Harsh Realities: Science and Technology Information Caught in a Shifting Paradigm

Presentation to:

National Security and National Competitiveness:
Open Source Solutions - OSS '94
Arlington, Virginia

Presented by:

Bonnie C. Carroll
Information International Associates, Inc. (IIa)
Oak Ridge, Tennessee

November 10, 1994

THESES/CONCLUSIONS

- Nature of Science is Changing
- Technology is Enabling and Confounding
- STI Management is in a Shifting Paradigm
- The Winners Will Provide Less, *But Better,* Information, Not More Data

Scientists and engineers involved in R&D often spend between one-quarter and one-half of their time on information related activities that include both analyzing and reporting on one's own research and searching for and applying the research results of others.

- Helping America Compete
  The Role of Federal Scientific & Technical Information OTA, 1990

SLIDES1:B:\WATTEC92.219

The Electronic World Cannot be Dealt With as a Linear Extension of the Print World

CHANGING USER EXPECTATIONS

1/3 of the population know what the superhighway is

2/3 think it is a good idea

Nature of Science is Changing

Basic Changes in the Structure of Science Itself (1)

- Disciplinary, mission, problem-solving orientations
- Blurring boundaries among science, social science, politics, marketing, ethics
- Specialization but linkages
- New tools and new methods — computational sciences

Basic Changes in the Structure of Science Itself (2)

- Big science, International science
- Increase in commercialization and marketability of science
- Shift from military to industrial R&D
  - Global Politics
- Changing user expectations
  - Computer literacy of next generation
  - User community initiatives

Changing Patterns in Traditional Forms of STI (1)

- Amount of formal documentation and reading decreasing on a per capita basis
- Traditional publishing is changing, if not in major difficulty
- Some evidence that scientists and engineers read fewer journals and spend less overall time reading
  - Fewer articles/books per S&E
  - Less time available for reading
  - Price of published material and cost of acquisition increasing
  - Other routes available like electronic
  - New graduates do not perceive same need for reading

Changing Patterns in Traditional Forms of STI (2)

- Evidence that electronic communications are changing communication patterns of scientists and engineers in two ways:
  - Replaces oral interpersonal communication
  - Replaces formal documentation (e.g., books, journals, technical reports)

    [Raises all of the issues of peer review, intellectual property, etc.]

