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16. Abstract

In order to promote linkages between transit and community needs, as well as enhance the development and transfer of technology, researchers and communities must begin to utilize new and emerging tools designed for the computer. One such tool is the on-line computer network. This report provides a framework for the technology planning process within the overall strategic planning for computerizing technology transfer activities by incorporating the transportation community, and the interested public into the decision making process by providing a means for all to be able to give input into the kind and depth of research conducted.

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LINKING TRANSPORTATION RESEARCH AND EXPERTISE TO COMMUNITY INTEREST: A TECHNOLOGY TRANSFER INITIATIVE

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ABSTRACT

In order to promote linkages between transit needs and community needs and to enhance the development and transfer of technology, researchers and communities must begin to utilize new and emerging tools designed for the computer. One such tool is the on-line computer network. This report provides a framework for the technology planning process within the larger context of overall strategic planning for computerizing technology transfer activities and incorporating the transportation community and the interested public into the decision making process by providing a means for all to be able to give input into the kind and depth of research conducted.

EXECUTIVE SUMMARY

With the increasing use of the Internet for education and design communications, an important next step is the deployment of our expertise on the web, thereby offering scholars, staff, students, and citizens the opportunity to accomplish online research and to collaborate in a global, electronic environment. Because its online and electronic services and databases would be available to anyone with Internet access, the ability of a Transportation Community Research Center (TCRC) to increase its service base within the State of Texas and beyond and to conduct collaborative research would be greatly expanded.

Travel expenses can be reduced or eliminated with this Internet process and partnerships quickly forged at all levels of expertise. An online TCRC will provide a flexible, collaborative, and interdepartmental research forum where scholars, faculty and students, community organizations, and industry stakeholders could work from a distance via personal computer, with each other or in combination. Experts from great distances and/or nearby citizens could equally access this mediated design environment to participate in symposiums or conferences. TCRC staff and scholars could pursue grant funding, and provide greatly enhanced visibility for these significant information technologies by acting as a single resource to other research centers, citizens groups, universities, government, and business.

In many ways 1998 can be described as the year the Internet went mainstream. The Internet began the year as the world's largest depository of information. By year-end it had become the fastest growing source of consumer entertainment and news, the most talked about technology for e-commerce, and an increasingly important network for audio and video-based communications for both consumer and corporate needs. The evolution is now in full swing - from the age of voice communications to the age of visual communications. Vendors are fueling the transition by introducing exciting new conferencing solutions, which address real time (synchronous) and non-real time (asynchronous) communications needs and which operate across a heterogeneous networking architecture. In addition, while equipment interfaces are becoming user-friendlier, the opportunities to create larger and more complex heterogeneous networks are increasing. The year 1999 is likely to be remembered as the year in which the computer and communications industry acknowledged the fact that the future will be based on Internet Protocol (IP). IP is the technology of the Internet. Too often research leaves out a key player in the wise use and revitalization of our neighborhoods, rural lands, and preserved spaces: the citizen. Many software programs are super expensive, often funded by corporations or national government agencies for exclusive knowledge bases. Research is slow to trickle down to the level of activists and local governments. It is clear that virtual design languages, like VRML, and online access to GIS databases, are challenging the traditional ways that we accomplish planning and design projects. In this report, technology transfer for the next century is framed by four critical concepts: collaboration, access, technical infrastructure and institutional infrastructure.

Collaborative tools from electronic sketchpads, to personal digital assistants and computer generated virtual worlds are of little use to us without substantial investment in online community networks and design processes, which are supported by ongoing public/private support. Sustainability is defined here as the continued support of long term public-private partnership building, the construction of global democratic participation networks (i.e.- equal access to technology) for all citizens, and a focus on the not-for-profit sector as a bridge builder between the community, big government players and the private sector. They can shorten communications paths, speed decision making, improve teamwork, improve relationships, and help corporations, state agencies, community stakeholders and educational institutions of all kinds extend their reach.

This research outlines the technology steps needed to start a community research network and gives cost breakdowns for the optional ways that this can be done. It is found that while the technology is currently available and easily implementable, attitudes and policies must also be considered in the success or failure of such a project.

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CHAPTER 1

INTRODUCTION

The Federal Transit Administration (FTA) outlines challenges for transit in America in its Strategic Plan. Central among the challenges and strategies proposed in the plan is the need to strengthen linkages between transit and communities throughout the nation. Strategies call for greater involvement in the local planning and design process by neighborhood and community organizations, small and minority business enterprises, persons with disabilities, and other stakeholders. Increasing access and collaborating with other Federal agencies to foster integration of transit with other community services are several desired goals. Emerging technologies must play a key role in promoting linkages between transit and community needs at the local, regional, state, and federal levels.

