Information
Infrastructure
Task Force

BREAKING THE BARRIERS TO THE NATIONAL INFORMATION

INFRASTRUCTURE

A CONFERENCE REPORT BY THE
COUNCIL ON COMPETITIVENESS

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The conference, "Breaking the Barriers to the National Information Infrastructure (NII)," was co-sponsored by the Clinton Administration's Information Infrastructure Task Force (IITF) and the Council on Competitiveness. The following report summarizes this September event to capture the excitement surrounding the NII applications.

The IITF Committee on Applications and Technology is accepting comments at the following email address: cat_exec@nist.gov

FOREWORD

Two years ago, the Council launched its project on the 21st Century Information Infrastructure. We did so with a clear goal in mind--to create the private sector consensus necessary to guide public policy related to the development of this infrastructure. First, we developed a vision statement, which showed that competing stakeholders could rally behind a shared perspective. Then we turned our attention to competition policy, which will have a fundamental impact on the way the National Information Infrastructure (NII) evolves. Here, we were able to forge a remarkable consensus among a diverse group about the need for competition in very aspect of the communications industry.

This latest report captures the excitement and lessons surrounding NII applications. By showcasing them, we can better understand how to harness the NII

to improve our daily lives. And by examining the barriers users are facing, we can set the stage for a more constructive national policy debate.

When we started this project, there was a lot of concern about the ambitious plans of some European and Asian countries. Today, all eyes are on the United States. Part of the reason for this shift is that the United States already has a robust infrastructure which is evolving rapidly. Telephone, cable, and satellite delivery systems are linking together, and the United States is clearly in the lead when it comes to technology and systems integration. But there is another reason that is just as compelling--nowhere else are applications sprouting as quickly as in the United States.

Many of these applications will be false starts. Some will never be technically feasible. Others will never generate enough market demand. Still others will be stymied by heavy-handed regulations. But some will succeed. Indeed, on the pages that follow, you will see that many of them are already well on their way. As they flourish, they will transform our notion of what the NII can offer and the kinds of policies that we will need to ensure that it matures.

As the NII grows, it will have a revolutionary impact on national competitiveness. Those nations that establish the infrastructure and develop a broad range of applications first will have a tremendous competitive advantage over those that lag behind. This advantage will accrue not only to the telecommunications industry, but also to such industries as manufacturing, banking and entertainment and to such activities as education and healthcare.

Much of the technology is here. The market is beginning to emerge. The next step is to transform some pilots and small-scale experiments into full-fledged applications and to create a policy environment that stimulates, rather than discourages, them. In the year ahead, the Council will continue its work on applications to achieve these goals.

Paul Allaire
Council Chairman
Chairman and CEO
Xerox Corporation

John Young
Project Co-Chair
Chairman, Smart Valley, Inc.
Former CEO
Hewlett-Packard Company

Charles Vest
Project Co-Chair
President
Massachusetts Institute of Technology

INTRODUCTION

For two days this past fall, over 500 leaders of industry, academia and government received a first-hand look at the National Information Infrastructure (NII), its opportunities and obstacles. The event, "Breaking the Barriers to the National Information Infrastructure," was co-sponsored by the Council on Competitiveness and the Clinton Administration's Information Infrastructure Task Force.

This conference was one of a series of activities sponsored by the Council's 21st Century Information Infrastructure Project. The Council articulated its vision for an NII in its May 1993 report Vision for a 21st Century Information Infrastructure:

The information infrastructure will enable all Americans to access information and communicate with each other easily, reliably, securely and cost effectively in any medium--voice, data, image or video--anytime, anywhere. This capability will enhance the productivity of work and lead to dramatic improvements in social services, education and entertainment.

At the conference, participants had a chance to sample some of the innovative products and services that are emerging in the fields of healthcare, education, manufacturing, electronic information management and commerce, and entertainment/home services. In all, 28 demonstrators showcased their industries' state-of-the-art applications. In addition to the live demonstrations, five panels of users and application developers revealed the barriers they are facing as they use these new applications.

Physicians, for instance, are enthusiastic about the potential value of telemedicine, but frustrated that legal and regulatory uncertainties are inhibiting its use. For most educators, new applications and the tools to run them are enticing, but still prohibitively expensive. For organizations interested in tapping into the NII to conduct electronic commerce, incompatibility among applications, computers and computer networks, and the lack of network security have been troubling hurdles.

Panelists also commented on the "valley of despair" that sometimes results when the learning curve for these new tools is too high. Yet all agreed that the promise of increased productivity, better healthcare, new and enhanced educational tools, electronic access to new markets, and increased entertainment and personal services delivered to the home are worth the current struggle.

The conference also revealed that the pace of diffusion has been slower than expected. It is difficult enough to deliver applications locally; doing so nationally is an even greater challenge. Niche applications and testbeds are showing what we must do to fully realize these applications, and we must forge ahead. If we do not, the nation will have missed an historic opportunity to enhance its competitiveness in world markets.

The private sector bears much of the responsibility for overcoming these obstacles. Developers must build and operate the infrastructure and make their applications easy to use--as easy as the telephone, said one panelist. For their part, users must be willing to change to benefit fully from these new applications; as part of this transformation, investments in training and a commitment to changing the culture of the organization will be needed.

Policy makers must do their share as well. Unfortunately, progress on key regulatory fronts has been slow. Current market forces and new technologies are rendering today's regulated telecommunications monopoly framework obsolete, but so far efforts to bring existing federal communications regulations in line with market realities have failed. If a versatile information infrastructure is to emerge, the current regulated monopoly framework in the local

cable and telecommunications services market must be replaced with a competitive communications environment. As stated in the Council's report, Competition Policy: Unlocking the National Information Infrastructure:

[T]he key issue is not whether, but when and under what conditions to permit full competition in all markets. Ultimately, any vendor should be able to offer any communications service to anyone anywhere using any technology.

By identifying the major areas of concern, conference panelists and demonstrators took an important step toward overcoming the barriers preventing all Americans from benefiting from these applications. Their insights and lessons are summarized on the following pages:

-Section I highlights the major findings.
-Sections II-VI examine five industry sectors. Panel discussions focused on the potential benefits, current barriers and insights for the future.
-Section VII profiles the 28 demonstrations that were on display at the conference and provides points of contact for each.

In opening the conference, U.S. Commerce Secretary Ronald H. Brown observed, "As the demonstrations clearly show, information technology already is changing the way we work, the way we learn, the way we communicate." Indeed, the demonstrations convincingly displayed what is possible with the information superhighway. But the parallel panel discussions of expert users spotlighted just how far we have to go before these possibilities become reality for the millions of Americans who are still living on the backroads of the Information Age.

If the conference had had a road sign, it might have read:

Benefits in Sight,
More Construction Ahead.

FINDINGS

The findings below enumerate the barriers users

believe are impeding the development and deployment of applications created to run on the National Information Infrastructure (NII). But as the conference--and the examples in this report--clearly demonstrate, much progress is being made in spite of these obstacles. The applications that are already in use leave no doubt that competitiveness in the future will depend on the ability of organizations to distill, package and deliver knowledge and information via this advanced infrastructure. The success that has already been achieved underscores the need to eliminate barriers swiftly so that the potential benefits of the NII can be realized by all Americans.

1) ALTHOUGH NII APPLICATIONS POSSESS GREAT POTENTIAL, FEW HAVE BEEN BROUGHT TO MARKET.
While new applications show great promise, testbeds and demonstration projects reveal the very real difficulties in delivering many of them to market. Although some are available locally, few are available nationally. The slow pace of imple-menting change, regulatory and legal restrictions, technical challenges, and difficulties quantifying costs and benefits are tempering prospects of rapid market growth.

2) THE RELUCTANCE OF PEOPLE AND ORGANIZATIONS TO CHANGE REMAINS THE MOST SIGNIFICANT BARRIER TO THE WIDESPREAD USE OF NEW APPLICATIONS.
Fear of change, reluctance to collaborate, unwillingness to use new applications and systems regularly, unwillingness to loosen control over information, and lukewarm commitment from higher management are a few of the user responses that threaten large-scale use of promising applications. To realize the full benefits of these applications, users must be willing to change their work habits and life styles, and organizations must be willing to change their traditional ways of doing business.

Boeing faced many internal organizational challenges to the implementation of its 777 project. With this project, Boeing began a new process of using advanced networking and omputing technologies to nurture partnerships between its design and manufacturing teams, as well as with their customers and suppliers during the design and development phases. This required significant internal cultural changes aimed at improving communication and sharing

ownership. Extensive on-the-job training was required to ensure employee acceptance. Boeing employees and their suppliers had to learn that in this new environment, sharing information and partnering were not only acceptable but mandatory.

The Virtual School project in Tennessee developed a strategy to overcome resistance to change. The project was part of an effort to set up a statewide education network. To overcome teachers' reluctance to incorporate computing technologies and applications into their traditional teaching methods, the project established a colleague-to-colleague training and assistance program. Teachers volunteered to train their peers. This collegial, grassroots approach succeeded in engaging teachers who were initially resistant and in building widespread state acceptance for the new network.

Image Works is one of several stock photography companies that is working to help its customers accept a new way of viewing and selecting pictures for purchase. Customers, such as advertisers, usually scan printed catalogs from multiple agencies and must request images from each of them individually. But, companies like Image Works are making their photographs available in digital catalogs through a commercial on-line service. With on-line services, customers can browse large databases with hundreds of thousands of images from multiple photography companies. While this can be significantly faster and less expensive, picture users are not accustomed to using digital image data bases. They have been reluctant to trade in their hard copy catalogs to adopt this new approach. The success of the electronic retrieval portion of the sale of stock photography will depend on the willingness of picture sellers and buyers to do business differently.

3) THE DELIVERY OF NII APPLICATIONS TO THE MARKET IS BEING DELAYED IN THOSE AREAS THAT FACE EXTENSIVE AND/OR UNCERTAIN REGULATORY AND LEGAL ENVIRONMENTS.
Technologies and their new applications are, in certain sectors, colliding with current regulatory and legal boundaries governing their use. In some cases, the laws and regulations are inconsistent with new technologies. In other cases, conflicts exist between state and federal laws or between differing state laws. In still others, no laws or regulations exist,

but concerns about liability in these untested waters are so great that they hamper both the development and use of new NII applications. The uncertain regulatory environment coupled with immense liability concerns is stifling the entrepreneurial spirit and risk taking necessary to push forward.

In healthcare, for example, some states still have "quill pen" laws requiring medical orders to be hand written in patient charts. While this is important for authentication purposes, it is an obvious obstacle to developing electronic patient record systems. Conflicts in the laws between different states are also inhibiting the use of new applications. It is usually not clear whether a physician in one state using a video link-up to examine a patient in another state is subject to the distant state's licensing requirements. The uncertainty surrounding a physician's and patient's legal rights and obligations is limiting the use of telemedicine across state lines.

In some cases, although there are no specific or conflicting prohibitions, companies and organizations have decided that the potential liability costs are so great they will not move forward without laws or regulations explicitly granting permission. The Food and Drug Administration, for instance, has not established clear guidelines for distributing medical software, particularly electronically distributed software. As a result, medical groups developing software that might help physicians at other facilities are not sharing it because of regulatory uncertainty and potential liability. Additionally, FDA regulations for computer and networking hardware are unclear. Current policy calls for FDA approval of complete systems, including any computers and networking devices. Thus the FDA could consider part or all of a network supporting telemedicine to be a medical device subject to its regulatory authority.

The consequence of such legal and regulatory uncertainties is that the full market potential of new applications will be realized first in those sectors such as electronic commerce, entertainment and manufacturing that face less uncertain environments. For example, laws or regulations are not constraining QVC from taking advantage of electronic information delivery mechanisms to expand home shopping. In 1995,

QVC will introduce an on-line shopping service. Customers will log on to their personal computers to find thousands of products available for quick delivery at affordable prices. QVC is making substantial investments to harness the personal computer and modem as tools to increase its share of the home shopping market.