TECHNOLOGY IS ENABLING AND CONFOUNDING

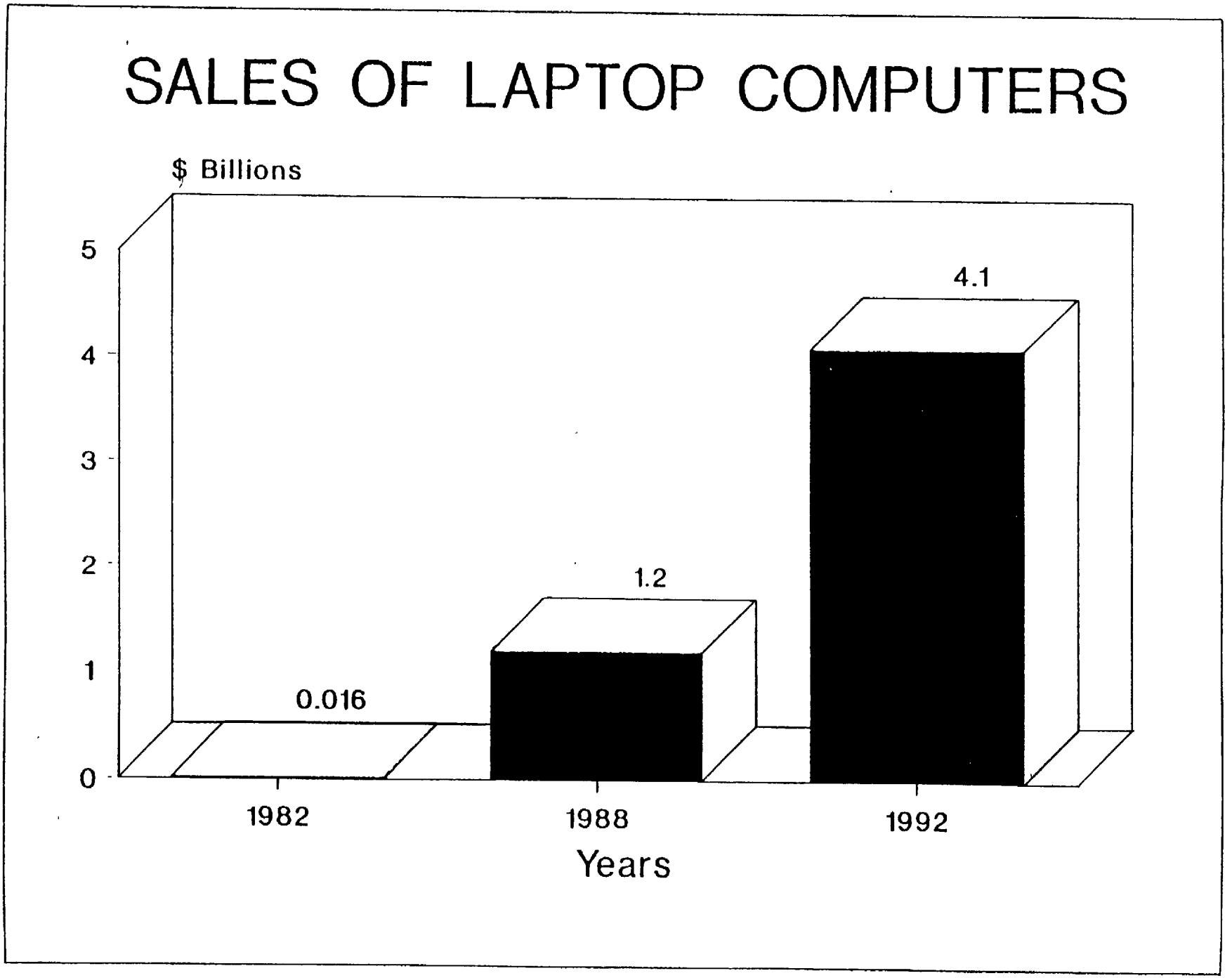
THREE CONVERGING FORCES

- Computing Revolution
- Networking Revolution
- Policy Revolution

RAPIDLY ADVANCING TECHNOLOGIES HAVE OPENED NEW OPPORTUNITIES

"Five years ago, right after the start of the personal computer revolution, industry experts observed that if the automobile business had developed like the computer business, a Rolls-Royce would cost $2.75 and go 3 million miles on a gallon of gasoline."

-- Fortune Magazine
August 1, 1988, p.4


SALES OF LAPTOP COMPUTERS
$ Billions
5
4
3
2
1
0
0.016
1.2
4.1
1982
1988
1992
Years

Palmtops or Personal Information Managers (PIMs) Have Appeared

1991	50M
1993	219M
1997	[387M]

- Handwriting
- Voice Recognition

GROWTH OF THE INTERNET

- **1969**
  ARPANET — First large-scale packet switching network

- 1987
  7 Major Supercomputer Centers

- 1993

1,000	Institutions	
10,000	Networks	*12,000*
1,000,000	Computers	*1,500,00*
10,000,000	Users	*30,000,000*
100	Countries	*137*

- 1987 200M packets/month
  1992 1B packets/day
  1993 *25B packets/month*

3/93 3 Terabytes of traffic

World Wide Web Browser Mosaic Embodies the New Paradigm

- Annual growth rate of WWW traffic is 341,634% (Internet Index by Win Treese [rev. 12/93])
  - 1993: 100 WWW servers
  - 1994: 5,000 with 600/month added
- Mosaic
  - 4 - 6 million users
  - 100,000 copies of client/month
  - NCSA contacted 2.3M times/week
  - 12 - 15 commercial licenses
- Anyone is a publisher
- Everyone is an information navigator

NOAA ESTIMATES VOLUMES OF DATA & HPCC USE

- 15 LIBRARIES OF CONGRESS
- GROW AT THE RATE OF 2 LC'S PER YEAR
- 145,000 REQUESTS/YEAR THROUGH THE NETWORK
- 2000 K-12 SCHOOL PROGRAMS

ELECTRONIC DATABASE GROWTH
Growth
Year

The growing use of electronic devises such as VCRs, answering machines, fax machines, and electronic mail are used because they set the user free from time constraints. Such machines enable constant access to "information space" and will exert increasing influence on daily and business life.

- Japan Information Processing Development Center, "Informatization White Paper" 1991

- **This notation clearly echoes the U.S. statistics indicating increasing time pressures on scientists and engineers.**

"But this embarrassment of riches has created a problem: How can you find anything in that mass of data?" ... Unless you know what you're looking for, you probably won't find it.

