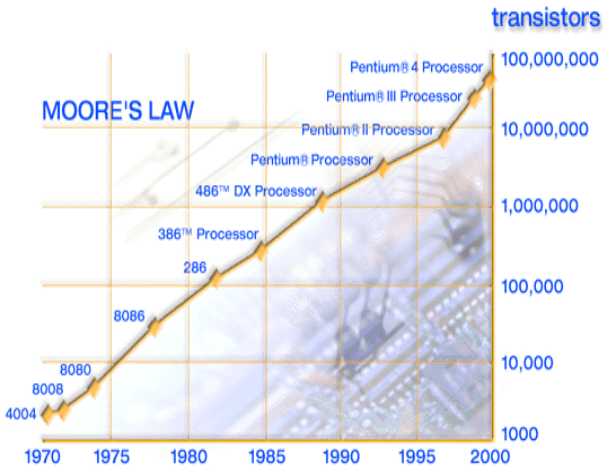
TCU Environmental Scan—TECHNOLOGY

Introduction

The technology environment is constantly changing. This situation is not characterized merely by the IT infrastructure, but increasingly by the content, uses and users that it supports. This premise is true across a broad spectrum of industries and organization types. It is highly applicable to the university setting. Frequently, Moore's Law has been used to predict the rapid change in information technology.

Gordon Moore, one of the now famous founders of the Intel Corporation, made an observation in 1965. He predicted exponential growth in the number of transistors on each inch of integrated circuits. He said that number would double every year for the next twenty years or so, after he made his observation. In fact, the average time for increases in numbers of transistors and the attendant increases in processing speeds has been about eighteen months, instead.



[1]

As a consequence of this rapid change in the engines that drive many physical pieces of technology, technology proponents have extended Moore's law to cover many more aspects of technology than merely the density of transistors in circuits on a chip. For example, as chip speed and capacity increases, various technological components such as the available models and features of cellular phones and PDAs changes; these changes seems to occur nearly every six to twelve months.[2] The rate of change in many areas of technology has shrunken to less than a year in some cases.

[1] Graphic available at www.intel.com/research/silicon/mooreslaw.htm
[2] Available at www.intel.com/research/silicon/mooreslaw.htm and www.webopedia.com/TERM/M/Moores_Law.html

The computing era began over fifty years ago. It morphed into the information age, as more uses for computers were found, and transformed further into the Internet age in the 1990's. As Brown and Duguid point out in their book, *The Social Life of Information*:

> "Even those people who continue to resist computers, faxes, e-mail, personal digital assistants, let alone the Internet and the World Wide Web, can hardly avoid taking advantage of the embedded microchips and invisible processors that make phones easier to use, cars safer to drive, appliances more reliable, utilities more predictable, toys and games more enjoyable, and the trains run on time. Though any of these technologies can undoubtedly be infuriating, most people who complain want improvements, not to go back to life without them.
>
> Nonetheless, there is little reason for complacency. Information technology has been wonderfully successful in many ways. But those successes have extended its ambition without necessarily broadening its outlook. Information is still the tool for all tasks. Consequently, living and working in the midst of information resources like the Internet and the World Wide Web can resemble watching a firefighter attempt to extinguish a fire with napalm."[3]

Information technology (IT) is a term that is broadly applied across multiple areas of activity in an organization. Generally, it includes most of an organization's electronic and digital elements, both assets and functions. Various technologies, whether they support manufacturing, scientific research, administration, automobile maintenance or entertainment, generate data that becomes information. Data and information have become the fuel that drives all types of activities. Information technology contains the tools that help the organization progress and achieve its mission.

Over the last fifty or so years, various predictors have presented views on the impact of technology on everyday life. These predictions have ranged from the rapid pace of change, such as that cited above in terms of Moore's Law, to the "intelligent" computers depicted in many pieces of cyber literature, both fictional and non-fiction. Developers and designers are working towards intelligent computers, larger networks that can handle unimaginably large sets of data and computer/human interfaces that are becoming intimately connected to the user, such as wearable computers and biological interfaces.

> "It has been more than a decade since the contents of the New York Public Library were actually in New York. Their exact location is now classified, but this has not reduced -- rather , it has enhanced -- user access.
>
> Donald Hogan sat among 1235 other people any or all of whom might be consulting the same book or magazine as he was at any given instant."[4]

In 1968, the preceding quotation was basically fantasy, speculation and futuristic thinking. At the present time, it has become a near reality. As one source stated, "…we are still very much in

[3] John Seely Brown and Paul Duguid. *The Social Life of Information*. Boston, Harvard Business School Press, 2000.

[4] John Bruner, *Stand on Zanzibar*, Garden City, NY, Doubleday, 1968, n.p.

the Information Age."[5] In fact, information **content** is growing exponentially every year. In their report, *How Much Information? 2003*, researchers at the University of California, Berkeley estimated that there has been an overall, worldwide increase in the creation of "original" information of 69% from the previous year.[6] In this study, the researchers considered information stored in print, film, magnetic and optical media that is accessed through telephone, radio, TV and the Internet. The results of their work confirm that:

- We are living in the **information age**,
- There is an **information explosion**, and
- There is validity to the concept of **information overload**.

US Internet Users' Opinions Regarding the Ease of Finding Information that they search for online, by category, September-October 2002 (as a % of respondents*)[7].

Category	Always Find Information	Mostly Find Information
News	41%	46%
Commerce	29%	56%
Health	28%	48%
Government	20%	51%

Note: n=1,318 internet users. * respondents who have sought information in each category

The world of technology is populated by acronyms and 'techno-speak". Such terms as wi-fi, IM, XML, RFID and "open source" are part of the ever changing vocabulary that describes the technology landscape, as are such terms as infrastructure, architecture and, of course, ubiquity. All of these words are associated with elements of IT's physical and logical manifestations, as well as other related resources, and the funding and management of the totality. Additionally, nearly every source of information on technology futures and the challenges that organizations face include such terms as standards, information storage and retrieval, security, and collaboration.

