TELECOMMUNICATIONS TECHNOLOGY:

Impacts on Transportation and Economic Development

Occasional Paper No. 18

May 1985

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INTRODUCTION

This report was sponsored by the University of Wisconsin-Extension, Department of Urban and Regional Planning. The main purposes were to provide the reader with an overview of changes occurring in the telecommunications field, and to suggest some implications of these changes for urban and regional development, particularly transportation and economic development. The report should be of interest to local planners, county resource agents and local officials who have little background in the telecommunication field but are interested in knowing more about the likely impacts telecommunication changes will have on Wisconsin communities and its citizens in the future.

The report contains three sections: (1) General Context; (2) Telecommunication and Transportation; (3) Telecommunication and Economic Development. It also includes a glossary of telecommunication terms, selected annotated bibliography, and a list of other unannotated references on the subject.

In the first section, the major interactive telecommunication systems are introduced, with brief examples of their uses. Three cases of contemporary telecommunications projects are discussed. The first (the Minnesota Project) shows how telecommunication is used to connect trade-related businesses and institutions in one state with their partners within the United States and through out the world. The second (New York Teleport) is an example of the use of telecommunication to induce firms to stay within a large metropolitan area. The third (The Japanese Project) is an example of one government's efforts to use telecommunication technology to reduce regional disparities.

The second section covers how telecommunications can be used as a substitute or alternative for travel. The use of teleconferencing in business is introduced with a hypothetical case in which the costs of different types of teleconferencing are compared with that of travel. The impact of teleconferencing on energy costs also is discussed.

The third section discusses the role of both private firms and government in the planning for telecommunication services for the purpose of economic development. The "resale" of services as an alternative to private networks is discussed in terms of its cost effectiveness to small, medium and large businesses. An example of how governments plan for telecommunication system is provided from the Minnesota case which may be applicable to Wisconsin.

The authors wish to thank Professors Harold Jordahl and Jerry Kaufman for reviewing earlier versions of this paper and for this helpful suggestions. Pat Cantrell typed the manuscript and assisted in formatting the document.

ABSTRACT

It is apparent that we are in the beginning of a fundamental revolution in communications technology which is as equally important, if not more, as the first industrial revolution. This report is an attempt to answer three major questions concerning this revolution and its socio-economic implications: 1) what are the principal changes in telecommunications systems and how are these systems used in society?; 2) are they a substitute for transportation?: 3) what are the major factors which private firms and governments should consider in planning for use of telecommunication systems in their activities and what are the implications for the state of Wisconsin?

Regarding the first question, the report introduces three major telecommunications systems: The first is High Speed Data Transmission in which telephone and computer networks are connected to transmit data from one location to another. Examples include electronic funds transfer, word processor networks, and data banks. High Speed Data Transfer can also be used to conduct audio teleconferences.

The second system is Audio Plus Graphics, which can be used when two or more parties at remote locations need not only to converse but also to view data, blueprints or other materials. It requires conference rooms with high fidelity audio systems and some means of transmitting data or graphics such as Facsimile Machines, Electronic Blackboards, and Captured-Frame Video.

The third system is the Full-Motion Video Conference. These systems are of two types: 1) one-way video plus two-way audio (basically a broadcast from one point to many points); and 2) two-way audio and video which is the most sophisticated and most expensive form of telecommunication.

Three specific telecommunication projects have been outlined. The first is the Minnesota World Trade Center, which is designed to connect trade-related businesses and institutions in one state with their partners within United States and throughout the world. The second is the New York Teleport Project, which is an example of the use of telecommunication technology to induce firms to stay within a large metropolitan areas. The third is The Japanese Technopolis and Teletopia Program which is an example of government's efforts to use telecommunication technology for reducing regional disparities.

Addressing the question of whether telecommunications substitutes for or complements transportation, the report differentiates between the movement of physical goods and materials, and the movement of people (travel). In the movement of physical goods, use of information technology cannot be an alternative. However, it may substitute for part of the physical movement by providing more efficient coordination. In the movement of people, information technologies can substitute for or provide an alternative to several aspects of travel.

Examining planning factors that should be considered, the report distinguishes between "service in demand" and "right to service". The first implies the tendency of the private sector to react to actual demand for telecommunication service. The second term implies a strategic planning for telecommunication services. For private firms, the concept of "resale" of telecommunication services was introduced as a means of providing accessible and cost effective services.

In discussing state government's role, the Minnesota initiative provides a good example for Wisconsin to follow. Minnesota has established a focal point at the state level for dealing with the many changes going on in the field of telecommunications. The Minnesota Legislature established a Telecommunications Council which works under the administrative and fiscal aegis of the State Planning Agency. This example raises several issues related to state government's role in developing the expanded applications of telecommunications in the state's economy.

I. GENERAL CONTEXT

The term telecommunications covers a wide range of communications systems. Their function is to transmit information electronically from one place to another. These systems can be categorized in two ways: switched, point-to-point systems and broadcast systems.

Broadcast systems provide for one way communication from one terminal to many. A familiar example is a television broadcasting station. However, some broadcast type systems such as cable television can be made to have very limited point-to-point capability (Lewin, 1979).

A switched point-to-point system (of most concern here) provides communication between any two groups of terminals. This is accomplished by a communication link from each terminal to a switching center. The switching center (or centers) are capable of connecting the communication links of any two of the terminals. This type of communication system provides basically two-way communication between two persons or between two machines (computer or computer terminals), or between a person and a machine. Sometimes the communication involves several persons or machines; and in some cases such a system has very limited one-to-many or broadcast capability (Lewin, 1979).

Telecommunication systems can carry audio, video or data or a combination of the three. In general, a combining of cable television[1] with two-way capability, ground or satellite-based microwave links[2] and/or direct broadcast satellite[3], make up "broadband communications systems."[4] Broadband systems can be used to substitute communications for travel in the delivery of public and commercial services. They can link doctors with their patient, teachers with their pupils, police sub-stations with their headquarters, and business branches with their headquarters, as well as markets, consultants, financial institution ...etc. (U.S. Congress, Office of Technology Assessment, 1976). Unlike narrowband communications systems such as the ordinary telephone system, broadband systems transmit an extremely wide range of frequencies which enable transmission of dozens of channels (Martino, 1979). A switched broadband system is one in which any two subscribers can be connected directly together. This type would combine the bandwidth[5] of cable systems with the switching capability of telephone systems. With this most advanced network, it is possible to make two-way video and high-speed data transmission between any two subscribers (Martino, 1979).

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[1] CABLE TELEVISION: The use of broadband cable (coaxial cable or optical fiber) to deliver video signals directly to television sets.

[2] MICROWAVE: High-frequency radio waves used for point-to-point transmission.

[3] DIRECT BROADCAST SATELLITE (DBS): A satellite system designed with sufficient power so that inexpensive earth stations can be used for direct residential reception.

[4] BROADBAND COMMUNICATION: Communications using high frequency signals (e.g., 6 MgH, the bandwidth of a TV channel). Video teleconferencing is a broadband medium.

[5] BANDWITH: The maximum frequency (spectrum) measured in Hertz or cycles per second, between the two limiting frequencies of a channel.

A. Types of Telecommunications Systems

The rapid development of telecommunications technology has made it possible to improve various aspects of human life. This section, will classify telecommunications systems into different categories, and show how each can be used to improve the economic, social, or political aspects of life.

1. High Speed Data Transmission

Examples of this category include electronic funds transfer, and word processor networks through inter-connected computer networks. Large companies with facilities in more than one location use these networks to transmit data from one company location to another. These networks can also provide a means for companies, individuals, or government organizations to utilize large data banks maintained by other organizations.

A data bank or data base as defined by Vail (1980) is a "comprehensive collection of libraries of data". A computer data bank includes all the facts, numbers, instructions, text, or other symbols stored in the computer's memory circuits". Vail points out that there are computer data banks available to the public today that contain such things as stock market quotations; wire service news stories; bibliographies and abstracts of books and articles on science, law, medicine, history, literature, and the arts. Many computer data banks are interactive -- that is, instead of reading what they contain, users can add information of their own to share with others.

By using high speed data transmission, as Hald (1981) points out, new forms of governance could evolve based on many-to-many interaction. Although structure of government might remain intact, the process of governance may change dramatically as new channels for communication emerge. Consensus networks could be developed through which many individuals could interact to consider meaningful options for the future. Political leaders tied into such consensus networks might feel closer to the voters and more committed to the directions chosen. Individuals whose ideas and actions precipitate consensus might even rise to positions of leadership through the networks.

In many-to-many interaction, multi-party telephone connections are utilized to conduct audio teleconferences. In its simplest form, the audio teleconference is a conference call between several parties. There is no need for special equipment except for amplifier systems to pick up voices in a group and transmit them clearly to another location. Various parties are linked together by either "dedicated" lines or "bridges".

Dedicated lines are private lines leased from the phone company; larger firms often have their own lines as part of their in-house phone system. Many teleconferences are linked by bridges -- a "switchboard" which can control multiple lines (Runzheimer Reports, March 1983). This is the most accessible method of teleconferencing because anyone with a phone can initiate an audio teleconference. However, the audio teleconference is obviously less valuable if face-to-face contact or a visual presentation is required. In such cases, this method may serve as a good back-up or follow-up to a face-to-face meeting.

2. Audio Plus Graphics

This system can be used when two or more parties at remote locations need not only to converse with each other, but also to view data, blueprints or other material not distributed in advance. It is more advanced than "only audio conferences" discussed previously. "Audio plus graphics" requires conference rooms with high fidelity microphones and speakers and some means of transmitting the data or graphics to be discussed (Report of Air Transport Association of America, 1981). Graphics that can be sent include slides, charts, agendas, summaries, or reference material which would be used in face-to-face meetings. As stated in Runzheimer Reports (1983), several methods are currently available for transmitting graphics, all using standard phone lines:

a. Facsimile machines can send printed material, ranging from agendas to blueprints, from one meeting location to another within minutes.

b. Electronic Blackboards perform the same function as conventional blackboards. The image originates on a pressure-sensitive electric blackboard and is reproduced on remote TV screens via telephone lines.

c. Captured-Frame Video permits transmission of images at intervals ranging from a few seconds to over a minute. Pictures of slides, charts, or drawings can be sent in conjunction with sound to remote TV screens.

Runzheimer comments that although special equipment is needed, its installation is not complicated. In addition to aiding the audio teleconference, simultaneous transmission of graphic data offers a fresh, up-to-the-minute atmosphere to the meeting. Often, however, charts and printed material can be sent by mail to remote locations and explained through an audio teleconference (Runzheimer Reports, March 1983).

