

Higher Education in the 21st Century

Presentation to the
Naval Personnel Task Force

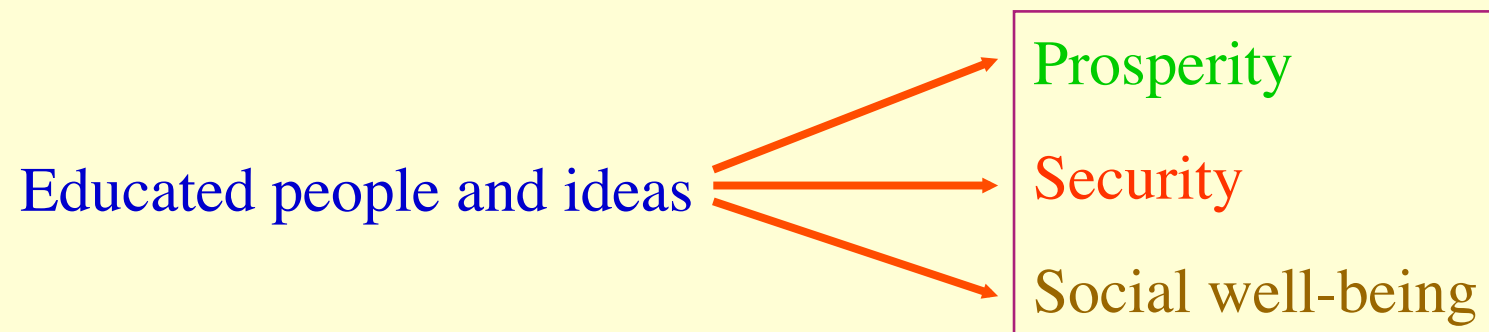
June 2, 2000

Goals of Presentation

Goal: To provide some context for considering the long term human resources and educational needs of the U.S. Navy:

1. The broader educational needs of a knowledge-driven society.
2. The forces driving the restructuring of higher education into a global knowledge and learning industry.
3. The role technology plays--particularly information technology.
4. Some brief comments on the importance of the Naval Postgraduate School to the Navy's future.

The Age of Knowledge



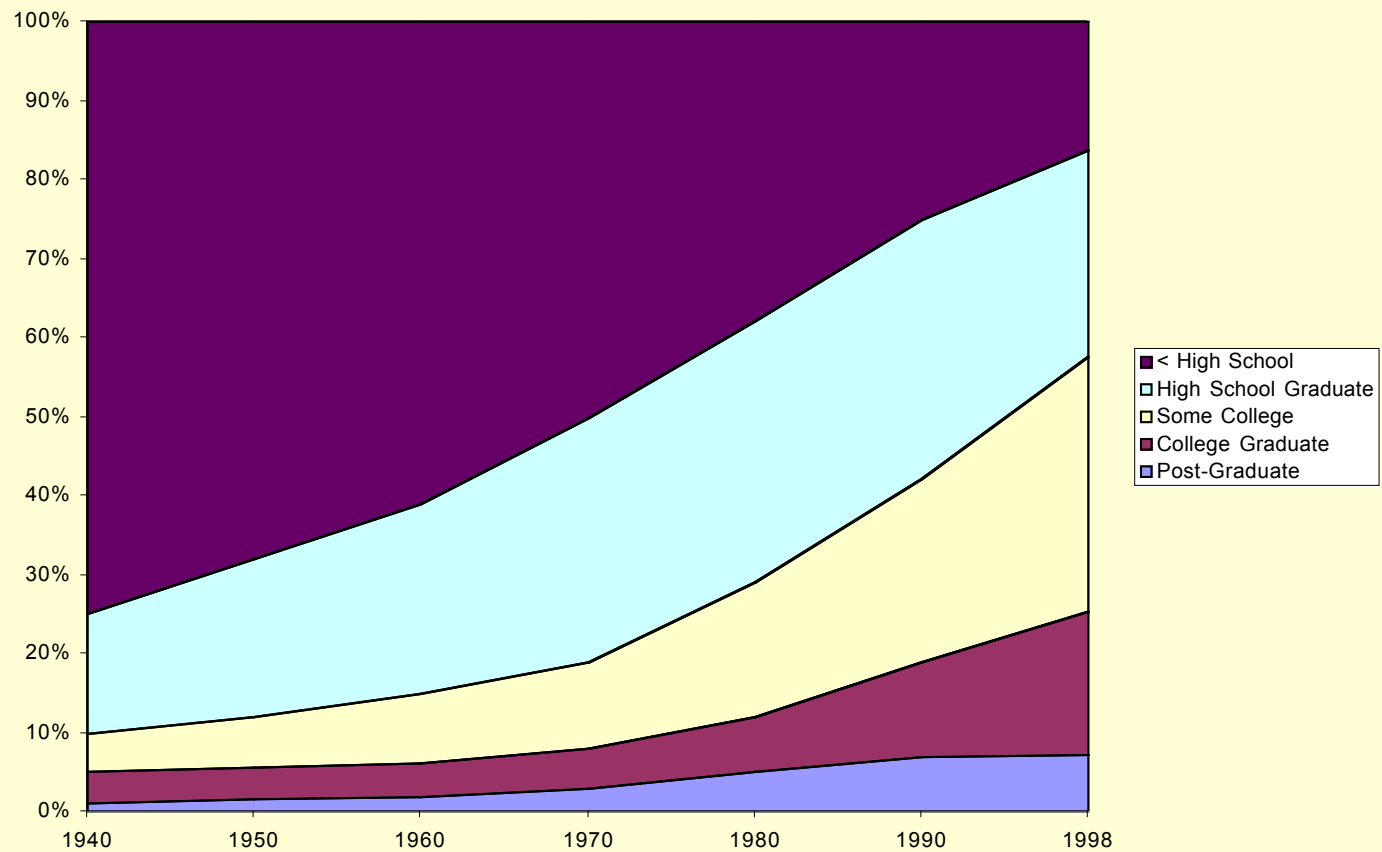
Educated people are the most valuable resource
for 21st societies and their institutions!!!