Telecommunications research findings and information technology could play an important role in the transportation future of Texas. The application of new and emerging technologies could possibly induce changes in overall travel demands and services, serve as a travel substitute, and improve the overall performance of the transportation system. To enhance efforts to link transit to community needs and to provide for the utilization of research findings and expertise, the partial answer to the need to develop a mechanism facilitating the transfer of technology and encouraging the deployment of Intelligent Transportation Systems (ITS), may lie in the extent to which a cooperative effort between government, private industry, research institutions, transportation and community planners can be developed. Because the

nation's transportation problems are in a state of constant flux, there exists an urgent need for cutting edge research and education geared toward producing new approaches, new solutions, and new modes of information dissemination and technology transfer. The proposed project is designed to establish a network of research centers to link transit and community needs. Through them, the following advances can occur:

- **Students** will discover how their new skills and knowledge work in practice to solve problems through teamwork, thus preparing them for future employment;

- **Faculty** can use the Research Centers to connect theory with practice, research with teaching and community service, and their own discipline with others;

- **Universities** can raise the profile of research in transportation by demonstrating its value to society;

- **Communities** will gain easier access to the resources which universities can provide to make their own organizations more effective in meeting social needs;

- **The Public** will understand better the university's unique mission which combines teaching, research, and community service;

- **Governments**, proposing to reorganize many social programs, can support a new connection between the resources of universities and the needs, which community organizations are struggling to meet.

CHAPTER 2

BACKGROUND

Project Purpose

The purpose of this research is to develop for future implementation a methodology designed to promote linkages between transit needs and community needs to enhance the development and transfer of technology. The objectives of the project include:

- Determine the current state of information technology being used to support distance collaboration;
- Determine the type and level of information needed by communities;
- Identify the technology available to meet current and future needs and its interoperability, quality, and costs;
- Examine the benefits of creating a network of intellectual resources and information among major transportation stakeholders;
- Develop recommended actions for meeting the distance sharing needs and performance expectations of community organizations and major transportation stakeholders.

The methodology proposed would, by necessity, require that a network of "Transportation Community Research Centers" (TCRC's) be established that would be responsive to local and regional transportation conditions. The system would have among other things the capability to link individuals working on similar problems together. The TCRC would provide a healthy counterweight to university research and technology transfer ties to the transportation industry.

Definitions

Within the context of this research, certain concepts must be defined. The terms related to the interaction of individuals and groups not constrained to the same location are as follows:

- *Distance Based Information Sharing* can be defined as the transfer of information and/or collaboration among organizations and individuals that is not constrained to occur in real-time or to a physical exchange of documents or materials.

There are two types of distance interaction possible[1]:

- *Synchronous Interaction* involves the simultaneous participation of all parties and occurs in real-time. Synchronous communications media include interactive video-conferencing, computer conferencing and chat, and audio conferencing via voice communications.

- *Asynchronous Interaction* has participation times and locations chosen by the end user; accompanying materials are available on demand or in advance. Such media include videotaped information, compact disk interactive (CD-I), and digital video disk (DVD). These media provide high levels of convenience[1] and any time service.

Table 1 defines the types of computer-based activities that fall into each category. The next section will expand upon the previous definitions of asynchronous and synchronous by looking in more detail at the tools in each category within the context of changing academic needs and the growth of community research networking.

Table 1. Synchronous and Asynchronous Distance Based Information Sharing Tools

Tools	Category	Function
White Board	Synchronous	Shared Drawing
Interactive Slide Show	Synchronous	Synchronized Presentation & Browsing
Computer Conferencing & Chat	Synchronous	Text-Based real-time Communications
Audio Conferencing	Synchronous	Voice Communications
Interactive Videoconferencing	Synchronous	Video-Based real-time Communications
E-mail	Asynchronous	1-to-1 or 1-to-many direct messaging
News Groups	Asynchronous	Thread Discussions
Browseable Document Library	Asynchronous	Document Sharing/Posting
Calendar	Asynchronous	Posting of Important Dates/Events
Compact Disk Interactive (CD-I)	Asynchronous	Interactive Video Communication
Digital Video Disk (DVD)	Asynchronous	Video Communication
WWW-Based Courses	Asynchronous	Internet-Based Education
Video Taped Information	Asynchronous	Video Communication
Virtual Reality Simulation	Asynchronous	Interactive Desktop Learning Environment

[1] Haze, Tom, David Plazak, and Michael Hancock, "Evaluation of Information Technology to Support Distance Sharing and Learning Between and Among Federal Region VII State Transportation Agencies, Region FHWA Offices, and Major Transportation Research Universities", Center for Transportation Research and Education-Iowa State University, sponsored by the Mid-America Transportation Center, December 1998, p 3.

State-of-the-Art

Computer supported collaboration amongst academics and their community is becoming increasingly important. Factors influencing this requirement include the development and administration of intercollegiate courses, the growing use of electronic media for university administration, the need to reduce the time and cost of travel between institutions, and the global demand for information sharing. The success of the Internet, and applications such as email, file transfer, and the World Wide Web have encouraged academics from a wide range of disciplines, not just Computer Science, to use networks for remote collaboration. While those tools are useful, they were not designed to support the wide range of collaborative activities that users now need to undertake.

Considerable effort is going into support for real-time collaboration based on videoconferencing, but there has been less attention in the academic world on the requirements of asynchronous collaboration. While academics have continued to rely largely on email, the distance based information sharing tools are becoming more common in research based computer systems. These systems typically integrate a number of tools for communication, workflow, database sharing, contact management, and group scheduling, and operate across a variety of environments. The most common tools for distance based information sharing will be described in the next sections.