There are no conflicting state laws preventing organizations from conducting electronic commerce across state lines. For example, through CommerceNet, a consortium of companies and organizations exploring ways to conduct electronic commerce, buyers can browse multimedia catalogs, solicit bids and place orders, all over the Internet. Sellers can respond to bids, schedule production and coordinate deliveries. Since it started in 1994, CommerceNet has fielded over one million electronic requests.

4) DIFFICULTY OF USE AND LACK OF INTEROPERABILITY FRUSTRATE USERS AS THEY ADOPT NEW APPLICATIONS.
Application developers must work with users up front to design applications that are easy to adopt, require minimal training and are specific to their needs. Implementation must be as simple as possible so that the changes and new skills required to use the application are perceived to be trivial. Otherwise customers will become easily discouraged and will not use the applications that could assist them.

Telemedicine trials in South Carolina, for example, show that rural physicians are simply too busy caring for patients to free up much time for their own or staff training. But when offered limited sets of easy-to-use telemedicine tools, designed for their specific needs and accompanied by on-site training programs, the doctors overcame their reluctance.

Companies interested in conducting electronic commerce, meanwhile, often struggle to navigate the Internet to create an electronic marketplace. Once on that sprawling network, they are having trouble finding other companies, products and services. CommerceNet is helping by developing directories of its own subscribers, making those directories available for free, and providing links to third-party directories to assist its subscribers. CommerceNet also provides the software tools that allow a company to provide information about its products and services

via the Internet.

The advent of electronic commerce has created an uncertain environment for many banks. Banks have long been interested in using electronic delivery mechanisms to reach customers in their homes. Easy to use home devices, however, have been lacking. Banks are also grappling with interoperability challenges as they move to link their proprietary networks with public infrastructures like the Internet. As more companies conduct business transactions over open networks like the Internet, banks must learn to facilitate electronic payments and funds transfers safely and securely.

Network publishing, the ability to send documents on-line to one or more locations and retrieve them in a printed and bound format, offers potential savings in the time it takes to print and distribute books and documents as well as savings in production and distribution costs. These benefits, though, remain largely unrealized because of a lack of common procedures and standards. Today's custom publishing and print-on-demand activities almost always entail elaborate advance arrangements, significantly slowing the print process and undercutting the ability of network publishers to respond to targets of opportunity and spontaneous requests. For network publishing to be a success, it must be as easy as today's desktop publishing.

While addressing interoperability issues, organizations should also ensure that systems are easy to use. The case of the Val Verde School District in Southern California shows that schools can move to make use of new technology too quickly as well as too slowly. A school reform plan included placing high performance, multi-tasking, Unix-based computers on every teacher's desk and additional computers in classrooms for student use. Val Verde discarded its existing system and replaced it with new computers. Unfortunately, the new system was unfamiliar to the teachers and students and was not considered user friendly. As a result of this premature scrapping, teachers and students struggled with steep learning curves, and the school system experienced higher than planned training expenses.

The National Information Infrastructure Testbed

(NIIT), a consortium of 60 companies, universities and federal laboratories across the United States, has discovered that creating a global system that is truly interoperable is a major hurdle for applications development. NIIT was formed expressly to build a model NII by creating fully functional, demonstrable and market- driven, distributed computing applications to solve real problems in the areas of astrophysics, aerospace, healthcare, environmental management, agile manufacturing, financial services, education and electronic commerce. Developing and deploying a comprehensive information infrastructure architecture to support interoperability and integration across multiple, distributed computing applications has proven to be a significant task. Consortium members spend considerable time synchronizing members' hardware and software systems to work together and providing users with familiar interfaces so that the distributed environment is as comfortable and easy to use as their local one.

5) ORGANIZATIONS OFTEN RESIST NEW APPLICATIONS BECAUSE THEY HAVE NO CLEAR WAY TO MEASURE BENEFITS AGAINST THEIR COSTS.

For most organizations, conducting a cost-benefit analysis is an important prerequisite for making a large investment. Unfortunately, few organizations have effective methods for evaluating the payback of new applications, especially early on. Often, payoffs are not predictable and applications must be in place and used for some time before benefits are realized. Even then, the benefits may vary widely, depending on the degree to which organizations change the way they work. Finally, the pressure for short-term payoffs can curtail or derail implementation. Organizations often overlook longer term, less tangible benefits such as improved customer service, the ability to gather more reliable information more quickly for more people, and improved efficiencies.

In healthcare, the difficulty in quantifying the benefits of computer-based medical support systems is hampering their dissemination. Adding to the complexity is the fact that different participants in the healthcare system are seeking different benefits. Insurance companies want assurance that such systems will reduce healthcare costs. However, while access to additional information permits patients to make more informed healthcare decisions,

these decisions may not always result in lower healthcare costs. Although a patient may believe that his decision will result in a better quality of life, it is unclear if insurance companies or managed care providers will consider that sufficient to cover the expense of these systems.

In contrast, administrators of the Texas Education Network (TENET), a statewide initiative electronically connecting teachers throughout Texas, have been successful enough in calculating its benefits to obtain state financial support. By focusing on professional development opportunities, the reduction of paperwork and the increase in teacher and administrator productivity, they have convinced state legislators that this program warrants continued state investment.

It took the visible support of the president of the Electric Power Research Institute (EPRI), along with the persistence of several executive "champions" to convince EPRI management and staff to develop EPRINETTM. EPRINETTM, an on-line computing, information and networking infrastructure, was slow to mature in large part because it was difficult to articulate and quantify the benefits member utility companies would realize from more and better organized technical information. Staff members gradually climbed on board and ultimately created an award-winning system. EPRINETTM allows the electric utilities and their vendors and suppliers to communicate and collaborate more effectively with each other. This significantly shortens research cycle times, and allows more effective management of R&D projects. EPRINETTM typically receives 2,500 inquiries a month. Last year it served over 6,000 users from over 250 utilities and 550 contractors and other organizations.

II. USING THE NII TO IMPROVE HEALTHCARE

PANELISTS

Moderator:
John Silva, MD - Advanced Research Projects Agency

Speakers:
Stanley Fowler, PhD - University of South Carolina

Medical School
David Gustafson, PhD - University of Wisconsin Medical School
Julian Rosenman, MD - University of North Carolina School of Medicine
Helen L. Smits, MD - U.S. Department of Health and Human Services
Michael Wood, MD - Mayo Foundation

The healthcare panelists focused on the barriers they are experiencing in two areas: telemedicine delivery and computer-based medical information support systems. These are discussed below.

TELEMEDICINE

BACKGROUND

Telemedicine--the use of two-way, interactive telecommunications video systems to examine patients from remote locations, to facilitate medical consultations, and to train healthcare professionals --has the potential to increase dramatically the quality of medical care available to communities with few medical resources. Patients, particularly in rural areas, can have access to sophisticated medical care and distant specialists. They can receive rapid responses to diagnostic tests without having to spend the time and money to travel to urban medical centers. Just as importantly, they can maintain their relationship with their rural family physician.

Rural practitioners, meanwhile, can use telemedicine systems for education and training. Local health professionals and students can receive ongoing professional training through links to urban medical centers. Pilot telemedicine projects also are revealing that telemedicine can help rural physicians overcome "burn out" by reducing their sense of isolation and enhancing their ability to provide quality healthcare.

Moreover, telemedicine can help spur economic development in rural areas. With the increased availability of quality healthcare through telemedicine services, these communities become more attractive as sites for new businesses and manufacturing plants.

Unfortunately, the full promise of telemedicine has not been realized. Only 2,000 telemedicine consultations were conducted in the United States in the past year, according to the Health Care Financing Administration (HCFA), which oversees the Medicare and Medicaid programs.

Panelists identified a number of barriers, including physician resistance to the new technological tools; legal restrictions and uncertainties, including privacy issues; regulatory barriers; and inadequate financing.

BARRIERS AND LESSONS LEARNED

Barrier 1: Limited physician and patient acceptance--The spread of telemedicine is hampered by a "chicken and egg" problem: telemedicine will not be used until it is considered a proper standard of medical care, and it will not be considered acceptable care until it is more widely used. Additionally, telemedicine requires rural and urban physicians to alter their schedules . Rural physicians are typically overburdened with treating patients, and older physicians are especially reluctant to use the new technology available to them. At the other end, the urban specialists with well established, lucrative practices are often hesitant to meet the scheduling needs of a telemedicine program.

In both urban and rural settings, younger medical students and recent medical graduates are more accepting of, and even anxious to use telemedicine. Similarly, younger patients are much more comfortable with "being on television;" the presence of cameras, computers and recorders during examination tends to bother older patients.

Lessons Learned and Insights--One way to overcome physicians' reluctance to use telemedicine is to start by offering very limited sets of telemedicine tools, designed to meet specific needs of rural physicians. Later, once physicians have accepted and effectively used these tools, they will demand more sophisticated applications. Well designed, on-site training programs in rural areas sponsored by urban hospitals are also essential; physicians tend to be too busy with patient care to free up much training time for

themselves and their staffs. Also, urban hub hospitals must expand or reorganize their healthcare delivery systems to make sure that enough specialists are available at regularly scheduled times to meet the demands of rural patients and practitioners.

In short, telemedicine applications must be user-friendly, the training must be regular, the "urban teachers" must be readily available, and the applications should be phased in. As one panelist observed, telemedicine systems ultimately must be as easy to use as the telephone.

Barrier 2: Legal restrictions--To date, telemedicine has largely been limited to intrastate applications. Physicians and hospitals attempting to broaden telemedicine capabilities into interstate healthcare delivery systems are facing significant legal obstacles. Uncertainties regarding licensure, personal jurisdiction and protection of patient privacy are becoming particularly thorny problems as telemedicine applications are delivered across state lines.

a. State Licensing Requirements. Physicians must be licensed in each state in which they practice. This requirement is a critical issue for interstate telemedicine because the violation of state licensing laws has serious consequences for the practicing physician; disciplinary proceedings in the patient's or practitioner's home state and criminal prosecution for practicing medicine without a valid license are among the potential consequences of today's tangled web of 50 individual state licensing systems. Because few state licensing bodies have legally defined "practicing medicine" in the context of telemedicine, practitioners are at risk.

Adding to the legal complexity, the telemedicine practice model has many variations. Telemedicine consultations can be between physician and physician, between patient and physician, or between a non-physician practitioner and physician. Each of these interactions could have its own set of rules.

Panelists expressed concern at the potential precedent set by the state of Kansas, which recently became the first state to apply its medical licensing statute to telemedicine. Its amended law specifies

that any physician--"regardless of location"--who practices medicine on individuals located in Kansas must have a Kansas license. This law essentially requires every physician who establishes a telemedicine link with that state to have a Kansas license. Such a rule --if adopted by other states-- could severely inhibit interstate use of this application.

b. Hospital Credentialing Requirements. Hospitals must review the credentials of each physician applying for a position on their staffs. Hospitals and their accrediting organization, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) have generally not amended their credentialing rules to account for the practice of telemedicine. It would be extremely burdensome and time consuming if physicians who performed telemedicine consultations were required to undergo credentialing at every hospital in the telemedicine network.

c. Personal Jurisdiction/Venue/Governing Law. A particularly difficult legal obstacle for telemedicine is the potential for malpractice actions to be brought against physicians far from their homes. This may well prove to be one of the most contentious issues that impedes the wide-spread use of telemedicine services. The key question is whether a distant physician who performs a telemedicine consultation can be sued in the jurisdiction where the patient was located. If so, the physician would face the higher costs of a distant defense, may be subject to a less favorable law and a potential for a higher verdict.

Regular telemedicine contacts with a distant state create an additional problem if the physician is regarded as "doing business" in that state. Persons who are doing business in a state may be subject to suit in that state without regard to whether that state has any connection to the lawsuit. For example, a California physician who has regular telemedicine contacts with New York could be sued in New York by any of his patients, even if they were not located in New York. Understandably, the risks and uncertainties associated with this area of the law may deter many physicians from providing telemedicine services.

d. Theories of Liability. Telemedicine may also give rise to new theories of liability. Technical

limitations with image fidelity, for example, mean that there may be less information available through telemedicine than there would be in a face-to-face encounter. A plaintiff might allege, for example, that a physician made an inappropriate diagnosis via telemedicine that would have been avoided had the physician recognized the medium's limitations and instead recommended an in-person examination.

