Working Paper 89-01

(formerly Working Paper 005)

The Telecommunications Service Sector : The Industrial Trends and Prospects for Oakland

Scott Campbell

The University-Oakland Metropolitan Forum is a partnership of the University of California at Berkeley; California State University, Hayward; Mills College; Holy Names College; the Peralta Community College District; and the Oakland community.

University of California at Berkeley
Institute of Urban and Regional Development

Table of Contents

The Telecommunications Service Sector: Industrial Trends and Prospects for Oakland --Interim Report -

Summary

This draft report examines the telecommunications service sector and its potential for growth in Oakland. Telecommunications is a rapidly changing industry, characterized by the reorganization and fragmentation of the traditional Bell System, the introduction of new technologies and services, and greater integration with computer technologies. Though the overall revenues and markets for telecommunication services are increasing, the industry offers less promise in terms of employment generation. Employment growth will slow or even decline over the coming years due to several factors: continued automation of services; standardization and modularization of equipment (requiring less installation and maintenance work); and deregulation of the industry. The shake-up and restructuring of the telecommunications sector are also threatening the industry's traditional job security and stable wages.

Oakland's prospects for gaining a good share of this changing industry are mixed. On the positive side, the city is centrally located within a huge and sophisticated regional telecommunications market. The city has a strong existing presence in Pacific Bell and AT&T. It also benefits from its proximity to the University of California (in Berkeley and systemwide offices in Oakland), to Bay Area Teleport (at Harbor Bay Isle in Alameda), and the expansion of Silicon Valley into southern Alameda County. The potential for Oakland to become a more important office center could also attract telecommunication services to the city.

On the negative side, there seems to be little about Oakland which gives the city a unique comparative advantage within the region. Telecommunications technology is ubiquitous in nature, and allows for greater decentralization of economic activities outside the central cities. The city also lacks the high tech image which some telecommunications firms seek. Finally, some telecommunciations firms have expressed concerns about whether the local labor force has the adequate skills required for future telecommunication jobs.

Oakland telecommunication firms currently serve not only local demand, but also some regional and transregional markets. This exporting of telecommunication services should continue in the future, but unfortunately the city has no clear competitive advantage over other Bay Area (or East Bay) communities. In addition, telecommunication activity may increase without a corresponding increase in employment. This reflects the nationwide trend of

increased productivity and automation, so that employment growth will not keep up with increases in markets and revenues. Nonetheless, East Bay telecommunications employment has fared better in the 1980s than the nation as a whole, and this trend should continue.

Inital policy directions include: improving the city's image as an information center; expanding the city's role as a center of telecommunications marketing and development; targeted retention strategies of the major telecommunication companies in the city (Pacific Bell and AT&T); expanding the city's role as a training center for the growing industry and its rapidly changing skill requirements; and better computer education in the city schools to meet the needs of this highly automated industry.

Introduction: Why Examine the Telecommunications Sector?

Telecommunication services have grown to become a major part of economic activity in the United States. Investment in telecommunication service infrastructure now constitutes more than ten percent of all gross fixed capital formation in the nation (and in Western Europe as well). Corporations spend an average of one percent of their operating budget on the movement and manipulation of information; in sectors such as banking, the figure is over 4 percent [*U.S. Industrial Outlook*]. About 85 percent of domestic telecommunications traffic is by voice, while 10 percent is by data.

We initially selected this sector as a potential target industry for several reasons:

- The communications service sector (SIC 48) employed 1,343,000 persons nation-wide in 1984, and is projected to gain 232,000 jobs by 1995 [Source: U.S. Bureau of Labor Statistics].

- Though overall telecommunication services employment declined by 2.0 percent nation-wide during 1980-85 (due in part to automation and rationalization of traditional telephone operations within the sector), Alameda County telecom employment actually increased by 33.3 percent during the same period. This is evidence that the county has become a center of the growing sectors within the larger telecom industry.

- The telecommunication service sector is not expanding in isolation; many interrelated sectors are also growing with it, including telecommunications equipment manufacturing. The growing interdependence of telecommunications and computers is also aiding the growth of telecom services. Thus the centers of telecom services may also attract related businesses.

- The concentrated presence of telecom service firms can also serve as an infrastructure amenity to attract other communications-intensive businesses.

- Oakland's central location within the growing Bay Area can and has been an important attraction for communications firms.

- The telecommunications sector has traditionally provided well-paid jobs. At an average wage of $12.57/hour in 1985 (and projected at $13.76/hour for 1988) wages are higher than in many other sectors.

- There has been considerable interest expressed within the Oakland metropolitan community about the possible economic development potential of the telecommunications sector.

2. Methodology and Function of Report

This report is one of three interim reports, issued by the University-Oakland Metropolitan Forum, which address potential sectors to target for employment growth in Oakland. (Parallel reports are analyzing the health care sector and the materials reprocessing/recycling industry, respectively.) The selection of the telecommunications sector does not necessarily indicate that this industry holds great promise for economic development strategies. Rather, this sector has been chosen because initial research suggested that it merited further study.

The telecommunications service sector fulfilled the major criteria that were seen as necessary for any target industry: encouraging national revenue and employment trends; decent wage rates; compatability with Oakland's workforce, infrastructure and land sites; potential to export services outside the city; interest among the local political and business communities; and the lack of potentially adverse environmental impacts. In addition, the potential of increased telecommunication activity in Oakland as a means to improve the quality of local high tech infrastructure, and therefore serve as an attraction for other types of businesses, has also been an appeal of the industry.

The structure of the report is as follows: We first define what is meant by the relatively general term "telecommunications service." Overall trends in the industry are then outlined; this includes the direction in technologies, services, and markets, as well as the employment picture. The locational pattern and requirements of the industry are then discussed. We then briefly outline the existing telecommunication services in the city of Oakland as well as the city's assets and drawbacks in attracting additional telecommunication firms. The relationship of telecommunications and economic development is then discussed. Finally, we offer some initial prospects for the industry's future in Oakland, as well as possible elements of a telecommunications targeting strategy.

This interim report draws upon several different sources of information. These include trade publications, other studies of the industry, and government statistics on employment, revenues and earnings. We have also conducted a series of interviews with experts at telecommunications service providers, large telecommunications users, government agencies, labor unions and universities. We have attempted to gain a broad perspective of the direction of the industry and of its potential for Oakland. Given this general approach, specific communication technologies have not been covered in much detail. In addition, the possible policy strategies are only briefly sketched. These are subjects which should receive greater attention in future versions of this or other reports, particularly if telecommunications is deemed an industry worth further study and targeting.

3. Telecommunications Defined

"Telecommunications" is a term encompassing a broad, interrelated range of activities. With regards to economic development, telecommunications has three primary aspects: a) the provision of telecommunication services (i.e., service employment); b) the design and production of telecommunication equipment (i.e., manufacturing employment); and c) the use of telecommunication as infrastructure (i.e., technology as an amenity). With regard to industrial classification, the first is SIC 48 (Communications, except SIC 483, television and radio broadcasting), and the second is generally, but not limited to, SIC 366 (Communication Equipment); the third, communication infrastructure, can lead to employment increases in a variety of industrial categories.

The primary focus of this ongoing study will be on *telecommunication services*. These services encompass a wide range of activities, from local and long distance telephone service to high-speed data transmission to international satellite communications. Service providers range from such giants as AT&T and the Bell Operating Companies (e.g., Pacific Bell), to newer value-added carriers (e.g., Telenet, Tymnet).