3. Video Communications

This method, sometimes referred to as the video conference, has received much publicity lately. It falls into two categories: (a) one-way video plus two-way audio; (b) two-way video and audio.

a. One-way Video Plus Two-way Audio:

This method is basically a broadcast from one point to multi-point. A camera picks up the video images, which are transmitted to multiple locations, much like closed-circuit TV. Two-way audio connections provide for verbal communication. Special equipment is needed for this type of communications. Some large companies have their own in-house systems. However, many convention halls can supply video-conferencing facilities. Several major hotel chains such as Holiday Inn, Marriott, and Hyatt have the satellite link-ups to broadcast conferences between their hotels in the network. As the Runzheimer Report states, this method is useful for presentations to large, dispersed groups that gather in various regional locations. A speaker can communicate to a dozen locations, and at the same time, have an interchange of ideas, and handle questions from the audience (Air Transport Association of America, 1981).

The United States Chamber of Commerce has installed a similar network for bringing important Washington programs, Congressional hearings and speakers to its members. This network (called BIZNET) provides a means of keeping local chambers of commerce and their members informed about developments of interest in the nation's capital as well as providing feedback from the membership to the chamber via audio portion of the system (Air Transport Association of America, 1981).

b. Two-way Audio and Video:

This type is the most sophisticated and most expensive form of telecommunications. With two-way audio/video system, two locations can receive and broadcast live audio and video images simultaneously via satellite. This system usually works from point-to-point because communication between multiple points would require multiple monitor screens. Geared to conferences between small groups, such systems most closely approximate face-to-face communications.

Two basic variants of two-way video systems are being introduced in large companies (Air Transport Association of America, 1981);

1. Slow Scan Video: Also known as freeze frame, transmits a new picture each 30 seconds in black and white or each 2 1/2 minutes in full color. Slow scan video is adequate for many corporate meetings whose purpose is to review and discuss data, engineering drawings or other graphic materials. For such purposes, full motion is not required since facial expressions and body language are less important than factual material for which the meeting is convened. Exxon reports that transmission of black and white slow scan video between New York City and Houston costs about $11 per hour -- for full motion video that transmission cost rises to $4,000 per hour.

2. Full Motion Video: The most highly publicized system of this type is the AT&T's picturephone Meeting Service (PMS). This is installed in conference centers in twelve major cities. Those centers are available for hourly rental.

B. Projects Under Progress

Telecommunication technology has become one of the major concerns of both firms and governments. By 1981, over 450 data bases were available to businesses, government agencies, and the public through computer commercial networks (Hald, 1981). The Source Telecomputing Corporation was the first company to offer this type of service. The Source makes its computer data banks and electronic mail service available 24 hours a day to users throughout the United States.

1. Minnesota World Trade Center (MWTC)

One of the most interesting recent projects is the Minnesota World Trade Center (MWTC). The project, which will be located in St. Paul, is designed as a "smart building" encompassing state-of-the-art telecommunications facilities. It contains telecommunications centers where members and trade-related businesses and institutions can reach trading partners within the United States and throughout the world. Important meetings outside the Twin Cities can be transmitted by a mobile audio and video satellite uplink. Minnesota Public Radio (MPR) would offer direct reception and connection to both the Trade Center and through it to similar centers throughout the nation and the world. (Figures 1 and 2) (Report by Telecommunication Committee to MWTC, December, 1983). The type of services offered by this Center are:

- video conferencing with other WTC's
- subscription to trade-related centralized data based (e.g., Lexis, Reuters, etc.)
- multi-channel video distribution
- word processing facilities
- paging systems
- public address system
- intercom service
- advanced telephone systems

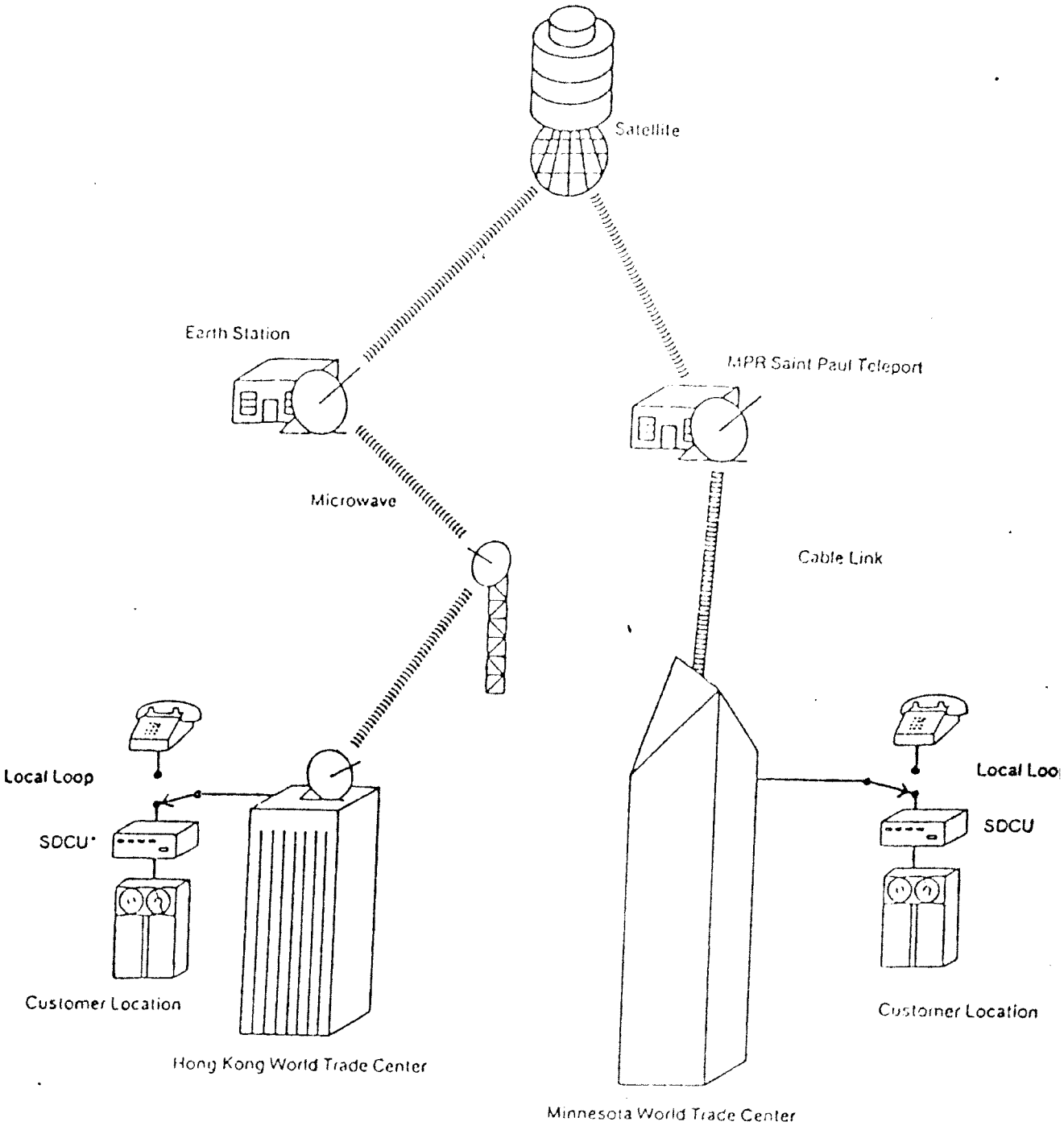
- Telex (a typewriter exchange service that enables subscribers to direct dial other teleprinter subscribers on a global basis. Telex terminal equipment can be business machines but is more often a teleprinter.
- centralized message service (attendant receives and stores messages until the subscriber is ready to receive them.)
- packet switching and packaged data transmission (The transmission of data through a channel that is occupied for the duration of transmission only, allowing multiple use of the same channel.)
- facsimile (a system for the transmission of images. the image is scanned at the transmitter and reconstructed at the receiving station and duplicated on paper.)
- electronic mail (the transmission of letters or other typically mailed documents through data transmission devices.)
- voice store and forward services (verbal messages are stored by the central processor until the receiving party is ready to accept the information.)

2. New York Teleport Project

This project is an example of the use of telecommunication technology to induce firms to stay within a large metropolitan areas. Without an effective communication system, banks and brokerage houses and other financial service firms vital to the metropolitan economy may leave the region because they would not be able to conduct the highspeed data communications necessary for their businesses.