Some data points

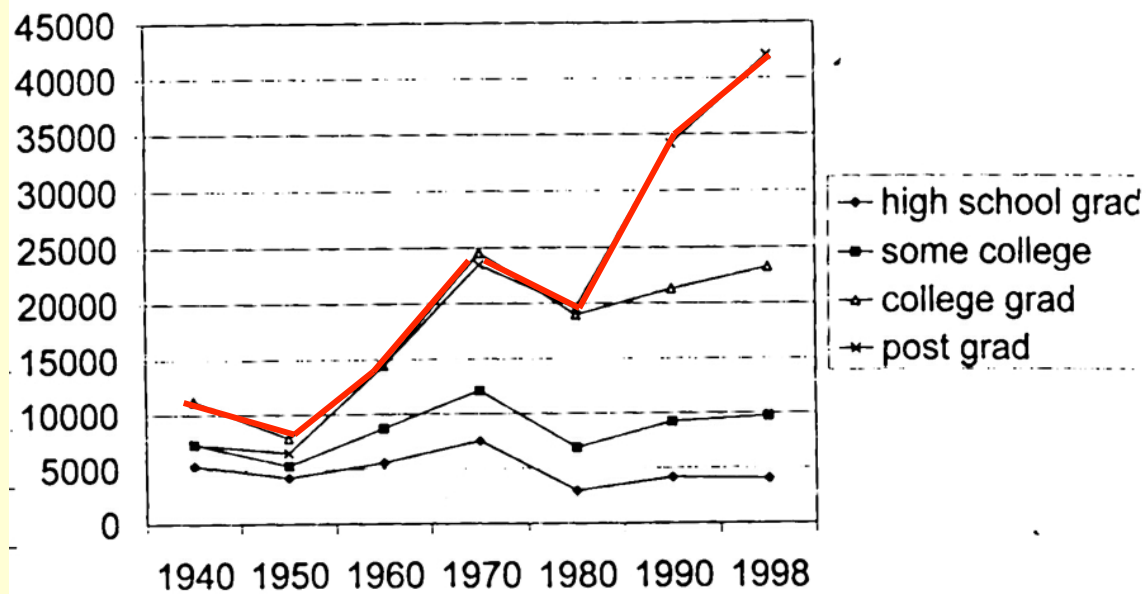
1. 50% of economic growth is driven by **new technology**.
2. 90% of new jobs require college-level education.
3. The single most important factor in determining personal income is the level of one's education, with the most pronounced impact from **graduate education**.
4. Corporate leaders estimate 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