- *Science*, Vol. 261, 13 August 1993. p.841, "Beyond Databases and E-Mail"

STI MANAGEMENT IS IN A SHIFTING PARADIGM

"We are surrounded by insurmountable opportunity."

...Pogo

CENDI STI DEFINITION

STI is information that derives from ... research, development, and deployment (RD&D) results of the efforts of scientists and engineers and individuals supporting their work. STI includes new theory and information obtained from experimentation, observation, instrumentation or computation in the form of text, numeric data or images. STI may be further transformed, described, evaluated, synthesized and recorded in print, micrographic, magnetic, optical or other media to enhance its communication and its usefulness and value to a wide spectrum of users and uses.

The interpretation of the STI definition has evolved as science and technology have become an increasingly important part of our everyday lives and in the governance of our nation.

Science has become more integral to national policy and national policy has become more dependent on science and technology.

d:\vgraphs\aprconfer.494

ISSUES IN STI ACQUISITIONS — *EXTERNAL*

- **CHANGES IN SCIENCE**
  - -- **Internationalization**
  - -- **Big Science Cooperation**
  - -- **Growth in Volume of Data**
- **POLITICAL**
  - -- **Changing Face of the Globe**
  - -- **Increasing Importance of Science in Business**
  - -- **Shift from Military to Industrial Competitiveness**
- **TECHNOLOGICAL**
  - -- **Paradigm Shift in Information Access**
  - -- **Decentralized, Uncontrolled Networks**

ISSUES IN STI ACQUISITIONS — *GOVERNMENTAL*

- **Tight Budgets—Leveraging Scarce Resources**
  - **Cutting Acquisitions**
- **U.S. Technology Preeminence (Lack of) & National Competitiveness**
- **Information as a National Resource and International Commodity**
- **National Security and Openness of Communication**
- **International Copyright — A Level Playing Field**

ISSUES IN STI ACQUISITIONS — *STI AGENCY*

- **Blurring Distinctions Among STI, Social, Business, and Political Information**
- **Different Traditions in STI and INTEL**
- **Purchase or Exchange Decisions**
  - **Defining "Quid Pro Quo"**
- **Coping With the "Security Blanket" Mentality of Needing to Have Everything Out There**
- **Understanding User Needs and Values**

ISSUES IN STI ACQUISITIONS — *PERSONAL AND CULTURAL*

- **Changing User Expectations**
- **Language Barriers**
- **Not Invented Here**
- **Value of Information**
- **Information Illiteracy**
- **Privacy and Security Values**

Advances in Electronic STI Processing is Dramatically Changing

1. Electronic Production or Automated Processing

2. Electronic Identification of and Access to Material

3. Electronic Delivery of Information

4. "Computer-aided Analysis" (CAA) and Knowledge Generation

- Forms of Input and Production Impact Form of Delivery
- *Ultimately*, these will be a single, intergrated electronic system.

CHANGING THE PARADIGM IN TERMS OF BOTH INPUTS AND OUTPUTS *

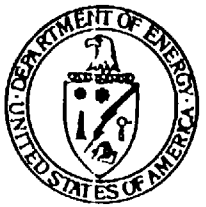
- "Information resource to be defined as a "complex of databases and application software that render these databases accessible.
- "Documents" do not have to exist as files; they can be "virtual" documents generated by a server in response to a query or document name.
- Now, in addition to knowing the structure, indexing, and focus of a variety of print reference tools, they must also have expertise in software packages and data transfer between these packages to help user access needed information.

* *From Huston and Kreitz, Paper given at the 1993 Foreign Acquisitions Workshop, in which they quote other sources.*

STI Managers Must Face the Challenge of Faster, Better, Cheaper Against this Backdrop

- Forming Alliances
  - CENDI
  - IGLWG
- Questioning Functions and Methods
  - "Just in case" to "just in time"
  - Coordinated tiered processing

Commerce



Energy

NASA

NLM

Defense

Information

WHAT IS CENDI?