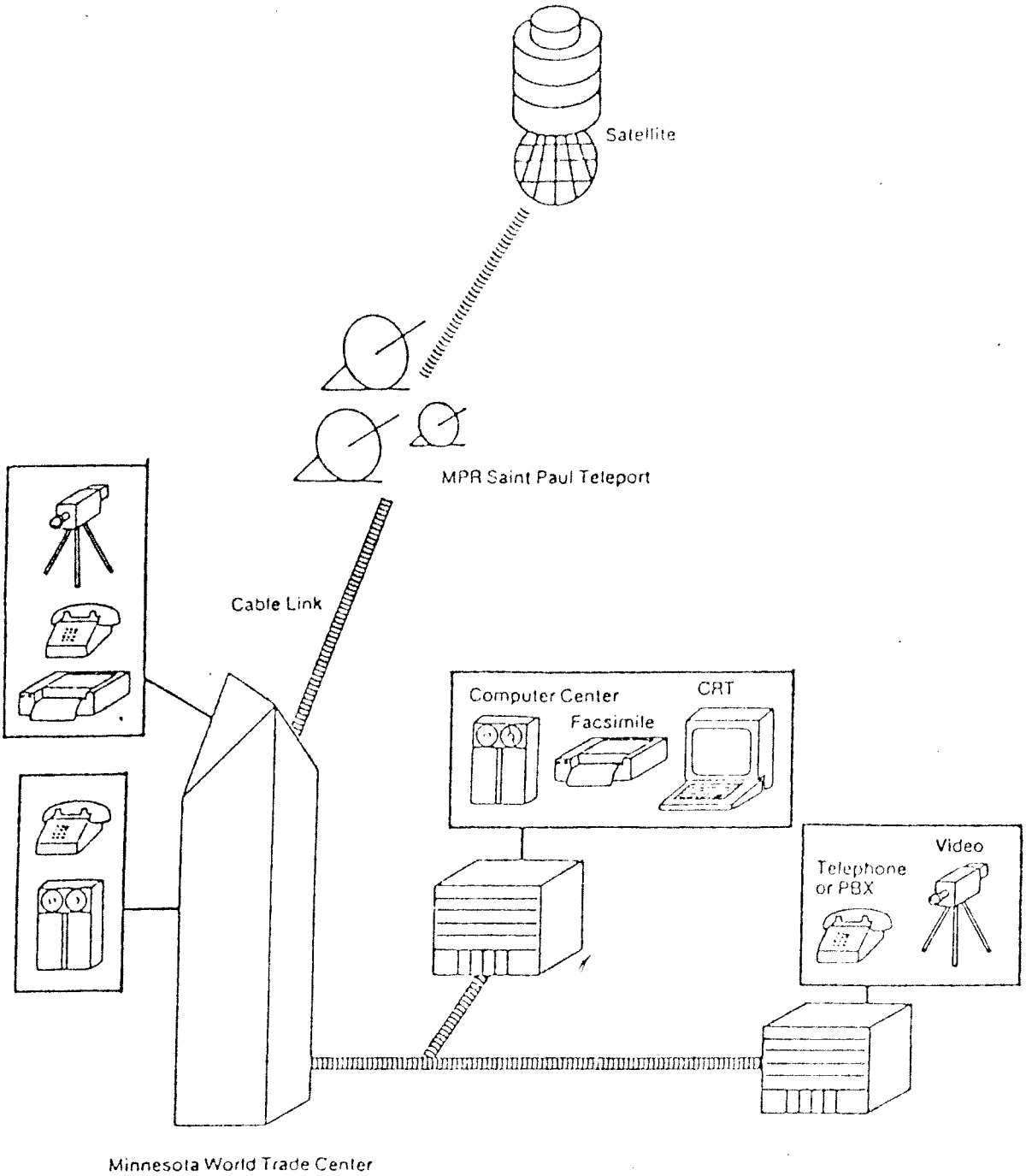
In New York, because of high real estate and communications costs, and because some older buildings are not equipped with the air-conditioning and power required for large computer installation, companies are moving their back-office functions out of the city. In order to overcome this disadvantage, the Port Authority of New York and New Jersey, Merrill Lynch & Company, and the Western Union Corporation have developed the "New York Teleport Project" to provide the metropolitan area with satellite communications. The project is the form of satellite antennas (17 dish antennas) in an area of Staten Island (220 acres) that is virtually free of interference. The antennas would be connected to offices in the New York-New Jersey area by high-capacity optical fibers in underground cables. Around the antenna farm, an office park will be built in which New York companies can locate their back-office computer facilities (Charles, July, 1984). Using domestic communication satellites, as well as international satellites positioned over the Atlantic ocean, the system will provide customers with a variety of forms of communications: voice conversations, computer data, facsimile transmissions or video conferences. The project is estimated to be in full operation by 1987 (Charles, July, 1984). New York City, which will spend some $15 million on the project's roads and other infrastructure, has leased the site to the Port Authority for 40 years. The Authority, which expects to spend $57 million on the project's real estate and development, has subleased a 21 acre parcel to Teleport communications, the for-profit partnership organized for the project by Merrill Lynch, which holds a 60 percent interest, and Western Union, which controls the other 40 percent.

FIGURE 1



1. Minnesota World Trade Center Voice Grade Satellite Network

FIGURE 2



II. Minnesota World Trade Center Digital Satellite Communications Network

They have together committed about $30 million to the Teleport, and jointly oversee all its technical facets. The City and the Port Authority will each receive half of the net revenues from developments on the subleased land, as well as 25 percent of any excess profits from the communications operations, after the private partnership has received a 21 percent return. Some 76,000 people are expected to be employed (Charles, 1984) as a result of the project.

3. The Japanese "Technopolis" and "Teletopia" Programs

This program is an example of government's efforts to use telecommunication technology to reduce regional disparities. The highly developed 400-mile-long belt stretching west along Japan's Pacific Coast from Tokyo through Nagoya and Osaka to Hiroshima is jammed with people, factories, research centers and investment. But regional development in less-accessible rural areas has been slow.

In order to overcome this problem, the Japanese government is planning to take high technology rapidly to the underdeveloped areas. They are designating outlying model cities as a way of getting it there. The major features of these model cities are implied in the two concepts of "Technopolis" and "Teletopia":

Technopolises are designed to be high-tech industrial park and research centers appended to "mother cities" of 200,000 or more inhabitants, located away from Japan's over-crowded population centers. Technopolis industries are to include electronics, biotechnology, software development, robotics and others (Wisconsin State Journal, March, 1984).

Teletopias are fitted with advanced communications systems linking businesses, homes and government offices. Their communication facilities are to include cable television, interactive-video systems, high-speed computer communications, expanded use of fiber-optic cable and teleconferencing, among others. If all goes well, Japan will be one of the leading countries to "retool" to an information-based economy.

II. TELECOMMUNICATION AND TRANSPORTATION

The availability of jobs in a city clearly is basic to its economic viability. Industrial activities which could provide new employment opportunities to a backward area, will locate only in such areas when they can be assured that they will not suffer because of diminished access to markets, resources, services, and customers. Thus the quality of an area's communications links help to determine its accessibility and this, in turn, affects its attractiveness to the economic activities. Results of a 1971 survey conducted by the Economic Development Administration of the U.S. Department of Commerce showed that transportation was one of the most important factors which determined the location of a plant (Goldmark, 1976).

The question now is to what extent can the flows of information via telecommunications substitute for or provide an alternative to travel? In order to answer this question we may differentiate between the movement of people (travel), and the movement of physical goods and materials.

In the movement of physical goods and materials, use of information technology cannot be an alternative; however, it may substitute for part of the physical movement by providing more efficient coordination. As Mandeville (1983) points out, efficient coordination will lead to less movement, less physical transfer of paper, less materials wastage, smaller space requirements due to reduction of stock levels and miniaturization of information processing and storage facilities.

In the movement of people (travel), Mandeville points out, telecommunication and other information technology can potentially substitute for or provide an alternative to: intra-city travel to work, intercity business travel, trips to health and education services, shopping trips, entertainment, job search trips, social calls, meter reading, mail delivery and library visits. However, Goddard (1971), quoting Mandeville, suggests that there is a possibility that by increasing the opportunities for interaction in society, the use of telecommunications can generate more travel than it substitutes for. Therefore, it would appear that telecommunications, complements, rather than substitutes for travel.

But whether telecommunications is a substitute or complement to travel, does it represent a significant benefit to business, and the economic development of society as a whole? To answer this question, examination of one of the popular uses of telecommunications by business and government -- teleconferencing and computer conferencing -- is needed.

1. Teleconferencing

Reducing travel costs should have a higher priority than merely recovering costs. The most effective way to reduce travel costs is to cut back on travel itself. The wasted time in travel can also mean wasted money (Reports on Travel Management [RTM], 1983). Teleconferencing can provide the alternative to business travel in many cases. Inspite of the belief that nothing takes the place of a face-to-face meeting, teleconferencing can come close.

> A teleconference can be as simple as a conference (telephone) call involving three or more people or as complex as a meeting shown on a television screen at two or more locations simultaneously. The televised meeting is called a video-teleconference, and messages are transmitted by satellite, telephone or microwave with a capacity for two-way audio-video hookup. Electronic blackboards are sometimes used to beef up a teleconference. Messages on the blackboard can be transmitted to different locations within seconds (RTM, 1981).

a. Teleconferencing in Business

According to Runzheimer's survey of 40 firms nationwide, 95 percent say they are using some form of teleconferencing. Only 5 percent are not engaged in it at all. Ninety-five percent of all these firms involved in teleconferencing use three-way (or more) conference calls, 15 percent use video-teleconferencing and 10 percent use electronic blackboards (percentages add up to more than 100 percent because some companies employ a mixture of teleconferencing modes.) Large firms seem to be the trendsetters in video-teleconferencing. Fifty percent of those firms with an annual sales revenue of more than $1 billion are using video-teleconferences. Most firms that coordinate video-teleconferences own their own equipment, use on-site conference rooms and estimate the system will pay for itself by the fourth or fifth year. Smaller firms, with under $1 million in sales revenues, use audio and multimode audio teleconferences. Only 5 percent of these firms use video-teleconferencing. About 14 percent of corporations in the $100 million to $1 billion annual sales category are using video-teleconferences (RTM, 1981).

b. Comparative Costs: Traditional Meetings vs. Teleconferencing

In Runzheimer's Report on Travel Management (RTM, March 1983), travel costs were compared with teleconference costs for a hypothetical meeting of three regional managers from three cities -- Seattle, Portland, and San Francisco -- to attend a one-hour meeting in Chicago to discuss company policy changes. The following tables show the cost of the traditional meeting and that of an audio-teleconference (the costs are for three people).

Cost of Traditional Meetings	
Airfare:	$2,292.00
Per diem cost in Chicago:	355.05
Airport bus limo:	36.00
value of executive time factor (V.E.T.)*	1,117.02
Total:	$3,800.07

Cost of Audio-Teleconference	
Long distance phone rates:	$ 88.00
V.E.T. Factor	139.62
Total:	$228.42

Source: Runzheimer Reports on Travel Management, March 1983.

*For more details about (V.E.T.) Factor, see RTM, April, 1983.

This comparison shows that the cost savings of teleconferences are dramatic: $228.42 vs. $3,800.07. Runzheimer comments that although travel expenses constitute the bulk of these savings, the day that would have been spent in travel was instead spent at the office. This adds significantly to the overall productivity.

Using the same method, Runzheimer calculated the costs of two-hour meetings for two groups of six executives, one in New York and the other in Chicago. They decided to use a video-teleconference. Otherwise, the New Yorkers would have to travel to Chicago and return the same day. The cost, if they travel, would be $5,283.94. The cost of video-teleconference would be $4,118.48 (RRTM, 1983). Runzheimer's comment on these figures is that, although the video-teleconference costs nearly as much as the day trip to Chicago, the value of executive time (V.E.T.) factor was underestimated by ignoring travel time from the airport to work -- after the conference.

c. Other Empirical Examples: (Source: ATA, Impact of Telecommunications On the Demand for Air Transport, Aug. 1981, author anonymous.

A report from the Bell System shows that communications costs are decreasing 11% per year; computer logic costs are decreasing 25% per year, and electronic memory costs decreasing 40% per year. Concurrently, the cost of travel continues to rise.

- In terms of costs and benefits for teleconferencing, this report shows the results of interviews with persons who are responsible for design and installation of new systems. In general these results indicate that savings in executive time is the real driving force.

- A NASA study to evaluate a teleconference network developed for the Apollo program concluded that teleconferences saved more than 20% of the travel budget, but that the unused travel funds were diverted to other travel. The real saving they discovered was in employee working time.