Lessons Learned and Insights--Licensing laws pose a key barrier to the development of telemedicine. Physician organizations and the healthcare industry must work with the federal government and the Commission on Uniform State Laws to develop physician licensing rules that permit interstate telemedicine consultations. Likewise, the JCAHO and hospitals must develop credentialing standards suitable to telemedicine. These standards should take into account the variety of telemedicine practice models. Different standards may apply depending on whether the physician is consulting with another physician, a non-physician practitioner or with the patient directly.

Practitioners of telemedicine must be aware of and prepared for the legal risks associated with this new technology. The biggest of these is the possibility of malpractice actions being brought against them in the patient's home jurisdiction. Regular telemedicine links create the additional risk that the physician could be subject to suit in a distant state for actions with no connection to that state. Physicians should ensure that their insurance provides coverage for lawsuits brought in those states and that their coverage is adequate for the higher costs and potential verdicts associated with defending a suit in the other jurisdiction(s).

Barrier 3: Regulatory uncertainty--Regulatory roadblocks are also inhibiting the broad distribution of telemedicine applications. Vague U.S. Food and Drug Administration (FDA) regulations, for example, are causing physicians to refrain from sharing some medical decision-making software. As a result, other physicians are prevented from delivering enhanced medical care to their critically ill patients.

The University of North Carolina (UNC) School of Medicine, for instance, is facing this roadblock. They

have developed special software which, when run on high performance computers, can render a three-dimensional model of a cancerous tumor and provide the appropriate radiation dose. This software links a computer tomography (CT) scan of the tumor, a radiograph computed from the CT scan and a computed picture of the patient. Radiation doses are calculated on UNC's high performance computer and the recommended three-dimensional dose distribution is displayed on a special graphics workstation. The physician sets up the radiation beams, views the resultant radiation dose distribution, and then fine tunes the system by changing beam angles and other variables until achieving the best possible result.

This process has been very effective in treating cancerous tumors while minimizing damage to surrounding tissue from excessive radiation. But complete three-dimensional treatment planning systems such as this are available at fewer than 20 of the estimated 1,500 radiation therapy clinics in the United States. Telemedicine, however, could make these systems much more widely available; remote users could log in to the central computers, create the appropriate three-dimensional models and calculate the appropriate radiation dosages for their patients.

Unfortunately, uncertainty about FDA regulations is slowing the process. The UNC School of Medicine, as the developer of this software, is exempt from FDA regulations as long as they use the software in their own facilities. However, FDA rules are unclear as to whether another hospital can access the same software over a network to treat its own patients. Adding to the complexity, the FDA requires approval any time a change is made to a medical device--a category that includes medical decision-making software. For devices such as pacemakers, these changes may occur only every few years. In the case of software, however, this rule could be interpreted to mean that new FDA approval is required after changing only one line of software code, no matter how minor. Such fine tuning could occur frequently--monthly or even daily--requiring continual clearances from the FDA. Obviously this would quickly prove to be an unworkable process.

FDA regulations regarding computing and networking hardware are also unclear. The FDA

requires approval for complete systems, including any computers and networking devices. It is conceivable that the FDA could consider the entire network to be a medical device since it would support telemedicine. At least some of the hardware on the network could fall under FDA regulations.

Lessons Learned and Insights--The future use of telemedicine could be severely restricted unless FDA regulations regarding both hardware and software are clarified. Until this occurs, physicians will be limited in their use of these highly effective tools to deliver enhanced medical care to their critically ill patients.

Barrier 4: Lack of Medicare/Medicaid coverage--Medicare and Medicaid will not reimburse providers for telemedicine services. Because private insurance companies (such as Blue Cross/Blue Shield and Prudential) tend to follow federal precedent, this lack of coverage is having an impact on non-Medicare and Medicaid patients as well. Until the government or insurance firms provide coverage to physicians and hospitals for telemedicine services, their use is likely to be inconsistent and limited.

Lessons Learned and Insights--The Health Care Financing Administration (HCFA), which administers the Medicare/Medicaid programs, is investigating the uses and benefits of telemedicine services to develop policies for coverage. While HCFA has not yet authorized Medicare/Medicaid coverage for these services, they recognize that such coverage is important for improving access to healthcare. A key question is under what circumstances telemedicine consultations would be considered appropriate care. Current Medicare rules, for example, require a physician and patient to meet in person. HCFA is asking other questions as well. Are some specialties better suited than others for this service? Will the use of telemedicine drive up costs, an increasingly important concern as the federal government is trying to stem the rapid increases in healthcare spending? What rules are needed to discourage patients and physicians from overusing telemedicine (as some other new high-tech tools have been overused)? How will "overuse" be defined? How can it be monitored and controlled?

HCFA is also struggling to measure the value of telemedicine. One benchmark might be the number of users/patients served. However, if telemedicine is particularly valuable for delivering healthcare services to sparsely populated rural areas, the aggregate number of users might not be an appropriate indicator. An additional challenge is to make sure that HCFA analysts have an adequate research base from which to draw conclusions; this may be difficult since only 2,000 telemedicine consultations nationwide were performed last year.

To get answers to questions such as these, HCFA is sponsoring a number of pilot programs around the country. In fiscal year 1994, it awarded five grants totaling $4 million for projects demonstrating the effectiveness of telemedicine as well as different payment methodologies. In addition, the agency has contracted with the Center for Health Policy Research in Denver, Colorado to conduct a literature review of state-of-the-art telemedicine practices. The center also is developing a framework to assess this service's effectiveness. Four reports are being produced and are due in December 1994. HCFA has also encouraged the private insurance industry to begin its own evaluations of telemedicine's potential.

Barrier 5: Lack of secure transmission methods--Telemedicine also presents unique challenges for ensuring the confidentiality of physician-patient interactions. Telemedicine transmissions are not encrypted and thus do not afford the kind of confidential interaction offered by face-to-face consultations. Similar issues arise with electronic medical records, which must be stored and/or transmitted securely to maintain patient confidentiality.

Lessons Learned and Insights--Encryption algorithms are needed to protect the confidentiality of on-line physician-to-patient interaction and private archived medical information. Standards need to be developed for the electronic formatting and transmission of medical information to ensure patient confidentiality.

COMPUTER-BASED MEDICAL INFORMATION SUPPORT SYSTEMS

BACKGROUND

Computer-based medical information support systems can offer patients more convenient access to information and support that can help them deal with medical problems. One such system, the Comprehensive Health Enhancement Support System (CHESS), has been developed by the University of Wisconsin and is operating as a pilot project. CHESS is demonstrating that these systems can be very cost-effective in helping people through a crisis.

By hooking their personal computer to a central data base, patients have access to a wide variety of services, including: articles and pamphlets about a broad range of diseases; answers to hundreds of common questions about each topic; information on the kind of help and support services available; real-life accounts of how others have dealt with similar health crises; and interactive discussion groups where users anonymously share information, experiences, hopes and fears.

Experimental trials of services such as these indicate that users experience improved quality of life, spend less time in doctors' offices and hospitals, and assume a more active role in their own care. However, widespread use of these systems is being slowed by barriers such as lack of access and financing.

BARRIERS AND LESSONS LEARNED

Barrier 1: Lack of access and ease of use--While users participating in experimental trials are enthusiastic about these systems, they are still not readily available. System providers and physicians need to decide where the systems should be set up. For many, the home is ideal because it affords privacy and convenience; people can use the system when they are ready and at their own pace. But broader usage might be encouraged if the systems were placed in community centers, schools, local support agencies and clinics. Additionally, the developers of such systems need to identify who the users are and what their requirements are in order to design a system that will meet these needs and be easy to use.

Lessons Learned and Insights--Where these systems are accessible, they are being more widely used than expected. Patients appreciate the system's

flexibility to participate more in their own medical care--and to do so at a pace and at times that suit their schedules. Test trials are also revealing that usage is widespread among groups thought to be less likely to try this new technology: women, minorities and people without college educations.

As in other application areas, organizations and individuals are reluctant to change. Therefore applications must be easy to use, preferably on existing technology. Implementation must be as simple as possible so that the change and new skills required to use these systems are perceived to be trivial. Otherwise customers become easily discouraged and avoid the very tool that could greatly assist them.

Barrier 2: Financing uncertainties--Who should provide and pay for these systems is unclear. While access to more useful information may permit patients to make more informed healthcare decisions, these decisions may not always lead to lower healthcare costs. However, if the patient believes that the result will lead to better quality of life, will insurance companies or managed care providers consider that sufficient to approve these systems as a covered expense?

Lessons Learned and Insights--One option is for physicians to purchase the system, with the expectation that they will improve their productivity and make their practices more attractive to patients. Another alternative is for insurance companies to treat such systems as a covered, reimbursable expense.

III. USING ELECTRONIC INFORMATION MANAGEMENT AND ELECTRONIC COMMERCE TO IMPROVE THE WAY AMERICA DOES BUSINESS

PANELISTS

Moderator:
Catherine Allen - Vice President for Strategic Alliances, Citibank and Chair, Smart Card Forum

Speakers:
Carol Christian - Professor of Astrophysics, University of California at Berkeley, National Information Infrastructure Testbed

Alan Carey - Owner & Co-Director, The Image Works
Cathy Medich - Executive Director, CommerceNet
Jim Mulvaney - Senior Consultant, Electric Power Research Institute
Randy Rehn - Information Express Manager, Nordstrom
Marty Wagner - Co-Chair, Federal Electronic Commerce Aquisition Program Management Office, General Services Administration

BACKGROUND

To meet the demands of an increasingly competitive marketplace, both the public and private sectors are turning to two key NII applications--electronic information management and electronic commerce. Electronic information management is the process of gathering important organizational information (such as billing, personnel files and manufacturing design information) and information from external sources (such as published research results), putting it on-line and using it to run an organization more effectively. Information and knowledge are emerging as the most valuable assets that a company or country possesses. The ability to effectively gather and use strategic information increasingly determines competitive advantage. Electronic information management, therefore, is a key component of all NII applications.

Electronic commerce is the term for conducting business transactions on-line rather than by phone or mail, or in person. Instead of looking through printed brochures, for example, customers can use a personal computer and modem to access an electronic data base to browse through product information and images. Instead of calling a supplier to place an order, or filling out a pre-printed order form and mailing it, a buyer can send a purchase request electronically to that supplier.

The Electronic Information Management and Commerce panel discussed efforts to harness information and knowledge and use them to achieve maximum productivity by creating internal informational databases for a single organization, distributed databases and systems used collaboratively among organizations, or informational assets used to conduct electronic commerce.

They were concerned, however, that organizations often fail to make the dramatic changes in internal processes, management methods and cultures necessary to realize the full potential of these information resources. Panelists focused on several major hurdles: the need to design new processes and procedures from scratch, the difficulty of accessing and using these services, limited security and the challenges of justifying investment in these applications.

BARRIERS AND LESSONS LEARNED

Barrier 1: Difficulty in reengineering business processes--Testbeds and pilot projects are revealing that it takes much longer than expected to position an entire organization to benefit from electronic information management and commerce. Reengineering paper-driven processes and convincing people to use the new systems regularly are slowing the pace of implementation.

In part, the hurdles stem from the significant resources required. The investment to convert information into a useful electronic format and to develop new methods to conduct paper-based processes electronically may be relatively modest for a large organization, but can be a major barrier for smaller ones. Still, large organizations may be saddled with significant hardware, old software and electronic and paper documents that do not meet the new required formats and standards. Organizations may not be able to afford to replace these and must adapt them to the new business processes.

In addition to cost concerns, organizations face the resistance to change which is common in every sector. For electronic information management and electronic commerce, users are finding resistance both within their organizations, and among customers and suppliers.

The experiences of companies selling stock photography illustrate these problems. These companies typically provide customers with choices by showing them hard copy images pulled from an elaborate filing system. Now, customers such as advertisers can search for photos by using an on-line image database. But customers do not regularly take this approach.