In the introduction to a report entitled, *Digital Economy 2003* from the U. S. Department of Commerce, the writer noted that information technology has become integrated into and been involved in transforming numerous elements of the socio-economic dimensions and daily activities of our lives. She points out that these infusions range from the use of computers to support such research as the human genome project to the increased reliance of the business community on computing and related technologies for their on-going operation and growth,

[5] "That's why we use lots of acronyms". *CFO, The Magazine for Senior Financial Executives*, Winter 2003, Volume 19, Issue 5, p. 11.
[6] *How Much Information? 2003*, Compiled by Peter Lyman and Hal R. Varian (Senior researchers), Kirsten Swearingen (Project coordinator), and : Peter Charles, Nathan Good, Laheem Lamar Jordan, Joyojeet Pal (Researchers), Berkeley, CA, Regents of the University of California, 2003 (release date October 27, 2003). Available at: http://www.sims.berkeley.edu/research/projects/how-much-info-2003/
[7] Source: *Pew Internet & American Life Project*, December 2002

including e-commerce activities. Most importantly, she describes how individuals have become dependent on technology, as noted below:

> "Like any new technology, the capabilities made possible by IT are accompanied by challenges that must be resolved in order to fully realize its benefits. (Chapter 7.) As individuals, we are now able to access a vast amount of data. However, many issues remain with regard to searching, archiving, and controlling or limiting access to certain information. New management challenges accompany new means of interaction, such as e-commerce and e-business processes (e.g., business-to-business data exchange). And, finally, issues related to identity—from identity theft to privacy and rights to anonymity—intersect with almost all IT capabilities."[8]

[8] Sabrina L. Montes "Introduction: Information Technologies in the U.S. Economy". *Digital Economy 2003*. Washington, D.C., U.S. Department Of Commerce, Economics and Statistics Administration. December 2003. P. 7.

Information Technology and Higher Education Today

In the recent past and continuing into the near future, most IT concerns in institutions of higher education have been focused on the acquisition, management and maintenance of the physical infrastructure – hardware, software, wiring, networks, computers, information systems (administrative and academic), etc. These elements of the technology environment comprise the basic tools of a technology-based institution. For example, the characteristics that describe some of these elements for organizations like TCU (i.e. doctoral institutions of higher education) are depicted below:

Sample Characteristics Of Information Technology In Colleges And Universities[9]

IT Organization, Staffing, Planning
By types of institution, survey covered reporting lines, titles, staff size, student employees, support to both faculty and students, planning activities and types of campus IT advisory groups and the composition of those groups.

Characteristic	All	Doctoral
IT Organization, Staffing, Planning		
% Top IT Administrators in President/Chancellor's Cabinet	43.6%	49.3%
% IT FTE staff in central IT for selected functional areas		
Academic/research computing	5.6%	6.5%
Administrative systems	18.5%	20.6%
Public help desk	6.3%	4.3%
Campus strategic plan includes strategies and directions for IT	77.6% – Y 22.4% - N	73.1% – Y 26.9% - N
Stand alone IT strategic plan	72.0% – Y 28.0% - N	76.9% – Y 23.1% - N

IT Financing And Management
By types of institution, survey covered the types of funding sources, amounts and expenditures for information technology, including summary inventory data, professional compensation and technology fee structures.

Characteristic	All	Doctoral
IT Financing And Management		
Median Amounts of funding for Central IT organization	$3,743,000	$17,901000
% of campuses charging general technology fees	50.2%	59.0%
Number of computers on campus		
Mean	4,116	11,596
Median	1,578	7,450

[9] Extracted from: Brian L. Hawkins, Julia A. Rudy and Joshua W. Madsen. *EDUCAUSE Core Data Service, 2002 Summary Repor*t. Boulder, CO, EDUCAUSE, 2003.

Faculty and Student Computing
The focus of this part of the survey was on services and support provided by the IT organization, including classroom technology, faculty technology training, student owned computers, and course management systems support.

Characteristic	All	Doctoral
Faculty and Student Computing		
Help Desk availability		
# hrs/week help desk is available	66.5 hrs	82.5 hrs
% campuses having 24X7 support	4.7%	13.4%
% institutions issuing e-mail accounts to all students	85.8%	91.0%
% classrooms equipped with various technologies		
Wired Internet connectivity	81.5%	78.6%
Wireless Internet connectivity	17.7%	20.7%
% students in private institutions, using their own computers on campus	70.1%	83.7%

Networking and Security
Survey covered speed and bandwidth available, videoconference capability, remote access, VOIP, PKI and other authentication methods, web services, firewalls, security management, including policies and procedures.

Characteristic	All	Doctoral
Networking and Security		
Status of web services technology		
Deployed	57.2%	77.6%
Piloting	2.9%	3.0%
In progress	12.9%	6.7%
# Selected Firewalls on campus		
At external connection	77.6%	50.7%
Around certain high security servers or networks	48.6%	75.4%

Information Systems
Covered ERP systems and associated costs, as well as other institution-wide systems, development and implementation methods, vendors used, age of large systems and replacement cycle.

Characteristic	All	Doctoral
Information Systems		
% selected Major information systems installed, and (expected to be replaced in next three years)		
Student information systems	99.0% (27.5%)	100.0% (38.1%)
Financial information systems	98.7% (20.1%)	100.0% (29.1%)
Development systems	77.9% (15.1%)	86.6% (20.1%)
Library information systems	88.7% (15.1%)	88.1% (9.0%)
Course management systems	91.8% (13.0%)	95.5% (11.9%)
Selected Status of web portal development		
Implemented	27.4%	35.1%
In process	18.4%	23.1%
Planning	39.5%	30.6%
No plans	14.8%	11.2%

The characteristics cited above are a sampling of the IT concerns of colleges and universities. Both EDUCAUSE and The Campus Computing Project conduct surveys and accumulate data, annually, about the technology environments of higher education organizations. These instruments have a retrospective view, and any forward projections arising from the results generally span a short time horizon of three to five years. Though there other data collection activities performed by various consortia, collaborations and the like, these two sources are the major and most visible ones.

> ***Regarding TCU:***
>
> *In its recent technology plans and reports, TCU Information Services has addressed many of the issues noted above, including making improvements to administrative systems, piloting wireless implementations, supporting experiments with various distance learning and other instructional technologies, extending information security capabilities and drawing attention to funding and staffing concerns.*

As part of their 2003 data collecting activities, both two organizations have compiled lists of the issues that are considered to be most important to information technology organizations in colleges and universities. These are the concerns that will have a potential impact on the information technology environments of those institutions in the near future. The areas of interest include the following items.

The EDUCAUSE list is a hybrid that summarizes the overall findings. The annual current issues survey displays information by question and by type of institution.