- A survey by Satellite Business System of users of teleconferencing systems asked, among other questions, "what do you consider the most important advantage of teleconferencing?" The responses are shown below:

* Save travel time	34%
* Less time for decision making	25%
* Having the right people accessible	17%
* Ability to get more people involved in a meeting	16%
* Save travel expenses	7%

- The Aetna full color, full motion video-teleconferencing system that connects the Hartford and Windsor offices eight miles apart was installed at a cost of approximately $340,000. Aetna's study in 1979, conducted to determine the feasibility of the proposed

system, estimated that the full cost of the installation could be saved in less than one year by savings in travel time alone, priced at standard labor rates for the employee groups involved.

- The Picker Corporation, a medical equipment manufacturer, formerly held its annual sales meeting in a conventional, single location at a cost of $420,000. Later the company held its sales meeting at multiple locations, using Holiday Inn's HI-NET Satellite Telecommunications System, at a cost of $80,000, resulting in savings of about $340,000.

- The Bell System in a briefing on Information Management for the 1980's, reported a savings of $1.5 million in travel costs during 1979 through replacement of travel with AT&T's picturephone meeting service.

- Exxon finds that its employees take 7,200 trips between New York City and Houston each year. At a cost of $800 per trip, this travel bill alone amounts to nearly $6 million a year. If 10% of those trips could be saved by teleconferencing, a sophisticated video system, operating through satellites and connecting these two Exxon locations, could pay for itself in less than two years.

2. The Computer Conference

Computer conferencing is one of the simplest and efficient types of telecommunication. This method allows geographically-separated people to communicate either simultaneously or on a delayed basis. Participants do not need any technical expertise or even previous experience with computers. What is needed is a standard computer terminal or home computer and ordinary telephone lines. In computer conferencing, time and distance are dissolved. Visual cues no longer exist. Each person's "memory" of what has been said is accurate and complete. And everyone may speak at once or listen at leisure. Using this method, people can attend a conference that runs continuously 24 hours a day, for as long as the participants want. Vallee et. al. (1975) point out that with this capacity, it is not surprising that computer conferencing might actually establish an altered state of communication in which the realities of face-to-face communication are distorted and entirely new patterns of interaction emerge.

Computer conference functions as an interpersonal medium for a variety of activities, including planning and forecasting, group conferencing, joint writing projects, electronic notepads (in which messages are stored in a computer instead of on paper), social simulations, and questionnaires (for more details about the different uses of computer conferencing see Hiltz, et. al., 1978.

3. Impact of Teleconferencing and Computer Conferencing on Energy Costs

One aspect of the potential substitution of telecommunication technology for transportation is the impact on energy use. Niles et. al., (1976) estimated that total transportation operating energy use range from 23.8% to 25% of gross national energy use (estimate was based on 1975 data).

Automobile transportation constitutes approximately 50% of all transportation usage. Urban automobile usage accounted for 36.7% of all transportation energy use in 1975. This estimate for total transportation use amounts to 9.2% of total energy consumption in the United States. In electrical terms a 1% reduction in urban commuting would result in a reduction in total U.S. energy consumption of approximately 8.6 billion kilowatt hours annually (Niles et. al., 1976).

In the same study, Niles et. al., estimated that a fully loaded mass transit system, that is, one in which all available spaces were always occupied by commuters (in practice no such highly conservative system exists), would use 4.8 kilowatt hours per day for each commuter. On the other hand, a typical computer terminal continuously uses 100 to 125 watts, or less when it is in operation. A 4-kilohertz band-width phone line uses less than 1 watt once the connection is established in a typical urban area. The marginal costs of computer and peripheral equipment operation per terminal are estimated at approximately 10 watts. If a terminal is used for 5 hours per day, the total energy consumption will be 2.20 kilowatt-hours per day for each telecommuter.

From these estimates, it was concluded that the relative energy consumption advantage of telecommuting over commuting (the ratio of commuting energy consumption to telecommuting consumption) is at least 29:1 when the private automobile is used, 11:1 when normally loaded mass transit is used, and 2:1 for 100% utilized mass transit systems. Since approximately 97% of urban passenger traffic uses the automobile (1975 data), the net savings in energy consumption produced by telecommuting is 96% of the fraction of commuting replaced (Niles et. al., 1976).

III. TELECOMMUNICATION AND ECONOMIC DEVELOPMENT

Telecommunications are beginning to become an integral part of economic infrastructure and vital for a region with slow economic growth. Telecommunication links can compensate for some of the physical disadvantages of location. The importance of telecommunications to society is growing both as an instrument of business and for the communication of non-commercial information. As was discussed in Section II, in industry and commerce telecommunication is of growing importance as firms strive to improve their productivity through the process of substituting for transportation or inventory holding cost. In the aggregate, the substitution of factor costs in this manner can be expected to favor greater decentralization of industry and therefore benefit regional development.

This section discusses the role of telecommunication and information industries in economic development, and how private firms and government can collaborate, to provide this service.

1. Information Industry and Economic Structure

Agriculture and manufacturing no longer constitute the foundation of the economy. A new economic order has emerged -- one based not on material goods but on information (Molitor, 1981). The U.S. economy has been gradually transformed since 1940 in a way that is unique in history. By the mid-1970's, America's working population was predominantly engaged in information

handling: more people were involved in the manipulation of information than were employed in mining, agriculture, manufacturing, and personal services combined (Niles, et. al. 1976; Goldmark, 1976; Hamrin, 1981). By 1976, only 4% were engaged in agriculture, 29% were in manufacturing, 50% were in information, and 17% were in other service occupations (Molitor, 1981). Therefore, information and knowledge have become the critical new factors in economic growth. As Castells (1984) points out since the new technologies are basically aimed at information-processing, we can see emerging the possibility of the historical supercession of the barrier existing to extend the productivity drive from industry to services. Office automation and telecommunications are leading the change. With them, and with a fundamental reorganization of the production process, manufacturing and services become increasingly complementary and feeding each other both in demand and in enhancement of their productive capacities. He argues that this trend has a tremendous potential impact on the labor market and occupational structure.

Concerning the impact of the new information technologies on urban structure, Castells argues that there are three major spatial consequences of the economic effects of these technologies on service sector:

> (1) the increasing mixture of consumer services and residential areas in the suburban landscape; (2) the decentralization of second-level service activities to the suburbs and to non-metropolitan areas; and (3) the rapid growth of CBD's, particularly in those metropolitan areas that are highly placed in the urban hierarchy of corporate networks (Castells, 1984).

2. Roles of Private Firms and Government

In order to determine the roles of private firms and government, it is important to distinguish between two terms: (1) service in demand; and (2) right to service. The first implies the tendency of the private sector to react to actual demand for telecommunication service. This reaction is based on cost-benefit analysis adapted by the firm. It is likely that this type of service occurs in areas which already are in an advanced stage of development. The second term implies long-term subsidization, by the government, of a particular service (Department of Communication , Canada, 1971). Because the telecommunication industry is capital intensive, it is risky for small firms to provide this service economically to depressed areas where there is no demand for it. The government role in this situation is to provide the infrastructure or to subsidize those firms in order to attract this type of service to depressed areas.

a. Private Firms

> Reliable voice and data communications networks are essential to the continued successful operation of large corporations. As a result, corporations are finding a larger share of their budget devoted to the purchase of these services. Large corporations are interested in and, in some cases, developing non-public, switched and non-switched networks to provide their telecommunications needs. Use of these private networks likely would have substantial impact on the cost of telecommunications services (Robert Muir Company, 1983).

Medium-sized and small businesses, which comprise 80% of the telecommunications market, cannot afford to own efficient telecommunications systems. Therefore, what is needed is better coordination of existing telecommunications networks such as telephone and broadband cable systems. This could make these technologies more accessible and cost effective for small, medium, and large businesses.

An effective way of providing accessible and cost effective telecommunication is the "resale" of the services (Wolgast, 1984). "Resale" is a process involving a vendor's bulk purchase of discounted long-distance services from a common carrier and the subsequent reselling of those services to customers, generally at a gross profit margin* of 40% and a net profit margin* of 15% (Wolgast, 1984, quoting from Center for Communications Management, Inc. [CCMI], 1982). Despite the reseller's profit margin, resale is desirable from the customer's point of view, because it involves considerable cost savings, 20% on the average, as compared to what would normally be paid for non-bulk long-distance service (Guenther, 1984).

Today's typical resellers are persons who decide to go into business for themselves, entrepreneurs who can raise enough capital to make the initial investment, which, according to Wolgast (quoting CCMI), is about $100,000 plus $20,000 in interest charges, amortized over five years (in 1982 price).

After the breakup of American Telephone & Telegraph Co. (AT&T), reselling of telecommunication services became a new field for commercial developers such as Lincoln Property Company, a big office and apartment developer in Dallas. In January 1984 a Lincoln subsidiary (Lincoln Corporation) began offering telecommunications services to some tenants of its Lincoln Plaza in Dallas. That was just the first of 18 Lincoln developments where Lincoln will be offering telecommunications by the end of 1984 Guenther, 1984). Acting as telecommunications brokers, developers buy the wiring, switches and equipment, negotiate for long-distance services from AT&T (or from another carrier) and sell the services to tenants.

b. Government's Role

As is implied in the term "service in demand", the behavior of private firms is profit oriented. One of the major problems associated with the application of service in demand is its tendency toward unbalanced development. As Goldmark (1976) points out, although communications capacity has been vastly increased in recent years, most of the increase has been confined to transmissions systems; so the main beneficiaries have been institutions and businesses rather than the public, and urban areas rather than the rural regions of the country.

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*see Glossary

Planned investment in telecommunications systems could do much to alleviate imbalance at the inter-regional and intra-regional levels. These investments need to be associated with a guided pattern of location decisions that take account of communications criteria within the framework of regional policies (Goddard, 1971). Most firms are ill-informed about their communications patterns and therefore make location decisions without adequate data.

Government's role, then, is to provide or to subsidize the development of telecommunication infrastructure in less developed areas such as local area networks capable of linking major businesses and institutions. Governments can also develop an updated information center to provide small as well as large firms with the potential advantages of different locations.

Strategic planning for telecommunications is the most important role of government. Recently the "Report by Telecommunications Committee to the Minnesota World Trade Center Commission" (December, 1983) recommended the Governor appoint a special advisory commission on telecommunications.

