprise, globalization

# Information Technology and the Future of the Research University

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Premise: Rapidly evolving information technology poses great challenges and opportunities to higher education in general and the research university in particular. Yet many of the key issues do not yet seem to be on the radar scope of either university leaders or federal research agencies.



# NAS/NAE/IOM Steering Committee

- Jim Duderstadt (chair)
- Dan Atkins, Michigan
- John Seely Brown, Xerox PARC
- Gerry Butters, Lucent
- Marye Anne Fox, NCSU
- Ralph Gomory, Sloan Foundation
- Nils Hasselmo, AAU
- Paul Horn, IBM
- Shirley Jackson, RPI
- Frank Rhodes, Cornell
- Marshall Smith, Stanford
- Lee Sproull, NYU
- Doug Van Houweling, Internet2
- Bob Weisbuch, Woodrow Wilson
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Technology

Education

Staff

# Process

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Technology Scenarios: What technologies are likely (possible) in the future (perhaps a 10 year planning horizon).

Implications for Research Universities: What are the implications of this evolving technology for the activities, organization, and enterprise of the research university?

Policies, Programs, Investments: What is the role, if any, for the federal government in protecting the valuable contributions of the research university in the face of these challenges

# Products?

- A dialog among technologists, higher education leaders, and federal policy leaders.
- A report? (Likely to be out-of-date before it is written, reviewed, and released.)
- Targeted discussions with research universities (faculty, leaders, administrators)
- An ongoing “roundtable”, similar to GUIRR.
- A “knowledge environment”.

## Some early conclusions about the evolution of information technology

- 1) There is no evidence of slowdown in the pace of IT evolution, by any measure or characteristic. In fact we appear to be on a superexponential technology learning curve that is likely to continue for at least the next several decades.
- 2) Photonic technology is evolving at twice the rate of information technology, with miniaturization moving even faster, implying that the rate of growth of network appliances will be incredible.
- 3) There are likely to be major technology surprises, comparable to the PC in 1980 and the Internet browser in 1994.

# Some Theorems of the Digital Age

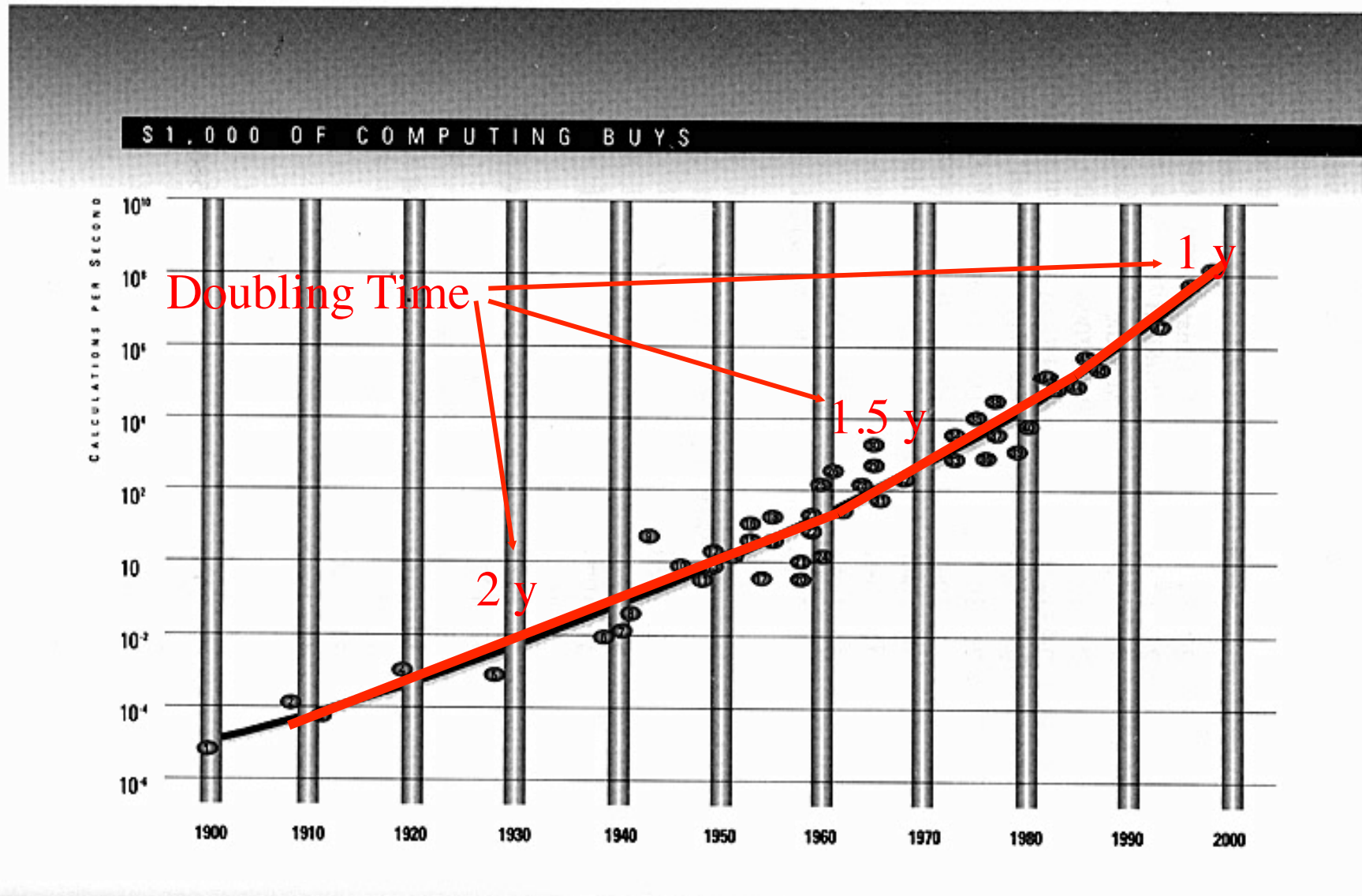
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Moore's Law: The power of computing for a given price doubles every 18 months. In ten years, the power of the technology increases by a factor of 100.