Some simply prefer the stacks of hardcopy images to the digital data bases. Few have worked on digital image bases, and most are not comfortable conducting searches by typing in keywords, such as "child, winter, sleigh" to identify prospective images. Stock photography companies, meanwhile, have yet to develop a standard keyword listing to ensure that all companies index their pictures in the same way.

Lessons Learned and Insights--Reengineering efforts can have substantial payoffs. The Nordstrom department store chain, for example, is successfully moving away from its paper-based merchandise ordering system. It provides vendors with a special e-mail system to check their purchase orders and invoice status. They even provide mailbox software, if necessary. The installation and implementation is so easy that technical expertise is rarely required. To date, more than 420 suppliers have signed up and more have expressed interest.
Suppliers currently exchange more than 10,000 messages per month with Nordstrom employees, with purchase order inquiries comprising roughly half. They have become so reliant on this application that when gateways or circuits experience outages, Nordstrom's system support group is bombarded with calls. Suppliers have fine-tuned their business processes to such a degree that, if they do not receive replies on purchase orders within 20 minutes, they are often unable to send shipments on time.

Printers and publishers are also finding that new technologies offer the potential to change their traditional procedures. New printing systems can be connected to data networks such as the Internet and, upon receiving electronically transferred documents, print and bind them in a finished format. This could lead to fewer press runs, less warehousing and waste, faster turn-around of orders, quicker response to content changes and reduced transportation costs. This could also permit customers to tailor their print orders.

For example, rather than printing all documents at a single point and then shipping them to multiple locations, printing could occur closer to or even at the sales location. Researchers could browse a digital library and request local printing of a specific book. Textbooks and other course material

could be distributed in different versions to different locations. As these network publishing capabilities become more widely available, new businesses may emerge.

Barrier 2: Difficulty of using complex electronic information systems--The growing availability of electronic information from around the world is creating a crisis of rising expectations. Users want to be able to gather this information and sift through it effortlessly, but they often lack the necessary software tools to do so. They need tools to access networks, and to locate and use the electronic information systems that these networks link.

The Internet remains difficult to access. Organizations that want to provide information over the Internet have difficulty obtaining low-cost and high bandwidth connectivity, and finding the hardware and software tools they need, which are not available commercially. And without the usual consumer-oriented manuals and market-driven improvements, the software, once retrieved, is often difficult and time-consuming to install, even for the experienced user. For new and for small organizations interested in participating in electronic commerce on the Internet, the lack of easy-to-find and easy-to-use tools makes it difficult to link up to offer their wares. Their potential customers often find it difficult to locate companies, products and services.

Participants in the National Information Infrastructure Testbed (NIIT), a consortium of 60 companies, universities, and federal laboratories, are experiencing the challenges of accessing and using information across widely distributed systems. Members have expended a lot of time and resources to link multiple hardware, software, data, and information systems. They find that individuals resist using new distributed systems if they do not resemble their local systems.

Lessons Learned and Insights--NIIT participants noted that deploying a network for distributed applications can be rather chaotic. Often, special equipment is needed to bridge different communications hardware among collaborators. Frequently, NIIT members must provide additional training to participants to ensure that each site has an appropriate level of technical

expertise to manage the testbed activities.

Developers of EPRINETTM, the research and problem solving network for the nation's electric power companies, emphasized the need to organize information so that users can access it at incremental levels of detail. One state's utility looking for a solution to frozen power lines, for example, may want only basic information on what other states have done. But a utility searching for the latest research on the topic may need much more detail. The first utility should be able to access the basic information without plowing through unwanted research descriptions. The second should be able to access the topic in the same way, then travel quickly through the database to the desired level of detail.

Panelists stressed the need for on-line directories that help buyers find companies and products. The directories should be organized by topic, like the yellow pages in the telephone book, and by geography. Recognizing this need, CommerceNet, a consortium of companies and organizations exploring ways to conduct electronic commerce over the Internet, is now developing its own directories to identify and link participants.

To increase the use and usefulness of the Internet, panelists recommended that tools be fine tuned and commercialized so that more users would have access to them. In the meantime, organizations like CommerceNet are gathering these tools into one place for "one stop shopping" and offering them for free. Organizations can access this software on the CommerceNet server, download it and use it to establish themselves as a server of product information on the Internet.

Panelists agreed that users, especially those who are non-technical, need services that help them navigate the Internet and locate widely distributed information. They were excited about the World Wide Web, a growing subset of computers on the Internet whose information is collectively linked. Software "tags" written in a special language identify key information within documents on Web computers and facilitate these links. These tags also permit sophisticated graphics, audio clips and video clips to be embedded within the document to enhance the textual

information. People can select data in one document on a Web computer, receive an index of documents with related information, and automatically connect to any one of these other sources, even if they reside on other computers in this Web. Panelists also praised MOSAIC, a special software tool that recognizes these informational links so that users can easily browse information on Web computers and download graphics, audio clips and video clips along with text.

Barrier 3: Lack of security within the Internet--The absence of security management and user authentication is one of the most challenging issues related to distributed network environments. Security management ensures that no one can tamper with, or intercept information transmitted along the network. User authentication verifies the identities of parties on both sides of an electronic transaction. The Internet, however, has evolved as an open networking environment, and information is generally exchanged without security management or user authentication.

Users and providers are finding this open environment inadequate for electronic commerce. CommerceNet users, for example, are reluctant to exchange sensitive information, such as credit card numbers, bid amounts and other private data. They cannot be certain of buyer's or seller's identity making it difficult to ensure that the transaction is legally enforceable. The Nordstrom department store chain is also grappling with these issues as it begins adding e-mail to its personal shopping services. Similarly, participants in the NIIT have expressed concern about protecting proprietary scientific and technical data. The banking industry also has identified lack of security and user authentication as a deterrent to using public networks. Banks envision individuals and organizations increasingly conducting business over public networks like the Internet and requiring such traditional banking services as fund transfers to pay for products and services. But the lack of security guarantees for the transfer of payments and the difficulty in verifying people as they access bank accounts are slowing the adoption of these applications.

Lessons Learned and Insights--To cope with the lack of security on the Internet, electronic commerce users and providers currently offer credit authorizations

and fund transfers in a more secure, off-line mode. Commerce-Net, for example, is exploring alternatives to provide secure electronic transmission of payment data, but payment functions are often handled off-line through its financial members. Nordstrom requires customers who communicate via e-mail with its personal shoppers to send personal billing or credit card information the more traditional way, by mail or telephone.

Banks are investing in "smart cards" that would allow consumers to securely access their bank accounts--like today's ATM cards --while acting as an authentication device. Such cards would contain encrypted electronic signatures and bank account numbers. In addition, they would serve as an "electronic purse," allowing customers to transfer funds from their bank accounts to their cards electronically. In a process similar to withdrawing cash from an ATM machine, people would be able to put money "on" their cards, where a microprocessor would hold that amount. They could then use the card as cash. At a store, for example, a merchant would slide the card through a scanning device, deducting the merchandise price from the balance on the card. To replenish the balance, customers would simply transfer more money from their personal accounts to the card.

Barrier 4: Difficulty in measuring the benefits against the costs of new applications--When organizations conduct cost-benefit analyses of investments in NII applications, they often fail to understand or even consider the potential long-term advantages. The costs of designing and implementing a new information management system are usually fixed and easy to determine at the outset. The benefits, however, often accrue based on how much an organization uses the application, and how much it integrates those applications with new ways of doing work. The initial investment, therefore, is harder to justify.

The federal government, for example, is facing the enormous task of transforming its paper-driven procurement process. The government is convinced that electronic procurement will increase productivity, and that agencies must change their current work processes to capture the NII's full benefits. The agencies are struggling to identify the costs of modifying their current systems to allow potential suppliers to bid

for work electronically in a uniform government system.

Lessons Learned and Insights--Organizations conducting a cost-benefit analysis of NII applications should consider more than monetary savings. Improved information management, customer service and employee efficiency are other probable advantages, though difficult to measure. If an organization is overly concerned with immediate returns or short-term margin improvements, it may cripple its potential for long-term benefits by incompletely implementing NII applications, or choosing not to implement them at all.

Participants in NIIT, for example, have learned this lesson first hand. Now, instead of focusing on increasing profits in the short term, they view their participation as an opportunity to gain a competitive advantage by learning how to use distributed applications.

The federal government, meanwhile, has decided to develop models that compare the costs of processing an acquisition in a current paper-based, labor-intensive procedure with the costs of a fully automated system. Estimating the costs of this automated system, however, will have to include the expense of making agency procurement systems compatible. Potential suppliers dealing with the Department of Energy's software, for example, should be able to use that same software when dealing with the National Science Foundation.

IV. MANUFACTURING IN THE INFORMATION AGE

PANELISTS

Moderator: Al Narath - President, Sandia Corporation and Director, Sandia National Laboratories

Speakers:
Dale Hougardy - Vice President and General Manager of 777 Division, Boeing Commercial Airplane Group
Dave Levering - Director, Business Processes and Information Management, General Motors Corporation
Henry Morneau - Director of the Scientific Computing Division, DuPont

Thomas Patterson - Director, Information Security, Microelectronics and Computer Technology Corporation (MCC)
William Ranson - Director of Advanced Technology, Southeast Manufacturing Technology Center, University of South Carolina

BACKGROUND

Manufacturing continues to be a mainstay of the American economy, accounting for almost 20 percent of Gross Domestic Product (GDP) and 17 percent of employment. But U.S. manufacturers are facing intense competition, and they are turning to computer and information technologies and applications to maintain their edge. They are using these technologies to integrate all the steps that creating a product entails--from design through final assembly--through a process known as "knowledge management."

Today's customers are insisting on increasingly customized products at mass-produced prices. As a result, manufacturers must find ways to tailor products with the ease, speed and cost of similar mass-produced goods. In the future, manufacturers will have to be in constant contact with their suppliers and subcontractors to jointly design products, manage inventories, and schedule shipments. Design, manufacturing, and distribution processes will have to be linked through a computing and information system that focuses on knowledge management.

Even though manufacturing is ahead of many other sectors in making use of new technology, relatively few manufacturers are taking advantage of knowledge management applications. Not surprisingly, small- and medium-sized manufacturers are the least likely to have established computer networks connecting them to customers, suppliers and subcontractors. This is not a trivial issue since 350,000 small companies do 40 percent of the nation's manufacturing. Barriers need to be removed to entice and enable more manufacturers to make use of new knowledge management technologies and applications. Panelists and demonstrators discussed the financial, technical, and organizational obstacles that are slowing the adoption of these systems.

BARRIERS AND LESSONS LEARNED

FINANCIAL

To integrate knowledge management applications into the manufacturing process, businesses must make enormous capital investments. Such investments can be difficult to justify because quantifying the benefits associated with these applications is not easy.

Barrier 1: Difficulty in justifying organization-wide information applications--Organizations have not yet developed effective methods for measuring the benefits of these new applications against the costs. Calculating benefits requires predicting potential improvements in productivity, profitability, market share and customer satisfaction.

Lessons Learned and Insights--Without a way to quantify these costs and benefits many smaller companies may be reluctant to implement these applications. Larger organizations are more likely to be able to afford to take the "leap of faith" required to overhaul their information and communications infrastructures.

Boeing, for example, decided to entirely revamp its traditional design and manufacturing processes as part of its 777 project before it could adequately measure the potential benefits. In its 777 project, begun in 1990, Boeing linked its widely dispersed design teams through a worldwide communications network. This allowed the teams to communicate with each other and work simultaneously on the same designs as well as to incorporate input from their customers and suppliers. The faith in the 777 project proved to be justified: Boeing was able to reduce its error and rework rate by over 50 percent and thus significantly cut its costs. In addition, Boeing reduced its cycle time from 16 months to 12 months.

TECHNICAL

Panelists emphasized the importance of establishing an interoperable, reliable and secure communications web between manufacturers and suppliers that would make use of private, commercial and perhaps public networks. The panelists identified the following barriers.