The Commission should:

a. include members from the private sector, the legislature, local government, relevant state agencies and commissions and telecommunication users;
b. survey existing telecommunications providers across the state to determine where existing services fall short of meeting the state's economic development goals;
c. survey current and expected developments in telecommunications technology;
d. provide recommendations regarding the development of a coordinated telecommunications network;
e. review current state agencies, boards and commissions with respect to telecommunications to more clearly define their function and to determine what role they will play in planning for better telecommunications coordination and management by recommending improvements in the state's telecommunications infrastructure;
f. conduct a systematic assessment of a new telecommunications facilities. The assessment should include:

1. a precise definition of the telecommunication facilities;
2. an analysis of the telecommunications needs of businesses and institutions, particularly medium-sized and small businesses and institutions;
3. identification of potential users of the telecommunication facility by major industry sectors and in the public sector;
4. a determination of who should own and manage the facility;
5. estimates of cost of developments;

6. estimates of revenues and commercial viability;
7. a definition of technical standards the facility should meet.

Several public policy issues should be examined by any assessment of the need for new telecommunications facilities. These issues are:

a. the roles of state and local government in developing these resources;
b. the relationship of new facilities to existing telecommunications resources including telephone, cable and satellite systems;
c. the relationship of existing regulatory structures to new telecommunications technologies; and
d. potential economic and social consequences of advanced telecommunications technology.

As a response to these recommendations, the State of Minnesota has created a "Telecommunications Council" by 1984 legislative session (Sec. 65 [16B.01]). The major purpose of the Council is to establish leadership in the use of advanced telecommunication resources by both the public and the private sectors. This includes encouraging the development of telecommunication technology to promote economic development of the state, to provide a vehicle for coordinating a variety of telecommunications activity at the state level, and to examine the changing regulatory environment and what changes that state should make to respond to the problems and opportunities presented by deregulation and divestiture of AT&T.

In a recent memo (August 3, 1984) to members of the new Council, Tom Triplett, Director of State Planning Agency points out that the administrative and fiscal responsibility for the Council has been assigned to the State Planning Agency. The Agency is developing an action research agenda as a way of providing technical assistance to the Council which includes identifying relevant local and national telecommunications initiatives now in process as well as defining initial polity research areas which might be addressed by the Council.

Several key issues which state and local governments need to address are presented in Triplett's memo. These issues were identified by both "The Council of State Planning Agencies", which is an arm of the National Governor's Association, and "The Metropolitan Council". These issues are:

<u>Why States Have a Pivotal Role in Telecommunications:</u>

- States continue to regulate local telephone service;
- States determine the conditions for local franchise of cable systems;
- State tax telecommunications businesses;
- State labor laws and tax policies determine the conditions of work in the office and in the home;
- States invest in economic development;
- States invest in health, education, and other essential services

which can be delivered in new ways with telecommunications;
- States directly provide and are a major user of communications services;
- States can play a key role in coordinating public sector investment in telecommunications infrastructure and can build partnerships with the private sector in this area.

Key Policy Questions the States Must Address:

- What are the developments occurring in telecommunications technology and how are they likely to affect the economic development of the state?
- Does telecommunications warrant a distinct set of state policies?
- What is the role of telecommunications in promoting international trade?
- What degree of flexibility is needed in state policy during this period of divestiture and deregulation?
- How should state policy address the entry of new carriers and services?
- How should states go about maintaining essential services?
- Can state policy accept marketplace failure?
- Should state policy promote statewide development of communications facilities, i.e., ensure universal service?
- Should states finance communications systems in a manner similar to other public infrastructure?

Policy Issues in Telecommunications Identified by the Metropolitan Council

Economic Issues:

- What are the relationships between telecommunications and economic development in the seven-county metropolitan area?
- How can the economic development impact of investing in telecommunications infrastructure be measured?
- What impacts on the labor force will take place because of the growth in the information industry?
- What are legitimate public sector roles in promoting telecommunications infrastructure investment?

Coordination Issues:

- What are appropriate public sector roles in coordinating the development of telecommunications systems and services in the metro area?
- How can local government address the telecommunications issues at its level?
- What is the role of government in attempting to ensure some compatibility of the various telecommunication systems being developed in the area?
- What degree of coordination of telecommunications infrastructure with other major metro systems is necessary?

Accessibility and Affordability of Information:

- What will be the effects of increased costs of local telephone service on metropolitan area public and residential and private users?
- What role should the public sector play in ensuring equitable distribution of information to all parts of the region?
- How can all elements of society be ensured access to information services?

Public Services and Telecommunications:

- What public services can be most effectively delivering using telecommunications technologies?
- Should the public sector develop and operate its own telecommunications networks?
- How can government agencies ensure the privacy and security of information which they deliver via telecommunications systems?

The Minnesota initiatives are directly applicable to Wisconsin's situation. While high technology industrial development has been proceeding rapidly in the Minneapolis-St. Paul metropolitan area, little has been done to attract similar development to Wisconsin.

Two recent developments suggest that there is the beginning of local interest in these issues. The first is the Wisconsin Legislative Council's Special Committee on Telecommunication founded in 1984 to study the regulation of telephone utilities and related telecommunications issues. The study is proposed to cover two areas: (1) the impact of deregulation on certain aspects of the telecommunications industry and; (2) current statutes governing the regulation of telephone utilities in light of technical, economic and regulatory changes presently occurring in this industry. The study shall include an examination, and revision where appropriate, of relevant state regulatory activities. The Committee is directed to report to the Council by January 15, 1985 (State of Wisconsin-Special Committee on Telecommunications, June, 1984). While focused primarily on telephone matters, the wide spectrum of membership on the committee indicates some interest in the broader picture as well. The second development involves the Department of Administration's ongoing attempt to plan for a statewide telecommunications utility for state government. The plan puts DOA in the position of "reseller" for the public sector in Wisconsin.

In their recent memo to the Special Committee on Telecommunications, John Stolzenberg and Bill Ford have raised several questions to be answered concerning the role of Wisconsin state government in developing the telecommunications system for economic development:

> - should new competitive providers of local telecommunications service, e.g., cellular phones and two-way cable systems be regulated?...

- should some local phone service utilities be exempt from certain regulations due to their size or type of organization?...

- should state agencies be authorized or encouraged to develop the most efficient and least costly telecommunications system for their needs, even though it may be "by passing" the public switched network?...

- should state agencies be allowed to sell or lease excess capacity in the state telecommunications system to private customers?

- what, if anything, should the state do to encourage the development of a telecommunication system, or "infrastructure", necessary to meet the future development needs of Wisconsin's businesses? For example, should the state develop communications facilities for private use, such as is being done by the New York Port Authority? (Stolzenberg, and Ford, July, 1984).

The most recent goals statement is presented in John Stolzenberg's memo to members of the special committee on telecommunications (September 25, 1984). This statement provides two alternative goals of the state government concerning the use of telecommunications in economic development. Stolzenberg points out "...this area [development of the state economy] of potential telecommunication goals is based on the following question: Does state government have a role in developing the expanded applications of telecommunications in the state's economy, other than as a regulator?" In relation to this question the statement provides two alternative goals:
"1) rely upon privately- and cooperatively-owned telecommunication utilities and companies to provide new telecommunication services in Wisconsin; 2) encourage, through technical and financial assistance and other appropriate means, the development of new telecommunication services sought by Wisconsin businesses and not presently provided by the telecommunications industry.

While both efforts are still in the formative stage, they indicate some movement toward the strategic planning necessary if Wisconsin is to maintain a competitive position regarding information-based industrial development.

IV. GLOSSARY

- ANALOG: Representations which bear some physical relationship to the original quantity: usually electrical voltage, frequency, resistance or mechanical translation, or rotation. Contrast to digital.

- ARTIFICIAL INTELLIGENCE: Computer systems which perform functions normally associated with human reasoning and learning.

- BANDWIDTH: The maximum frequency (spectrum) measured in Hertz or cycles per second, between the two limiting frequencies of a channel.

- BAUD: Bits per second (bps) in a binary (two-state telecommunications transmission).

- BINARY: The basis for calculations in computers: a numbering system having only two numbers, typically 0 and 1; a base system.

- BIT: One binary digit. The smallest part of information with equally like values or states, "0" or "1", or "yes" or "no." In electrical communication systems, a bit can be represented by the presence or absence of a pulse.

- BROADBAND COMMUNICATION: Communications using high frequency signals (e.g., 6 MgH, the bandwidth of a TV channel). Video teleconferencing is a broadband medium.

- BYTE: The group of bits, processed or operating together, needed for one character.

- CABLE TELEVISION: The use of a broadband cable (coaxial cable or optical fiber) to deliver video signals directly to television sets. Current systems may have the capability of transmitting signals in two directions.

- CATV: Cable television or community antenna television.

- CARRIER: Electromagnetic signal with a constant amplitude and frequency.

- CENTRAL OFFICE: The local switch for a telephone system; sometimes referred to as a class 5 office, or a wire center.

- CHIP: A thin silicon wafer on which electronic components are deposited in the form of integrated circuits.

- COAXIAL CABLE: A metal cable consisting of a conductor surrounded by another conductor in the form of a tube which can carry broadband signals by guiding high-frequency electromagnetic radiation.

- COMMUNICATIONS SATELLITE: Satellite used to transmit voice, data, and program signals. A communications satellite serves as a microwave relay in space. Such satellites are placed in a geostationary orbit so that their position remains fixed over a particular location on earth. Because microwave repeaters transmit along a line-of-sight path, location of such

repeaters on a satellite permits coverage of a large portion of North America by each repeater, rather than, as in land-based relays, requiring one repeater every 20 to 30 miles.

- CPU: Central Processing Unit. The component in a stored program digital computer which performs arithmetic, logic, and control functions.

- CRT: Cathode Ray Tube. A video display vacuum tube used in television sets and computer display terminals.

- DATA: The raw information within a computer system.

- DATA BANK: (also called a data base) is commonly defined as a comprehensive collection of libraries of data. A computer data bank includes all the facts, numbers, instructions, text, or other symbols stored in the computer's memory circuits.

- DIGITAL: A function which operates in discrete steps as contrasted to a continuous or analog function. Digital computers manipulate numbers encoded into binary (on-off) forms, while analog computers sum continuously varying forms. Digital communication is the transmission of information using discontinuous, discrete electrical or electromagnetic signals which change in frequency, polarity, or amplitude.

- DIRECT BROADCAST SATELLITE (DBS): A satellite system designed with sufficient power so that inexpensive earth stations can be used for direct residential reception.

- DISH: A parabolic antenna that is the primary element of an earth terminal.

- DOWNLINK: The transmission from a satellite to an earth station.

- DUPLEX: A transmission in which signals can go in both directions simultaneously.

- EARTH TERMINAL (or EARTH STATION): Equipment on the ground used to send and/or receive satellite communications.

- ELECTROMAGNETIC RADIATION: A form of energy including radio and light which propagates through space in the form of oscillating electric and magnetic fields or waves.

- END-USER: Ultimate consumer of a service.