From the EDUCAUSE Top 10 Current Issues[10]. Concerns of IT management requiring resolution for strategic success

IT Funding Challenges
Administrative/ERP/Information Systems
Security And Identify Management
Maintaining And Upgrading Network And IT Infrastructure
Faculty Development, Support And Training
IT Strategic Planning
Web Services/Web-Based Systems
Distributed Learning/Teaching And Learning Strategies
Enterprise Level-Portals
Online Student Services

This summary from The Campus Computing project report reflects the major sections of the findings from the survey.

[10] Grant Crawford, Julia A. Rudy and the EDUCAUSE Current Issues Committee. "Fourth Annual EDUCAUSE Survey Identifies Current IT Issues". *EDUCAUSE Quarterly*, Number 2, 2003. Pp. 19 – 26

From the Campus Computing Project's 14th Annual Survey[11]. Extracted from response to the survey questions.
Copyright And Campus Codes Of Conduct Wifi Competing Priorities Course Management/Learning Management Software Faculty Recognition And Reward For Technology Integration Portals Ecommerce/Eservices Infrastructure And Budget

Both of the preceding lists are composed of responses that have been provided by campus IT management from the participating institutions. It is obviously, and for good reason, conscientiously devoted to the physical technology environment and the near future time frame. In both instances the statistics have been gathered to support decision making and are often used to justify resource requests by providing benchmarks with other similar types of institutions.

However, information technology is much more than the infrastructure and its supporting elements. Over time, more attention will be paid to the content that is either created or managed using the technology, as well as those uses and the users of the technology. Some of this changing emphasis is implied in the concerns listed above as faculty development, support and training, faculty recognition and reward for technology integration, competing priorities and distributed learning/teaching and learning strategies.

"At its heart, the information revolution is about transformation—transformation of the very structures and processes by which the economy works."[12]

[11] Kenneth C. Green *Campus Computing 2003, The 14th National Survey Of Computing And Information Technology In American Higher Education*. Encino, CA, The Campus Computing Project, December 2003. pp. 3 – 11.

[12] W. Brian Arthur. "Why Tech Is Still The Future: It seems almost irresponsible to say so, in this sober post-bubble age. But the information revolution really is leading us into decades of prosperity". *Fortune*, November 24, 2003, Volume 148, Issue 11. P.119.

Information Technology and Higher Education In the Future

In the commercial world, a variety of new categories of information systems and manipulation tools have arisen because of the information explosion. Though some have been around for many years, many of them had not been commercialized to the extent that they are now. They include such things as:

- Business intelligence systems to analyze and structure data.
- Knowledge management systems to help organizations sort, classify, access and retrieve knowledge-based material such as documents, web sites, etc.
- Improved natural language processors to support information inquiry and retrieval.
- Content management systems to help manage the creation and distribution of intellectual content, including web site content, records, documents, and other digital assets.
- Collaborative systems that support real-time interaction between individuals, including instant messaging, chat software, online meetings, information and application sharing, and a variety of communication methods.

These technological trends represent changes in the for-profit workplace that can be applied to the academic arena. All types of organizations are working toward ways to use these tools to provide services to their users in a secure way that protects privacy and confidentiality.

In a special section on information technology in its January 30, 2004 issue, *The Chronicle of Higher Education* highlighted "10 Challenges for the Next 10 years". The topics on this list were:

- Collaboration: Seeking Tools That Are Easy To Use
- Wireless Networks: Looking For Reliability
- Managing Bandwidth: Packet Shapers Control The Flow
- Distance Education: Keeping Up With Exploding Demand
- Fund Raising: Managing Data Is A Key Task
- Big Systems: Living With Fewer Customizations
- Course Management: Colleges Push For An Open Approach
- Security: Threats Will Get Worse
- Archiving: Ensuring Storage Space And Access
- Intellectual Property: Digital-Copyright Law Is Ripe For Revision[13]

According to the article, during the last ten years, IT spread across the campus. The focus of the next ten years will be improvements in the management and use of IT, and its support of the transformation of higher education. The challenge will be for the IT function of the institution to keep pace with and manage the needs and desires of its constituents, as it seeks to help them use

[13] "10 Challenges for the Next 10 years". *The Chronicle Review, Information Technology, The Chronicle of Higher Education, Section B*, January 30, 2004. Pp. B1, B3.

the technology efficiently and effectively. Several of thee areas of demand on institutional and resources and energy are considered below.

Teaching and Learning

> ***Regarding TCU:***
>
> *TCU instituted the Center for Teaching Excellence at Texas Christian University (www.cte.tcu.edu)in 1998. The center helps faculty and others to integrate "effective teaching/learning methodologies and technologies into instructional environments; it includes e-Learning at TCU (www.elearning.tcu.edu). In addition the Center for Instructional Services (222.cis.tcu.edu) helps faculty to deliver instruction effectively, and provides both training and assistance in instructional design.*

Teaching and learning are the reasons for the existence of institutions of higher education. Among the most important aspects of information technology in higher education will be support for new ways of teaching and learning. The traditional lectures and other conventional modes of teaching are expected to continue to exist for some time. However, both the growth of distance education and the integration of technology assisted learning and digital enhancements to courses with on-line components have accelerated the need for more of the kinds of tools described above. This change has been corroborated by the emergence of Blackboard and WEbCt as the current universal tools for course management.

In the chapter entitled "The Research & Learning Landscape", the OCLC environmental scan refers to this hybrid e-learning environment as "one of the disruptive innovations in education", while acknowledging that its use has grown throughout the academic world.[14] Disruptive technologies, for example, give people direct access to products or services that previously had been inaccessible to the mainstream. In addition, a technology that is considered disruptive is expected to be simple to use and straightforward. Consequently, it appeals to the masses, as it demystifies something that previously was hard to understand. Though considered to be disruptive in some fashion, e-learning meets these criteria in multiple ways and provides a means for greater enhancements in education, as well as for encouraging life long learning.

Among the differences between old style learning and the new approaches will be increased collaboration, as previously noted. Many institutions, including TCU are moving toward supporting student work in teams and groups, information sharing through instant messaging and weblogs, use of digital learning objects, and extended inter-campus faculty collaborative activities. The growth of the "centers" concept, where institutions implement writing centers, math centers and other academic support mechanisms to help students achieve, is dependent upon information technology in many ways. Further, both faculty and students are seeking opportunities to form communities of interest to share information and pursue common goals. As more life long learners become part of various campus communities, technology will need to be available to support adult learning styles.