We have emphasized services over communication equipment *manufacturing* because the former potentially holds more promise for the city of Oakland than the latter. In addition, we are emphasizing services over telecommunication *infrastructure* because the initial goal of these reports is to identify specific sectors which could provide additional employment for Oakland, rather than analyzing the effectiveness of Oakland's infrastructure and its impact in business attraction. Nonetheless, we initially speculated that the development of a center of communication service providers could also potentially spur development both of equipment design and manufacture, as well as of improved communication infrastructure in Oakland. In particular, the relationship between telecommunication infrastructure and economic development will be briefly addressed in this report.

4. Overview of the Telecommunications Industry

The telecommunications industry has been undergoing dramatic changes during the past decade, and the dust has not yet settled. Though one can say that virtually *all* industries are currently undergoing changes, the telecommunications industry has been witness to simultaneous changes in government regulation, markets, technologies, and products. One can characterize these changes with several key words:

Restructuring: Changes in the industry have not been merely of size and breath (e.g., of scale), but also of organization and direction (e.g., of the structure)

Divestiture: The break-up of the traditional Bell monopoly during the early 1980s has led to changes in the regulation of pricing and the markets in which various regulated companies are allowed to compete.

Competition: This divestiture, combined with the deregulation of certain elements of the industry, has dramatically increased the level of competition in an industry once dominated by regulated/monopoly pricing and marketing. Much of this competition is fierce, with many smaller operations being forced out of business. For example, many industry observers expect that the existing myriad of long-distance carriers will be whittled down to AT&T plus one other carrier, most likely MCI.

Automation: The automation of many services, traditionally provided by telecommunication service employees (such as credit card calling and direct international call dialing), has both improved the efficiency of operations and eliminated many jobs from the industry.

Growth: Industry revenues continues to grow at a pace which exceeds the the rate of population growth in the nation.

New Markets: This growth is due not only to increased demand for existing services, but also for services never before provided (such as high-speed data transmission and E-mail).

Bypass: Larger corporations and other major users of telecommunication services are developing ways to cut their telephone costs by setting up their own private networks, and thereby bypassing public networks. This practice has raised some concern about the loss of business for the existing public networks, and the resulting need of the public networks to replace these lost revenues.

Uncertainty: The industry is still in a state of great uncertainty about when and how the telecommunications service sector will stabilize. Up to this undetermined point in time, one can expect continued upheaval in terms of pricing, the number of specialized and value-added service providers, employment levels and industry wages.

The industry is also characterized by a series of interrelated technological changes in products and services. The most significant change has been the blurring of the traditional distinctions between data, text, voice and video. Traditionally, these four forms of communication were provided through distinct and separate channels, such as digital transmission (for data), the analogue telephone (for voice), the television (video), and printed material and telegraph (for text). The current trend is toward transmission of all four on one network, leading to the Integrated Services Digital Network (ISDN). This transformation reflects

the increasing integration of computers and communications--two technologies which were once as distinct as adding machines and rotary telephones. One need only view the the rise of such services as voice mail and electronic data interchange (EDI) to understand that it is becoming increasingly harder to determine where the communication equipment ends and the computer begins.

These broader changes described above have been made possible by recent advances in technology. Of particular importance is the ongoing transition from analogue to digital transmission. Traditional telephone lines send sound in the form of waves, whereas modern technology transforms these waves into digital code (as a series of "1s" and "0s"). The use of digital allows for at least two advances: (1) faster transmission, and (2) the standardization of all communication, be it voice, data, text or video, into uniform digital code.

This change in the form of information has been accompanied by changes in the means of transmission. Traditional copper wire has been joined by microwave transmission, fiber optics, and satellite communication. Standard television cable can also be used to transmit data. Finally, cellular phones enable wireless telephone connections over a seamless cellular grid of radio receivers/transmitters.

These technologies have also been combined into new types of telecommunication facilities. These include "local loops" (which link a downtown together with high-speed fiber optics), teleports (which add a satellite connection to this local loop), and "smart buildings" (so named because they integrate new telecommunication transmission technologies into the very walls of the building).

Finally, new types of services have emerged. A small selection include: *voice mail* (essentially a very sophisticated interactive answering machine); *packet switching* (which allows for very-high-speed digital data transmission); *electronic mail* (which allows for the direct transfer of files from one computer to another via telephone lines); and *Electronic Data Interchange* (which takes electronic mail one step further, and allows electronic information to be directly inputed into another computer's control systems, such as computer-aided design or computerized inventory control and ordering systems).

Telecommunications Revenues

Current revenues for telecommunication services in the U.S. are estimated at $138 million for 1988 (see Table 4.1). Even when adjusted for inflation, this still constitutes a 38 percent real increase over 1983 and a 162 percent increase since 1974. Revenue increases have clearly surpassed the rate of increase in the number of telephones, which means these increases are not merely a function of new subscribers, but of increased sales to existing subscribers. In addition, the level of capital expenditures has not increased as fast as revenues,

and actually declined modestly from 1986 to 1988. This trend would suggest a greater return to investment in recent years.

Table 4.1: SIC 4811, 4821 Telecommunication Services, Trends and Forecasts
(in millions of dollars except as noted)

	1974	1978	1983	1986	1988	% Change 1983-88	Comp. Annual Growth Rate 1974-88
Operating Revenues (1982$) Domestic Tel % Tel.	32,200	49,500	86,870	117,493	138,323	+59.2%	+10.9%
Operating Revenues (1982$) Domestic Tel % Tel.	43,989	62,579	83,288	94,600	115,173	+38.3	+7.1
Capital Expenditures	13,000	17,600	21,125	24,010	23,972	+13.5	+4.5
Total Employment (000)	1,010	1,013	984	896	906	-7.9	-0.8
Production Workers (000)	778	756	720	667	674	-6.4	-1.0
No. of telephones (millions)	145.0	169.0	189.0	212.0	228.0	+20.6	+3.3
Industry Price Index (1982=100)	73.2	79.1	104.3	124.2	120.1	+15.1	+3.6
Average hourly earnings ($)	5.66	7.53	11.90	13.06	13.76	+15.6	+6.6

Note: 1986 figures estimated; 1988 figures projected. Employment Figures include both telephone and telegraph workers.
Source: U.S. Dept. of Commerce. 1988. *U.S. Industrial Outlook.*

Employment

Despite the dramatic growth in revenues in recent years, employment actually declined somewhat during the early 1980s [see Table 4.1]. This decline arose in part as a result of consolidation and retrenchment in the industry following divestiture. Continuing automation of services is also contributing to the loss of jobs. Such automation includes the substitution of computerized credit card calling and direct international dialing, as well as the automated response systems for 411 Directory Assistance. The development of modular equipment (whereby a customer can install the equipment without assistance) has either reduced or eliminated the need for custom installation. This change, combined with pre-wiring of many buildings, has greatly reduced the role of telephone company equipment installers. This modularization has, in effect, shifted the the location of value-adding labor from the service end to the manufacturing end--a shift which often implies a transfer of jobs from the local telephone service company to foreign telephone equipment manufacturers. Furthermore, the pre-wiring and related services often implies a shift of jobs from the local regulated telephone company to a local private, unregulated contractor.