- FACSIMILE TRANSMISSION: The electronic transmission of pictures, charts, graphs, etc. from one place to another by radio, telegraphy, or telephone.

- FIBER OPTICS: Communications technique based on a laser transmission that uses a fiber, or thread-like material, which carries light the way copper wires carry electricity.

- FLOPPY DISC: A small, flexible disc carrying a magnetic medium in which digital data are stored for later retrieval and use.

- FOOTPRINT: That part of the earth's surface where a particular satellite's signal can be picked up. A footprint can cover one third of the globe, but will usually be less.

- FM: Frequency modulation. (See Modulation.)

- FREQUENCY: The number of recurrences of a phenomenon during a specified period of time. The measurement unit of electrical frequency is the Hertz.

- GEO-SYNCHRONOUS COMMUNICATION SATELLITES: Orbital space vehicles which appear to be stationary over one point above the equator, permitting the use of less-expensive earth stations without tracking equipment.

- GIGAHERTZ: (GHz) Billion Hertz (cycles per second).

- GROSS PROFIT MARGIN: is the gross revenues of the Reseller - payments to the common carrier + subscriber's fees.

- GROUND STATION: See Earth Terminal.

- HARDWARE: The electrical and mechanical "body" or equipment used in telecommunications or computer systems.

- HEADEND: Cable system site that houses the specially designed equipment needed to receive, process, and originate signals for a cable system.

- HERTZ: (Hz). The unit of frequency. One Hertz is equal to one cycle per second.

- INPUT: The data that is entered into the commputer; the act of entering data.

- INTERACTIVE MEDIA: A two-way telecommunications system that permits viewer response or participation. It allows direct exchanges among people via one or more communication channels.

- INTERFACE: The place at which two systems (such as a computer and its supplementary equipment) meet and interact with each other; the means by which the interaction is made.

- INTERNATIONAL TELECOMMUNICATION UNION (ITU): An international organization affiliated with the U.N. which allocates radio frequencies through mutual agreement and coordinates telecommunications interconnections. Founded in 1865, it is the world's oldest such cooperative organization.

- KILOHERTZ: (KHz) Thousand Hertz.

- LOGGED IN: Connected to a computer.

- MAGNETIC DISC: A form of computer memory in which data are stored in a magnetic oxide that coats a plastic or metal disc. The data are recorded and played back (read) by magnetic heads which traverse the rotating disc under programmed control.

- MEGAHERTZ: (MHz) Million Hertz.

- MEMORY: The computer's information storage capability, also called "storage."

- MICROCHIP: An electronic circuit with multiple solid-state devices engraved through photolithographic or microbeam processes on one substrate.

- MICROCOMPUTER: A set of microchips which can perform all of the functions of a digital stored program computer. (See Micro-processor.)

- MICROPROCESSOR: A micro-chip which performs the logic functions of a digital computer.

- MICROWAVE: High-frequency radio waves used for point-to-point transmission.

- MODEM: A device which is used for interfacing (or matching) different functions of a communications system.

- MODULATION: The process of modifying the carrier to impress on it the characteristics of another signal by changing its amplitude (AM, its frequency (FM), or its phase (PM), or by turning it on and off in a predetermined pattern (pulse code modulation).

- MULTIPLEX: The ability to transmit several signals from different sources to different destinations over a single channel at once.

- NARROWBAND COMMUNICATION: A communication system capable of carrying only a few voice channels or relatively slow-speed computer signals.

- NET PROFIT MARGIN: is the gross profit margin - (expenses + salaries + fringes + promotion/advertising + office/furniture central + utilities + amortiz. PBX and accessories + amortiz. installation costs + access line changes + amortiz. start-up costs/interest).

- NONBROADCAST: Transmission directed to a specific audience. Also called narrowcast, it can include cable TV, satellite, teletext, etc.

- OFF-LINE: Method of operation in which a device is not directly connected to a telecommunications system or operating computer.

- ON-LINE: A method of operation in which a device is directly connected to a telecommunications system or an operating computer.

- OPERATING SYSTEM: A set of instructions for a computer which permits it to run various programs and handle scheduling, control of printers, terminals, memory devices, etc.

- OPTICAL FIBER: A thin, flexible glass fiber the size of a human hair which will transmit light waves capable of carrying vast amounts of information.

- OUTPUT: The information generated by a computer.

-PACKET SWITCHING; A technique of switching digital signals with computers whereby the signal stream is broken into small packets and reassembled in correct sequence at its destination. There are many variations used in data networks, in satellite communication, and for secure voice communications.

-PBX: Private Branch Exchange: a telephone switching office.

- SIMPLEX: Transmission in only one direction at a time.

- SLOW-SCAN TELEVISION: A technique of placing video signals on a narrowband circuit, such as a telephone line, which results in a picture changing every few seconds. Useful for transmitting still pictures.

- SOFTWARE: The instructions which direct a computer program. Any written materials or script, including films, videotapes, etc., for use in a communications sytem, or the program produced from the script. (See Hardware.)

- TELECOMMUNICATIONS: The use of wire, radio, optical, or other electromagnetic signals to transmit or receive signals, sounds, or images.

- TELECONFERENCE: A meeting where participants in different locations are linked by a telecommunications system. Can be audio teleconference (voice only) or video teleconference (where participants see one another via TV). Satellites represent a successful communications medium for teleconferencing.

- TELETEXT: Broadcasting service using several otherwise unused scanning lines bewtween frames of TV pictures to transmit information which is displayed on the screen.

- TRANSLATORS: They are broadcast stations "...operated for the purpose of retransmitting the signals of a television broadcast station, another television broadcast translator station, or a television translator relay station by means of direct frequency conversion and amplification of the incoming signals..." Translators are used to receive signals at strategically located points and to distribute those signals to areas where acceptable signals cannot be received directly from the originating broadcast station. Distribution is accomplished by "translating" the signals to another channel to avoid interference with the originating station, and rebroadcasting the signal over the air. One translator is required for each signal received and rebroadcasted.

- TRANSPONDER: The equipment on a satellite that accepts the signal sent from earth and after amplifying and changing the frequency, sends it back to earth for reception.

- UPLINK: The transmission from an earth station to satellite.

- VIDEOTEX: Service similar to teletex except that information is delivered by telephone and can be used in the interactive mode.

V. ANNOTATED BIBLIOGRAPHY

1. General Context

Brown, Arnold, "Equipping Ourselves for the Communications Age", Futurist, World Future Society, August, 1981.

Abstract: The new information technologies could launch a transformation as revolutionary as the changes wrought by the automobile. In the enthusiasm with which we greet these new technologies, we tend to overlook one very significant fact about the communication age: It is not the information itself but the control of information that is power.

Headings: SKILLS: gateways to power; the communicator; the message; the medium; the recipient; survival skills in the new age; the twin barriers of ego and arrogance; banishing fear of the future.

Castells, Manuel, Towards the Informational City?, High Technology, Economic Change and Spatial Structure: Some Exploratory Hypotheses, Working Paper No. 430, Institute of Urban and Regional Development, University of California, Berkeley, August 1984.

Cornish, Edward, "The Coming of an Information Society", Futurist, World Future Society, April, 1981.

Abstract: This paper is a summary of what has been happening and what it may suggest about the future of the new information technologies - telecommunications and computers.

Headings: electronics enters communications; the computer revolution; instant information about everything; the electronic newspaper; electronic "yellow pages"; teleshopping; networking; impacts.

Dabbs, P. H., et. al., "French Revolution", British Telecommunication Journal, V. 3, N. 2, pp. 19-21, Summer, 1982.

Abstract: In this paper the authors talk about the French experience in modernizing and expanding the domestic telephone network and establishing a secure telecommunications manufacturing base to compete in the world marketplace. The objectives were to: (1) give the entire population access to the telephone; (2) reduce regional and socioeconomic inequalities; (3) promote regional development; and (4) guarantee regular industrial production.

Hald, Alan P., "Toward the Information-Rich Society", Futurist, World Future Society, Aug. 1981.

Abstract: A house that talks? A robot tutor that can make your kid a genius? These are just a few of the wonders that may be brought to you in the 1980's courtesy of advancing microcomputer technology. This new technology is dramatically increasing our ability to recall information, communicate, create knowledge, and understand complex relationships. We are moving from a society perceived as resource-constrained to one that is "information-rich".

Headings: The technology; ecological stress; Fred the house; conscious environments; access to knowledge; The genius generation; self-selective media; many-to many communication; new realities.

Jennings, Lane, "The Human Side of Tomorrow's Communications", Futurist, World Future Society, April, 1979.

Abstract: Four recent innovations in communications technology appear to have wide potential that they could radically transform the process of idea exchange in the near future. These innovations are: satellite broadcasting, the use of optical fiber waveguides, and home computers. However, human -- not technological -- factors will decide whether or not these innovations achieve their full potential.

Headings: communications satellites; optical fibers; video-recording equipment; home computers; ads of the future; public access to satellite services; multi-media libraries; the future of language; new directions in communications.

Jones, Martin V., "How Cable Television May Change Our Lives", Futurist, World Future Society, October, 1973.

Abstract: Cable television (CATV) is moving into more and more homes. Unlike broadcast television, CATV makes possible a vast range of two-way information services, such as computerized teaching, thousands of plays and movies available whenever one wishes, and electronically-delivered newspapers edited specially for the individual reader. These new services can be delivered by means of a cable, and demonstration projects already are under way. Many communications experts believe that CATV will drastically change human life in a wide variety of ways. This article reports on current research at the MITRE Corporation in McLean, Virginia, on the impacts of CATV.

Larson, Reed, "The Search for Self-Knowledge Enter a New Era", Futurist, World Future Society, October, 1981.

Abstract: The ancient Greeks believed that it was important to "know thyself", but their only tools were reflection and soul-searching. Today, we can learn much more about ourselves by using modern technology to monitor our physical and psychological states.

Headings: The study of moods; Biomechanical sources of self-knowledge; computer projections of states; the psychological states of a writer; coordination of body and mind.

Martino, Joseph P., "Telecommunications in the Year 2000", Futurist, World Future Society, April, 1979.

Abstract: Households in the year 2000 may have instant access to information from hundreds of sources all over the world, thanks to the electronic wizardry now being devised or already starting to be used for communication.

Headings: broadcast television; the telephone system; cable television; telecommunications in the home; communications satellites; special communications services; who will pay?; television as an information utility; monopoly or competition?

Myers, Del, "The Expanding World of Telecommunications", Telephony, V. 205, N. 23, Nov. 28, 1983.