[14] "The Research & Learning Landscape" in *The 2003 OCLC Environmental Scan: Pattern Recognition.* Dublin, OH, OCLC Online Computer Library Center, 2004. Available at www.oclc.org/membership/escan/default.htm

Finally, both digital games and gaming theories and methods are being integrated into the learning environment. Additionally, a recent article in the New York times highlighted the efforts of several individuals to create a formal field of study on the topic of video and computer games. Games can be used to build skills. In addition, a large number of students are accustomed to video games and simulators. Over time, these kinds of tools will become more prevalent in university settings across a wide range of disciplines.

Higher education can use technology to reconstruct teaching and learning at all levels. For example, the e-Portfolio concept has been growing in the higher education community within the last few years. Portfolios of student work have been used in the K-12 arena for much longer. In colleges and universities as concerns about student achievement, changes in methods of assessment and interest in providing students with a more holistic experience have grown, the use of portfolios has become more accepted. In some institutions, portfolios are required. Generally, portfolios provide students with a way to store and preserve their experiences in the academy both inside and outside of the classroom. They may create and store presentations as part of their course work, develop materials that help them get internships, or fellowships, prepare resumes for seeking employment, or work on projects for community service activities. Often integrated with portal capabilities, electronic portfolio management tools have recently become available and will continue to expand in prominence in the academic technology environment.[15] Since nearly as much learning takes place outside of the classroom as inside, the use of various technologies, including all of the various aspects mentioned above, will provide the student with a more meaningful experience than the conventional lecture/lab course, alone.

Content Management

> ***Regarding TCU:***
>
> *TCU has recognized the need for and begun to explore the types of content management tools described below.*

Closely associated with the changes in tools used for teaching and learning is the concept of content management. A content management system is a type of computer application that has the capability to process unstructured and/or semi-structured data, as opposed to a data base that provides defined structures for holding data and information. Content management systems overlap in functionality with those technologies that are called knowledge management applications; and they are closely integrated with collaborative software. Content management tools are becoming more important in higher education because of the sheer volume of unstructured data and information produced in such an environment. The ability to capture, store and maintain this type of information, as well as to make it more accessible adds significant value to it. As with all technologies, a content management system will only be as good as the material that is put into it.

In the future, content management tools will be the norm, rather than the exception for managing information from documents, web sites, video and other multi-media sources. As improvements

[15] Trent Batson. "The Electronic Portfolio Boom: What's it All About?" *Syllabus*, December 1, 2002. n.p. Available at: www.syllabus.com/article.asp?id=6984

in retrieval tools grow, more natural language processing technology will make it easier extract information and knowledge from these sources. In addition to information management, some content management applications can be used to help organizations manage the creation of content, including handling work flows, approvals, and controlling versions. In the future, these types of tools will be used to help institutions improve management of important records and preserve their historical resources. The overall objective of content management will be to integrate the management of disparate sources of intellectual and organizational content in a comprehensive way.

"Open" Everything

Though the copyright and intellectual property discussions continue, more institutions are seeking ways to share the results of scholarly work in a more open way and to provide their students with readily accessible, on-line materials to support their studies. One of the trends though which institutions hope to achieve this desire to share knowledge, information and data is the move toward open systems and tools that support sharing. In his article, "The Next Wave: Liberation Technology" that was featured in *The Chronicle Review* in January of 2004, John Unsworth of the University of Illinois Graduate School of Library and Information Science, noted, at the start of the article, that the technology environment has moved from the "e-" decade of the 1990's to the "open-" decade of the 2000's, with many types of institutions in the educational and not-for-profit sectors, as well as in the for-profit arena supporting open source, open systems, open standards, etc.[16] The "open" environment includes:

- Tools and standards for developing systems that can be interoperable and compatible,
- Ways to open up information to a broader community that was formerly available only to a particular and narrowly defined society, and
- Means for scholars in different institutions to collaborate on projects in much more efficient and effective ways than have previously been available.

He notes that the Human Genome project is an example of the "open-" concept applied to a function in the real world of scholarship.

The concept of "open-ness is growing". In the commercial world, open standards are the key to interoperability. An article on open standards entitled, "The fortune of the commons. Open standards – information technology. Industry overview", notes that: "The controversy points to a more general problem … where to draw the line between the IT commons and the areas where firms should compete with proprietary technology". However, the article goes on to point out that the boundaries need not be rigid and that open standards will, most likely, be driven by market forces.[17]

[16] John M. Unsworth, "The Next Wave: Liberation Technology". *The Chronicle Review, Information Technology, The Chronicle of Higher Education, Section B*, January 30, 2004. Pp. B16, B20.
[17] "The fortune of the commons. Open standards – information technology, Industry overview". *The Economist* (U.S. version), May 10, 2003, Volume 367, Issue 8323. n.p.

From A Google Search
Web Definition: **Intellectual Property** - Property that enjoys legal protection and stems from the exercise of the mind. Includes patents, trademarks, copyright, design protection and some minor rights.[18]

As implied by the second bullet point above, the "open" concept can be applied to intellectual property, as well as the hardware/software environment. The issues with respect to content in the "open" environment are influenced by laws and regulation. The issues revolve around ownership, rights, permissions, credit for producing the intellectual property, etc. The related concerns range from downloading of copyrighted music and video content to whether or not an institution recognizes scholarly work published on the web, rather than in paper-based journals.

Such organizations as the Creative Commons are working toward alternatives to conventional copyright. As stated in a description of the institution found in the FAQ (Frequently Asked Questions) section of the web site:

> **What is Creative Commons?**
>
> Creative Commons is a non-profit corporation founded on the notion that some people may not want to exercise all of the intellectual property rights the law affords them. We believe there is an unmet demand for an easy yet reliable way to tell the world "Some rights reserved" or even "No rights reserved."… For whatever reasons, it is clear that many citizens of the Internet want to share their work -- and the power to reuse, modify, and distribute their work -- with others on generous terms. Creative Commons intends to help people express this preference for sharing by offering the world a set of licenses on our Website, at no charge.[19]

Another well-publicized example of openness is the MIT OpenCourseWare web site. The site is open and available to anyone who has access to the World Wide Web. According to MIT, one of the key purposes for this set of material is to "Create an efficient, standards-based model that other institutions may emulate to openly share and publish their own course materials." [21] The site opened in September 2002 and the number of courses posted has grown since then. However, the intellectual property issues have remained one of the most difficult aspects of the project both in terms of gaining permissions to use copyrighted materials and in protecting the intellectual property rights of MIT faculty contributing to the site.[22]

