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Globalizing Business, Education, Culture Through the Internet

the science of future technology

THE WORLD BECAME A SMALLER PLACE IN THE 20TH CENTURY. TRANSportation technology caused physical distances to shrink by several orders of magnitude, and telecommunications technology made terrestrial distances insignificant. The transformation of the world into a global village caused revolutionary changes in the physical and social infrastructure, rivaling those of the industrial revolution. Even the types of jobs people did changed or disappeared, replaced by new jobs that had never existed before. Other results included great changes in society's economic infrastructure.

Computer technology further supports globalization by radically changing the economics of communication, so geographic proximity is even less a requirement for effective collaboration and business interaction. Moreover, globalization of computer technology makes possible new forms of technical and social organization that influence the efficiency of business enterprises as well as the quality of life of ordinary citizens. However, our ability to influence the evolution of globalization depends on our understanding of the technology of globalization and its social implications.

Globalization occurs at both the national and international levels. Infrastructure is initially developed

and regulated nationally, since most use of the telecommunication infrastructure is within—rather than among—nations. However, many of the technical and social questions at the national level are relevant to international globalization, while some issues, such as interoperability among heterogeneous multilingual components, are primarily at the international level. A 1995 report "The Changing Nature of the Telecommunications/Information Infrastructure" [1] by the National Research Council and the Computer Science and Telecommunications Board describes this infrastructure in terms of three elements:

- Production of information in film, video, audio, text, or digital formats
- Distribution media, including telephony, broadcasting, cable, and computer networks
- Reception technologies, including computers, videocassettes, and satellite dishes

Charles Firestone of the Aspen Institute recently suggested that the infrastructure has evolved through three stages corresponding to human infancy, adolescence, and adulthood. During infancy, from the 1930s to the 1970s, infrastructure was developed by such monopolies as AT&T and regulated by the government. Adolescence, or deregulation, allowed private companies to develop efficient information resources through the mechanism of free market competition. Adulthood, today, is concerned with achieving a balance between efficiency and the social goals of equity, liberty, community, and participatory access. As networks become part of the social fabric, tensions are created between individual freedom and privacy and between institutional control and the public good. Such conflicts arise at the global level in the government's desire to institutionalize eavesdropping through such mechanisms as the Clipper chip to help it catch criminals and international terrorists. It arises at a personal level in privacy safeguards against, say, employers reading employee email and network service providers and the FBI reading personal email. Regulation of the Internet, currently focusing on national interests, needs to be modified by international regulations in the face of increasing globalization.

The World-Wide Web is an example of a truly international information infrastructure that evolved from national infrastructures like the ARPANET and made an easy transition from national to global structure thanks to international transmission protocols independent of local languages or national reg-

ALI VIEIRA

ulations. But, today, spectacular growth is straining the Internet's addressing and routing protocols. New protocols are being developed to expand the address space from 32 bits to 128 bits and to anticipate evolution from current computer-oriented applications to mobile (nomadic) computing, networked entertainment, and device control.

International agencies, including the United Nations and the G-7, are turning their attention to global cooperation projects that use the Internet. One of the authors (Yesha) is involved in planning G-7 pilot projects for global interoperability, cross-cultural education, training, electronic libraries and museums, natural resources and emergency management, and global marketplaces for small enterprises.

Commercial Incentives

The technology of globalization is driven by commercial incentives for improving the efficiency of business enterprises as well as by the social concern of improving the quality of life of individual citizens. Electronic commerce is a major component of the emerging global open marketplace for information, goods, and services. That marketplace will soon provide electronic analogs of current practices and financial instruments while protecting the rights of individuals and enterprises and stimulating new uses of information technologies. This digital agora will combine research and technologies from many subfields in computer science as well as the expertise of other disciplines.

Without a simple interface to the digital agora, electronic commerce cannot make significant advances.

The flavor of electronic commerce applications is illustrated by Borenstein's account of First Virtual, a cybercommerce service company existing only in cyberspace during its first 15 months in business [2]. First Virtual is an Internet service company facilitating secure consummation of contracts between buyers and sellers through secure authentication services. The First Virtual experience illustrates how business enterprises can adapt globalization of their organizational and customer-support structures.

A distributed organizational structure makes it more difficult for a company to have informal brainstorming sessions, make presentations to customers, or supervise employees. Such problems can, however, in principle be handled through a combination of electronic and human supervision. Electronic customer service is likewise qualitatively different from service provided through face-to-face meetings, and questions of authentication and security that cannot yet be handled by networks must be dealt with in a special way. Sensitive information, such as credit card numbers, is held in a secure computer repository and need never be sent over the Internet, while nonsensitive agreements negotiated through nonsecure communication can be verified and consummated securely.