Abstract: Telecommunications network providers and equipment manufacturers are engaged in a massive ad, often, frenzied campaign to educate the public on the genuine wonders of the information age and its vital telecommunications links. This article addresses the non-technical public need for accurate, understandable and usable telecommunications information. The article is based on a presentation to the International Public Relations Association at Symcom 83, Bern, Switzerland.

Roland, Jon, "The Microelectronic Revolution: How Intelligence on a Chip Will Change our Lives", Futurist, World Future Society, April, 1979.

Abstract: Today's technology is packing the power of yesterday's large, expensive computers into tiny electronic circuits smaller than a printed character. These "microelectronic" circuits are being mass-produced at low cost, and they are appearing in thousands of new applications from pocket calculators and digital watches to personal computers and space probes.

Headings: The potential to be realized; breaking through the costs; the coming personal computer network; security and privacy; transactions and banking; dedicated applications; the future of education; strategy for occupational survival.

Smith, William, "An Independent Service for Pretesting Media Messages", Development Communications Report, N. 31, July, 1980.

The importance of pretesting media programs and messages is becoming more accepted by communication planners and media production directors. One problem, however, remains critical: how to administer an effective pretesting system for a relatively small volume of programs. Programs and materials can be improved if they are pretested with representative groups of a given target population.

Snow, Marcellus, S., "Comparing Costs vs. Elasticity of Demand Guides Satellite Plans for the Pacific Region", Telephony, V. 204, No. 17, pp. 40-72, 80, Apr. 25, 1983.

Abstract: In 1981, researchers spent 7 months studying the communications needs in the Pacific basin area, and recommended use of satellite technology for this communications-poor region. This article discusses a follow-up study in which the feasibility of alternative satellite options and pricing scenarios are compared.

Vail, Hollis, "Taking Charge of Television: The Videocassette Recorder", Futurist, October, 1979.

Abstract: By giving people a way to control which programs they watch and when they watch them, the videocassette recorder could revolutionize the way that people watch television -- and could even cause significant changes in the medium itself.

2. Transportation & Telecommunication Tradeoff

Air Transport Association of America (ATA), Impacts of Telecommunications on the Demand for Air Transport, Washington, D.C., August, 1981.

Abstract: The impact of the new telecommunications technology on the growth rate of business travel and business use of first class mail is negligible in the present year (1981) but could begin to reduce the rate of growth of revenues from business travel and mail by 1985. Strategic and fleet planners will want to monitor the growth of these new competitive systems to observe the timing and degree of impact.

Headings: telecommunications systems; high speed data transmission; telephone conference calls; audio plus graphics; one-way video plus two-way audio; two-way video; costs and benefits of teleconferencing; summary.

Baran, Paul, "30 Services that Two-way Television Can Provide", Futurist, World Future Society, October, 1973.

Abstract: In 1970 the Institute for the Future made an indepth study on the potential of two-way broadband communications services to the home. In this article, the principal investigator discusses the findings and describes 30 specific services that interactive television could provide.

Headings: education; business conducted from the home; general information access, shopping facilitation; entertainment; person-to-person communications.

Goddard, J.B., "Office Communications and Office Location: A Review of Current Research", Regional Studies, V. 5, pp. 263-380, Pergamon Press, 1971.

Abstract: This paper first establishes the growing importance of office type activities, the role of communications in office location and the problem of assessing the likely impact of future telecommunication systems on location. Three basic research questions are suggested. First, what forms of personal contact could be satisfactorily maintained by future telecommunication system? Second, what are the patterns of communication within and between existing organizations and, do these reveal characteristics that suggest strong locational constraints or substantial volumes of contact that might be transferred to telecommunications, so enhancing locational flexibility? Third, how, with knowledge of existing communications patterns and of substitutability, can decisions about location be made to take account of communications characteristics? Finally, how can knowledge about contact systems be used by planners to influence patterns of regional development? These questions are approached by reference to current research into each topic.

Goldmark, Peter, "A Selective Literature Review of Transportation and Telecommunications Studies", The New Rural Society Project, Cornell University, Dept. of Communication Arts, 1976.

Abstract: This report focuses on rural economic development and the impact of transportation and communications on this phenomenon. The central hypothesis is: "Improved Accessibility gained through an upgrading of transportation and communications links will enhance the economic development potential of a rural area."

Headings: Location theory and agglomeration economies and diseconomies; transportation and rural economic development; communications and rural communities; spatial dispersion and diffusion of innovations; a discussion of impact models.

Mandeville, Thomas, "The Spatial Effects of Information Technology: Some Literature", Futures (UK), V. 15, N. 1, pp. 65-72, February, 1983.

Abstract: In this paper the author makes a comparison among different studies on the spatial effects of information technology. He concludes that information technologies can encourge and also substitute for the physical movement of goods and people, with consequences for centralization and decentralization. Which of the two effects will appear in any given case appears to depend more on factors other than the choice of technology.

Headings: information technology and decentralization; barriers to the technology-induced dispersal of people; both centralization and decentralization.

New Rural Society Project (NRS), The Project's Reports, Fairfield University:

1. Survey of Business Relocation in Connecticut (NRS Reference 201) - Winter 1972.

The purpose of this study was to determine the extent that communications concerns played a role in a company's decision to move. Results showed that communications, at least when discussed after a relocation, was low on the list of concerns, and the cost of land, plant and labor were the key areas of interest to the decision makers.

2. A Survey of Reasons Urban Based Corporations Decide Against Moving (NRS Reference 202) - April 1973.

The results of the study of organizations which had already moved showed that telecommunications had not figured as an important locational factor, but one cannot dismiss communications. Communications is often treated as a utility and, as such, is often the responsibility of lower level managers who specialize in providng the service to the rest of the organization. To explore this, an investigation of metropolitan-based firms which had considered moving, but had (at least for the present) decided against it, was undertaken. Each firm's communications manager was interviewed.

3. A methodology for Identifying Prospective Organizations for Relocation and Analyzing Their Operations. (NRS Reference 203) - May 1973.

A research strategy for finding prospective relocators was encouraging their consideration of rural sites for their operations was developed. In keeping with the primary interest of the project, the methodology, after acknowledging that there are a large number of considerations affecting a relocation decision, goes on to deal with the communications aspects in detail. The general process from finding relocation candidates to the final move is diagrammed in a flow chart.

4. A Matrix Method for Classifying Communications Devices and Systems.

5. The Communications Factor in Dispersal: An Overview by JUPR (NRS Reference 205) - October 1972.

The Communications Studies Group of the Joint Unit for Planning Research of Great Britan was a subcontractor to the NRS Project. They prepared this report reviewing studies (including their own) in the fields of office relocation and communication in England and Europe.

6. The Office Communications Audits (NRS Reference 206) Unpublished.

The NRS project is engaged in exploring ways to make it attractive for business and government operations to expand into rural parts of the country. Internal and external office communications are an important ingredient of this. NRS is exploring techniques through its office communications analyses to facilitate the applications of existing communications technology to the decentralization and relocation of business and government operations. The intent is to characterize the communications needs of an organization, such as meetings, correspondence, telephone contacts, etc. These data, along with an understanding of how long distance electronic systems could handle some of these contacts, permit identification of the organization's components which could be most easily decentralized. A significant step in this direction is NRS' communications audit recently conducted with four Criminal Justice Agencies in Connecticut. The report on this activity is presently in preparation.

Niles, Jack M., et.al., The Telecommunications-Transportation Tradeoff: Options for Tomorrow, Wiley & Sons, New York/London, 1976.

Abstract: This book documents a research program begun in 1973. It provides a general overview of some of the possibilities for substituting telecommunications for transportation, and of the societal implications of widespread adoption of the substitutes.

Contents: (1) background; (2) the information industry; (3) case studies; (4) establishing decentralization requirements; (5) general telecommunications network considerations; (6) some human factor considerations and operating scenarios; (7) transportation and energy costs; (8) cost-benefit analysis; (9) effectiveness, perceptions, and attitudes; (10) other tradeoffs and direct impacts; (11) indirect impacts; (12) policy implications (App. - related research, and communication survey).

Lathey, Charles E, Telecommunications Substitutability for Travel: An Energy Conservation Potential, U. S. Dept. of Commerce/Office of Telecommunications, Report 75-58, Washington, D.C., January, 1975.

Abstract: This document was developed by the Office of Telecommunications in cooperation with the Office of Energy Conservation and Environment as a part of a continuing program aimed at energy conservation through an increased and better use of the telecommunications technology. The document's results supports the role of telecommunications as an effective substitute for the information handling functions of travel. Such substitution has the potential of saving the equivalent of as much as seven percent of the total petroleum consumption of the U.S.

Contents: Introduction; energy consumption: transportation and telecommuncations; factors relating to and influencing travel; teleconferencing as a substitute for travel; sources of information.

Report on Travel Management (RTM), "Teleconferencing", Runzheimer and Company, Inc., Northbrook, IL., V. 1, N. 7, November, 1981.

Abstract: As the cost of business travel continues to take a bigger bite from the corporate budget, executives are questioning the productivity of corporate travel. They are also exploring alternatives to busines travel. One of the most promising alternatives on the horizon may be teleconferencing.

Headings: alternatives to travel; new technology emerges; everything from simple to complex

Runzheimer and Company, "Trend in Teleconferencing", Runzheimer on Travel Management, Northbrook, IL, V. 2, N. 11, March, 1983.

Abstract: Reducing travel costs should have a higher priority than merely recovering costs. The most effective way to reduce travel costs is to cutback on travel itself. The typical business trip also wastes much time, and wasted time can mean wasted money. Thus, firms look for alternatives that allow personal contact without the difficulties and expense of travel. Although nothing takes the place of a face-to-face

meeting, teleconferencing can come close. This article discusses the different types of telecommunications and makes a comparison between the average costs of traditional meetings and that of teleconferencing.

Headings: types of teleconferences; is teleconferencing a substitute for travel?; is teleconferencing cheaper?

Vallee, Jacques, et. al., "The Computer Conference: An Altered State of Communication?", Futurist, World Future Society, June, 1975.

Abstract: Using ordinary telephone lines, people can now join an invisible network and attend a conference that runs continuously, 24 hours a day, for as long as the participants want. The authors believe that this unique medium can create an altered communication state. By enabling people to escape the normal bounds of time and space, computers may thus provide an opportunity to create and explore new patterns of human expression.

Headings: an altered physical environment; alteration of time and space; altered structures in communication; mapping the altered state; implications for the future.

3. Telecommunications and Economic Development

Anonymous, "Technology Moves in on Corporate Decision-Making", Chemical Week, V. 132, N. 11, pp. 30-34, Mar. 16, 1983.

