

Higher Education



In an Age of Knowledge

An interesting perspective ...



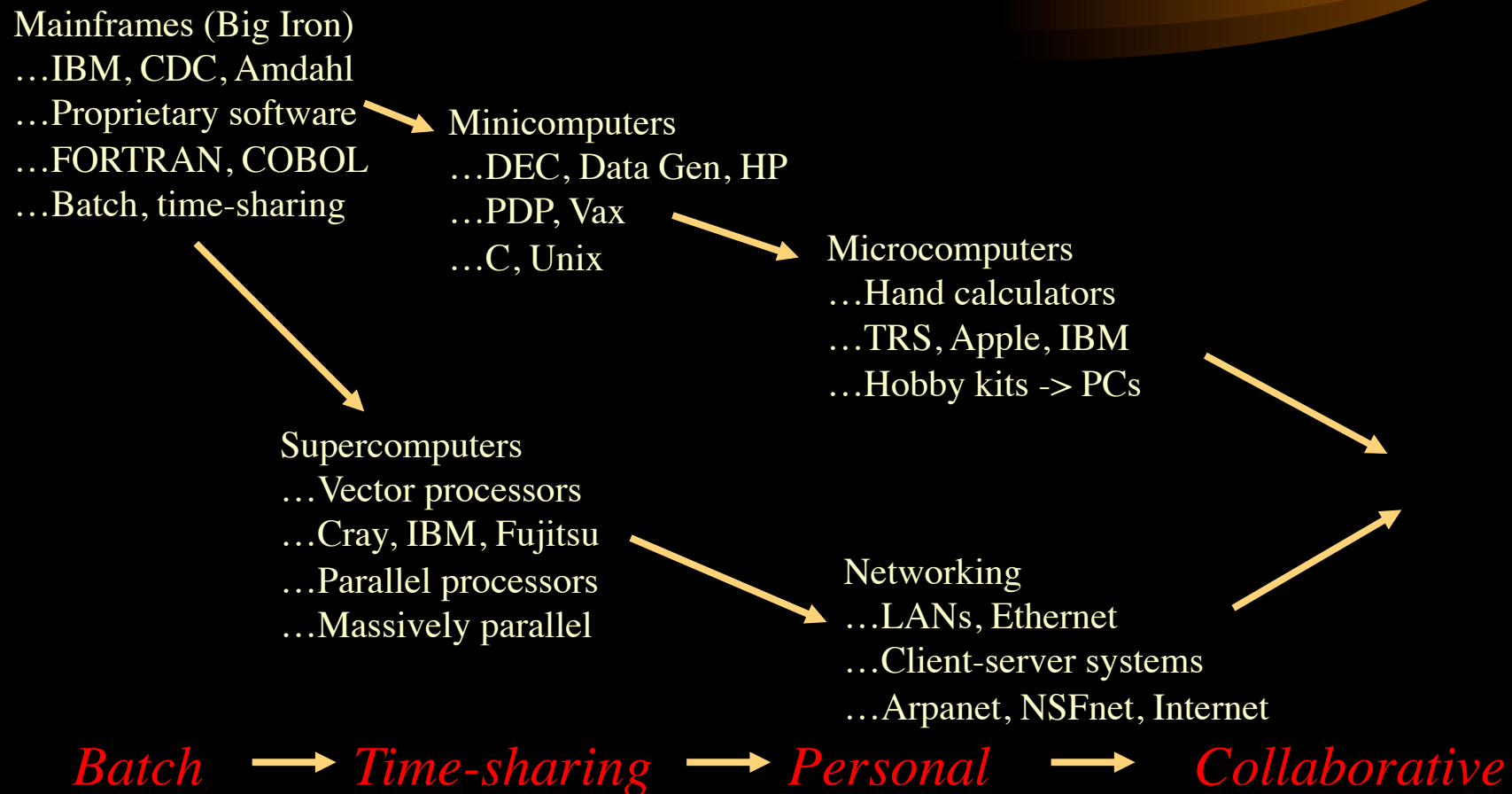
The impact of information technology will be even more radical than the harnessing of steam and electricity in the 19th century. Rather it will be more akin to the discovery of fire by early ancestors, since it will prepare the way for a revolutionary leap into a new age that will profoundly transform human culture.

Jacques Attali, *Millennium*

The Themes of Our Times

- **An Age of Knowledge**, in which educated people and their ideas have become the strategic commodities determining prosperity, security, and social well-being.
- The **global** nature of our society.
- Rapidly evolving **information technology** that reshapes, strengthens, and accelerates the activities of knowledge-driven organizations.
- **Networking**, the degree to which cooperation and collaboration among individuals and institutions are replace more formal structures such as governments and states.

The Evolution of Computers



A Change in Perspective



Moore's Law: The power of computing for a given price doubles every 18 months.

New Law: The power of computing for a given price doubles every year. In 10 years, speed, memory, bandwidth, whatever, will increase by 1,000.

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

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 cellular to Iridium to Teledysec

Some Extrapolation of the PC

	<u>2000</u>	<u>2010</u>	<u>2020</u>
Speed	10^9	10^{12}	10^{15}
RAM	10^8	10^{11}	10^{14}
Disk	10^9	10^{12}	10^{15}
LAN	10^8	10^{12}	10^{15}
Wireless	10^6	10^9	10^{12}

Computer-Mediated Human Interaction



- 1-D
 - Text, e-mail, chatrooms, telephony
- 2-D
 - Graphics, video, WWW, multimedia
- 3-D
 - Virtual reality, distributed virtual environments
 - MUDs and MOOs, avatars, telepresence
 - Virtual communities and organizations

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
- 37 million “hosts” today; 50% growth per year
- Estimates:
 - 100 million people in 2000
 - 1 billion (or more) people in 2005

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 Social Transformation



The 20th Century

Transportation

Cars, planes, trains

Energy, materials

Prosperity, security

Social structures

?