However, many industry analysts generally believe that the combination of new market areas, increased revenues and profits, and continued national economic growth, will cause telecommunications employment to increase during the coming years. Much of this growth will occur in non-traditional areas of telecommunications. This trend is partially reflected in the highly disparate estimates for the different sectors (see Table 4.2): whereas the conventional telephone operations side of the industry is projected to gain only 3.5 percent new employment

from 1984 to 1995, the category "all other communication services" (which includes many emerging areas of the industry) may increase by 93.3 percent over the same period.

Table 4.2 SIC 48 Communications: U.S. Employment (in 000s), 1984 -1995

SIC	Industry	1984	1995 (a)	% Change 84-95
48	Communications	1,343	1,575	+17.3
481	Telephone Communication	954	988	+3.5
483	Radio and Television Broadcasting	232	284	+22.5
482,9	All other Communication Services	157	303	+93.3

(a) BLS "Moderate" Estimate
Source: U.S. Bureau of Labor Statistics. 1986. *Employment Projections for 1995.*

In the related area of communication equipment manufacturing, there were 617,000 people employed nation-wide in the industry in 1984. By 1995, 170,000 new jobs are expected to be added. This 27 percent increase over eleven years is faster than projected growth in the electronics sector as a whole (at 20 percent) [see Table 4.3].

Table 4.3 SIC 36 Electrical and Electronic Machinery and Equipment and selected 3-digit sectors: U.S. Employment (in 000s), 1984 -1995

SIC	Industry	1984	1995 (a)	% Change 84-95
36	Elec. and Electronic Mach and Equip	2,208	2,648	+19.9
365	Radio and TV Receiving Equipment	91	85	-6.2
366	Communication Equipment	617	787	+27.6

(a) BLS "Moderate" Estimate
Source: U.S. Bureau of Labor Statistics. 1986. *Employment Projections for 1995.*

Job Quality

Traditionally, jobs in the telecommunications services have been stable and well-paid. These attributes can be seen as arising from the stable environment of a regulated monopoly which characterized the industry until a few years ago. In addition, the high degree of organized labor also provided job security and good wages. Furthermore, the relatively high technical skill level required in the industry has traditionally garnered a higher wage than for similar occupations in other sectors. For example, clerical workers in telecommunications have tended to be more skilled than their counterparts in banking, since the former have greater

experience with computers and more responsibilities. The relatively high pay in the industry can be seen in Table 4.

Table 4: Average Hourly Wage in Selected Industries, United States, 1985.

SIC	Industry	Wage/Hour
4811, 4821	**Telecommunication Services (selected)**	**$12.57**
891	Engineering & Architectural Services	12.37
15-17	Construction	12.32
28	Chemicals & Allied Products	12.26
2711	Publishing (Newspapers)	10.64
3612	Electronics (Transformers)	9.95
2741	Publishing (Miscellaneous)	8.11
54	Retail (food, non-supervisory)	7.35
23	Apparel	5.70

Source: U.S. Dept. of Commerce. *U.S. Industrial Outlook 1988.*

The divestiture and deregulation of the industry has created uncertainty and instability in the communication service labor market. No longer can a telecommunication worker expect lifetime job guarantees. In response, the unions (e.g., Communication Workers of America, or CWA) seem to be stressing *employment security* rather than *job security*--a strategy which therefore requires retraining of existing workers.

The traditionally high wages are also being threatened by these changes. Though union wages (e.g., for the CWA) are set at the national level, the growing number of non-union jobs will potentially undercut this nation-wide standard of wage setting.

Job Skills

The nature of communication service employment has changed in response to the transformation of the industry's structure, technologies and services. For example, production workers composed about 76 percent of the work force during the mid 1970s. This figure dropped by the late 1970s and early 1980s, though now this figure is about 74 percent (see Table 4.4 and Figure 4.1).

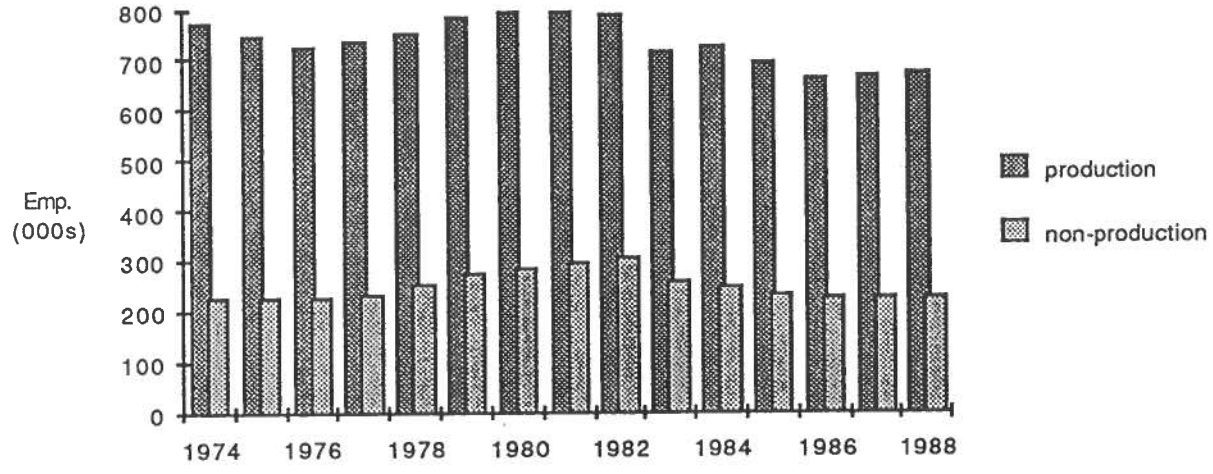
Perhaps the greatest drop in employment by skill category has been of operators and technicians. As noted earlier, much of this drop is due to the automation and modularization of telephone equipment and service. These two categories are expected to continue their dramatic drop through the year 2000. For example, Pacific Bell apparently has a surplus of

Table 4.4: Telecommunication Service Employment, Production vs. Non-Production Workers, for the United States, 1974-1988
(in 1000s unless otherwise noted)

Year	Total Employees	Production workers	Production as % of Total
1974	1,010	778	77.0%
1975	981	748	76.2
1976	961	730	76.0
1977	975	738	75.7
1978	1,013	756	74.6
1979	1,070	789	73.7
1980	1,082	795	73.5
1981	1,095	796	72.7
1982	1,100	790	71.8
1983	984	720	73.2
1984	982	731	74.4
1985	931	694	74.5
1986	896	667	74.4
1987	904	671	74.2
1988	906	674	74.4

Source: U.S. Industrial Outlook 1988
Notes: 1986 estimated; 1987 & 1988 forecasted.
Telecommunication Service employment is defined here as SIC 4811, 4821

Figure 4.1: Employment in Telecommunication Services (SIC 4811, 4821) by Employment Type for the United States, 1974-1988



