

# **Chapter 14**

# **Industry Structure**

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# Chapter 14

## Industry Structure

### Introduction

In less than 30 years the electronic data processing (EDP) industry has grown to be a major economic sector of the economy. The total revenues for the industry worldwide were estimated to have been over \$60 billion in 1979. The U.S. industry share of this market was about \$46 billion.

The top 20 domestic companies in the EDP business in order of size are listed in table 9. Some of these firms are also engaged in other types of business, but only their EDP revenues are shown. The total EDP revenues in 1979 of the leader, IBM, were over \$18 billion, nearly eight times those of the next largest company, Burroughs. Revenues of the eighth company, Hewlett-Packard, were nearly twice those of the ninth, Memorex.

The top eight companies are those marketing full lines of general purpose computers,

referred to in both the industry and this report as *mainframe computers*. The rest succeed, in general, by focusing on a more limited market sector—very small machines, very large machines, specialized peripheral hardware, or various types of computer services.

The companies examined in this study range widely in size. While the market is clearly dominated in terms of size by the top eight (70 percent of the total revenues), much of the significant market shifting and innovation that will affect the future of computer use are taking place among the smaller companies. It has been estimated that there are over 4,000 firms in the EDP industry.

Growth in the hardware side of the industry will continue but not spectacularly. Rapidly decreasing prices for hardware will be more than offset by increased sales. How-

Table 9.—Top 20 EDP Companies in 1979

Rank	Company	1979 EDP revenues (\$ million)	Percentage	
			Domestic market	Principal product
1	IBM,	\$18,338	46 %	Mainframe computers
2	Burroughs	2,434	59	Mainframe computers
3	N C R	2,404	46	Mainframe computers
4	C o n t r o l   D a t a	2,273	68	Mainframe computers
5	S p e r r y   R a n d .	2,270	55	Mainframe computers
6	Digital Equipment	2,032	62	Mainframe computers
7	Honeywell	1,453	67	Mainframe computers
8	H e w l e t t - P a c k a r d	1,030	52	Minicomputers
9	M e m o r e x	664	51	Memories
10	D a t a   G e n e r a l	540	73	Minicomputers
11	S t o r a g e   T e c h n o l o g y	480	88	Memories
12	Xerox	475	85	Peripherals
13	TRW	440	77	Services
14	T e x a s   I n s t r u m e n t s	425	82	Minicomputers, terminals, and consumer goods
15	Computer Sciences	415	88	Services
16	Automatic Data Processing	401	92	Services
17	G E	350	79	Services
18	E l e c t r o n i c   D a t a   S y s t e m s	312	96	Services
19	3 M	310	81	Peripherals
20	Northern Telecom	300	65	Peripherals

SOURCE: Datamation, July 1980, pp. 98-99.

ever, those companies using new computer and communication technologies to provide innovative information services to individuals and business will grow the most rapidly.

The advent of the microcomputer and low-cost digital communication opens new opportunities to entrepreneurs. Microprocessors lower the cost of system implementation to a mass-marketable level; and readily available, inexpensive communication technology provides a mechanism for mass distribution that has been lacking in the past.

These developments do not necessarily imply that the principal participants will change drastically over the next 10 years. The large EDP and communication corporations have been highly adaptable, and can be expected to move into these new services. The traditional information firms, researchers, and publishers are merging with the newer, high technology computer and communication companies. For example, ABC has bought MacMillan Press. On the other hand, Dun & Bradstreet, an established retailer of information, has purchased National CSS, Inc., a major supplier of com-

puter programming and time-sharing services, and Readers Digest has purchased The Source, a new on-line information service.

This emergence in the 1980's of technology-based information service industries as a major business sector is significant both with respect to an overall analysis of market trends and for this assessment. The nature and social consequences of these new services are likely to have a major impact on Federal policies concerned with information and information processing. The form and availability of these services will, in turn, be affected by Government policy.

A final important characteristic of the U.S. computer and communication industry is its major role in the international market. International sales are concentrated among the top nine corporations, which average from 40 to 50 percent of all the foreign sales. The smaller firms are much less active internationally, probably because they view the domestic market as adequately rewarding and because of the high cost and uncertainty surrounding the marketing of high technology abroad.

## Computer Hardware

The computer industry has been highly segregated along product lines for some time. Several companies manufactured so-called "super computers." Along with a few other firms, they produced a full line of small to large systems. Others specialized in minicomputers. However, the lines between these major categories have blurred as many intermediate size systems, both general and special purpose, have arisen to fill the gaps. The needs of computer users have also shifted substantially, creating more opportunities for small specialized companies to develop.

This evolutionary shifting of products, producers, and user needs makes difficult any attempt to chart historical trends for a particular class of machine. For example, the

minicomputer of today is, in some ways, more powerful than a large computer of several years ago. Companies such as Texas Instruments, that used to sell only electronic components for computers, now market entire systems.

The principal characteristics of the computer hardware industry are summarized in table 10 (also see tables 11, 12, and 13). For analytical purposes, the industry has been divided into six sectors. Although the boundaries between them are vague, these sectors are generally recognized by the industry.

The principal characteristics of change in the computer hardware industry are the following:

**Table 10.—Computer Industry Structure**

Characteristics of hardware	Purpose and/or use	Nature of present industry	Nature and size of present market	Future trends
<p><b>Microcomputer</b> The smallest sized computers; can fit on one circuit board, and soon on a single silicon chip; inexpensive.</p>	Used as "intelligent" components for games, appliances, watches, etc., or as the heart of larger general computing systems.	Modest to small companies in terms of electronic data processing revenues.	Growing rapidly; over \$1 billion by the early 1980's. United States leads with increasing competition from West Germany and Japan.	Growth rate between 30 to 40 percent per year. Sales growth from \$100 million in 1977 to \$1 billion in early 1980's. Small firms being acquired by large international conglomerates.
<p><b>Personal or desktop computer (see table 11)</b> Small, but fully capable computer systems, costing several hundred to a few thousand dollars.</p>	For use by individuals in the home, in business, or in school.	Many small entrepreneurs—"a cottage industry." Very successful entry by a consumer electronics retailer, Tandy (Radio Shack).	Individual users. Storefront and mail order sales. 1979 sales of \$500 million.	Explosive growth of market in next few years. Possible acquisition by large consumer product firms and retailers emulating Tandy success.
<p><b>Minicomputer (see table 12)</b> Small computer systems selling for less than \$50,000.</p>	Designed to be used for a dedicated set of applications with informal, hands-on access.	Mix of large and small companies. Has provided opportunities for new entrepreneurs such as Prime Computer.	Shipments of \$4.3 billion in 1979. Worldwide market growth rate for past several years of 35 percent.	Growth rate will slow to 25 percent per year; relative flattening of market in 1980's; software gaining in importance. Fewer new entrants.
<p><b>Mainframe computer (see table 13)</b> Medium- to large-scale computer systems, costing from a few hundred thousand dollars to several millions.</p>	General purpose computers, usually serving several users and applications.	Dominated by several large corporations, with IBM the revenue leader by a wide margin.	The bulk of general computer sales—\$8 billion in 1979.	Continued steady growth, with no major changes in relative positions of the top seven companies. Increased foreign competition.
<p><b>Plug compatible computer</b> Electronically equivalent to the equipment of other manufacturers—usually IBM.</p>	Same as above, but with potentially better performance, better delivery, or lower price than IBM offers.	A very few companies concentrating narrowly on particular market opportunities.	Appears to be surviving new IBM product announcements and growing. Strongest growth is in specialized systems.	Risky market, very sensitive to IBM product and price announcements. Not likely to become a significantly large industry, but to prod big companies through competition.
<p><b>Supercomputer</b> Extremely large, powerful computers.</p>	Predominantly for scientific and technological applications requiring large amounts of computing and data analysis, e.g., meteorological forecasting.	A few companies—most specialize in this type of system.	Small, specialized market, estimated at about \$500 million.	Market growing more diversified. Will continue to be important but relatively small. IBM may bring in a totally new system; potential growth of foreign sales.

SOURCE: Off Ice of Technology Assessment

**Table 11.—Desktop and Personal Computer 1980 Worldwide Shipments**

By units	444,000 units total
Tandy-Radio Shack	25 %
Commodore	23
Apple	17
Hewlett-Packard	6
IBM	2
Others	27
<b>By revenue</b>	<b>\$1.9 billion</b>
Hewlett-Packard	21%
Apple	10
IBM	9
Tandy-RadioShack	7
Tektronix	3
Others	50

SOURCE International Data Corp. 1981 Computer Industry Briefing Session, p.D-8

**Table 12.—Minicomputer and Small Business Computer 1980 Worldwide Shipments**

Minicomputer <sup>a</sup>	
<b>By units</b>	<b>137,000 units</b>
Digital Equipment Corp.,	44%
Data General	14
Hewlett-Packard	8
IBM	7
Honeywell Information Systems.	4
Others	23
<b>By revenue</b>	<b>\$6.35 billion</b>
Digital Equipment Corp.,	34%
Hewlett-Packard	16
Data General	11
Honeywell information Systems.	7
Iam.	6
Others	26
<b>Small business computer<sup>b</sup></b>	
<b>By units</b>	<b>71,000 units</b>
IBM,	33%
Others	23
Digital Equipment Corp.,	12
National Cash Register	11
Wang	8
Burroughs	7
Data General	6
<b>By revenue</b>	<b>\$3 billion</b>
Others	33%
IBM	28
National Cash Register	10
Wang	10
Digital Equipment Corp.	8
Burroughs	7
Data General	4

<sup>a</sup>International Data Corp 1981Computer industry Briefing Session, p. D-4.

<sup>b</sup>International Data Corp 1981Computer Industry Briefing Session, p.6

**Table 13.—Computer Mainframe 1980 Worldwide Shipments<sup>c</sup>**

Rank	Company	Revenues	
		(\$millions)	Percent
1	IBM	\$10,650	62.4%
2	HIS	1,550	9.1
3	Sperry Univac	1,410	8.3
4	Burroughs.	1,000	5.9
5	NCR.	480	2.8
6	C D C	400	2.3
7	Amdahl	380	2.2
8	DEC	205	1.2
9	National	190	1.1
10	Cay	50	0.3
11	Magnuson.	35	0.2
12	IPL.	10	0.1
(b)	Compatible peripherals,	700	4.1
<b>Totals</b>		<b>\$17,060</b>	<b>100.070</b>

<sup>a</sup>Shipments of large general purpose computers only Companies listed may derive significant additional revenue from shipments of other types of computer systems

<sup>b</sup>Value of shipments of plug-compatible peripherals produced by many smaller companies

SOURCE International Data Corporation 1981 Computer Industry Briefing Session, p C-3.

- The mainframe business is still the major component of computer sales and will be for the foreseeable future. IBM has the largest market share by far, and there is no evidence that its lead is shrinking.
- The growth rate for sales of very small systems—desk-top or personal computers—will be very high, while the historically high rates of growth for larger systems will level off somewhat.
- In response to the changing nature of the computer marketplace, more emphasis will be placed on retail marketing and customer services. Retail firms not traditionally associated with computers will enter the small computer field.
- The explosive growth of the microprocessor industry maybe slowed by limited production capacity and by the increasingly high costs of design and tooling for new applications.
- There has been recent evidence of a trend toward acquisitions of small semiconductor companies by large firms. According to one report, of 36 new semi-

conductor companies formed since 1966, only seven remain independent. Many of the acquisitions have been by foreign firms: French, West German, Japanese, Canadian, and Dutch.

- While foreign competition has made some inroads in electronics sales, and computer manufacturers are wary, particularly of Japanese competition, no evidence of any substantial impact on

the domestic computer hardware market exists at present. The microprocessor and personal computer markets seem to be most vulnerable to such threats.

- Particularly in the small machine and special application markets, there appears to be wide opportunity for entrepreneurs to innovate and make a successful market entry.

## Auxiliary Equipment

Many companies have successfully competed in the computer market by providing the peripheral equipment—terminals, memories, and the like—that extend the capabilities of existing computer systems. This independent peripheral market can be roughly divided into two parts—equipment in direct competition with that offered by the system vendor, and specialized hardware not commonly manufactured by the mainframe companies.

Most mainframe computer companies sell a wide range of peripheral devices for information storage and for input and output of data. However, other manufacturers claim that by specializing in some specific category of device they can offer better quality at a lower price. Often, in fact, these units are sold to the computer system manufacturer, which in turn puts its own name on them. The total auxiliary equipment market is estimated at around \$7 billion or more. Thus, even though the major mainframe manufacturers take a large portion of that market, the remainder is well worth competing for.

The categories of equipment shown in table 14 below are not a complete list. The range of accessory equipment sold for computers is extremely wide.