The savings to the federal government of shifting to paperless recording, management, and maintenance of business records will be huge, yielding changes in the quality of service and in the quality of life. However, the success of electronic commerce depends on these methods' ability to attract non-computer-literate people to use them with ease. To help them achieve such popularity, we should learn from other areas with mass-market appeal and ease of use, such as cars, telephones, and televisions. All have one thing in common—a simple unified interface, so, for example, drivers can be completely ignorant of how the engine works. Without a simple interface to the digital agora, electronic commerce cannot make significant advances.

Another issue that must be studied in great detail is the social impact on the retail market—today the middleman between the manufacturer and the consumer. For example, disappearing downtown stores have a domino effect on the rest of the downtowns in metropolitan cities, so the impact is felt by restaurants, book stores, and other retailers that depend on people walking in while shopping for clothing and other goods.

Education and the Quality of Life

Education is by many measures the world's potentially largest information industry. Globalization allows new methods of packaging and delivering educational products, partly to enhance traditional methods of knowledge acquisition and partly to impart the new skills and tools needed to educate productive and creative members of the information society. Global access to information changes the

relationship between people and knowledge.

The concept of a traditional education does not fit well with the concept of life-long learning that will be a major requirement and a major change agent in the 21st century. Today's education structure needs an overhaul to accommodate students in large numbers who do not physically attend classes but need to get just-in-time education to perform their jobs. The new student profile is expected to include people with both family obligations and full-time jobs while trying to compete for new jobs for which they lack knowledge or education. Such students could be from all over the world, so the education system must be available 24 hours a day, seven days a week.

Harnessing computers in the service of education is also partly an economic issue. Supplying computers to inner-city schools gives teachers an effective tool for expanding their students' views of the world while enhancing their self respect, enabling them to feel like first-class citizens of the information society. For example, experiments in the Newark, N.J. school system provide students and their parents with computers in the home and encourage students to help their parents learn email. The result so far: enhanced communication among teachers, students, and parents while raising morale and test scores.

Computers can level the learning playing field, so students at all levels of society have greater economic opportunity. Computers can also level the playing field internationally, allowing third-world countries the same access to the Internet as technologically advanced countries. And the Internet is a great leveler of social structure. Countries without business or entrepreneurial infrastructures can leapfrog traditional social and economic structures by building Internet-based infrastructures competitive with those in technologically advanced countries. India, Brazil, and other countries with ambitious plans for building a competitive Internet-based economic infrastructure can compete effectively with G-7 countries, because an Internet-based business infrastructure can be created cheaply.

Globalization also allows students to visit distant museums, make electronic field trips to archaeological sites, and interact via video conferencing with students around the world. The article "Can K-12 Education Drive on the Information Superhighway?" [1] by Robert Crook cites numerous examples of interactive education, including students in a Hawaiian high school giving a presentation in Japanese to students at a Japanese high school followed by a presentation in English by students at the Japanese school to students at the Hawaiian school.

The online education industry still lacks critical mass, so companies investing in educational products do not yet have a market of sufficient size to recoup their costs. Moreover, we do not yet understand how educational tools for the information age should be structured. The Internet contributes to the globalization of education even in its present form, but in the future, today's Internet will be viewed as a primitive precursor of powerful multimedia network technologies.

> Nationalism and fundamentalism create walls of separation and intolerance against which networking is at best a weak and ineffectual tool.

Achieving an online education market of critical mass depends on both government economic investment and educational guidance ensuring that educational products educate rather than merely amuse. It is too easy to be fixated on computer games, turning computers into a drug rather than an enriching experience. Television also has great educational potential, but its practical contribution to education has been limited in part because it is driven by advertising rather than educational interests. It will be difficult to realize the educational potential of computers once the commercial possibilities of computers in schools are exploited by commercial interests.

Enabling Technologies

Underlying globalization is a set of networking technologies for human-computer interaction (HCI), supporting the finding and filtering of information, as well as security, negotiating and matchmaking, and integration and interoperability.

Networks. "The Strategic Directions Report on Network and Telecommunications" [3] concludes that the

principal driver of network evolution is no longer technical innovation but user demand. Computer deployment in the home is primarily a matter of cost rather than of technical limitations. It suggests that technical issues of reliability and scalability are adequately solved so sufficiently high-bandwidth is available, but software issues in HCI and economic issues of cost and regulation still need solutions. Globalization requires new forms of regulation transcending current national regulations of network usage.