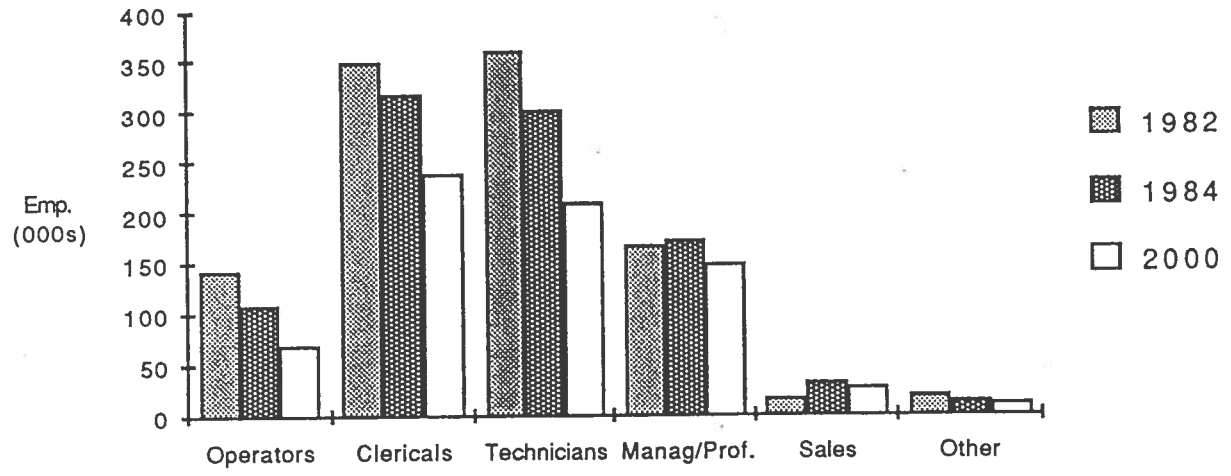
Source: U.S. Industrial Outlook 1988.
Note: 1987 & 1988 figures are estimates.

Table 4.5: Telecommunications Employment by Occupation for the United States, 1982-2000
(in 1000s unless otherwise noted)

Category:	Operators	Clericals	Technicians	Managers & Professionals	Sales	Other	TOTAL
Year							
1982	145.2	351.2	361.3	168.7	18.6	18.8	1063.8
(% of total)	*13.6%*	*33.0%*	*34.0%*	*15.9%*	*1.7%*	*1.8%*	*100.0%*
1984	109.3	318.6	303.7	174.0	33.8	14.9	954.3
(% of total)	*11.5%*	*33.4%*	*31.8%*	*18.2%*	*3.5%*	*1.6%*	*100.0%*
2000	70.4	239.1	211.8	149.4	27.8	11.5	710.0
(% of total)	*9.9%*	*33.7%*	*29.8%*	*21.0%*	*3.9%*	*1.6%*	*100.0%*

Source: CWA Information Industry Report July, 1987.
(original source: BLS. 2000 estimates are CWA estimates based on BLS 1995 figures

Figure 4.2: Occupational Employment in Telephone Communications, 1982-2000



Source: CWA, July 1987, based on BLS figures and projections.

technical employees, and wants to downgrade these technical people into hybrid tech-clerical jobs (at a lower pay level). Another big employment loss is anticipated among clerical workers in the industry; this drop is largely related to the automation of the workplace. And how does the future look? There is great variation between differing employment projections for the indsutry. Perhaps the most pessimistic employment projections by occupation are provided by the Communication Workers of America, which predicts a combined loss of 336,400 jobs in these three categories between 1982 and 2000 (see Table 4.5 and Figure 4.2, which contrast significantly with the Bureau of Labor Statistics estimates in Table 4.2).

Relatively greater demand is forecast for the managerial, professional and sales ends of the industry. This shift from the traditional dominance of operators, clericals and technicians (i.e., back-office and service personnel) to what can be labelled, in part, front-office functions (sales and administration) reflects larger changes in the industry. Unlike the relatively placid era of the Bell regulated monopoly, sales and marketing are becoming crucially important in this post-divestiture era of new competition, markets and technologies. As a result, the development and marketing of new services has assumed a greater role in the industry.

Some industry observers note a bifurcation of skills in the industry. Some deskilling of jobs is taking place, with a corresponding pressure to lower wages. For example, cable pullers often do very little connection work, and the modularization of equipment has further reduced their array of skills. In contrast, other jobs in the future will require a higer technical level of skills, which could command higher wages. If a short-term shortage arises for these skills, then wages will be driven further up. An additional trend in skills appears to be a software/hardware hybrid, combining both technical and systems skills.

Traditionally, many of these skills have been obtained through on-the-job training. Yet the modularization and fragmentation of skills described above will reduce the number of "generalists" among the technicians. As a result of this trend and the overall increase in technical sophistication, many industry experts see a greater need for vocational training in the future.

Finally, there has been a shift of many jobs from the large, regulated, unionized companies to new and smaller, non-regulated, non-union operations. Many of these new companies are seizing market niches, such as private wiring, repair and installation activities. In addition, greater subcontracting of work by large operations (such as Pacific Bell) to smaller operations is also lowering the employment levels at the traditional communication service providers. As with other aspects of the telecommunications revolution, this shift is creating greater flexibility in the industry, but also greater instability and uncertainty.

5. Locational Patterns and Requirements of the Industry

The pattern of industrial location is often a function of whether the industry is driven by resources, labor supply, infrastructure, or markets. Given that telecommunications companies provide a service, rather that manufacture a product, natural resource issues are not a factor. The remaining three factors, however, are the key elements which shape where telecommunications firms--and jobs--will be located.

The most obvious orientation of the industry is towards markets. The almost universal ownership of telephones leads to a geographically ubiquitous distribution of service provision and maintenance; the concentration of telephone users and high-volume business users in central cities leads to a corresponding concentration of these services in central places. Markets require not only service and maintenance, but also sales and marketing efforts. These activities need to be available throughout the service area, but tend to be concentrated in order to most effectively reach the highest density of users, the high-volume users, and the users of new products and services. The largest users of telecommunication services are roughly, in order: wholesale trade, retail trade, government, banking, business services, insurance and hotels [U.S. Dept. of Commerce, 1984]. As a result, these sales and marketing activities need to be next to large population and business concentrations.

The location and quality of infrastruture also shapes where telecommunication firms will be. Infrastructure consists of two types: telecommunication infrastructure *per se*, and other infrastructure. Regarding the former, the key issue is the quality of local infrastructure to allow for connection into the larger telecommunications network. For example, a long-distance carrier needs quality access to the local telephone company trunk lines. This locational factor is complicated by the fact that telecommunication service providers don't merely use existing infrastructure; by building their own telecommunication networks, they also create infrastructure of their own. As a result, such firms are not necessarily tied to the location of exising telecommunication trunk lines and other facilities.

Regarding the non-telecommunications infrastructure, telecommunications firms have no unusually strong need, as compared to other high tech service firms, for access to transportation facilities, utilities, or other traditional infrastructure. For example, the industry does relatively little in the way of "product" shipment. Perhaps the most important infrastructure is an adequate transportation network to transport skilled and cost-effective workers to and from work.

Likewise, telecommunication firms have requirements for support services which roughly compare to other high tech services. These include access to computer and telecommunication equipment, maintenance and repair operations, and use of banking, legal,

and other business services. The industry is also a huge purchaser of telecommuication equipment, but this does not necessarily require geographic proximity to these manufacturers.