Another, related example can be found in the Networked Digital Library of Theses and Dissertations that has been reviewed by TCU. This effort has been under way since the late 1980's. Its initial purpose was to help graduate students understand electronic publishing and to provide a venue for digital publication of theses and dissertations. It supports "authoring,

[18] Source: www.lawyerlocator.co.uk/glossary.php3
[19] Source: Creative Commons, FAQ at creativecommons.org/faq
[20] Source: Creative Commons, FAQ at creativecommons.org/faq
[21] Source: MIT OpenCourseWare at ocw.mit.edu/OcwWeb/Global/AboutOCW/about-ocw.htm
[22] Lisa Currin. "MIT's Double-Secret Hidden Agenda". *E-Learn Magazine*, March 2004. Available at www.elearnmag.org/

indexing, archiving, retrieving an dissemination of electronic theses and dissertations worldwide. NDLTD's goal is to improve graduate education by encouraging students to produce electronic documents, use digital libraries and understand publishing issues."[23]

The intellectual property discussions, similar to those experienced by the organizations described above will not be resolved simply or quickly. The need for faculty, students and institutions to understand and adopt digital document capture and management will continue to grow. These and many similar concerns will, however, shape and impact the creation and distribution of intellectual content in all types of institutions for some time.

In this "open" atmosphere, institutions of higher education will need to re-think how they configure and manage their own technology environments when using open products and standards. By their very nature, these products and services are malleable and require a more structured approach to programming and customization than is usual in the academic technology world. At the same time, the overall cost of ownership is lower than for many commercial tools; and it may be both faster and cheaper for the institution to develop new applications.

The Internet and the World Wide Web

While there are many aspects to an organization's technology environment, one of the most pervasive elements is the Internet in the form of the World Wide Web. According to one source, the Web has seven basic themes that draw users. They are that:

- It is **hyperlinked** (plug in anywhere, not sequential or linear)
- It is **decentralized** (no real controls, not hierarchical)
- It runs on **hyper time** (Internet time, the clock does not dictate Internet use)
- It supports **open, direct access** (nothing between the user and the information being sought)
- It contains **rich data** (complex organization to present information)
- It is always **broken** (as defined by Beriners-Lee, i.e., never really complete)
- It is **borderless** (don't know where the boundaries are, no limits).[24]

These features, along with a significant amount of commercial hype have attracted people to the Internet since it "went public" as the World Wide Web, around 1993 – 1994 with the introduction of Mosaic, followed by the first version of the MS Internet Explorer[25]. Some of the results of the growth of this information medium are shown in the table below.

---

[23] From the Networked Digital Library of Theses and Dissertations (NDLTD) web site *About the Conference* on web page of ETD 2004, "Distributing knowledge worldwide through better scholarly communication" available at www.uky.edu/ETD/ETD2004/

[24] Rick Levine, Christopher Locke, Doc Searles, Davie Weinberger. *The Cluetrain Manifesto: The end of business as usual*. Cambridge, MA, Pegasus Publishers, 2000. P. 125- 127.

[25] Both of these were the early browser software that changed the way that users gained access to the information on the Internet.

America's Online Pursuits: Summary of Findings at a Glance
Close to two-thirds of Americans now go online to access the Internet; the growth in penetration slowed dramatically over the course of 2002, but has inched up slightly in 2003.
Internet use still differs significantly across some demographic groups.
Email continues to trump all as the most popular use of the Internet.
Information-seeking activities have grown across the board since 2000 – most by 50% or more.
As the online marketplace has matured, financial and transaction-based activities have grown more than any other type of online pursuit.
Online Americans continue to explore new hobby and entertainment activities on the Internet.[26]

In the introduction to the environmental scan report, entitled. *The 2003 OCLC Environmental Scan: Pattern Recognition*, the On Line Computer Library Center (OCLC) stated that: "Whatever benefits to personal lives, the ubiquity and ever-present nature of the Web and the billions of pages of content accessible in this matrix are both a boon and a bane."[28] For higher education institutions, this statement is most certainly true. The web is one of the key pieces of the technology and information milieu. For the institution, management around such an unmanageable, yet critical resource is just one of the many challenges presented by information technology.

Web Services

Web services have become more and more pervasive in the academic world, and will continue to build in the future. Web services allow an institution to automate many of its business processes and deliver services and support to its constituents in ways that had previously been impossible, including 24-hour access to certain functions. Further, web services support e-commerce and other "e-" activities by making these possible via the Internet.

Web services are the tools and technologies that allow web-based applications and information to interact. They generally help to bring together disparate software that has been written in different languages, created by different organizations, etc. Because they use the internet protocols and standards, it is easier for both vendors and users to make the connections; and the IT community, including a number of major vendors, is setting standards for web services. Web services are enabling technologies that support integration of applications across organizations.

[26] Mary Madden and Lee Rainie. *America's Online Pursuits* . Washington, DC: Pew Internet & American Life Project, December 28, 2003
[27] Mary Madden and Lee Rainie. *America's Online Pursuits* . Washington, DC: Pew Internet & American Life Project, December 28, 2003
[28] *The 2003 OCLC Environmental Scan: Pattern Recognition.* Dublin, OH, OCLC Online Computer Library Center, 2004. Available at www.oclc.org/membership/escan/default.htm

Security

Security in the technology environment is a hot topic now and will be for the foreseeable future. In addition to an increased awareness of security issues raised by world events, all institutions must consider their business risks, laws and regulations concerning privacy and confidentiality of data, and other liability concerns that influence their operations. Although Microsoft is moving toward a new version of Windows that is alleged to eliminate the security problems that have plagued that software, its users and most of all IT departments throughout the world will continue to be diligent on security issues. The use of computers and networks to engage in criminal activity, and authentication and identification issues are closely tied to network concerns, especially those in the wireless arena; and there will continue to be unique security threats and challenges to the cyber environment.

Traditionally, information security has been focused on technical issues. It has usually been the responsibility of the institution's technology organization to establish security and implement the procedures. However, with the infusion of technology throughout the organization, information technology security has become a concern and responsibility of the broader institutional leadership. Universities and colleges are expected to demonstrate exemplary stewardship of resources and trusted accountability. Based on these needs, ensuring the security an institution's information technology assets will become an essential part of overall institutional management.