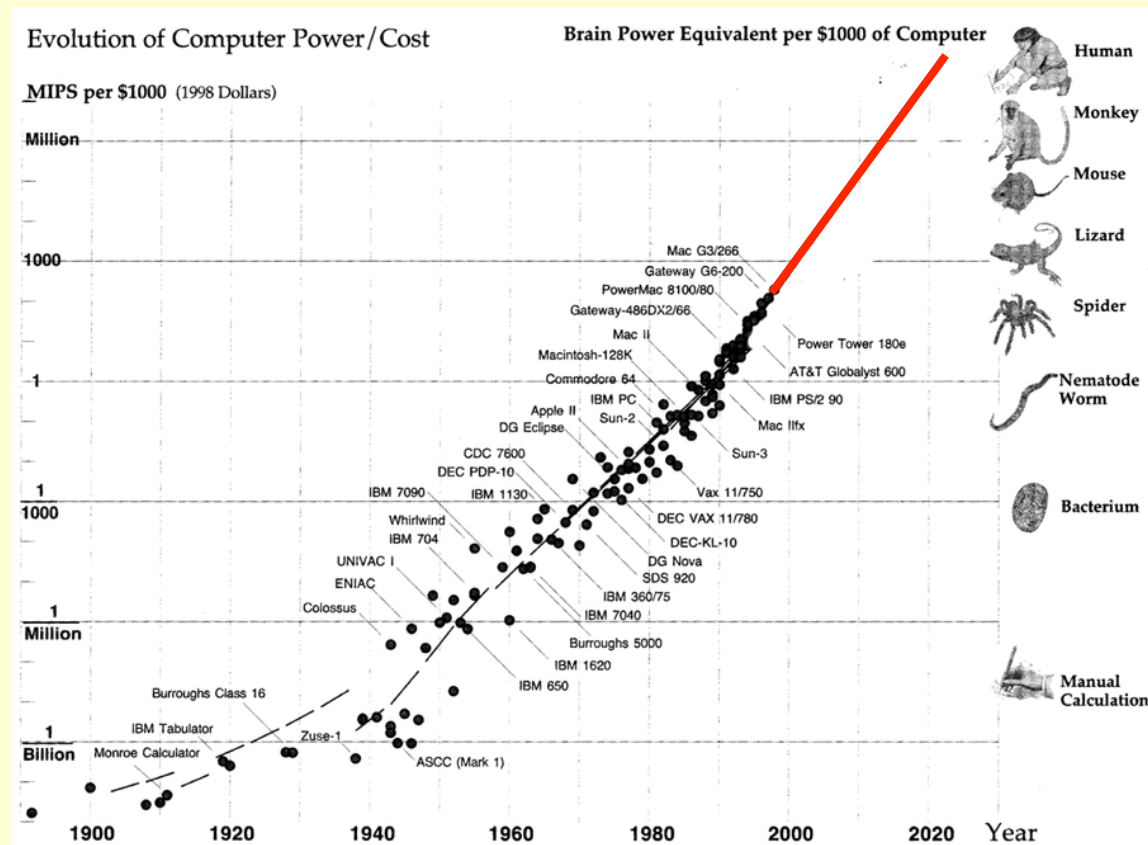
Metcalf's Law: The usefulness of a network increases as the square of the number of users.