Finally, the industry is a big user of labor. As noted earlier, the traditional dominance of clerical, technical and operational workers is being somewhat diminished relative to employees involved in the developing, marketing, sales and administration of new products and services. The former categories still constitute the bulk of the industry's employment, however. The modularization and automation of equipment is reducing the need for blue collar and technical skills, and the automation of much of the billing, directory assistance, international dialing, and other office work is somewhat lowering the demand for pink-collar, clerical skills. The telecommunication firms of the future will demand higher skilled workers, who are computer literate, more aggressive in marketing, and adaptable to constantly changing technologies. These are skills generally found in larger metropolitan areas, though certainly not limited to central cities. Suburban areas often offer an appealing labor force which is educated, tractable and cost-effective.

Overall, the strong market orientation of telecommunication services insures that these firms will be heavily concentrated in metropolitan areas. This is in contrast to many manufacturing operations, which have less need to be near markets and greater pressures to abandon metropolitan industrial locations. Yet *within* the metropolitan area, these telecom firms demonstrate a fair amount of flexibility in terms of the specific city they choose as their base. Though the demands of sales and marketing require a strong presence in the primary business districts, these firms are fairly free to locate many administrative, research, development, and back-office functions throughout the metropolitan area. In fact, their own products and services have allowed for this geographic separation of their various business functions. (Pacific Bell's new facility in San Ramon is evidence of this locational flexibility.) Access to local telephone trunk lines, microwave and satellite facilities, and other telecommunication network access points is crucial, yet in the world of electronic information, *accessibility* does not necessarily mean *geographic proximity.* As access pricing begins to reflect the real cost of information transmission, rather than simply distance (a relic of railroad-era thinking), geographic proximity to trunk lines and other network access points should become an even less important locational determinant.

In the end, what attracts telecommunication service firms to a particular location within a region will most likely be the quality and price of office space, access to important business support services and major customers, good ground and air transportation access for its top employees, and access to a skilled, flexible and cost-effective workforce.

6. Existing Telecommunications Services in Oakland

There are a number of existing telecommunication firms in the city of Oakland. The two largest operations are Pacific Bell and AT&T. In addition, there are smaller operations which provide specialized and value-added services, including long distance telephone service, cellular phone service, and local bypass service.

Unfortunately, accurate employment counts for telecommunication workers are not readily available for the city of Oakland. Looking at figures for Alameda County, there were 11,200 communication employees at the end of 1986. (Note: this is for SIC 48, including SIC 483, television, & radio broadcasting.) This figure represents an increase from 6,800 employees in 1980 [Economic Development Department, 1987]. This increase of 4,400 jobs in the county compares favorably to trends in the state, where communications employment dropped from 171,300 (1980) to 161,300 (1986). It is hard to estimate accurately what share of this county employment is in Oakland, but we know that AT&T and Pacific Bell alone account for ca. 3,500 employees in the city.

Several of the Oakland telecommunications operations are described below:

Selected Telecommunication Operations In Oakland

Allnet Communications
475 14th Street
Oakland
(Hdqtrs: Chicago)

Allnet is a Chicago-based company which provides roughly 0.5 percent of the nation's long-distance business (it is ca. the 4th largest long-distance carrier). The company was founded in 1981 by Combined Network Inc. of Chicago (founder: Melvyl J. Goodman). The total employment nationwide for Allnet is ca. 1000-2000.

In March of 1982, Allnet opened a switching center in Oakland to handle calls between the Bay Area and the rest of the country; by 1983 the company had 22 switching centers in the nation. At that time, Allnet needed 1000 commercial accounts to break even in an area in which it had established a switching center. (The computer hardware involved alone could cost $2 million.)

American Telephone and Telegraph (AT&T)
1000 Broadway
Oakland

AT&T, which was formed in 1885 to develop long-distance telephone communication, is still the nation's largest provider of long-distance service. AT&T has approx. 1,200 employees

in Oakland at several buildings located around the city: 1607 Franklin St. (where much of the technical operations are, including switching, programming, etc.); 2101 Franklin St.; 1000 Broadway (the largest concentration of AT&T employees in the city, focusing on marketing and services); 2101 Broadway (consumer-oriented operations); and 300 Lakeside in the Kaiser Building (though these personnel employees are being transferred to 1000 Broadway).

Bramtel
1221 Broadway
Oakland

Bramtel is a small telecommunications operation, wholly-owned by Bramalea Pacific, and serving the latter's commercial tenants in the Oakland City Center complex. The operation currently has ca. 8 full-time employees and 2 consultants (which includes 3 technicians, 2 sales staff, and 3 customer service representatives). Bramtel provides telecommunications equipment for tenants, as well as both local and long-distance services (with in-house switching). This is part of a broader trend among larger office developments in providing in-house telecommunication services. In addition, Bramtel provides long-distance service to customers outside City Center. This outside service is the major revuenue source for Bramtel.

Cellular One
505 14th St.
Oakland
(Hdqtrs.: Burlingame)

Cellular One (Bay Area Cellular Telephone Co.) is one of two providers of mobile telephone service in the Bay Area (the other being GTE Mobilnet, whose sales offices are located in Hayward). Cellular One is controlled by the Pacific Telesis Group; Telesis's two partners in the car phone business are McCaw Communications Inc. and Associated Communications Corp. (of Pittsburgh, PA).

Cellular One has been on-line since September 1986. Before that time, GTE Mobilnet had an 18-month monopoly over the Bay Area cellular phone market. Since price is regulated in the car-phone market, the two companies compete on the basis of service. Cellular One claims that its combination of high- and low-cell sites provides for better quality, a broader transmission area, and less "dead spots" than GTE. (The Bay Area is known as a particularly difficult topography for cellular phone systems given the combination of mountains and water.) In October of 1986, construction of a new Cellular One facility was completed at Oakland City Center. The facility contains switching equipment to service more than 100,000 Bay Area telephone subscribers. Two reasons were offered for the location selection: 1) "City Center's proximity to the important landline connections of Pacific Bell, Allnet, AT&T and MCI, will allow

Cellular One to provide clearer cellular transmissions to its customers." 2) "The operations team at City Center exhibited an understanding of the building needs for a telecommunications company, which greatly assisted the highly technical construction of the facility" [*Oakland Tribune,* 10/12/86]. The facility has approximately 25 employees, consisting mostly of engineering and support staff.

Until recently, Cellular One was based in the Bishop Ranch Business Park in San Ramon. In a move seemingly against the tide, Cellular One moved its operations to Burlingame in January of 1988. Reasons cited were the need for a more central location and proximity to both San Francisco International Airport and cellular phone dealers. In addition, the 17,000-square-foot Burlingame site has greater possibilities for expansion than the 7,000-square-foot San Ramon site. Finally, Cellular One's president Will Luden lives in nearby San Mateo [*Contra Costa Times,* 1/21/88]. (Note: The location of the CEO is often a key factor in intraregional location decisions--at least of office facilities).

MCI
1221 Broadway
Oakland

MCI, the second largest long distance company in the nation, operates a small technical facility in the Clorox Building at Oakland City Center. The facility contains terminals and switching equipment, covers about 3,700 square feet, and employs a maintenance staff of 2-3 people. It has been in Oakland since July of 1983.
The technical facility, one of five MCI has in the Bay Area, serves MCI operations in the Oakland area. Proximity to the Pac Bell connection office in Oakland was probably a key factor in siting the facility at Oakland City Center.