Barrier 1: Reluctance in linking with the NII due to the rapidly changing nature of technology--The rapid pace of technological change makes it difficult to decide which systems to install and when. Continual change can lower productivity as workers need to be retrained repeatedly. In addition, because the NII is a fluid concept, manufacturers are not sure how to connect with it and to develop strategies that incorporate its use.

Lessons Learned and Insights--Manufacturers are not yet focusing on connecting with the National Information Infrastructure, instead they are building internal, private knowledge management systems to meet their corporate needs first. Companies such as DuPont, Boeing and General Motors are building extensive computing and communications systems that link their manufacturing processes. These systems, though worldwide, are not linked to publicly accessible networks.

Barrier 2: Lack of interoperability and interconnectivity--Manufacturers often find that new applications are incompatible with existing equipment and may be equally incompatible with future generations of equipment. In addition, manufacturers use a variety of computer systems as do their suppliers.

Lessons Learned and Insights--Manufacturers need their applications to operate across a broad spectrum of old and new technologies and networks. To better facilitate its joint design process, Boeing developed 18 major applications to integrate the diverse hardware and software of the company's seven design centers around the world.

General Motors took a different tack by replacing the dissimilar hardware and software that existed throughout the corporation and creating an integrated system known as C4 (computer-aided design, computer-aided manufacturing, computer-integrated manufacturing and computer-aided engineering). As part of its C4 program, GM linked the design, manufacturing and assembly teams that were previously unable to communicate with each other. GM made the decision that although its legacy systems represented a sizable capital investment, it was important that the entire manufacturing process be overhauled to

ensure interoperability and interconnectivity among all the players on the new network, including suppliers.

Barrier 3: Difficulty in ensuring network security--Network security is a prerequisite for the widespread use and adoption of NII applications in the workplace. Many current systems, however, are secure precisely because they are not connected to a larger, nationwide network. Guaranteeing that private networks remain secure when they are linked to a public network requires manufacturers to control access through a system of identification and authentication. Systems that can do this are only in the early stages of development.

Lessons Learned and Insights--Businesses are becoming increasingly concerned about the security of their networks. Responding to this demand, the Microelectronics and Computer Technology Corporation (MCC) has developed EINet to connect existing corporate networks with each other while providing key value added services, like security. The EINet security services include user authentication devices and controls that will verify the identity of a user and regulate access to corporate networks. The developers of EINet believe that this element of security will become increasingly important as competitors continue to work together on specific projects.

Barrier 4: Lack of standards for both internal and external systems --Companies believe they are spending too much time struggling with uncertain and ill-defined standards and product data exchange protocols. GM faced this problem when it created C4. Since only a limited number of standards and protocols were in place, GM had to spend a great deal of time developing standards and data exchange protocols that could be adopted by companies not now doing business with GM.

Lessons Learned and Insights--In a world of dissimilar networks, standards are essential. Without standards, effective cooperation and collaboration cannot occur. Standards not only enable rapid communication, but also reduce the risk of investing in complex products and systems. They can be key to accelerating market penetration and diffusion. While the panelists hesitated to assign responsibility for developing

these standards, they did agree that standards and protocols should be developed by the private sector.

In a recent example, DuPont was involved with a major automotive manufacturer and an injection molding company to develop an innovative, lightweight, polymer-based air intake manifold to replace heavier, less efficient metallic-based air intake manifolds. Scientists and engineers from the three companies worked together simultaneously to take advantage of each others' capabilities and expertise. Using advanced information, computing and communications technologies, both a new product and a new process were developed and brought to the marketplace.

While this project was a great success, it highlighted the difficulties that must be overcome to permit electronic collaboration. Technology incompatibility across companies, specifically lack of data standards, proved to be a barrier, sometimes requiring reformatting and even reentry of data. Some of the companies' networks were inadequate to transmit required information, forcing them back to reliance on mail and travel. The project also faced problems common to any collaboration, such as concerns regarding intellectual property protection, security and team building across diverse corporate cultures.

ORGANIZATIONAL

To realize the full potential of the NII, manufacturers must be willing to change the way they do business. Large gains in productivity and market share have traditionally been made when technological change is combined with organizational restructuring. Not only is business conducted more efficiently, but new business opportunities are often created that previously did not exist. Panelists agreed that organizational factors will have the greatest impact on whether NII applications find their way into the workplace.

Barrier 1: Complexity in forging new alliances with traditional competitors and suppliers--The information age has created a new system of customer/supplier relationships, but companies are not used to involving customers and suppliers in the design and development stages of manufacturing. Nor are they prepared to respond automatically to the concerns of customers and

suppliers.

Lessons Learned and Insights--Companies like Boeing and GM have spent an enormous amount of time developing "working together relationships" with their suppliers, subcontractors, and customers. For example, Boeing has worked extensively with the commercial airlines to develop a plane that meets the needs and desires of air passengers. GM has worked with its subcontractors to enable them to implement just-in-time assembly procedures to reduce inventory and lower costs.

Barrier 2: Difficulty in reengineering business processes and practices--Changing an organization's internal processes and culture can be at least as difficult--for both management and labor--as working with outside companies. And smaller businesses, particularly, may have difficulty obtaining advice on how to make this transition effectively.

Lessons Learned and Insights--The National Institute of Standards and Technology (NIST), a federal laboratory, has established Manufacturing Technology Centers (MTCs) to help small- and medium-sized manufacturers develop "virtual enterprises." Small companies can link with the MTCs electronically to use such applications as computed-aided design without having to make a large, up-front capital investment.

One center, the Southeast Manufacturing Technology Center (SMTC) in South Carolina, for example, helped a South Carolina company that makes fishing rods. The company was losing market share and was about to go out of business. It approached the MTC, which worked with the company to redesign its fishing poles using computer simulation tools that the company accessed over a network to create a prototype. As a result, the company recaptured its lost market share and became more competitive.

Barrier 3: Resistance to change and fear of shared responsibilities--Employees are often resistant to changes that increase automation and promote shared ownership of information. Companies need to train their workforce to understand that sharing information is vital to the success of the organization. Employees must be convinced that using these applications will result in a competitive advantage

for the company and help them to do their jobs more effectively.

Lessons Learned and Insights--Boeing faced many internal organizational challenges to the implementation of its 777 project. This project required significant internal cultural changes aimed at improving communication and teaching shared ownership. Boeing had to convince its employees that a collaborative approach would result in the best design. Extensive on-the-job training was required to ensure employee acceptance of the sharing that was fundamental to this program. Ultimately, Boeing employees and their suppliers had to adapt to a new environment where sharing information and partnering was mandatory.

V. USING THE NII TO IMPROVE EDUCATION

PANELISTS

Moderator: Linda Roberts - Special Advisor on Education Technology, Department of Education

Speakers: Lionel Baldwin - President, National Technological University
Frederick Carrigg - Executive Director for Academic Programs, Union City, New Jersey, Board of Education
Jacqueline Shrago - Chancellor for Information Technologies, Tennessee Board of Regents
Connie Stout - Director, Texas Education Network
Leona Williams - President and CEO, Educational and Corporate Technologies, Inc.

BACKGROUND

The impact of NII applications on lifelong learning will be extraordinary. Several studies have suggested that replacing conventional approaches to education with multimedia instruction saves time and improves academic achievement. Yet teaching methods have changed little since the turn of the century. The textbook is still the basic source of student information; teachers still "instruct" rather than encourage students to participate in interactive and collaborative learning activities; and teachers still work largely in isolation from their peers.

There are, however, signs of progress. School administrators, teachers, parents and students are all demanding better educational programs, and many are beginning to see the NII as a key tool for achieving that goal. The NII can take students and teachers beyond the limits of traditional school buildings, offering them greater access to a variety of instructional materials from a wealth of sources. But, the country needs to invest some of the billions it spends on education each year on NII applications if we are to enhance the country's productivity and competitiveness.

The great potential of the NII is making this an exciting time for educators--but one of great frustration as well. Educators face barriers that prevent them from bringing new educational applications into the classroom and using them effectively. Panelists and demonstrators discussed their concerns about acceptance and adoption; funding and affordability; installation and use; and laws and regulations.

BARRIERS AND LESSONS LEARNED

ACCEPTANCE AND ADOPTION

Conference demonstrators and panelists repeatedly emphasized that application developers need to do more to solicit the insights of the administrators, teachers, parents and students who will make use of the NII in America's schools. Otherwise, educational systems will continue to be slow to adopt these applications.

Barrier 1: Resistance to change--While many institutions and businesses have been forced to make advances to regain or maintain their competitiveness, schools' instructional methods have not changed appreciably over the past hundred years. School officials still are not convinced that traditional teaching techniques will be enhanced by these new educational tools, and they are therefore reluctant to make the enormous investments necessary to obtain them.

Lessons Learned and Insights--Providing teachers with ongoing training as well as ready access to equipment is the key to enlisting faculty support and adoption. Some school districts run training programs that

conclude by having teachers take their computers home with them. When educators feel comfortable with the applications and can have their questions and problems resolved quickly, they adopt the new information tools much more rapidly. Colleague-to-colleague training is especially effective. The Virtual School program in Tennessee, for example, developed a one-on-one volunteer program that pairs technologically inexperienced teachers with their more adept peers within the district or state. This has helped teachers overcome their fear of technology. The program has trained more than 4,200 teachers and training classes are booked a full three months in advance.

Barrier 2: The complexity of integrating information highway applications into all aspects of the curriculum--Because it is often difficult to envision NII applications as part of everyday teaching practices and the general curriculum, educators often separate technology-related activities from regular classwork. Schools may place all of their computers in a computer lab and use the lab for programming activities only. Others may have computers in the classrooms, but allow students to spend time on them only as a peripheral activity.

Lessons Learned and Insights--Schools and application developers both learned that unless NII applications are integrated into the regular curriculum, students cannot realize the full benefits of the new technology. They miss the chance to work on projects with students from around the world and to tap into a wealth of reference sources worldwide. Indeed, students and teachers tend to lose interest in new technology quickly if it appears to be a gimmick rather than a real aid to learning.

The Christopher Columbus Middle School in Union City, New Jersey has successfully accomplished this integration of the NII and the curriculum. The school, located in a low income, urban area, rewrote its curriculum to concentrate on enhancing the reasoning and collaborative skills of its students. The new curriculum required the students and teachers to use new computing technologies and applications to gather information for research projects. Test scores went up, attendance increased, and students could be found lining up in the mornings to use the computers

before school opened for the day.

The developers of the Collaborative Visualization (CoVis) project, a joint project between Bellcore and Northwestern University, also stressed the importance of integrating NII applications into the curriculum. CoVis allows students at remote locations to communicate with university researchers and other scientific experts on issues related to atmospheric and environmental science. Through their work, the developers of CoVis have concluded that their application should not be treated as an add-on technology but rather as an integral part of a new curriculum. In fact, CoVis developers have found that when educators adopt new project-based teaching styles, students become increasingly excited about learning.

FUNDING AND AFFORDABILITY

Severe budget constraints are complicating nearly every effort to improve America's schools, and the incorporation of NII applications into the curriculum is no exception.

Barrier 1: Existing school budgets are inadequate to fund the introduction of new technologies and applications--Incorporating telecommunications networks and new applications into schools requires a large initial capital investment. Schools must be completely rewired to provide classrooms with modem lines, a basic requirement for using the NII. In addition, they have to purchase and install new computer hardware, multimedia devices and software systems. For most schools, this type of investment is impossible within their current budgets. Many urban schools are in a perpetual financial crisis, without enough funding for adequate teacher salaries let alone for new technology and applications.

Lessons Learned and Insights--Schools that have forged ahead with NII programs have generally dealt with these issues in one of two ways: restructuring their budgets to include an NII allocation or, when funds simply could not be found, seeking corporate donations.

The Val Verde school district, located in Southern California, was able to create a reserve for an NII implementation plan by completely overhauling its operations. Val Verde was able to build up a reserve

equal to 21 percent of its total budget by increasing its administrative efficiency and lowering its internal costs through the elimination of travel expenses and unnecessary spending. It then used this reserve to provide every teacher with an advanced desktop computer and placed additional computers in every classroom.