Moore's Second Law: The cost of the manufacturing facility for chip production also doubles every 18 months.

# The Evolution of Computing



# The evolution of computer power



(After Moravec)



# Some Examples

- Speed
  - » MHz to GHz (Merced) to THz to Peta Hz
- Memory
  - » MB (RAM) to GB (CD,DVD) to TB (holographic)
- Bandwidth
  - » Kb/s (modem) to Mb/s (Ethernet) to Gb/s
  - » Internet (Project Abilene): 10 Gb/s
- Networks
  - » Copper to fiber to wireless to photonics
  - » “Fiber to the forehead...”

# Computer-Mediated Human Interaction

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- 1-D
  - » Text, e-mail, chatrooms, telephony
- 2-D
  - » Graphics, video, WWW, multimedia
- 3-D
  - » Virtual reality, distributed virtual environments
  - » Immersive simulations, avatars
  - » Virtual communities and organizations
- And beyond...
  - » Telepresence
  - » Neural implants

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  - » MUDs and MOOs, avatars, telepresence
  - » Virtual communities and organizations
- And beyond...
  - » Telepresence
  - » Neural implants

## Another Way to Look at It ...

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A “communications” technology that is increasing in power by a factor of 1,000 every decade will soon allow any degree of fidelity that one wishes. All of the senses will be capable of being reproduced at a distance ... sight, sound, touch, taste, smell ... through intelligence interfaces.

At some point, we will see a merging of

- ...natural and artificial intelligence

- ...reality and virtual reality

- ...carbon and silicon ...

# Evolution of the Net

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- Already beyond human comprehension
- Incorporates ideas and mediates interactions among millions of people
- 100 million today; more than 1 billion in 2001
- Internet II, Project Abilene

# Some Other Possibilities

- Ubiquitous computing?
  - » Computers disappear (just as electricity)
  - » Calm technology, bodynets
- Agents and avatars?
  - » Fusing together physical space and cyberspace
  - » Plugging the nervous system into the Net
- Emergent behavior?
  - » ... Self organization
  - » ... Learning capacity
  - » ... Consciousness (HAL 9000)

# A Case Study: the University

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Missions: teaching, research, service?

Alternative: **Creating, preserving, integrating, transferring, and applying knowledge.**

The University: A **“knowledge server”**, providing knowledge services in whatever form is needed by society.

Note: The fundamental knowledge roles of the university have not changed over time, but their realizations certainly have.



# Research

- Simulating reality
- Collaboratories: the virtual laboratory
- Changing nature of research
  - » Disciplinary to interdisciplinary
  - » Individual to team
  - » “Small think” to “big think”
- Analysis to creativity
  - » Tools: materials, lifeforms, intelligences
  - » Law, business, medicine to art, architecture, engineering

# Libraries

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- Books to bytes (atoms to bits)
- Acquiring knowledge to navigating knowledge
- What is a book?
  - » A portal to the knowledge of the world.
  - » Minsky: “Can you imagine a time when books didn’t talk to one another?”

# The Plug and Play Generation

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- Raised in a media-rich environment
  - » Sesame Street, Nintendo, MTV,
  - » Home computers, WWW, MOOs, virtual reality
- Learn through participation and experimentation
- Learn through collaboration and interaction
- Nonlinear thinking, parallel processing

# Teaching to learning

- Student to learner
  - » Classroom to environment for interactive, collaborative learning
  - » Faculty to designer, coach, Mr. Chips
- Classroom
  - » Handicraft to commodity
  - » Learning communities
  - » Virtual, distributed environments
- Open learning
  - » Teacher-centered to learner-centered
  - » Student to learner to consumer
  - » (Unleashing the power of the marketplace!)

# IT-Mediated Distance Learning

Sloan Foundation has invested over \$30 million in the development of Asynchronous Learning Networks. Their conclusions from over 100,000 sponsored course units in thousands of courses:

1) **This stuff works.** You can reproduce the classroom over the Internet with no apparent loss of educational quality (as measured by test scores, etc.).

2) **It is not expensive** to convert a course into ALN format (about \$10,000 per course), if the aim is interactive rather than automated teaching.

**The key: Don't automate the classroom, but break it free from the constraints of space and time!**

# The Digital Divide

Concern: The “digital divide” between those who have access to information and those who do not.

Another View: The real divide is not access to technology but rather between those who have access to educational opportunity and those who do not because of economic means, family responsibilities, or job constraints.