The 21st Century

Communications

Computers, networks

Knowledge, bits

Prosperity, security

Social structures

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

Some Interesting Statistics

- Today's entering UM student
 - 90% enter with 3 or more years of computer experience
 - 60% own a computer (90% will own a computer when they graduate)
 - Spend 15 to 20 hours a week using computer
- The Global Teenager
 - In year 2000 there will be 2 billion teenagers
 - Cellular phones and PDAs are replacing Sony Walkmans
 - They will identify more with their age group than with their ethnicity or nationality, creating a new world culture ...

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!)

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



- 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 Characteristics of the 21st Century University



- Learner-centered
- Affordable
- Lifelong learning (a seamless web)
- Interactive and collaborative learning
- Diverse
- Asynchronous (anyplace, anytime, anyone)
- Ubiquitous (everyplace, everytime, everyone)
- Intelligent, adaptive, and customized

A Time for Experimentation



We came to the conclusion that in a world of such rapid and profound change, as we faced a future of such uncertainty, the most realistic near-term approach was to explore possible futures of the university through **experimentation** and discovery. That is, rather than continue to contemplate possibilities for the future through abstract study and debate, it seemed a more productive course to build several **prototypes of future learning institutions** as working experiments. In this way we could actively explore possible paths to the future.

The Michigan Experiments



- We altered very significantly the racial diversity of our students and faculty, thereby providing a laboratory for exploring the themes of the “diverse university”.
- We established campuses in Europe, Asia, and Latin America, linking them with robust information technology, to understand better the implications of becoming a “world university”.
- We launched major initiatives such as the Media Union (a sophisticated multimedia environment), a virtual university (the Michigan Virtual University), and played a key role in the management of the Internet to explore the “cyberspace university” theme.
- We launched new cross-disciplinary programs and built new community spaces that would draw students and faculty together as a model of the “divisionless university.”
- We placed a high priority on the visual and performing arts, integrating them with disciplines such as engineering and architecture, to better understand the challenges of the “creative university”.
- And we launched an array of other initiatives, programs, and ventures, all designed to explore the future.

Existing Activities and Resources



The Media Union



<http://www.ummu.umich.edu/>

The Millennium Project



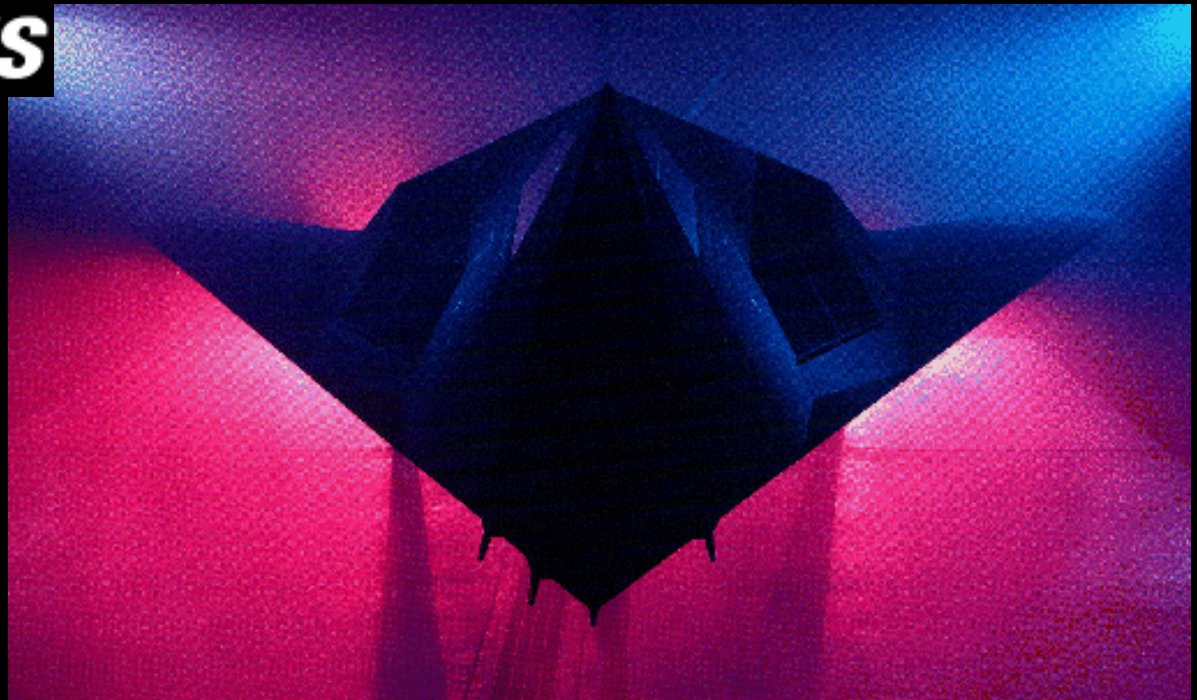
An incubation center, where new paradigms of learning institutions can be designed, constructed, and studied.

<http://milproj.ummu.umich.edu/>

Millennium Project = "Skunk Works"



***The
Skunk
Works***



A Knowledge and Learning Network