In contrast, the impoverished Christopher Columbus Middle School could not build sufficient capital reserves. Determined to develop its telecommunications infrastructure anyway, the school sought and received support (hardware, software and phone lines) from Bell Atlantic to develop an interactive multimedia system that could be delivered into the classrooms over the public telephone network.

The Texas Education Network (TENET) is a state-funded initiative designed to connect all of the educators throughout Texas. TENET was formed in response to a legislative mandate that called for the development of a statewide educational technology plan. Panelists suggested that state legislatures should take the lead in solving these funding issues by rethinking how they could provide enough capital for their schools to take advantage of the NII.

Barrier 2: Inadequate funding to support the use of on-line services --Initial capital outlay for NII infrastructure, hardware and software is not the only financial barrier. Educators said they are particularly concerned about the day-to-day expense of using on-line information services. They balk at current telephone line charges and say that the cost per minute of using these services can be prohibitive for schools. Additionally, since overall cost is based on use, and since use varies per person, it is difficult to know in advance how much to budget and whether funding will be sustained.

Lessons Learned and Insights--The education community is uncomfortable with this uncertainty and is struggling to allocate funds appropriately for this variable expense. Educators have made relatively little progress in dealing with the issue of on-line charges. Some have responded by drastically limiting the amount of on-line usage per person, but others fear that such rationing will discourage usage, prompting teachers and students to return to more

traditional classroom methods. While some institutions have had the help of corporate sponsors, most of these partnerships are for a limited start-up period. These schools are still grappling with how they will afford on-line costs when that period ends.

Several panelists suggested that perhaps schools could be charged a special usage rate, less expensive than the business rate. They contended that the public interest would be best served by this type of discount for education.

INSTALLATION AND EASE OF USE

While some American classrooms have computers and some type of communications capability, very few have high-speed communications technology. In fact, 80 percent of the elementary and secondary schools with computers could not support multimedia graphics applications. And only 4 percent of the teachers in the schools have modems in their classrooms.

Panelists discussed several key issues that partially explain these disappointing statistics: schools' inadequate communications infrastructures, their difficulty in dealing with network and system problems, and interoperability hurdles.

Barrier 1: Inadequate communications infrastructure--The education system is one of the only sectors left in America without an advanced communications infrastructure. Planners for TENET, for example, found that only 2 percent of the classrooms they intended to serve had access to phone lines. Schools that would like to use NII applications have to be completely torn apart and rewired to have a modem line installed in each classroom. For many, this barrier is so daunting that many schools have concluded that it is just not worth the investment to upgrade the school's communications infrastructure.

Lessons Learned and Insights--Without this investment, schools will not be able to use and benefit from NII applications. Several panelists said that schools will be unable to make the necessary investments without help from the private sector. This was the experience of New Jersey's Christopher Columbus Middle School which has had to rely on the help of corporate sponsor Bell Atlantic.

Barrier 2: Difficulty in dealing with network and system failures--Educators said they are extremely discouraged by the frequent technical problems involved in using the NII. For teachers and students who have limited skills, these inconveniences may mean the difference between no change and quick adoption. A help-desk set up for network users in Union City, for example, is receiving between 30 and 50 calls a day for system failures and network difficulties.

To some degree, the teachers' frustration stems from having to make a major adjustment in instructional methods--from textbooks and chalk-boards that never break down to new and unfamiliar technical equipment. Schools face other difficulties as well in dealing with these failures. Most, for example, cannot afford a back-up system or technical support staff. These investments would be automatic for a large corporation.

Lessons Learned and Insights--Although system failure has slowed many schools' efforts to adopt NII applications quickly, others have found ways to answer questions and solve problems. In New Jersey, Bell Atlantic provided the Christopher Columbus Middle School with a support person who is on call full-time to the school. Faced with a similar problem and unable to provide each Texas school involved in TENET with its own technical support, the network established a central help-desk to provide solutions to educators statewide.

Barrier 3: Hardware and software interoperability and interconnectivity problems--The vast majority of America's schools are using equipment that is nearly obsolete. Although few can afford to upgrade their entire systems, many are seeking ways to add new equipment that would allow them to bring at least a few NII applications into the classroom. But these schools often find that new hardware or software is incompatible with existing equipment, and there are no assurances that any new equipment will integrate with future applications. Schools cannot afford to replace their equipment frequently so the constantly changing nature of the technology is especially problematic.

Lessons Learned and Insights--Some schools have found ways to minimize the expense and risk associated with

achieving interoperability. TENET planners, for instance, decided to start small and aim for annual growth. They have managed to integrate multiple networks and protocols by developing a network model that will allow the program to grow every year. In addition, they managed to cap costs and integrate much of their existing hardware by using lower-end applications rather than the higher-end, multimedia options. Today, three years after its inception, this teacher's network is used by more than 90 percent of Texas' districts, has over 35,000 active participants and averages 155,000 log-ins per month.

LAWS AND REGULATIONS

Two promising NII applications--particularly for higher education--are customizing educational materials and conducting university classes in one part of the country while students watch and respond via two-way video in another. Both are running into legal and regulatory hurdles. Outmoded intellectual property laws and differing state education requirements must be altered for the NII to move forward.

Barrier 1: Uncertainty surrounding use of intellectual property--How copyright law applies to the use of electronically transmitted materials is often unclear. For example, is copyright law violated if a teacher electronically distributes an article published by an on-line service to a class? In other instances, the law is clear, but restrictive. For instance, showing a videotape in a classroom is clearly permitted under the copyright law. Transmitting that same videotape to remote students in a "virtual classroom" via satellite is not permitted.

To remain clearly within the law, a teacher would have to receive the permission of every copyright owner whose work was to be distributed via satellite or on-line. This complicated, costly and time-consuming process could stifle the use of the NII for educational purposes.

Lessons Learned and Insights--A few organizations have dealt with these risks and are able to provide more educational services to more students in more locations. The National Technological University (NTU), for example, is one of the few examples of a "virtual campus" operating in the United States. Its faculty are top professors from 46 campuses whose

lectures NTU beams to 540 locations nationwide. NTU obtained written permission, at significant time and expense, from each of its participating universities and faculty to transmit and reproduce each lecture.

Barrier 2: Differing state education requirements and uncertain authority--The authority to regulate education belongs to the states. But, in distance learning programs courses can be delivered electronically across state lines. For a nationwide institution like NTU, that could mean dealing with 50 jurisdictions, each with its own standards and requirements--some of which may specifically seek to regulate distance learning programs. But, it is not clear yet whether state laws should apply to distance learning, or whether transmitting education across state lines constitutes interstate commerce, potentially making it subject to federal jurisdiction instead of state jurisdiction.

Lessons Learned and Insights--Although small in number, distance learning programs have proven to be effective. NTU has been especially successful, delivering 26,000 hours of graduate instruction from some of the nation's most respected professors to 10,000 technical professionals each year. NTU dealt with the regulatory obstacles, seeking permission from any state explicitly exerting authority over distance learning. Although this was a lengthy process, it eliminated the specter of costly and protracted litigation. States and the federal government need to examine the legal regime governing distance learning if it is to expand.

VI. USING THE NII TO DELIVER ENTERTAINMENT AND HOME SERVICES

PANELISTS

Moderator: Bran Ferren - Senior Vice President, Creative Technology, Walt Disney Imagineering

Speakers: Ellen Lovell - Director, President's Commission on the Arts and Humanities
Gene Quinn - General Manager, Chicago Online
Michael Sherlock - Executive Vice President, Technology, NBC
Stephen Tomlin - Vice President and General Manager, Interactive Technology, QVC Inc.

BACKGROUND

Growth in the entertainment and home services market is being driven by the development of new interactive technologies and applications to take advantage of them. The promise of new interactive delivery technologies has captured the imagination of the public and many entertainment and information service providers. But application developers are finding that offering "gee-whiz" interactive technologies without compelling content is insufficient to capture market share.

Panelists focused on the challenges of developing and delivering interactive home services such as on-line shopping and news delivery, as well as broadcast entertainment. Unlike the other panels which comprised users, these panelists were developers and deliverers of content. While they noted the need to address complex public policy issues such as intellectual property protection and efficient use of broadcast spectrum, comments were focused on the more immediate challenges they are facing in the daily business of creating and marketing entertainment and information services. These include developing exceptional content, ensuring access to the market for all information providers, including the not-for-profit arts sector, and adjusting market analysis models to the new interactive market.

BARRIERS AND LESSONS LEARNED

Barrier 1: The potential distraction of interactive technologies--In an effort to gain market share, application developers can become so distracted by new interactive technologies that they pay insufficient attention to their core businesses of providing content.

Lessons Learned and Insights--The best way to capture the consumers' attention is to offer unique and valuable information, programming and services. This material, no matter how it is delivered, must be compelling, widely promoted and packaged so that it provides more value than alternative sources of similar information. The key is identifying what the customer wants and finds interesting.

Users of interactive personal services are seeking tailored information available on their personal computers. They are less interested in video displays of dancing toasters than in timely personal e-mail and targeted, personalized information and services.

The Tribune Company and America Online understood this when they developed Chicago Online, an on-line information service targeted to the Chicago metropolitan area. It provides train and bus schedules for Chicago and the surrounding suburbs, the full editorial text of the Chicago Tribune, in-depth information on local businesses, universities, restaurants, concerts, theater and sporting events, as well as ticket purchasing services for these events. New information features are added frequently.

By offering valuable, time-saving information in an accessible format, Chicago Online has created a local identity and seen its business grow from 5,000 subscribers in 1992 to over 40,000 today. The success of this service has prompted the Tribune Corporation and America Online to launch Destination Florida, a similar service targeted to Florida residents and frequent vacation travelers.

QVC learned that focusing on technology at the expense of content can limit the growth of an interactive business. QVC offers potential customers the convenience of viewing merchandise on their television screen and calling a special phone number to place their orders. They learned that just offering shopping services directly to the home via the television is not enough to compete against traditional stores. They must also excel at fundamental retailing practices. Customers still expect good value, quality products, efficient merchandise ordering and delivery processes, and reliable customer service. A convenient interactive retailing service that is not supported by this kind of solid retail program will not survive.

Barrier 2: Lack of access to the market--Broadcasters and on-line information service providers both expressed concern that their access to the market could be hindered artificially by the telephone and cable companies, both of which are already competing with them in some services. Additionally, the low

penetration of personal computers in the home is a barrier to market growth for on-line consumer service providers.

Not-for-profit cultural organizations such as museums, performing arts organizations, libraries and historical societies are concerned that they may not be able connect to the infrastructure and deliver a rich array of cultural resources. These organizations are often struggling for funds to keep their doors open and serve their audiences with plays, exhibits, concerts or other cultural events. They rarely have the resources to acquire and apply the new technologies and applications that are being developed to take advantage of the NII. And yet they are driving technology and applications development by creating and supplying important intellectual and artistic content.

Lessons Learned and Insights--On-line information service providers want to ensure they have access to the information delivery infrastructure, such as telephone lines and cable delivery systems at a competitive cost. As information carriers like the telephone companies are permitted to offer expanded information services, on-line providers are concerned that they not be restricted (through price or technology) from using these delivery systems.

Television broadcasters provide free, over-the-air information services and entertainment. They are concerned that their access to the market could be hampered if information carriers such as cable companies and telephone companies are permitted to develop their own content. For television broadcasters, the key to market access will be the development of a system that displays programming information in a format that is not biased toward any one provider.

Televisions today provide a simple, easy to use navigational guide called the tuner control. Select a specific channel number by turning a dial or punching a button on a hand-held remote control device and the service associated with that number appears. Turn the television off and turn it on later and the last selected channel reappears. Channel selection is in the control of the consumer.

Future computer-based navigational guides will be more complex. Instead of the last customer-selected channel reappearing when the television is turned on, certain services, perhaps developed by the information carrier and offered for a fee, may appear first. Information regarding free services such as those provided by today's broadcasters may be buried in complex menus and not readily visible or accessible to the consumer. Broadcasters are concerned that future navigational systems be easy to operate and assure equal ease of access to all offerings, not just those developed by the carrier providing service to the home.