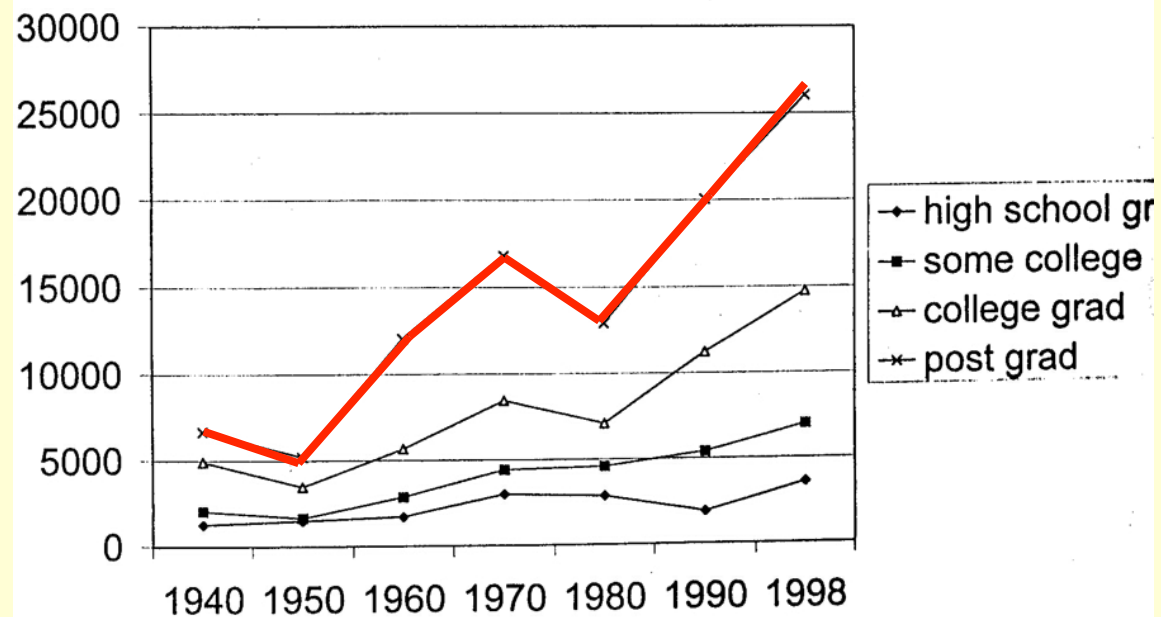
Highest Level of Education Attained by Year



**Figure 10: Monetary returns to education
1940-1998, males**



**Figure 11: Monetary returns to education
1940-1998, females**



Forces of Change on Higher Education

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?



Forces on the University

- 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.

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.

Market Forces

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

The Role of Markets

- 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

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.

United States Higher Education “System”

AAU-Class Research Universities (60)

Research Universities (115)

Doctoral Universities (111)

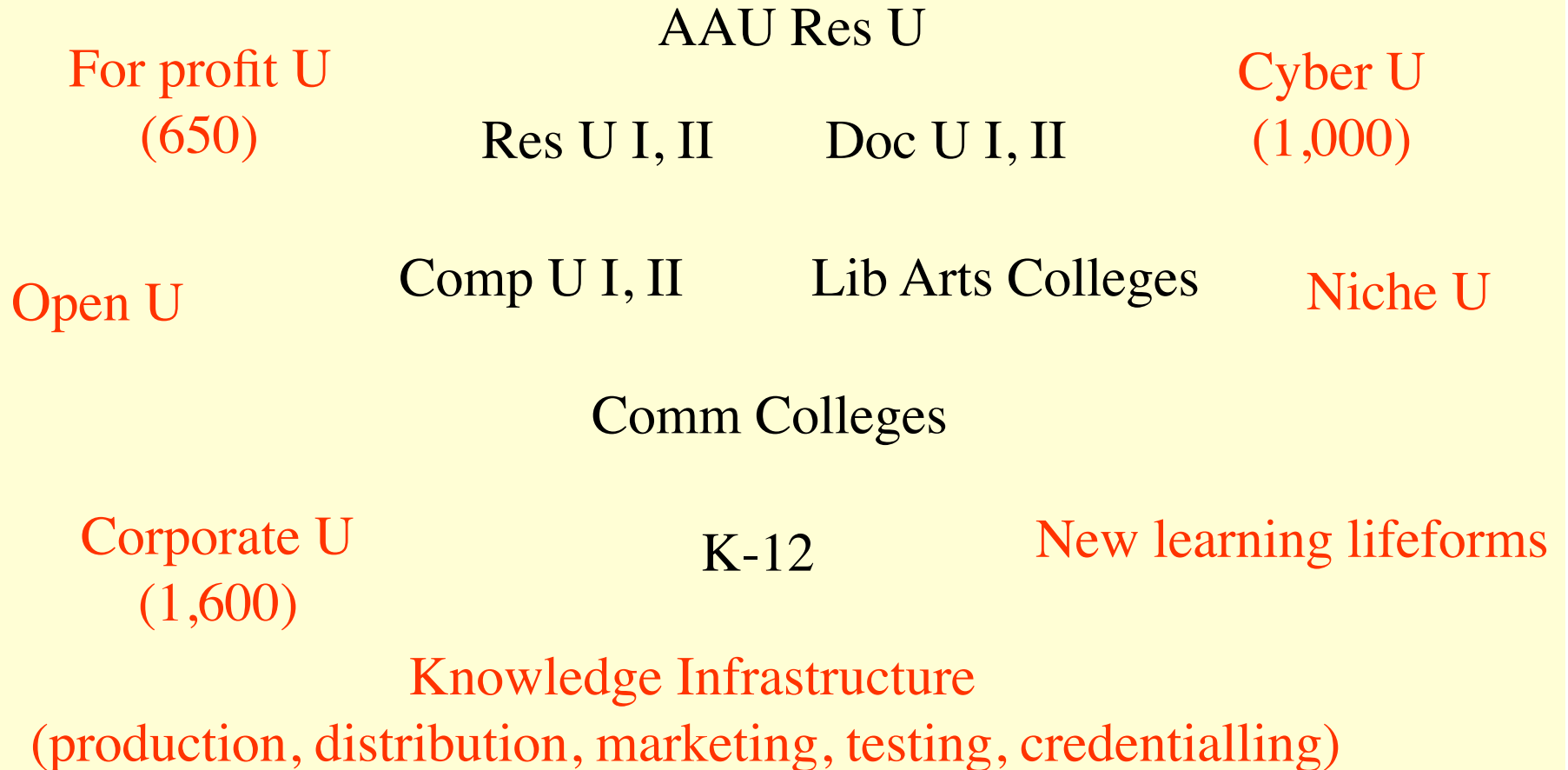
Comprehensive Universities (529)