Asynchronous Collaboration Technology

Within the research community the most commonly used tools for peer collaboration are e-mail, browseable document libraries, online calendars and www-based courses.

E-Mail

E-mail is the most basic service that you will get no matter how you hook up to the Internet. It is also perhaps the most important tool for reaching out on the Internet to others in your community. It provides quick and easy ways to work with people and information. In addition to the traditional e-mail, most mail programs will allow you to set up an automated reply mailbox, which will send out standard information in reply to a request for information. Such add-on tools as video e-mail and voice e-mail allowing users to add a more personalized touch to their communications have also augmented traditional e-mail.

Newsgroups

A newsgroup is a distributed messaging interchange focused on topics. The groups number in the thousands. The newsgroups are very active venues for the exchange of ideas and information. Depending on the topic, some groups have hundreds of postings a day. Each newsgroup has its own charter and may have certain restrictions for posting. Some newsgroups are moderated, while others are not. Moderated groups are monitored by a systems operator (Sys Op), who will in some cases edit content of messages for appropriateness of content.

Browseable Document Libraries

The focus of browseable document libraries is to dramatically advance the means to collect, store, and organize information in digital forms, and make it available for searching, retrieval, and processing via communication networks[2]. Most of the research related to this technology was done in two phases and is based in the USA, though there is some international collaboration. The first phase of this research focused on computer and information sciences applications. The second phase covers a broader range of issues relating to digital libraries, and the projects were announced in August 1999, with end-dates between spring 2002 and autumn 2004. The larger projects include[3]:

- Re-inventing Scholarly Information Dissemination and Use, University of California Berkeley. This project is developing existing and new tools to support the development and management of digital libraries, and to assist researchers in searching and using their holdings. It looks at ways of supporting searching of text-based documents, datasets, including GIS, and images.
- Alexandria Digital Earth Prototype Project (ADEPT), University of California Santa Barbara. This is a continuation of a DLI1 project, making available the extensive holdings of the university's Map and Imagery library, and collaborating with related collections held elsewhere. The DLI2 project is developing tools to support flexible and tailored learning environments for users to access the virtual library.
- Informedia Digital Video Library, Carnegie Mellon University: This is also a continuation of an earlier project (of the same

[2] http://inf2.pira.co.uk/top010a.htm, "Information Engineering: Educational Publishing and Electronic Libraries, accessed August, 2000.
[3] Ibid.

name), looking into ways for supporting cataloguing, retrieval and access to video and audio resources. The project makes use of speech recognition, natural language processing, and image understanding to support full-content searching and on-demand delivery across dispersed holdings.

- Personalized Search and Summarization over Multimedia Information (PERSIVAL), Columbia University. This project is developing a virtual library to provide clinicians and patients with access to dispersed multimedia holdings, including patient records and medical literature. Results will be summarized and tailored to meet user needs and assumed prior knowledge.

- PRISM: Information Integrity for Distributed Digital Libraries, Cornell University. PRISM is exploring standards and strategies for ensuring the integrity of data in the expanding digital libraries sector, particularly where these make use of dispersed holdings. It is focusing on five key areas: preservation, reliability, interoperability, security, and metadata.

- Virtual Data Center, Harvard University. The Virtual Data Center will be a virtual library of social sciences data, for research and education uses within and beyond education institutions. A prototype server is already in use at Harvard, and the project will develop this to support interoperability with other libraries.

- National Gallery of the Spoken Word, Michigan State University: The NGSW will provide access to dispersed collections of audio recordings, in most cases on people and events relevant to the USA. Its users are students and teachers in schools and other education institutions.

- Web-Lab, University of Southern California. Web-Lab is a virtual library and laboratory for economics and sociology. It is developing tools to enable collaborative research between departments within and beyond the USA, including multilingual support. Software, datasets and other resources will be made available through the Web-Lab.

- Stanford Digital Library Technologies, Stanford University. This is a continuation of the DLI1 project California Digital Library. The Stanford Digital Library Technologies project will focus on software to support interoperability across collections described in different ways and delivered on different systems. It will also focus on information retrieval, providing access to

resources through portable devices, and economic models for maintaining digital libraries (including payment mechanisms).

- Digital Library for the Humanities, Tufts University. This will be an extension of the Perseus Project, an extensive digital library for the classics combining diverse resources from museums and libraries. The new project will expand its collections to cover a wider range of subjects, explore and develop tools to support complex searching and information retrieval, and to evaluate the impact of digital libraries on learning.

The documented projects are multidisciplinary. A transportation specific document library will serve the industry well. Shared document capabilities are a great aid to collaboration. These tools allow the author of a document to permit others to make changes to the document. This permits the creation of a shared work without the constant transfer of the document between participants and the logistical challenges associated with it. For example, each researcher might contribute a section to the document. Then, they might review the total document making changes until a final product was agreed upon. Sophisticated systems would keep track of document changes as well as the original text and the author of each. This would permit several people to suggest rewrites of the same passage simultaneously. The group could then view all the proposed changes and pick the overall best. This has been done to some degree in public conferences that allow multiple authors and editors.