Panelists also commented that government and corporate assistance may be required to ensure that the not-for-profit arts community has access to this national infrastructure both as information and entertainment providers and users. In many respects, they can be and are application innovators. The entertainment, software and publishing industries, which draw upon the work of artists and scholars, in particular need to invest in them as they do in more traditional sources of scientific research and development.

Barrier 3: Lack of understanding of the interactive services market --Businesses expanding into interactive entertainment and home services often find that they are dealing with a different set of customers than they had expected, or with existing customer attitudes that are incompatible with this new market.

Lessons Learned and Insights--In the process of developing an on-line interactive shopping service for delivery over personal computers, QVC discovered that the limited product selections and high margins of its current televised format do not appeal to the individuals who are using personal computers for electronic shopping. The interactive world of free-flowing and low-cost information dictates instead a marketing model comprising unlimited selection, prices close to cost and two-way communication capability.

As broadcasters and newspapers begin to offer interactive services, they will have to address long-held customer attitudes regarding pricing. Broadcasters and newspapers currently finance their

businesses by offering advertisers mass markets for delivering their message in return for large advertising fees. The public has been trained to think that the news, information and entertainment they receive should be free or nearly free and that detergent manufacturers will pay the bill. This approach may not be viable in the future interactive service medium when mass markets are replaced by customers selecting their information and their information delivery methods. Information service providers will have to develop ways to charge customers directly and convince them that such charges are justified.

Finally, because offering interactive services raises so many business issues, developing an interactive strategy should not be left to the computer support team. "Getting on the information highway" sounds technical, so organizations often delegate the task to the technical departments. A better approach is to develop a cross-functional team comprised of technical staff as well as marketing and sales personnel. The team should be seasoned with "techno-illiterates" who can't operate the fax machine but who understand the core business.

VII. DEMONSTRATION HIGHLIGHTS

HEALTHCARE DEMONSTRATIONS

THE COMPREHENSIVE HEALTH ENHANCEMENT SUPPORT SYSTEM (CHESS)

CHESS is a home-based application that enables patients with certain illnesses to access answers to commonly asked questions; a library of several hundred articles, brochures and pamphlets; a catalog of real-life personal stories of living and coping with health crises; e-mail communications with health care experts; and on-line discussion groups.

Barriers

n Lack of patient access to personal computers.
n Uncertainty surrounding how to market CHESS.
n Difficulty in making CHESS a reimbursable medical expense.

Lessons Learned

n Developers must fully understand who they are trying to serve and what the patients need.
n Home access is essential for use.
n CHESS must be made available on existing personal computing technology.

Point of Contact:
David Gustafson
CHESS Research Consortium
Room 1109 WARF Building
610 Walnut Street
Madison, WI 53705

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DYNAMIC RADIATION THERAPY PLANNING

Dynamic Radiation Therapy Planning is a cancer treatment planning program in which physicians create 3-D models of cancerous tumors on a supercomputer and develop accurate radiation treatment plans. Doctors using this system are seeing higher cure rates and less destruction of healthy tissue. This radiation treatment tool was developed by the University of North Carolina's Medical School and uses hardware systems linked by an experimental high-speed network.

Barriers

n Lack of clear guidelines from the Food and Drug Administration regarding the distribution of medical software.
n The challenge of combining the talents of medical and computer experts to develop the system.

Lessons Learned

n The network must have a gigabit per second capacity to link hardware resources.
n This tool provides better radiation treatment plans than do conventional techniques.

Point of Contact:
Julian Rosenman, MD
Dept. of Radiation Oncology

Univ. of N.C. Medical School
University of North Carolina
Chapel Hill, NC 27514

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HEALTHNET

HealthNet is a prototype designed to provide critical healthcare information at home via interactive television. Patients will be able to select informational segments on such topics as breast cancer treatment options, the long-term effects of divorce on children, fitness for women, nutrition for men, and coping with depression. Roughly two-thirds of the HealthNet information concerns prevention and the other third concerns specific illnesses.

Barriers

n Limited interactive television penetration.
n Difficulty anticipating user demand.
n Uncertainty about how interactive video should be priced.

Lessons Learned

n For maximum usefulness, content should be delivered in a variety of styles such as expert advice and personal testimonials. It should also be available as text.
n Successful health information providers will be those who create useful and attractive content that meets the needs of consumers.

Point of Contact:
Steve Schlossstein
President and CEO
Interactive Health Network
175 Fairway Drive
Princeton, NJ 08540

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INTERPRACTICE

InterPractice is a workstation-based system that

enables physicians and clinical staff to capture, store and transmit patient medical information electronically in real time, allowing on-line order placement (lab, pharmacy, etc.), referral prompts, clinical reminders, and allergy or medical alerts. As a result of using this system, hospitals have realized significant cost savings.

Barriers

n Difficulty gaining clinical acceptance for use of the system.
n Developing a comprehensive cost justification and benefit analysis.
n Lack of protocols and standards for deployment at multiple sites.

Lessons Learned

n Developers and users must work together to ensure adoption.
n Extra support staff during transition time helps to reduce frustration.

Point of Contact:
Susan Belmont
InterPractice Systems
620 Folsom Street
San Fransisco, CA 94107

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PINE RIDGE INDIAN RESERVATION TELEMEDICINE PROJECT

This project is using NASA's ACTS satellite system to conduct a telemedicine trial between the Mayo Clinic and a clinic at the Pine Ridge Indian Reservation in South Dakota. In addition to conducting patient consultations via satellite linkages, the physicians make use of advanced technologies such as an electronic stethoscope, an ultra-sound, and an electrocardiogram and transmit the information between the reservation's clinic in South Dakota and the Mayo Clinic in Minnesota.

Barriers

n Limited land-based broadband capability required link-up to be via satellite.
n Uncertainty surrounding state medical licensing laws relating to interstate telemedicine. (Indian reservations are not subject to some state laws.)

Lessons Learned

n Patients miss the "touch" of the physician.
n Telemedicine is an effective tool to bring specialized healthcare to remote locations with limited medical resources.
n Interstate telemedicine usage will be limited until state licensing laws are clarified.

Point of Contact:
Bijoy Khandheria, MD
Mayo Clinic
Cardiovascular Division
200 First Street, SW
Rochester, MN 55905

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EDUCATION DEMONSTRATIONS

BILL NYE THE SCIENCE GUY GOES INTERACTIVE

This program is an interactive version of the children's education show Bill Nye the Science Guy. The program will allow children to participate in on-line experiments, quizzes, games and various other activities. It is being developed to enhance and supplement science education for junior high school students. The interface to Bill Nye the Science Guy interactive will be virtual "Nye Labs"--electronic laboratories with many "rooms" to visit and explore.

Barriers

n Difficulty transforming previously produced video into interactive segments.
n Lack of user demand and uncertain commercial viability.

Lessons Learned

n Intellectual property rights must be clarified as interactive television develops.
n Television stations may have to move from a conventional broadcasting model to an interactive programming model.

Point of Contact:
Walter Parsons
Senior Vice President
KCTS - 9
401 Mercer Street
Seattle, WA 98109

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COVIS - LEARNING THROUGH COLLABORATIVE VISUALIZATION

CoVis is a scientific visualization application that uses collaborative hardware and software tools, including desktop videoconferencing. It allows high school students and teachers to study environmental and atmospheric science with their peers and scientists from around the nation. Funded by the National Science Foundation, CoVis aims to bring additional knowledge and excitement to students as they work on projects related to science, mathematics and technology.

Barriers

n Resistance to new methods of teaching.
n Lack of sufficient computing and communications infrastructure in the schools.

Lessons Learned

n Teacher training, preparation, and collaboration are critical to success.
n The costs of purchasing hardware and software are easier to justify than variable costs, such as per-minute line charges.

Point of Contact:

Harry Klancer
Bellcore
Room MRE 2E267

445 South Street
Morristown, NJ 07960

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EDUPORT

EduPort, a digital multimedia library designed to enhance K-12 education, is being used at a high school in Nebraska. Video, audio, image and text information are gathered from various sources, including the Discovery Museum, NASA, and the Smithsonian. Teachers can easily access EduPort's multimedia library and integrate this information into their lessons. EduPort also provides teachers with examples of lesson plans that make use of EduPort information.

Barriers

n Most schools lack telephone lines in the classrooms, personal computers and communications modems and thus cannot connect with EduPort.

Lessons Learned

n This project could not have succeeded without the collaboration among the K-12 schools, universities and the private sector who developed the system.

Point of Contact:
Miriam Masullo
T.J. Watson Research Center
IBM Research Division
P.O. Box 704, H2-A06
Yorktown Heights, NY 10598

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GLOBAL SCHOOLHOUSE

Global Schoolhouse is a collaborative project that allows students to use advanced video tools to work and learn with other students, teachers and scientists in different locations. The project has expanded from four to eighteen schools in several countries and students have become more enthusiastic. The Global Schoolhouse project hosts its own World Wide Web

server with newsletters, student information, movies, and projects.

Barriers

n Lack of high bandwidth telephone lines in participating schools.
n Not all schools were at the same level technically; there was a long ramp-up time waiting for hardware, software and network connections to be installed.

Lessons Learned

n The training and support of the teachers and students using these applications is of great importance.
n Teachers and students are excited about the ability to communicate instantly with their peers around the world.

Point of Contact:
Lynn Elmers
Sprint
Government Systems Division
13221 Woodland Park Road
Herndon, VA 22071

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PBS MATHLINE

PBS Mathline is an educational service that uses computer-based and video-based technologies for interactive communication between math educators around the country. The project allows teachers to help each other meet teaching standards developed by the National Council of Teachers of Mathematics. Teachers who participate in this program have access to video modules that illustrate classroom techniques.

Barriers

n Inadequate computing and communications infrastructure in schools and classrooms.
n Insufficient training of teachers on new technologies and applications.

Lessons Learned

n Partnerships with organizations with the same educational goals strengthens endeavor.
n Engaging content overcomes reluctance to use new technologies.
n New applications and technologies require extensive training and support.

Point of Contact:
Jinny Goldstein
VP Education Project Development
PBS
1320 Braddock Place
Alexandria, VA 22314

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VARIATIONS MUSIC INFORMATION SYSTEM

VARIATIONS is a digital information system that enables individuals to select audio and visual recordings for review directly from workstations. Users can select specific musical passages for listening or viewing, concentrating on parts that are important to them. This tool has been developed to augment the music curriculum at Indiana University with its music library of over 150,000 items.

Barriers

n Difficulty ensuring protection of intellectual property.

Lessons Learned

n Users of this application tend to attach a lot of importance to the appearance of the workstation's interface and its ease of use.

Point of Contact:
David Fenske
Head, Music Library
School of Music
Indiana University
Bloomington, IN 47405

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BUSINESS AND HOME SERVICE DEMONSTRATIONS

THE C4 PROGRAM: AUTOMATED AUTOMOTIVE MANUFACTURING

The C4 program integrates General Motors' computer-aided design, computer-aided engineering, computer-aided manufacturing, and computer-integrated manufacturing capabilities, linking the product development and manufacturing processes. C4 is helping GM bring its products to market faster by reducing the time required for design, engineering and testing.

Barriers

n Difficulty reengineering business processes and practices.
n Existing hardware and software systems represent a sizable capital investment and overhauling them requires extensive justification.

Lessons Learned

n As part of its deployment activities, GM has had to develop standard workstation configurations.
n Organizational acceptance of this system was much more difficult than anticipated.

Point of Contact:
Norb Martz
Business Dev. Manager
EDS
750 Tower Drive
Troy, MI 48098

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CHICAGO ONLINE

Chicago Online is an interactive information and entertainment service providing information to and about Chicago and its 19 surrounding counties. It provides in-depth local coverage of Chicago's shopping and entertainment opportunites. Chicago Online offers

such services as the text of a daily newspaper, advanced event ticket purchasing and electronic mail.

Barriers

n Low penetration of personal computers in the home.
n Lack of consumer acceptance of new information delivery mechanisms.

Lessons Learned

n Users want customized, time-saving information.
n Establishing a local presence is key to success.