As access to IT appliances becomes more ubiquitous (e.g., PDAs) and IT breaks learning free from constraints of space and time, technology may actually narrow the stratification in our society by opening up access to education.

# The Impact of Technology

- The digital generation will demand interactive, collaborative, nonlinear learning.
- Faculty will have to become designers of learning experiences, motivators of active learning.
- A transition to open learning environments, in which strong market forces challenge the traditional university monopolies.

## Some early conclusions (continued)

4) Getting people to think about the implications of accelerating technology learning curves as well as technology cost-performance curves is very important. The event horizons are much closer than most realize (e.g., for when the cost of digital storage will become cheaper than paper storage).

4) Yet most universities still look at IT as a cost, not as an investment with staggering cost benefits as industry is learning. If you are not going to invest in IT, you may as well get out of the game.

**Investment in robust information technology represents the table stakes for survival in the age of knowledge!**



# A Concern

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Although there is a great deal of activity in IT-mediated distance learning (over 1,000 “virtual universities”), as one goes up the learning curve, from community colleges to regional universities to research activities, there is less and less participation.

While there are experiments by research universities such as Unext.com, these are largely hands off, with little participation by the research university faculty. As a result, most research universities are not really learning how to implement this technology like others in the post-secondary education enterprise.

# Market Forces

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Powerful economic forces, changing societal needs, and technology are creating **powerful market forces**.

# The Role of Markets

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- For students (particularly the best)
- For faculty (particularly the best)
- For public funds (research grants, state appropriations)
- For private funds (gifts, commercial)
- For everything and everybody

# The current monopoly

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Universities operate with a monopoly sustained by geography and credentialing authority.

But this is being challenged by

- demand that cannot be met by status quo
- antiquated cost structures
- information technology
- open learning environments

# Restructuring

Hypothesis: Higher education today is about where the health care industry was a decade ago, in the early stages of a major restructuring.

However, unlike other industries such as energy, telecommunications, and health care that were restructured by market forces after deregulation, the global knowledge and learning industry is being restructured by emerging information technology, that releases education from the constraints of space, time, and credentialing.

## A quote from a venture capital prospectus

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“As a result, we believe education represents the most fertile new market for investors in many years. It has a combination of large size (approximately the same size as health care), disgruntled users, lower utilization of technology, and the highest strategic importance of any activity in which this country engages . . . . Finally, existing managements are sleepy after years of monopoly.”

# United States Higher Education “System”

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AAU-Class Research Universities (60)

Research Universities (115)

Doctoral Universities (111)

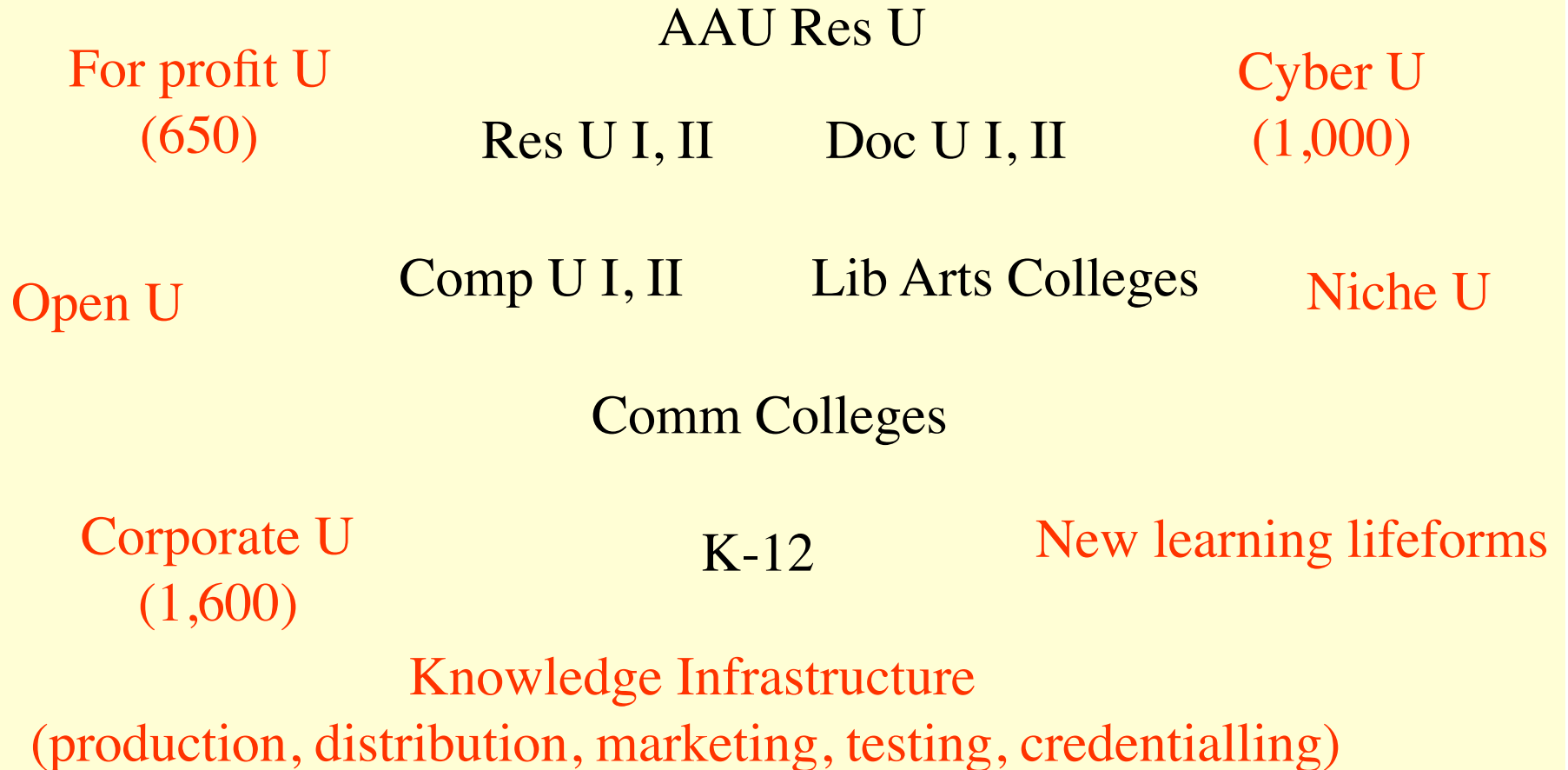
Comprehensive Universities (529)