The industry for auxiliary equipment has the following principal characteristics:

- All of the major manufacturers offer a wide assortment of peripheral equipment for use with their systems, and the sale of this equipment constitutes a major portion of the market. However, there is an active and profitable group of independent manufacturers selling equipment of all types. In many cases, the large computer corporations have an agreement whereby they purchase this independent hardware and put their own brand name on it.
- Users are more likely to accept new and improved devices as they come on the market, because it is much easier to change auxiliary equipment with minimum disruption of their operations. Furthermore, different auxiliary equipment can perform an identical function with a greater variety of possible internal technologies and designs. These two advantages lead to market opportunities for inventors and, hence, to profitable new enterprises.
- Much of the interest in the area of data storage is concentrated on large and inexpensive bulk memories. Current activity is in bubble memory and floppy disk technology, although the use of the video disk for very cheap data storage is also being explored and appears likely in a few years.
- The terminal industry is growing quickly, matching the growth in the use of

Table 14.—Auxiliary Equipment Industry Structure

Characteristics of hardware	Purpose and/or use	Nature and size of present industry	Nature and size of present market	Future trends
<p><b>Random access memory devices</b> High-speed, usually uses large-scale integration technology (500 + circuits on a single chip), recently IBM introduced very large-scale integration (VLSI) technology (several thousand circuits on a single chip) Connects directly to the computer processor</p>	The main storage for data while being used by the computer	All computer manufacturers sell these as an integral part of their systems, also sold by some independents, mostly as IBM compatible equipment	Market for Independent vendors has developed, especially for IBM-compatible products	Independents are motivated to develop products faster to compete with IBM cheap VLSI technology The market is risky due to the uncertainty over IBM plans
<p><b>Bulk memory devices (a) Magnetic tape and fixed head disks</b> Communicates with the central processor through an intermediary controller, has slower access times and larger capacity.</p>	An auxiliary memory device to hold data not currently being used by the system	Several Independent manufacturers, very competitive. Major suppliers include firms such as Memorex, Storage Technology, 3M, Xerox, and Ampex	Independents can serve a larger potential customer base than any mainframe vendor, because they can design high-performance equipment that can be interfaced with a variety of computer makes Over \$1.5 billion in sales	Some improvements are still likely, but major breakthroughs are unlikely It will still be a common technology during the next decade, but will eventually be replaced by electronic technologies
<p><b>(b) Floppy disks</b> Inexpensive, easy-to-handle, and reliable form of bulk memory storage</p>	Originally developed by IBM as a control memory for the System 370 series of computers At present, it is the medium-of-choice for small computer systems, intelligent terminals, word processing systems, and similar applications	Successful area for small entrepreneurs Leading Independent producer is a small, California-based company, founded in 1973—with \$18 million in sales that year Presently, more than a dozen large and small manufacturers in the field	Because of applications to small computers (see <i>Purpose and/or use</i> column), its market is somewhat different from the markets for the predominantly medium- and large-scale systems for magnetic tape and fixed-head disks	The technology is developing rapidly, driven by competitive pressures, and the demand is growing due to the proliferation of small computers
<p><b>(c) Very large memories</b> Stores trillions of bits of information A few very different technologies are used, e.g., video tape and laser photoglyphics</p>	Acts as an archive for very large quantities of data, where the information is rarely changed and infrequently accessed	Very few manufacturers, principally Ampex and IBM	Limited, special purpose market	The demand for this type of storage will grow, but rapid growth will depend on the development of new technologies, such as holographic storage, and appropriate software techniques
<p><b>Graphical display equipment: (a) Video graphics</b> Picture displayed on a cathode ray tube with the capability to display color and fully shaded solids.</p>	Presents computer output graphically for such applications as computer-aided design. Users can interact with the display to control computation or put information into the system	Has been domain of a few, small companies selling relatively expensive systems to a narrow range of users. As cost of electronics has dropped and more efficient graphics software has been developed, cost of graphics systems has decreased markedly.	The market for full video graphics is growing rapidly as graphics-oriented applications are becoming more accepted by users	The further lowering of prices due to the economy-of-scale effect, along with the accumulation of experience are expected to increase market demand inexpensive systems are increasingly being incorporated into remote data terminals The prediction is that by 1983, the market for all graphics display terminals will reach \$500 million annually, and for graphical display equipment will grow to a billion dollars or more from the present quarter of a billion



**Table 14.—Auxiliary Equipment Industry Structure (continued)**

Characteristics of hardware	Purpose and/or use	Nature and Size of present industry	Nature and size of present market	Future trends
<p><b>(b)Plotter graphics</b> Picture is drawn by a mechanically controlled pen</p>	Gets graphical information out of a computer in the form of hard copy	Dominated by California Computer Products (Calcomp) The plotters sold by most major computer vendors are made by this company (Vendors put their own names on )	The revenues of Calcomp exceed \$100 million	
<p><b>Printers</b> An alphanumeric text is printed on paper Offers a wide range of speeds and technologies from impact printing to photo Xerox Imaging</p>	The principal means of producing printed reports from a computer on paper	Mainframe manufacturers dominate, but there are some successful entries by Independents The principal Independent manufacturers are Centronics and Dataproducts	The revenues of the principal Independent manufacturers are about \$100 million each	The market is expected to reach \$36 billion by 1985 The development of a reliable printer in the 1980's that would sell below \$1,000 would tap rapidly expanding small computer markets, and would not compete directly with industry giants
<p><b>Data entry systems</b> Includes these products Keypunches (cards) Keyboard to tape and disk Terminals—video and typewriter Optical readers—bar code, marks, or characters Magnetic character readers Direct data recorders Voice data entry</p>	Gets information into computers, optical and magnetic readers as well as direct data recorders transmit data directly to the computer from the source For readers, the source is a machine-readable code, e.g., magnetic characters on a bank check and printed bar codes on grocery items For recorders, direct measurements are made of physical properties, e.g., temperature and pressure Voice recognizers convert oral communication to computer code	Numerous small companies. IBM's domination through the emphasis on punched cards is fading as new, better technologies are coming into use	Sales, which were about \$1.77 billion in 1977, are growing at about 15 percent per year The market for voice recognizers has been surprisingly good	The market is expected to grow rapidly in the 1980's as the technology improves Data recorders Will become more important as computers are used for controlling processes both in industry and in the home

SOURCE Office of Technology Assessment

communication-based computer applications. The current trend is toward graphical display, and putting more computer processing logic in the terminal itself.