Point of Contact:
Gene Quinn
General Manager
Chicago Online
435 N. Michigan Avenue
Chicago, IL 60611-4001

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COMMERCENET

CommerceNet is a consortium that enables electronic commerce on the Internet. Using CommerceNet, buyers browse multimedia catalogs, solicit bids, and place orders, while sellers respond to bids, schedule production, and coordinate deliveries. In addition, several value-added services are available such as specialized directories, referral services, vendor certification, credit reporting, and financial services.

Barriers

n Difficulty accessing the Internet.
n Difficulty using the Internet.
n Lack of transaction security.
n Lack of secure payment methods.

Lessons Learned

n It is difficult and expensive for small businesses to get started as information providers.

n Software tools to help organizations set up a World Wide Web server are not readily available and usable.

Point of Contact:
Cathy Medich
Executive Director CommerceNet
459 Hamilton Avenue
Palo Alto, CA 94301

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ENTERPRISE INTEGRATION FOR MANUFACTURING

This is a decision-support tool that helps industry understand the capabilities of STEP, an emerging international group of data exchange standards. Decision-support tools using STEP can be employed to communicate and manage the development of a product over its life-cycle and across organizations. This system illustrates how graphical software toolkits can speed the development and testing of new applications that will enable effective concurrent engineering and design.

Barriers

n Length of time required to develop international standards.
n Absense of software to help in development of standards.

Lessons Learned

n As companies become more familiar with STEP they are more willing to adopt industry standards that facilitate communications outside of their organizations.

Point of Contact:
Mark Luce
NIST
Bldg. 220/A127
Gaithersburg, MD 20899

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EPRINET (TM) - THE ELECTRIC UTILITY INFORMATION NETWORK

EPRINET is an on-line computing and information system that allows the electric utilities to share research and technical information and communicate more effectively. The information services designed to facilitate and accelerate the transfer of research results include electronic mail, news, bulletin boards, full-text databases and on-line ordering.

Barriers

n Target audience was inexperienced in using on-line information services.
n Initial applications were not integrated and had different user interfaces.

Lessons Learned

n Support of top administrator was essential for success.
n The most important factors in attracting and keeping customers included:
-valuable content,
-convenient and easy access,
-reliable network communications.

Point of Contact:
Jim Mulvaney
Senior Consultant
EPRI
3412 Hillview Avenue
Palo Alto, CA 94304

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INTERNET PUBLISHING AND DOCUMENT ACCESS

This project is a cooperative effort among several leading companies and universities to define an architecture for distributed printing of high quality publications over the Internet. The same set of services will enable publishers to distribute their materials digitally to multiple sites for production, or library patrons to browse a digital document collection and have a high quality paper copy

produced on demand.

Barriers

n Lack of standards and common procedures to facilitate custom publishing and print on demand.
n Inadequate mechanisms to prevent illegal use of digital intellectual property and to pay for its legal use.

Lessons Learned

n Distributed printing must be as easy as today's desktop printing to be successful.
n Systems must become easier to use even as their capabilities expand.
n Network publishing could lead to lower warehousing and transportation costs.

Point of Contact:
Glen Alexander
Xerox Corporation
345 Woodcliff Drive
Mail Code 819-01A
Fairport, NY 14450

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MuUSE

MuUSE is a software system that generates synthetic environments from digital data. The virtual reality capabilities allow users to become "immersed" in a three-dimensional, computer-generated world where they can examine designs and interact with data to an extent not possible otherwise. For example, a surgeon can enter a 3-D CT scan of a human body as if he were there; or an engineer can investigate microscopic details of a mechanical design assembly.

Barriers

n Intensive graphics require expensive computers.
n Potential users do not understand

Lessons Learned

n Showcasing examples of applications make the potential of virtual reality more clear.
n Human/computer collaboration can be improved far beyond today's practices

Point of Contact:
Arlan Andrews, Sr.
Manager, Advanced Manufacturing Initiatives
Sandia National Laboratories
P.O. Box 5800
Albuquerque, NM 87185-0955

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ON-SCREEN TELEPHONE BANKING

This system uses a new screen telephone and a special access/authentication card, similar to a banking ATM card, to allow customers to conduct banking transactions, such as balance inquiries, money transfers, and bill payments from home. In addition, stock quotes and securities transactions can be completed from home within minutes. These systems are being successfully deployed in New York, Chicago and Washington, D.C.

Barriers
n The cost of necessary equipment for home use is high.
n Difficulty developing standards, open architectures, and compatible interfaces.

Lessons Learned
n Customers demand:
-ease of use,
-convenience,
-control/security.

Point of Contact:
Susan Vladek
Philips Home Services
New England Executive Park
Burlington, MA 01803

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PICTURE EXCHANGE

Picture Exchange is an on-line image library and marketing service that links image providers to image users. To date, over 1,000 publishers, advertising agencies and graphic designers are using it to obtain images offered by over 20 providers. These pictures are ready for rapid brokerage between image providers and users. This system is creating new business opportunities and relationships between picture buyers and sellers that otherwise might not have developed.

Barriers
n Difficulty gaining consensus on a common format for digital images and a common standard for image indexing.
n Many users are reluctant to substitute digital data bases for stacks of hard copy images.

Lessons Learned
n Picture sellers and buyers must be willing to do business differently if this kind of service is going to be successful.
n Widespread adoption of electronic image retrieval will be slow, but steady since work processes must be redesigned.

Point of Contact:
Roger Hansen
Kodak Picture Exchange
Eastman Kodak Company
1447 St. Paul Street
Rochester, NY 14653-7107

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SOUTHEAST MANUFACTURING

The Southeast Manufacturing Technology Center (SMTC) is connecting electronically with small manufacturers and helping them use its advanced computing capabilities. The SMTC, funded by the federal government, provides access to sophisticated applications such as design engineering, rapid prototyping, and predictive engineering. by using these tools, companies are better able to meet customer demands, compete more effectively, and expand market share.

Barriers
n Many rural companies have little or no computing and communications infrastructure.
n Convincing manufacturers that these applications could improve their competitive position is difficult.

Lessons Learned
n When no separation was made between technology and the business aspects of manufacturing operations, the company usually adopted the new technology or procedure and realized a bottom-line value.

Point of Contact:
William Ranson
Swearington Engineering Center
University of South Caroling
Columbia, SC 29208

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PUBLIC SERVICE DEMONSTRATIONS
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THE ADVANCED DRIVER AND VEHICLE ADVISORY NAVIGATION CONCEPT (ADVANCE)

ADVANCE is an electronic navigation system for automobiles that delivers real-time traffic information to drivers. A public/private partnership developed ADVANCE and is evaluating its effectiveness in helping drivers avoid traffic congetion, thereby enhancing safety. The ADVANCE test area covers approximately 300 square miles around northwest Chicago. By the end of 1994 over 5,000 privately owned vehicles will be equipped with these intelligent vehicle highway systems (IVHS).

Barriers
n Unclear legislation surrounding public/private partnerships and the private sector's disclosure obligations.

Lessons Learned
n Private sector partners must be willing to invest significant resources to ensure success.
n Continuity of project management personnel is essential.

Point of Contact:

Paul Dowell
ADVANCE
Project Business Manager
Motorola IVHS
4000 Commercial Avenue
Northbrook, IL 60062

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INFO/CALIFORNIA

Info/California is a newtork of interactive kiosks that provide a multi-lingual system to conduct routine transactions between the state government and California citizens. These kiosks allow citizens to file job applications, renew their automobile registration, learn about training pograms, change their DMV mailing address, order birth certificates, and conduct many other routine government transactions. The kiosks -- which look similar to an ATM booth -- are widely distributed in such areas as grocery stores, mall, and libraries.

Barriers
n Difficulty getting state agencies to work together to support kiosks.
n Inflexibility in the procurement cycle that fails to keep up with technological change and forces the kiosks to adopt outmoded technology.

Lessons Learned
n Sharing costs across agencies can be a motivator for working together.
n A project champion was critical to the project's success.

Point of Contact:
Shirley Marshall
IBM Corporation
6700 Rockledge Drive
Bethesda, MD 20817

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MARINE SPILL RESPONSE

The Marine Spill Response is a state-of-the-art

emergency management response tool that is used in the event of an oil spill. It links multiple aspects of an oil-spill response effort to each other: initial response decisions, damage mitigation actions, environmental, social and economic threat assessments, and equipment procurement efforts. This system allows relief workers to organize themselves for a prompt and appropriate response effort.

Barriers
n Extensive data transfer is necessary for this operation to exceed. However, there are no established data exchange standards.
n Linkages need to be made across the globe between different systems at different locations.

Lessons Learned
n An easy application interface must be provided for the user, or the application will not be used.
n User requirements must be carefully documented before construction of the application begins.

Point of Contact:
James D. Black
Account Manager
EDS
1350 Eye Street NW
Suite 300
Washington, DC 20005

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MIRA-NATIONAL GALLERY OF ART

The MIRA system is an electronic database designed to capture, edit, store, retrieve, and display the Nationa Gallery's art collection. In addition, it is linked to a text-based system that provides background o each work of art. This system will be used throughout the Gallery in its cataloging section as wel as its art education division. The goal of the MIRA project is to provide access to the masterpieces a the National Gallery via other on-line services.

Barriers

n Scanning every piece of art in the Gallery's collection is a long and extensive process.

Therefore, it will take many years before all of the work can be available on-line.

Lessons Learned
n MIRA is becoming an increasingly valuable tool for the museum curators and their staffs.

Point of Contact:
Pam Jenkinson
Dept. of Special Projects
National Gallery
4th and Constitution Ave.
Washington, DC 20565

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NORTH CAROLINA INFORMATION SUPERHIGHWAY

The North Carolina Information Highway (NCIH) is a public/private project to link more than 3,400 sites with a multimedia, broadband network. This network will deliver new applications including distance learning, telemedicine and government services. It eventually will link sites throughout the state including state government operations, prisons, hospitals, public schools, colleges, libraries, and businesses.

Barriers
n Increased cost due to laws that prevent local telephone companies from providing long distance service.
n High cost of ensuring that all schools have access to the NCIH.

Lessons Learned
n Interactive town hall meetings hold great potential for improving the responsiveness of government at all levels.
n Distance learning via videoconferencing capabilities have great potential for reducing the cost of training.

Point of Contact:
Lynn Roberson
BellSouth Telecommunications
P.O. Box 30188
Charlotte, NC 28230

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PEOPLE WITH DISABILITIES AND THE NII

This demonstration showcased hardware and software tools that assist people with physical disabilities in accessing on-line information resources. To make the information accessible, voice and text recognition software is incorporated with intelligent interface devices and used to supplement or replace computer monitors, keyboards or telephones.

Barriers
n Difficulty providing needed education and information to developers concerning the needs of people with disabilities.
n Immaturity of attitudes and open systems impede responsiveness.

Lessons Learned
n Awareness of access requirements varies greatly by company.
n Repetitive strain injuries heighten awareness of design deficiencies.
n Planning for modality choice during product inception eliminates need for retrofitting.

Point of Contact:
Susan Brummel
Clearinghouse on Computer Accommodation, GSA
18th and F Street NW
Room 2022
Washington, DC 20405

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WIRELESS IMAGERY COMMUNICATIONS SYSTEM FOR CRIME INFORMATION

This project is an interactive real-time wireless system that provides officers with the ability to accurately identify a wanted, missing or unidentified person within seconds. Currently, officers are able to transmit images of fingerprints, mug shots, stolen objects, contraband and personal property between all law enforcement and related agencies. Eventually, this application will be placed in police patrol cars,

improving an officer's ability to accurately identify a suspect.

Barriers
n Lack of digital standards for image transmission.
n Insufficient bandwidth has been allocated for public safety agencies.
n Cost of providing a wireless network and upgrading existing networks.

Lessons Learned
n Real time identification of suspects and victims has saved lives.

Point of Contact:
Wayne Leland
Corporate VP of Sector, Spectrum, and Standards
Motorola, Inc.
1301 E. Algonquin Rod.
Schaumburg, IL 60196

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Council Associate Carolyn Harings and Council

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