Online Calendars

Online calendars allow community research network web sites to organize and maintain online events, new research report releases, news, appointments, and individuals online schedules.

Virtual Courses

Courses and workshops are being offered via a variety of media, including videotape, CD-I, DVD, www-based courses, satellite, and compressed videoconference. The majority of traditional universities offer web based courses or distance learning. A large portion of the classes is aimed at professional development and the continuing education public. In the beginning stages are what are becoming known as virtual universities where terminal degrees can be earned totally by www-based courses. More popular at this time are classes being taught via the Internet by one instructor and being shared by two or more universities (see Figure 1).

Synchronous Collaboration Technology

White Board

The whiteboard lets you draw and write onto a shared whiteboard - you see what other people are drawing and they see what you are drawing.

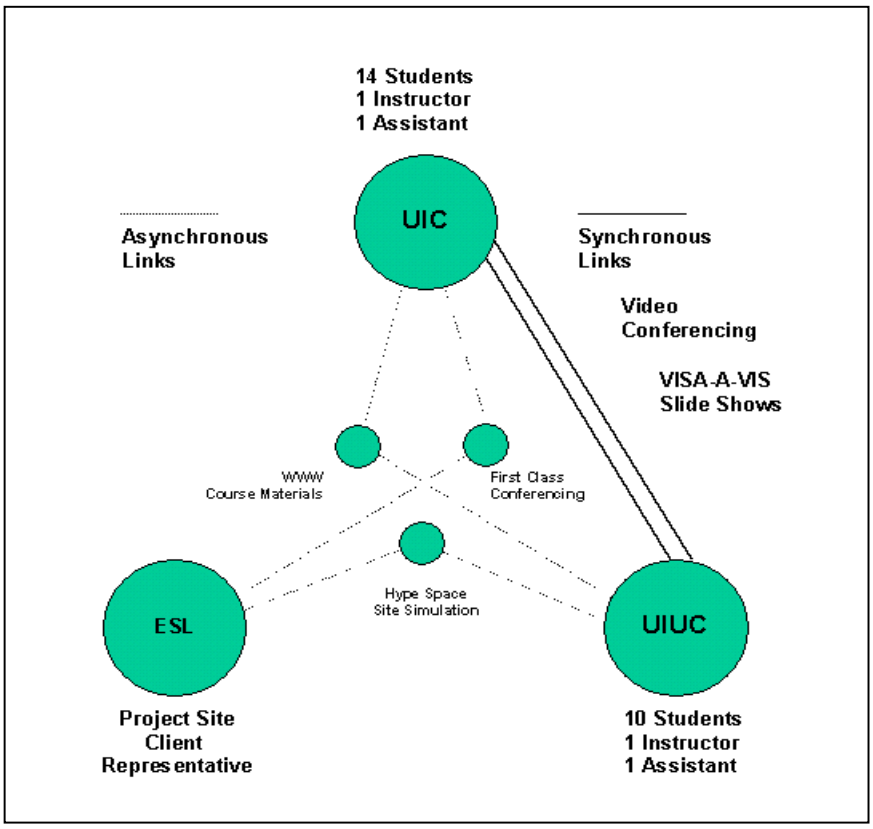


Figure 1. Proposed Virtual Links Among Three Universities

Source: www.aln.org/alnweb/magazine/Vol3_issue1/Al-Kodmany.htm, 2000

Interactive Slide Show

Most of the products that create interactive slide shows produce self-running executable files that can be distributed on CD, floppy disk, and e-mail. Sometimes a separate player is required to view the slide shows, but commonly the player is packaged as part of the executable file so that the recipient does not need to install any additional software (i.e. PowerPoint's Pack-n-Go function).

The slide shows you create will generally combine images, background music, transition effects, and captions. There is very little interactivity with the viewer, other than moving forward and backward in the sequence of slides.

Computer Chat

Online chat services allow two or more people anywhere in the world to communicate with each other over the Internet - usually not with their voices, as "chat" would suggest, but by typing back and forth messages to each other in real time. To chat online, all that's required is an Internet connection and the proper software. The software needed is called a chat client, which helps users connect to remote servers (the computers on which the back-and-forth is actually taking place). A variety of these clients are available, and many are free. The original programs were simple and text-based, but several types that were pioneers in the field are still popular today, including Internet Relay Chat (IRC), Multi-User Dungeons or Dimensions (MUDs), and MUDs that are object oriented (MOOs). Recently, with the development of Java-based servers, browser plug-ins, and pure HTML-based chat, real-time online communication has moved to the Web's vast and colorful multimedia environment. Users may now receive limited audio and video streams, and can participate in chat rooms where others are having the same audio and video experiences. Courses are being taught in virtual classrooms, and transcontinental business meetings and slide presentations are happening via chat technology as you read this. Still, many prefer black text on a white background; after all, the main thing is to chat.