Abstract: Corporations increasingly view technology not merely as providing the competitive edge, but also as the key to survival. According to a survey of more than 700 manufacturing companies, new products developed from 1981 through 1986 are expected to yield 27% of their net incomes in 1986. As a result, many companies are restructuring to bring research and development (R & D) managers directly into the business planning process. The purpose of this restructuring is to give voice to technology so that the right production and marketing decisions can be made at the right time. To achieve integrated decision making, some companies are organizing work groups and committees to allow technical and business executives to work more closely. In addition, new corporate units and separate operating companies are evolving to coordinate these activities.

Black, Sena H., "The Information Processing Industry: A Market Niche for South Carolina?", Business & Economic Review, V. 30, N. 2, pp. 7-11, January, 1984.

Abstract: California's success in attracting high-technology industries has inspired many states to try to do the same. However, high-technology industries will never be distributed evenly across the U.S. These industries tend to be located in areas where highly skilled people find cultural and recreational

facilities, as well as jobs. While South Carolina does not have these characteristics, it should not abandon the pursuit of these emerging industries,. The information processing industry holds promise for South Carolina. Opportunities within specific sectors of the information economy can be tailored to meet the particular needs of the state and pursued successfully in an economic development strategy based on entrepreneurial encouragement.

Castells, Manuel, Towards the Informational City?, High Technology, Economic Change, and Spatial Structure: Some Exploratory Hypotheses, Working Paper No. 430, Institute of Urban and Regional Development, University of California, Berkeley, August 1984.

Abstract: In this paper, the author attempts to explore the impact of the current information technological revolution on the process of transformation of cities and regions. The overarching hypothesis of the paper is that technological change, in general, can only be understood in the framework of two fundamental historical processes that are transforming our society: the restructuring of the capitalist mode of production, and the emergence, within capitalism of the informational mode of development. Within this context, there are two modes of development related to the form in which the elements of the process of production are combined to obtain the product: the industrial mode, and the informational mode. In the industrial mode, productivity results from an increase in the quantity of labor, matter, or energy. In the informational mode, productivity results from the way of combining the elements of the process of production, itself depending upon knowledge to predict the most productive combination. While industrial development is based on the quantity of the "product", information development is based on the quality of the "process". Both modes of development coexist historically, but the new informational mode is increasing its dominance at our exponential rate. Therefore, this paper examines the interaction between modes of production, mode of development, and technological change, and explores the new urban and regional processes emerging from this interaction.

Headings: (1) The blurred profile of high technology; (2) the locational pattern of high tech manufacturing and its impact on the spatial structure; (3) the potential impact of new communication technologies on the spatial structure; (4) high technology, economic re-structuring and the urban process; (5) conclusion: spatial restructuring, city lights and urban shadows.

Cramer, Deborah, "Videotex Infrastructure Builds as Banks, Vendors Join Bandwagon", Bank Systems & Equipment, V. 20, N. 2, pp. 97-103, February, 1983.

Abstract: During the 1980's, videotex, which is the generic label for video information retrieval systems, will experience a maturing process. Rapid commercial develoment is developing an industry infrastructure in which the financial services community will play a major role. Videotex reduces the costs associated with a labor-intensive branching system, while extending the marketing range and potential. Prominent banks across the nation taking an active role in the reseearch and development of this electronicdelivery system include: First Bank System, Inc. (Minneapolis, Minnesota); Chemical Bank (New York); Bank of America (San Francisco, California).

Culnom, Makry J., "Human Communication Needs and Organizational Productivity: The Potential Impact of Office Automation", Journal of the ASIS, V. 34, N. 3, pp. 215-221, May, 1983.

Abstract: White-collar workers comprise the majority of the labor force in the U.S. today and the majority of present labor costs. Much of what they do in offices is Related to communications. Since office automation (OA) represents more productive, structured techniques for handling written and oral communication, OA provides the potential to make organizations more productive by improving organizational communications. This article examines the potential impacts of OA on organizational communication and, therefore, on organizational productivity.

Greenbaum, Howard H. et.al., "Organizational Structure and Communication Processes: A Study of Change", Group & Organization Studies, V. 8, N. 1, pp. 61-82, March, 1983.

Abstract: The effects of a change in organizational structure on organizational communication processes and goal attainment were studied for an industrial organization which had instituted a work-group program. The program was designed to improve communication, employee knowledge and morale, and productivity. The communication processes which were studied included: (1) the regulative-task network; (2) the adaptive-innovative network; (3) the integrative-maintenance network; and (4) the information-instructive network. Minutes of group meetings were analyzed and group participants were surveyed about the effectiveness of work groups. Work groups were found to be most effective in improving knowledge of work and in promoting discussion of work-related problems, and least effective in improving productivity and supervisor-subordinate communication. Organizational communication was most improved through informative-instructive and adaptive-innovative communication networks, and least improved through the regulative-task network. Tables. References.

Hamm, J. David, "Telecommunications Developments: Implications for the 80's", Journal of Telecommunication Networks, V. 1, N. 4., pp. 307-311, Winter, 1982.

Abstract: The entire structure of U.S. business is being transformed by the telecommunications and computer industries. The telecommunications industry in particular is moving from a mature industry into a growth industry characterized by innovation and rapid change. The changes that have been taking place in the industry fall into 2 categories: regulatory and technological. The implications of these changes include (1) the increase of level of competition; (2) the availability of a variety of services and products; (3) the increasing level of innovation within the industry; (4) the increasing dependency of corporations on facilities for information-handling; (5) the complexity of all areas of communications.

Hamrin, Robert D., "The Information Economy: Exploiting an Infinite Resource", Futurist, World Future Society, August, 1981.

Abstract: By the mid-1970's, America's working population was predominantly engaged in information handling. Now that one-half of the American work force is in information processing, we can begin to see some of the coming changes that experts say may exceed those of the industrial revolution.

Just as the industrial revolution expanded the physical capacity of humans, so the information revolution will magnify the power of the brain. But unlike the industrial revolution, which depended on finite resources, the new information age will be fired by a seemingly limitless supply of knowledge and ideas.

Headings: the amazing technology; information market booms; "intelligence" saves energy; education and computers; interpersonal communication; productivity gains; jobs: more or fewer?; trade opportunities.

Harrington, Lisa H., "Plugging into World Markets", Traffic Management, V. 2, N. 10, pp. 31-38, October, 1983.

Abstract: Computerization is gaining a strong toe-hold in the export/ mport industries and is bringing new efficiencies and savings. Intermodel shippers face problems in trying to keep documentation timely,and they want, eventually, to create an electronic data interchange system to replace much of the paperwork and associated delays. While the network is still some years away, a number of enterprises as well as the U.S. customs service have made some individual advances.

Henry, David M., "Planning Telecommunication for Local Governments", Telephone Engineer & Management, V. 86, N. 20, pp. 110-116, Oct. 15, 1982.

Abstract: Many city and county governments in the U.S. are becoming interested in owning their own telephone systems. Understanding the communications system is time-consuming, but it needs to be done. An effective telecommunications management policy should be created. Several alternative telephone systems are available. A system can be leased from the phone company, leased from another company, or purchased. A cost model should be developed for each alternative.

Miller, Landon C., "Communications Planning", Journal of Systems Management, V. 34. N. 10, pp. 18-21, October, 1983.

Abstract: In today's business environment, companies need a formal structured approach to telecommunications planning that anticipates change, managers errors, and focuses on requirements. One such common plan consists of 4 steps that integrate business elements with planning phases: (1) general planning/management and organization; (2) requirements/ applications; (3) design/operational; and (4) implementation/ technological. In the general planning stage, the communications network must reflect the organization's structure and must operate both horizontally and vertically within the organization.

Molitor, Graham, T., "The Information Society: The Path to Post-Industrial Growth", Futurist, World Future Society, April 1981.

Abstract: Information and knowledge have become the critical new factors in economic growth. As the pre-industrial society depended on labor in drawing resources from nature's bounty, and the industrial society depended on man-machine combinations, the post-industrial society depends on "knowledge" as its major resource. By the year 2000, two thirds of the American work force will be allied with information. However, the policies that the U.S. adopts in response to this new situation will prove crucial to its future economic and social health.

Morrow, Paula C., "Explorations in Macro-Communication Behavior: The Effects of Organizational Feedback on Organizational Effectiveness", Journal of Management Studies, V. 19, N. 4, pp. 437-446, October, 1982.

Abstract: In this study, previous organizational theory is used to produce propositions which link organizational feedback (vertical and horizontal) to organizational effectiveness so that the construct validity of feedback could be evaluated.

Nobs, Charles H., "Strategic Planning for Telecommunication Management in the 1980's", Business Communications Review, V. 13, N. 3, pp. 12-17, May/June, 1983.

Abstract: If the interweaving of business and technology is be effective, telecommunications management needs strategic planning to anticipate the future and position resources accordingly.

Simmons, William W., "The Consensor: A New Tool for Decision-Makers", Futurist, World Future Society, April, 197 .

Abstract: The consensor, a new computer tool, is making it easier for planners and decision-making groups to find out how much they know and how strongly they feel about alternative choices facing them. The consensor offers a way to make businiess meetings and public discussions shorter, more productive, and, at the same time, more democratic and more representative of the participants' true feelings.

Headings: introducing the consensor; working with the consensor; instant opinion poll; the consensor and the future.

Spector, Bertram, "Decision Support Systems Integrating Managerial Judgment, Objective Analysis", Telephony, V. 204, May 23, 1983.

Abstract: Computer-based decision support systems help telecommunication facilities and business managers monitor and assess operations and performance indicators.

Teubal, Morris et. al., "Government Policy, Innovation and Economic Growth", Research Policy (Netherlands), V. 11, N. 5., pp. 271-287, October, 1982.

Abstract: This article examines the involvement and role of NASA in satellite communications technology (SCT) development. The purpose is to provide some structure to the growth rate, maturation, and new industries generated by SCT, and to measure social benefits derived from it.

Turoff, Murray, "The Future of Computer Conferencing: An Interview with Murray Turoff", Futurist, World Future Society, August, 1975.

Abstract: In an interview with the "Futurist" in 1975, Murray Turoff, the developer of the first computer conferencing system, predicted widespread use of computer conferencing by 1980. By that time, he said, "computer terminals would cost about the same as a color TV costs today (1975) -- Now, in 1984 Turoff's prediction is true. In this interview, he stated that, computer conferencing may benefit deaf and handicapped people, developing countries, doctors, housewives, and students. It may even help to ease sex, age, racial, and ethnic biases and to maintain world peace.

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Mandeville, Thomas. "The Spatial Effects of Information Technology: Some Literature". Futures (UK), V. 15, N. 1, pp. 65-72, Feb. 1983. (See Abstract in section III).

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