Baccalaureate Colleges (637)

Two-Year Colleges (1,471)

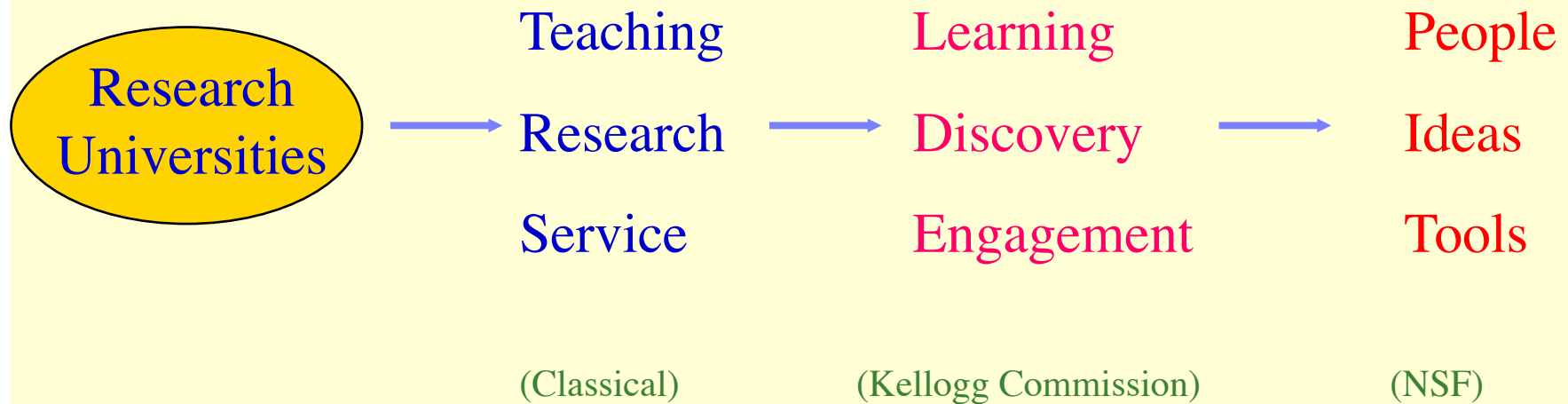
Total U.S. Colleges and Universities: 3,595