The report also claims that security techniques of encryption and authentication are well understood, but overall models guaranteeing network security do not exist. Security appears to be a major bottleneck in the adoption of network technology for a wide range of sensitive applications. Credit card fraud is still relatively easy, and even smart cards with built-in authentication checks are subject to fraud. However, security can be enhanced by sacrificing user convenience. For example, firewalls can help provide adequate levels of security by complicating access for legitimate users and hackers, and sensitive information, like credit card numbers, can be maintained securely by not transmitting them over the Internet and by requiring non-network authentication, as in the First Virtual electronic-commerce model.

In the industrialized nations, the technical problems and the infrastructure are well planned and managed through both private industry and government legislation, but unfortunately, in the developing countries, this process is much slower. Globalizing the information revolution requires that we pay special attention to the developing countries, helping them catch up and compete on an equal footing with the industrial world. Failing to do this, we may create a tense world in which those who have and those who lack information technology will be in constant conflict. History records that nations feeling boxed in economically react aggressively, causing instability in their regions, possibly overflowing into worldwide crisis.

Mobility. Mobile computers let travelers take their offices with them, allowing them to be globally available and promoting location-independent global access through the Internet. Though there is intense competition among telecommunications companies providing infrastructure services for globalization, the system architecture is relatively mature and the entry barriers and required capitalization allow only very large companies to compete. The stakes and the rewards of controlling system architecture are enormous, not only for hardware providers, like AT&T, but for software providers. For example, Microsoft's failure to recognize the importance of controlling network services in the early 1990s, allowing Netscape to gain a dominant position as a network services provider, rivals IBM's lapse in the 1980s of failing to control system software for personal computers. It remains to be seen whether the consequences for Microsoft will be as severe as those for IBM. Today, Bill Gates [4] seems more aware of the need to adapt to globalization. The current battle between Netscape's Navigator and Microsoft's Internet Explorer is a battle for control of the standards for globalized computer technology.

Human-Computer Interaction. HCI is less mature as a technology but has lower entry barriers than system architecture. A report on strategic directions in HCI [3] indicates that related challenges include how to serve a much more diverse and less expert user community than that of professional programmers and how to support a wider variety of applications in an environment of increasingly powerful and sophisticated technology. HCI can contribute to applications by providing better interfaces and by conducting studies to determine the effectiveness of alternative approaches to interface design. Interfaces are particularly important in such areas as education in which a presentation's form often makes an enormous contribution to student learning.

Spreadsheets, which were a precursor of electronic commerce, pioneered the presentation of commercial data as a basis for business decision making. Information visualization, using techniques of computer graphics and virtual reality, can greatly increase the expressiveness of interfaces—provided the requisite bandwidth is available.

Computer-supported cooperative work relies on HCI to support computer conferencing and other collaboration forms among users, pioneering the globalization of work environments that support virtual business and educational enterprises.

HCI depends on bandwidth, storage capacity, and computer speed, as well as on presentation and visualization techniques. Fragility is another major concern in today's systems. Error messages often mean nothing to the novice user or even to experts in most cases. Handling errors, especially in heterogeneous environments, cause major user headaches, and in most cases, there is almost no way to recover from

them, except by rebooting the system. We need to teach systems to recover from errors and, when recovery is impossible, to give the user information for appropriate action. Given the state of software testing today, we will not be able to eliminate errors, but at least we should learn to make them more tolerable.

Communication Capacity. Processing speed and storage capacity double every 18 months, according to Moore's law, but bandwidth and communication capacity, which are not as easily improved, are increasingly a bottleneck to globalization. For example, delivery of television-quality video through the network still requires several orders of magnitude improvement of bandwidth. However, intelligent HCI, which makes use of past experience stored in increasingly cheap memory and retrieved by intelligent pattern-matching algorithms, can help compensate for bandwidth deficiencies. Intelligence is useful in other ways (e.g., supporting speech, handwriting, natural language, and other new modes of interaction). We expect within a decade, 3D interfaces and multimodal interfaces of virtual reality to be commonplace as forms of network interaction.

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User interfaces need to incorporate a variety of techniques for rich interactions among diverse users and the information they seek. In such an environment, a large amount of data scattered on a number of system resources necessitates intuitive interfaces for consumers to query and retrieve highly heterogeneous information sources while adapting to variations of language, culture, domain, and education level. The ability to change the consumer's perspective from high-level summary information to a specific paragraph in a document or a scene in a film remains a challenge to user interface researchers.