Baccalaureate Colleges (637)

Two-Year Colleges (1,471)

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

The Evolving U.S. Education System



Some implications

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

A Society of Learning

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

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

Evolution or Revolution?

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.

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*

Information Technology and the Future of the Research University

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.

Implications for Research Universities

Activities: teaching, research, outreach

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

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

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
- Bill Wulf, NAE
- Joe Wyatt, Vanderbilt
- Tom Moss, NAS/GUIRR
- Charlotte Kuh, NRC
- Ray Fornes, NRC

Technology

Education

Staff

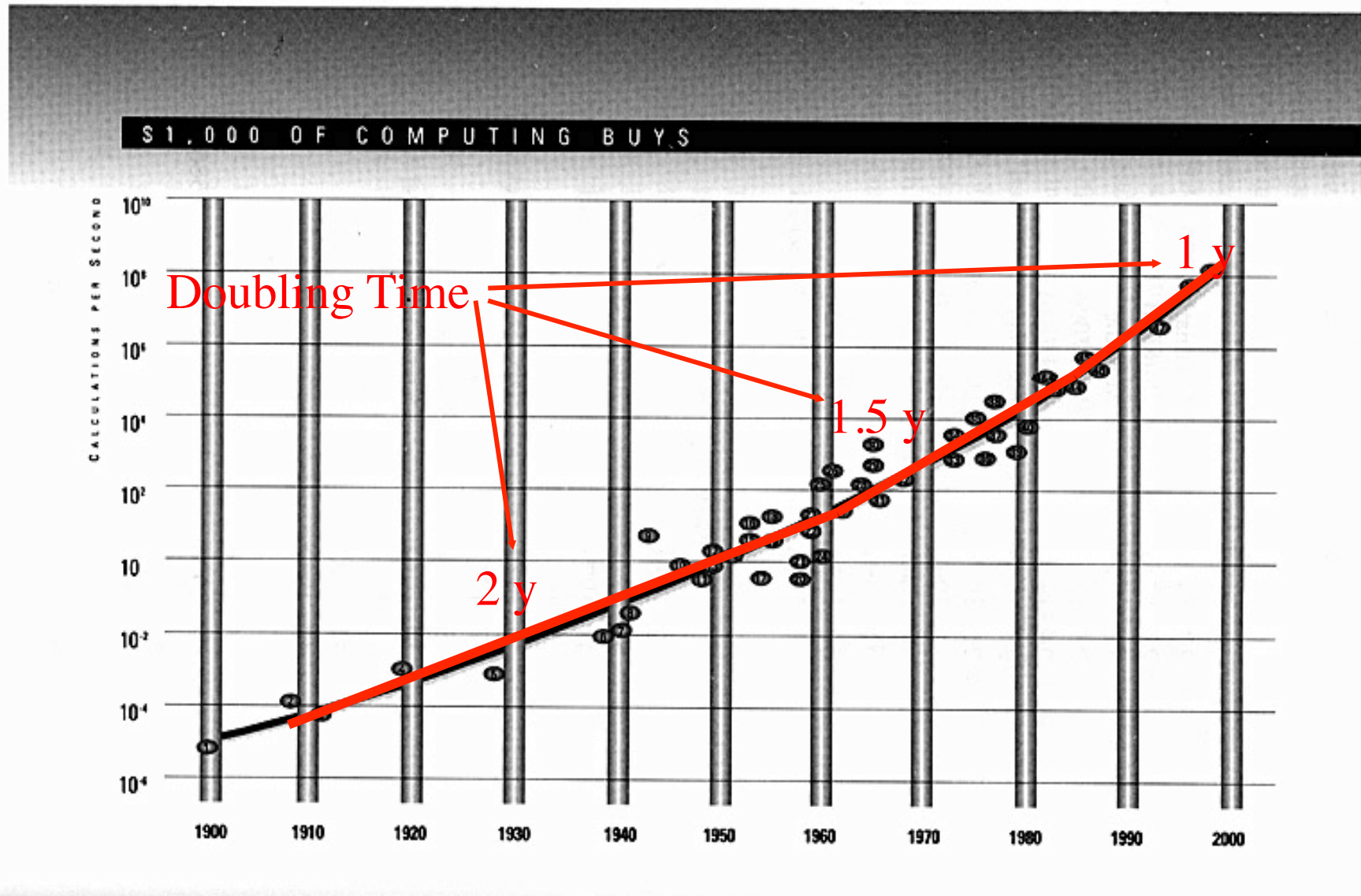
Process

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

The Evolution of Computing



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

- 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

Another Way to Look at It ...

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

- 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

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.

The Plug and Play Generation

- 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

Today's college graduates ...

- Believe that their future will be one of great **uncertainty** in which they will have many careers.
- Realize that the key to their future has become **lifelong learning**.
- Seek careers and employers that can provide them with continual access to **advanced learning opportunities**.

The Importance of the Naval Postgraduate School

1. Clearly, as advanced education becomes a more pervasive need of the high-performance workplace, and as the best college graduates seek careers requiring lifelong learning, employers are under great pressure to provide **graduate educational opportunities**.
2. The fact that the number of corporate “universities” has increased during the past decade from 450 to over 1,600 suggests that most companies are finding that building **inhouse capability** is more advantageous than relying on “outsourcing” educational programs from traditional colleges and universities.