# The Evolving U.S. Education System





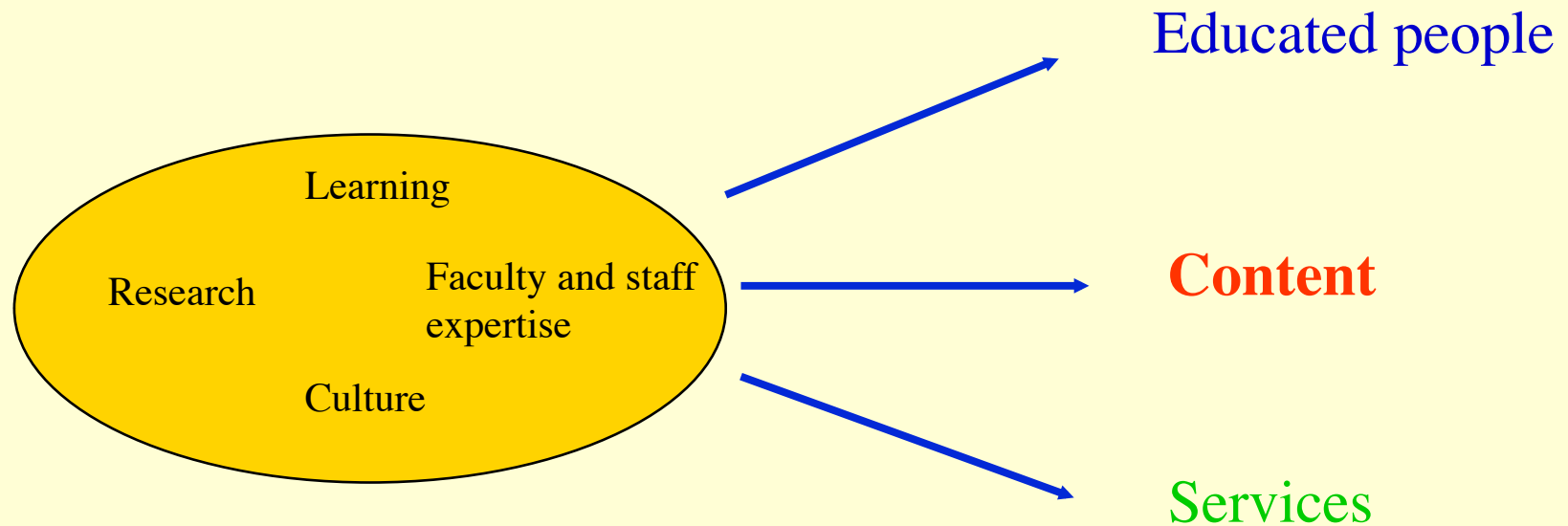
# Contributions of the Research University



# The Knowledge Industry

Hardware	→ Boxes, PCs, PDAs	→ IBM, HP, Sun, Lucent, Nokia, Erickson
Networks	→ Backbones, LANs, Wireless	→ AT&T, MCI, Telcoms
Software	→ OS, Middleware, Applications	→ Microsoft, IBM, Sun
Solutions	→ Systems, Integrators	→ Anderson, Peoplesoft, EDS, IBM
Content	→ Data, Knowledge, Entertainment, Learning?	→ Time-Warner, Disney, "dot.coms", AAU?

# The Core Competencies of the University



# Content

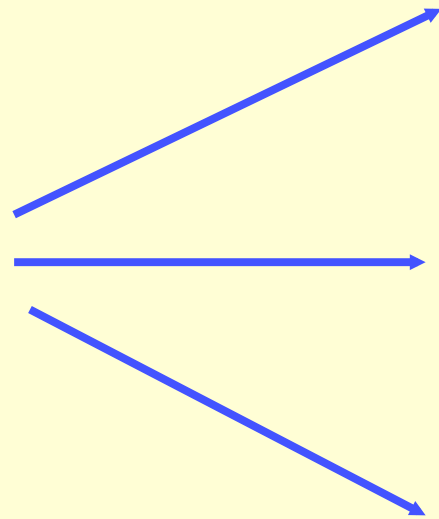
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Intellectual  
Property

The Library Model

The Internet2 Model

The NCAA Model



# Caveat

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The content of the university is contained in the minds of people – faculty, staff, and even students.

*It can walk out the door!*

Can you bottle it up (a la Harvard)?

*No! Too many other opportunities.*

# Some implications

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- Unbundling
- A commodity marketplace
- Mergers, acquisitions, hostile takeovers
- New learning lifeforms
- An intellectual wasteland???

# A possible future

- \$300 billion (\$3 trillion globally)
- 30 million students
- 200,000 faculty “facilitators”
- 50,000 faculty “content providers”
- 1,000 faculty “celebrity stars”

(compared to 800,000 current faculty serving a \$180 billion enterprise with 15 million students ...)