Audio Conferencing

Audio Conferencing enables people at different locations to conduct interactive meetings. Audio Conferencing is, by far, the most widely used means of teleconferencing because it is virtually 100% reliable and the only equipment required to participate is a telephone. The software required to perform an audio conference acts as a bridge or multi-point control unit (MCU). The bridge or MCU is used to establish a connection with the telephone at each audio conference participant's site simultaneously.

Video Conferencing

Tools such as video conferencing and streaming video empower researchers and educators to be more productive by reducing travel requirements and enabling more efficient working sessions with distant colleagues and partners. Video conferencing enables individuals to work together and communicate efficiently across distances, in a multimedia environment. The technology supercharges meetings with full-motion video and high-quality audio and data collaboration capabilities. Customized applications can be utilized for a wide range of applications, from troubleshooting machinery on a factory floor to distance sharing and remote consultation. Most offices, conference rooms and classrooms offer a comfortable meeting environment for video conferencing. For personal or face-to-face meeting any individual office may be used. For group sessions, a conference room meets the space requirement. In most cases, changes do not need to be made to an existing

facility to hold a successful videoconference. However, there are ways to customize the experience, with lighting, seating arrangements and the like.

CHAPTER 3

ARCHITECTURE OF A COMMUNITY RESEARCH NETWORK

Computer networks are an attempt to use computer-networking technology to address the needs of the community. Community networking is about access to knowledge. Networking does not require the building of edifices, it does not involve manufacturing and the subsequent pollution, and it does not need high population densities and the accompanying transportation gridlock.[4] It is about moving information, not moving people. It is about the technology required to remove time and place constraints from social and educational interaction.

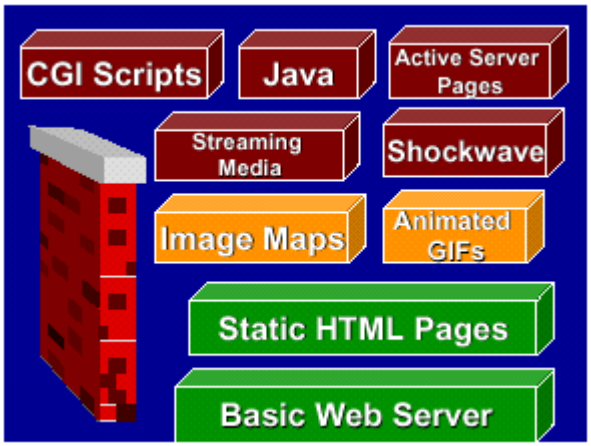
Service Models

A good analogy for a service model is that of a transportation system: we do not expect the roads to take us to a destination, we expect them to allow us to drive there, but we do expect a train or a plane to take us to a destination. These represent two different levels of service guarantees. We can take the analogy further if we add that we have no expectation from the existence of roads about journey times, but we have an expectation from the existence of timetables for our train journey times. Thus, we can see that a service model refers both to the interface and to the performance that a system gives us. In this sense, it is more subtle and rich than most contracts.

[4] Cohill, Andrew and Andrea Kavanaugh, "Community Networks Lessons from Blacksburg, Virginia", p ixv-iv.

More than computer systems, they are social systems: community networks are organized groups of people who strive to make a difference by employing information technology in the service of community development. However, no two community networks are exactly alike. Figure 2 depicts one of the possible network configurations. They vary according to the nature of the local setting, the technology platform chosen, and the nature of their organizational sponsors and structure. The mission and goals of community networks usually encompass an emphasis on local information and issues, ensuring broad and equitable access to information technology, strengthening the local community and empowering its individual members, and improving democratic processes. What sorts of connections do these systems use? Every system allows local users to connect to the host computer(s) using a personal computer or public terminal and modem or, in some cases, a dedicated line or wide area network. Generally, each system has a bank of modems to handle multiple callers at one time at speeds of 300, 1200, 2400, 9600 or more bits per second. A few systems only have a couple of phone lines, while others have broadband Ethernet (nominally 10 million bits per second) connections for some users and dialup for the rest. New systems such as the TeleCommUNITY Network in San Marcos, Texas, employ fiber optic links running at 45 million bits per second between a few school and training sites and offer two-way video, audio, and data networking for the participants. The goal of this effort is to move information and not people and to involve more parts of the community than just the school systems.

Figure 2. Example of a Possible Network Configuration



Source: www. Si.unmich.edu/community/techno.html

Many of these systems have terminals or personal computers in public places such as school classrooms, public libraries, laundromats, and government offices. Some systems are experimenting with new wireless radio networks as a way of providing less expensive links between community information providers, and the field trials of this technology are encouraging. Typical services offered by community networks are:

- Electronic mail;
- Online discussion forums;
- Development of an online repository of community information;
- Gateway to local, and often global, networked information and services and;
- Awareness, outreach, access, training.

When preparing the foundation to implement a community research network or any kind of Internet based network there are several service model options[5] that can be considered. These options are contingent upon several factors: funding resources, development time, personnel commitments, and project parameters. The following sections will outline four options for service alternatives.