An interagency group of senior STI managers who have agreed to cooperate by —

- **Exchanging information and ideas**
- **Sharing resources**
- **Undertaking joint initiatives**
- **From policy to standards to operations**

CENDI IS FORMALLY ESTABLISHED UNDER AN INTERAGENCY MOU

- 1973 — Phase out of COSATI
- Mid 1970s - early 1980s — Cooperation on an ad hoc basis
- 1982 — Regular but informal meetings
- 1985 — Formal Interagencies MOU among four agencies
- 1987 — NLM joined through MOU Amendment
- 1988 — Secretariat created
- 1993 — NAIC joined CENDI

CENDI
PRINCIPALS AND ALTERNATES

	Principals	Alternates
NTIS	Don Johnson	Wally Finch
DOE/OSTI	Elizabeth Buffum	Mark Fornwall
NASA	Sylvia Kraemer	Terese Ohnsorg
NLM	Kent Smith	Elliot Siegel
DTIC	Kurt Molholm	Carl Randall
NAIC	Thomas Pedtke	Blaine Baker

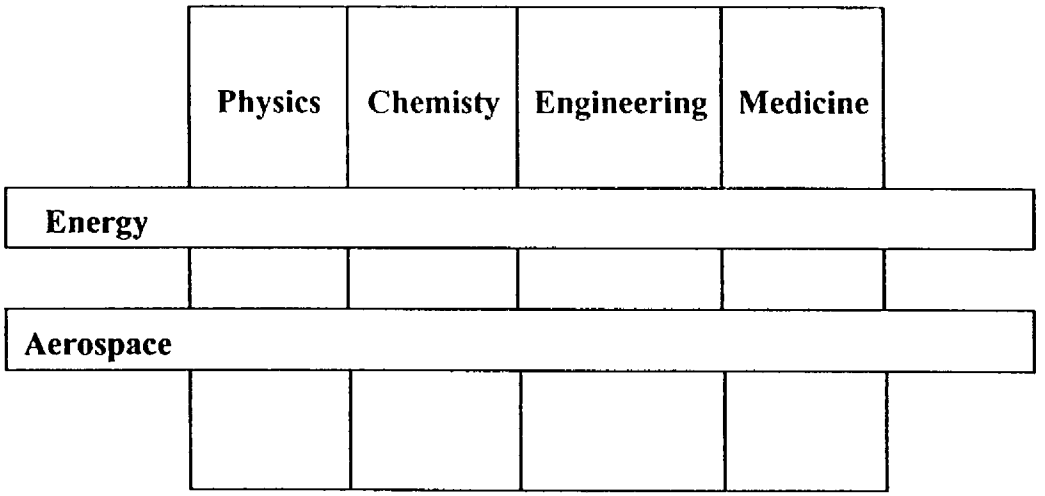
Interagency Gray Literature Working Group (IGLWG)

- Consists of DoD, Intelligence, and civilian agencies interested in cooperating on the collection, management, and dissemination of open source gray literature.

  Chairman - Mike Pounder (FBIS)

Fundamental STI Management Activities are Being Reassessed

- Case for the mission-oriented S&T database



- Need for manual subject analysis (abstracting and indexing) in view of developments in retrieval technology

The Madison Avenue Approach: TECHNOLOGY IS SEXY

- WWW/MOSAIC IS OPENING THE DOOR TO A BROADER USER BASE
  - Promoting senior management interest
  - NASA Langley Technical Report Server Example
- The Administration is Committed
  - NII ⇒ GII
  - Representing Agencies Electronically
  - Technology not content focus

THREE ISSUES OF TECHNOLOGY ADVANCES

- Can't find things
- Can't process all that was found
- Don't know if it's good when you have it

"ONE OF THE MAJOR PROBLEMS ASSOCIATED WITH ELECTRONIC PUBLISHING ON INTERNET HAS BEEN THE LACK OF A CENTRALIZED DISTRIBUTION MECHANISM."

"Until recently, trying to find a particular file at an FTP site has been a bit like looking for a particular book in the Library of Congress without the benefit of a card catalog."

- "Electronic Distribution of Hypermedia on Wide-Area Networking Systems: An Update," T.W. Howard, Technical Communication, Third Quarter 1993, pps. 438-448.

FROM GIGO TO GAGS

GARBAGE IN — GARBAGE OUT

GARBAGE AT GREAT SPEEDS

Traditional Search Quality Metrics or Surfing the Internet

- Recall and Precision
- Any Information
- Some Information
- The Best Information
- All the Information

Challenges of our Networked Society

- Productivity in the Information Age
- Information as a National Resource and International Commodity (Intellectual Property)
- Dealing with the Crisis of Information Overload
- New Issues of Data Quality and Liability
- Personal and Professional Discontinuities in the Information Age