- Data entry has been moving gradually away from the use of punched cards and

toward the use of other media such as magnetic disks. The most significant trend in the 1980's will be toward systems designed to capture information directly from the source by voice recognition, by image analysis, and by direct measurement.

## The Data Communication Industry

The data communication industry produces goods and services necessary to transmit digital data between computers or between computers and a terminal. For convenience, the industry is split into two sectors, the hardware manufacturers and the carriers, as shown in table 15. (The description of the industry presented in this study presents an information processing view. The OTA report on *Telecommunication Technology and Public Policy*, in press, presents a common carrier view of the data communication industry. )

The magazine *Datamation* estimates the total data communication industry to be running currently at over \$4 billion per year, and to be growing rapidly. The carriers have most of the action, nearly three-quarters of the market; AT&T has the biggest individual share, about 56 percent of the total market. The top 10 companies (other than AT&T) in the data communication hardware market are listed in table 16, and the top 10 data carriers in table 17. All revenue estimates are from *Datamation*.

The following comments about the data communication industry appear pertinent:

- The most apparent characteristic of the data communication hardware market is the continued presence of IBM at the top of the list. Even though only one product covered in the survey is offered, a communication front-end processor, IBM's revenues are more than double those of the next largest company. Yet

this income represents less than 1 percent of IBM total corporate income.

- There appear to be many healthy small firms in the communication hardware business. Generally, they specialize very narrowly along specific product lines. Six of the 10 companies listed in table 16 are small firms earning most or all of their income in the data communication field.
- The entire market for data communication is still not very large compared with that for other services, principally voice. It is estimated at between \$2 billion and \$3 billion. Accurate numbers are hard to get, because the carriers themselves do not always know when their lines are being used to carry voice or data.
- Most experts expect a major explosion of the market for data communication over the next two decades. The most interesting developments are the plans of some very large corporations for providing sophisticated data communication services in the near future. Although behind schedule, AT&T's ACS (Advanced Communications System), should begin operation soon. IBM and Aetna are underwriting a new corporation, SBS (Satellite Business Systems), to provide such services. Exxon is reputed also to be planning services of this kind. A highly flexible system will be offered by these companies that is designed specifically for high-speed data transfer in many forms—e.g., com-

**Table 15.—Data Communication Industry Structure**

Characteristics of hardware	Purpose and/or use	Nature of present industry	Nature and size of present market	Future trends
<p><b>Hardware manufacturers (table 16) (a) Front-end processors</b>                      Small specialized processors dedicated to controlling communications they are located between the main computer and the communication network</p>	<p>Control communications by handling all the messages between the main computer and the terminals</p>	<p>IBM dominates with the 370X processor for its own machines Other major computer vendors are also principal suppliers The two largest Independents are Comten Inc., with over \$37 million in front-end processor revenues and Computer Communications Inc. with over \$17 million The number of minicomputers bought to serve in this capacity cannot be estimated</p>	<p>Total sales approached \$400 million in 1979 Due to the growth of Communication based applications an independent industry is arising to market these processors which for many years mainframe manufacturers have been providing as standard add-on equipment for their machines</p>	<p>Will grow rapidly paralleling the trend toward the application of Integrating data communication and computer systems</p>
<p><b>(b) Modems and multiplexors</b>                      Modems change the electric characteristics of the data signal to be transmitted on the communication line from digital to audio—to match the requirement of a communication system to transmit voice Multiplexors mix multiple data messages into a single stream of information down the wire</p>	<p>Adapt computer systems and terminals to the communication systems designed to carry voice</p>	<p>AT&amp;T is a major supplier of modems (estimates are that Bell has as many in use as the entire Independent market)                      Multiplexors are supplied mainly by Independent manufacturers principally Motorola Racal-Milgo, General Data Comm Paradyne and Rixon All but the first one are small companies with their principal revenues from this market</p>	<p>1979 Independent market estimated at over \$450 million.</p>	<p>Similar to above, except that these functions may be Included to some extent in new data communication services</p>
<p><b>(c) Network/node controllers</b>                      These are a recent concept which look and perform very much like front-end processors They are located within the communication network</p>	<p>Principally control data flow through a complex network of computers and communication lines</p>	<p>Supplier picture is not clear It appears to be dominated by two Independents, Comten and Computer Communications Inc.</p>	<p>A new market motivated by the evolution of distributed processing systems containing several computers Interconnected on a communication network In 1979 sales were about \$70 million</p>	<p>Similar to above</p>

**Table 1 S.—Data Communication Industry Structure (continued)**

Characteristics of hardware	Purpose and/or use	Nature of present industry	Nature and size of present market	Future trends
<p><i>(d) Terminals</i> Any human-operated input-output device through which information can enter or leave a communication network</p>	Connect a human user with a computer	Appears to range from large, mainframe manufacturers to small specialist companies. Some merging may be possible between small computer and terminal industries, as terminals become more "Intelligent" and small computers gain more communications capability	Estimated to be large—over \$1 billion—and growing rapidly. A vast market exists for high-quality, low-cost hard-copy printed output, now too costly relative to the small computer to which it may be attached. A high demand is anticipated for terminals, concomitant with a projected explosive market growth for small and networked systems	Terminal costs will fall, but not as fast as electronics. "Intelligent terminals" will dominate the 1980's market, and be indistinguishable from small computers with communication capabilities. There will be a shift to more sophisticated graphics terminals capabilities, including color and half-tone, will be built into terminals, thus obviating the need for putting them on the main computers
<p><i>(e) Other devices</i> A miscellaneous group of relatively cheap specialized devices, for managing and testing communication network</p>	These are for setting up and maintaining a data communication network. Includes such devices as those for monitoring communication lines for data accuracy and performance and those for tracing errors in a network system, also voice response units that interface a computer on one end of a telephone line with a human on the other	Racal-Milgo and Northern Telecom, which largely produce test equipment, are the principal suppliers	A still quite small market relative to the entire communication market, but amounts to over \$100 million	This will continue to be a relatively small market
<p><i>Data carriers (see table 17)</i> The medium that is used to transport or carry communication data or information, e.g., AT&amp;T long lines, satellites</p>	To transfer data such as computer data, electronic mail, facsimile, and video conferencing with a high degree of flexibility at high speeds	Currently, AT&T is the principal data carrier. Most other major carriers (see table 17) also predominantly supply telephone service. A competitive industry of pure data communications is developing. The high capital requirement will keep the competition to a few large firms	A large data communication market, (\$4 billion in 1979) but still relatively small when compared with voice. Accurate figures are difficult to obtain since carriers often cannot distinguish whether their lines are carrying data or voice	A major explosion of the data communication market is predicted over the next two decades. Some very large corporations are moving toward providing sophisticated data communication services in the near future. New services will be based on communication networks with substantial built-in "Intelligence" allowing data storage for future retrieval

SOURCE : Office of Technology Assessment

**Table 16.—The Ranking and Revenues of the Top 10 Manufacturers of Data Communication Hardware**

Rank	Company	1979 revenues (\$ million)
1	IBM .....	\$ 1 5 8
2	Racal-Milgo.....	121
3	NCR.....	82
4	Motorola.....	81
5	Memorex.....	54
6	3M.....	49
7	General Datacom.....	42
8	Paradyne.....	41
9	Control Data....	40
10	Rixon.....	36

SOURCE: Datamation, June 1980, pp. 120-121.