Service Model Option 1

Option 1 is the simplest kind of community network. Network administrators lease space for a World Wide Web site. Access is provided by a local or national dialup (SLIP/PPP) modem pool providers. Services such as mailing services can be purchased from the Internet Service Providers (ISP). This approach is very inexpensive. Modest web sites can be obtained free or for as little as $50 per month. Individuals in the community use their personal or company Internet dialup access to visit the research community web pages.

The cost breakdown varies a great deal because there is more than one way to provide the resources needed to support the network. The following table (1) shows approximate cost breakdown for equipment, services and technical management. For example, if the research community website offices are housed in a university research center the cost for office space and utilities will be very low because this expense is covered by the center's budget. Similar options exist for staff as well, for example graduate research assistants already subsidized by the same budget.

[5] Ibid. P42-46.

Table 1. Cost Breakdown for Option 1

Startup Costs		
Item	**Provider**	**Cost**
Initial design of Community site	Web page design firm or student Webmaster	$500 - $5,000

Ongoing Costs		
Item	**Provider**	**Cost (Monthly)**
Research Community Website	ISP	$0 - $500
Email mailing lists	ISP	$50 - $100
Content Maintenance	Part time staff	$100 - $2,000
Tech Support	Staff	$100-$2,000
Office Space and utilities	Per staff member	$300 - $500

Source: Community Networks, 1997.

Service Model Option 2

Another option is to purchase a host computer and server software, lease an Internet feed and run a community web server. This gives more control over the website, and may be less expensive in the long run. With this option, users still access the Internet with a modem. A single computer for a Web server (most use Macintosh because they are user friendly) will cost about $1,500 to $4,000, and ongoing cost for the Internet feed will vary depending on the size and type of feed. However, you can

expect to pay between $500 and $2,500 per month for a full-time dedicated connection.

Service Model Option 3

Option 3 is very similar to option 2, but there is a larger investment in computer hardware and software so that all essential services and some core functions are offered by the community network rather than by private sector companies. The advantage to this option is the ability to provide more services such as free e-mail accounts, newsgroups, and bulletin boards at a much lower cost. With this option, a part- or full-time technical support person is needed to manage the two or three computers used to provide these services. Distributing e-mail accounts will also mean that office space and at least a part-time staff will be needed to perform administrative work related to e-mail accounts. An initial investment of $10,000 to $25,000 in computer and network hardware will be required. Staff and office expenses could total $15,000 to $30,000 per year. The Internet feed will vary depending on size and type of feed, but expect to pay between $500 and $2,500 per month for a full-time dedicated connection (see Table 2).

Table 2. Cost Breakdown for Option 3

Startup Costs		
Item	**Provider**	**Cost**
Initial design of Community site	Web page design firm or student Webmaster	$500 - $5,000
Web server/mail server	N/A	$2,500 - $9,000
Network interface	N/A	$3,500 - $8,000
Network/Internet feed installation	N/A	$1,000 – $2,000
Software license and server software	N/A	$2,000 - $5,000
Ongoing Costs		
Item	**Provider**	**Cost (Monthly)**
Research Community Website	Community network	N/A
Email mailing lists (2-3)	Community network	N/A
System maintenance and Support	Staff or contractor	$500 - $2,000
Content maintenance	Part-time staff	$500 - $2,000
Tech support for users	Staff	$500 - $2000
Office Space and utilities	Per staff member	$300 - $500
Internet feed	Telco or IAP	$500 - $2,500

Source: Community Networks, 1997.

Service Model Option 4

For this option, community research network developers will make a substantial capital investment to become an Internet service provider (ISP). In addition to the equipment purchased in option 3, a high capacity Internet feed and additional network equipment is required to provide users with high-speed direct connections. A full-time system administrator is needed to monitor the network and manage the network and help set up and administer other community sites that have purchased connections. Table 3 describes the costs associated with this option. With this option it is possible to break even or make money if enough organizations, government offices, and other research facilities buy direct connections. In this manner a community could become self-financing.

To summarize, a host organization for a TCRC would need to meet the following requirements:

- Ability to host staff needed to operate a distance based information sharing program.
- A high-speed and high capacity WWW server.
- High-speed communications access for Internet servers.
- E-mail, threaded discussion group server and software capabilities.
- High-speed communications access for videoconferencing.
- Access to a videoconferencing bridge.
- Facilities and equipment needed to duplicate electronic media, for instance videotapes, CD-ROM disks, and DVD disks.

- The ability to catalogue, manage, and distribute materials in various electronic media such as PDF files.

Table 4. Cost Breakdown for Option 4

Startup Costs		
Item	**Provider**	**Cost**
Initial design of Community site	Web page design firm or student Webmaster	$500 - $5,000
Web server/mail server	N/A	$2,500 - $9,000
Network interface	N/A	$3,500 - $8,000
Multiport router for local Internet feeds	N/A	$25,000-$50,000
Network/Internet feed installation	N/A	$1,000 – $2,000
Software license and server software	N/A	$2,000 - $5,000
Ongoing Costs		
Item	**Provider**	**Cost (Monthly)**
Research Community Website	Community network	N/A
Email mailing lists (2-3)	Community network	N/A
System maintenance and Support	Staff or contractor	$500 - $2,000
Content maintenance	Part-time staff	$500 - $2,000
Tech support for users	Staff	$500 - $2000
Office Space and utilities	Per staff member	$300 - $500
Internet feed	Telco or IAP	$1,500 - $2,500

Source: Community Networks, 1997.