The Physical IT environment

> ***Regarding TCU:***
>
> *Through collaborations among such units of the university as Information Services, the University Library, Center for Instructional Technology, and the Center for Teaching Excellence, TCU is continuously seeking to enhance its physical IT environment and to improve services to its constituents. The Information Commons, located in the Library and operated jointly by the Information Services and the Library is an example of this type of collaboration.*

Changes in the physical IT environment are more difficult to predict for the longer term, and the planning horizon in this arena is frequently as short as three years. This situation exists because of the rapid pace of change in technologies, as cited at the beginning of this document. As previously noted, the emphasis for IT management in the future will be on managing information and data and making it easily accessible and useable. Hardware, software and the network infrastructure are part of the physical IT environment.

Technologies and Tools to Watch
• Interactive White Boards • Grid Computing/Parallel Computing • XML (Extensible Markup Language • VOIP (Voice over IP) • CRM (Customer Relationship Management
• Robots and Robotic Devices • P2P (Peer to Peer) Computing

Potential near term hardware changes include such things as hybrid computing devices, cell phones and PDAs that imitate each other, and tablet computers. The proliferation of these types of devices contributes to problems of both managing the security of the enterprise and providing support to the users. Over the next few years, as the market defines what users want in these types of devices, vendors will create handheld and hybrid computing tools with which campus IT organizations must be prepared to cope.

Similarly, network technologies change constantly with faster servers, new monitoring software and other management tools. One of the short term areas of work for institutional IT organizations are the concepts of "single sign-on" and overall identify management. These physical elements are part of the overall information security environment, using such tools as LDAP (Light Directory Application Protocol) and, ultimately, PKI (Public Key Infrastructure) to ensure authenticity. According to the EDUCAUSE core data report, "over half of all campuses currently have LDAP deployed…There are significant differences with this technology deployment with more than 75% of doctoral institutions having LDAP deployed, while only 40% of baccalaureate institution have deployed this technology"[29]. PKI is not yet widely used, as there are many aspects of it that are still in development. Managing these areas helps an institution maintain privacy and confidentiality of both personal and institutional information. From the perspective of the security management concerns, the institutional network is the greatest target for threats and is susceptible to the most vulnerabilities of any physical element of the organization.

With respect to the network, wireless technology will be both a near-term and a future consideration. The term, wireless, applies to many things, such as wireless networks, cell phones, RFID (radio frequency identification). Yet, the use of such tools should be based in clear, specific business needs in situations where it makes sense to do so. Wireless networks are becoming more widespread on college and university campuses, generally based on the culture of such institutions. IN many cases, wireless networks help the institution expand capacity for network access to the campus community. Some parts of the commercial world have embraced wireless technologies for the computer, the most well known of which is called Wifi. Wireless computing provides a degree of freedom to the user by releasing the user from the plug in the wall. Until recently, wireless has networking has been the exception, rather than the rule. The

[29] Brian L. Hawkins, Julia A. Rudy and Joshua W. Madsen. *EDUCAUSE Core Data Service, 2002 Summary Repor*t. Boulder, CO, EDUCAUSE, 2003. P. 38.

primary elements about which IT organizations have been most concerned, have been security issues, followed by transmission speed. However, users are accepting wireless for its convenience in spite of the problems.

> "In theory, the latest generation of Wi-Fi gear can move data at up to 54 megabits per second. That's 50 times faster than typical broadband speeds, though hardly anyone ever sees that yet because the wireline Internet connections that feed into a Wi-Fi distribution node rarely approach that velocity."[30]

In addition to providing users more freedom of movement, increasing the efficiency of networks will be another future concern for IT. At the present time, the demand for bandwidth is one of the most important matters that IT organizations face.

Back to the Technical Future – Enterprise Architecture

The notion of architecture has existed for some time in the technology world, usually as a series of separate, but related structures, including the ideas of system architecture, data architectures, network architecture and the like. Lately, however, "architecture" has been viewed through the lens of the total organization or enterprise, and has it has become connected more closely to business strategies than purely to the realm of technology. It is the means to bring all of the elements of information technology together. Enterprise architecture (EA) provides a set of guiding principles that shape how information technology resources and services are developed to meet core requirements. Additionally, it can provide an understanding of how the organization is operating and where improvements can be made. It supports the empowerment of members of the community through the use of technology.

The concept of EA, as it is commonly accepted, is grounded in a highly non-technical foundation. According to leaders in the field, the primary purpose of an enterprise architecture is to support the business strategies of the organization[31]. Organizations that truly align their IT solutions with business requirements will be the successful ones in the future. According to a recent Gartner report[32], "the business architecture removes the artificial distinction between business and IT planning" because it is the means to integrate business needs with the IT environment. An enterprise architecture is a future-oriented concept. EA supports IT planning activities that take advantage of emerging technology, address new requirements, and promote interoperability.

---

[30] "Before Wi-Fi Can Go Mainstream. SPECIAL REPORT: WI-FI'S GROWING PAINS." *BusinessWeek Online,* February 18, 2004. Available at www.businessweek.com:/print/technology/content/feb2004/tc20040218_4891_tc140.htm?tc

[31] Paraphrased from R. Evernden. "The information framework. (John Zachman's framework for information systems)". *IBM Systems Journal*, March 1996 Volume 35, Number 1. P. 34.

[32] Alexander Drobik. "Enterprise Architecture: Far Too Important to Be Left to the IT Team". *GartnerG2 Report* (Rpt-0702-0130), July 2002.

Conclusion

In the 21st century, information and its uses are more intertwined than at any other point in history. As a consequence, more cooperation and integration are required between and among organizations that were independent in the past. As technologies evolve, there will be new organizational structures and different ways of working, including some of those mentioned in this document. Of special interest to colleges and universities will be opportunities for research partnerships, expansion of interactive computing and communications systems, information and data sharing, broad-based knowledge management, and innovative teaching and learning strategies. For example, the growth of Internet2 will provide opportunities for such things as large file transfer capabilities, improved network quality of service, increased sharing of interactive learning and training activities, as well as greater cross-organization collaboration. In addition, other consortia and collaborative activities will contribute data and information that can be shared and used across many projects. As these workplace changes occur, the institution will need to provide leadership and coordination to support creativity and encourage this new environment.

"The computer aspect is really only one-tenth of anything we do -- the other nine tenths is figuring out who does which jobs, how to work well across different departments, how to use and monitor your data, and on and on. ..."

References For Technology Section of Environmental Scan

References For Technology Section of Environmental Scan

NOTE: Items preceded by and asterisk, "*" were **cited directly** in the Technology document.

*"10 Challenges for the Next 10 years". *The Chronicle Review, Information Technology, The Chronicle of Higher Education, Section B*, January 30, 2004. Pp. B1, B3.