The Winners will Provide Less, But Better, Information, Not More Data

DEALING WITH THE CRISIS OF INFORMATION OVERLOAD

- Irony Of Information Age Is Not A Problem Of Scarcity
- Science (8/12/83) Article Shows That Information Availability Is Increasing More Rapidly Than The Ability To Absorb It
- Due To Effectiveness Of Electronic Access Systems, Too Much "Relevant" Information Is Identified
  - Need the right information at the right time
- With Technological Advances, The Problem Will Be Magnified
- Algorithms For Quality Discriminations Are Not Yet Developed
- This Is A Task That Will Impact Success Of Future Information Systems

The Information Overload Problem is Not New, but the Actors Have Changed

- 1963 Weinberg Report was Major Review Proposing Solution
- Evaluation for Precision and/or Comprehensiveness
- Who are Evaluators? What is the role of Information Professional?
  - Information Analysis Centers
  - New Category of Researcher who does Analysis and Synthesis
  - Never Fully Reached Envisioned Goal
  - Reward Structure Inappropriate
  - May See Some Change in Marketplace
  - Advances in Technology not Fully Anticipated

THE NEED FOR THE NEXT GENERATION SYSTEM --
1978 National Science Foundation Report "*Passing the Threshold Into The Information Age*"

- **Transition From Information Systems To Decision Support**
- **Forces Are Both Technological Push - User Pull**
- **Move From Passive To Active Systems - Extend Intellectual Power**
- **Needs Of Our Age Are In Crisis Management And Decision Making**
  - **Need to integrate STI and societal information (STSI)**

THE NEED FOR THE NEXT GENERATION SYSTEM --
1989 National Academy of Sciences Report
"Information Technology and the Conduct of Research"

- **Need For Interconnected National Information Technology Network**
- **New Information Infrastructure**
  - **Stores information in forms accessible**
- **Provides Means Of Communication**
- **Aids In Information Manipulation To Create New Insights & Knowledge**
- **Provides Human & Computer Assistance, i.e., "User Friendly"**

"Infory" Of The Future

- **"Distributed" in physical sense**
- **Professional career structure to identify & respect**
- **Dissemination of reliable, personalized software**

"NATIONAL ACADEMY OF SCIENCES STUDY ON INFORMATION TECHNOLOGY AND THE CONDUCT OF RESEARCH: A USERS VIEW"
CONCLUSIONS

- **Information technology has changed the conduct of research**
  - **on the whole, led to improvements**
- **Widespread use of technology not without problems**
  - **technological, financial, complex institution and behavioral constraints.**

THE RELATIONSHIP OF HUMAN V.S. MACHINE ANALYSIS IN THE NEW INFORMATION ARCHITECTURE WILL BE AN INTERESTING MARRIAGE

- Development of a digital library system with expert system "knowbots"
- Use of computer-aided tools such as visualization, expert systems
- A reemergence of the concept of the information analysis center

DIGITAL LIBRARIES are More Than Just Digitizing Books in Libraries

- We don't understand them yet.
- A common definition and standards of practice are evolving — R&D
- We may be reinventing wheels

A Digital Library is a combination of software tools, content, and hardware infrastructure which allow for ingestion, storage, management, and retrieval of information.

- Systems Research Associates via NAIC
(Tom Pedke)

LIKE THE BIBLIOGRAPHIC SERVICES FOR THE PRINT WORLD, WE NEED TO FIND NEW TOOLS IN THE ELECTRONIC WORLD

• Technological	Knowbots
• Government Tools	GILS
• Bottoms Up Efforts	Archie, Gopher, Veronica, Mosaic

Visions of the Future

- Apple's Information Navigator
- Star Trek

In the paleo-electronic world, predator / prey relationships are rapidly reversing.

- **Print world talks of "food for thought"**
- **Networked world users will be the prey and information is the predator**

- Paul Peters, Talk at NASA Third Annual Foreign Acquisitions Workshop, September 23, 1993

THE NEW INFORMATION ARCHITECTURE IS NOT ONLY A TECHNICAL FIX -- INITIATIVES RAISE MANY NATIONAL POLICY ISSUES

- **INTELLECTUAL PROPERTY**
- **PUBLIC PRIVATE INTERFACE**
- **COST/PRICING**
- **EQUITY OF ACCESS (RICH/POOR, NORTH/SOUTH)**
- **STANDARDS & INTEROPERABILITY**
- **QUALITY OF INFORMATION**
- **FREE ACCESS VS CONTROL**