CHAPTER 4

BENEFITS OF DISTANCE BASED INFORMATION SHARING

Distance based information sharing has both tangible and intangible benefits. Some of the major benefits would be as follows:

- Breaks barriers of distance;
- Allows community linkages;
- Enables just in time collaboration, anytime, anywhere, in sync with on-going projects;
- Makes a level playing field by allowing the sharing of specialized expertise to community members who might not otherwise have access to such information;
- Promotes problem solving and collaborative learning because colleagues in different locations can communicate simultaneously;
- Allows communities to multiply resources by allocating scarce resources to multiple agencies;
- Expands opportunities by providing a broader range of opportunities to more people at a lower cost through technology and;
- Acts as a cost efficiency measure by being designed to provide greater distribution of expertise because information is shared among a wider audience.

A final key benefit would be enabling interactions that would not normally take place because of time and cost constraints.

CHAPTER 5

STRATEGIC PLAN

Guidelines for Implementation

The broad understanding that can generate solutions to local problems does not flow solely from research reports, systems analyses, or other documents. Thorough comprehension also requires participation in a knowledge community that allows members to collaboratively view, explore, and discuss concrete evidence of practice, materials, and effects permitting them to grasp how such evidence interacts with specific contexts and cultural features. Transforming information into knowledge that is useful to people in different places requires understanding of an interlinked and mutually reinforcing cluster of innovations, not simply the appropriation of recipes for isolated shifts in practice and policy.[6] This report has defined a Transportation Community Research Center as a community that uses technology to transform itself and its ways of carrying out the research issues of the community. When we talk about building an online research center we are talking about changing a complex system. The options models presented here can help planners, technicians, and decision makers understand their community as a system as part of developing area plans. For the purposes of planning an online community research center, four dimensions require attention: key individuals, tools, technical infrastructure, and institutional infrastructure. A detailed explanation of each dimension is provided later in this section.

[6] Dede, Chris. The Role of Emerging Technologies for Knowledge Mobilization, Dissemination, and Use in Education, 1997.

Key leaders and individuals are people who are representative of the community, as well as people who command and manage key institutions and community resources.

Tools are the software applications that help the key leaders and the members of the community carry out the work of the community. Technical infrastructure is the technical environment into which the tools "plug" usually, a network or system, and Institutional infrastructure is the means by which the community's key institutions allocate their resources and carry out the community's work.

Key Leaders and Individuals

The first element, key individuals, is the most important. Every successful smart community project had at least one key leader who took the initial steps to deploy technology for community benefit. In most cases, other key individuals quickly joined this individual. Occasionally, a single key leader carried the project through from beginning to end. The advantages of projects dominated by a single key leader tend to be their internal consistency, unified vision, and compressed development cycles. One disadvantage of a single key leader is the likelihood that a project will not be sustained if that individual leaves. Another disadvantage relates to long-term survivability. There is a danger that, if ideas come from just one person, the "genetic pool" of competing ideas will be too small. Such projects may have a tendency to veer off into dead-ends or prematurely stable states, and may not take into account enough of the interests of the community to win broad community support.

As a result, the most successful online research community projects start with a group of individuals who are enthusiastic about the potential of technology to help their

community. They develop specific projects and energetically explore possibilities. Key leaders also act as advocates to bring other individuals and institutions into the process.

Tools

Tools are usable pieces of technology. Sometimes they are referred to as "applications." For our purposes, we are interested in tools that can be used to create, maintain, and support the community. Custom tools can be developed to carry out specialized functions or to extend the capabilities of a standard tool such as e-mail. Tools are discussed in-depth earlier in this report.

Technical Infrastructure

Technical infrastructure is the overall technical environment that facilitates the use of the various tools that "plug into" it. In a technology project, the technical infrastructure is comprised of systems and networks. An appropriate analogy is to the relationship between an automobile and the road system. An automobile is a "tool" for moving people and things. The road system is the "technical infrastructure" that the automobile "plugs into" to actually travel from one point to the next. Without a road system, the automobile is a much less effective tool than it otherwise might be.

The technical infrastructure thus provides the road system that lets technology tools work. The same principal applies in online networks. For example, electronic mail becomes more useful as a communications tool with each new user. The Internet is the technical infrastructure that makes distance based information sharing possible. The

Internet is composed of both the physical networks that connect all computers; and the agreed-upon ways of communicating between different kinds of machines ("protocols").