2002 Best Practices for Electronically Offered Degree and Certificate Programs. The Higher Learning Commission, North Central Association. - http://www.ncahigherlearningcommission.org/resources/electronic_degrees/

2003 Forum Futures. EDUCAUSE and Forum for the Future of Higher Education, 2003.

Arenson, Karen W. "Students' Data on Web, and N.Y.U. on Defensive". *The New York Times*, January 10, 2004 found online at www.newyorktimes.com

*Arthur, W. Brian. "Why Tech Is Still The Future: It seems almost irresponsible to say so, in this sober post-bubble age. But the information revolution really is leading us into decades of prosperity". *Fortune*, November 24, 2003, Volume 148, Issue 11. Pp.119.

Bash, Lee. "What Serving Adult Learners Can Teach Us: The Entrepreneurial Response". *Change*, January/February 2003. Pp. 32 – 37.

*Batson, Trent. "The Electronic Portfolio Boom: What's it All About?" *Syllabus*, December 1, 2002. n.p. Available at: www.syllabus.com/article.asp?id=6984

*"Before Wi-Fi Can Go Mainstream. SPECIAL REPORT: WI-FI'S GROWING PAINS." *BusinessWeek Online,* February 18, 2004. Available at www.businessweek.com:/print/technology/content/feb2004/tc20040218_4891_tc140.htm?tc

*Brown, John Seely and Paul Duguid. *The Social Life of Information*. Boston, Harvard Business School Press, 2000.

*Bruner, John. *Stand on Zanzibar*. Garden city, NY, Doubleday, 1968.

Buchen, Irving H. "A Radical Vision for Education". The Futurist, May-June 2000. Pp. 30 – 34. (pdf)

Carlson, Scott. "A $20-Million Carrot: A university wants faculty member to compete to get into a new high tech building". *The Chronicle of Higher Education,* April 18, 2003. n.p. Available at chronicle.com/free/v49/i32/32a03901.htm

Charp, Sylvia. "Professional development". *THE Journal*, June 2003, Volume 30, Issue 11. Pp. 8.

Chisholm, Ines, Marquez and Jane Carey. "Information Technology Skills for a Pluralistic Society: Is the Playing Field Level?" *Journal of Research on Technology in Education*, Fall 2002, Volume 35, Number 1. Pp. 58-79.

*Crawford, Grant, Julia A. Rudy and the EDUCAUSE Current Issues Committee. "Fourth Annual EDUCAUSE Survey Identifies Current IT Issues". *EDUCAUSE Quarterly*, Number 2, 2003. Pp. 12+)

*Currin, Lisa. "MIT's Double-Secret Hidden Agenda". *E-Learn Magazine*, March 2004. Available at www.elearnmag.org/

**Digital Economy 2003*. Washington, D.C., U.S. Department Of Commerce, Economics and Statistics Administration. December 2003.

Dolezalek, Holly. "Building Better Learners". *Training*, January 2004. Pp. 30 – 34. Available at www.trainingmag.com.

*Drobik, Alexander. "Enterprise Architecture: Far Too Important to Be Left to the IT Team". *Gartner G2 Report 0702-0130*. Gartner, Inc., July 2002.

*Evernden, R. "The information framework. (John Zachman's framework for information systems)". *IBM Systems Journal*, March 1996 Volume 35, Number 1. P. 34.

Funding Information Technology: An EDCAUSE Executive Briefing. December 2003, EDUCAUSE and NACUBO. Available at: www.educause.edu/ir/library/pdf/pub4002.pdf.

Goodyear, Marilu and Beth Forrest Warner. "A Model for IT Policy Development". *College Planning & Management*, January 2003. Pp. 64-65.

*Green, Kenneth C. *Campus Computing 2003, The 14th National Survey Of Computing And Information Technology In American Higher Education*. Encino, CA, The Campus Computing Project, December 2003.

Hanna, Donald. Building a leadership vision: Eleven Strategic Challenges for Higher Education. *EDUCAUSE review*, July/August 2003. Pp. 25 – 28, 30 – 34.

Hansen, Brian. "Distance Learning: Do online courses provide a good education?" *The Congressional Quarterly Researcher*, December 7, 2001, Volume 11, umber 42, Pp. 993 – 1016

*Hawkins, Brian L., Julia A. Rudy and Joshua W. Madsen. *EDUCAUSE Core Data Service, 2002 Summary Repor*t. Boulder, CO, EDUCAUSE, 2003.

Higher Education Trends for the Next Century: A Research Agenda for Student Success. Edited by Cynthia S. Johnson and Harold E. Cheatham. Washington, D.C. American College Personnel Association, n.d. Available from the web site at: www.acpa.nche.edu/seniorscholars/trends/trends.htm

Hitt, John C. "Managing IT Transformation". *College Planning & Management*, December 2002. Pp. 14, 16, 18.

**How Much Information? 2003*, Compiled by Peter Lyman and Hal R. Varian (Senior researchers), Kirsten Swearingen (Project coordinator), and : Peter Charles, Nathan Good, Laheem Lamar Jordan, Joyojeet Pal (Researchers), Berkeley, CA, Regents of the University of California, 2003 (release date October 27, 2003). Available at: http://www.sims.berkeley.edu/research/projects/how-much-info-2003/

Jackson, Shirley Ann. Ahead of the Curve: Future Shifts in Higher Education. *EDUCAUSE review*, January/February 2004. Pp. 10 – 18.

*Jones, Steve, Mary Madden, Lisan N. Clarke, Sabryna Cornish, Margaret Gonzales, Camille Johnson, Jessica N. Lawson, Smret Smith, Sarah Hendrica Bickerton, Megan Hansen, Guenther Lengauer, Luciana Oliveria, Wendy Prindle, and James Pyfer. *The Internet Goes to College: How students are living in the future with today's technology.* Washington, DC, Pew Internet & American Life Project, September 15, 2002. Available at: www.pewinternet.org.

Keizer, Gregg. "The Future Of E-Mail; E-mail is receding into the background and within five years will blend with an even wider range of collaborative functions, according to Ferris Research". *Internet Week*, 2004

Kirkpatrick, David. "Stupid-Journal Alert: Why HBR's View of Tech is Dangerous". *Fortune*, 2003. n.p.

Lau, Linda K. "Institutional factors affecting student retention". *Education*, Fall 2003 Volume 124, Issue 1. Pp126 contains (11 pages).