Model for Developing Future Strategies in STI Management

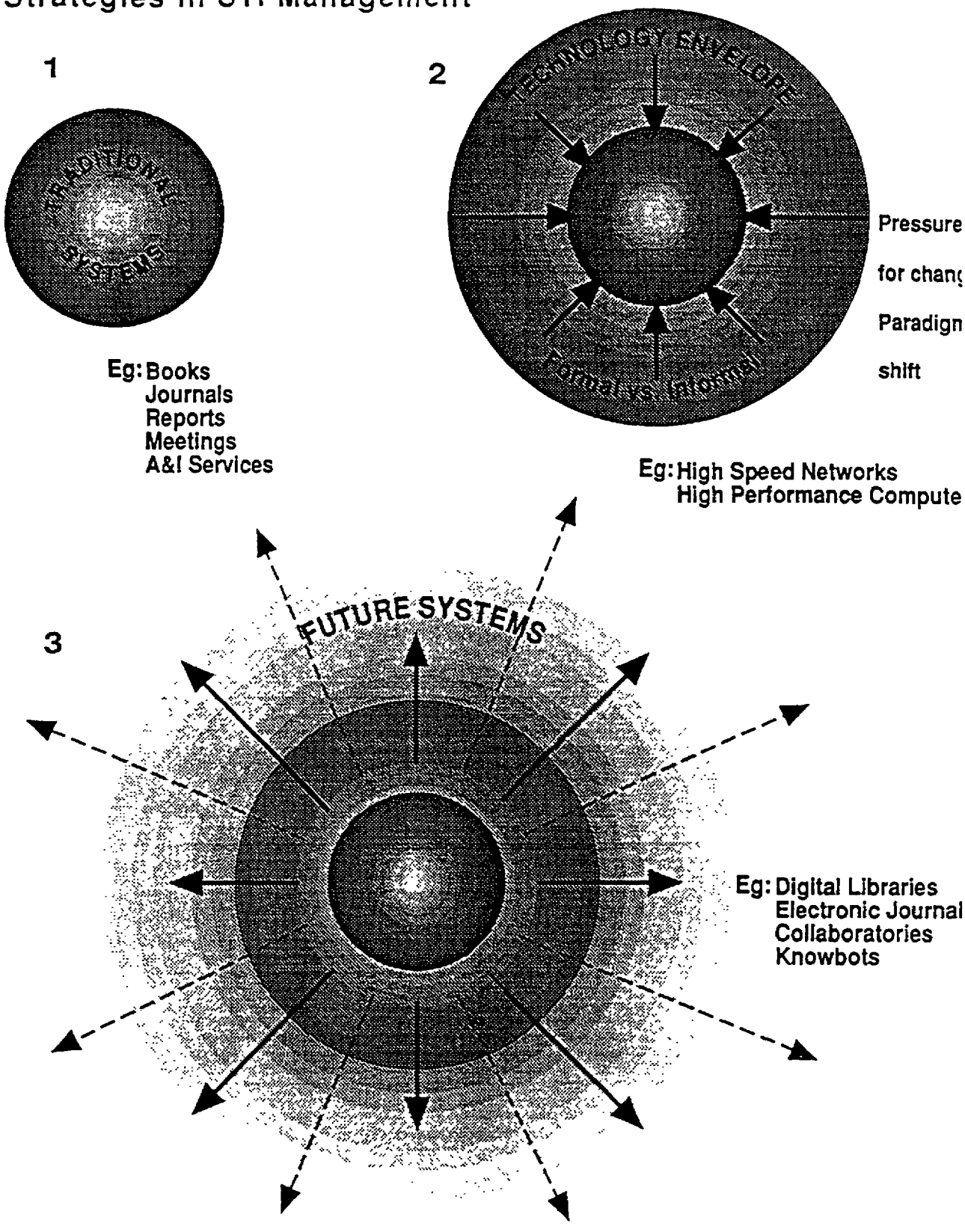


FIGURE 1.

QUESTION OF THE MONTH ON INTERNET (1993):

In What Month will the Number of Bytes Run Through the Internet Exceed the Number of Atoms in the Universe?

THIRD INTERNATIONAL SYMPOSIUM on NATIONAL SECURITY & NATIONAL COMPETITIVENESS: OPEN SOURCE SOLUTIONS Proceedings, 1994 Volume II - Link Page

Previous	OSS '94 Douglas Bernhardt, 'I want it fast, factual, actionable'--Tailoring Competitive Intelligence to Executive Needs,
Next	OSS '94 Nicholas Chantler, Queensland University of Technology, Producing Intelligence in Australia: How a National Open Source Foundation Might Serve National Security As Well As National Competitiveness,

Return to Electronic Index Page