**Table 17.—The 10 Leading Carriers of Digital Data and Their Data Communication Revenues**

Rank	Company	1979 revenues (\$ million)
1	AT&T.....	\$2,309
2	GTE.....	798
3	Western Union.....	451
4	ITT World Communications . . .	170
5	United Telecommunications . .	68
6	TAR T.....	28
7	Tymnet.....	24
8	Continental Telephone.. . . .	21
9	Central Telephone.....	20
10	WUI.....	16

SOURCE: Datamation, August 1980, p. 107

puter data, electronic mail, facsimile, or video teleconferencing.

- These services will be based on communication networks that will have sub-

stantial “intelligence” built into them; thus, the services will not easily be classified as pure data carriage or as information processing. Since one industry (communication) is regulated and the other (data processing) is not, a complicated regulatory problem is created, the resolution of which will allocate a multibillion dollar market among competing industrial giants.

- The computer industry has two strong but contradictory reactions to these developments. They see the evolution of these new services as providing exciting possibilities for new computer-communication applications, some linked on a worldwide scale. Many of the new applications being planned will serve large multinational corporations or consortiums of smaller users, such as stockbrokerage houses.

On the other hand, some fear that a big winner of this competition for the data communication market would be a monopoly controlling all data communication services worldwide. While the carrier business is not a game for small players, such massive domination by one supplier could be threatening to the hardware and service sectors that are currently promising for the creative small business entrepreneur.

## Special Applications

The emergence of microprocessor technology has led to a new type of industry that incorporates the processor into a device that performs a specialized function. This type of industry will grow rapidly during this decade, fueled by growing consumer demand for computerized products. Eventually, such markets for computers may dominate the industry and become analogous to those for electric motors. Few consumers purchase them directly, but buy many products in which they are incorporated.

Some of these products will be full computer systems programed to perform specific jobs; for example, the word processing applications discussed later. Others, such as the popular computer games, incorporate intelligence but do not look like computers. These applications are also distinguished from the incorporation of microprocessors in common consumer goods such as microwave ovens and automobile engines. The applications discussed here are new products, offering new, intelligence-based capabilities to

their users. It is impossible to describe such an industry generically; therefore a few current examples are provided (see table 18) that illustrate the variety of ways in which this set of industries will develop. Clearly, the opportunities are endless for inventive novel applications of this new technology. The analogy mentioned above with the electric motor is particularly useful in picturing the future potential of this industry sector.

**Array Processors:** An array processor is a special purpose computational unit designed to solve specific types of mathematical problems. (See ch. 5.) It is normally attached to a general purpose computer system or mini-computer that sets up the data, feeds the problem to the array processor, and puts the answer out in appropriate form. Array processors have become particularly popular for research and engineering applications that involve signal processing or the modeling of large physical systems.

Over 15 firms market these units, ranging from IBM to small companies for which such a processor is the only product. The processors cost between \$5,000 for a small unit on a printed circuit card to several million dollars for Control Data's Star computer. Many small companies (such as Floating Point Systems) and larger ones (such as Raytheon and Westinghouse), which don't engage in the general purpose computer business, have found the lower end (up to \$150,000) of the array processor market to be attractive, and have thus far successfully competed in it.

**Speak and Spell:** This is a specific product invention of Texas Instruments, which is a leading manufacturer of microelectronics. Unlike some of the other semiconductor companies, which sell their devices wholesale to other manufacturers for incorporation into products, Texas Instruments also produces a line of consumer devices that use their own electronics. These are largely centered on electronic hand and desk calculators and a recently announced personal computer.

In 1978, Texas Instruments produced a small hand-held device that combined their microcomputer technology with some new speech synthesis capabilities to produce a combination toy and teaching aid called "Speak and Spell". The device speaks a word and the learner types the word into the machine on a small keyboard. "Speak and Spell" was an instant success, encouraging Texas Instruments to plan not only improved versions of the original but to find other specialized products that combine speech synthesis and microcomputers.

**Translators:** The hand-held language translator is a new consumer device that has been appearing in the stores over the last 2 years. It resembles a pocket calculator but has an alphabetic keyboard and a somewhat longer display window. A person types in a word or phrase in one language and reads the translated phrase on the display.

The machine was invented by a small group of entrepreneurs who were not in the electronics business at the time. Forming a company called "Friends Amis," they developed the design and specifications of the logic chip required. They then contracted with a microprocessor manufacturer to produce the specialized electronics, and arranged with a distributor of consumer electronics to retail them under the distributor's brand name.

The translators were an instant hit, enough so that Texas Instruments and Lexicon have been drawn into the market. Despite the competition, Friends Amis has been a success, turning an initial investment of \$1 million into an \$8 million profit last year on sales of \$30 million. Still growing, the company soon plans to market a hand-held computer through an agreement with Matsushita. The Japanese corporation will provide the marketing capability the small company lacks. Besides making money, Friends Amis has, in the words of Fortune magazine, "managed to' father a new branch of consumer electronics. "