Institutional Infrastructure

With these three dimensions individuals, tools, and technical infrastructures in place, is our understanding of the steps needed to implement a TCRC project now complete? Not if our goal is a transformation in how technology transfer is conducted. We have to consider one more element institutional infrastructure, which describes the means by which the community's key institutions allocate their resources and carry out the institution's work. Examples of institutional infrastructures include policies and procedures, incentive and reward systems, and budgets. For example, take the idea of videoconferencing. Videoconferencing is a tool that makes it possible for a group of experts and community stakeholders to work with each other, regardless of where they are physically located. Videoconferencing depends on a pretty robust technical infrastructure in order to work well, although desktop videoconferencing applications have been developed which operate well enough at modem speeds. However, even if there is a tremendous technical infrastructure a very high-speed network, for example, transformation of the research collaboration process will not occur. The barrier in this case is institutional infrastructure. As long as funding for projects continues to be competitive, research reports will continue to be disseminated in the traditional way, with duplication of effort a major drawback to progressive research. The institutional barrier of the research community network model will prevent the effective use of the tool

regardless of the influence of key individuals or the development of tools and technical infrastructure.

How Do the Dimensions Interact?

Is the order of attention and development in each dimension important? Because of the particular tool we are using for this report (ink on a page), we are limited to a linear presentation of these dimensions. However, aside from the first element (the key individuals), the order for the other three dimensions is a matter of choice. A common pattern for a successful community-networking project is as follows:

1. Individuals perceive a need, and strongly believe that it can be met by the use of technology (because of successful personal and professional experiences with a relevant technology). A sufficient number of key individuals and users are involved to accurately represent the interests, needs, and unique character of that particular community.
2. One or more distinct tools are developed, adapted or adopted, becoming tools that begin to address community needs and solve community problems. For the successful implementation of a research community, these tools must be easy to use and widely available. In addition, individual users must receive support and help in the adoption of the tools.
3. Additional key individuals in institutions begin to recognize the effectiveness of the tools in doing the institution's work and in solving its problems. A critical mass of individuals begins to use the tools, and institutional infrastructures begin to change. Institutions begin to transform how they do business in order to fully

incorporate the power of the tools. Institutions revise their budgeting priorities in order to accomplish this.

4. An open and sufficient technical infrastructure is funded and developed, and the tools can be plugged into it throughout the community. This development allows for the most effective organization of the research community effort and makes community-wide use of the tools possible.

Except for the essential first step the initiation of the research community effort by key individuals in the community, the order of the steps will vary with each TCRC project. An effort driven by the private sector, for example, may naturally move from key individuals to concentrate on technical infrastructure and then to institutional infrastructure. In other words, there is no necessary order of the steps, nor even a minimum emphasis required for every dimension. The order and the emphasis vary from community to community, and from project to project.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

Most institutions of higher learning are using information tools in traditional and distance learning courses. Increasingly, faculties are using the Internet and e-mail in their research activities. Tools such as home pages, asynchronous discussion forums, chat rooms, e-mail, and File Transfer Protocol (FTP) can be used to share data sets; organize conferences; jointly write proposals and research papers, and engage scholars on a global basis in dialogue on research issues of interest to them. Researchers can also conduct library research given the growth of electronic journals. This paper offers a glimpse of how information tools can be used in both teaching and research. As mentioned previously, the Internet and e-mail can be invaluable tools to promote collaborative research. However, to use these tools effectively, scholars must develop a set of new skills. These include strategies to search for relevant materials, skills in evaluating the quality of documents found, knowledge of web design, skills in using discussion forums and chat rooms, and a basic understanding of how to send e-mail attachments. An understanding of copyright protection issues and issues of privacy are also useful, especially for those who intend to develop web pages. Knowledge of FTP is also needed to publish and update web sites, and to transfer data sets.

The following recommendations are provided in order to further study in this research topic:

1. Form a panel of advisors composed of transportation professionals, community leaders, organizations and other stakeholders to guide the set-up of a TCRC.

2. Have advisors conduct an Internet Services Questionnaire (Appendix) to begin the process of TCRC implementation.

3. Implement a transportation specific (TCRC) site to facilitate industry collaboration.

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APPENDIX

INTERNET SERVICE QUESTIONAIRE

Internet Services Questionnaire	
Develop a set of criteria for evaluating Web Site designers and Internet Service Providers (ISPs). Possible questions to ask include:	
Web Site Designers	**ISPs**
☐ **Costs.** How much have similar projects cost? What services does the estimate include?	☐ **Costs.** What are the monthly costs? What is included?
☐ **Design philosophies.** How do you develop the design concept? How much input will I have?	☐ **Connection speed or bandwidth.** What kind of Internet connection do you have? Do you have a T3 or T1 line?
☐ **Maintenance.** How do you manage site updates? Can someone on my staff make changes or must they go through you?	☐ **Clients.** How many other clients do you have? Do other clients' sites experience usage peaks that might affect access to my site?
☐ **Experience.** What is your technical expertise? Who will be performing the work? What other projects have you completed? Can I see your portfolio?	☐ **Support.** What kind of technical support do you offer? Is someone on site 24 hours a day? What kind of security do you provide? What kind of backup systems do you use? How much storage will I get?
☐ **Timing.** How long will it take to design the site? Can you meet our deadlines?	☐ **Services.** Do you host audio and video files? What kinds of reporting do you provide? How many e-mail addresses do you provide? Do you support electronic commerce?
☐ **Other services.** What other Internet or marketing communications do you provide?	☐ **Other questions:**

Source: www.microsoft.com. Accessed July 2000.