# A Society of Learning

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Since knowledge has become not only the wealth of nations but the key to one's personal prosperity and quality of life, it has become the responsibility of democratic societies to provide their citizens with the education and training they need, throughout their lives, whenever, wherever, and however they desire it, at high quality and at an affordable cost.



# Key Characteristics

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- Learner-centered
- Affordable
- Lifelong learning
- A seamless web
- Interactive and collaborative
- Asynchronous and ubiquitous
- Diverse
- Intelligent and adaptive

# Evolution or Revolution?

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Many within the academy believe that “this too shall pass”.

Others acknowledge that change will occur, but within the current paradigm, i.e., evolutionary.

Some believe that both the dramatic nature and compressed time scales characterizing the changes of our times will drive not evolution but revolution.

Some even suggest that long before reform of the education system comes to any conclusion, the system itself will have collapsed.

# Some quotes...

“Thirty years from now the big university campuses will be relics. Universities won’t survive. It is as large a change as when we first got the printed book.”

Peter Drucker

“If you believe that an institution that has survived for a millennium cannot disappear in just a few decades, just ask yourself what has happened to the family farm.”

William Wulf

“I wonder at times if we are not like the dinosaurs, looking up at the sky at the approaching comet and wondering whether it has an implication for our future.”

Frank Rhodes

# The Key Policy Question

How do we balance the roles of market forces and public purpose in determining the future of higher education in America. Can we control market forces through public policy and public investment so that the most valuable traditions and values of the university are preserved? Or will the competitive and commercial pressures of the marketplace sweep over our institutions, leaving behind a higher education enterprise characterized by mediocrity?

# A warning

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“There is no more delicate matter to take in hand, nor more dangerous to conduct, nor more doubtful of success, than to step up as a leader in the introduction of change.

For he who innovates will have for his enemies all those who are well off under the existing order of things, and only lukewarm support in those who might be better off under the new.”

Niccolo Machiavelli

# Governance

## The traditions:

- **Institutional Autonomy**
  - » Academic freedom
  - » Tenure
  - » Constitutional (or statutory) autonomy
- **Shared Governance**
  - » Governing boards
  - » Faculty
  - » Administration

# Shared Governance

## Academic Decisions

- ...Students (e.g., admissions)
- ...Faculty (e.g., hiring and promotion)
- ...Teaching (e.g., curriculum, degrees)



The Faculty

## Administrative Decisions

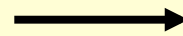
- ...Finance (e.g., resources, expenditures)
- ...Facilities (e.g., hiring and promotion)
- ...Fund raising (e.g., gifts, grants)



The Administration

## Public Accountability Decisions

- ...Governments (federal, state, local)
- ...Legal (compliance, litigation)
- ...Public (e.g., press)
- ...Selecting the president ...



The Governing Board

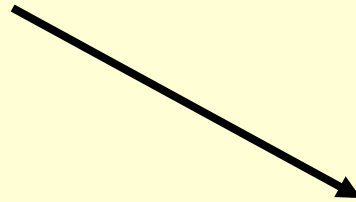
# Another way to look at decisions





# But what about ...

**Strategic Planning?**



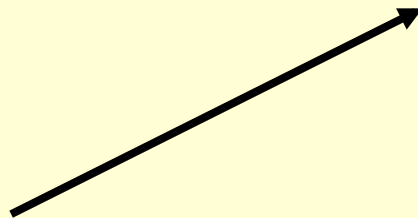
The Faculty?

**Crisis Management?**



??? The Administration?

**Institutional  
Transformation?**



The Governing Board?

# The Players

## Internal Stakeholders

...students

...faculty

...staff

...governing board

## External Stakeholders

...federal government

...state government

...local communities

...the public

...the press

The tensions arising from the incompatibility of the values, needs, and expectations of our many stakeholders.

# Process Characteristics

- **Federal Government**

- » Funding to individuals (grants, financial aid)
- » Influential policies and politics (land-grant acts, G.I. Bill, R&D, health care, etc.)

- **State Government**

- » Funding to institutions (state appropriations)
- » Great diversity in policies (and politics!)

# Governing Boards

- In theory,
  - » Fiduciary and legal accountability
  - » Focus on policy
  - » Select president
- In practice,
  - » Frequently become involved in management
  - » Highly political (at least in public universities)
  - » Sometimes viewed as “governors” rather than “trustees”

# Faculty Governance

- At level of academic units (departments, schools)
  - » Executive authority
  - » Key academic decisions (promotion and tenure)
  - » Strong faculty participation
- At level of university (faculty senate)
  - » Advisory only
  - » A “debating society”
  - » Weak faculty participation
- Selection of administration from ranks of faculty
  - » E.g., president, provost, deans, chairs, directors,...