**Table 18.—Special Applications Industry (examples)**

Characteristics of hardware	Purpose and/or use	Nature of present industry	Nature and size of present market	Future trends
<p><b>Array processors</b> Specialized units for very economic and fast solutions for particular mathematical problems. Usually attached to a mini- or general-purpose computer for control and input/output</p>	<p>Research and engineering applications involving signal processing or modeling large physical systems</p>	<p>Units marketed by over 15 firms from IBM to small companies with processor as their sole product cost from \$5000 for smallest unit on printed circuit card to several million dollars for the largest size opportunities for small entrepreneurs</p>	<p>Research and engineering design laboratories are principal users</p>	<p>More specialized designs targeted. al unique types of calculations. The potential large revenues from such specialization will stimulate growth</p>
<p><b>Speak and Spell *</b> Consumer electronics device—small hand held combining the manufacturer's (Texas Instruments) micro computer technology with speech synthesis capabilities</p>	<p>Combination toy and spelling teaching aid—machine speaks word then child types it on small keyboard</p>	<p>Specific product invention of Texas Instruments</p>	<p>Instant consumer success</p>	<p>The manufacturer will improve present product and develop additional specialized products combining speech synthesis and microcomputers.</p>
<p><b>Language translators</b> Consumer electronics device—a hand held language translator with an alphabetic keyboard and a display window similar to but larger than that on normal calculators</p>	<p>Type in word or phrase— read off translation on display</p>	<p>Developed by entrepreneurs originally not in electronics business who contracted electronics to microprocessor firms</p>	<p>Consumer electronics success— company that developed product had \$30 million in sales in 1979 on an Initial Investment of \$1 million</p>	<p>Consumer electronics market still growing—several electronics companies are entering. The unit may evolve into a more general hand-held personal computer</p>
<p><b>Word processors</b> A computerized 'Intelligent' typewriter that stores a document electronically as it is entered, and displays the image on a cathode ray screen</p>	<p>Allows operator to edit and correct text directly in memory, and automates repagination, hyphenating and justification. Some systems can correct spelling</p>	<p>Principally companies that make or have made computers e.g. Wang, IBM, and Digital Equipment Corp. Other firms are now entering, illustrating new opportunities being opened by cheap electronics, e.g. Lamer Business Products, a leader in Dictaphone sales. Also major firms such as Xerox and Exxon are developing strong positions</p>	<p>Over 80 percent growth in 1979 growth expected to continue over 50 percent in 1980</p>	<p>In 1980's Integrated office systems will display sophisticated capabilities for correcting grammar and formatting text. They will merge with new data communication services linking geographically separated offices through high speed data communication networks offering video, audio, and computer conferencing, and distributed information processing. Electronic archival storage for storing and retrieving information efficiently and easily will be offered</p>

SOURCE Office of Technology Assessment

**Word Processing Systems:** These are important new applications around which a major industry will grow in the 1980's. Word processing systems, the first entry in the office automation trend, are designed to increase the productivity of information handling by automating its preparation and flow. The applicable technologies will be drawn from both computers and communication, and the trend will be toward the integration of document preparation, storage, and transmission.

For now, the principal offering on the computer side is the word processor. It is essentially a computerized, intelligent typewriter that stores a document electronically as it is entered, displays the image on a cathode ray screen, and allows the operator to edit and correct the text directly in its memory. Tedious tasks such as repagination, hyphenating, and justification are taken care of automatically. Some systems even correct spelling, and some observers expect systems in the 1980's to display sophisticated intelligence for correcting grammar and formatting complicated text. The market for sophisticated word processing systems grew over 80 percent last year, and next year market growth should still be over 50 percent.

The principal actors in the word processing business have tended to be companies that make or have made computers, such as Wang, IBM, and Digital Equipment Corp. However, other firms are now entering the market, illustrating the opportunities for new entries being opened by cheap electronics. Lanier Business Products, for example, a leader in the sale of dictaphones, has

entered with both stand-alone systems and those using a shared computer that serves several terminals. Lanier, principally viewed as a firm with marketing expertise, purchased interest in a small data products company, AES Data Ltd., that designs and manufactures the word processing equipment.

The most important trend that experts think will dominate in the 1980's is the merging of these word processing systems with the new data communication services being planned, such as SBS or AT&T's ACS. Using these new services, geographically distributed organizations will be linked together through a very high speed data communication network offering video and audio conferencing, computer conferencing, and distributed information processing.

The final ingredient for the integrated office systems of the next decade is the development of electronic archival storage. The hardware base exists for storing information at a cost lower than that of filing paper. The need now is for appropriate software that would allow the user to store and retrieve information efficiently and easily. Some systems are on the drawing board. Systems Development Corp. and Datapoint have announced prototypes for systems they will sell in a year or so.

As these trends merge, whether small firms can continue to successfully develop and compete in the word processing market may depend on the degree to which interfaces become standardized, allowing competition for particular components of an integrated office system. Major firms such as Xerox, IBM, and Exxon have taken aim at the automated office market, and competition will be severe.

## Computer Services

The computer services industry, summarized in table 19, performs a wide variety of tasks that make the computer more accessible, more usable, and/or less expensive

for computer users. Some companies sell time on their own computers; others provide programming or operations services (including training, consulting, and facilities manage-



**Table 19.—The Computer Services Industry Structure**

Services provided	Purpose and/or use	Nature of Industry	Nature and size of market	Future trends
<p><b>Processing services</b> These firms called service bureaus provide access to computer time. They also provide access to programs designed for specific control applications</p>	<p>For computer users preferring to purchase computer time from outside firms rather than owning and operating their own systems</p>	<p>A relatively few very large companies and a large number of small but profitable Operations (See table 21 ) Good opportunity for small companies to compete successfully by taking advantage of specialized services targeted at a market in which they have particular expertise</p>	<p>About \$67 billion worth of computer time was purchased in 1980 and the market is growing at nearly 20 percent per year</p>	<p>The coming generation of cheap computers will be a threat to those companies that just provide computer time without adding market value in the form of application packages and consulting. Consequently the move is toward providing programming and other support activities that are less sensitive to the specific source of computer power</p>
<p><b>Professional software products and services.</b></p> <p><b>(a) Software products</b> Prewritten programs to do specific tasks that can be leased or purchased by users. Because heavier program development costs can be written off against multiple users, this commercial software can be more soundly based mathematically, more flexible, more reliable, and better documented than a home-grown program would be. In addition, the vendor assumes the burden of the continued maintenance and improvement of the package</p>	<p>The majority are for applications although some are designed to improve the operation of the user's system. They tend to be large and complex designed for broad applicability e.g. large data management and file Inquiry systems optimization programs, and packages of sophisticated statistical routines</p>	<p>A large number of small firms. Over 90 percent of the companies fit into ADAPSO's category of those that are smallest in size. The large hardware vendors also sell some software products tailored for their machines</p>	<p>For the total software products in industry, the market is estimated at over \$1.5 billion per year</p>	<p>The growth rate for the next 5 years for this unusually fast growing industry is estimated at 30 percent</p>
<p><b>(b) Software services</b> Provides programming expertise to develop a specific program for a particular user</p>	<p>For a user's own projects, and to assume the responsibility for the major development efforts for which the customer does not have the appropriate staff</p>	<p>A few small companies specialize in programming. Many large firms, hardware manufacturers, service bureaus etc., offer programming services to support their customer's needs</p>	<p>A market about equal to that for prewritten packages. It is estimated at around \$1 billion per year</p>	<p>The industry predicts substantial growth of over 20 percent annually for the next few years, depending in part on the continued scarcity of skilled talent, which makes it costly, thus discouraging users from establishing their own staff of application programmers. More market segmentation and specialization seems likely</p>
<p><b>Other services</b> The industry provides a variety of support services to users</p>	<p>For consulting, for operating the customer's computer center, for maintaining the hardware and for integrated hardware/software systems</p>	<p>Mostly very small firms</p>	<p>No solid estimates of market size could be comparable to that of professional software support market</p>	<p>A new service industry is developing providing books, magazines, software, exchange services, employee education, and consulting, for small computer users. With the increase in the use of small computers in the 1980's, some major growth potential may exist for services designed to make these new systems most useful to a new class of inexperienced users</p>