Much larger Bay Area MCI operations are located in San Francisco, Hayward, and Walnut Creek. The Hayward facility is a large technical facility (80,000-85,000 square feet, with ca. 150 employees). It has two 30-meter earth satellite dishes, and connections to other microwave stations and fibre optic networks (key factors in the decision to locate in Hayward). The Walnut Creek facility (with ca. 30-35 people) is the East Bay sales office, and thus serves Oakland.

Significant expansion of MCI business in the Oakland area could lead to the need to expand the technical capacity of the Oakland facility. Yet this could probably be done through the replacement of technology within existing space, leading neither to a major increase in either leased space nor employment. Expansion of business in Oakland, combined with increased traffic congestion between Walnut Creek and Oakland, could also lead to a decision to set up a sales office in Oakland (though this possibility is currently only speculative).

Pacific Bell
2150 Webster St.
Oakland, CA

Pacific Bell is the regulated provider of local telephone service in the Bay Area. It is one of seven regional Bell Operating Companies (BOCs) in the United States. Pacific Bell is part of the Pacific Telesis Group, which also includes a series of non-regulated operations known as PacTel Companies (including PacTel Cellular, PacTel Infosystems, and Pacific Telesis International). Its offices are in San Francisco, with a major new facility located in San Ramon, 15 miles east of Oakland. Total Pacific Telesis employment was just under 72,000 at the end of 1987, with revenues of over $9 billion.

Pacific Bell has ca. 2,300 employees in Oakland. The main Oakland facility is at 2150 Webster St., with additional facilities at many other locations throughout the city. The leading occupation represented is probably craft and technicians, followed by order takers, operator services and administration. As in other aspects of the industry, Pacific Bell anticipates hiring more people in the sales and marketing areas as the company seeks to develop and market new services. Yet this will probably not represent an increase in employment, but rather a reshuffling of where people work. Automation counteracts the pressure to expand employment due to growth of the market.

Pacific Bell estimates that roughly 10 percent of its Oakland operations serves the local demand, with ca. 90 percent serving demand outside the city. Thus Pacific Bell, in effect, "exports" the vast majority of its services outside the city.

Oakland is Pacific Bell's primary northern California training center. This training involves many skill types from service representatives to crafts. At any given moment, there are 700 Pacific Bell employees training in the city in addition to the 2,300 permanent employees. This training takes place at a facility on Edgewater near the Oakland Airport, at the 2150 Webster St. facility, as well as at many training worksites around the city.

Unlike many other California cities, Oakland was probably the least adversely affected by Pacific Bell's new facility in San Ramon. This is in contrast to such cities as San Jose, Sacramento and San Francisco. Nontheless, Pacific Bell anticipates constructing no new facilities in the city; most of the changes in operations, such as automation and modernization, can be done within existing spaces.

There are other operations in the city. Several of these firms are listed below:

Table 6.1: Telecommunication Firms in Oakland (SIC 48, ex. 483 TV & Radio Brdcst)
(Note: this list, drawn from the Feb. 1987 edition of the *Business Prospector*, is not necessarily a complete or up-to-date list of all firms in the city.)

Company Name	Address	Zip Code	Operation Type	Emp. Class
SIC 4811 Telephone Communication (7 firms in Oakland, 18 total in Oakland Metro Area)				
AT&T	1000 Broadway	94607	branch	251-up
Geo Pacific Communication	401 Grand Ave.	94610	hdqtr	1-3
Cellular One	505 14th St.	94612	hdqtr	41-100
Contemporary Digital Svcs Inc.	1330 Broadway	94612	local	1-3
Telesaver	1624 Franklin St.	94612	branch	1-3
Telesphere	180 Grand Ave.	94612	branch	1-3
Western Telephone	P.O. Box 2621	94614	local	1-3
SIC 4821 Telegraph Communication (3 firms in Oakland, 5 total in Oakland Metro Area)				
Western Union Telegraph Co.	1808 Franklin	94612	branch	16-40
Western Union Telegraph Co.	7770 Pardee Ln.	94621	branch	4-15
Western Union Telegraph Co.	303 Hegenberger Rd	94621	branch	41-100
SIC 4899 Communication Services Not Elsewhere Classified (6 firms in Oakland, 18 total in Oakland Metro Area)				
TMC - Telephone Maintenance Co.	3301 Georgia St.	94602	local	1-3
Cable Oakland Productions	1900 Embarcadero	94606	local	1-3
International Comm. Svcs	717 Rand [?] Ave.	94610	local	1-3
Lo-co Cable Television	401 Grand	94610	hdqtr	1-3
Davés Radio & TV Service	4800 MacArthur Blvd.	94619	local	1-3
Da Montel Engineers Inc.	330 Pendleton Way	94621	local	4-15

7. Oakland's Assets (and Deficits): The City's Match with the Industry

How do the locational requirements, described in Section 5, match with the city of Oakland? Specifically, to what extent does the city offer attractive amenities in terms of markets, infrastructure & support services, labor, and office space?

Markets

Perhaps Oakland's greatest asset is its central location within the Bay Area--a dynamic, growing, affluent, and sophisticated market of nearly six million people. As the nation's fourth largest metropolitan area and a critical center of advanced business control functions serving national and international markets, the Bay Area is an especially large user of high-volume and advanced telecommunications services. In and around Oakland are several major users and

potential users, including downtown offices, port tenants, the airport, government, the cluster of hospitals, large engineering firms, and the University of California (both the Berkeley campus and the systemwide offices at the Kaiser Center on Lake Merritt).

Yet the geographic centrality of the city does not necessarily lead to telecommunication network centrality. Unfortunately, it is difficult to find a local comparative advantage for Oakland in the technology *per se*. Nevertheless, geographic centrality does play a role in terms of marketing and sales efforts. One would expect that as the city becomes a more important center of office work, it will also become a more advantageous center of telecommunications marketing and service development.

Infrastructure and Support Services

There are several telecommunication facilities nearby which can be locational assets for Oakland. These include the pre-existing facilities of AT&T and Pacific Bell in Oakland, as well as the Bay Area Teleport on nearby Harbor Bay Isle in Alameda. In addition, Oakland is the hub of overseas long distance on the West Coast, having the most number of connections to the Pacific Rim. These connections include undersea cables, microwave transmission, and satellite connections. It has even more activity than Los Angeles. This is a legacy of past private infrastructure investment decisions, and this will continue to be the case in the future (given the size of the investment in equipment). This presence in Oakland does not give communication firms an absolute advantage in being near the city; but it could serve as a helpful image asset.

Some industry observers see microwave congestion in the Bay Area as a potential drawback (since a given area has only a limited number of unobstructed microwave transmission routes). Though this is potentially a serious problem, it does not uniquely affect the city of Oakland. In addition, this problem can potentially be mitigated (e.g., through alternative transmission via fiber optics, as was done at the New York Teleport).