The Importance of the NPS (continued)

3. The Naval Postgraduate School is a **high quality operation**, comparable in the quality of its programs, its faculty, and its students to the best graduate schools. (Note: national rankings such as USN&WR generally focus on faculty research reputations, NOT graduate program quality which depends more in instructional quality.)

4. It is my conclusion, after a brief review of financial data, that the actual academic costs of NPS are quite reasonable, more comparable to the best of the public university graduate engineering programs (U. Michigan, Purdue, U. California) than the most expensive private universities (MIT, Stanford, Caltech).

The Importance of the NPS (continued)

5. NPS provides “customized, learner-centered” programs consistent with most views of the 21st Century university:
- focusing on topics responsive to Navy priorities
 - tailoring programs to the backgrounds and needs of students
 - aligning research activities of faculty with both
Navy priorities and instructional programs

Furthermore, the unique character of the NPS students and academic programs builds the “communities of practice” felt to represent the most effective approach to professional education by educators and researchers (e.g., Xerox PARC).

The Importance of the NPS (continued)

6. NPS is well-positioned to develop and provide the distance learning programs that will be of increasingly vital importance to the Navy (“educating the fleet”).

7. It is important that the Navy track the rapid evolution of advanced educational needs, programs, and technology. NPS, both through its own activities and its relationships with other leading university graduate programs, provides this “over the horizon” perspective of the evolution of the global knowledge and learning enterprise.

The Importance of the NPS (continued)

It is my belief that the Naval Postgraduate School should be viewed as a critical resource for the Navy's future, not only in achieving the skill level that will be required of an increasingly knowledge-intensive armed forces, but furthermore as a vital factor in recruiting and retaining the very best talent from our colleges and universities.

If the U.S. Navy did not already have such a resource, it would likely be compelled to create such an institution, just as most major corporations attempting to compete in a knowledge-intensive global marketplace have learned.