Internet Limitations

A global network must address the concerns of its constituents with respect to confidentiality, authenticity, and integrity, balancing security concerns against responsiveness and performance. The system must be secure against malicious use, misuse, and data corruption while protecting the privacy of its users and the intellectual property of the vendors. Moreover, the system must provide open access so vendors can add and update information and services at any time. Also provided should be authentication and security services, covering privacy, integrity, confidentiality, authorization, and controls.

Authentication is concerned with attributing the source of an object to its creator or owner. There is a need to specify and enforce policies reflecting the types and uses of information and products on the network. In a global environment, the problem is especially complex because an object may have multiple owners, and modifiers may be in different parts of the world, each operating under diverse local policies and resources for enforcing the policies.

Most electronic commerce transactions are done today through dedicated lines and value-added networks. These media ease security issues but complicate open access. An interesting question is: Should global commerce even be done through the Internet? The Internet supports open access, involves more than 30 million users worldwide, and is experiencing an enormous growth rate. However, the Internet in its current state also has some shortcomings, including:

- Insecure transactions, though secure protocols are being considered;
- Protocols that provide minimal or nonexistent guarantees of service quality;
- No mechanisms for protecting intellectual property; and
- No support for interoperation or data interchange standards.

Social Effects

Cyberspace is an engaging and addictive realm in which some people find greater fulfillment than they do in the real world. But the networked world of computer groups, discussion and chat groups, and virtual social environments may represent an addictive drug more insidious than television. The Inter-

net has had a positive effect on the democratization of society, making it more difficult to bottle up and suppress information. Network support of global freedom of information contributes to freedom of thought and to social and political freedom. The stronger virtual interconnections (making the world a smaller place) also make it more difficult to grossly curtail freedom of information in any part of the world with a substantial population of Internet users. Human rights initiatives have been helped by the free flow of network information, and networks can play a role in making the world a better place to live. But nationalism and fundamentalism exert a powerful force in the opposite direction, creating walls of separation and intolerance against which networking is at best a weak and ineffective tool. The net can be a tool for creating common values and mutual respect among children and adults in democratic humanist societies, but those who believe in common values have to work against forces of intolerance and divisiveness. Regulation of the net is needed for a number of reasons:

- To provide common standards and security for the global user community. Common standards can be realized through a combination of trust and regulation. Standards are needed for domain-independent general use and for domain-specific areas, such as electronic commerce and education. The domain-specific standards can be embodied in an ontology-defining terminology and a knowledge-interchange format for each domain.
- To provide protection (copyright) for knowledge providers. Questions of copyright protection are quite different on the net from their counterparts in hardcopy publication. These questions are beginning to be considered and copyright regulations formulated by the ACM and other groups concerned with a fair apportionment of rights between authors and publishers. The goal: to allow publishers to flourish while rewarding authors for their creativity.
- To balance freedom of speech against offensive and libelous use. Freedom of speech on the net is not a simple matter. One of the authors recently encountered a genuine dilemma when asked to sign a petition to deny a racist Nazi group use of the net. The two options—freedom of speech and offensivenes—would probably be resolved in favor of pure freedom of speech if left to the American Civil Liberties Union, but the net in its wisdom submits such questions to a vote, denying access if a broadly advertised request for votes elicits at least 150 votes, of which at least 67% are against access.
- To encourage educational and socially beneficial uses. Using the net for socially beneficial purposes depends on finding imaginative applications. It is difficult to predict how the net will be used and how far companies will take advantage of it to promote their products in scenarios of violence or other alluring but antisocial situations. The example of television is not encouraging in this context.
- To protect against antisocial uses by criminals and terrorists. Evaluating the Clipper chip as a tool for discovering terrorists and censorship of pornography as desired by fundamentalist religious groups shows that censorship in the service of socially desirable goals is a controversial issue that simply moves the questions to a new arena.
- To protect countries, languages, and cultures, ensuring access for rich and poor individuals and countries. ◻

Acknowledgment

We thank Shamim Naqvi of Bellcore for his invaluable comments. Yelena Yesha acknowledges the support of IBM CAS and Johns Hopkins University. And Nabil Adam acknowledges the support of the NASA Center of Excellence in Space Data and Information Sciences.

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Education, Culture. Through the Internet. the science of future technology. Computer technology further supports globaliza-. tion by radically changing the economics of commu-. nication, so geographic proximity is even less a. requirement for effective collaboration and business. interaction.Â 7 countries, because an Internet-based business. infrastructure can be created cheaply. Globalization also allows students to visit distant. museums, make electronic field trips to archaeologi-. cal sites, and interact via video conferencing with stu-. dents around the world. The article â€œCan K-12 Edu