*Levine, Rick, Christopher Locke, Doc Searles, Davie Weinberger. *The Cluetrain Manifesto: The end of business as usual*. Cambridge, MA, Pegasus Publishers, 2000. P. 125- 127

*Madden, Mary and Lee Rainie. *America's Online Pursuits: The changing picture of who's online and what they do*. Washington, DC, Pew Internet & American Life Project, 28 December 2003. Available at: www.pewinternet.org.

Mayers, Camille M. and Donna L. Schnorr. "Getting it together: effective strategies for University/School partnerships". ***Education***, Fall 2003, Volume 124, Issue 1. Pp. 108(7 pages)

Naidu, Som. E-*Learning: A Guidebook of Principles, Procedures and Practices*. New Delhi, Commonwealth of Learning, Commonwealth Educational Media Centre for Asia (CEMCA), 2003.

National Learning Infrastructure Initiative. *2003 NLII Annual Review, The New Academy*. EDUCAUSE, 2003.

Noerr, Peter. Santa Clara, CA: *The Digital Library Toolkit*. Sun Microsystems, January 2003, third edition. Available at: 222.sun.com/edu.
PriceWaterhouseCoopers. *Technology Forecast 2003 – 2005: The Intelligent, Real-Time Enterprise*. PWC, 2003.

Robyn, Elisa. "Creating Tribes. (creating learning communities)", *College Teaching*, Spring 2000, Mar 22,2000, Volume 48, Issue 2. Pp. 65

Ross, Jeanne W. and Peter Weill. "Six IT Decisions Your IT People Shouldn't Make." *Harvard Business Review*, November 2002, Pp.

Scott, Geoff. "Effective Change Management in Higher Education". *EDUCAUSE Review*, November/December 2003, Volume 38, Number. 6. Pp. 64–80.

Sern, Garret and Wendy Wigen. "Same Issues, Different Packaging" (policy@edu). *EDUCAUSE review*, January/February 2003. Pp. 58-59.

Smith, J.T. "Open Source: Do You Suffer from Open Source Phobia?" *Darwin Magazine, Online Archive*, March 2004. Available at: www.darwinmag.com/read/030104/open.html

Surmacz, Jon. "Numbers: sizing up the new economy. Corralling Content:. *Darwin Magazine*. Available at: www2.darwinmag.com/learn/numbers/number_detail.cfm

*"That's why we use lots of acronyms". *CFO, The Magazine for Senior Financial Executives*, Winter 2003, Volume 19, Issue 5, p. 11

**The 2003 OCLC Environmental Scan: Pattern Recognition*. Dublin, OH, OCLC Online Computer Library Center, 2004. Available at www.oclc.org/membership/escan/default.htm

"The 2003 HBR list: Breakthrough ideas for tomorrow's business agenda". *Harvard Business Review*, April 2003 (Volume 81, Issue 4). Pp. 92-98.

*"The fortune of the commons. Open standards – information technology, Industry overview". *The Economist* (U.S. version), May 10, 2003, Volume 367, Issue 8323. n.p.

*The Internet and the University: 2000 Forum***,** Denver, EDUCAUSE., 2001.

The Internet and the University: 2002 Forum, Cambridge, Forum Publishing., 2003.

"The next big thing? The future of computing". *The Economist (US)*, Jan 17, 2004, Volume 370, Issue 8358. Pp. 52US

Twigg, Carol A. "Improving Quality and Reducing Cost: Designs for Effective Learning". *Change*, July/August 2003, Pp. 23 – 29.

*Unsworth, John M. "The Next Wave: Liberation Technology". *The Chronicle of Higher Education*, January 30, 2004. n.p. Downloaded from chronicle.com/weekly/v50/i21/21b01601.htm

Van Horn, Royal. "Technology: Looking Ahead". *Phi Delta Kappan*, May 2003, Volume 4, Issue 9. P. 715+

Varian, Hal R., compiler The Information Economy: the Economics of the Internet, Information Goods, Intellectual Property and Related Issues. Available at www.sims.berkeley.edu/resources/infoecon/

Vinge, Vernor. "Technological Singularity". *Whole Earth Magazine*, Spring 2003, Volume 111, Issue 3. n.p. Available on line at www.wholeearthmag.com.

Ward, David and Brian L. Hawkins. Presidential Leadership for Information Technology. *EDUCAUSE review*, May/June 2003. Pp. 36, 38 – 40, 42 – 47.

Weatherly, Gail and Randy McDonald. "Where Technology and Course Development Meet". Technology source, November/December 2003. Available at ts.mivu.org/default.asp?show=article&id=951

Weimer, Maryellen. "Focus on learning, transform teaching". *Change*, Sept-Oct 2003, Volume 35, Issue 5. Pp. 48 (7 pages)

Wingard, Robin G. "Classroom Teaching Changes in Web-Enhanced Courses". *EDUCAUSE Quarterly*, Number 1, 2004. Pp. 26 – 35.

Yang, Bijou, Philip Lo and David Lester. "Purchasing textbooks online". *Applied Economics*, July 20, 2003, Volume 35, Issue 11. Pp. 1265 – 1269.

Additional Web Sources

*Creative Commons, FAQ at creativecommons.org/faq

DSpace Federation, DSpace at MIT - dspace.org/index.html

Digital Library Project of the University of California, Berkeley - elib.cs.berkeley.edu/

*Intel (for information on Moore's Law) - www.intel.com/research/silicon/mooreslaw.htm

*Lawyer Locator, Glossary - www.lawyerlocator.co.uk/glossary.php3

*Massachusetts Institute of Technology, MIT OpenCourseWare at ocw.mit.edu/OcwWeb/Global/AboutOCW/about-ocw.htm

NMC (New Media Centers) - www.newmediacenters.org/

*Networked Digital Library of Theses and Dissertations (NDLTD) web site at www.ndltd.org/, *About the Conference* on web page of ETD 2004, "Distributing knowledge worldwide through better scholarly communication" available at www.uky.edu/ETD/ETD2004/

Project Gutenberg - promo.net/pg/index.html

The Berkeley Digital Library SunSite - sunsite.berkeley.edu/

The Berkman Center for Internet & Society at Harvard Law School - cyber.law.harvard.edu/home/

The McLuhan Program in Culture and Technology - www.mcluhan.utoronto.ca/

The Midgard Project, Open Source CMS Framework - www.midgard-project.org/

*Webopedia (for information on Moore's Law) - www.webopedia.com/TERM/M/Moores_Law.html

Wiki Wiki Web - www.c2.com/cgi/wiki?WikiWikiWeb