SOURCE: Office of Technology Assessment and Association of Data Processing Service Organizations

ment) to users who own their systems. Still others sell prewritten programs or provide access to those programs on a service bureau computer. Most recently, some companies offer processing services through integrated hardware/software systems.

The Association of Data Processing Service Organizations (ADAPSO) is the principal organization representing this industry. They define the role of their industry as adding "value to the computer hardware utility by integrating into the service people, expertise, products, distribution networks, and education. The structure of the computer service industry as discussed here reflects, in part, that used by ADAPSO.

The largest publicly held independent computer service corporations along with their estimated 1973 revenues from computer services are shown in table 20.

**Table 20.—Estimated 1979 Revenues for the Top Five Independent Computer Service Companies**

Company	Estimated 1979 revenues (\$ million)
Automatic Data Processing . . . . .	\$372
Computer Sciences Corp. . . . .	343
Electronic Data Systems. . . . .	274
Tymshare . . . . .	193
Bradford National. . . . .	120

<sup>a</sup>The three Companies with the largest computer services revenues — IBM, Control Data Corp., and Burroughs—derive their primary revenues from hardware sales and thus are excluded from this list

SOURCE: Association of Data Processing Service Organizations

Table 21 shows the structure of the computer services industry in terms of size of firm.

The following observations can be made about the computer services industry:

- The availability of inexpensive capable computer hardware will put pressure on service firms that only provide customers with access to computer time. Even so, most observers do not expect the computer service bureaus to fold up.
- The service bureaus are showing a trend toward offering an integrated set of services based not only on access to pure computing services, but also to specialized programs and data bases already present in the company's system.
- The service industry seems to be characterized by a few large firms and many, equally profitable, very small operations serving very specialized markets (such as law firms, pharmacies, and civil engineering firms). The development of new data communication facilities will make more of this type of specialized service possible by providing a national marketplace for it.
- A new industry will develop to support the personal and desk-top systems now being marketed. These services will offer maintenance, programs, consulting, and education specifically oriented to owners of these very small systems.

**Table 21.—Industry and Revenue Structure of Computer Services Industry<sup>a</sup>**

Size of operation	Number of companies	1979 revenues (\$ billion)	1979 gross profit margin (percent)	Growth rate (percent)
Over \$25 million. . . . .	40	\$ 4.0	10%	200/0
Between \$10 million and \$25 million . . . . .	70	1.5	7	23
Between \$2 million and \$10 million . . . . .	450	2.0	9	22
Under \$2 million. . . . .	3,500	2.5	9	22
Total . . . . .	4,060	\$ 10.0		

<sup>a</sup>This table includes estimated revenues for computer services provided by independent computer service companies and computer hardware manufacturers. Numbers are rounded off

SOURCE: Association of Data Processing Service Organizations

## Information Services

Selling information is a centuries-old business; however, the computer is forcing a radical change in the character of this industry. The nature of the information sold, the way it is provided, and the principal organizations supplying information services are all changing rapidly, which will shape a new type of industry in this decade.

The traditional information industry has always been predicated on the assumption that some information has tangible economic value and can be treated as a commodity. The industry, taking this traditional approach, views itself as similar to any other industry in structure. That is, it is divided into producers, distributors, and retailers. For example, an author might be a producer, a publisher, a distributor, and the bookstore the retailer. Similarly, in broadcasting there are show producers, networks and syndicates that distribute the programs, and the local stations that broadcast them into homes.

Now the industry is computerizing. Traditional information organizations such as Dun & Bradstreet, Macmillan Press, and the Knight-Ridder newspaper publishers are exploring new uses of information technology to expand their offerings. On the other hand, computer service bureaus, as pointed out in the previous section, are moving away from offering pure computer time and toward providing program and data services that are certainly classifiable as information services even by the most traditional standards. Finally, new companies such as Data Resources, Inc. (now part of McGraw-Hill) have been formed specifically to provide computer-based information services. The computer's impact is being felt by all three sectors of the information industry.

In the *production* of information, increased computerization of social activities means that there is a swiftly growing pool of information of all kinds that can be read by a computer. Financial information, airline res-

ervations, stock transfers and commodity prices, and even wire service news, are examples of information already available in electronic form. Much of it is already transmitted on communication lines.

The next decade or two will see most of the information needed to run people's lives and businesses originated and stored in computers. This trend will stimulate the distribution and retailing of information, because putting the information into computer readable form is a major cost of current automated information services.

Data communication technology is changing the rules for the *distribution of information*. Traditional distributors such as broadcast networks, book publishers, and common carriers are looking carefully at the potential advantages offered by data communication. The publishers see a new mechanism to distribute newspapers, books, and magazines, in addition to possible new services; the common carriers and broadcasters see new uses for their facilities as vehicles for these services.

Many of these services will soon be retailed directly to the home or office via telephone, television, and cable. Precursors to these services already exist in a few local cable systems, and experiments such as the recently canceled AT&T Electronic Information Service provide an automated telephone directory and a selection of other information systems over a telephone line to a home terminal.

Some information services are transformed by the use of technology, others are created. It is the new computer-based services that are of particular interest to this study.