Labor Supply and Skills

The Bay Area is generally seen to have an unusually well-skilled and educated labor force. But what about the city of Oakland specifically? Unfortunately, a comprehensive skills and training assessment of the city's labor force is lacking; such a study would prove to be of great assistance. Nevertheless, several conclusions can be made: Pacific Bell's large training facility in the city is certainly a positive factor for the city's labor resources. In addition, the nearby presence of the University of California at Berkeley is certainly a major plus for the city's labor force (although this institution satisfies only certain skill level requirements). Of potential

concern are those jobs which don't require a college education, but nonetheless necessitate a basic understanding of computers, as well as basic math and English skills.
According to Pacific Bell, its current labor needs at its Oakland facilities are being met by the Oakland area labor force. However, they have expressed concern about the future. One must also note that (roughly) only 700 of the company's 2,300 Oakland employees live in the city. These concerns have led the company to place greater emphasis on training and skills issues. As a reflection of this concern about quality labor, the company has dramatically shifted its philanthropic efforts in recent years to benefit local training programs. One example of this is the OYSTER program (the "Oakland Unified Schools Technology Resource" program) in Oakland middle and high schools, which is basically functioning on a $20,000 grant from Pacific Bell. This program trains teachers on the use of telecommunications for the classroom, and has provided several schools with modems and communication software. It aims to improve computer literacy--a prerequisite for virtually all telecommunications jobs in the future. This effort by Pacific Bell reflects a larger concern with the teaching of computer skills. Current computer education in the Oakland schools is seen by many as inadequate: there are insufficient financial resources and equipment; teachers are not well-trained in computer skills and computer education; and there is insufficent coordination of computer programs between schools. Though the school board approved a computer education plan several years ago, this plan has not been fully implemented or funded. In addition, much greater cooperation between the schools and the Oakland business community is needed, including interships, school courses taught by visitors from business, equipment donations, and information about what computer skills are currently needed by industry.

Office Space

The relatively affordable office space available in the city represents an important attraction for telecommunication firms. This most likely is not a factor which in and of itself would bring these firms to the city; rather, the availability of this space removes one reason why these firms would *not* come to Oakland. Of potential concern is the city's outside image; firms looking for a high tech address and image would not necessarily be attracted to Oakland office space.

8. Telecommunications and Economic Development

An emerging theme of this report is that telecommunications offers mixed results for economic development. On the positive side, the industry is growing, has huge revenues and jobs with generally high skills, and can have positive spin-off effects on other sectors. Yet there is a great deal of uncertainty in the industry, and the overall employment prospects are not uniformly encouraging. Many traditionally secure, well-paid jobs are being eliminated, and it will be hard to determine the long-run employment prospects until the volatile industry has more of its reorganization behind it. In addition, our initial optimism about the promises of manufacturing-service linkages have not been borne out; there is little evidence to suggest that communication equipment manufacturers would be attracted to Oakland by the increased presence of telecommunication service providers.

A second aspect of telecommunications in economic development is its role as infrastructure. There has been much discussion about "electronic highways," and the role of telecommunications as the modern-day version of transportation infrastructure. There is certainly some validity to the importance of this comparison. Yet are microwave links and fiber optic networks really the modern equivalent of 19th century railroads and early 20th century highways? One hundred years ago, it was absolutely crucial for an industrial town to be on the main railroad line; otherwise, transportation time and money costs made the city's industries uncompetitive. Today, an advanced service city must also be tied into the main telecommunication networks. Yet this *accessibility* no longer necessitates *proximity*. The ubiquitous nature of telecommunications technology means there is much less of a disadvantage to be off the trunk line. For railroads, cost was basically proportional to distance, creating great localized effects. For telecommunications, distance is no longer a huge factor.

If it is hard to attract firms just with telecommunications infrastructure, then it is particularly hard to attract the larger firms. These large operations generate high volume demand for telecommunication services and thus allow for economical bypass of the public network. As a result, cities should avoid investing huge sums of money into public telecommunications networks to attract large employers, only to have these firms set up their own private networks.

There is quite a bit of hyperbole about telecommunications, yet many businesses see this service simply as basic infrastructure. It is taken for granted in the same way as water, gas and electricity service. As a result, the mere presence of telecommunications is often, by itself, not an adequately unique factor to attract businesses. On the other hand, telecommunications infrastructure investment can be an important tool of business retention if firms are threatening to move out due to frustration with existing telephone and data communication service.

Some unsuccessful development strategies have been based on the questionable assumption that infrastructure generates economic development. This assumption may have been partially true with the era of highways and railroads, but with telecommunications, the causality often runs the other way: economic development generates infrastructure. (The under-utilization of Harbor Bay Isle's teleport is reflective of this pattern.) This relationship is often the case because firms frequently do not fully know their telecommunication needs before they start up in a location. As a result, these firms usually do not place great weight on existing telecommunications infrastructure. And as previously noted, firms generally assume that this infrastructure will be there, and if it proves to be inadequate, the larger operations can economically bypass the public network.

Finally, one must not assume that major telecommunication service users and providers will necessarily make their business location and expansion decisions based simply on the quality of existing telecommunication infrastructure. What attracts these activities to Oakland may have nothing directly to do with Oakland's technological telecommunication advantage *per se,* but may rather be due to the city's centrality for other amenities (labor, business services, markets, real estate, etc.). For example, the attraction of San Ramon in the eyes of Pacific Bell had little to due with the communications-technological advantage of the location, but rather with the site's price, location, housing prices, nearby labor markets, and other non-technical factors.

9. The Future of Telecommunications in Oakland

What emerges from this initial review of telecommunications and its promises for Oakland is a mixed picture. The city benefits from a central location within a large and growing market for these services. The existing presence of such major operations as AT&T and Pacific Bell provides a good telecommunications base in the city. Large telecommunications users nearby (e.g., port tenants, the University of California, and a potentially growing Oakland office market) are creating a larger telecommunications market in and around the city. Though some concerns have been expressed about the skills of the city residents relative to the future demands of the industry, the overall local infrastructure and support services do not seem to impose major obstacles to potential Oakland telecommunication firms.

Yet there seems little about the city which gives it a clear advantage over its neighbors in attracting this business. The industry is fairly mobile, and has a certain degree of flexibility in terms of its chosen base to serve the region. In addition, the continuing shake-out and automation of the industry means that it will probably not be a large generator of new jobs in the near future.

Several possible strategies can be suggested for maintaining or increasing the importance of this industry for the city. First, given the uncertainty about the industry's future, what new jobs will be created, and what amenities will attract new telecommunication firms, the city's first focus should be on job retention. Given that Pacific Bell and AT&T are two major employers in Oakland, the city should directly approach these two operations and better understand their needs, their problems, and their future investment plans. In addition, given that MCI may emerge as one of the few survivors of an approaching shake-out in the long distance market, the city should examine strategies to increase MCI's presence in the city.

Training and retraining are becoming increasingly important for retention of existing jobs in the industry. No longer can a worker gain the necessary skills just from on-the-job training--and he or she needs to be constantly ready to adapt to new technologies and services. This is a role which the nearby technichal schools can assume. Apprenticeship programs could also be effective. In addition, attention should be placed on more general skills required to face the telecommunications revolution--computer literacy and better English skills. Training should also involve a greater cross-fertilization of hard technical/electronic skills and software/systems skills. Furthermore, training should address the greater role that the development and marketing of new products and services is playing in the post-divestiture telecommunications industry. Finally, greater efforts should be made in the Oakland schools to ensure that students are adequately equipped with computer skills and experience *before* they enter the job market.

Greater emphasis on training and computer education also applies to the attraction of new telecommunication firms to the area. This attraction will also be dependent on more general business attraction factors: quality and price-competitive office space, affordable housing, adequate business services, access to ground and air transportation for employees, and an expanding nearby market.