# The Administration

- The need: The size, complexity, impact, and accountability of the contemporary university requires competent management.
- University administrations are comprised of:
  - » Faculty as “amateur” administrators
  - » Professional staff
- A myth: “University administrations are bloated and excessive...”
- (In reality, most universities have very lean management compared to corporations or government.)

# Some Challenges

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- **The complexity of the university**
- **Bureaucracy**
- **The pace of change**
- **The resistance to change**
- **The academic culture**
- **Mission creep**

# Some Particular Challenges

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- The increasing tensions between market forces and public policy ... between higher education as a wealth creating industry and as a public good
- The tension between short-term demands for accountability and long-term responsibilities for preserving academic values



## Challenges (continued)

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- The crisis in the academic presidency, where authority is weak and responsibility great
- The increasing vulnerability of four-year public universities, responsible for far broader missions than k-14, increasingly competing with private colleges for public resources, and increasingly vulnerable to predatory faculty raids from wealthy private institutions

# A Particular Challenge Faced by Public Universities

Public universities must function in intensely political environments, e.g., state regulations, politically determined governing boards, sunshine laws (and an intrusive press).

Politics is **reactive** rather than **strategic** in nature and tends to protect the status quo.

**A serious issue: Will public universities be able to respond and adapt to the changes in our society?**

# Some other issues ...

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- Planning and decision making during a period of rapid (or even discontinuous) change
- University transformation (e.g., “reinventing the university”)
- The university as a “public corporation”

# The university as a “public corporation”

The size, complexity, impact, and accountability of the contemporary university may require an overhaul of our governance traditions, e.g.,

**Governing boards** that are selected based upon expertise and experience and held accountable for the interests of all stakeholders of the university.

**Leadership authority** commensurate with responsibility (and sufficient to allow risk taking).

A recognition that the **academic decision process** (e.g., consultation, consensus building, and bribery) may occasionally need to be set aside in favor of rapid, decisive action ...

# Key Principles of Governance

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- Driven by academic values
- Capable of change
- Responsive ...and responsible
- The principle of subsidiarity
- Institutional diversity
- Alliances
- Consultation, communication, cooperation

# Values of the University

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- Freedom of inquiry
- An openness to new ideas
- A commitment to rigorous study
- A love of learning

# Roles of the University

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- Providing both the young and the experienced with not only knowledge and skills, but the values and discipline of the educated mind.
- Defending and propagating our cultural and intellectual heritage, while challenging our norms and beliefs.
- Producing the leaders of our governments, commerce, and professions.
- Creating and applying new knowledge to serve our society.

# An Action Agenda

- Determine those key roles and values that must be protected and preserved during this period of transformation
  - » Roles: education of the young, preservation of culture, research, critic of society, etc.
  - » Values: academic freedom, a rational spirit of inquiry, excellence, etc.
- Listen carefully to society to learn and understand its changing needs, expectations, and perceptions of higher education.



## An Action Agenda (continued)

- Prepare the academy for change, by removing unnecessary constraints, linking accountability with privilege, redefining tenure, and restructuring graduate education.
- Restructure university governance, particularly lay boards and shared governance models, to allow strong, visionary leadership.
- Development a new paradigm for financing higher education, balancing public and private support, implementing new cost structures, and enhancing productivity.

## An Action Agenda (continued)

- Encourage experimentation with new paradigms of learning, research, and service by harvesting the best ideas from the academy (or elsewhere), implementing them on a sufficient scale to assess their impact, and disseminating the results.
- Place a far greater emphasis on building alliances among institutions that will allow individual institutions to focus on core competencies while relying on alliances to address the broader and diverse needs of society. Differentiation among institutions should be encouraged, while relying upon market forces rather than regulations to discourage duplication.

# Concluding Remarks

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We have entered a period of significant change, driven by a limited resource base, changing societal needs, new technologies, and new competitors.

The most critical challenge before us is to develop the capacity for change.

Only a concerted effort to understand the important traditions of the past, the challenges of the present, and the possibilities for the future can enable institutions to thrive during a time of such rapid and radical change.

# A Renaissance?

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Certainly the need for higher education will be of increasing importance in our knowledge-driven future. Certainly, too, it has become increasingly clear that our current paradigms for the university, its teaching and research, its service to society, its financing all must change rapidly and perhaps radically.

Hence the real questions is now whether higher education will be transformed, but rather **how** and **by whom**.

If the university is capable of transforming itself to respond to the needs of a culture of learning, then what is currently perceived as the challenge of change may become the opportunity for a **renaissance** in higher education in the years ahead.