The Information Industry Association identifies nine categories of information industry. These are:

1. producers of primary information (books, journals, research studies, etc.);

2. producers of secondary information (indexes, bibliographies, data bases, microforms, directories, etc.);
3. communication companies (broadcast, cable, switching, etc.);
4. information distributors, agents, or brokers (on-line service, sales representatives, dealers, etc.);
5. information transactors (banks, lending institutions, investment houses, etc.);
6. consultants or contract suppliers of information (designers, developers, etc.);
7. information retailers or outlets (on-demand services, search services, etc.);
8. equipment or supplies companies (computers, micrographics, text processing, graphic arts, etc.); and
9. popular media organizations (news, education, advertising, etc. )

Some of these classifications are of particular interest to the computer and communication industry.

**Producers of Primary Information:** For some time, the intermediate processes of publishing have been undergoing automation. Computerized typesetting, on-line editing and other uses of word processing, and digital communication of edited text are being widely adopted and should increase productivity substantially.

For the time being, the final product will continue to be in paper form. However, the future widespread use of the video disks and high-speed data communication systems may gradually lead to products being published in digitized formats as well.

**Producers of Secondary Information:** Many producers of bibliographies and information directories now regularly prepare them on computers. Some even offer the final product on-line from a computer. The user dials in from a remote terminal to get the desired information.

These industries have found the computer to be useful not only to automate the more routine aspects of their operations, but also to provide more sophisticated analyses and customized arrangements of the information

they maintain. Since a large on-line data base can be searched far more effectively by computer than by hand, the services provided by such a producer are qualitatively different from those provided by a traditional bibliographic service.

Such information, however, is currently very expensive to prepare. Persons must first read the printed material, then analyze, index and otherwise code it, and put it into machine-readable form. In the future, when most printed text will originate on computer-based text processors, automated computerized indexing systems will eliminate most of these tasks.

This high labor cost, coupled with the fact that the initial significant market for such systems is the research community, means that most bibliographic systems now available were originally supported, at least partially, by the Federal Government. Some are now self-supporting, while others continue to be subsidized, depending on their purposes. Bibliographic information is the hardest case, however.

There have been some successful entrepreneurial experiments in providing other forms of on-line data service. Data Resources, Inc. (DRI) is one of the best known. Founded by the well-known econometrician, Otto Eckstein, DRI provides econometric data and access to sophisticated computer-based models to economists, particularly those in private industry. Most of the major corporations in the United States now subscribe to DRI services.

There are a number of such firms that have been founded to provide computerized databank services. Many are still quite small, specializing in particular types of data to serve narrowly targeted markets. The range of services is quite broad. One industry analyst identified 22 different categories of databank service.

**Data Transactors:** There are many firms that create useful information in the course of their business, although they may not be in the primary information business. For ex-

ample, banks, stockbrokers, airlines, and credit card companies all create transactional information. More and more of this information is in computer-readable form and, furthermore, is possibly valuable to some other party. This firm or individual may be in a related business, or may have no connection with the principal field of the original data collector.

The market for such data is likely to grow significantly over the next decade. Pools of data from transactions will accumulate in computer systems, and new enterprises will spring up to collect, organize, and sell them. The transactors will find that wholesaling their data pools to such firms will be a profitable side business. When that happens, pressures may well build to increase the amount of information collected beyond that necessary to serve the immediate transaction, thereby increasing the resale value of a company's data pool. These firms will then become principal actors in the information industry.

**Information Retailers:** Information retailers provide computer-based information products directly to the business or private consumer. They may also be the producers, or they may simply retail other producers' products. So-called "videotext" service providers, which offer in-home information over broadcast or cable television channels, usually serve as brokers, making their facility available to anyone who wants to provide an

information service, in the same way that a grocery store carries soup made by different producers.

Many of the databank providers discussed in the section on secondary producers offer very complicated systems that require some training and experience to use. Therefore, these services are often provided through an intermediary, such as a consultant, librarian, or stockbroker. In a sense, these persons serve as retailers of the information service, marketing it to individual users. The characteristics of the information services sector are summarized in table 22.

The following conclusions can be made about the information services sector:

- Traditional information producers such as book publishers, newspapers and network broadcasters will be converting their services into computer and telecommunication-based offerings.
- New information services will be transmitted to the home over telephone, cable, and broadcast carriers. Some of these services may be integrated with in-house computer systems and video disk and tape units.
- Libraries will extend their services beyond mere provision of books into offering computer-based services. Such new activities may conflict with the new commercial in-house services mentioned above.

Table 22.—The Information Services Industry Structure

Nature of the Information	How Information is provided	Nature of Industry and/or market	Future trends
<p><i>Producers of primary information</i> Published materials</p>	For time being in paper form	Traditional book, magazine and newspaper publishers	The Increasing adoption of computerized typesetting, on-line editing and other uses of word processing, and digital communication of edited text should substantially increase productivity. The future widespread use of video disks and high-speed data communication systems may gradually lead to the publication of products in other digitized formats such as in-home video Information systems
<p><i>Producers of secondary information</i> Bibliographies, information directories, econometric data, and other particular types of data that serve narrowly targeted markets—over 22 different categories of data bank services have been identified. Most are prepared on a computer</p>	On Paper and on-line from a computer. The user dials in from a remote terminal to get the desired Information	Most bibliographic systems available were originally supported, at least in part, by the Federal Government, because their initial chief market was the research community. Some are now self-supporting, others, depending on their purpose, continue to be subsidized. Data Resources, Inc., is an example of a successful entrepreneurial experiment in providing other forms of on-line data services—econometric data and access to sophisticated computer-based models for economists. Many small firms have been founded to provide a broad range of computerized data bank services	Most of this data will reside in computer systems to be called up as needed by customers
<p><i>Data transactors</i> Firms create useful transactional information in the course of carrying out their business, e.g., banks, stockbrokers, airlines, and credit card companies</p>	Most is in a computer-readable form that may be of value to some other firms or individuals	Currently, the number of transactors is growing but there is only a small market for their data	Pools of data from transactions will accumulate in computer systems, and new enterprises will spring up to collect, organize, and sell them. Transactors who profit from wholesaling their data pools to such firms, will be motivated to increase the quantity of information collected in order to raise the resale value of their data pools. These firms will then become principal members of the information industry.
<p><i>Information retailers</i> Computer-based Information products</p>	Directly to businesses or private consumers.	Retailers may also be information producers or may just retail the products of other producers, e.g., so-called "videotext services that offer in-home information over broadcast or cable television channels usually serve as brokers who make their facilities available to anyone wanting to provide an information service	Computers are having the effect of blurring the distinction between the products and services offered by the computer industry. This new hybrid industry will offer new forms of information services, marketed in new ways, to new users

SOURCE: Office of Technology Assessment