This report has only briefly addressed the role of telecommunication infrastructure investments. However, a few tentative conclusions can be made. First, though economic development tends to generate infrastructure rather than vice versa, one can nevertheless guide this infrastructure development in the right direction to best benefit the city. For example, one could guide telecommunication infrastructure towards the development of networks which all companies could potentially use, rather than a private, dedicated network only accessible to one party. Governments themselves are major users of telecommunication services, and they can use this leverage in shaping the price, innovation, configuration and control of these networks. The apparent commitment by Pacific Bell to maintain the 2,300 employment figure in Oakland, which arose roughly at the same time as discussion within the city to explore alternative telecommunication service providers, is evidence of this government leverage. The

future arrival of the federal government as a major tenant, and as a major telecommunications user, in Oakland City Center should be also viewed in this light.

Further analysis of the industry and the community will be required before one can better pursue any potential targeting strategy. In particular, several questions need to be addressed: Who will be the major competitors with Oakland? Should there be any inter-city co rdinated efforts (e.g., joint ventures between Oakland and neighboring cities)? How and when will the industry stabilize? What are the specific skill deficiencies among Oakland residents relative to the needs of the industry?

In the end, a minimal goal of the city should be that Oakland play a role in the region's telecommunication network commensurate with its position as the 3rd largest city--behind San Francisco and San Jose. This implies that Oakland performs central city functions of control, coordination, and concentration in the regional exchange of information. The city could potentially play a role as the center of East Bay telecommunications, but it might lose this position to the 580/680 corridor to the east. As long as Oakland can create and maintain this role, and as long as the region continues to prosper, the industry should do well in the city. This role can be assisted by focusing on several areas: improving the city's image as an information center; expanding the city's role as a center of telecommuncations marketing and development; better understanding the needs of the major telecommunication companies in the city (Pacific Bell and AT&T); and expanding the city's role as a training center (both in the local schools and in company training facilities) for the growing industry and its rapidly changing skill requirements.

Telecommunications Industry and Technology: Glossary of Terms

Abbrev.	*term* and definition
AT&T	*American Telephone and Telegraph Company* formed as a wholy owned subsidiary of American Bell in 1885 to develop long-distance service. It is still the nation's largest provider of long-distance telephone service.
BOC	*Bell Operating Company*
	broadband wide-range transmission capacity
	bypass private systems that bypass public networks
CCSA	*common control switching arrangement* allows a subscriber to link a system of private lines through telephone company switches to provide a private network.
	circuit switching (also: *space division switching*) the traditional form of switching telephone transmission
	Class 5 Switch the type of switch often found in a central office of a BOC.
	common carrier a regulated telecommunications company that provides services to the public at a published rate.
CWA	*Communication Workers of America* union representing many communications workers
EDI	*electronic data* (or document) *interchange* (also: "X-25")
ENFIA	*exchange network facilities for interstate access* a tariff filed by AT&T in 1978 to provide local service to MCI; it provided drastically higher rates for local exchange lines provided to other companies such as MCI.
FCC	*Federal Communications Commission*
	fiber optics glass strands which transmit information in the form of light.
FX	*foreign exchange* a version of of private-line service in which the user ties into the local network of a distant city, effectively gaining a local number in a distant city, rather than only gaining the ability to communicate with a single location as in ordinary private-line service.
GEISCO	*GE Information Services Co.* (Provides value-added service)
ISDN	*Integrated Services Digital Network*
KTS	*key telephone sets* each telephone line is connected to each set and the user selects a line by pushing the appropriate key. (generally used by smaller businesses than those using PBXs).

LATA *local access & transport areas*

MCI Microwave Communications Inc.
first filed a request for authorization as a common carrier in 1963; it opened for service in Jan 1972 (private-line microwave service initially between St. Louis and Chicago).

Modem (modulator-demodulator)
translates signal from analog mode (used in telephone lines) to digital mode (used in computers).

MTS *message telecommunications service*
AT&T's term for the switched long-distance market.

narrowband
limited transmission capacity

packet switching (also: *time division switching)*
information is processed and switched in "packets". Advantage over circuit switching: transmission lines are only tied up while data is transmitted; hence it is faster and less expensive. (i.e., efficient line capacity use).

PANS *pretty amazing new stuff*
(in contrast to "POTS")

PBX *private branch exchange*
a small switch that allow users to connect multiple phones or computers to central telephone offices via trunk lines leased at bulk rate prices. (i.e., an on-premise switch).

POTS *plain old telephone service*

SDN *software defined network*
ATT's term for virtual private network

specialized carrier
telecommunications companies that provide a limited range of services. (e.g., ATT, MCI, U.S. Sprint)

Telenet (provides value added service)
the industry leader with ca. $100 million revenues (in 1984).

Tymnet (provides value added service)

value-added carrier
lease communication services from the common carriers, enhance them, and resell them to end users.(e.g., Tymnet, Uninet, Telenet). focus: packet-switched data communication.

VAN *value-added network*

VPN *virtual private network*

WATS *Wide Area Telephone Service*

X-25 (also: *EDI*).
the name of the international stardard/norm specifying how EDI packets are cut and routed.

Bibliography

Bamberger, Rita J., William A. Blazar, George E. Peterson. 1985. "Infrastructure Support for Economic Development," *Journal of the American Planning Association.*

Bar, François, Michael Borrus, Sabina Deitrick, Jeffrey A. Hart, and Jay Stowsky. 1988. "Case Studies on Manufacturing and Overseas Production in Semiconductors and Related Industries." Berkeley: Berkeley Roundtable on the International Economy (BRIE), University of California. [see, in particular, Chapter 5: "Telecommunications Equipment".]

Blanc, G. 1983. "The impact of telecommunications on employment." Series Title: *Telecommunications for Development.* Case Study no. 2. Geneve: General Secretariat of the International Telecommunication Union.

Blazar, William A., et. al. 1985. "The sky above, the teleport below: Telecommunications as a development tool in four cities." *Planning,* Vol. 51, no. 12.

Brock, Gerald W. 1981. *The Telecommunications Industry: The Dynamics of Market Structure.* Cambridge, MA and London: Harvard University Press.

California, State of. Assembly Committee on Utilities and Commerce. 1986. "The Future of Electronic Commerce in California". Sacramento, CA: Joint Publications Office.

California, State of. Assembly Committee on Utilities and Commerce. 1988. "An 'Information Age' for Everyone? Telecommunications and Information Services in California's Future." Sacramento, CA: Joint Publications Office.

California, State of. Economic Development Department. 1987. *Annual Planning Information. Alameda County, 1987-1988.* Sacramento: EDD.

California, State of. Economic Development Department. 1987. *Annual Planning Information. California, 1987-1988.* Sacramento: EDD.

Communications Workers of America. 1987. *Industrial Information Report.* Vol. 1, No. 1. Washington, D.C.: CWA.

Institute for the Future. 1986. "Telecommunications Networks". prepared for the California Department of Commerce, Office of Economic Research. May.

Nicol, Lionel. 1983. "Communications, economic development, and spatial structure: a review of research." Working paper No. 404. Berkeley: University of California, Institute of Urban and Regional Development.

Pacific Telesis Group. 1987. "Telesis at Work in the Information Age" (Annual Report).

United States Department of Commerce. 1988. *U.S. Industrial Outlook.* (see Section 33: "Telecommunication Services").

United States Department of Commerce. Bureau of Economic Analysis. 1984. *The Detailed Input-Output Structure of the U.S. Economy, 1977.* Washington, D.C.: GPO.